AN ASSESSMENT OF THE ROLE OF NON-MOTORIZED TRANSPORT IN PROMOTING RURAL MOBILITY: A CASE STUDY OF LAIKIPIA COUNTY, KENYA.

By

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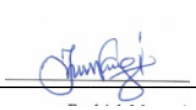
DECLARATION

This is my original work and has never been presented to the University of Nairobi or any other university for the award of degree or other academic award.

Signature  Date____22-2-2020_____

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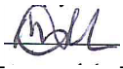
Signature _____  ____ Date__24-2-2020_

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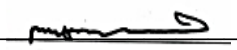
Signature _____  _____ Date_____24-2-2020___

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DEDICATION

I dedicate this piece of work to my late parents, Mzee Robert Karema and Mrs. Lydia Wanjiku Karema and the entire family for their patience and strong belief in my success all through the period of study.

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ABBREVIATIONS / ACRONYMS

AfDB	African Development Bank
ESDA	Education for Sustainable Development
FAO	Food Agricultural Organization
GoK	Government of Kenya
HIV/AIDS	Acquired immunodeficiency syndrome (**AIDS**) is a chronic, potentially life-threatening condition caused by the human immunodeficiency virus (**HIV**)
IMT	Intermediate Modes of Transport
INTP	Integrated Transport Policy
KENHA	Kenya National Highway Authority
KRB	Kenya Roads Board
KERRA	Kenya Rural Roads Authority
KURA	Kenya Urban Roads Authority
LATF	Local Authority Transfer Fund
LDCs	Less Developed Countries
NGR	Next Generation Researchers
NTSA	National Transport and Safety Authority
NMIMT	Non-Motorized and Intermediate Means of Transport
NMT	Non Motorized Transport
RARP	Rural Access Roads Programme
RMLF	Road Maintenance Levy Fund
SDGs	Sustainable Development Goals
TIMS	Transport Integrated Management System
WB	World Bank
KARA	Kenya Alliance for Residence Association
KISIP	Kenya Informal Settlements Improvement Project

ABSTRACT

The main objective of the study was to examine the role of non-motorized transport in promoting rural mobility in Laikipia County, Kenya. The specific objectives of the study were:- (a) To determine the relationship between socio- economic factors and NMT usage in Laikipia County; (b) To examine whether there is significant difference in travel distances by walking and cycling in Laikipia County; (c) To determine the extent to which availability of NMT has affected access to schools and market centers in Laikipia County; (d) To investigate whether there were existing cultural policies guiding gender promotion in usage of NMT in Laikipia County.

Data was collected from both primary and secondary sources. Primary data was obtained from Laikipia County through interview schedule, observation and questionnaires. Secondary data was collected by thorough literature search and review of both published and unpublished research reports, journals and, books. The stakeholders that were interviewed include: Non-Motorized Transport Users, Key Informants, and Non-Motorized Transport Operators. Data was analyzed using Statistical Package for Social Scientists (SPSS). Descriptive statistics was used to analyze survey data related to non-motorized travel. Inferential statistics was used to determine whether the observed non motorized transport characteristics differ from the null hypothesis. The study had two hypotheses tested.

The first hypothesis was: (a) there is no significant relationship between socio-economic factors and NMT usage in Laikipia County. This hypothesis was tested using multiple linear regressions. The socio-economic factors which were tested included: income, distance, age, marital status, education level, and occupation. The multiple correlations of income and distance variables revealed weak positive relationship of 0.205; income and age correlations also had a weak positive value of 0.260; while income and marital status correlations showed a weak positive value of 0.250. This implies that these variables were weak determinants of walking and cycling in Laikipia County. A correlation between respondents' occupation and distance travelled showed a significant positive correlation of 0.492. This indicates that respondents' occupation determines the distance travelled by walking and cycling in Laikipia County. It can also be interpreted that business location determines the distance travelled by the

respondents in Laikipia County. The study also revealed that there was a significant positive correlation between education level and distance travelled in Laikipia County. This means that the higher the level of education the greater the need of social interaction in search of business opportunities irrespective of the distance within the county. A multiple linear regression between walking and cycling showed a weak positive relationship which was denoted by $R^2 = 0.015$. This was a weak positive correlation which implies that the relationship between walking and cycling was independent of the distance travelled. The low value of socio-economic factors of R square indicates that other factors than the measured socio-economic factors influenced the patterns of non-motorized transport used in Laikipia County.

The second hypothesis was tested using Chi-square statistic (X^2). The hypothesis tested was: (b) walking and cycling are independent of distance travelled in Laikipia County. The value of the calculated X^2 at 2 degrees of freedom was 0.006 while the Critical X^2 at 2 degrees of freedom at 0.05 significance level was 5.99. Therefore, the Calculated X^2 was smaller than the Critical X^2. Therefore, a conclusion was drawn that, there was no adequate evidence to reject the null hypothesis that, walking and cycling were independent of distance travelled in Laikipia County. Hence, the hypothesis was adopted. In other words, walking and cycling were not determined by the distance travelled in Laikipia. The study therefore, concluded that non motorized transport modes are not determined by spatial distance in Laikipia County.

The study recommended that: (a) Interrogation of the non-motorized transport technologies adopted in Laikipia County should be done. (b) Lane segregation for both pedestrians and cyclists with physical partitions between motorized traffic and non motorized transport should be provided, and (e) Prices of spare-parts should be reduced by the government.

CHAPTER ONE: INTRODUCTION

1.0 Background of the study

The sole principle of transportation is to address space. This is shaped up by human and physical problems like time, distance, topography and administrative divisions. These factors cause friction to movements, usually referred to as friction of space. The ease of travel of passengers or information is referred to as transportability. This heavily relies on transport cost and the nature of goods to be transported. For example, some goods are highly perishable while others are fragile. Since transportation is a derived demand, the specific purpose of transport is to meet mobility demand (Rodrigue, Comtois, & Slack, 2017).

According to UN HABITAT (2013), mobility encompasses transport infrastructure development and the solutions to social, economic, political and physical problems to movement. These problems originate from the following factors: gender relations, class, affordability, poverty and physical disabilities. Therefore, mobility implies providing right of entry to opportunities and allowing people to fully utilize their human rights. Sustainable mobility has no comprehensible definition, but it carries a wider meaning compared to sustainable transport.

Scholars have been seeking for the concept's meaning drawing from the sustainable development's Brundtland definition which embraces on, "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). Steg & Gifford (2005) indicated that sustainable mobility is attained on the basis of three indicators: economic, social and environment. Holden *et al*., (2013) recognized Brundtland's concept of sustainable development along the transport

context highlighting the need of four key scopes for promoting and measuring it: (a) environmental impact caused by transport's activities should not threaten long-term ecological sustainability. (b) Fundamental transport's basic human requirements and affordable, suitable modes' equal access should be met. (c) Support of equity and equal access to population groups for both intra-generational, inter-generational transport; and transport needs for future generation's provision (Holden *et. al*., 2013).

Starkey, *et.al.*, (2002), argues that, initiatives in rural transport need to be addressed in a holistic manner in order to improve infrastructure and transport services. They observed that integrating motorized transport (MT) and Non-Motorized Transport (NMT) is a challenge in rural areas of developing countries. The road infrastructure within rural areas is mainly planned for motorized transport leading to inadequate attention of non-motorized transport. Demographic characteristics of rural areas transport users have a wide variation. For instance, rural transport users have different incomes, gender and powers. This creates uneven distribution of economic and social statuses in terms of access to rural facilities. Rural road infrastructure is characterized by poor and inadequate roads, Majority of rural roads are impassable especially during the rainy season. This situation favours non-motorized transport modes of transport. Non motorized transport modes in rural areas are mainly built and operated by men, hence, disadvantaging rural women who may have low incomes but high transport burdens. Poverty alleviation needs less seclusion, better mobility and access, which can be attained through complementary transport and integrated infrastructure. Few studies of such kind have been done in developing countries and especially in Kenya. The main aim of the study was to examine the role of non-motorized transport in promoting rural mobility in Laikipia County, Kenya.

Emmanuel (1995) defines infrastructure as the basis on which interaction of production factors interact to generate services. Likewise, Hirschman (1958) viewed infrastructures as essential services which determine the functioning of primary, secondary and tertiary production activities. In addition, there are diverse services under infrastructure such as education, public health, transportation, communication, power, water supply and agricultural overheads. All these services are characterized by economies of scale and are non-tradable.

NMT modes do not generate greenhouse gases, noise and air pollution. The option of non-motorized transport modes increases the coverage area by motor-vehicles (Adjei, 2010). Walking and cycling can improve accessibility of the users by allowing them reach destinations of choice. Social exclusion is associated with lack of mobility (Ohnmacht *et al*., 2009, Lucas, 2012). According to Dercon and Hoddinott (2005), mobility in rural poor is highly circumscribed. They found out that in Ethiopia it limits people's interaction with the nearest markets and urban centers. Their study found out that remote households' likelihood of withdrawing from market interactions was sharply increasing forcing people to be dependent on agricultural production for home consumption. Economic growth was experienced in communities with better roads which enabled access to market towns.

Dercon and Hoddinott (2005) pointed out that rural settlements in developing countries are isolated and remote from major economic hubs, such as local markets. This tends to limit market opportunities from rural traders forcing them to be reliant on their production for local consumption. This was the motivation for undertaking this study.

Limited mobility options in the rural areas of less developed countries (LDCs) lead to inability to access economic opportunities. This contributes to what Illes (2005) describes as, perpetuated poverty. Therefore, there is need for the county governments in Kenya to improve NMT since it plays a key role in promoting rural mobility. It raises the standards of living, economic growth, the enrichment of people's opportunities and improved life, and the strengthening of environmental protection behavior like greenhouse gases emission reduction. Non-motorized transport is also regarded as a tool for fighting poverty.

The study intends to make a contribution towards addressing endemic inaccessibility in rural areas of the study in Laikipia County. Lack of institutional support of non-motorized transport has severely limited use and contribution of non-motorized transport. NMT includes non engine means of transport e.g. walking, bicycling while Intermediate Means of Transport (IMT) includes all non motorized transport and small engine vehicles. NMT facilitates intra-village and inter-village trip making in developing countries. Women are inaccessible to Intermediate Means of Transport (IMT) compared to men (Masika, 1997: 9). For instance, women do not have access to capital for buying transport equipment. Intermediate Means of Transport are viewed as symbols of social class and repute. Women are perceived to be physically weak in handling draught animals' driven carts and as well as probable gynecological risk (Grieco *et al*. 1996: 92-3).

According to Law (1999:570), men and women are affected differently by security issues. Transport provision and delivery systems are associated with women's sexual assaults. Rural farmers in developing world cannot afford to transport agricultural

produce to the market due to high cost of bicycles, or animal drawn carts. Farmers barter their produce or sell them at a throw-away price. Sometimes they end up paying high transport cost generating any surplus capital to cater for health care, and education (Karema, *et al.*, 2017a). To reduce cost for agricultural production and marketing, there is an urgent need for cheap and affordable modes of transport which promote rural mobility.

Non-motorized transport (NMT) is linked to poverty and low-technology.NMT is not categorized in the innovative modes, and therefore regarded as a means of transport that countries aim to develop. There are a few pedestrian facilities with poor design which limits their usage. The problems caused by increasing motorization have encouraged people to start reflecting on non-motorized transport, for example, research has found out that travelling by NMT means often lead to good mental health (Frank and Engelke, 2001). Non-motorized transport reduces carbon emissions and road congestion (Litman, 2003). Lack of road congestion reduces travel time leading to huge economic benefits (Litman, 1999).

Key issues that affect non-motorized transport are: lack of information on existing options, high cost of appropriate means of transport, low purchasing power of potential users and limited production and distribution capacities. Poor provision of non-motorized transport leads to the bias towards motorized transport. For instance, the city and road agencies poorly and inadequately maintain foot bridges (GOK, 2009). Mostly, on-motorized transport in rural areas is characterized by unclear and uncoordinated responsibility of the diverse institutions dealing with transport issues; non-availability of resources for implementation; lack of trained personnel in rural transport issues, lack

of mobilization of existing capacities within communities. Different needs of various members of rural households are not clearly understood. Therefore, there is need of establishing the role of non-motorized transport in promoting rural mobility in Laikipia County in Kenya.

Effect of head-loading and back-loading to human health in the developing world and Gender inequality in rural areas

According to Porter, *et.al*, (2013), vulnerable groups play a significant role in pedestrian load-transport. Some of the tasks they involve themselves with are fetching water and firewood by head-loading. This affects their school attendance, budgets, gender relations and performance. Head-loading and back-loading are known to cause injuries which ranges from, acute injury risk, repetitive strain injury (RSI), degenerative disorders, pain, ill social participation, maternal and foetal disruption, high percentage of oxygen consumption and pain. Maloiy, *et. al*., (1986) concentrates on individual understanding of the physiological data and instinctively describes back loading and head loading. However, there is no physiological data on head-loading and this call for further research.

Despite the various forums organized by the international agencies on gender inequality, women are still far down in the social hierarchy. Women in developing countries have poor access to collaterals. One of the serious setbacks is the HIV/AIDS pandemic which is destroys the health of people in developing countries. This crumbles most of the development achievements women attain in Africa. According to Peters (2011) women's travel patterns involves a series of segments which follow one another and linked to place of work from residential areas. Such travels are known as trip

chaining and are characterized by stops of less than 30 minutes. For instance, stops at health centers, shopping areas, educational institutions and parents' visits.

UN Research Institute for Social Development (2006), found out that, in 1990 - 2000, poor people decreased in all developing countries. But contrary to this fact, Africa has an increase of more than 82 million poor people. Women constitute majority of the poor in Africa. Men have higher chances of employment than women and hence, easier access to credit institutions (Figure 1.1). Unlike the past decades, there exists a well established literature review on gender, a good number of transport experts would agree on gender sensitivity improvement in rural transport planning. Africa Recovery (2002) pointed out that gender budgeting tool could be used to address macroeconomic policies that favours men and boys at the expense of women and girls. This entails evaluating government spending allocations on the affected group. Earnings are important indicators of economic well-being and personal success. A comparison between women's and men's pay reveals women's disparities in the labour market.

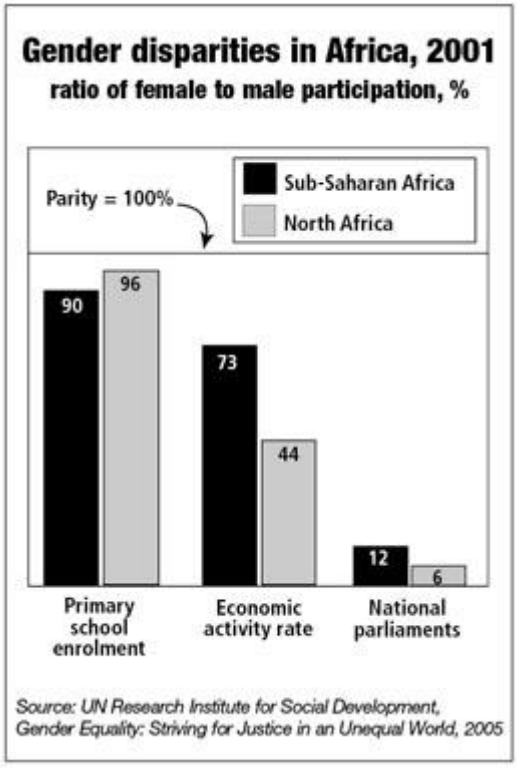


Figure 1.1: Gender disparities in Africa, 2001.

According to Kabubo-Mariara (2003), the basic step in understanding the gender gap in earnings is identifying the differences between their pay. For example, in many cases the ratio of earnings starts from 40 percent in Kenya. This study intends to capture the various economic activities brought about by existence of non motorized transport in Laikipia and their role of narrowing the gender gap in earnings.

Such past NMT studies have tended to concentrate in urban areas and little is known about NMT in rural areas. For example, a study carried out by Oyier (2008) on integrating non-motorized transport and motor transport system was done in Westland commercial centre, Nairobi, Kenya. However, there was no mention on gender disparities or inequality in the study which is an ingredient of NMT.

Jennifer and Marianne (2010) carried out an investigation of the effects of implementation and upgrades of NMT facility in Cape Town. The study observed that, NMT was important in improving levels of safety of pedestrians and cyclists in South African settlements. The study also revealed that NMT facilities have the potential of improving the quality of service for the users. This study intends to carry out an assessment of the role of non-motorized transport in promoting rural mobility: a case study of Laikipia County.

1.2 Statement of the Problem

In many parts of the rural areas of the developing world, women undertake frequent and short trips during off-peak hours and off the main-routes for child care, household activities, and other informal employment. The elderly, non-car owners and school

children are often deprived of ready access to services due to lack of finance. Curtis (1986) revealed that off-road transport is a burden on women and that water collection times in Kenya vary. Dawson and Barwell (1993) pointed out that transport burden shouldered by women is worsened by rural-urban migration of males.

Women mainly participate in farm production, food preparation and marketing of farm produce. Women travel mostly for subsistence goods' provision, e.g. water, firewood, crop production and internal marketing. All these tasks are achieved by walking. Ownership of vehicles in the rural areas is low, especially in Sub-Saharan Africa, hence limited choice of transport modes (Ellis, 1996).The study is expected to contribute new knowledge on non-motorized transport, inform non-motorized transport policies and change people's perception on non-motorized transport in Laikipia County. Gender equality, democracy and good governance are the pillars for human well-being. Sida (2007) pointed out that gender equality was a necessary ingredient for eliminating poverty. Most rural roads infrastructure construction in Laikipia County focus on motor vehicle traffic, with little thought on non-motorized transport. There are no bicycle lanes in Laikipia, and therefore, there is need for road segregation.

Bicycle ownership in Africa is dominated by males due to cultural differences which may not apply in cosmopolitan areas like in Laikipia County. Grieco, Turner and Kwakye (1995) indicated that cultural attitudes vary amid ethnic communities of Accra. Household expenditure mounts a lot of financial pressure to women and gives no chance of bicycle purchase. In the same study, it was realized that lack of access to reasonable credit facilities imposes a significant cost on bicycle ownership.

Creating public awareness campaigns is a general policy which has successfully been implemented in some developing countries. This policy intends to shift societal values and economic initiatives which results in women empowerment. This leads to credit access and tax incentives for firms to employ women. The interventions may help in alleviation of the vicious circle responsible for women's situation in majority of African countries. This enables growth and education to prosper and revert the cycle in favour for man-kind in developing countries. This study is geared towards such facts and more so change people's attitude and realizes the importance of non motorized transport in poverty alleviation in Laikipia County. Each trip originates and ends with walking. At some point, people walk. Existing policies should be reflecting this fact by ensuring that investments in road infrastructure for walking and cycling makes massive environmental, safety and accessibility benefits (Karema, 2017 a & b). To achieve the goals of the study there is need to examine the characteristics, benefits, challenges and opportunities for non-motorized transport facilities in the county.

According to a study by Betolini *et al*., (2005) accessibility measures in land use and transport planning encounter methodological challenge in finding the balance between a measure that is theoretically and empirically sound. Consideration of high levels of spatial disaggregation of the accessibility measure is required. It also enhances the consistency of the measure of a limited number of origin points. It also enables the development of comparable values across modes and land use characteristics. In order for the study to set clearly the requirements for an easy operationalization and communicability, the study will apply quantitative design approach. This calls for data gathering instruments which contain items that seek for measurable distinctiveness of the population. The study opted for survey method to collect the required data from the people of Laikipia County.

Underpinning conventional rural transport planning is a belief that investment in roads would lead to increased motor traffic from the private sector, which in turn would stimulate household demand for travel. This analysis is driven by the theory of economic growth that implies a hidden link between infrastructure and the production function in agriculture and trade. Starkey *et al*., (2001:2) pointed out that apart from transport infrastructure there are other valid facets to efficient transport and travel needs such as inadequacy of affordable means of transport, lack of attention to the village level transport network and lack of integration of health, water, education and market services. Most of the non-motorized transport studies are based in urban areas which make this study valuable for small towns and rural areas at large. Non-prioritization of NMT especially in urban areas causes high rates of pedestrian crashes, due to high speed approach by drivers at pedestrians. In March 2012, Arrive Alive recorded 1187 fatal crashes, of which 42% involved pedestrians (Arrive Alive, 2012) in South Africa.

According to the Kenya Traffic Police Department, 2,893 people died on road traffic accidents in 2007. In the year 2012, National Transport and Safety Authority (NTSA) reported that 3,141 people die each year on Kenya's roads. The Ministry of health in Kenya (MoH, 2012) reported that 4,997 people die each year on roads. Reduced mobility and limited access in the rural areas are the main issues of concern in the study area. Therefore, this study is an assessment of the role of non-motorized transport in promoting rural mobility.

On the basis of the studies done globally on the role of non motorized transport, some questions were raised in this study. The questions formed the basis of the research objectives of the study.

1.3 Research Questions

1. To what extent does walking and cycling usage relate to social and economic facilities in Laikipia County?
2. How does NMT contribute to rural mobility in Laikipia County?
3. What is the contribution of cultural aspirations towards gender promotion in NMT usage in Laikipia County?
4. Which policies are responsible for guiding safe and adequate NMT access to social services in Laikipia County?

1.4 Objectives of the Study

The main objective of this study is to evaluate the role of non-motorized transport in promoting rural mobility in Laikipia County, Kenya.

The specific objectives of the study are:-

1. To determine the relationship between socio-economic factors and NMT usage in Laikipia County.
2. To examine whether there is significant difference in travel distances by walking and cycling in Laikipia County.
3. To determine the extent to which availability of NMT has affected access to schools and market centers in Laikipia County.
4. To establish whether there are existing cultural policies guiding gender promotion on usage of NMT in Laikipia County.

1.5 Research Hypotheses

Ho There is insignificant relationship between socio-economic factors and NMT usage in Laikipia County.

Ho Walking and cycling are independent of distance travelled in Laikipia County.

Ho There is no NMT access to social facilities in Laikipia County.

1.6 Justification of the Study

Majority of traffic in rural roads mainly comprise of pedestrians frequently carrying head loads (DFID 2008; Lindsay 2015). Small producers and consumers have expressed concern on poor and inadequate rural roads. Rural Africa's access stands at 34% while the rest of world is 90% (AFDB 2010). Rural people live in remote villages where access to education, health and economic services is almost impossible due to lack of bridges when floods occur. During post-harvest it is also impossible to market their surplus production. Inadequate accessibility hinders small-scale farmers from obtaining farm inputs and new technologies.

Inadequate planning and poor provision of non-motorized transport (NMT) infrastructure has been pointed out by scholars and this has resulted in non-motorized transport modes competing for space and conflicting with motorized transport (GoK, 2010). Laikipia County is in the arid and semi-arid lands which are characterized by low agricultural potential, low rainfall and perennial unemployment. Inhabitants of Laikipia County experience hardships in accessing social and economic resources due to poor road network and poor transport facilities. This makes the county to be vulnerable to poverty and social exclusion.

According to Sessional Paper No. 2 of 2012, Integrated Transport Policy (INTP) and National Transport and Safety Authority (NTSA, 2013) have made contributions to NMT policy, but still do not consider other basic issues such as flow control, physical bottlenecks, formalization of the sector, reduction in conflict, passenger comfort, routing issues and passenger safety. The INTP policy only addresses issues of licensing

and speed regulations. These inadequacies have motivated the researcher to take up this study. Access and use of transportation infrastructures are highly gendered. Women's travel habits differ from men's in the sense that there are perpetual inequalities both culturally and in duties allocation. Women in rural setting remotely access private and public means of transport. On the basis of gender division of labour women play a key role in household's travel burden, reproductive and care-giving responsibilities. This leads to disparities in resource control and allocation, gender biases in rights and entitlement. Most studies on non-motorized transport are on urban areas and therefore, there is a dire need of research in the rural areas. This prompted the choice of the study topic in order to have a comparative approach of both rural and urban setups.

Rockstrom *et. al.,* (2009) observed that limits of key resources which sustain human life have been exceeded due to industrialization of human-kind. This mainly relies on fossil fuels. Chapman (2014) pointed out that the finite resources' limits are likely to occur at a later stage in life. There is need to develop alternative modes of transport and their infrastructure as a way of cushioning the finite resources use.

1.7 Scope and Limitations of the Study

Challenges of non-motorized transport have been identified and best ways of addressing them have been sought in the study. Some of the socio-economic factors considered were educational level and income of the non-motorized transport operators. Due to limitations of fund and time no roads were selected for the speed-volume study.

1.8 Definition of Operational Terms

The following key terminologies have been used in this study:

Accessibility: can be defined as the ease of people's ability to reach goods, services and activities.

Biomimicry: Innovation Inspired by Nature.

Cycle lane: Refers to part of the cross section of the trafficked road carriageway for cyclists only.

Cycle-path: Refers to a route segregated or shared by pedestrians and cyclists away from a road carriageway.

Community cohesion/social capital: refers to the quality of relationships among people in a community.

Community Livability: refers to the residents', employees' and visitors' perception on environment and social quality of an area.

Flows: Refers to network traffic's volume which is a function of demand and capacity of the linkages. Flows experience space friction and distance is the most important inhibiting factor.

Gender: Refers to the stratification of the roles and behaviour of males and females.

Mobility: Refers to the time and costs required for travel.

Mobility indicators: measure travel times and costs, and their variability. There are people indicators and there are system indicators.

Non-Motorized Transport (NMT): refer to all forms of travel that do not rely on an engine or motor for movement.

Poverty: Refers to lack of enough material possessions or income for a person's needs. Poverty in relation to the amount of money necessary to meet basic needs such as food, clothing, and shelter is known as absolute poverty. Poverty in relation to the economic status of other members of the society is known as relative poverty. The Ministry of Finance and Planning (2000) draws poverty line for rural areas as Ksh.1,239 and Ksh. 2,648 for urban areas.

Resilience: Is the ability to cope with shocks.

Rural Access Index (RAI): Refers to an indicator that measures share of a country's rural population living around 2 km of an all-season road.

Shoulder: Refers to part of the roadside used for design support and drainage. It is also set aside for use by non-motorized transport and vehicle emergencies.

Side walk/Pavement: Refers to roadside foot way for pedestrians

Street furniture: Refers to objects such as information signs, lights, bollards, benches, bicycle stands and plant displays for public guidance.

Sustainable Development: is defined as development that meets the needs of the current generation without compromising the ability of future generations (WECD, 1987).

Transport fuel shocks: Refer to a drastic and severe drop in fuel availability which affects motorized transport signaling a lasting reduction in fossil fuel.

Trip allocation/route assignment: is the type of mode assignment to the transportation network.

Vulnerability: Refers to the degree of loss that can result from the occurrence of a potentially damaging phenomenon.

Walkability index: Refers to an indicator that identifies precise actions taken by cities to improve pedestrian infrastructure, e.g. walking paths and crossings available, the existing conditions of transport modes.

CHAPTER TWO: LITERATURE REVIEW

"Human rights are violated not only by terrorism, repression or assassination, but also by unfair economic structures that create huge inequalities."Pope Francis I"

2.0 Introduction

This section critically reviews past Non-Motorized Transport research studies conducted in both developed and developing countries. The literature review aims at establishing different approaches that have been used in previous Non-Motorized Transport studies; the key findings of the previous Non-Motorized Transport studies; and, identifying research gaps. It is also done to avoid repetition and recurrence of facts concerning the subject understudy. It enables the reader to have a good understanding of the essential ingredients of an NMT policy, and the main actions required to promote walking, cycling and other NMT modes. Several studies on Non-Motorized Transport have been carried out in the developed countries, few in Africa and in Kenya, but to-date, none have been carried out in the study area. Therefore, there is need for a comparative study to be carried out.

2.2 Global Perspectives of Non-Motorized Transport

According to World Bank report (2005), Non-Motorized Transport is usually ignored and not planned for in Sub-Saharan Africa. For instance, fresh construction and improvement of roads does not offer actual infrastructure like overpasses for open non-motorized transport operators. Consequently, cars and other motorized modes are favoured hence, disadvantaging the poor. Lisa (1996) pointed out that sound policy options for several transportation problems are triggered by inadequate and relevant data. About 98 per cent of the people who use public transport in Scandinavian cities start their journey on foot or on bike. In rural districts, 90 per cent walk or cycle part of the way. To promote public transport use, there is need to improve the state for

pedestrians and cyclists and also guide them on how to make a choice. About 63 per cent of Copenhagen's cycle since it is easy, fast and convenient. There is need to integrate schemes that are well thought out. Cycling is believed to have significant potential in providing affordable, cheap and efficient transport in the world. Despite the fact that in Brazil cycling possession levels are high, this potential has not been realized. The size of cities makes cycling inappropriate for entire trips, however integration of cycling into public transport, when analyzed and planned, may contribute immensely in raising the modal share of bicycles (Carvalho de Souza, 2011).

Fang, Ke (2013) pointed out that China is ranked first in greenhouse gases emission in the world and transport is the major source. According to the international energy agency, light duty transport from China is expected to increase its carbon dioxide emission from 65 mega tones in 2005 to about 300 mega tones in 2020, a rise of 290 percent which contributes towards global climate change. His study's aim was to link the knowledge gap through a guide on neighbourhood improvement of walking and cycling.

According to (Jobanputra, 2013; Masaoe, 2013), about 62% of the accidents of young people of 15 and 44 years old in Africa occur on roads. The vulnerable categories have poor mobility. This contributes to their isolated access to health-care, education and financial opportunities. Poor access to these opportunities leads to inadequate affordability and use of the existing Non- motorized transport facilities. It is hard to evaluate pedestrian mobility at country level because walking is used for short trips which are not registered by national travel surveys and therefore, significance of walking is not highly rated. Seven European countries survey data indicate that 12-30%

of the entire trips especially Great Britain is done by walking. Average length of trips is about 1 km in Great Britain to 2.8 km in Finland. Comparison of average trip length is impossible as it varies from country to country. For example, in Great Britain all trip lengths are included, while in Denmark trips less than 300 metres are not included and 300-1500 metres are termed as 1 km.

The 1970s oil crisis led to a deeper understanding of the oil dependent countries in Western Europe. In the Netherlands, about 3,300 people died in traffic in 1972 (Van den Bergh, 1997). The government saw the need of change and bike paths were separated from other modes of transport in the city centers. The cyclists were given back the rights to the streets as it was initially. This led to boosting of biking culture in Netherlands. Percentages of trips by travel mode in Developed Countries are as illustrated in Table 2.1 below.

Table 2.1: Percentages of trips in different modes of travel in Developed Countries

Percent of Trips by Travel Mode					
Country	bicycle	walking	public transport	car	other
Netherlands	30	18	5	45	2
Denmark	20	21	14	42	3
Germany	12	22	16	49	1
Switzerland	10	29	20	38	1
Sweden	10	39	11	36	4
Austria	9	31	13	39	8
England/Wales	8	12	14	62	4
France	5	30	12	47	6
Italy	5	28	16	42	9
Canada	1	10	14	74	1
United States	1	9	3	84	3

Source: John Pucher, Transportation Quarterly, 98-1.

According to Wegman and Aarts (2005), in their study in the Netherlands on walking and cycling transport modes showed that 29 percent of 0-11 years age category value cycling and walking more than the other categories (Table 2.2). 20 percent of the age category of 18-24 years walked and 23 percent cycle. Public transport was commonly used and had a share of 18 percent. The age category of 12-17 years, bicycle is the most popular mode of transport which accounts for 52 percent of all trips made.

Table 2.2: Percentage of modal split by age group in the Netherlands

	0-11	**12-17**	**18-24**	**25-29**	**30-39**	**40-49**	**50-59**	**60-74**	**75+**
Pedestrian	29	18	20	19	18	17	18	25	34
Bicycle	29	52	23	17	20	23	22	24	17
Moped/mofa	0	3	2	1	1	1	1	0	1
Motorcycle/ scooter	0	0	0	0	0	0	0	0	0
Passenger car	40	17	37	56	56	55	54	46	38
Bus	1	5	8	2	1	1	2	2	4
Tram/metro	0	1	3	2	1	1	1	1	1
Train	0	2	6	3	2	2	1	1	1
Other	1	1	0	0	0	0	0	1	3

Source: Wegman & Aarts (2005)

According to a survey carried out by Minnesota Department of Transportation (Mn/DOT) survey (2006), in the Twin Cities, work trips constitute about 1 percent done by bikes. A quarter of walking trips in Florida have no sidewalks' provision, and cycle lanes are available for a small proportion of cycling trips (NHTS 2001). According to Metropolitan Council data (2006), 2 percent of adults and 6 percent of children ride a bicycle in the Twin Cities. 90 percent of bicycle trips are used for recreation. Males account for 61 percent while children account for 50 percent.

These in-depth case studies of ten countries (Table 2.3), sought to evaluate the success of alternative solutions to transportation problems leading to alleviation of the transport crisis.

Table 2.3: Percentage of modal split in urban areas

Country	Car	Transit	Cycling	Walking	Others
Austria	39	13	9	31	8
Canada	74	14	1	10	1
Denmark	42	14	20	21	3
France	54	12	4	30	0
Germany	52	11	10	27	0
Netherlands	44	8	27	19	1
Sweden	36	11	10	39	4
Switzerland	38	20	10	29	3
UK	62	14	8	12	4
USA	84	3	1	9	2

Source: Pucher and Lefevre, 1996

2.3 Regional Perspectives of Non-Motorized Transport

According to (HLAGST, 2016), rural communities in developing countries are not well connected to the major roads and rail lines. This limits the rural people from public transport services that enable access to economic and social activities and opportunities in cities. In most cases opportunities may be measured in terms of employment while impedance is measured in units of distance or time. According to Cuong (2011), in his study in Vietnam, rural roads increase employment and income and therefore play an important role in boosting economic growth and household level. The study also pointed out that, rural roads and other infrastructure like, markets and schools have to

be improved in order to realize economic growth. Accessibility is characterized by three key factors: land use, transport, and individual uniqueness or personality (Venter and Cross 2012).

According to Ellis and Hine (1998) in their comparison of villages in Zimbabwe with Sri Lanka, they found out that a motor-vehicle was shared by 300 people in Zimbabwe while in Sri-Lanka 5 vehicles were shared by same number of people. There is no specific Sustainable Development Goal (SDG) objective on rural access, but several associations in both rural access and the SDGs exists. In total there is 17 SGDs in which the following SDGs are closely linked to Non Motorized transport in the rural areas which is the study's main concern. This was established by Roberts, *et. al*., (2006) using their Rural Access Index (RAI). This index is a development indicator used globally in the transport sector. The RAI was estimated at 68.3 percent based on household surveys. This translated to about 1 billion of the rural population which is unconnected to quality road network. SDGs 9 and 11 aim at contributing to sustainable infrastructure and communities for all, and are directly linked to rural areas. It is mainly concerned with proportion of the rural population who live within 2 km of an all-season road.

Mokitimi and Vander Schuren (2015) in their study in Sekhukhune, Limpopo Province in South Africa cited 64 per cent of students that walks daily to educational institutions and 21 per cent of workers to their work place (Statistic SA, 2014). 32 per cent of workers in Limpopo Province walk to their working place while38 per cent of those who walks to their work place were found in rural areas (Statistic SA, 2014). In SSA rural population experience high transport costs, low service frequency and unreliable services which affect people in rural Sub-Saharan Africa in wet seasons. This is caused by low density of demand, problems in matching demand and supply; poor transport

operators information flows and users due to lack of emphasis by government's inappropriate ways of strengthening and promoting the private sector.

According to World Bank Discussion Paper No. 344 (1996), earlier work suggested that rural households in Sub-Saharan Africa (SSA) dedicate a lot of time and effort to rural transport, especially around the village, on foot, meet domestic and subsistence needs. There was also an indication that main transport burden falls on women. It was also realized that, Intermediate modes of transport (IMT) use was lower in SSA than in developing world. For example, in Asia both motorized and non-motorized transport has evolved. To compare and contrast the findings of other scholars the study was set out to establish the relationship between socio-economic factors and NMT usage in Laikipia County; to examine whether there is significant difference in travel distances by walking and cycling in Laikipia County; to determine the extent to which availability of NMT has affected access to schools and market centers in Laikipia County and, to establish whether there are existing cultural policies guiding gender promotion in usage of NMT in Laikipia County.

According to World Bank (1996) survey on five village households carried out in Burkina Faso, Uganda and Zambia on African Village-Level Travel and Transport Surveys, it was found out that the average time spent on travel and transport was 1127 to 2700 hours on every rural household per year or 0.8 to 2.5 hours daily for every adult. The survey also identified five main rural transport problems which were as follows: water and firewood collection; transport constraints in crop production and marketing; and, access to social facilities. The study suggested the following as ways of solving the problems identified: location and maintenance of sources of water and firewood should be close to the household, use of fuel efficient stoves, improvement of footpaths;

increased use of IMT for load carrying at peak periods and for personal travel; and provision of additional NMT facilities close to communities and upgrading of existing NMT facilities.

According to Yussuf, *et al.,* (2015) in their study on "analysis of walking and trekking as an alternative to motorized trip in Akoka, Lagos Nigeria", 93.3 percent of the respondents liked walking while 52.2 percent believed that walking was a way of exercising their body system. However, the study pointed out that pedestrians faced some challenges which range from harassment by commercial motorcyclists, motorists, and adverse weather conditions on roads. The study recommended that land use planners should integrate non-motorized and motorized vehicles through provision of footpaths alongside the roads.

European Woonerf concept views streets as channel for vehicular mobility as well as social space (Collarte, 2012). This concept was developed in Delft city in Netherlands in the late 60s. This occurred shortly after surroundings of certain residents were affected by traffic speeding within the area causing confusion and turmoil. The residents uprooted brick streets and replaced them with snake like paths. This resulted in residential yard initiation, which prioritized living environment rather than vehicular roads. This gave rise to residential needs' accommodation and space for vehicles hence, improving the quality of life in the surrounding streets. Since then, the streets in the city are shared by bicyclists, pedestrians and cars but pedestrians and cyclists take the lead forcing motorists to be quite cautious. This not only limits the car speed but also promotes residents safety and sharing of public space. This allows new street features such as street trees, benches and places for social interaction. The concept is a great success in Netherlands urban planning and spreading to other countries in Europe. This concept is commonly practiced in Germany, the United Kingdom, Japan, Australia, and

Israel. The positive effects of the concept can be summarized thus: cutting driving speeds and promoting safety levels; adding efficiency of space utilization; promoting socialization behavior creating conducive environment for attractive street.

However, the concept has some drawbacks. For example, in UK it is known to cause delayed rate for emergency cases. Sporadic traffic snarl up has been associated with home zone schemes contributing to shortage of parking spaces near homes due to traffic calming measures. Moreover, mix of transportation means, cause fear of accidents.

2.3.1 African NMT policies' review

South Africa's NMT Policy (draft, 2008) categorizes women, the disabled, children, rural communities and the poor as vulnerable groups. It also states that, apart from mobility and roads, transport entails cultural roles and household tasks which hold back women's and girls' development. Uganda's National NMT Policy (2012) 'emphasizes on availability of proper pedestrian access for all. It recognizes NMT as the most significant and unsafe means of transport. This policy redresses this through the following objectives: recognizing non motorized transport, planning and design provision; providing pedestrians' and cyclists' infrastructure; safety enhancement for non motorized transport users by regulations' enforcement of the policy. Ghana's National Transport Policy (2008) calls for the government to reflect on transport facilities for the vulnerable group. Malawi National Transport Policy, draft (2014) seeks to ensure that rural transport demands for the vulnerable groups are satisfied. Integrated National Transport Policy of 2012 in Kenya has no provisions on NMT being incorporated into any policy, law, or regulation. This undermines NMT infrastructure development.

Out of 36 states of Nigeria only Lagos state is mounting an NMT policy. Nigeria's National Policy on Transportation (2015) aims at establishing a framework to guide transport activities in an efficient and effective way for collective and financial growth of Nigeria. The policy fundamental goal is to stimulate use of NMT in tourism, sport and recreation.

The Integrated National Transport Policy (2009) points out that transport burden is borne mostly by women and girls. The policy emphasized on balancing the load of women's time allocated in transport activities in the village, for example, fetching water, firewood, journeys to market centers, health clinics, and harvesting. Nairobi's NMT Policy (2015) underlines that: vulnerable groups are faced by difficulties and susceptible to criminal attack and harmful behavior while travelling. They also fear being robbed and harassed. Therefore, NMT planners for routes and facilities should carefully consider safety and security needs.

2.4 Local Perspectives of Non-Motorized Transport

Few studies have been carried out in the rural areas concerning non-motorized transport in Kenya. Majority of non-motorized studies have been carried out in the urban areas and therefore, rural areas have been neglected. This has given this study a research gap. For instance, Owira (2009) in his study on integrating non-motorized transport into the urban transport system found out that there was increasing development without commensurate infrastructure hence posing a threat. He recommended that development and maintenance of Non-Motorized Transport infrastructure should be supported by local authorities in provision and maintenance of sidewalks, footpaths and pavements for pedestrians.

According to Nkurunziza (2013) in his study on sustainable transport in Dar-es-Salaam, cycling is inexpensive and reliable. He views cycling importance and emphasizes on its condition for better access to activities and facilitating the people to live on by accessing social amenities. He also views cycling as service prospect which generates great amounts of semi-skilled service. World Bank (2005) carried out a study on, an assessment of non motorized transport programme in Kenya and Tanzania, and found out that cycling had not gained enough recognition and in some cases it is treated as a poor form with a low modal share particularly in East African cities. For instance, cycling in the city of Dar-es-Salaam is about 5% with a low contribution (JICA, 2008).

Poor provision and inadequate planning of Non-Motorized Transport infrastructure has been pointed out by scholars. This has resulted to NMT modes competition for space with motorized transport which causes conflict and compromising safety (GOK 2010). According to an NMT study carried out by Mitullah and Makajuma (2009) on the Jogoo Road corridor in Nairobi, it was established that the road environment is not yet conducive for NMT. They deduced that inadequate attention resulted from lack of NMT awareness. They therefore, recommended that there was need for sensitization of the agencies involved in infrastructure development. They also found out that pedestrian observation method is a low-cost method for evaluating the pedestrians' severance due to high speed roads in urban centers. Kenyan economy is influenced by agriculture which currently represents 24 per cent of GDP. According to Vision 2030 non-motorized transport aims at providing a way for product collection and market infrastructure to improve the supply chain from small scale producers to retail markets (Vision, 2030). In pursuit of the importance of non motorized transport, two programmes were funded by World Bank in 2016 in Kenya. The programmes were:

Kenya Municipal Programme (KMP) and Kenya Informal Settlements Improvement Project (KISIP). The projects constructed the Sosiani footbridge in Uasin Gishu County. Bicycle paths and pedestrian walkways comprise of over 80 Kilometres in Eldoret by the Bank funded projects.

2.5 Role of Non-Motorized Transport in Kenya

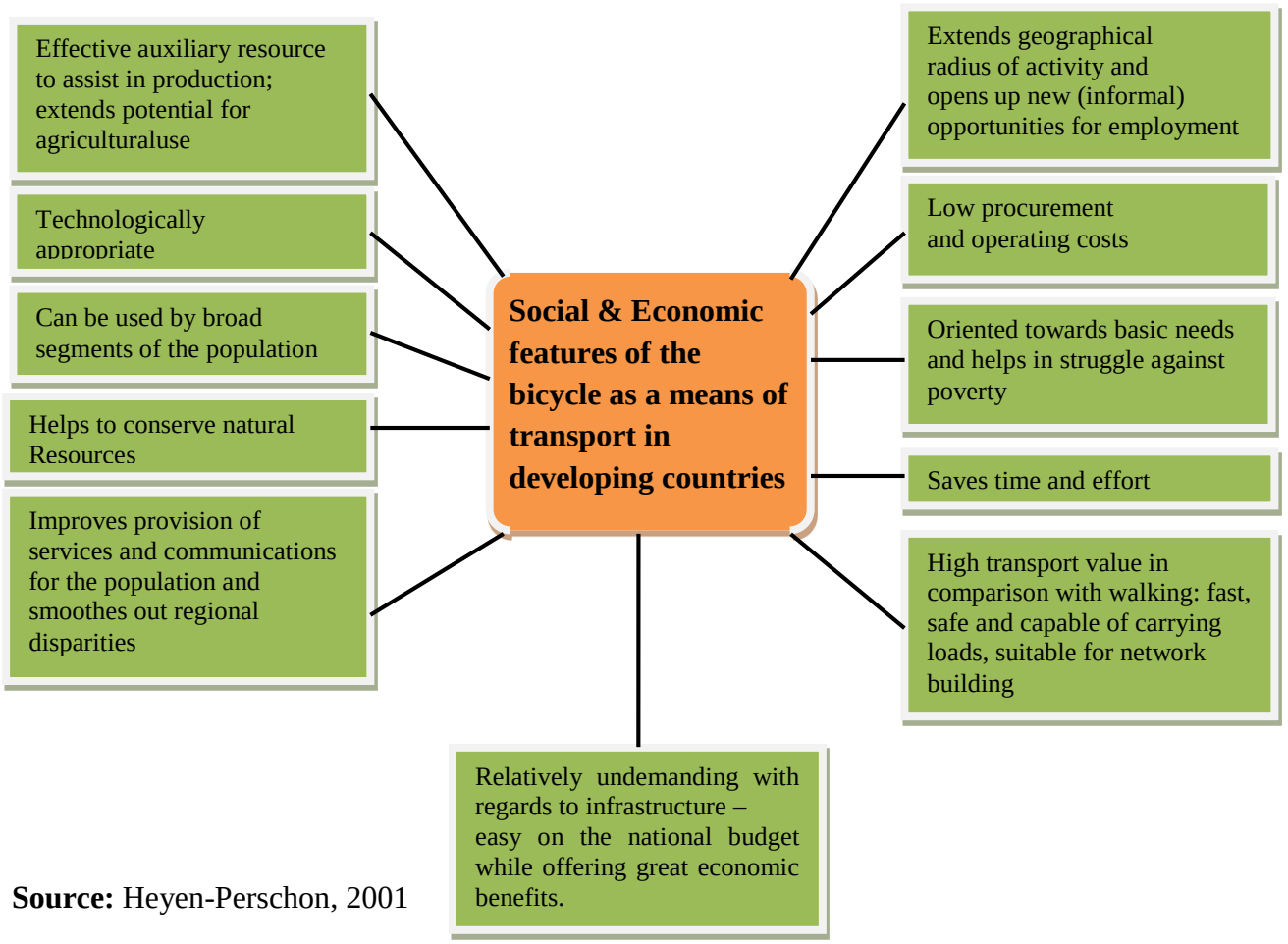
Non-motorized transport modes in Kenya, particularly walking, are exceptionally important though neglected means of mobility. Sperling and Clausen (2002) and Gwilliams (2003) in their studies in Kenya found out that, walking account for 90 percent, cycling for 4 percent, para-transit 2 percent and buses for 0.5 percent of rural trips. A traffic scenario comparison on the role of non-motorized transport in both developed and developing countries found out that rapid motorization has been a problem. Non-motorized transport existence as a main transport choice calls for transport policies to look forward to their efficient incorporation in the system rather than their eradication. Particularly, they stated that technical support and government investment mechanism, policy planning and capacity building should be sustained by sound non-motorized transport industry expansion. Gwilliams (2003) pointed out poor institutionalization and weak policy being liable to traffic congestion in developing countries rather than non-motorized transport existence and therefore, the need of concerted effort towards non-motorized transport improvement.

Okoth (2013) in his study on sustainable urban mobility (Non-Motorized Transport) in Kenya found out that there exists high NMT traffic congestion, lack of NMT promotion programs and lack of NMT infrastructure which has led to unstable urban mobility and development. He recommended that NMT should be promoted within the frame work of sustainable transport development due to its transportation, economic, and

environmental benefits. Equally there is need to explore how promotion of non motorized transport in the rural areas of Laikipia County can be enhanced through provision of NMT infrastructure.

Integrated National Transport Policy (INTP, 2012), recognizes that transport growth has emphasized on roads for motorized transport since non-motorized transport was unpopular. The INTP indicates that the responsibility of expansion and maintenance of non-motorized transport infrastructure is for the local authorities and road agencies. There are no champions at national and county levels even though non-motorized transport national policy exists. The policy outlines the expected output indicators as: increased non-motorized transport space coverage; increased services along with non-motorized transport facilities; safe non-motorized transport crossings; better designed streets and improved non-motorized transport conditions. The study was out to establish how NMT modes could be integrated and complemented within the policy. However, the INTP (2012) policy totally disregards the needs of the vulnerable groups in the rural areas as allocation of resources and development of NMT policy is concerned. The INTP (2012) policy has no guiding provision for NMT laws and regulations. This contributes to lack of harmonized approach and standards, hence, dominance of motorized perspectives on the road infrastructure development. This undermines NMT infrastructure development against post 2015 sustainable development era which lays emphasis on green development. Bicycles play a key role in extending agricultural potential in the rural areas by carrying fertilizers and farm manure to the agricultural fields (Figure 2.1). They extend the geographical radius of activities and open up new areas and create opportunities for informal employment. For example, agricultural extension officers, artificial insemination officers, school going children, small traders

going to the market centers use bicycles to deliver their essential services to the rural communities in less time. According to Heyen (2001), social and economic features of the bicycle can be summarized as in Figure 2.1:



Source: Heyen-Perschon, 2001

Figure 2.1: Social and economic features of the bicycle

Bicycles are of high transport value in comparison with walking: fast, safe and capable of carrying loads, suitable for network building, contributes to improved livelihood and prosperous communities. They have high productivity despite their low capital and operating cost. According to Grava (2003), bicycle saves a lot of space since it occupies 2 m^2 space while standing and 5 m^2 while moving as compared to 25 m^2 and 55 m^2 for private car. It also provides social cohesion and community livability. However, the

principal virtues of cycling are some of its liabilities. Cyclists use a lot of energy and exhaust themselves around the knees. Training of cyclists is doubtful and remains the biggest cause of accidents between cyclists and motorists.

2.6 Gender and Mobility in Rural Areas

Access to information, rights, assets, money, education and skills is mainly a gendered fact in the developing countries. Accessibility to services such as water points, market places, health facilities, educational institutions and recreation in rural areas is a function of the transport system and is indeed critical. Mobility data will be gathered from Laikipia County. Rural travel and transport patterns can be classified into domestic, agricultural and service access. Dawson and Barwell, (1993); Nutley, (1998) observed that, "there has been a paradigm shift, at least at the level of rural transport experts, that rural transport should be planned using a 'needs-based approach'. Such an approach specifically considers every trip made by individuals, no matter how 'small' and 'uneconomic' the travel is". Gender differences in travel behaviour remain unknown due to the non-availability of suitable data. Large gender differences originate from travel behavior related to trip rate, travel mode, duration and purpose of travel. Treatment of women has been uniquely recognized due to differentiated access and attitudes to both private and public transport, varied patterns of commuting and employment, and emerging differences from the contextualization of traditional roles.

According to World Bank (1996) existing gender-sensitive transport policies are: street lighting provision and other actions to develop women's safety both in public and private transport exercise; linking women in transport planning; introducing credit

purchase transport facilities for women; and, collecting information on women transporters.

Kenya government has four policy tools which enables women to enjoy same benefits with men from public resources: "Public Procurement and Asset Disposal Act (2012); Women Enterprise Fund; the Uwezo Fund and the Free Maternal Health Care programme". Public Procurement and Asset Disposal Act (2012) show the number of youth, women and disabled people's procured goods and services through procuring entity. This enables the system to be accountable and ensure equalization of opportunities for persons with disability, youth and women. Women Enterprise Fund was established in the Ministry of Gender, Children and Social Development which provides access to affordable credit for women's business support services.

Uwezo Fund is part of Vision 2030 programme which enables access to finances by the youth, women and persons with disability and aims at businesses and enterprises promotion. This enhances economic growth and realization of Millennium Development Goals – extreme poverty and hunger eradication; women empowerment and gender equality promotion. This fund was initiated by the President of Kenya in 2013. It was enacted by the Public Finance Management Act, 2014 under Legal Notice No.21. The Fund also offers mentorship at the constituency level to people with disability, women and the youth enterprises. The Fund also catalyses innovation, promotes employment, industrial and economy growth.

According to Gitobu *et al*., (2018) the Free Maternal Health Care programme was effected on 2013 by the President of Kenya aiming at promoting delivery services utilization and cutting down on pregnancy-linked mortality in the country. They used time series analysis on health facilities meant for delivery services, maternal and

neonatal mortality. This was done two years before and after the introduction of the policy in 77 health care facilities within 14 counties in Kenya. They found out that statistically there was a significant increase in facility oriented deliveries. They also found out that there were insignificant changes in both maternal and neonatal mortality ratio. They drew a conclusion that cost limits health facility service use in Kenya. However, there was an urgent need to address other factors that led to pregnancy and neonatal deaths.

2.7 Factors influencing mobility situation in developing countries

Jean-Paul Rodrigue (2017) observed that, poverty reduction can be achieved by improving access to people and markets. He also illustrated using a diagram the relationship between connectivity and inequality (Figure 2.2). In rural areas, limited connectivity is a critical constraint as per the current rural accessibility index. About 450 million people in Africa are likely to be unconnected as a result of incomplete transport systems and infrastructure.

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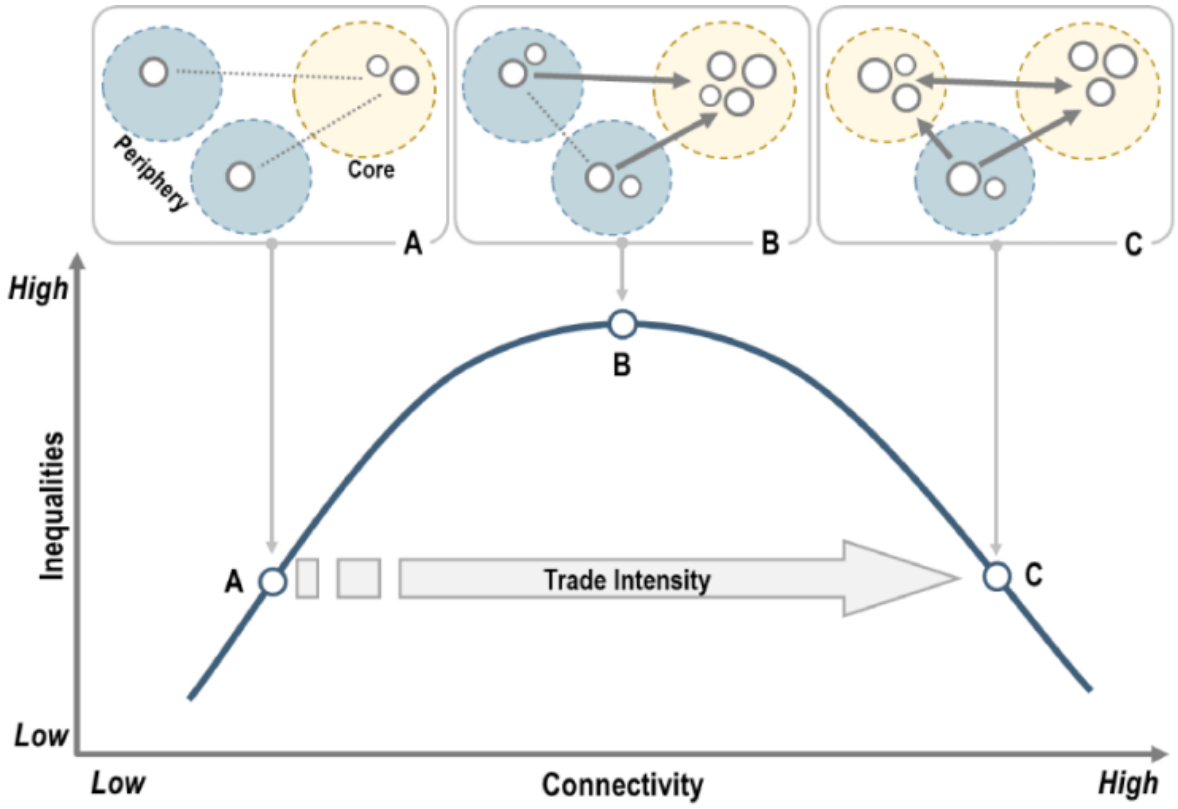


Source: Jean-Paul Rodrigue (2017)

Figure 2.2: Transport Costs and Spatial Inequalities

Figure 2.2 illustrates how increase of connectivity influences regions' comparative advantage. For instance, if production is located where labour is available, there occurs competitive advantage which increases trade intensity. Economies of scale are achieved as a result of wider markets due to high connectivity and related low transport cost. For example, low connectivity identifies itself with self sufficient regional economies and lower levels of inequalities. Transport costs get reduced as connectivity improves, inequalities increase with economies of scale. The core has a higher development rate than the periphery phase and a model of unequal trade may rise. It is worth noting that regions with low levels of connectivity usually get resulting trade profit, but regions whose level of connectivity is high are more reliant on derived benefits.

Mobility is a concept which encompasses access and travel to various destinations. It is the ability of individuals to move from one point to another at different times. The ingredients of mobility are: fulfillment of individuals' access and travel needs to various destinations, psychological satisfaction, sense of freedom, comfort and fitness, community participation in social activities, and emergency possible travel. Trip frequency is associated with mobility, distance covered, and means of transportation. Mobility aspects are measured in the following ways:

Table 2.4: Factors affecting mobility of the elderly

Factors	**Explanation**
1.Individual	
Opportunities for social & recreation time.	The elderly tend to go outside their homes for leisure activities more than other age groups because the elderly have more free time.
Age, gender, disability	-Being female, of advanced age, and disabled negatively impacts mobility -Women tend to require more assistance to maintain mobility.
Marital status, income, support from children, living arrangement, and support networks	The elderly living with family and children tend to have extra responsibilities. They have more out-of-home activities and are more likely to need transportation to maintain mobility.
Financial status	Lack of financial support may reduce personal independence, access to ac participation
Housing type and residence location	Living in apartments or high density of residences is associated with more trips.
House ownership and educational level	Being highly educated and owning a house is associated with more trips outside the home.
Ability to drive and vehicle availability	The ability to drive, availability of a license and car ownership influence the transportation mode used.

Physical conditions	Disabilities make common activities exhausting. The elderly often prefer to spread activities out over longer periods of time. -The feeling of lost independence may make the mobility hazardous and impossible -Physical impairment makes walking difficult for the elderly.
Psychological condition	Independence and freedom positively affect elder mobility.
2.Destinations (public space)	
The choice of places and activities.	Desired activities motivate the elderly
	Shopping malls attract older women more than men
The location of out-of-home activities	Geographically dispersed activities can make journeys longer
3.Transportation	
Transportation choices	In the developed countries, most elderly rely on cars. In developing countries, they rely on public transportation. The use of public transportation by the elderly is increasing.
	Location of one's residence influences the choice of transportation modes.
	Available transportation in communities influences transportation mode used by the elderly
	Cars and taxis are commonly used by the elderly living in suburbs since there are few alternatives and activities are more dispersed. In dense urban areas, most activities can be reached by walking or public transit.
Distant and travel time.	Length of time required for travel influences elder mobility.

Source: Burkhardt, J. (1999).

A combination of transport and enhanced mobility in the rural areas of developing countries leads to improved access to medical facilities hence, a decrease in maternal and child mortality. This facilitates gender equity as it plays a key role in high school attendance in the rural areas particularly for girls. Rural Access Index is a global

standard of measurement for rural planning access. It is an expression of the percentage of population living within a radius of 2 Kilometers from all weather roads.

Table 2.5: Rural Access Index for Selected Countries in Sub-Saharan Africa

Country	Year of survey	Rural Access Indicator (Percent)
Burkina Faso	2003	32
Burundi	2003	32
Cameroon	2001	21
Ethiopia	2001	17
Kenya	1997	44
Tanzania	2000	38
Madagascar	1997	25
Congo DRC	2003	26

Source: Robert P, Shyam *et al*, 2006

2.7.1 Non-Motorized Transport Structure in Laikipia

Non-Motorized Transport in Laikipia County includes walking, cycling, and cargo transport with various handcarts and provides flexible options to mobility. Emissions reduction is quite significant in this type of transport structure. Supplementing cars with more serene modes of transport would attract tourists. This would also enable them to purchase handicrafts and other wares from the vendors. Non-Motorized Transport is any mode of transportation that uses human energy or animal power for personal or goods mobility by methods that do not rely on combustion motor engine (Adebambo and Yetunde, 2010).

2.8 Challenges Facing Non-Motorized Transport in Rural Areas

Increasing motorization and inadequate infrastructure heavily contributes to non-motorized transport insecurity, in rural areas. The requirements of non motorized transport are usually disregarded by the road improvement designs. This results to

adverse road accidents for NMT users, mainly pedestrians and cyclists. According to (DBSA: 2006), transport infrastructure is crucial to the development of any nation. Lack of access to transport leads to social exclusion. Spatial exclusion arises in low density areas. In such areas cars are the only realistic mode of transport since public transport is not economically viable. Temporal exclusion refers to the problems encountered by night, early morning and weekend travellers when transport service is infrequent. Personal exclusion arises from individual attributes which inhibits people's mobility and access to transport. Economic exclusion results from people's inability to pay for transport costs. Non-Motorized Transport in Laikipia is characterized by bad road behavior and over-speeding (Karema, 2015).

According to Mahapa (2003), rural women's responsibilities can be summarized in three-fold; reproduction, production and community management. Reproductive roles include provision of household necessities, for example, fetching water and fire-wood, producing and preparing food; giving care to the sick and children; escorting elderly people to pension-pay points and children to school. Women engage themselves in productive roles such as income generating activities as part of their informal employment. They also involve themselves with subsistence farming and social obligations like organizing and maintenance of communal amenities. All these activities involve transport and especially non motorized transport.

The Encyclopedia of World Problems & Human Potential (2019) holds a similar view on transport systems and communications in rural communities as it puts it:

> *[Developing countries] Transport systems and communications in rural communities have remained the same for many decades: the single-lane mud and gravel roads leading into many villages cannot accommodate much traffic; motorized or commercial means of transport are lacking; there is rarely access*

to fields other than by footpaths so that farm machinery or trucks are unusable during rainy seasons; ankle-deep mud on roads makes travel very difficult so that people (in particular students and teachers) are cut off from education, commerce or any social exchange, often for long periods of time, particularly in countries that have long rainy seasons. Most travel in many villages, including crop transport, is by foot over long distances and difficult terrain. Although most families make one or more trips to market each week, such trips are a major undertaking, and obviously any travel is judged carefully against a number of inhibiting factors. This is especially evident in the limited amount of travel done even within a village, further isolating neighbour from neighbour.

2.8.1 Vulnerable groups in African NMT Policies

South Africa's NMT Policy (2008) spells out the category of people that the policy serves, which include, women, children, the disabled and the poor. The policy identifies the societal role of transport as socio-cultural and tasks that hinder the progress of the group, as well as the impacts of accessing health services, educational facilities and employment. Nairobi's NMT Policy (2015) points out that the problems encountered by women and children when travelling are numerous. They are vulnerable and scared of criminal attacks and anti-social behavior. This calls for safety and security needs when planning for NMT routes and facilities. The study is concerned on rural basic needs assessment and the best way possible to address them in order to realize the importance and the role of NMT in rural areas of Laikipia County.

Ghana's National Transport Policy (2008) forces its government to consider the vulnerable group in transport facilities accessibility. Malawi National Transport Policy draft, 2014 and Zambia's Rural Accessibility and Mobility Programme are compelled to ensure that NMT facilities are well integrated with the rural transport needs for the vulnerable groups.

The Integrated National Transport Policy in Kenya (2009) cites the transport burden and time spent by women and girls on transport activities like, fetching water, firewood,

trips to market centers, health clinics, and harvesting. Nairobi's NMT Policy (2015) points out that vulnerable group encounter several problems when travelling more than other road users. Such problems include criminal attack and anti-social behavior. Even though the state acknowledges that men and women are entitled to equal rights as far as use and ownership of bicycles are concerned, gender bias must be discouraged. This calls for NMT planners to consider safety and security needs. Barwell (1996) in a study in Burkina Faso, revealed that female adults transport about 10.3 to 15.5 ton-kilometers while male adults transport 3.6 to 4.4 ton-kilometers.

Namibia's Sustainable Urban Transport Master Plan (SUTMP, 2013) emphasizes on NMT planning and education facilities. SUTMP sees children as an unpredictable lot and demands motorists to handle them carefully. In this connection, safe travel to and from school should be designed to care for the vulnerable group, for instance, physical separation from moving vehicles and pedestrian crossing priority. Some of the achievements of Namibia's policy is that the poor category has constrained accessibility through car ownership leading to more use of non motorized transport. Secondly, the speed of low income households has been improved by using public transport saving more than one hour per trip maintaining the speed of an average household.

2.8.2 Significance of Gender Issues in Transport Planning and Policy

The main reasons behind women's inequality are deeply entrenched in society. The interplay of political, socio-cultural and economic basis and their associated analyses on gender and three transport variables on women's uneven access such as partriarchy, poverty and planning needs.

Patriarchy

Is a concept that control power interaction and cultures which is associated with gender distribution of labour in traditional and modern societies in regard to family unit as the inner support of the society. Men tend to allocate themselves the most ideal modes of transport and dominate their control. Overton (1996) illustrates this with an example from rural Mozambique where distributions of bicycles to poor village women were snatched away by their husbands and other male family members who later used them for recreation and status. There were reported cases of domestic violence where women resisted the move. Local cultures tended to regard women's use of bicycles as unsuitable and rebellious. They also branded such women as unworthy for marriage.

Poverty

Poverty illustrates gendered transport and mobility behaviour as economic activities and regard socio-cultural facets as vital, yet, it is less important. This view misreads many development institutions portraying women's lack of capacity to pay. This heavily contributes to women's ill access to transport services and infrastructure. Overall trend of "feminization of poverty" has surfaced in developing and developed countries due to lack of power in women's household statuses. Women entry into the employment market has completely changed this situation hence, reducing the inequality. However, the spread of reproductive and unpaid labour is worsened by the fact that men's productive labour is economically over rated compared to that of women.

Planning

According to Caren (1990) the main problems of traditional transport planning can be summarized by three assumptions, (a) Households' composition is made of a wife,

husband, children and nuclear family. (b) Man assumes the productive role as an income earner while wife takes reproductive role of the home-maker. (c) Everyone within the household has equal entitlement to resources and decision-making power in their livelihood and well-being. This elaborate stratification of household duties made men to have dominance in transport planning and policy making. Nonetheless, this stereotype assumption is being overtaken by time in the developing countries. This prescribes an outdated dichotomy. A third of world's productive labour comprise of women whose reproductive role is significant in perpetuating household's survival. A clear inventory of women's role enables transport planners to meet women's travel and transport needs. Women in developing countries suffer from limitation of access making them dependent on public means of transport. Rural poor especially, women usually travel at off-peak hours and walk in most of their trips. Infrastructures planning mainly consider motor-vehicles which does not address women's needs properly. There is need of focusing on women transport problems in order to alleviate their burdens.

2.8.3 Transport and Gender

According to Malmberg-Calvo (1994), Curtis (1994), Bradshaw (1995), Barwell (1996) studies sponsored by International Labour Organisation (ILO) shed light on off-road transport load and women activities in Africa and Asia. Off-road activities include walking and riding on paths, tracks and trekking around villages. Majority of off-road activities are done by women. As a result, there is need to consider gender differences in roles in patterns of transport and travel which arise from differential access of resources.

Gender roles

Gender stratification is manifested in needs, roles, division of labour, cultural norms as well as societal perceptions. This is clearly reflected in activities patterns of men and women. This seriously affects priorities and infrastructure improvement and development. In addition, men and women are affected differently by infrastructural development. The criteria for differentiation should be grounded on social and gender factors. Sanitation facilities are treated in a different way by men and women especially in management of household hygiene (IWTC 1982).

According to Mahapa (2003), majority of men are migratory workers in towns, living women to take part in various responsibilities in the rural areas. Examples of roles played by women in the rural areas are: taking care of children, livestock, and soil tilling during planting season. Men act as pallbearers for funerals as women prepare food. Men dominate in use of non motorized transport which range from use of ox-carts to handcarts. Men play key roles in fetching water and firewood due to the increased use of IMTs particularly for long distances. Transport is a key driver for subsistence, economic, social needs and generates human capital.

Subsistence needs

The fundamental subsistence needs are: food, water and fuel-wood. Several modes of transport are used to access the basic commodities. Such modes include and not limited to wheelbarrow, animal carts and head-loading. Women in the rural areas usually carry water by head-loading and wheel-barrows for short distances. While animal carts are used to carry agricultural production from fields and wood fuel from far distances. Women who accesses wheelbarrows for fetching water save a substantial amount of time and money which is directed towards other domestic needs' provision. For

instance, the number of trips made by rural women when carrying water by head-loading is reduced and therefore time spent on fetching water is allocated to other important tasks. Rural women involve themselves with land preparation which include pre-cultivation, seeds, manure and fertilizer transport. According to Mahapa (2003), access to fuel wood in Limpopo in South Africa is a nightmare since resources are far away from villages. In addition, it was also found out that, on average 15-25 Kilogrammes are consumed by one household which is obtained from about 2.5 Kilometers to 8 Kilometers daily. The same research further found out that the level of consumption and the standard of living were related, while consumption and level of access had no relationship. The main mode of access to firewood was found out to be walking and was done every second day. Consequences of these activities were seen to be detrimental to girls in particular since they denied them opportunities to study, grow or even rest on school holidays. This disadvantages girls as compared to boys by denying them their precious time for other productive work.

Social needs

Women make intra-and inter-village trips for several reasons. Most of the trips are crucial trips. Such trips are usually made by employed rural women who happen to access income generating activities. In this case rural unemployed women access such opportunities via walking and other non motorized transport modes in order to cut expense. Such visits include: relatives and friends' visit, church visits, government offices' visit, shopping, social networks maintenance, market, schools and hospital visits. Employed rural women frequently undertake these ventures while unemployed rural women irregularly engages themselves in such visits due to finance limitations. Rural employed women's visits are both internal and external while those of self-employed women and unemployed are mostly internal due to financial constraints.

Human capital

Rural women participate in rural development by engaging themselves in trips to meetings, health services and educational centers or empowering training sessions and skills development. Sometimes such basic and necessary travels are impaired due to lack of adequate roads resulting to rural women seclusion. Rural women's realistic needs are derivatives of life experiences such as health care, food, water. The quality of such basic facilities depends on individuals' education level, occupation or nature of employment, income and location.

2.8.4 NMT users improved convenience and comfort

The Pedestrian Master Plan, of the City of San Mateo in California cited in Litman *et al*. (2011), identified four areas that influence convenience and comfort of pedestrians and cyclists. Amongst the key indicators identified were the physical infrastructure which determines convenience and accessibility to all by fulfilling the needs of people irrespective of age and ability. Department of Transport (2000), identified safety and security improvement as the second indicator. This is achieved by increasing safety through improvement of lighting, crossings and signal settings, traffic calming measures, signing and accident remedial schemes.

Putcher *et al*., (2010), identified the third indicator as promotion of special NMT programmes. This is attained by provision of safer routes to school programmes, workplace travel plans, cycle-to-work-daily programmes, travel awareness campaigns, health campaigns and travel smart programmes. The author cited that safe routes to school are programmes that include education, infrastructure and enforcement, in order

to increase student safety by cycling and walking to school. Litman *et al*., (2011), cited the fourth indicator as pedestrian design which demands pedestrian network and destinations to be well connected. They should be continuous, direct routes and convenient connections between destinations such as homes, schools, shopping areas, public services, public transit and recreational opportunities. The Pedestrian Master Plan, in Litman *et al*., (2011), indicates that walking environment must be easy to use and provide good places. Community livability is mainly impacted on by walkability. Streets are places where people interact and therefore, a main sector of the public sphere. Attractive, safe and walkable roads increase community livability (Forkenbrock and Weisbrod, 2001). According to Putcher *et al*., (2010), majority of reviewed cases portrays an image that, all-inclusive approach generates greater impact on bicycling than uncoordinated individual measures. Therefore, integrated complimentary measures are more successful and efficient.

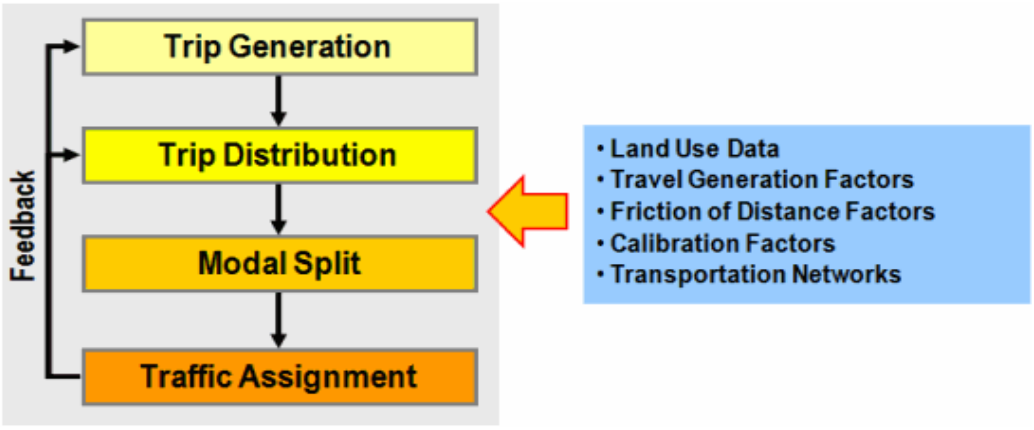
2.9 Theoretical Framework

Theoretical framework is the 'blueprint' for a research which consists of theoretical principles, constructs, concepts, and tenants of a theory (Grant & Osanloo, 2014). It is based on an existing theory in a field of inquiry that is related to the hypothesis of a study. It serves as the foundation upon which a research is constructed. Theories are formulated to explain, predict and understand phenomena besides falsifying accessible knowledge in the confines of decisive bounding assumptions (Swanson, 2013). Theory building is termed as "the resolute progression or recurring cycle by which coherent images, and representations of practical or skilled phenomena are generated, verified, and refined" (Lynham, 2000b, p. 161). Good theory building includes: outcome and progression knowledge which is capable of explaining and predicting knowledge; for example, insight understanding of meaning and working principles. Dubin, (1976) and

Chapin (1974) provided a framework on how societal constraints and inherent individual motivations interact to shape activity involvement patterns. However, the framework ignored the spatial context and failed to address the relationship between activities and travel. This creates a gap in the research and informs the current study on areas to concentrate on. Hagerstrand (1970) shared first discussion on literature about activity participation and proposed inclusion of time and space. Jones (1979) held a seminar and looked into the relationship between activities, travel, time and space. He regarded travel as a derived demand from the need at various points in space and time. This triggered, travel demand analysis (TDA): Activity-based and other new approaches. Human kind has unintentionally created vast issues linking the sustainable future. 'Biomimicry' seeks answers for sustainability for human-designed challenges by emulating nature's developed strategic patterns (Hargroves and Smith 2006). This is a new design paradigm in practice. The four theories that guides this study are:- Four stage model, theory of repeated actions; social cognitive theory and socio-ecological model.

2.10 The Four Stage Model Theory (FSM)

The four stage model is the main tool for predicting future demand and presentation of a transportation method (Figure 2.3). The model states that, an individual's acceptance of a movement's basic values believes that valued objects are threatened. It also states that, their actions helps in restoring those values which experiences a personal norm for pro-movement action that creates a predisposition to provide support.



Source: adapted from EPA420-R-97-007.

Figure 2.3.: Four Stage model/ Land Use Model

The four stage model estimates the spatial generation and distribution of trips while gravity model measures interactions between all the possible location pairs. Due to this comparative advantage four stage model is more frequently used to analyze spatial interaction more than gravity model.

The FSM gives a device to resolve stability flows. Trip generation, trip procedures rates are generated by the tendency to travel. Trip allocation, travel generations are distributed to match the travel desirability sharing how essential travel impedance, yielding trip schedules of person-trip load. Trip schedules are mainly factored to prove relative size of trips by different modes. Modal trip schedules are assigned to mode-specific networks. After travel, time dimension is introduced where the production-attraction time-tables are factored to show observed travel allocations.

2.11 Theory of Repeated Behaviour (TRB)

According to Ronis, *et. al.*, (1989) behaviour can be predicted by rational decisions or unreasoned influences. The theory suggests that routine is mainly the determinant of

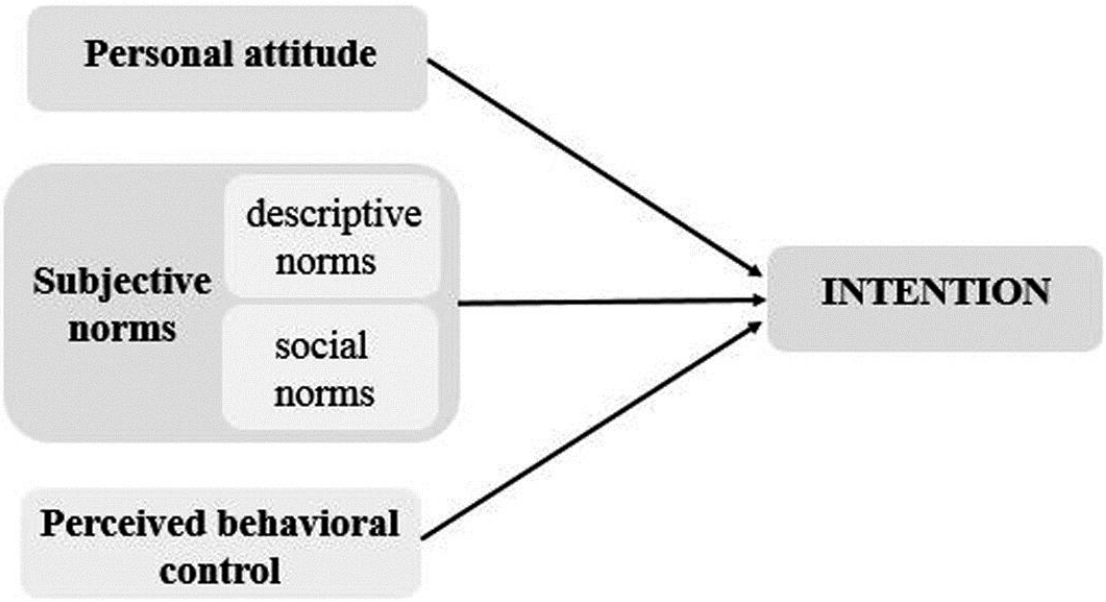
recurring behaviour. Purpose may compel the start of behaviour and its determination is affected by habit. Stimuli cause conscious management and probable regular behaviour deviations. For example, a campaign on walking awareness promotion may persuade an individual to weigh up habits of driving to work. This theory's main contribution show how habit informs recurring behaviour. Travel choices are influenced by decision and habit in the theory of this thesis. Gardner (2009) in his study showed that habits influence the link between purpose and the actual mode choice.

2.12 Theory of planned behavior (TPB)

This theory is grounded on the idea that coherent use of existing information determines individual's behaviour (Ajzen, 1991). Adoption of certain behaviour is shaped by three psychological concepts: Attitude, Subjective Norm, and Perceived Behavioral Control.

Attitude depends on individual's beliefs and the consequences of the actions. A positive feeling on cycling leads to the possibility of commuting using a bicycle. The key factors that influence bicycle use for transport are: environment and pleasure of cycling (Xing *et al*., 2010, Handy and Heinen, 2012). Dill and Voros (2007) illustrated that, utilitarian trips are based on positive attitude in cycling. For example, if employees use a bicycle in commuting to their work place, an individual is influenced towards cycling. This increases the chance of using this transportation mode. A study done in Netherlands by Heinen *et. al*., (2011) found out that convenience, low cost and health benefits were important factors which led to use of bicycles as a mode of transport. Subjective Norm denotes the social pressure created by individuals' feelings grounded on normative beliefs. People influence individuals on their decision and motivation to use a bicycle as a means of commuting. Perceived behavioral control implies the people's view over their ability to perform a particular behavior which is an accurate reflection of the real

behavioral control. Both perceived behavioral control and intention can be directed towards prediction of behavior. This study contributes to the expansion of the theory of planned behaviour broadly and in the perspective of NMT via new insights concerning the direction and power of the influence of natural factors.



Source: Adapted model from Ajzen (2002)

Figure 2.4: The conceptual framework of the theory of planned behaviour.

Ajzen (1991) in his theory of planned behavior, explains the fact that actions are mainly directed by individual factors like, attitudes and real behaviour control. Perceived behavioural control consists of perception of individual's abilities and intelligence of managing the surrounding circumstances. Verplanken *et al*., (2008, p. 122) in their habit discontinuity hypothesis argued that environment adjustment gives a high chance of previous behaviour recurrence.

2.13 Social Cognitive Theory (SCT)

Social Cognitive Theory is important in the depiction of interventions to shape up behaviour (Bandura, 1986). Mutual determinism is the interaction of people's behaviour, and the environment. In SCT, behaviour informs and is informed by personal, behavioural, and environmental factors. Self-evaluative outcome expectations are shaped up by people's attitude towards a certain action. For example, a person may have pride of leaving the car at home and walk to the grocery store. Sometimes a person with friends who often cycle or walk has a positive descriptive norm about cycling and walking. This may shape-up mobility improvement and justifies the need of the study's aim of assessing the role of non-motorized transport in promoting rural mobility.

2.14 Socio-ecological Model

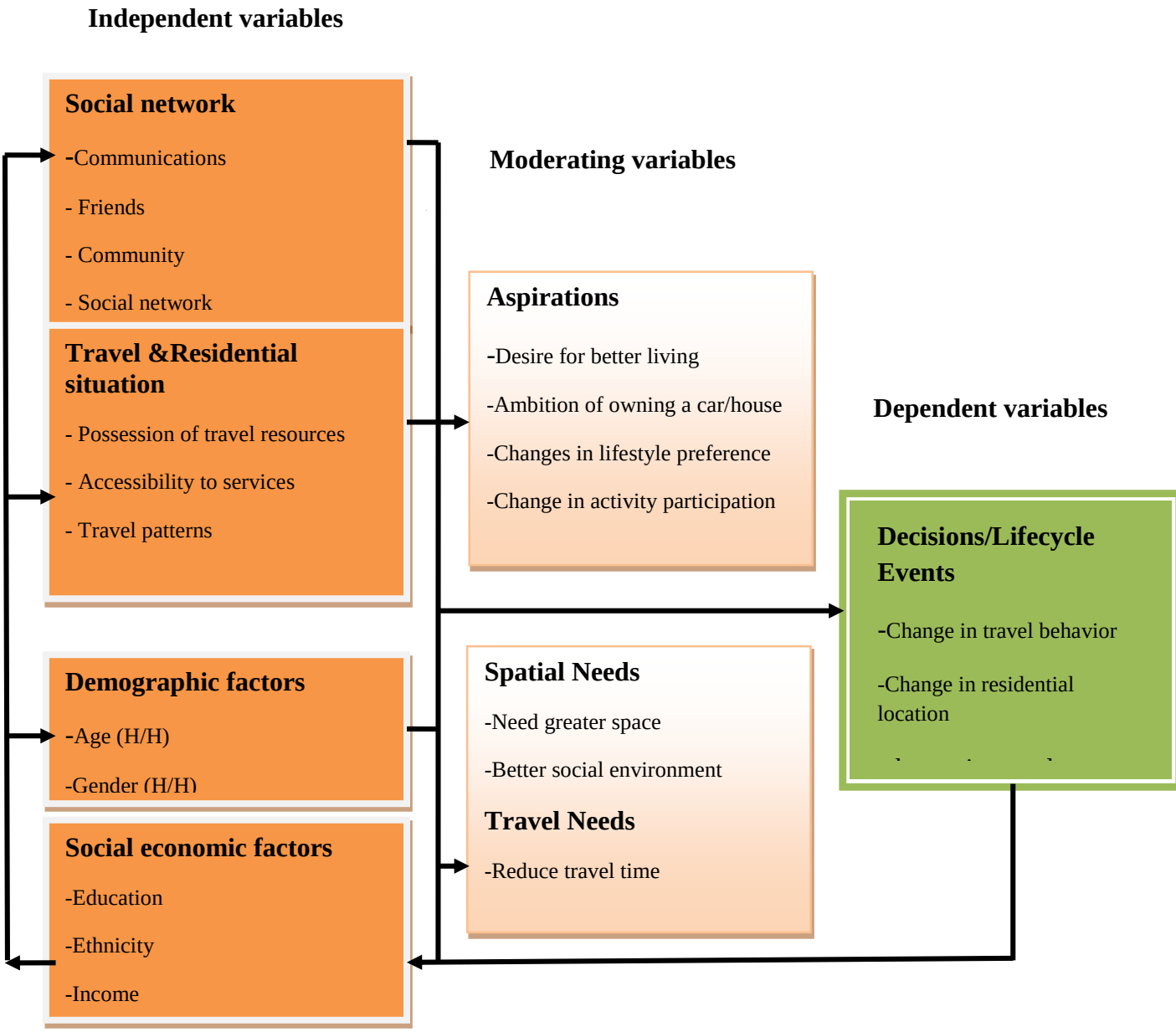
Socio-ecological model focuses on the link between behaviour and environment as mutual and by isolating the social environment into analytical levels. It is likely to pay attention on certain levels of social attributes with the aim to expand right interventions (Bronfenbrenner, 1979; McLeroy*et al*., 1988). The socio-ecological model planned by McLeroy and colleagues (1988) aims to direct behavioral interventions and to offer a distinction on levels of intervention and the goals of intervention.Socio-ecological framework is significant in the sense that attitudes, perceptions and cultural forces are easily accommodated. The following conceptual framework is derived from the above theories which are related to the study. The model conceptualizes land use, non-motorized transport user characteristics, travel behaviour, transport systems, and external effects. Alfonzo (2005) used the social-ecological model to resolve the decision to walk and found out that, built environment is a critical precursor but cannot singly determine the decision to walk. He cited other inter-processes such as, social-

environment and individual factors. However, the model has limitations such as being too simplistic on distinction of walking outcomes by three trip modes and duration taken by two categories. The choice of travel modes is influenced by socio-economic factors like income, car ownership and travel cost. These factors are not considered in the model.

The 500-Series Shinkansen Japanese bullet train operating from Tokyo to Hakata is among the fastest trains in the world. The biggest challenge in its' design was to achieve quiet run while at high speed. Learning that the owl family is the most silent and stealthy fliers of all birds, the Shinkansen design team adopted the owl family whose wing plumage design with stealthy fliers made it to be the most silent bird. The bird has several protruding saw-toothed feathers called serration feathers in its outer rim of their main feathers which generate small vortexes in the airflow which break up the vortexes that generate noise. This principle was used in the Shinkansen design and succeeded in reducing noise that met the world's standards. The technology is referred to as 'vortex generator', and is being used in designing aircraft and caps and boots of professional skaters.

2.15 Conceptual Framework

Individuals demand for transport services are attributed to, age, sex, household structure, education level and job type. Travel behaviour depends on modes, distances, time of day and routes (Figure 2.4). The study aims at defining a framework that promotes transport investments that improves the rural economy. Household's mobility decision depends on the household's social network. Barwell (1984) argued that, basic communal needs are linked to transport and access conditions.



Source: Own construct (2017), inspired by *Oakil et al., 2011a*

Figure 2.5: Conceptual framework of mobility decisions

Oakil et al. (2011) observed that, there were guiding effects between life events and travel mode change even though their sample was quite small. Lack of information on transport interventions experienced by various studies on NMT creates a gap for future research. This prompts the dire need of the current study which seeks to identify how

life events interact with transport interventions to influence commuting behavior and hence promoting mobility within Laikipia County.

Figure 2.5 indicates that life events associated with residential and employment location are linked to increased likelihood of commute mode choices. Facilitating conditions such as, social network, travel and residential situation, demographic factors and social economic factors play a key role in the desire of mode choice. The moderating or intervening variables like, individual aspirations, spatial needs and travel needs has some influence on final decisions or lifecycle events, for example, change in travel behavior or change in residential location. The theoretical framework informs this study in terms of planning policies concerned with encouraging active commuting. This may be promoted by prioritizing mixed developments with short distances between residential areas, amenities and employment opportunities. This supports the investment in measures to reduce journey times by public transport to employment places. However, the study did not establish why residents of socially deprived neighbourhoods had no likelihood of commuting by active modes.

2.16 Research Gaps

The literature search established that, inadequate capacity in the local authorities and user groups were major constraints to attaining capacity building outputs (Porter, *et al*., 2013). Therefore, bringing appropriate NMT infrastructure planning and design to the level of motorized transport was hard. Porter, *et al*., (2013) recommended that, engineering input, design and interventions test should be implemented. The study also noted that solutions that work in the developed world were unsuccessful in some developing countries mainly due to inadequate capacity for infrastructure maintenance and law enforcement.

This study identified the need for: (a) research on effect of car journeys' reduction to promote walking and cycling in Laikipia County. (b) Interrogating the non-motorized transport technologies adopted in Laikipia County to ensure appropriateness of cultural and social aspects. (d) Provision of a complete lane segregation which has exclusive rights for both pedestrians and cyclists with physical partitions between motorized traffic and non motorized transport.

The data related to non-motorized transport are partially collected, compiled and presented by researchers. The data is also fragmented which contributes to conceptual gaps of non-motorized transport in rural areas. It is worth noting that data collection and decision making contributes to NMT policy development (UNEP, 2016).

Little attention has been given to people's perception when making travel choices. For instance, contextual gaps of non-motorized transport are experienced in lack of education and awareness. Technical design gaps do not permit a rapid and comfortable flow of non-motorized transport in the rural areas. Rural roads in the study area are characterized by bumps, potholes, gradients, and stopping at junctions. The study identified appropriate roles of non-motorized transport; established prospects for non-motorized transport in Laikipia County and drew recommendations, such as key actors to be included in the NMT strategies; evaluating factors which may limit the use of non-motorized transport; suggesting criteria for the separation and integration of motorized and non-motorized transport users; identified potential gender and cultural biases for non-motorized transport use and possible approaches; specified the circumstances in which non-motorized transport should be encouraged; and benefits of most important interventions and opportunities were provided.

According to Ben Clark *et al*., (2016) no information is available on transport interventions encountered by other scholars and future research should try to find out how transport interventions interact with life occurrences to influence commuting behaviour. However, the research firmly emphasized that life events should be prioritized in travel behaviour studies as well as in transport policies for promoting commuting behaviour. However, this creates another gap to be researched on and hence the motivation of the study.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter aims at discussing the study area, location, position and size of Laikipia County as well as justifying the various types of data, methods used in data collection in the thesis, and statistical analytical techniques applied in data analysis. The chapter describes the sources of the data collected, sampling frame, sampling design and philosophical approach, feasibility of the study area, and data processing procedures, along with the relevance of the analytical techniques used.

3.2 Study Area

3.2.1 Location

According to Laikipia County Integrated Development Plan 2018-2022, Laikipia County consists of three administrative sub-counties: Laikipia East, Laikipia North, and Laikipia West. Laikipia County is located in Rift Valley. The name Laikipia means '***treeless plain'*** in Maasai language an apt description of the county, which is a vast plain where both wildlife and domestic animals are found. It is the 15th largest county in Kenya and occupies an area of 9,462 Km^{2}of land. It experiences an average of 400 mm and 750 mm annually. Its annual mean temperature is 16^{0}C - 26^{0}C.

The county is served by two district hospitals, Nanyuki Referral and Teaching Hospital and Nyahururu General Hospital. Other healthcare facilities include 56 dispensaries, 8 health centers, 9 medical clinics and 2 nursing homes. The county has 350 primary schools and 91 secondary schools. The county has two universities, namely, Laikipia University and Karatina University College - Nanyuki Campus. Administratively, the county has 15 wards, 51 locations and 96 sub-locations. Laikipia East sub-county is in

the east, in the north is Laikipia North, in the south-east is Laikipia Central and in the west of the county is Laikipia West.

The county is gifted with rangeland, forests, wildlife, undulating landscapes and rivers. The county has high - medium potential land which constitutes 20.5 per cent of the county's size while low potential land accounts for 79.5 per cent which is suitable for livestock and wildlife. The main soils in the county comprise of loam, sand and clay. Black cotton soil dominates the plateau. The hillsides of the county have dark reddish brown to red friable soils and rocky soils.

The available industrial activities are found in Nanyuki and Nyahururu towns within Laikipia County. The industries mainly concentrate on leather, milk, meat and food processing. The only meat processor is in Rumuruti and is known as Ngare Narok Meat Industry. The county has two bakeries, four main flour mills, milk cooling depot and saw milling firms. The county has seven *Jua kali* associations offering employment to about 255 artisans. Petroleum products are stored and distributed in the county at a low scale. Honey harvesting and wax processing takes place within the County in Rumuruti, Lariak, Marmanet, and Mukogodo forests.

Ecological Conditions

Soils in Laikipia County are mainly composed of loam, sand and clay. Most parts of the county contain black cotton soil. Hillsides are characterized by rocky soils, dark reddish brown and red friable soils. Weather dictates agricultural production in the county. The weather comprise of dry spell and poor distribution of rainfall. The gazette forest area is about 580 Kilometer squared with indigenous forest situated in

Mukogondo and Rumuruti, while Marmanet and Shamaneik has plantation forests. Wildlife spreads within the semi-arid areas all the way to Samburu, Meru and Mount Kenya corridors. Large ranches are owned by private developers and occupy about 50 percent of the county. Additional ranches are owned by Maasai along with the unsettled land in the county. Occasionally there occurs conflict between farmers and the pastoral communities. The ranches are inhabited by African wild dog, gazelles and the leopard, lion, buffalo, rhinocerous, and elephants.

Climatic conditions

Central Rift Valley and the nearby plateaus are in Central Kenya. The rainfall distribution within the year varies between unimodal and bimodal. This results to trimodal rainfall occurring in April, July, and November. The Laikipia Plateau is in leeward part of Mount Kenya. Nyandarua Range are in the eastern side of Mount Kenya and experiences the bimodal rainfall. General classification of the zonal ecological pattern is as shown in Table 3.1.

Table 3.1a: Agro-ecological zones

Zone	R/Eo(%)	Classification	Average annual rainfall (mm)	E_o, average annual potential evaporation (mm)	Vegetation
I	>80	Humid	1100-2700	1200-2000	Moist forest
II	65-80	Sub-humid	1000-1600	1300-2100	Moist and dry forest
III	50-65	Semi-humid	800-1400	1450-2200	Dry forest and moist woodland
IV	40-50	Semi-humid to semi-arid	600-1100	1550-2200	Dry woodland and bush land
V	25-40	Semi-arid	450-900	1650-2300	Bush land
VI	15-25	Arid	300-550	1900-2400	Bush land and scrubland
VII	<15	Very arid	150-350	2100-2500	Desert scrub

Source: Sombroek et al. (1982)

Agro-ecological zones of Laikipia County fall under Rift Valley and Central Provinces.

The study area falls under LH4 and LH5 as shown in Table 3.1b.

Table 3.1a: Agro-ecological zones in the study area

Zone	Altitude in m	Annual mean temperatures in ^oC	Annual average rainfall in mm
LH 4 Cattle & sheep zone (Ng'arua)	1820 – 2280	15.6 – 14.9	700 – 850
LH 5 Lower highlands, ranching zone – Rumuruti, Ng'arua	1800 – 2140	17.3 – 15.3	680 – 780
UM 5 Livestock & sorghum zone	1760 – 1830	17.9 – 17.5	590 – 680
UM 6 Upper midlands ranching zone	1300 – 1800	20.9 – 17.8	380 – 600

Source: Farm management handbook Vol. II Part B (Central and Rift Valley)

Administrative boundaries of Laikipia County

Laikipia borders Samburu County to the North, Isiolo County to the North East, Meru County to the East, Nyeri County to the South East, Nyandarua County to the South, Nakuru County to the South West and Baringo County to the West (Figure 3.1). The County lies between latitudes 0 º 18" South and 0 º 51" North and between longitude 36º 11" and 37º 24' East. It covers an area of 9,462 km2 and ranks as the15th largest county in the country by land size. The figure 3.1 indicates the geographical position of Laikipia County in Kenya. The county was purposively chosen mainly due to its infrastructure network nature and partly due to researcher's proximity.

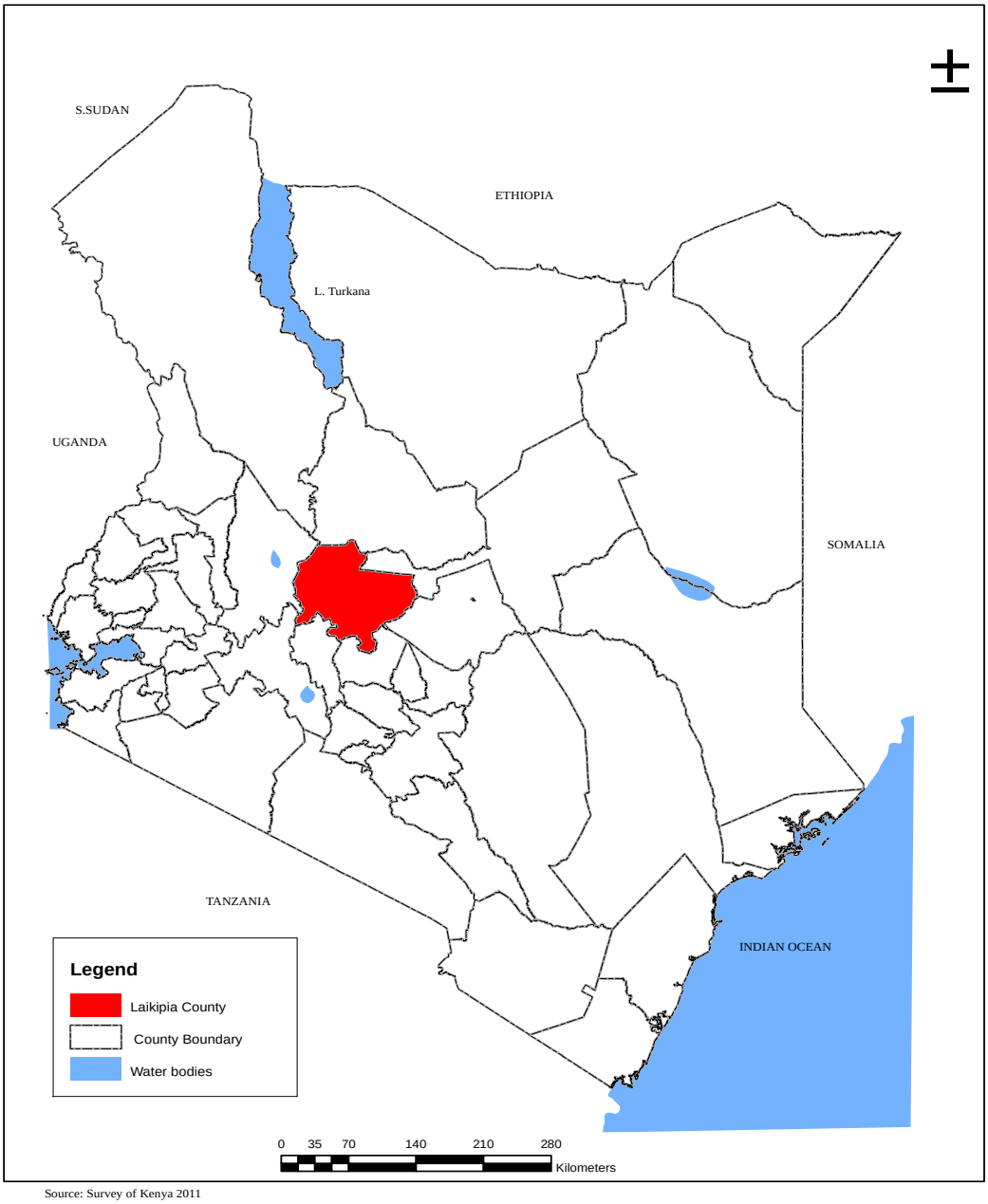


Figure 3.1: Map of Laikipia County in Kenyan Map

Laikipia County depends on rainfed farming practices which are susceptible to climate inconsistency particularly on drought periods. Rainwater is harvested from rooftops and dams. This is unreliable and therefore, unsustainable for irrigation purposes. Climatic hazards contribute to erratic and unpredictable rainfall in the county, leading to drought

and moisture stress. Controlling soil moisture and rainwater more efficiently and use of organic and inorganic fertilizers, improved water resources and market access are fundamental components for improved livelihoods in Laikipia County (Figure 3.2).

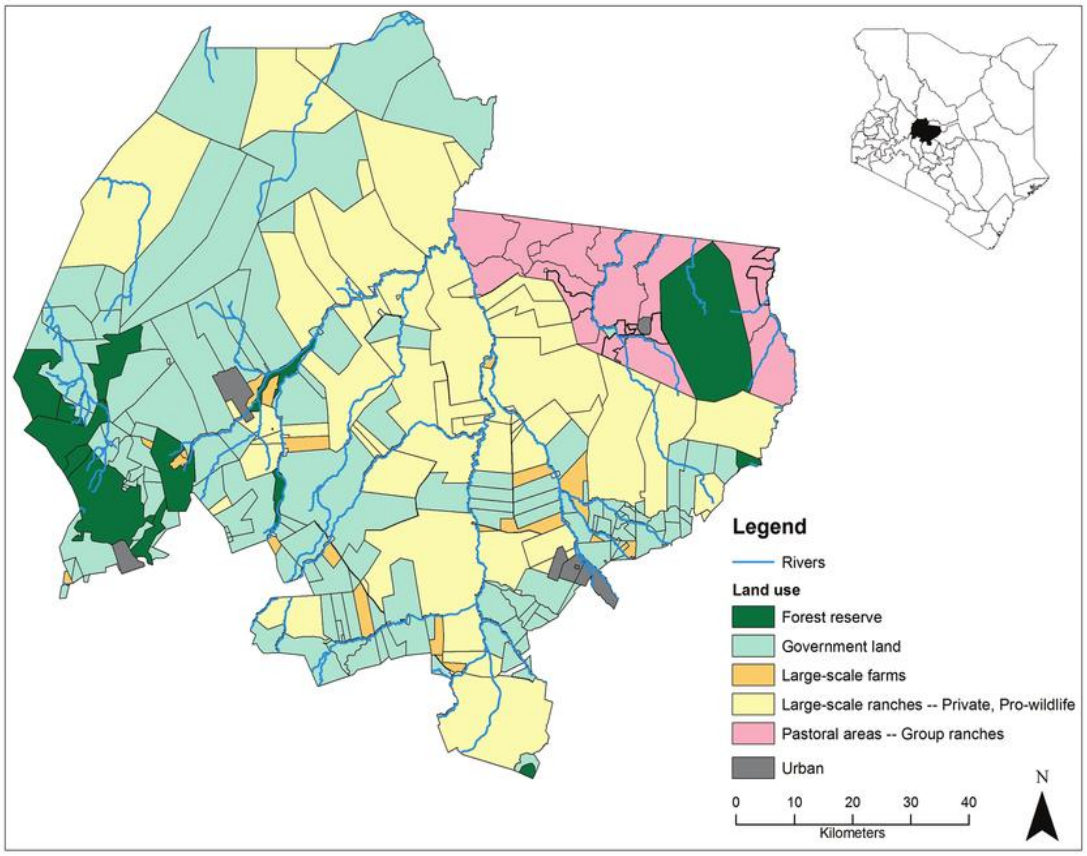


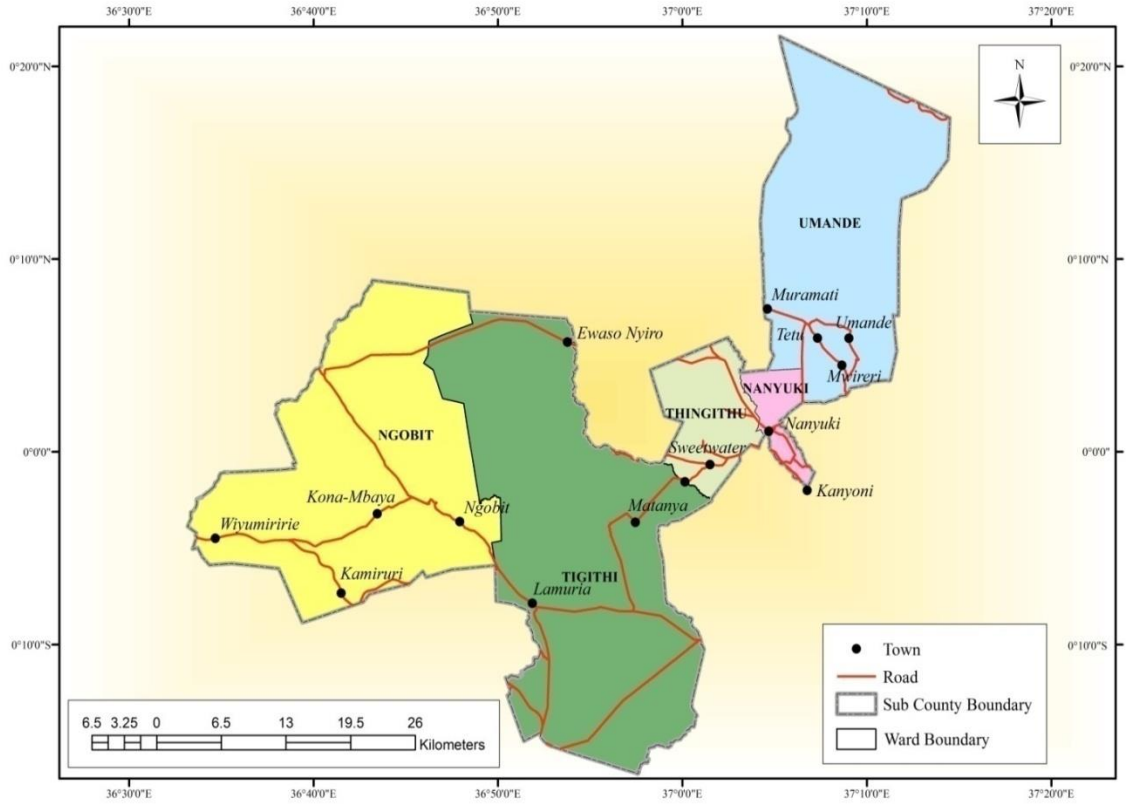
Figure 3.2: Map of Laikipia District showing the major land-use types.

Source: Property boundaries and land use data from Mpala Research Center.

Administrative boundaries and road networks of Laikipia East Sub-county

Figure 3.3 illustrates the administrative boundaries of Laikipia East Sub-County and its various road classes. This enables the reader to understand the importance of the study since many parts are inaccessible as seen from the map. This triggers non-motorized

transport importance in linking inaccessible areas of the county and consequently promotes mobility in the county.



Source: Field work (2018)

Figure 3.3: Laikipia East Sub- County Road Network

Administrative boundaries and road networks of Laikipia West Sub-County

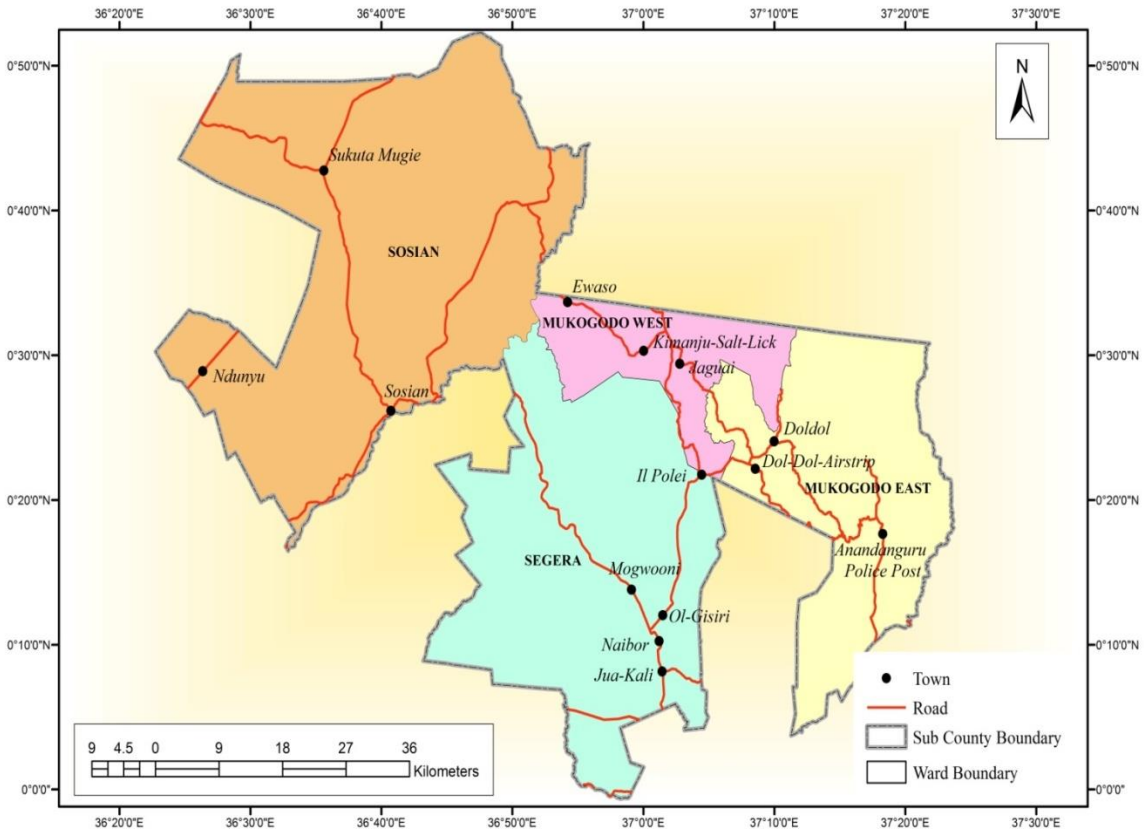
Figure 3.4 below illustrates the administrative boundaries of Laikipia West Sub-County and its various road classes. This enables the reader to understand the importance of the study since many parts are inaccessible as seen from the map. This triggers non-motorized transport importance in linking inaccessible areas of the county and consequently promotes mobility in the county.

Source: Field work (2018)

Figure 3.4: Laikipia West Sub-County Road Network

Administrative boundaries and road networks of Laikipia North Sub-County

Figure 3.5: Laikipia North Sub-County Road Network illustrates the administrative boundaries of Laikipia North Sub-County and its various road classes. This enables the reader to understand the importance of the study since many parts are inaccessible as seen from the map. This triggers non-motorized transport importance in linking inaccessible areas of the county and consequently promotes mobility in the county.



Source: Field work (2018)

Figure 3.5: Laikipia North Sub-County Road Network

3.2.2 Population distribution

The proportionate distribution of the sample size was derived from the county's population distribution. The projected population by the Kenya National Bureau of Statistics (2012) Laikipia County's population is 438,282. Males account for 218,056 while females account for 220,226.

Table 3.1a: Laikipia Population Census for four consecutive Decades

Name	Status	Population Census			
		1979-08-24	1989-08-24	1999-08-24	2009-08-24
Laikipia	County	134,524	218,957	322,187	399,227

Source: Kenya National Bureau of Statistics

Table 3.1b: Information on Laikipia Population Structure (Projected)

Population Census (Gender)							
1979-08-24		1989-08-24		1999-08-24		2009-08-24	
Males	Females	Males	Females	Males	Females	Males	Females
92,528	82,228	111,291	107,403	173,761	167,945	198,625	200,602

Source: District Statistical Office, Nanyuki, (1996)

3.3 Transport Network and distances in the rural areas

Transport activities at the household level derive from purely subsistence needs, the need to carry food crops, fuel-wood and water, for example, over long distances. Also the list of transport activities is extended by journeys to and from fields, agricultural inputs transportation from the markets, and transport of produce to markets. These trips are made on foot and in some cases, non-motorized transport devices. Measurable variables of mobility are travel times and costs and their variability. Most parts of the

road network is impassable during the rainy seasons. The roads are not segregated and therefore, cars, buses and trucks share roads with non-motorized transport modes. Lack of protection of motorcyclists, cyclists and pedestrians makes them vulnerable to fatal injuries (ACEM, 2004). This triggers the need of promoting walking and cycling facilities in the county.

3.4 Research Design and Philosophical approach

Slife and Williams (1995) identified two important components in research that is the philosophical assumptions as well as distinct methods or procedures. This study is based on both Social Cognitive Theory and the Socio-ecological philosophical assumptions. The main objective of socio-ecological model aims at directing behavioural interventions and to offer a distinction of levels of intervention and the goals of intervention. Sometimes a person with friends who often cycle or walk has a positive descriptive norm about cycling and walking which shapes-up mobility. According to (Labaree, 2009), research design is the overall strategy chosen and integrated into the study in a logical and coherent manner while addressing the research problem. The new approach to rural transport will be identified by (1) introduction of the household as the unit of analysis rather than a focus on the region or the country, (2) goods and rural people's movement in search of domestic, economic and social needs (Dawson and Barwell, 1993).

3.5 Target Population

The target population included all stakeholders who were involved in non-motorized transport sector within Laikipia County. Some of the stakeholders that were interviewed include, Non-Motorized Transport Users, Key Informants, and Non-Motorized

Transport Operators. 384 households were considered as a representative sample for the county.

3.6 Types of Data

Data may be categorized in two ways, qualitative data and quantitative data. Data was collected from two sources: primary and secondary sources. Primary data was obtained from the field through interview schedule, observation and questionnaires. Secondary data was obtained through thorough literature search and review of both published and unpublished research reports, journals and, books. Data collected from Laikipia County was in two formats: Categorical data and nominal data. Categorical data is attributed to things like a person's gender, language while nominal values have no order, assumes the form of discrete units and are used to label variables. Ordinal data has similar characteristics with nominal data but has no order. The data collected was both qualitative and quantitative. Qualitative data was assigned numerical variables to transform it to quantitative and therefore quantitative data was analysed by use of SPSS programme.

3.7 Sampling Frame

According to (Sudman, 1976), the best practice in sampling is to randomly select a large sample. Sampling is a statistical tool for data analysis where a few representative items of the population, known as a sample are used. The sample depicts the entire population characteristics. Sampling theory relies on two important principles: statistical regularity and inertia of large numbers. Statistical regularity principle states that, sample choice is random and all members have a likelihood of being selected and therefore, a right representative of the universe. Inertia of large numbers principle is grounded on the

view that large numbers show compact characteristics compared to the small numbers and the difference in the total of large numbers is trivial. The two principles discussed emphasize on the sample size. Simple random sampling was done in this study, where individuals in the target population were given equal chance of being sampled. This involved random selection of individuals from the target population. Stratified sampling was also carried out in the study where the population was divided into strata based on an appropriate characteristic, for example, age, level of education, and income, then selecting the participants within those groups or strata (Singleton and Straits, 2010: 151).The total number of households in Laikipia County is 103,114 (KNBS, 2013).

The stakeholders that were interviewed were non-motorized transport users, key informants, and non-motorized transport operators. Stakeholders usually have knowledge, wisdom and insight information that guided the study. They provided a broader scope of the interviewees' opinions on the topic which revealed a hidden concern from specific questions in the questionnaires.

3.7.1 Sample Size

Several approaches of determining sample size exist. They include: use of a census in cases of small populations; sample size of relevant studies may be used; making use of secondary data or published tables; and use of a formula to compute a sample size. A population of a given study may be too large for it to be feasible for research. Sometimes resources such as time and money may not be enough to cover the entire population of a given study. It is logical to consider a certain percentage of the population and make inferences on an entire population. The standard deviation of a population can be approximated by use of a sample. The population of the stakeholders in the study area is unknown. According to Ishmael Mensah (2014), the sample size of unknown population can be derived by computing the minimum sample size required,

for accuracy in estimating proportions. This can be done by considering the standard normal deviation set at 95% confidence level (1.96), percentage picking a choice or response (50% = 0.5) and the confidence interval (0.05 = ±5) (Ishmael Mensah, 2014). The following formula was used to compute the sample size:

$$n = \frac{z^2 (p)(1-p)}{c^2} \ldots\ldots \text{(Ishmael Mensah, 2014)}$$

Where: z = standard normal deviation set at 95% confidence level,

p = percentage picking a choice

c = confidence interval

Application of the formula to determine the sample size:

$$n = \frac{z^2 (p)(1-p)}{c^2} = \frac{1.96^2 (0.5)(1-0.5)}{0.05^2} = \frac{0.9604}{0.05^2} = 384.16$$

Stratified random sampling was done and a total of 384 non-motorized transport stakeholders were selected. The target population was divided into 15 strata of administration classification. The sample for each stratum was extracted from the sample frame. Within the stratum simple random sampling was performed for non-motorized transport operators (Ruth *et. al*., 2005). According to Hamilton *et al*., (2005) the agenda of gendered mobility was achieved by providing door-to-door demand-responsive services.

3.7.2 Data Collection Techniques

Data was randomly selected from individuals within a complete list of the population. Stratified samples from the population were used for primary data collection. The population was further divided into strata with similar characteristic and participants were selected within the strata (Singleton and Straits, 2010: 151).Interviewing key informants, focus group discussions and performing pedestrian questionnaires in Laikipia County was conducted. The county has three sub counties and 15 electoral wards. Proportionate sampling for the county was done. A total of 384 households were interviewed as indicated in table 3.4. Out of a total of 384 households, purposive sampling for key participants was done. Secondary data was also obtained from the review of peer refereed journals, published and unpublished materials.

Methods applied in data collection from Laikipia County were tabulated as in Table 3.2. Data used in the study was obtained as primary data and secondary data. Primary data included demographic data of the stakeholders which was captured through administration of questionnaires, semi-structured interviews, photographs, observations and key informants interviews. The respondents were also interrogated on the types of travel modes preferences through questionnaires and direct observations. Infrastructure condition and assessment was also captured through direct field observations and photographs. Secondary data was obtained by computing percentage of total trips by walking and cycling, averages on range of walking and number of bicycles in the market was also explored through research and reading the published documents, peer refereed journal articles and visiting documents libraries.

Table 3.2: Data Information and Method of Collection

Type of Data	Description	Methodology
Primary Data	Demographic data (Age, gender, mode, NMT users, NMT operators)	Administering questionnaires, Focus Group Discussions, Semi-structured interviews, Photographs, Observations, Key informants interviews
	Travel Mode data (Preferred mode and reasons for walking)	Administering questionnaires and direct observations
	Infrastructure condition and assessment	Direct field observations, photographs
Secondary Data	Percentage of total trips by walking and cycling, average range of walking, number of bicycles sold.	Research and reading the published documents, peer refereed journal articles and visiting documents libraries.

Source: Researcher (2018)

Physical characteristics of the sampling sites in the study area were considered with the help of a hand held Global Positioning System (GPS) as shown in (Table 3.4). The various characteristics considered were: site, altitude, Eastings grids and Northings grids. This generated the coordinates of the various sampling sites visited within Laikipia County. This enabled the researcher to map out the three sub-counties: Laikipia East, Laikipia

West and Laikipia North. The three sub-counties form the Laikipia County which was the location of the study area.

Table 3.3: Some Physical characteristics of the Sampling Sites in the study area

Sub-County	Site	Altitude (metres)	Eastings	Northings
Laikipia East Sub-county	Ngobit	2,022	-0.06000	36.79700
	Tigithi	1,832	-0.06100	36.95800
	Thingithu	2,132	-0.18333	37.96670
	Nanyuki	1,947	0.01667	37.07283
	Umande	1,792	0.09800	36.95800
Laikipia West Sub-county	Igwamiti	2,110	0.15100	36.37000
	Marmanet	2,358	0.17800	36.38100
	Githiga	2,110	-1.08333	36.71670
	Salama	2,041	0.12900	36.49400
	Rumuruti-Township	*1,828* 1,880	0.26200 0.54400	36.53600 36.48200
	Ol-Moran			
Laikipia North Sub-County	Sosian	1,843	0.44200	36.71900
	Mukogondo West	1,370	0.50300	36.99900
	Segera	1,673	0.22800	36.98500
	Mukogondo East	2,136	0.40000	37.16600

Source: Fieldwork (2018)

Administratively, the county has 15 wards, 51 locations and 96 sub-locations. The criterion for distribution was based on the administrative wards' population obtained from the Kenya Population and Housing Census (2009). The distribution of households' sample size within the sub-counties in Laikipia County (Table 3.5) was done proportionately.

Table 3.4: Distribution of Households' Sample Size within the Sub-counties in Laikipia County

Sub-County	Wards	Population	Target Population	Sample size
Laikipia East Sub-county	Ngobit	23,978	26	
	Tigithi	27,062	30	
	Thingithu	20,836	23	
	Nanyuki	28,485	31	
	Umande	16,201	18	
	Total	116,562	128	128
Laikipia West Sub-county	Igwamiti	66,466	51	
	Marmanet	42,422	33	
	Githiga	27,958	22	
	Salama	23,824	18	
	Rumuruti-Township	21,265	16	
	Ol-Moran	17,556	14	
	Total	199,491	154	154
Laikipia North Sub-County	Sosian	25,848	33	
	Mukogondo West	23,362	30	
	Segera	15,911	21	
	Mukogondo East	13,702	18	
	Total	78,823	102	102
	Total sample size			**384**

Source: Kenya Population and Housing Census (2009)

3.7.3 Data Analysis

Statistics is the scientific method by which information is collected, organized, analyzed and interpreted for the purpose of description and decision making. It can be categorized into descriptive and inferential statistics.

3.7.3.1 Descriptive Statistics and Inferential statistics

Descriptive Statistics deals with the presentation of data in tables or graphs and the methodology of analyzing the data. Inferential Statistics deals with techniques for deciphering inferences on the entire population regarding the observations from data samples. Descriptive statistics was used to analyze survey data related to non-motorized travel or physical activity. Hanson and Hanson (1977) embarked on an empirical study by relating data collected from a travel survey with weather data. These statistics

describe and summarize data in a significant way, for instance, patterns may surface from the data for example central tendency and variability. However, the statistics are limited in concluding beyond the data analyzed or invalidating any hypotheses.

Inferential statistics was used to understand the how mathematics and logic of generalization from the sample to population. This inference depicted the population's characteristics from the null condition that, no difference between means or no relationship between variables exists. This is done with some confidence in order not to make a mistake. The standard level of confidence when rejecting or failing to reject the null hypothesis is known as "alpha," whose probability is .05. This is done to avoid committing Type I Error. In summary, inferential statistics seek to establish whether the observed characteristics are adequately deviant from the null hypothesis.

3.7.3.2 Chi-square (X^2) Statistics

According to Kothari (2019), Chi-square statistic test determines the degree of relationship between two variables at a given significance level such as 0.01, 0.05, or 0.10; or any value between 0 and 1. The test method seeks for independence to determine the significance of relationship between two categorical variables. Rejection of a null hypothesis implies that there is a relationship between two variables, in this case walking and cycling.

The Chi-square formula: $X^2 = \sum (0-E)^2/E$

Where, X^2 = Chi

$\sum$ = Summation

0 = Observed

E = Expected

df is the degree of freedom involved in a given equation

df is calculated by multiplying the row(R) total-1 by column (C) total – 1 i.e (R-1)(C-1)

NB: (O-E) = Residuals

$\sum (0\text{-}E)^2/E$ = Component

3.7.3.3 Multiple Linear Regression and Correlation Analysis

Multiple Linear Regression is a statistical tool that predicts the outcome of a response variable by using many explanatory variables. Bivariate analysis is a statistical tool that predicts the outcome of a response variable by using two explanatory variables. It is used to find out if there is a relationship between two sets of values such as, X and Y. It is important to note that univariate analysis is the analysis of one variable only. Multivariate analysis is considered in the study due to its statistical power of analyzing more than two variables. Multiple Linear Regression and Correlation analyses falls under the multivariate techniques.

Multiple Linear Regression Model

Gravity model has been used heavily in the past studies to show the connection between origins and destinations. However, it is limited in the sense that it cannot explain factors and functions that contribute to the relationship between origin and destination, and how the factors interact (Ida, 1993). Traffic generation and attraction involves various factors, for instance, distance and volume of products transported which assume the following form:

$X_1, X_2, X_3 \ldots X_n$ ……3.1

It follows that:

$Y = f(X_1, X_2, X_3 \ldots X_n)$ ……3.2

Where, Y = dependent variable

$X_1, X_2, X_3 \ldots X_n$ = Independent variables (Distance, Income, Level of education)

Multiple Regression Equation is as follows:

$Y = a \pm b_1X_1 \pm b_2X_2 \pm \ldots\ldots b_nX_n \pm €$ ……..…..…..3.3

Where, Y = Dependent variable;

$X_1, X_2, X_3 \ldots X_n$ = Independent variables

$a, b_1, b_2 \ldots\ldots b_n$ = Partial regression constants

€ = Error term, which stands for the effects of undefined variables

Simple linear regression model have a single response measurement Y with a single predictor (covariate, regressor) X for every observation. The mean function of the model assumes a linear relationship:

$E(Y|X) = \alpha + \beta X$ ……..……..…..…..3.4

Multiple linear regression is an extension of simple linear regression, where the number of explanatory variables are, p. Simple linear regression is likened to a special case of multiple linear regression, where p=1. The term ‘linear’ is used since in multiple linear regression an assumption is made that y is directly related to a linear grouping of the explanatory variables. Most problems have more than one predictor variable. Since the

study requires analysis of more than two variables, hence the need of the following "multiple regression" mean function:

$E(Y|X) = \alpha + \beta 1X1 + \cdots + \beta pXp$……..…..…3.5

This reveals the relationship between selected explanatory variables by fitting a linear equation between independent variables and dependent variables to observed data.

$\hat{Y} = b_0 + b_1X_1 + b_2X_2 + \ldots + b_pX_p$, ……3.6

Where; $\hat{Y}$ = the predicted or expected value of the dependent variable,

$X_1 \ldots X_p$ = p distinct independent or predictor variables,

b_0 = the value of Y when all the independent variables ($X_1 \ldots X_p$)=0,

$b_1 \ldots b_p$ = the estimated regression coefficients.

Correlation coefficient was used to indicate the direction of the association between two continuous variables and it ranges from -1 to +1 denoted by R. To calculate the correlation coefficient 3 sums of square (SS) are required:

Sum of squares for variable Y

$SSyy = \sum (yi - \tilde{y})^2$

Sum of squares for variable X

$SSxx = \sum (xi - x)^2$

Sum of the cross products XY

$SSxy = \sum (yi - \tilde{y})(xi - x)$

Correlation coefficient (r) denoted by the following formula:

$$r = \frac{SSxy}{\sqrt{(SSxx)(SSyy)}} \quad \ldots\ldots 3.7$$

Or……..……

$$r = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{[\, n\Sigma x^2 - (\Sigma x)^2 \,][\, n\Sigma y^2 - (\Sigma y)^2 \,]}}$$

……..3.8

3.7.4 Ethical Consideration

According to Kovacs (1985), ethics refer to social norms or guidance towards acceptable and unacceptable behaviour. Ethical values concern daily requirements for the research, dignity of subject protection and publication of information in the research. It encourages the search of knowledge and reality which is the main goal of research. In accordance to ethical consideration, research permit and research authorization letter were secured from the National Commission for Science, Technology and Innovation (Ref. No. NACOSTI/P/18/55929/24875) as required by the Science, Technology and Innovation Act, 2013. Before embarking on data collection exercise, I reported to both County Commissioner and the County Director of Education, Laikipia County. Consent prior to participation of the respondents was sought. Participants freely volunteered to answer the in-depth questionnaire survey. To ensure the study was not prejudiced, simple language and expressions were used to describe the purpose of the research. Professional ethics were observed by maintaining anonymity and confidentiality of the responses from the interviewees. Accuracy in analysis, presentations and reporting the study findings were strictly observed.

3.7.5 Pilot Study

According to Lancaster *et al.,* (2004), pilot study is a small study which identifies weaknesses in the study from the field. It enables the researcher to check on the

appropriateness of the study instruments and data collection applying chosen interview technique. It also helps the researcher in data collection process in relation to time, research cost and willingness of the respondents in participation in the study; and appropriateness of statistical tests. Good study design was achieved by carrying out a feasibility study to pave way for the major study. The shortcomings were identified and the questionnaire was adjusted to suit the research objectives. During the pilot study preliminary data was collected which facilitated development of the research questions and plan.

CHAPTER FOUR: DATA DISCUSSION ON HOW WALKING PROMOTES MOBILITY IN LAIKIPIACOUNTY

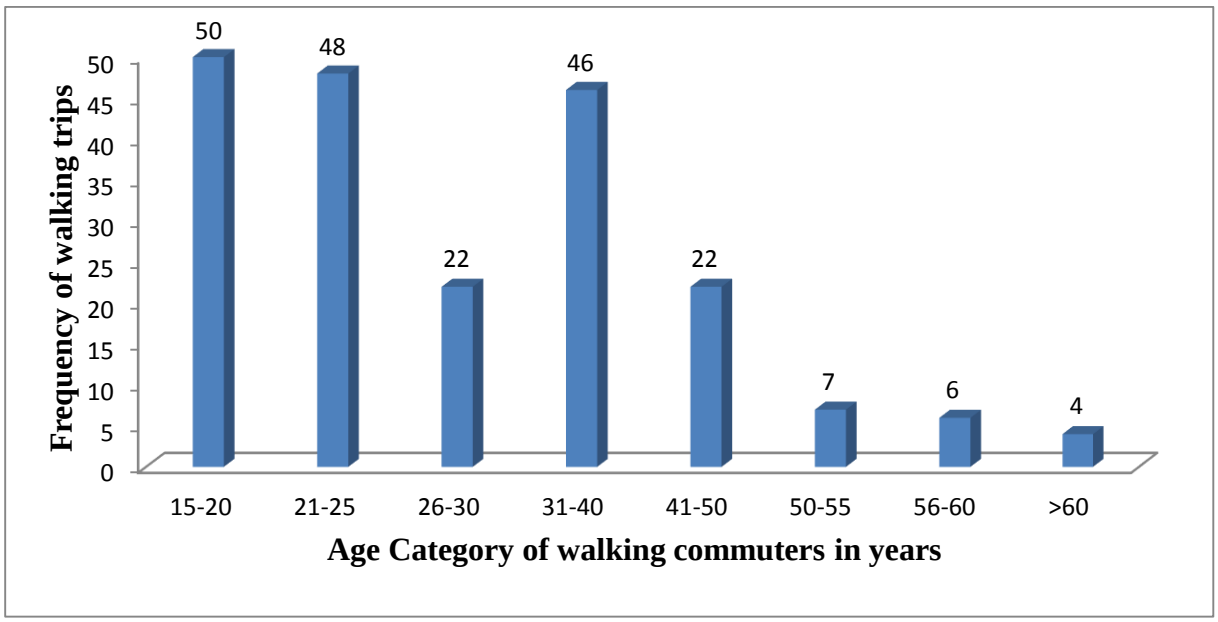
4.0 Introduction

This chapter summarizes the results with reference to the study objectives sequentially. The aim of the study is clarified, namely, the role of non-motorized transport in promoting rural mobility: a case study of Laikipia County, Kenya. The relationship between walking and mobility is discussed to address objective 1 of the study which sought to determine the relationship between socio-economic factors and NMT usage in Laikipia County. The variables which were considered in this case were the demographic and socio-economic attributes that indicate how travel distances vary with the individuals' characteristics such as age, gender, occupation, income and level of education. This helps the study to understand the relationships of the variables with median distance travelled. A total of 30 variables were generated by the help of SPSS programme version 20. Data validation was done with assistance of each variable's level of measurement.

4.1 Characteristics of Walking Commuters in Laikipia County

This study measured the age of the respondents by asking the respondents to fill in the questionnaire their age-category. The age of respondents was classified into 8 age categories and a bar chart was drawn for visual comparison. Majority of the respondents interviewed fell in three age categories. The highest age category was 15-20 years with a frequency of 50, followed by the age category of 21-25 years with a frequency of 48 and the third highest age category was 31-40 years. This indicates that walking and mobility

depends on individual's age. This implies that the higher the age the lower the tendency of walking and hence lower mobility rate.



Source: Fieldwork (2018)

Figure 4.1: Frequency of Age Category of Walking Commuters

The study found out that, physical exercise is predominantly common activity done by age category 15-20, 21-25, and 31-40 in Laikipia County. The other main reason which was given by the respondents was "saving on transport cost" as shown in Table 4.1.

Ho There is no NMT access to social facilities in Laikipia County.

The study found that several purposes were achieved through walking. Such purpose includes access to physical exercise which cut across the age categories. Walking trips by purpose (Table 4.1) showed that high frequencies fell in 15-20, 21-25, 26-30, 31-40

and 41-50 age categories. These are the categories forming the most productive groups in terms of economic performance in Laikipia County.

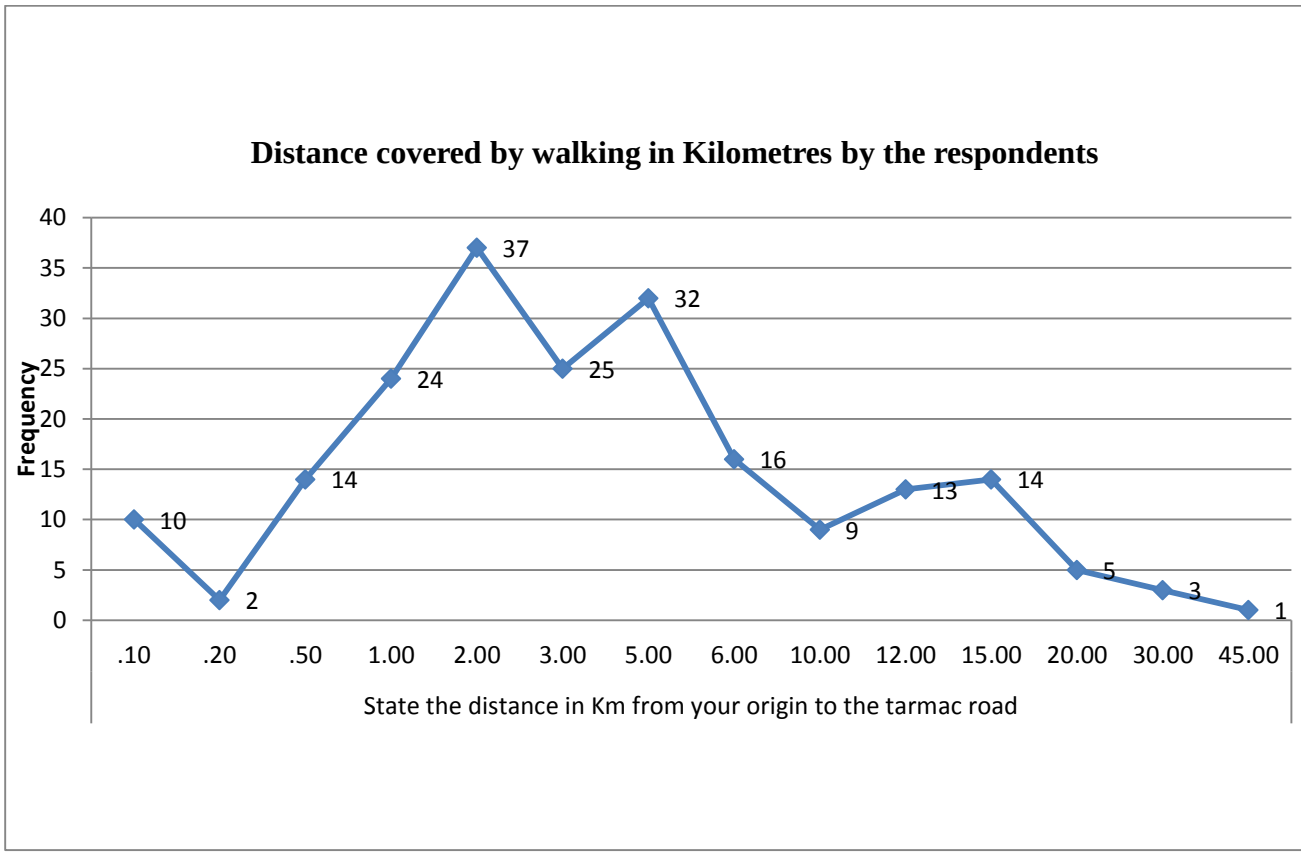
Table 4.1: Distribution of walking trips by purpose and age category

Purpose	All	15-20	21-25	26-30	31-40	41-50	50-55	56-60	>60
Physical exercise	171	43	44	16	38	18	6	4	2
Saving on transport cost	3	3	2	2	2	0	1	1	1
Reaching destination	3	0	0	1	0	2	0	0	0
Working place	3	0	0	1	1	0	0	1	0
Fetching firewood	1	0	0	0	1	0	0	0	0
Enjoying the environment	3	2	0	1	0	0	0	0	0
Shopping	2	0	1	0	0	0	1	0	0
Meeting friends	4	0	0	1	2	0	0	0	1
Interact with people	2	1	0	0	1	0	0	0	0

Source: Field work (2018)

Figure 4.2 revealed that 18 percent of the respondents interviewed walked a distance of 2 Kilometers daily. 16 percent of the respondents interviewed walked a distance of 5 Kilometers while, 12 percent of the respondents interviewed walked a distance of 3 Kilometers and 1 Kilometer daily. A trend line graph was drawn to describe the pattern of the distance in kilometers travelled by walking and it showed a steady increase in gradient from 0.1 Kilometer to 2 Kilometers. As the distance increased at 5 Kilometers onwards the gradient of the curve started falling which can be attributed to the distance decay model which suggests that as distance increases the spatial or cultural interaction

decreases. This accounts for the small frequency at the highest number of kilometers travelled in the study area. At the range of 0.1–5 Kilometers the trend curve indicated almost a steady increase of frequency but as the number of kilometers rose from the range 5-45 Kilometers there was a declining trend in the curve. The highest number of kilometers travelled by walking in Laikipia County was 45 Kilometers whose share was 1 percent.



Source: Fieldwork (2018)

Figure 4.2: A Trend line curve for frequency of the distance travelled by walking in Kilometres

Various types of non motorized modes were identified from the field. For example, back-loading was commonly observed from the field as illustrated in plate 1.

Source: Fieldwork (2018)

Plate 1: Women carrying loads by back-loading mode of transport in Laikipia County.

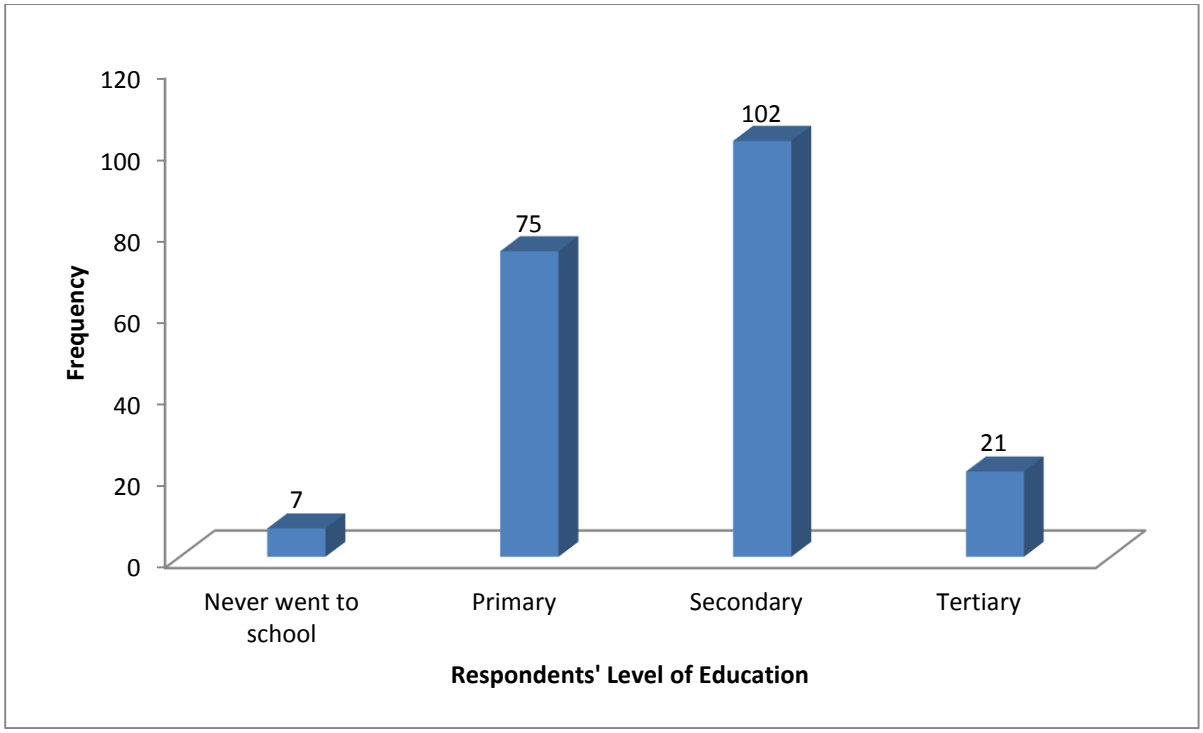
Plate 2: Fetching water using a donkey cart as a mode of transport in Laikipia County

Marital Status of bicycle operators in Laikipia County

The research found out that 45 percent of the respondents were single and had a frequency of44.9 which was close to half of the respondents, while 55 percent of the respondents were married with a frequency of 55.1 which was the majority of the respondents interviewed. Married people had several tasks to be achieved than single people in terms of provision of family needs.

Respondents' Level of Education

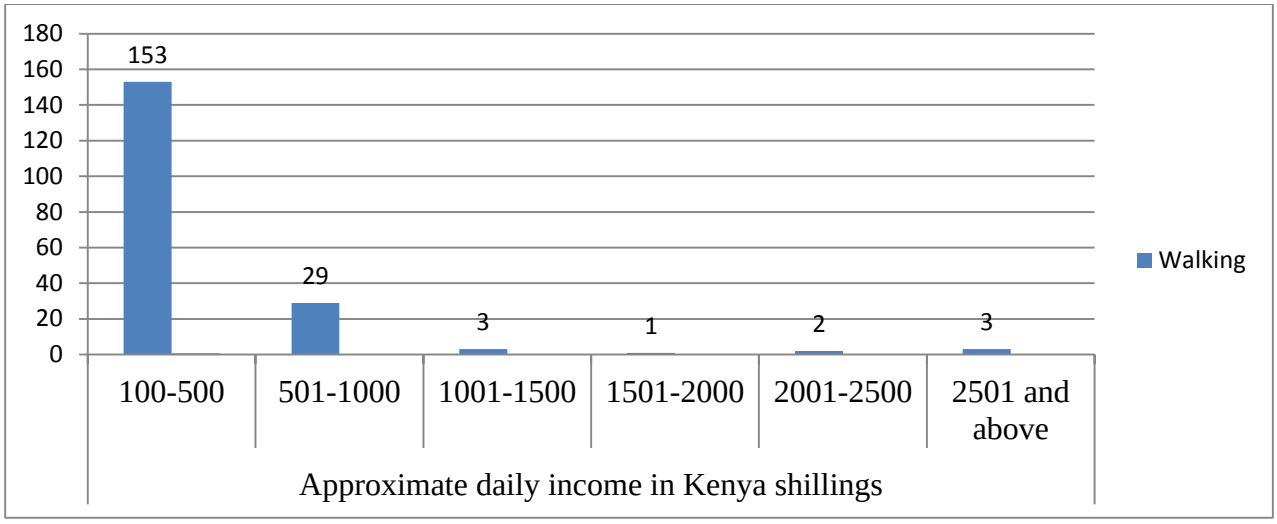
Majority of walking commuters were found to have a frequency of 102 while those of primary level of education was 75. Respondents who had attained the tertiary level had a frequency of 21 and those who never went to school had a frequency of 7. This means that the higher the level of education the greater the need of social interaction in search of business opportunities irrespective of the distance within the county. This applies upto secondary level of education. Respondents who had attained tertiary level of education had their own businesses and their own means of transport hence, the low frequency compared to secondary and primary levels of education.



Source: Fieldwork (2018)

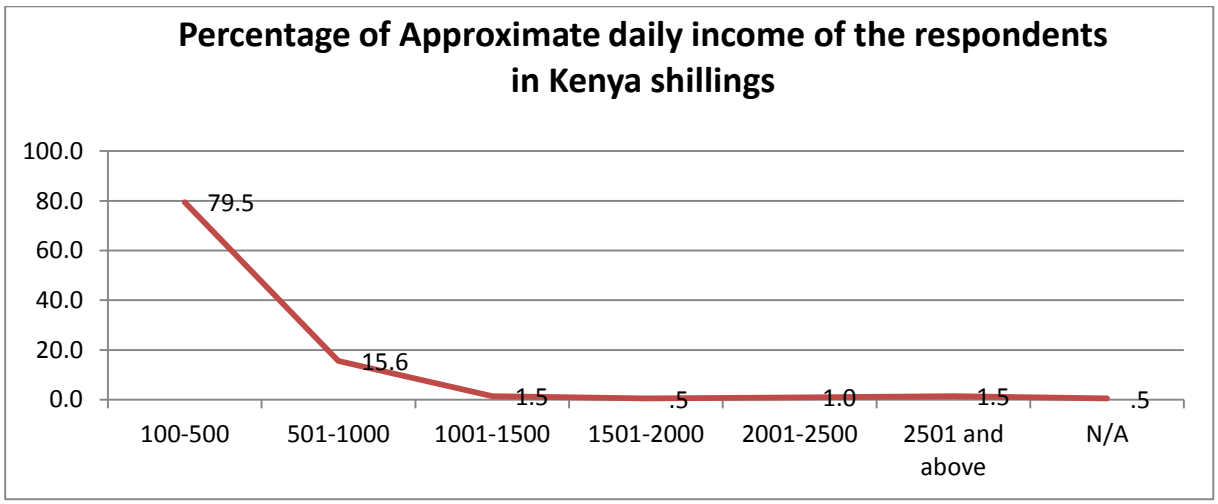
Figure 4.3: Respondents' Level of Education

Majority of the walking commuters in Laikipia County are poor. The bar graph (Figure 4.4a and b) suggests that their approximate daily income were in the range of Kshs.100-500 and had a percentage of 79. Walking commuters who earned Kshs.501-1000 had a percentage of 15.6. It was found out that majority of walking commuters were self employed or employed in the informal sector where earnings were low and unsustainable.



Source: Fieldwork (2018)

Figure 4.4a: Frequency of income categories and use of walking as NMT mode in Laikipia County



Source: Fieldwork (2018)

Figure 4.4b: Percentage of income categories and use of walking as NMT mode in Laikipia County

Hypothesis 1 Testing using Multiple Linear Regression statistics

Ho There is no significant relationship between socio-economic factors and NMT usage in Laikipia County.

Table 4.2: Correlation Matrix of distance travelled and the socio-economic variables

Pearsons Correlation	Distance travelled in Kilometers	Age of respondent	Gender	Marital Status	Level of Education	Approximate daily income
Distance travelled in Kilometers	1.000	-.044	.	-.100	.004	-.058
Age of respondent	-.044	1.000	.	.699	-.260	-.045
Gender	.	.	1.000	.	.	.
Marital Status	-.100	.699	.	1.000	-.283	-.048
Level of Education	.004	-.260	.	-.283	1.000	.250
Occupation	-.001	.037	.	.121	.009	-.014
Approximate daily income	-.058	-.045	.	-.048	.250	1.000
Sig. (1-tailed)						
Distance travelled in Kilometres	.	.268	.000	.077	.479	.205
Age of respondent	.268	.	.000	.000	.000	.260
Gender	.000	.000	.	.000	.000	.000
Marital Status	.077	.000	.000	.	.000	.250
Level of Education	.479	.000	.000	.000	.	.000
Occupation	.492	.299	.000	.043	.449	.421
Approximate daily income	.205	.260	.000	.250	.000	

Model Summary

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.124[a]	.015	-.009	6.38545	.015	.623	5	198	.683

a. Predictors: (Constant), Approximate daily income in Kenya shillings, Occupation, Age of respondent, Respondent's Level of Education, Marital status

Source: Fieldwork (2018)

R-Square (the *Coefficient of determination*)

R-Square is a statistic to evaluate model fit. If the variability of the residual values within the regression line is small, the predictions from the regression equation are good. For example, if there is no relationship between the X and Y variables, then the ratio of the residual variability of the Y variable to the original variance is equal to 1.0. Then R-square would be 0. If X and Y are perfectly related then there is no residual variance and the ratio of variance would be 0.0, making R-square = 1.

Interpreting the Correlation Coefficient R

This is the degree to which two or more predictors (X_1,X_2,X_3…) relates to the dependent (*Y*). This is the correlation coefficient *R* i.e. square root of *R-square*. In multiple regressions, *R* takes values between 0 and 1. The sign plus or minus of the regression or B coefficients makes it possible to know the variables' direction of the relationship. Positive *B* coefficient implies that the relationship of the variable with that of the dependent variable is positive and vice-versa. For example, the lower the class size the better the average test scores. If the *B* coefficient is equal to 0 then there is no relationship between the variables.

A correlation coefficient of 1 implies that a positive increase in one variable increases positively with a fixed proportion in the other. A correlation coefficient of -1 indicates that a positive increase in a variable denotes a negative decrease of a fixed proportion in the other. Zero implies no relationship in two or more variables. The absolute value of the correlation coefficient shows the relationship strength. The lower the number, the weaker the relationship.

Interpretation of the Correlation Matrix Table 4.2 in relation to the study

A correlation between distance travelled and the age of respondents revealed that, there was an insignificant negative relationship of -0.044. This implies that as age increases the value of the distance travelled decreases. Marital status and age of the respondents' correlation showed a strong positive correlation of 0.699 which is significant. This indicates that distance travelled by walking and cycling in Laikipia depends on age and marital status. This may be attributed to the fact that married people may be having more goods which could be obtained away from their residence. The research also found out that the level of education and age of the respondents have a weak and a negative correlation of -0.283 in determining the distance travelled by walking and cycling in Laikipia County. Level of education has no impact on walking or cycling in Laikipia County.

A correlation between the respondents' income and occupation had a significant correlation of 0.421 which implies that income and economic activities which the respondents in the study area engaged themselves with, significantly determined the distance travelled in Laikipia County. Another finding from the study indicated that occupation and level of education had a significant positive correlation of 0.449. This denotes that level of education and occupation of the respondents significantly determined the distance travelled by walking and cycling in Laikipia County.

A correlation between respondents' occupation and distance travelled in kilometers showed a significant positive correlation of 0.492. This indicates that respondents' occupation determines the distance travelled by walking and cycling in Laikipia County. It can also be interpreted that business location determines the distance travelled by the respondents in Laikipia County. The study also revealed that there was a significant positive correlation between education level and distance travelled in Laikipia County. This means that the higher the level of education the greater the need

of social interaction in search of business opportunities irrespective of the distance within the county.

Income and distance, age, marital status had a weak positive correlation of 0.205, 0260 and 0.250 respectively. This implies that these variables were weak determinants of walking and cycling in Laikipia County. The low value of socio-economic factors of R square indicates that other factors than the measured socio-economic factors influence the patterns of non motorized transport use.

Similar findings were revealed from a study carried out in Ethiopia, on the effect of rural road transport infrastructure on smallholder farmers' agricultural productivity in Horro Guduru Wollega Zone, Western Ethiopia (Sileshi and Tebarek, 2017). The study showed that 44 percent of respondents used human porterage as a mode of transport for their farm produce from fields to the houses while 30 percent showed that they used pack animals to transport their farm produce. The percentage pf the respondents who used animal cart for a similar purpose had a 21 percent. Collectively, it emerged that small holder farmers were mainly dependent on traditional NMT for agricultural harvest transport from fields to their homes. This was in tandem with Usman *et al*., (2013) and Starkey (2005) who found out that rural people in Africa rely heavily on NMT than automobile means of transport. This was attributed to poor road condition in rural areas. Usman *et. al*., (2013) clearly pointed out that 1.1 percent of the respondents owned four wheel drive vehicles forcing the rural people to depend on motorcycles and bicycles as a means of transport on narrow, bumpy and potholed rural roads.

Table 4.3: Contingency of Correlation coefficient by walking and cycling

Kms	NMT used				
	Walking (X)	Cycling (Y)	XY	X^2	Y^2
.00	1	1	1	1	1
1.00	9	9	81	81	81
3.00	40	42	1680	1600	1764
5.00	61	57	3477	3721	3249
6.00	15	17	255	225	289
10.00	24	26	624	576	576
12.00	8	8	64	64	64
15.00	11	12	132	121	144
20.00	14	15	210	196	225
25.00	0	1	0	0	0
30.00	3	4	12	9	16
40.00	2	2	4	4	4
49.00	3	1	3	9	1
Total	191	195	6543	6607	6414

Source: Fieldwork (2018)

Where,

- $\Sigma x = 191$
- $\Sigma y = 195$
- $\Sigma xy = 6543$
- $\Sigma x^2 = 6607$
- $\Sigma y^2 = 6414$

n is the sample size, in this case = 13

Formula for the Correlation coefficient (r):

$$r = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{[\, n\Sigma x^2 - (\Sigma x)^2 \,][\, n\Sigma y^2 - (\Sigma y)^2 \,]}}$$

$$r = 13(6543) - (191 \times 195) / [\sqrt{[[13(6607) - (191^2)] \times [13(6414) - 195^2]]}]$$

The correlation coefficient (r) =.0003

This is a weak positive correlation which implies that the relationship between walking and cycling is independent of the distance travelled.

Ho Walking and cycling are independent of distance travelled in Laikipia County.

Hypothesis 2 Testing using Chi-square statistic Test

Table 4.4: Chi-square (X^2) contingency table of walking and cycling distance travelled in Laikipia County.

Km		NMT used in Laikipia							
	Walking (O)	Expected (E)	(O-E)	$\sum(O-E)^2/E$	Cycling (O)	Expected (E)	(O-E)	$(O-E)^2/E$	Total
1-10	149	148	1	0.007	151	151.6	0.6	0.002	300
11-20	33	33.7	-0.7	-0.015	35	34.4	0.6	0.01	68
>20	8	7.9	0.1	0.001	8	8.1	0.1	0.001	16
Total	190			**-0.007**	194			**0.013**	384

Source: Fieldwork (2018)

$X^2 = \sum (0 - E)^2 / E = 0.006$

Calculation of Degrees of freedom

(r-1)(c-1) = (3-1)(2-1) = 2x1 = 2 df

Calculated X^2 at 2 degrees of freedom = 0.006

Critical X^2 at 2 degrees of freedom at 0.05 significance level = 5.99

Therefore, the Calculated X^2 is smaller than the Critical X^2

There is no adequate evidence to reject the null hypothesis that walking and cycling are independent of distance travelled in Laikipia County. Therefore, the hypothesis was adopted. A conclusion was drawn that, walking and cycling were not determined by the distance travelled in Laikipia. This implies that, non motorized transport modes use in Laikipia County was not determined by spatial distance.

4.2.2 Deterrents to walking Commuters in Laikipia County

Age as one of the demographic variables plays key role in decision making of whether individuals cycle or not. Bicycle commuting is popular in Laikipia than recreation trips. The main deterrents to cycling are traffic safety, absence of pedestrian/cycling lanes and weather. Lack of parking facilities, long distance to work place, safety are mainly the impediments of cycling. As a result, there is no single improvement can attract all cyclists, hence the need for integration approach to maximize such modes.

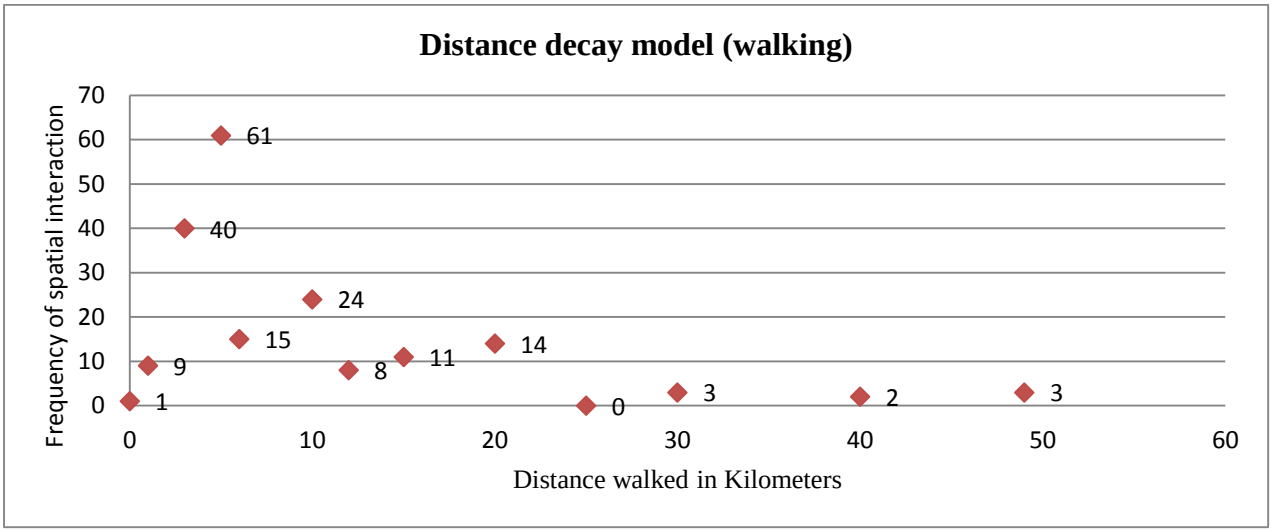
Distance decay functions are used in geography to describe mathematically the variance of phenomenon as a function of distance. Long distances are less likely to be travelled by walking. A decay function fixed on a data set presents a distribution of walking trips in a given distance. It is also capable of estimating probabilities of values out of the data coverage especially, analyzing processes for short distances. The distance decay function is specified as:

$$P(d) = e^{-\beta d},$$

Where $P(d)$ = the cumulative walking trips percentage at a distance equal to or longer than the value of d.

β = decay parameter to be estimated using empirical data. Distance *d*, smaller β increases the value of *P*, denoting a higher walking trips' percentage with distance equal or higher than *d*. *d* is also used to signify walking duration.

Distance decay concept is generally relevant particularly for Non-Motorized trips than motorized trips. Non-motorized trips decrease with increased spatial extent. Distance decay is a concept that illustrates the effect of distance on cultural or spatial interactions. The spatial interaction in two locations reduces as the distance increases as indicated in the figure 4.5a. The fitted curve indicates that the curve for distance walked in kilometers increases steeply for the first 5 kilometers and decreases much more gradually from 10 kilometers onwards.

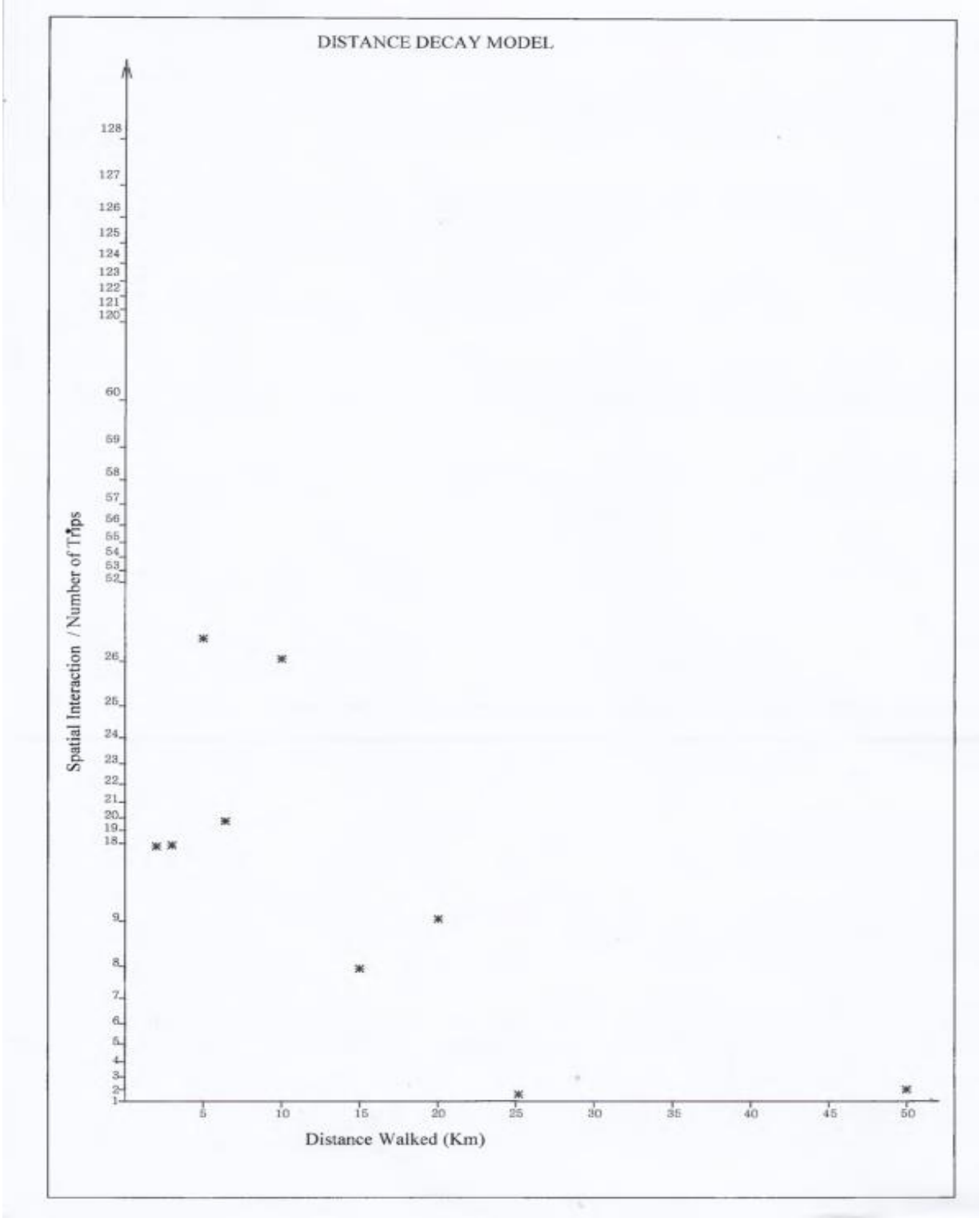


Source: Fieldwork (2018)

Figure 4.5a: Distance Decay Curve for Walking Trips in Laikipia County

Straight line was obtained by plotting the points on a semi-log graph paper. The Y – Axis had graduations in logarithms while the X –Axis had normal square-ruled graduations. The following straight line graph was obtained after joining points which

formed a linear pattern. Linear line indicates that as distance increases, the number of times walked reduces and vice-versa. This depicts the distance decay model (Figure 4.5b).



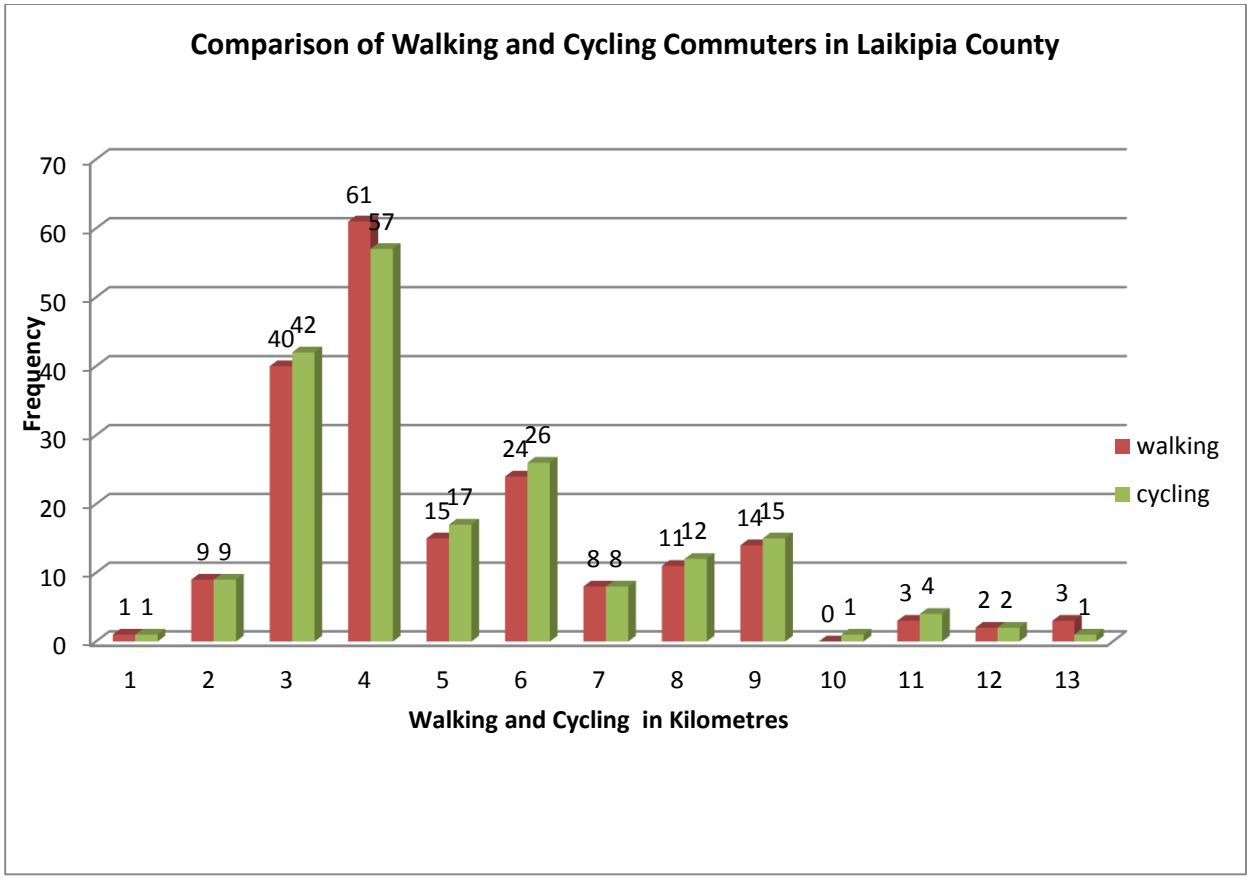
Source: Fieldwork (2018)

Figure 4.5b: Distance decay model for Walking Trips in Laikipia County on a semi-log graph paper

Distance decay model is a fundamental basis for understanding travelers' behavior. First, it is used to estimate the distance a particular mode of transport can make which enables transport planners in planning transport activities. The second importance of the model is to enable planners to calculate accessibility of a facility which delineates the catchment extent (Lacono, *et al.,* 2008). The study's aim was to determine the frequency of spatial interactions within Laikipia County by walking as a mode transport. The study confirmed that frequency of spatial interactions based on walking in the county is determined by the distance between two or more places from the origin as illustrated in figure 4.5b. Short distances between two locations attract high number of walking trips or the tendency of spatial interactions and vice-versa.

4.2.3 Distance Travelled in Kilometers by walking and cycling Commuters

A bar graph of walking and cycling of commuters in Laikipia County showed that the highest frequency of walking stood at the frequency of 61 at a distance of 4 kilometers, while cycling had a frequency of 57 at the same distance. At 3 kilometers walking commuters had a frequency of 40 at a distance of 3 kilometers, while cycling commuters had a frequency of 42 at the same distance. Walking commuters at 6 kilometers had a frequency of 24 while cyclists had a 26. This indicates that from the first 2 kilometers commuters may walk or cycle. As the distance increases from 3 kilometers onwards cycling commuters' frequency surpasses walking commuters' frequency.



Source: Fieldwork (2018)

Figure 4.6: Comparison of Walking and Cycling Commuters in Laikipia County

4.3 Physical environment factors influencing walking and cycling

4.3.1 Attitudes towards walking and cycling in Laikipia County

Community severance or non motorized transport barrier effects on roads has not been well researched. Barrier effects may result to difficulties for pedestrians such as children, older people and those with disabilities. The problems range from detours for crossing points, delayed signals or gaps in the traffic. For gender equitability to be achieved in promotion of cycling as a mode of transport in Laikipia County, attention should be paid to females' access to this mode. Success of NMT is dependent on implementation of change in behaviour or attitude towards cycling in both male and

females, at the same time, segregation of lanes should be done to promote both walking and cycling habits in Laikipia County.

Plate 3: Research Assistants interviewing pedestrians in Doldol Town, Laikipia County

CHAPTER FIVE: IMPORTANCE OF CYCLING IN PROMOTING MOBILITY IN LAIKIPIA COUNTY

5.0 Introduction

This chapter presents and discusses the results on how cycling as a Non Motorized Transport is likely to promote mobility in the study area. The objective of this chapter was to examine whether there is significant difference in travel distances by walking and cycling in Laikipia County. The hypothesis tested in this chapter was walking and cycling are independent of distance travelled in Laikipia County. The gender and age analysis of the respondents in the study area was important in finding out the reasons that motivated either men or women in using the bicycles in the county.

5.1 Characteristics of Bicycle Operators in Laikipia County

The distinction between mobility and transport is that, mobility is a contextualized fact whereas transport is the revealed part of it. Mobility implies the 'potential aspect' or natural acquaintance of the possible trips that are not made due to constraining factor(s).Such factors are some of the challenges facing women and children in their acquisition of their basic needs in Laikipia County. The study found out that the main motivator for bicycle use is convenience while low income earners have been influenced by financial savings and the distance from the origin to their destination. Litman (2004) pointed out that, changes in travel occur due to NMT improvement. He identified the following transport conditions as key to NMT users' improvement: convenience and comfort; transport modes; attractive and livable communities; basic mobility for non-drivers; and land-use efficiency. Upali (2010) argued that, as far as access and mobility are concerned the key point in the rural area is an advancement of appropriate technologies to alleviate communal produce and marketing cost rather than provision of public passenger transport by government or private sectors. According to

She, King and Jacobson (2017) each percent increase in public transit use decreases a 0.221 percent in county population obesity rates showing that its improvements could reduce obesity.

5.1.1 Distribution of age categories of bicycle operators

Table 5.1 shows the distribution of age categories of bicycle operators. The table indicates that there were 8 categories of bicycle operators. The highest age category was that of 31-40 years with a percentage of 19.8. The second age category of the bicycle operators interviewed was that of 15-20 years with a percentage of 17.1. The third age categories were those of 21-25, 26-30 and 41-50 years with similar percentages of 16.2 each. The rest of the categories were insignificant. It was also found out that the age of respondents' mean frequency was 3.66 while the standard deviation was 1.806.

Table 5.1: Frequency and Percentage of Age Categories of Bicycle Operators

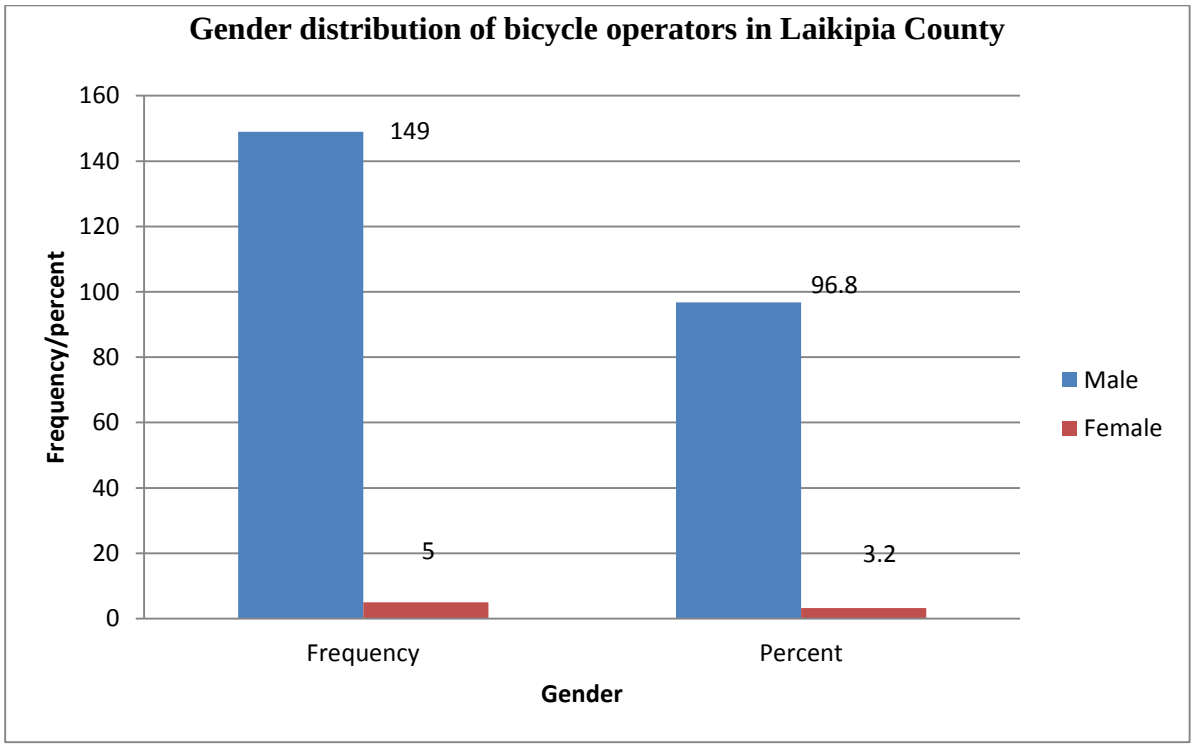
Age of respondent		
Age Category	Frequency	Percent
15-20	19	17.1
21-25	18	16.2
26-30	18	16.2
31-40	22	19.8
41-50	18	16.2
50-55	8	7.2
56-60	4	3.6
>60	4	3.6

Source: Fieldwork (2018)

5.1.2 Gender distribution of bicycle operators in Laikipia County

Gender distribution of bicycle operators in Laikipia County was dominated by male whose frequency was 149 with a percentage of 61 while females' frequency was 96.8 with a percentage of 39. This high dominance of male in bicycle operation in Laikipia County could be attributed to gender roles and gender stratification. Gender roles define the rights, obligations, responsibilities, behaviour, the society sets for the two sexes (Blumberg,1984). Gender stratification implies the social ranking, where men inhabit higher statuses than women. The terms gender inequality and gender stratification is interchangeably used. Even though a large number of women have gone into male occupations, sex typing of occupations has been rampant. This is evident from Figure 5.1 on gender distribution of bicycle operators in Laikipia County. Emond *et al*., (2009),

argued that, men and women cycle at fairly the same rates in countries like the Netherlands, Germany, and Denmark. They found out men's bicycle trips in the United States go beyond women's by two times. Garrard *et al*. (2006), in their observation study in Melbourne, Australia pointed out that female cyclist liked off-road paths. The study cited concern for safety and household responsibilities as two common factors affecting women on cycling.

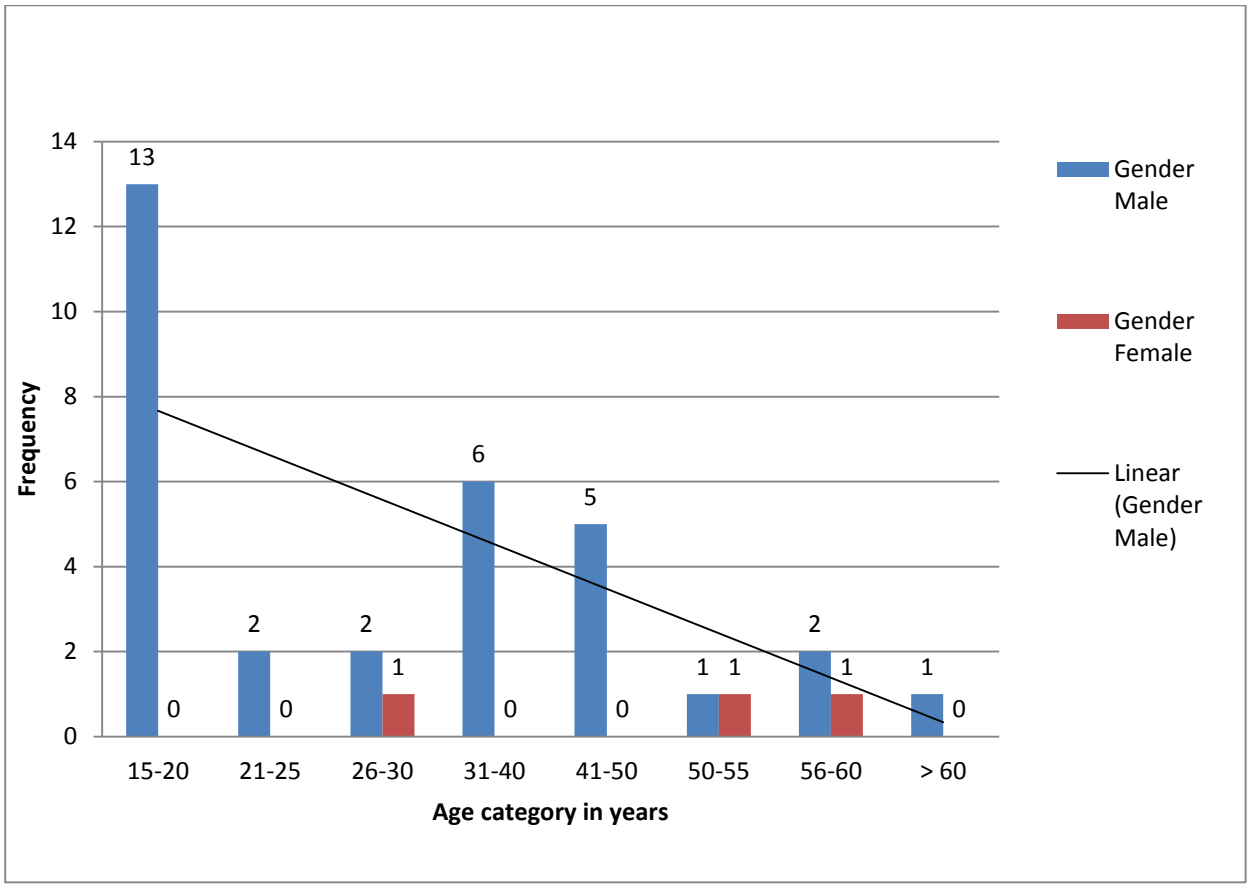


Source: Fieldwork (2018)

Figure 5.1: Gender distribution of bicycle operators in Laikipia County

The age of bicycle operators was classified into 8 age categories and a bar chart was drawn using Excel programme for a quick comparison (Figure 5.2). Majority of the respondents interviewed fell in three age categories. The highest age category was 15-20 years with a frequency of 13, followed by the age category of 31-40 years with a

frequency of 6 and the third highest age category was 41-50 years with a frequency of 5. This indicates that cycling and mobility depends on individual's age. This implies that the higher the age the lower the tendency of cycling and hence lower mobility rate. The trend line indicates a negative trend of relationship of age and frequency of cycling. According to the respondents interviewed cycling women in Laikipia County were found to fall on the age category of 26-30, 50-55 and 56-60 with a frequency of 1 each.

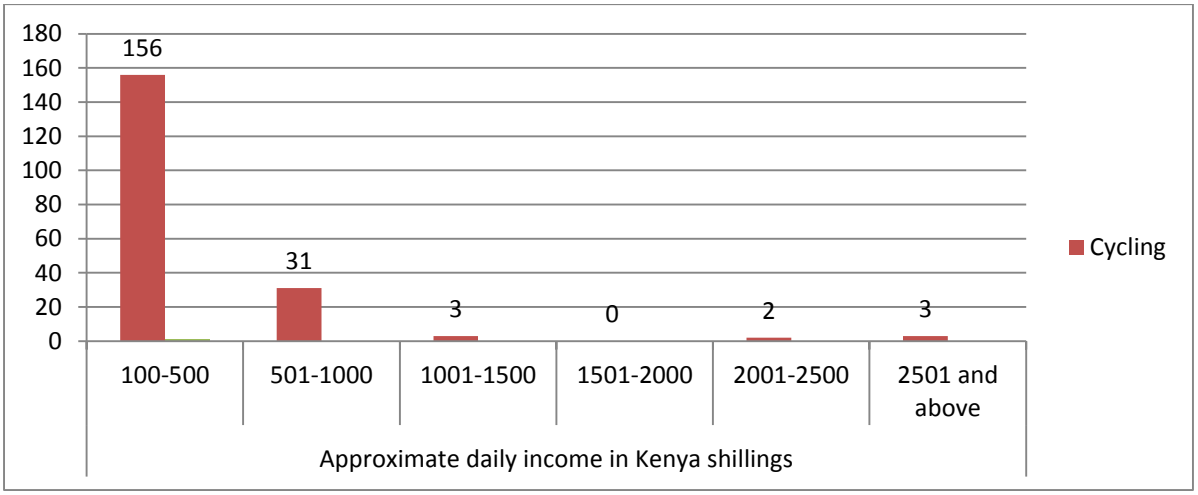


Source: Fieldwork (2018)

Figure 5.2: A Trend Line of Gender by Age Category of bicycle operators in Laikipia County

5.1.3: Categories of daily income for bicycle operators in Laikipia County

Daily income for the bicycle operators in Laikipia County were split into 6 classes (Figure 5.3). The classes were: Kenya shillings 100-500, 501-1000, 1001-1500, 1501-2000, 2001-2500 and 2501 and above. Majority of bicycle operators in Laikipia County had a frequency of 156 and was found to lie in the category of Kshs.100-500 which translates to 80 percent of the bicycle operators interviewed. The second highest category of the daily income in Kenya shillings was 501-1000 whose percentage was 16 percent of the bicycle operators interviewed. The rest of the categories were insignificant.



Source: Fieldwork (2018)

Figure 5.3: Approximate daily income categories of bicycle operators in Laikipia County

Source: Fieldwork (2018)

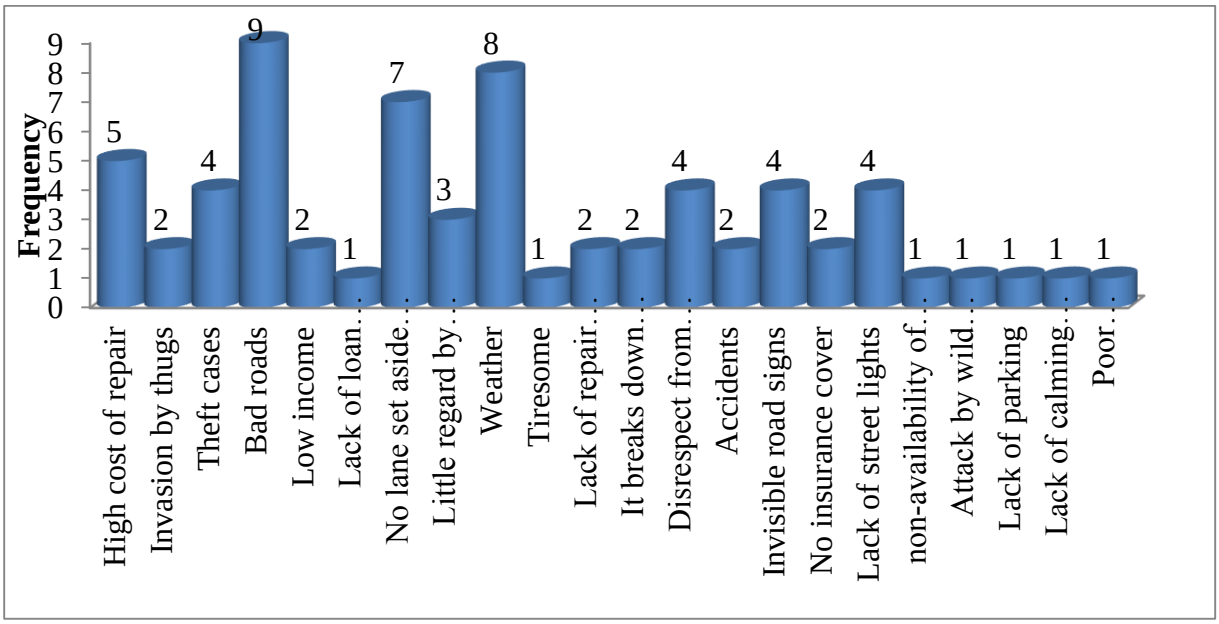
Plate 4: Sale of bicycles in Laikipia County

Source: Fieldwork (2018)

Plate 5: Fetching of fuel wood using bicycle in Laikipia County

5.1 Deterrents to Bicycle Operators in Laikipia County

The respondents cited bad roads as one the highest deterrent to cycling commuters in Laikipia County (Figure 5.4). This had a frequency of 9 which accounted for 13 percent of the problems faced by cyclists within the county. Weather was the second highest problem cited by the cyclists in the county with a frequency of 8. This accounted for 12 percent of the problems encountered by cyclists in the study area. The respondents also cited lack of separate lanes for bicycles which accounted for 10 percent of the non motorized transport problems encountered in the study area. High cost of bicycle repair accounted for 7 percent of the problems encountered by bicycle operators within Laikipia County.



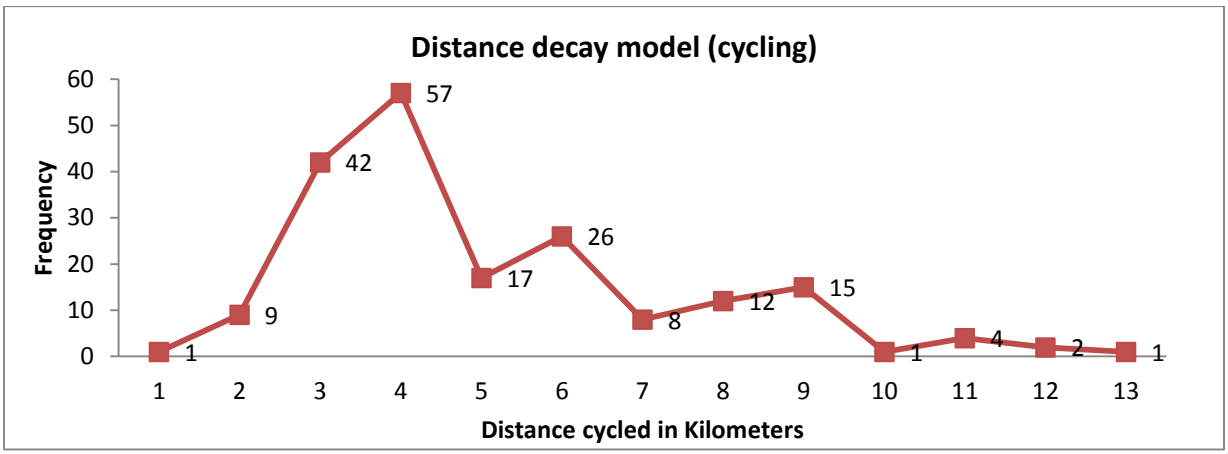
Source: Fieldwork (2018)

Figure 5.4: Problems encountered by Bicycle Operators in Laikipia County

Distance decay concept is used particularly for Non-Motorized trips than motorized trips. Non-motorized trips tend to decrease with increased spatial extent. Distance decay is a concept that illustrates the effect of distance on cultural or spatial interactions. The

spatial interaction in two locations reduces as the distance increases as indicated in figure 5.5a and figure 5.5b. The fitted curve indicates that the curve for distance cycled in kilometers increases steeply for the first 2 kilometers and decreases much more gradually from 10 kilometers onwards.

Raw Data pattern curve of distance cycled in Kilometers

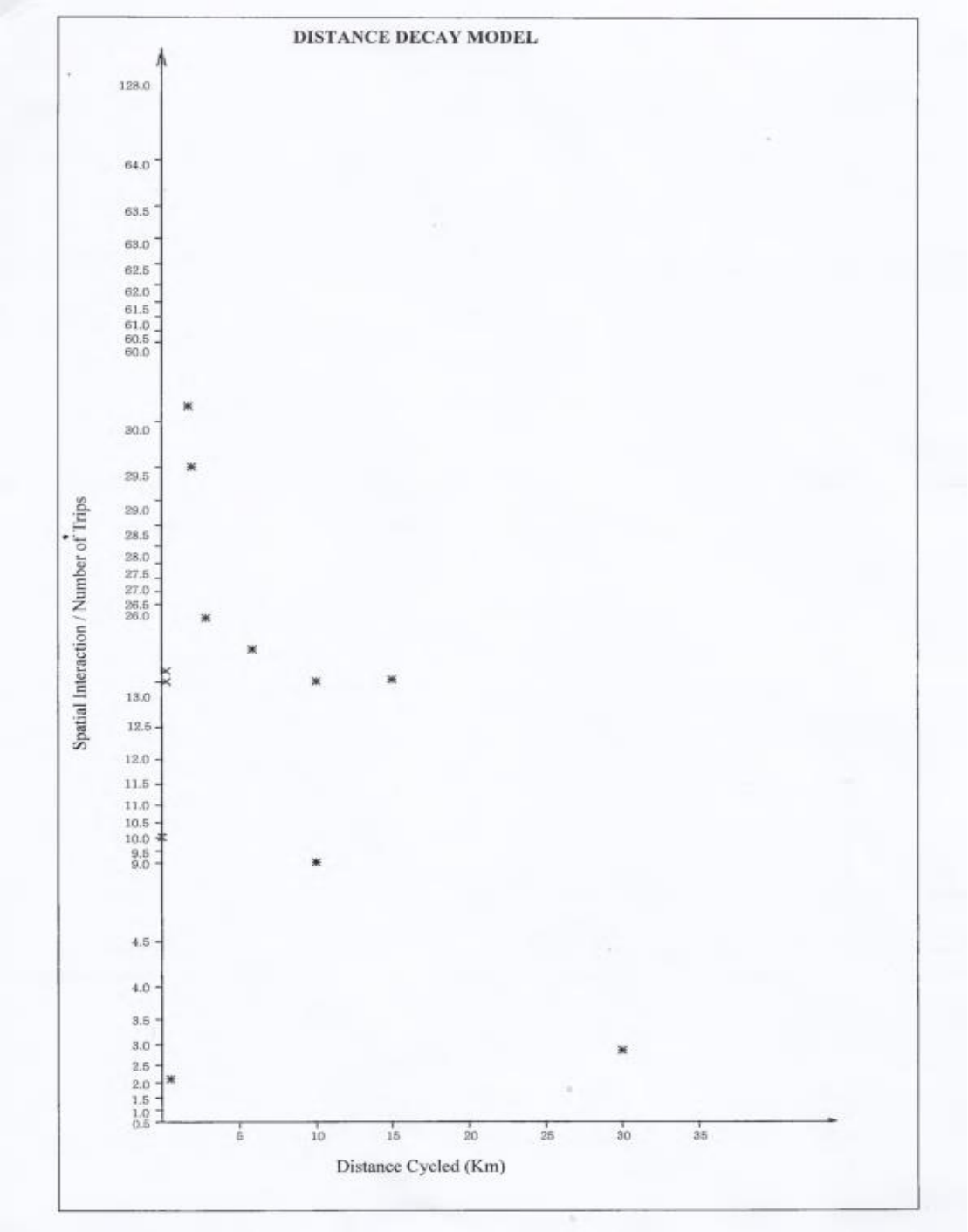


Source: Fieldwork (2018)

Figure 5.5a: **Distance decay model for bicycle operators in Laikipia County**

Data distribution of distance cycled in Kilometers drawn on a semi-log graph paper

Straight line was obtained by plotting the points on a semi-log graph paper. The Y – Axis had graduations in logarithms while the X –Axis had normal square-ruled graduations. The following straight line graph was obtained after joining points which formed a linear pattern. Linear line indicates that as distance increases, the number of times cycled reduces and vice-versa. This characterizes the distance decay model (Figure 5.5b).



Source: Fieldwork (2018)

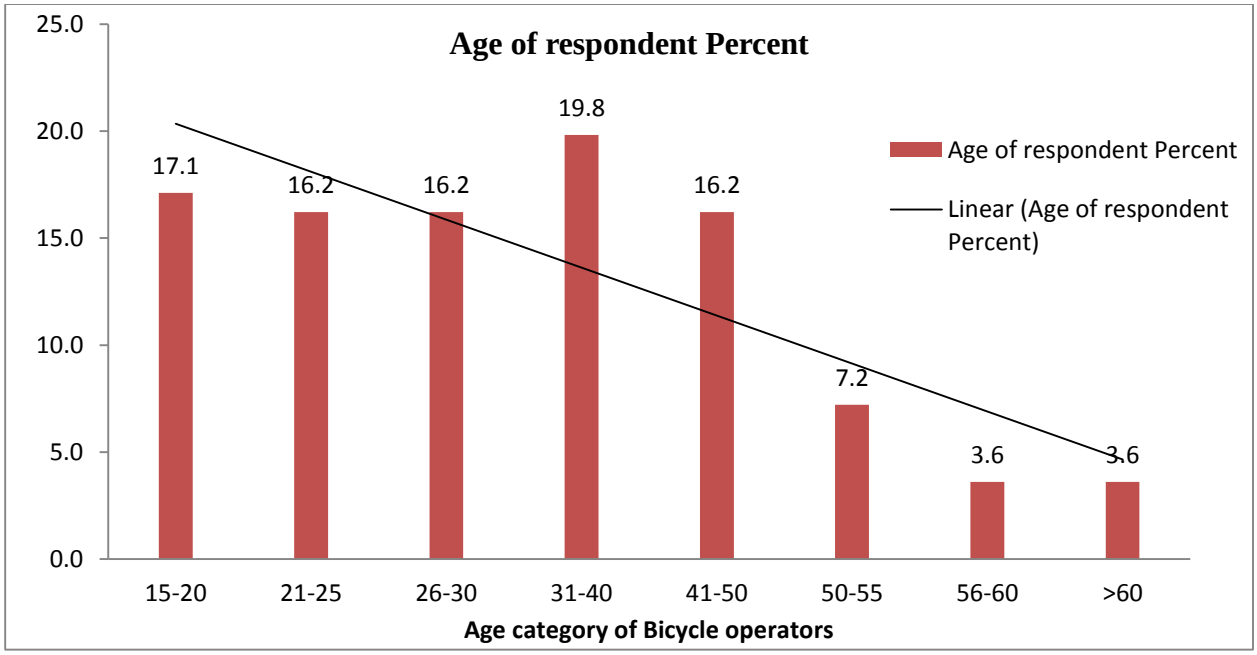
Figure 5.5b: Distance decay model for bicycle operators on a semi-log graph paper in Laikipia County.

Distance decay is the result of spatial distance amid two points. Spatial interaction for the two locations depends on the friction distance to be covered. Short distances attract high spatial interaction while long distances reduce the number of interaction between

the two points. Facilities' spatial accessibility can be determined by developing distance decay curve. There are two methods used in estimating distance decay function: (a) linear regression which uses ordinary least squares, and (b) non linear model which uses maximum likelihood estimation techniques (Myung, 2003; Iacono, Krizek *et al*., 2008). Ordinary least squares regression is a data fitting type that estimates unknown variables to form a linear regression representation which is known to reduce the sum of squared residuals in observed points. A normal distributed assumption derives ordinary least squares as a maximum likelihood predictor. Data's good-fit result depends on the high possibility of obtaining observed data. This technique reduces the chances of bias to zero as the sample increases towards infinity. However, it is usually biased when dealing with small sample size (Myung, 2003). .

5.3 A trend line curve of percentage of bicycle operators by age category

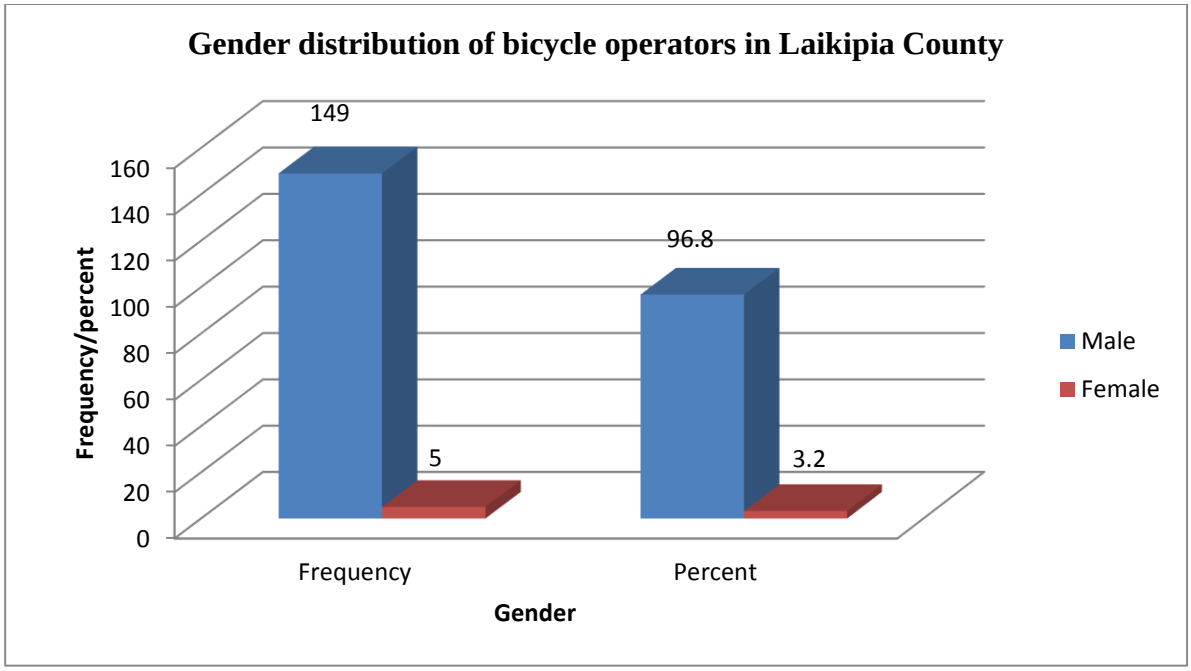
The age of bicycle operators were classified into 8 age categories and a bar chart was drawn using Excel programme for a quick comparison (Figure 5.6). Majority of the respondents interviewed fell in five age categories. The highest age category was 31-40 years with a frequency of 22 with a percentage of 19.8, followed by the age category of 15-20 years with a frequency of 19with a percentage of 17.1. The third highest age categories were21-25 years, 26-30 years and 41-50 years with a frequency of 18 with a percentage of 16.2 respectively. This indicates that cycling and mobility depends on individual's age. This implies that the higher the age the lower the tendency of cycling and hence lower mobility rate. The trend line indicates a negative trend of relationship of age and frequency of cycling.



Source: Fieldwork (2018)

Figure 5.6: Comparison of percentages of bicycle operators by age category in Laikipia County

Gender distribution of bicycle operators in Laikipia County had a percentage of 5 for males. Females had a percentage of 3.2. This indicates a very low percentage of participation of women in bicycle operations in the county (Figure 5.7). This could be as a result of the cultural attitude held by the respondents towards bicycle ridership on women.



Source: Fieldwork (2018)

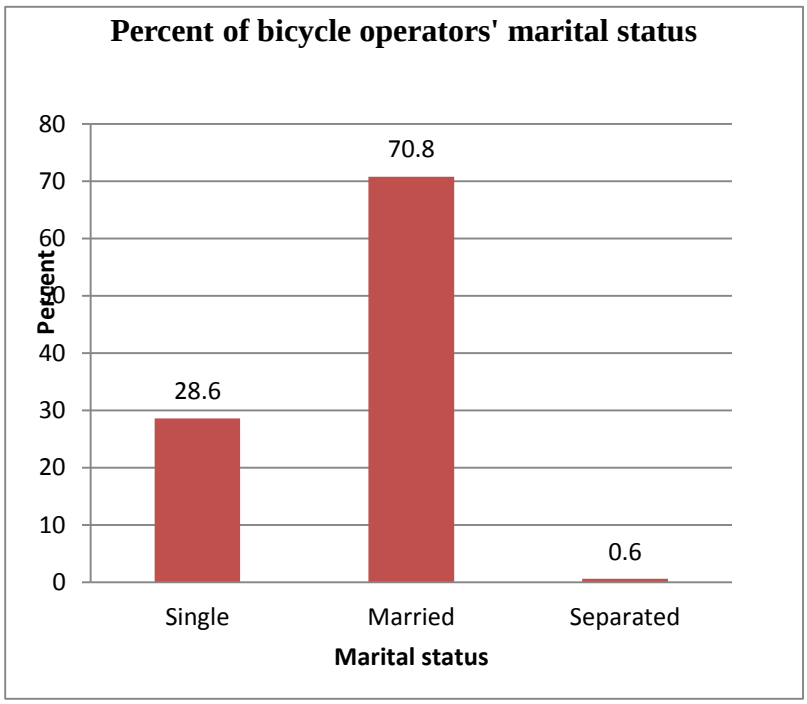
Figure 5.7: Gender distribution of bicycle operators in Laikipia County

Most of the operators interviewed in the county were male. This could be attributed to the type of business which requires a lot of physical energy and being away from homes for a long time. Most women in Laikipia County engage themselves with household responsibilities such as child care. This contributes towards their preference of income generating activities within their homes. Women have no voice and are ill represented in rural workers' organizations. This limits them to loan access facilities, hence low bicycle ownership.

From figure 5.8 married bicycle operators from Laikipia County had the highest frequency of 109 and a percentage of 70.8. Bicycle operators who were single had a share of 28.6 percent and a frequency of 44. This may be attributed to the heavy work load shouldered by married people of meeting their obligations. Such roles includes, taking children to school, fetching water and firewood, taking agricultural produce from farm fields and taking care for the elderly and sick parents.

The significance of reducing the domestic workload for women in rural areas

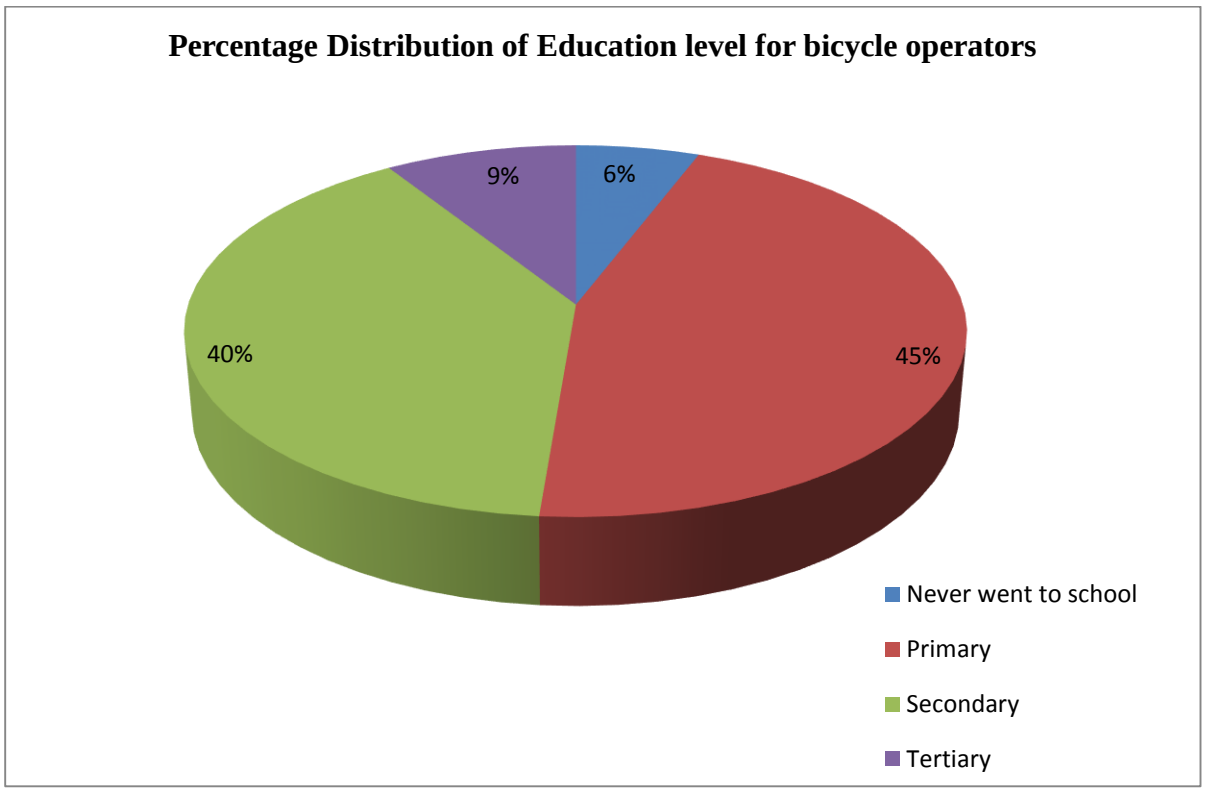
Men work for shorter hours than women especially in rural areas both on-farm and off-farm activities. In Africa, Asia and the Pacific, rural women exceed men's working hours by 12 hours weekly. In some cases poor rural women work for 16 hours, or more and perform many tasks at the same time with no pay. Rural women from Algeria and Pakistan often carry out domestic work for about five hours without any pay while men work for one hour. Inaccessibility of public infrastructure and services leaves women with no alternative apart from traditional ways of domestic chores delivery. This contributes to tiresome and time consuming workloads leading to poor health. According to IFAD (2015), women in Algeria spend about 5.5 hours to 7.3 hours with children below four years old. Vulnerable households are affected by domestic drudgery due to their low income, weak labour capacity and lack of assets which can act as collaterals for securing loans from formal institutions.



Source: Fieldwork (2018)

Figure 5.8: Percent of bicycle operators' marital status

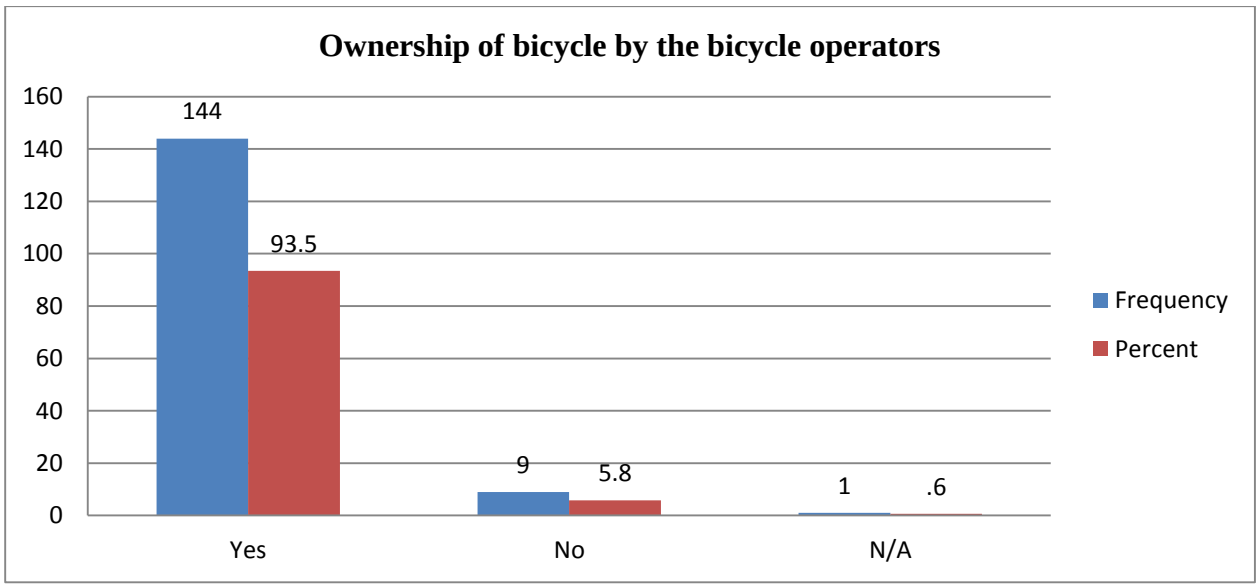
Education level for bicycle operators in Laikipia County was classified into four categories (Figure 5.9).The research findings indicated that majority of bicycle operators had attained primary level of education. This formed the highest category with a percentage of 45. The second category of bicycle operators had attained secondary level of education and had a percentage of 40.The third category of bicycle operators had attained tertiary level of education and had a percentage of 9. The fourth and the least category of bicycle operators had no formal education and had a percentage of 6.



Source: Fieldwork (2018)

Figure 5.9: Percentage Distribution of Education level for bicycle operators in Laikipia County

Figure 5.10 illustrates that, four parameters were considered during the time of interview. The study found out that the bicycle operators who owned bicycles had a frequency of 144 and a percentage of 93.5. Majority of bicycle operators in Laikipia County fell in this category. Those bicycle operators who never owned a bicycle had a frequency of 9 and a percentage of 5.8. The study also found out that majority of bicycle operators which constituted 51.3 percent, acquired their bicycles through casual labour proceeds, while 10.4 percent acquired their bicycles through sale of farm produce (Appendix VI).



Source: Fieldwork (2018)

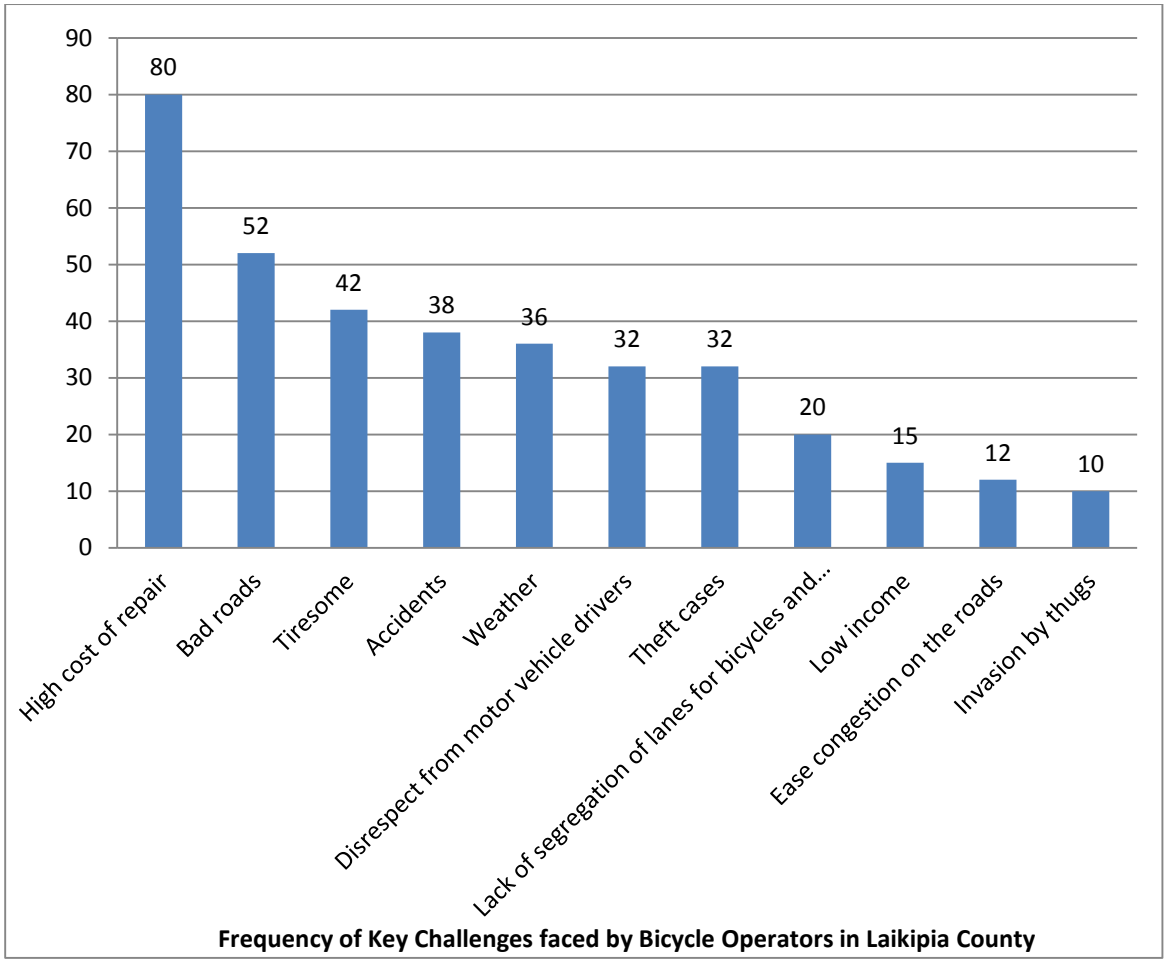
Figure 5.10: A bar graph illustrating ownership of bicycle by the bicycle operators

Source: Field work (2018)

Plate 6: Bicycle operators at Chumvi bicycle garage (Mukogondo East), Laikipia County

The study found out that bicycle operators in Laikipia County were faced by numerous problems (Figure 5.11). The main problems cited by the respondents from the field were; high cost of repair whose frequency was 80 with a percentage of 18.1. Bad roads were also mentioned as another challenge and had a frequency of 52 with a percentage of 11.8. The respondents also felt that riding a bicycle was tiresome and this feeling occurred 42 times which translated to 9.5 percent. Accidents were another challenge which was cited 38 times by the bicycle operators and had a share of 8.6 percent. Weather contributed towards challenges faced by bicycle operator and had a percentage of 8.1 with a frequency of 36. Disrespect from motor vehicle drivers and theft cases were cited by the respondents 32 times and both had a percentage of 7.2 percent each. Lack of segregation of lanes for bicycles and pedestrians accounted for 4.5 percent with a frequency of 20.Low income was cited 15 times accounting for 3.7

percent of challenges faced by the bicycle operators. Road congestion was mentioned 12 times and accounted for 2.7 percent of the challenges faced by the bicycle operators. Lack of parking space and invasion by thugs were both cited 10 times and each of them accounted for 2.3 percent.



Source: Fieldwork (2018)

Figure 5.11: Frequency of Key Challenges faced by Bicycle Operators in Laikipia County

The study had the following key findings on how the challenges encountered by bicycle operators in Laikipia County could be solved (Table 5.2).

Table 5.2 Key ways of overcoming bicycle operators' challenges in Laikipia County

	Ways of overcoming bicycle operators' problems	**Frequency**	**Percent**
1	Reducing prices of spare-parts by the government	69	18.2
2	Segregation of lanes for cyclists and pedestrians	62	16.4
3	Murraming of weather roads	59	15.6
4	Security improvement	42	11.1
5	Training of motor vehicle drivers to respect NMT drivers on roads	19	5.0
6	Installing street lights	17	4.5
7	Wearing reflector jackets	14	3.7
8	Ease congestion on roads	11	2.9
9	Provision of parking space	11	2.9
10	Government to avail cheap and affordable bicycle spare parts	10	2.6
11	Creating job opportunities for the bicycle operators	9	2.4

The statistical mean = 7.85 while standard deviation = 5.640

Source: Fieldwork (2018)

A frequency of 69 which translates to 18.2 percent of the ways of overcoming bicycle operators' problems cited reduction of prices of spare parts by the government as one

of the solutions. Another research finding was, “segregation of lanes for cyclists and pedestrians” which had a frequency of 62 and a percentage of 16.4. “Murraming of weather roads” was another way of overcoming bicycle operators problems, and had a frequency of 59 with a percentage of 15.6. A frequency of 42 of the NMT operators mentioned, ”security improvement” as another way of overcoming bicycle operators’ challenges in the county which accounted for 11.1 percent. Training of motor vehicle drivers to respect NMT drivers on roads was cited as another way of overcoming bicycle operators’ challenges in the county. This had a frequency of 19 and accounted for 5 percent. “Installation of street lights” was mentioned 17 times by the respondents as a way of overcoming the bicycle operators’ problems in the county. This accounted for 4.5 percent. Wearing of reflector jackets as one of the ways of overcoming bicycle operators problems had a frequency of 14 accounting for 3.7 percent. Respondents also felt that easing congestion on the roads and provision of bicycle parking space would be other ways of overcoming bicycle operators problems in the county. The two answers had a frequency of 11 with a percentage of 2.9 each. The respondents floated the idea that the government should avail cheap and affordable bicycle spare parts as a way of overcoming bicycle operators’ problems. This accounted for 2.6 percent and had a frequency of 10. The respondents were of the opinion that creating job opportunities for the bicycle operators would be another way of overcoming bicycle operators problems. This had a frequency of 9 and accounted for 2.4 percent.

5.4 Mobility and accessibility to economic and social opportunities in Laikipia County

Accessibility is a measure of development in the sense that it links people to economic and social opportunities (Rodrigue, Comtois, & Slack, 2017). The study explored the benefits of cycling in Laikipia County through a survey questionnaire. Respondents were asked whether there were any activities resulting from bicycle operation in Laikipia County. Those who were affirmative to the question had a frequency of 30 with a percentage of 85.7 and those who were not aware of the activities resulting from NMT operation had a frequency of 5 which translated to 14.3 percent.

The study found out that several economic activities had sprung up from bicycle operation in Laikipia County (Table 5.3). Some of the economic activities cited by the respondents were as follows:- Repair workshops had a frequency of 22 which accounted for 36.7 percent; sale of spare parts, roadside petrol, food, drinks, clothes and hawking had a frequency of 17 which accounted for 28.4 percent; bicycle race, cycling for charity and donation of bicycles to schools had a frequency of 7 which accounted for 11.7 percent; leisure parks, ambulance and fetching water had a frequency of 5 which accounted for 8.3 percent; and, cycling to the work place and school had a frequency of 4 which accounted for 6.6 percent.

Table 5.3: Activities resulting from bicycle operation in Laikipia County

Activities	Responses	
	Frequency	Percent
Sale of spare parts, roadside petrol, food, drinks, clothes and hawking	17	28.4%
Repair workshops	22	36.7%
Cycling to the work place and school	4	6.6%
Leisure parks, ambulance and fetching water	5	8.3%
Bicycle race, cycling for charity and donation of bicycles to schools	7	11.7%
N/A	5	8.3%

Source: Fieldwork (2018)

Source: Fieldwork (2018)

Plate 7: Repair workshop for trolleys and bicycles in Nanyuki Town, Laikipia County

5.5 Positive environmental and social effects on a societal level

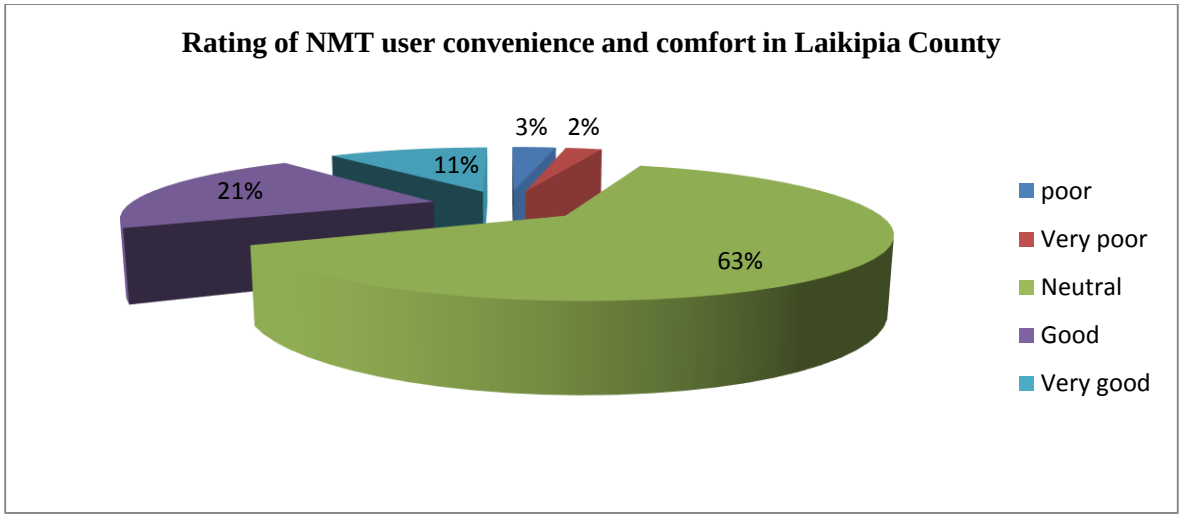
The study found out that 94.1 percent of the respondents felt that there was improvement on user convenience and comfort. At the same time 5.9 percent felt that there was no improvement on user convenience and comfort from bicycle operation in Laikipia County (Table 5.4).

Table 5.4: Is there any improvement on user convenience and comfort?

Response	Frequency	Percent
Yes	193	94.1
No	12	5.9

Source: Fieldwork (2018)

Likert scale was used to measure respondents' attitude towards positive environment and social effects on a societal level basis (Figure 5.12) in the study. The study found out that majority of respondents felt that NMT user convenience and comfort in Laikipia County was "neutral". This had 63 percent. A group of respondents also had a feeling that NMT user convenience and comfort in Laikipia County was "good". This accounted for 21 percent. Some of the respondents felt that NMT user convenience and comfort in Laikipia County was "very good". This set of respondents had 11 percent.



Source: Fieldwork (2018)

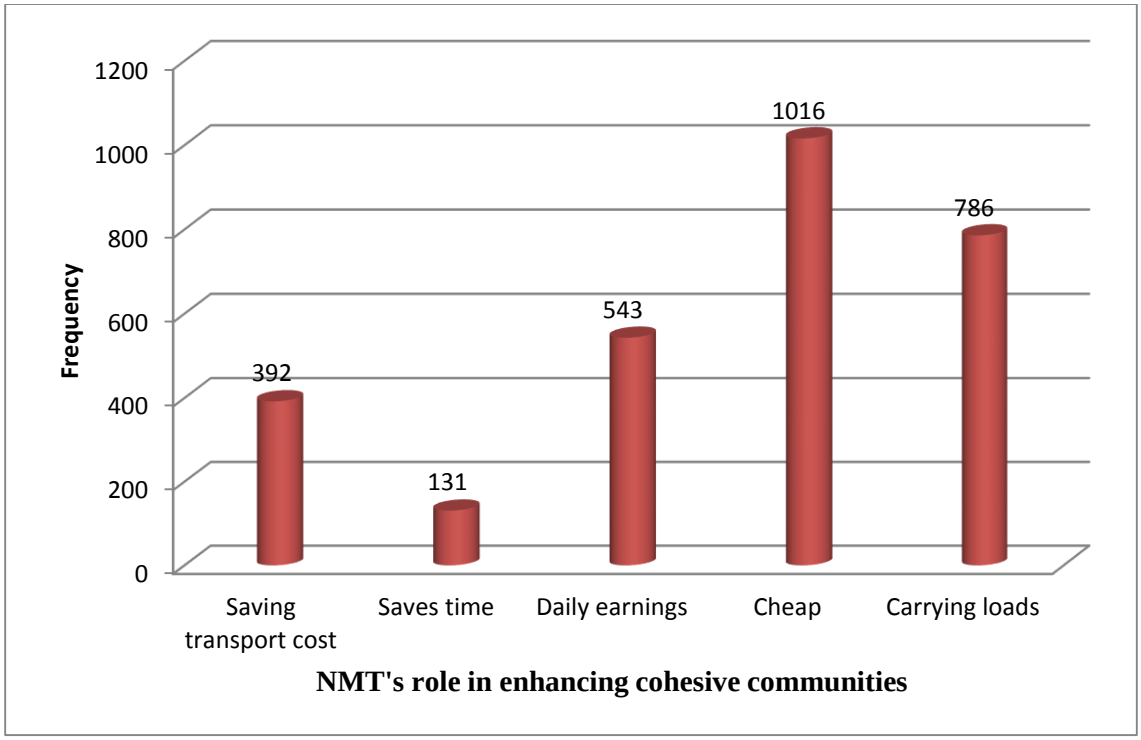
Figure 5.12: Rating of NMT user convenience and comfort in Laikipia County

A community is said to be cohesive where the following features are attained; a similar vision and sense of belonging is cultivated; appreciation of different backgrounds' diversity is valued positively; equal life opportunities of people with different backgrounds is emphasized; different backgrounds' diversity at workplace, neighbourhoods and schools is respected, Local Government Association *et al*, (2002). Community cohesion refers to the quality of interactions among residents in a community. Cohesion increases neighbourhood safety and security. This helps in co-operation of the neighbours and hence, forcing neighbours to develop a brothers' keeper attitude (Kamruzzaman, *et al*., 2014b). Their study found out that, community cohesion increases with walkability and therefore, its promotion would catalyse community cohesion. Some of the walkability virtues entail quality sidewalks, street environments and surrounding services such as kiosks, parks and schools.

According to Habibian and Hosseinzadeh, (2018), in their study on walkabilibity index across trip purposes, a group of researchers have devoted themselves to establish

walkability indices (WIs) which depicts the rank of walkability for certain zones. Nonetheless, thorough research has not been carried out to explain the cause of trip activities on WI. They developed a WI and calibrated through actual trip purposes such as job, educational and shopping in 112 traffic zones in Rasht, Iran. They found out that diversity was the most significant criterion among the WIs.

Similarly, the current study found out that majority of respondents felt that NMTs were cheap compared to other modes of transport and therefore, easy to enhance cohesive communities in Laikipia County (Figure 5.13). This had a frequency of 1016. Another group of respondents had a feeling that NMT user convenience in;"carrying loads" had a high possibility of enhancing cohesive communities in Laikipia County. This accounted for a frequency of 786. Some of the respondents felt that NMT operators' daily earnings play a vital role in promoting cohesive communities in Laikipia County. This set of respondents had a frequency of 543. Respondents also had a feeling that NMT modes were, "cost effective" hence, enhances cohesive communities. This had a frequency of 392. Other respondents cited the factor of "saving time". This accounted for a frequency of 131.



Source: Fieldwork (2018)

Figure 5.13: NMT's role in enhancing cohesive communities in Laikipia County

5.6 Travel conditions enhancing reduced car travel and respondents' perceptions

Litman (2004) enumerated some of the factors that influence changes in travel. He observed that high parking charges for cars was a precursor for non-motorized transport use. Kenyan parking charges are quite high. Parking facilities for bicycles usually cost less than that of cars since their space consumption is negligible, equally walking costs nothing in terms of parking. The study utilized 5-point Likert scale to measure the attitudes towards the conditions that enhance reduced car travel due to non-motorized transport existence (Table 5.5). The selected options against the respondents' feelings were measured in terms of occurrences and percentages in a specific condition. The key findings revealed that, "very good" option had the highest percentage of 68.8 in

“Pollution Reduction” condition; “Energy Conservation” condition had a percentage of 57.1; while, “Road and Parking Facility cost Savings” condition, had a percentage of 49.8.

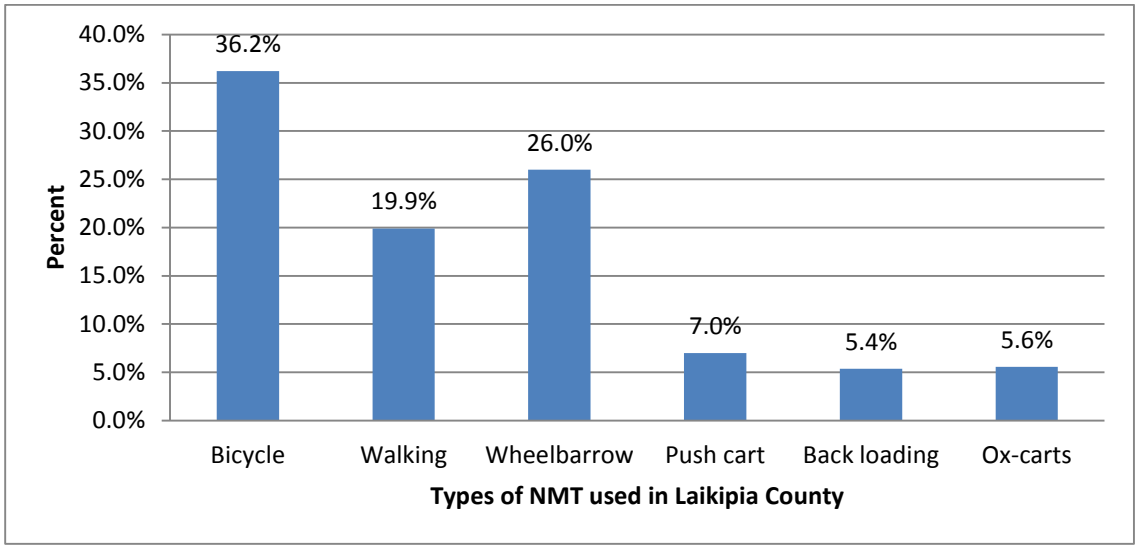
Table 5.5: Conditions that enhance reduced car travel due to Non Motorized Transport existence in Laikipia County

	Conditions enhancing reduced car travel						
	Reduced Traffic Congestion	Road & Parking Facility cost Savings	Consumer Savings	Increased Traffic Safety	Energy Conservation	Pollution Reduction	Economic Devt.
Poor	2.4	2.9	5.9	28.8	2.4	2.9	9.8
Very poor		1	5	11.7	1.5	2.9	3.9
Neutral	13.2	7.3	23.9	29.8	5.4	3.9	3.41
Good	57.1	39	42.4	17.6	33.7	21.5	28.3
Very good	27.3	49.8	27.3	12.2	57.1	68.8	23.4

Source: Fieldwork (2018)

One of the study objectives was to determine the extent to which availability of NMT has affected access to schools and market centers in Laikipia County. This objective was addressed by establishing the role played by a variety of non motorized transport modes used in Laikipia County. The study found out that there were several types of non-motorized transport modes used in Laikipia County (Figure 5.14). However, it was revealed that majority of respondents were using bicycles as their mode of transport. This accounted for 36.2 percent while use of wheelbarrows by the respondents as a mode of transport accounted for 26.0 percent. The respondents who mainly used walking as a mode of transport for their daily activities were represented by 19.9 percent. Although the main concern of the study was on walking and cycling, other non

motorized transport modes were identified from the field as illustrated in figure 5.14 and plate 8.



Source: Fieldwork (2018)

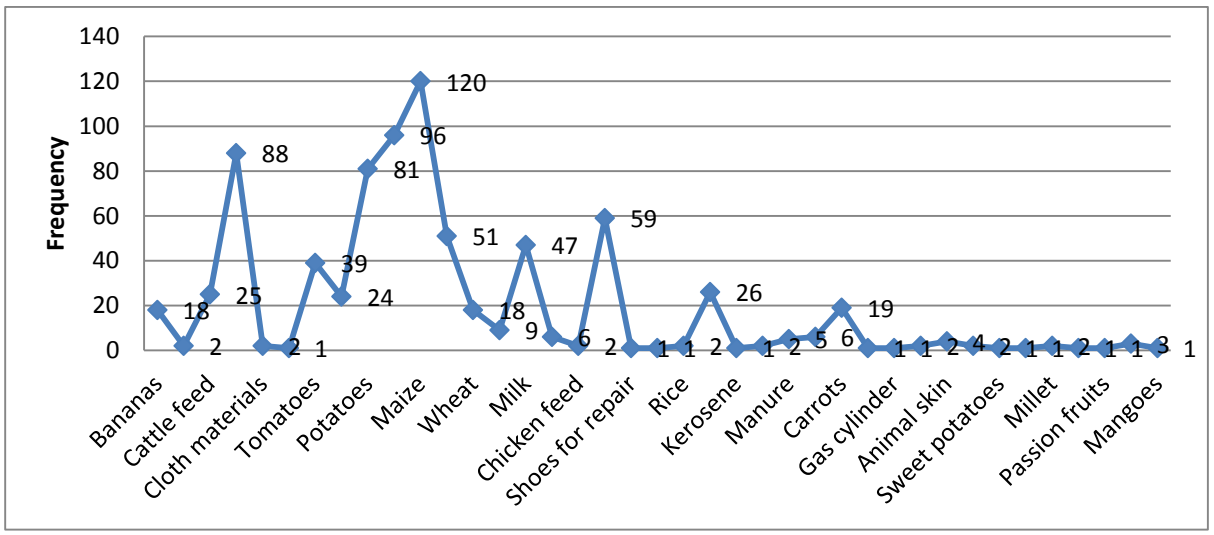
Figure 5.14: Percentage of Non-Motorized Transport modes used in Laikipia County

Despite the fact that, walking and cycling as means of non motorized transport was key in the study area, other forms of non motorized transport emerged in the study area. For example, donkey carts were used in Laikipia County to fetch water, wood fuel and carry grass for feeding livestock (Plate 8).

Source: Fieldwork (2018)

Plate 8: Donkey cart carrying grass for cattle in Marmanet, Laikipia County

The study also found out that, the key products transported by non-motorized transport in Laikipia County were; maize, water, potatoes, beans, tomatoes, charcoal, carrots and bananas. Maize was the most transported products in the county and accounted for a frequency of 120 (Figure 5.15). Cabbages were second most transported products by non motorized transport in the county with a frequency of 96. Water was the third most transported product by non-motorized transport in the county with a frequency of 88. The county falls in the arid and semi-arid lands. Most of the county has seasonal rivers which dry up during the dry spell. As a result, obtaining water during such seasons is hectic which contributes to the high frequency of water transport. Potatoes had a frequency of 81, while beans had a frequency of 59. Tomatoes accounted for a frequency of 39. Charcoal had a frequency of 26. Carrots accounted for a frequency of 19. Bananas accounted for a frequency of 18 for the products transported by non motorized transport in Laikipia County. The other products transported by non motorized transport modes of transport in Laikipia were insignificant.



Source: Fieldwork (2018)

Figure 5.15**: Frequency of Products Transported by NMT modes in Laikipia County**

Activities resulting from NMT operations represented the economic importance in job opportunities creation (Table 5.7). The study found out that repair workshops were the major activities resulting from NMT operations and it engaged 36.7 percent of the respondents. Sale of spare-parts engaged 11.7 percent while sale of clothes, food, drinks, petrol and hawking engaged 16.7 percent. Cycling for charity, leisure parks, work place, and children education engaged 3.3 percent each. Bicycle race accounted for 5 percent of the respondents. The rest of the activities had small percentages and were therefore, insignificant.

Table 5.6: Activities resulting from NMT operations

Activities resulting from NMT operations	Percent
Sale of spare parts	11.7
Clothes selling	1.7
Sale of food and drinks	6.7
Repair workshops	36.7
Roadside petrol sales	3.3
Children education	3.3%
Cycling to the work place	3.3
Leisure parks	3.3
Bicycle race	5.0
N/A	8.3
Fetching water	3.3
Serving as ambulance	1.7
Bicycle race	1.7
Cycling for charity	3.3
Donation of bicycles to rural school children	1.7
Hawking	5.0

Source: Fieldwork (2018)

CHAPTER SIX: SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

6.0 INTRODUCTION

This chapter presents the summarized findings, conclusion and recommendations of the study. Key aspects addressed in the study include, walking, mobility and cycling. Gender differences in cycling are not well-documented in Laikipia County. From the literature review it was observed that most analyses of gender differences in non motorized transport studies make broad comparisons. However, an effort was made in the study to randomly check on the cyclists' gender and their percentage from the key informants.

6.1 SUMMARY OF FINDINGS

The main objective of the study was to examine the role of non-motorized transport in promoting rural mobility in Laikipia County, Kenya. The aim of study was achieved by four specific objectives.

6.1.1 Link between socio-economic factors and Non Motorized Transport usage in Laikipia County

The first objective was to determine the relationship between socio- economic factors and Non Motorized Transport usage in Laikipia County. Analysis of socio-demographic characteristics of the respondents was done. This study revealed that male cyclists were represented by 91.4 percent while female cyclists had only 8.6 percent in Laikipia County. This was attributed to social and cultural attitudes which derive from the social statuses of both male and female. For instance, most women who were interviewed had no collateral to secure loans like men for bicycle purchase. The main

objective of the study was to examine the role of non-motorized transport in promoting rural mobility in Laikipia County, Kenya. From the key informants who were interviewed, a summary of the respondents' marital status in Laikipia County revealed that married cyclists were represented by 57.1 percent while cyclists who were single had 42.9 percent in Laikipia County.

A correlation between marital status and age of the respondents' correlation in Laikipia County showed a strong positive correlation of 0.699 which is significant. This indicates that distance travelled by walking and cycling in Laikipia is heavily dependent on age and marital status. The research also found out that the level of education and age of the respondents has a weak and a negative correlation of -0.283. This indicates that level of education has no impact on walking or cycling in Laikipia County.

A correlation between the respondents' income and occupation had a significant correlation of 0.421. A conclusion can therefore, be drawn that income and economic activities significantly determined the distance travelled in Laikipia County. Another striking result from the study showed that occupation and level of education had a significant positive correlation of 0.449. This denotes that level of education and occupation significantly determined the distance travelled by walking and cycling in Laikipia County.

Occupation and distance travelled by respondents in kilometers were correlated and the results showed that a significant positive correlation of 0.492 existed. This indicates that respondents' occupation determines the distance travelled by walking and cycling in Laikipia County. It can also be interpreted that business location determines the distance travelled by the respondents in Laikipia County. The study also revealed that there was a significant positive correlation between education level and distance

travelled in Laikipia County. This means that the higher the level of education the greater the need of social interaction in search of business opportunities irrespective of the distance within the county. The low value of socio-economic factors of R square indicates that other factors than the measured socio-economic factors influence the patterns of non motorized transport use.

6.1.2 Significance of difference in travel distances by walking and cycling in Laikipia County in Laikipia County

The second objective was significance of difference in travel distances by walking and cycling in Laikipia County in Laikipia County was done with the help of Chi-square (X^2) statistic test. From the results of Chi-square statistic (X^2) test, calculated X^2 at 2 degrees of freedom was found out to be, 0.006 while the Critical X^2 at 2 degrees of freedom at 0.05 significance level was 5.99. Therefore, the Calculated X^2 was smaller than the Critical X^2. It was deduced that there was no adequate evidence to reject the null hypothesis that walking and cycling are independent of distance travelled in Laikipia County. Therefore, the hypothesis was adopted. Walking and cycling were not determined by the distance travelled in Laikipia. The study therefore, concluded that non motorized transport modes are not determined by spatial distance in Laikipia County.

6.1.3 Perception on how availability of NMT has affected access to social facilities in Laikipia County

The third objective was to determine the extent to which availability of NMT had affected access to schools and market centers in Laikipia County. A 5-point, Likert scale was applied to measure the key informants' attitude. This revealed that majority felt that change in social facilities due to development of transport policies was "neutral". This constituted 40 percent of the respondents. It was also found out that, 31.4 percent of the respondents were of the opinion that, development of transport policies was "good" and had an impact to the social facilities. It was also found out that, 17.1 percent of the respondents felt that development of transport policies was "poor" and had very little impact to the social facilities while 5.7 percent of the respondents felt that transport policies in the rural areas were "very good" and had an impact to social facilities.

6.1.4 Existence of cultural policies guiding gender promotion in usage of NMT in Laikipia County

The fourth objective of the study was to establish whether there were existing cultural policies guiding gender promotion in usage of NMT in Laikipia County. In pursuit of the objective, a question was posed to non motorized transport operators on whether they were aware of any existing policy guidelines. Those who were affirmative had a percentage of 65.7 and those who were not aware of any existing regulatory policy guideline had a percentage of 34.3.

6.2 CONCLUSIONS

On the basis of the foregoing summary of the major findings, conclusions may be drawn to this study. The study found out that other ways of increasing safety includes, improving lighting, crossings and signal settings, traffic calming measures, signage and accident remedial schemes improvement. Litman *et al*. (2011), points out that physical infrastructure are indicators that influence convenience. He stresses that infrastructure must be accessible to all and should cater for people's needs irrespective of ability and age. Department of Transport (2000) identified a second indicator as an improvement of safety and security in a particular area.

The key areas identified in improvement of NMT modes of transport conditions in Laikipia County were; improved convenience and comfort for NMT users; improved transport options; building up attractive and livable communities; improved basic mobility for non-drivers; and improved land-use efficiency. However, the study found out that majority of respondents felt that NMT user convenience and comfort in Laikipia County was "neutral". This had 63 percent. Theft and vandalism for bicycles were identified as main distractions for cycling. Some of the key solutions suggested by the respondents as a measure of curbing theft and vandalism were; safe parking for bicycles, insurance provision, police surveillance, and use of GIS applications. Other specific measures include: integrated concepts which are more efficient than cycling or walking measures.

6.3 RECOMMENDATIONS

6.3.1 Researchers and scholars

- The low value of socio-economic factors of R square in the study area indicates that other factors than the measured socio-economic factors influence the patterns of

non motorized transport use. This prompts the need for further research on factors other than those considered in the study area.

- There is need to interrogate the non motorized transport technologies adopted in Laikipia County. This would ensure the appropriateness of cultural and social aspects and their sustainability in the field of study.

- Effect of car journeys' reduction should be explored further to promote walking and cycling to reduce air pollutant emissions and the risk of traffic injury.

6.3.2 Planners and Bicycle Manufacturers

Walking is the dominating mode of transport in Africa while cycling is also common particularly in rural areas. Yet, in terms of practical implementation and policy development, none has been given the right attention. From the foregoing discussion the following was established.

- "Reducing prices of spare-parts by the government" was the key solution of overcoming bicycle operators' challenges mentioned by respondents in Laikipia County. This accounted for 18.2 percent (Table 5.3). Exemption of bicycles' purchase tax would promote bicycle commuters. The study found out that bicycles are expensive to buy and therefore, rural people are not capable of importing bicycles. A tax waiver or reduction would have a great positive impact to the rural people.
- "Segregation of lanes for cyclists and pedestrians" as a solution to bicycle operators' challenges mentioned by respondents was the second alternative and had 16.4 percent.

- "Murraming of weather roads" was ranked as a third solution of overcoming bicycle operators' challenges with a percentage of 15.6 while,
- "Security improvement" was ranked as a fourth alternative to the challenges faced by the respondents and had 11.1 percent.

6.3.3 Policy-makers

Inadequate NMT planning has its consequences on Kenyan roads. Such consequences include: high fatality rate of pedestrian, poor-quality NMT environments, and high private car dependence. NMT characteristics are based on attitudinal dynamics related to age, gender and background, and policy makers should have a good understanding on these variables when planning for functional infrastructure.

Motorized and non-motorized traffic can coexist in three ways:

- Full integration does not give exclusive right for both cyclists and pedestrians.
- Partial segregation allocates a space for both cyclists and pedestrians which have no physical protection.
- Complete segregation has exclusive rights for both pedestrians and cyclists and has physical partitions between motorized traffic and non-motorized transport.

6.4 CONTRIBUTION OF THE STUDY

Transport geographers and planners may find this original data useful in their fields since no other study of this kind has ever been carried out in Laikipia County. Policy-makers may derive some of the policies from the recommendations made by the study. For instance, complete segregation which has exclusive rights for both pedestrians and

cyclists with physical partitions between motorized traffic and non motorized transport may be enforced in Laikipia County and the country at large.

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APPENDICES

APPENDIX I: INTRODUCTION LETTER TO NMT RESPONDENTS

I am a Ph.D. candidate in the Faculty of Arts, University of Nairobi, pursuing a Doctor of Philosophy in Transport Geography in the Department of Geography and Environmental Studies. My research topic is entitled, "*An Assessment of the Role of Non-Motorized Transport in Promoting Rural Mobility: A Case Study of Laikipia County, Kenya*". This research is for academic purpose and responses to the questions will enable the researcher to comprehensively compile the research findings. Kindly provide answers to the questions as honestly as possible. Do not write your name anywhere. Tick in the box that reflects your choice or fill in the required information in the space provided.

Your cooperation in filling this questionnaire will be highly appreciated.

Thank you.

APPENDIX II: QUESTIONNAIRE FOR NON-MOTORIZED TRANSPORT RESPONDENTS

Instructions to respondents

- Kindly tick against your answer and give a brief explanation where necessary.
- Please answer all questions.

SECTION A: Demographic profile of respondents

1. Age of respondent in years: 15-20 ☐ 21-25 ☐ 26-30 ☐

   31-40 ☐ 41-50 ☐ 50-55 ☐

   56-60 ☐ 61 and above ☐

2. Gender: Male ☐ Female ☐

3. Marital status: Single ☐ Married ☐ Separated ☐ Divorced ☐

   ☐ Widowed

4. Respondent's Level of Education

   Never went to school ☐ Primary ☐

   Secondary ☐ Tertiary ☐

5. Number of children. None ☐ 1-2 ☐ 2-5 ☐

6. Number of children in school. None ☐ 1-2 ☐ 2-5 ☐

7. Number of children employed and in which occupation

1-2 ☐ 2-5 ☐

QUESTIONNAIRE FOR NON-MOTORIZED TRANSPORT USERS

1. What is your current occupation?

2. State your daily income in Kenya shillings.

100 – 500 ☐ 501 – 1000 ☐ 1001 – 1500 ☐ 1501 - 000 ☐

2001-2500 ☐ 2501 and above ☐

3. State your origin to the tarmac road?.....

4. Which is your destination?

5. State mode of NMT owned (a) Bicycle (b) Wheel-barrow (c) Handcart

(d) Other, specify e.g. walking.

6. How long have you been in the NMT industry?

7. Ownership of the NMT (bicycle):

Employer ☐ Self ☐

8. Are there other factors that stop you from owning a bicycle apart from finance?

Yes ☐ No ☐

9. If Yes, List the factors

10. What is your current income per day from *NMT* business in Kenya shillings?

☐

100 – 500 ☐ 600 – 1000 ☐ 1001- 1500

1501- 2000 ☐ 2001- 2500 ☐ 2501 and over ☐

11. Is there any improvement on user convenience and comfort?

Yes ☐ No ☐

12. Rate NMT user convenience and comfort.

Poor ☐ Very poor ☐ Fair ☐ Good ☐

13. What is the current existing level of NMT infrastructure within the study area in comparison with other road infrastructure? e.g. pedestrian security and safety; accessibility (consider the 4Es – i.e. Engineering, Education, Enforcement and Evaluation. (Groenewald, 2013).

14. Is there any improved public fitness and health as part of non-motorized transport activity?

15. Is there any increased community cohesion (positive interactions among neighbours due to more people walking on local streets) which tends to increase local security?

16. Rank the following conditions on more compact communities due to non-motorized transport existence.

More compact communities	Poor	Fair	Good
(a) Improved accessibility, particularly for non-drivers			
(b) Improved accessibility, particularly for drivers			

(c) Transport cost savings			
(d) Reduced sprawl costs			
(e) Open-space preservation			
(f) More livable communities			
(g) Higher property values			
(h) Increased security			

17. Rank the following conditions on reduced automobile travel due to non-motorized transport existence.

Reduced automobile travel	Poor	Fair	Good
Reduced traffic congestion			
Road and parking facility cost savings			
Consumer savings			
Increased traffic safety			
Energy conservation			
Pollution reductions			
Economic development			

18. Which products do you transport?

(i) _____

(ii) _____

(iii) _____

(iv) _____

(v) _____

(a) Which type of non-motorized transport do you use in transporting the above products?

(i) _____

(ii) _____

(iii) _____

(iv) _____

(b) Give reasons for the choice of non-motorized transport mode in transporting the above products?

19. State the volumes in kilograms of the commodities transported per day/week/month.

_____

How often do you transport the commodities?

What is the distance covered when transporting the commodities?

_____

QUESTIONNAIRE FOR KEY INFORMANTS

Contribution of NMT Policies

1. Are you aware of any existing regulatory policy guidelines? Yes ☐ No ☐
2. Since the development of Transport frameworks and policies for rural areas; to what extent is change brought about in safe and adequate NMT access to social facilities within the area?
3. Are there any activities that have come up as a result of NMT operation?

   Yes ☐ No ☐

5. If Yes, state the activities.

   _____

6. Do you have any centralized coordination? Yes ☐ No ☐
7. (a) Do you have any welfare organization? Yes ☐ No ☐

   (b) If Yes, Indicate the name _____

8. Are you aware of any licensing institution? Yes ☐ No ☐
9. Are there any precautions taken against accidents when operating the non-motorized mode? Yes ☐ No ☐
10. If Yes, state the precautions:

    _____

    Are there conditions to be met before access to the Profession of non-motorized transport business? Yes ☐ No ☐
11. If Yes, state the conditions:

    _____

    Suggest ways on how non-motorized transport business may be improved?

    _____

QUESTIONNAIRE FOR NON-MOTORIZED TRANSPORT OPERATORS

1. Do you own any type of non-motorized transport? Yes ☐ No ☐

2. Do you have a license for the mode of non-motorized transport you own?

   Yes ☐ No ☐

3. How did you obtain money to acquire your non-motorized transport?

   _____

4. Are there challenges in non-motorized business? ☐ ☐

5. If Yes, state the nature and extent of the challenges.

---

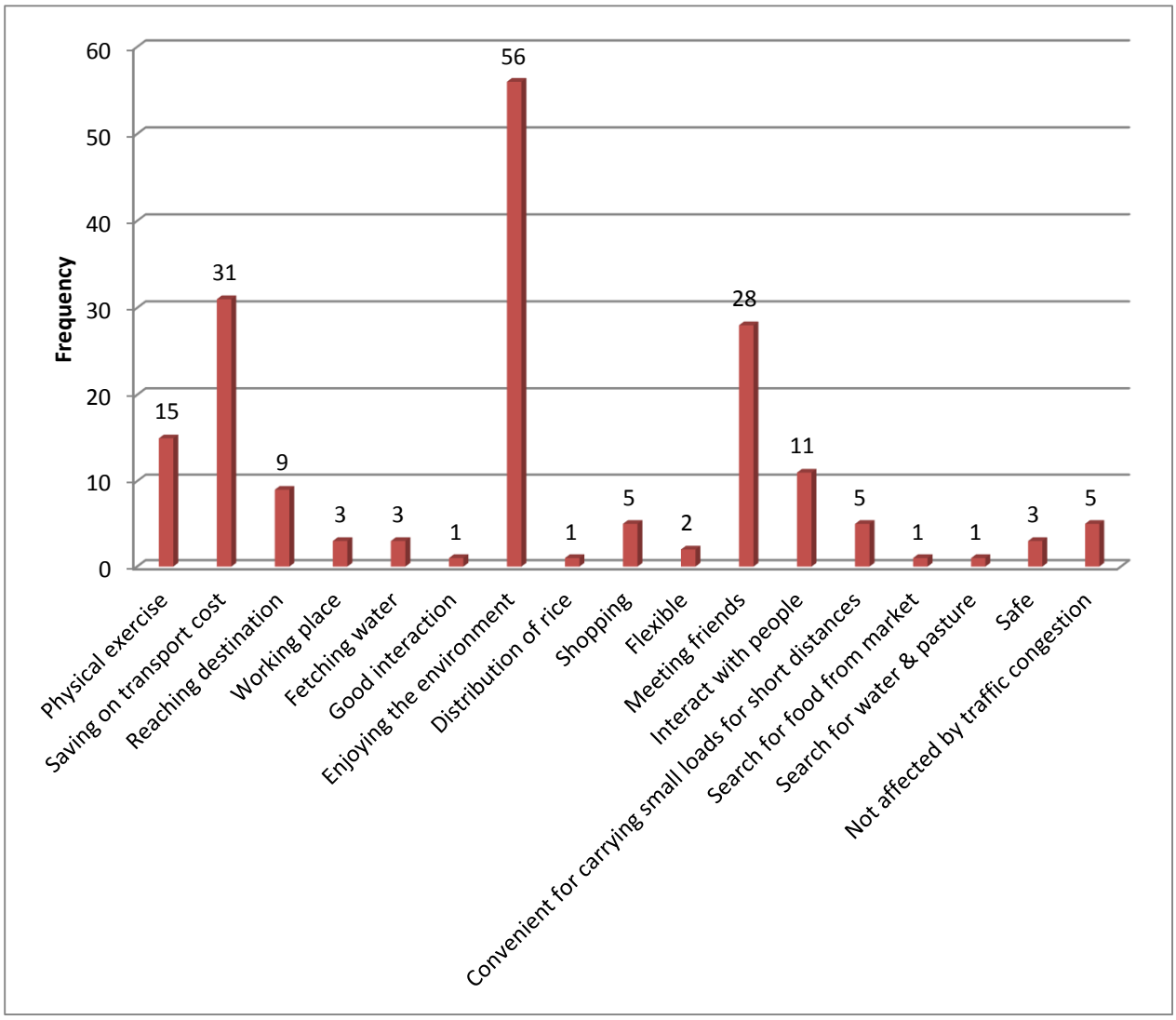
6. Suggest ways on how the challenges can be overcome.

   _____

Appendix III: Researcher interviewing one of the cyclists in Nyahururu (Laikipia County)

Source: Fieldwork (2018)

Appendix IV: Purpose of using walking as a non motorized transport mode in Laikipia County



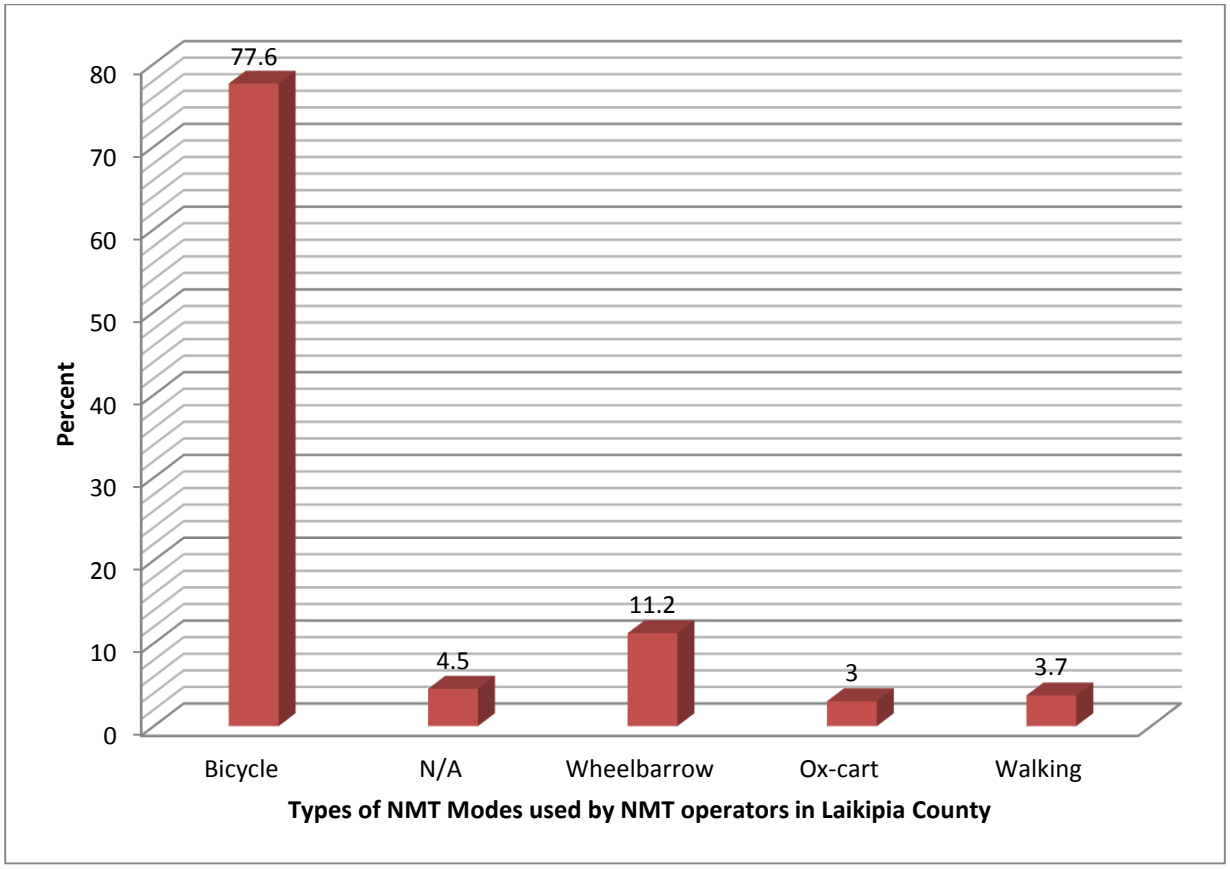
Source: Fieldwork (2018)

Appendix V: How non-motorized transport operators acquired their bicycles in Laikipia County

	Frequency	Percent
Casual labour	79	51.3
Farm produce sales	16	10.4
Gift from parents	11	7.1
Savings from business	7	4.5
N/A	5	3.2
Earnings from temporary employment	4	2.6
Sale of chicken	4	2.6
Sale of cattle and sheep	4	2.6
Employment	3	1.9
NAWASCO Employee	2	1.3
Merry-go-round savings	2	1.3
Formerly employed by Nanyuki Textiles	1	.6
Employed as a watchman	1	.6
Welder	1	.6
Shop assistant	1	.6
Charcoal burning	1	.6
Sale of manure	1	.6
Gambling	1	.6
Shoe-maker	1	.6
Bicycle race award	1	.6
Bank loan (Equity)	1	.6
Sales and marketing proceeds	1	.6
Kiosk's proceeds	1	.6
Car wash business	1	.6
Employed as a Hardware Shop Assistant	1	.6
Exchange of a phone with a second hand bicycle	1	.6

Source: Fieldwork (2018)

Appendix VI: Types of NMT Modes used by NMT operators in Laikipia County



Source: Fieldwork (2018)

Appendix VII: Table for finding a base sample size +5/-5% of margin error

Required Sample Size†

Population Size	Confidence = 95% Margin of Error				Confidence = 99% Margin of Error			
	5.0%	3.5%	2.5%	1.0%	5.0%	3.5%	2.5%	1.0%
10	10	10	10	10	10	10	10	10
20	19	20	20	20	19	20	20	20
30	28	29	29	30	29	29	30	30
50	44	47	48	50	47	48	49	50
75	63	69	72	74	67	71	73	75
100	80	89	94	99	87	93	96	99
150	108	126	137	148	122	135	142	149
200	132	160	177	196	154	174	186	198
250	152	190	215	244	182	211	229	246
300	169	217	251	291	207	246	270	295
400	196	265	318	384	250	309	348	391
500	217	306	377	475	285	365	421	485
600	234	340	432	565	315	416	490	579
700	248	370	481	653	341	462	554	672
800	260	396	526	739	363	503	615	763
1,000	278	440	606	906	399	575	727	943
1,200	291	474	674	1067	427	636	827	1119
1,500	306	515	759	1297	460	712	959	1376
2,000	322	563	869	1655	498	808	1141	1785
2,500	333	597	952	1984	524	879	1288	2173
3,500	346	641	1068	2565	558	977	1510	2890
5,000	357	678	1176	3288	586	1066	1734	3842
7,500	365	710	1275	4211	610	1147	1960	5165
10,000	370	727	1332	4899	622	1193	2098	6239
25,000	378	760	1448	6939	646	1285	2399	9972
50,000	381	772	1491	8056	655	1318	2520	12455
75,000	382	776	1506	8514	658	1330	2563	13583
100,000	383	778	1513	8762	659	1336	2585	14227
250,000	384	782	1527	9248	662	1347	2626	15555
500,000	384	783	1532	9423	663	1350	2640	16055
1,000,000	384	783	1534	9512	663	1352	2647	16317
2,500,000	384	784	1536	9567	663	1353	2651	16478
10,000,000	384	784	1536	9594	663	1354	2653	16560
100,000,000	384	784	1537	9603	663	1354	2654	16584
300,000,000	384	784	1537	9603	663	1354	2654	16586

Appendix VIII: Table for Chi-Square Distribution

Chi-Square (χ^2) Distribution

Degrees of Freedom	Area to the Right of Critical Value							
	0.99	0.975	0.95	0.90	0.10	0.05	0.025	0.01
1	—	0.001	0.004	0.016	2.706	3.841	5.024	6.635
2	0.020	0.051	0.103	0.211	4.605	5.991	7.378	9.210
3	0.115	0.216	0.352	0.584	6.251	7.815	9.348	11.345
4	0.297	0.484	0.711	1.064	7.779	9.488	11.143	13.277
5	0.554	0.831	1.145	1.610	9.236	11.071	12.833	15.086
6	0.872	1.237	1.635	2.204	10.645	12.592	14.449	16.812
7	1.239	1.690	2.167	2.833	12.017	14.067	16.013	18.475
8	1.646	2.180	2.733	3.490	13.362	15.507	17.535	20.090
9	2.088	2.700	3.325	4.168	14.684	16.919	19.023	21.666
10	2.558	3.247	3.940	4.865	15.987	18.307	20.483	23.209
11	3.053	3.816	4.575	5.578	17.275	19.675	21.920	24.725
12	3.571	4.404	5.226	6.304	18.549	21.026	23.337	26.217
13	4.107	5.009	5.892	7.042	19.812	22.362	24.736	27.688
14	4.660	5.629	6.571	7.790	21.064	23.685	26.119	29.141
15	5.229	6.262	7.261	8.547	22.307	24.996	27.488	30.578
16	5.812	6.908	7.962	9.312	23.542	26.296	28.845	32.000
17	6.408	7.564	8.672	10.085	24.769	27.587	30.191	33.409
18	7.015	8.231	9.390	10.865	25.989	28.869	31.526	34.805
19	7.633	8.907	10.117	11.651	27.204	30.144	32.852	36.191
20	8.260	9.591	10.851	12.443	28.412	31.410	34.170	37.566
21	8.897	10.283	11.591	13.240	29.615	32.671	35.479	38.932
22	9.542	10.982	12.338	14.042	30.813	33.924	36.781	40.289
23	10.196	11.689	13.091	14.848	32.007	35.172	38.076	41.638
24	10.856	12.401	13.848	15.659	33.196	36.415	39.364	42.980
25	11.524	13.120	14.611	16.473	34.382	37.652	40.646	44.314
26	12.198	13.844	15.379	17.292	35.563	38.885	41.923	45.642
27	12.879	14.573	16.151	18.114	36.741	40.113	43.194	46.963
28	13.565	15.308	16.928	18.939	37.916	41.337	44.461	48.278
29	14.257	16.047	17.708	19.768	39.087	42.557	45.722	49.588
30	14.954	16.791	18.493	20.599	40.256	43.773	46.979	50.892

Appendix IX : Percentage points of the Chi-Square Distribution

Percentage Points of the Chi-Square Distribution

Degrees of Freedom	Probability of a larger value of x^2								
	0.99	0.95	0.90	0.75	0.50	0.25	0.10	0.05	0.01
1	0.000	0.004	0.016	0.102	0.455	1.32	2.71	3.84	6.63
2	0.020	0.103	0.211	0.575	1.386	2.77	4.61	5.99	9.21
3	0.115	0.352	0.584	1.212	2.366	4.11	6.25	7.81	11.34
4	0.297	0.711	1.064	1.923	3.357	5.39	7.78	9.49	13.28
5	0.554	1.145	1.610	2.675	4.351	6.63	9.24	11.07	15.09
6	0.872	1.635	2.204	3.455	5.348	7.84	10.64	12.59	16.81
7	1.239	2.167	2.833	4.255	6.346	9.04	12.02	14.07	18.48
8	1.647	2.733	3.490	5.071	7.344	10.22	13.36	15.51	20.09
9	2.088	3.325	4.168	5.899	8.343	11.39	14.68	16.92	21.67
10	2.558	3.940	4.865	6.737	9.342	12.55	15.99	18.31	23.21
11	3.053	4.575	5.578	7.584	10.341	13.70	17.28	19.68	24.72
12	3.571	5.226	6.304	8.438	11.340	14.85	18.55	21.03	26.22
13	4.107	5.892	7.042	9.299	12.340	15.98	19.81	22.36	27.69
14	4.660	6.571	7.790	10.165	13.339	17.12	21.06	23.68	29.14
15	5.229	7.261	8.547	11.037	14.339	18.25	22.31	25.00	30.58
16	5.812	7.962	9.312	11.912	15.338	19.37	23.54	26.30	32.00
17	6.408	8.672	10.085	12.792	16.338	20.49	24.77	27.59	33.41
18	7.015	9.390	10.865	13.675	17.338	21.60	25.99	28.87	34.80
19	7.633	10.117	11.651	14.562	18.338	22.72	27.20	30.14	36.19
20	8.260	10.851	12.443	15.452	19.337	23.83	28.41	31.41	37.57
22	9.542	12.338	14.041	17.240	21.337	26.04	30.81	33.92	40.29
24	10.856	13.848	15.659	19.037	23.337	28.24	33.20	36.42	42.98
26	12.198	15.379	17.292	20.843	25.336	30.43	35.56	38.89	45.64
28	13.565	16.928	18.939	22.657	27.336	32.62	37.92	41.34	48.28
30	14.953	18.493	20.599	24.478	29.336	34.80	40.26	43.77	50.89
40	22.164	26.509	29.051	33.660	39.335	45.62	51.80	55.76	63.69
50	27.707	34.764	37.689	42.942	49.335	56.33	63.17	67.50	76.15
60	37.485	43.188	46.459	52.294	59.335	66.98	74.40	79.08	88.38

Appendix X: Nature of the challenges in NMT Business in Laikipia County

Challenges faced by NMT operators	Responses		Percent of Cases
	N	Percent	
High cost of repair	80	18.1	72.1
Invasion by thugs	10	2.3	9.0
Theft cases	32	7.2	28.8
Bad roads	52	11.8	46.8
Congestion on roads	12	2.7	10.8
Low income	15	3.4	13.5
Lack of loan provision	2	0.5	1.8
No lane set aside for bicycles	20	4.5	18.0
Police harassment	4	0.9	3.6
Little regard by motorized drivers	19	4.3	17.1
Cycling uses a lot of energy	3	0.7	2.7
Weather	36	8.1	32.4
Tiresome	42	9.5	37.8
Infection of respiratory diseases	3	0.7	2.7
Lack of repair workshops on the roadside	8	1.8	7.2
Lack of emergency brakes	1	0.2	0.9
It breaks down often	6	1.4	5.4
Disrespect from motor-vehicle drivers	13	2.9	11.7
Accidents	38	8.6	34.2
Invisible road signs	6	1.4	5.4
No insurance cover	2	0.5	1.8
Lack of street lights	4	0.9	3.6
non-availability of quality spare parts	3	0.7	2.7
Damaged bridges by floods	4	0.9	3.6
Attack by wild animals	5	1.1	4.5
Lack of parking	10	2.3	9.0
Low quality spare parts	1	0.2	0.9
Terrain	4	0.9	3.6
Limitation of carrying capacity	5	1.1	4.5
Lack of calming bumps	1	0.2	0.9
Poor representation of cyclists	1	0.2	0.9
Total	442	100.0	398.2

Source: Fieldwork (2018)

Appendix XI: Suggest ways of overcoming the problems faced by NMT Operators in Laikipia County

Ways of overcoming problems	Responses		Percent of Cases
	N	Percent	
Lower prices of spare parts by the Government	69	18.2	62.2
Segregation of lanes for cyclists and pedestrians	62	16.4	55.9
Murraming of weather roads	59	15.6	53.2
Security improvement	42	11.1	37.8
Train motor vehicle drivers to respect NMT	19	5.0	17.1
Lighting up roads	17	4.5	15.3
Wearing reflector jackets	14	3.7	12.6
Improvement of design to cater for theft cases	11	2.9	9.9
Loan provision	11	2.9	9.9
Government to avail cheap and affordable spare parts	10	2.6	9.0
Introduction of modern NMT to save body energy	10	2.6	9.0
Creating job opportunities	9	2.4	8.1
Provide parking for bicycles	9	2.4	8.1
Government to control accidents	6	1.6	5.4
Structuring strong bridges	6	1.6	5.4
Formation of rules and policies to cover cyclists	4	1.1	3.6
Form pedestrian and cyclists SACCOs by government	4	1.1	3.6
Training bicycle repairers	4	1.1	3.6
Introduction of insurance cover for bicycles	4	1.1	3.6
Bicycle riding competition should be introduced by the Govt.	2	0.5	1.8
Improvement of NMT operators' salary	2	0.5	1.8
To enforce rules for motor vehicle drivers	2	0.5	1.8
Licensing bicycle operators	1	0.3	0.9
Tubeless tyres provision	1	0.3	0.9

Appropriate signage on roads	1	0.3	0.9
Total	379	100.0	341.4

Source: Fieldwork (2018)

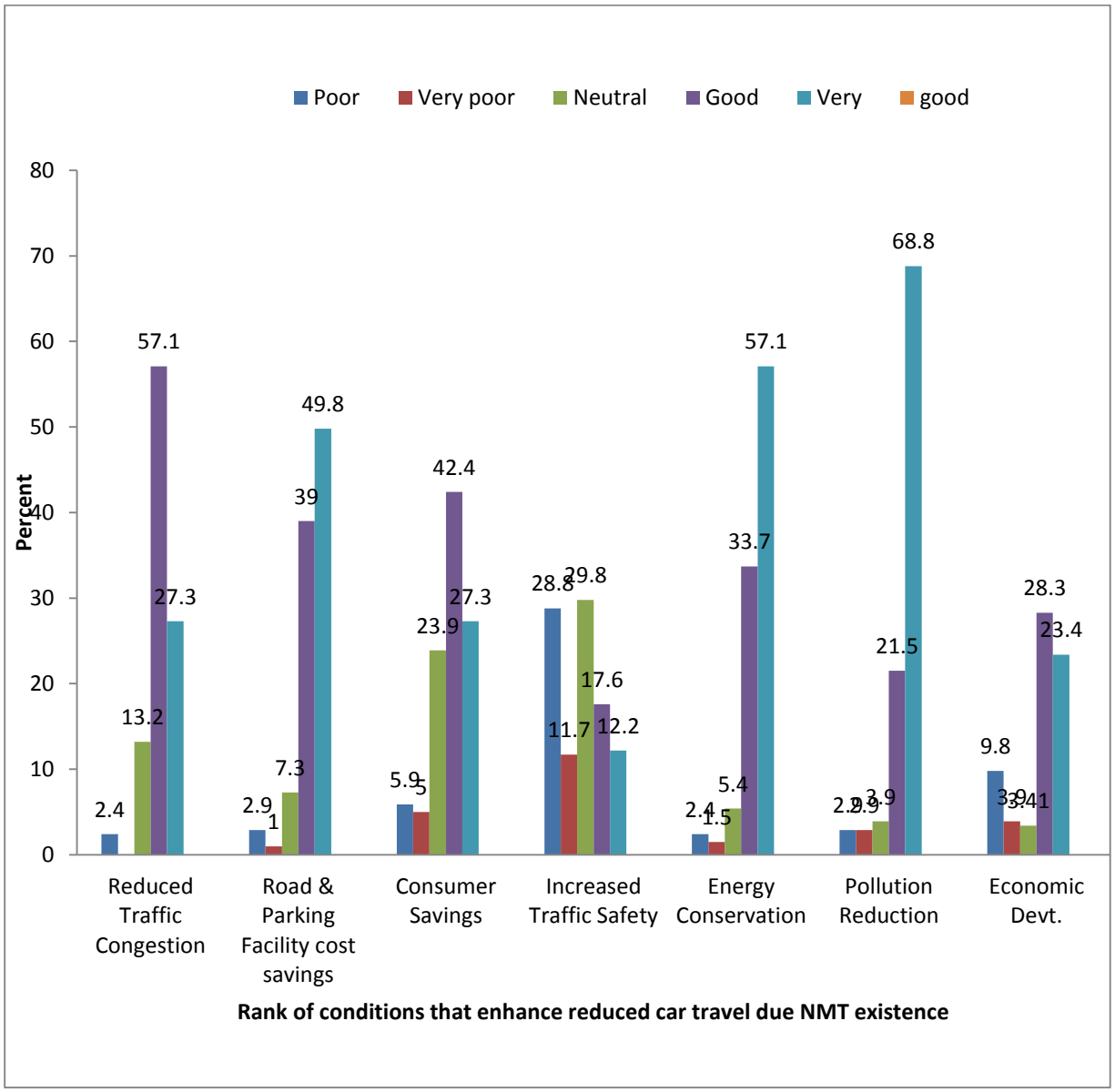
Appendix XII: Activities resulting from NMT Operators in Laikipia County

Activities resulting from cycling	Responses		Percent of Cases
	N	Percent	
Sale of spare parts	7	11.7	20.0
Clothes selling	1	1.7	2.9
Sale of food and drinks	4	6.7	11.4
Repair workshops	22	36.7	62.9
Roadside petrol sales	2	3.3	5.7
Children education	2	3.3	5.7
Cycling to the work place	2	3.3	5.7
Leisure parks	2	3.3	5.7
Bicycle race	3	5.0	8.6
N/A	5	8.3	14.3
Fetching water	2	3.3	5.7
Serving as ambulance	1	1.7	2.9
Bicycle race	1	1.7	2.9
Cycling for charity	2	3.3	5.7
Donation of bicycles to rural school children	1	1.7	2.9
Hawking	3	5.0	8.6

Total	60	100.0	171.4

Source: Fieldwork (2018)

Appendix XIII: Rank of conditions that enhance reduced car travel due NMT existence



Source: Fieldwork (2018)

Appendix XIV: Researcher explaining a point to NMT respondents

APPENDIX XVI: TIME PLAN

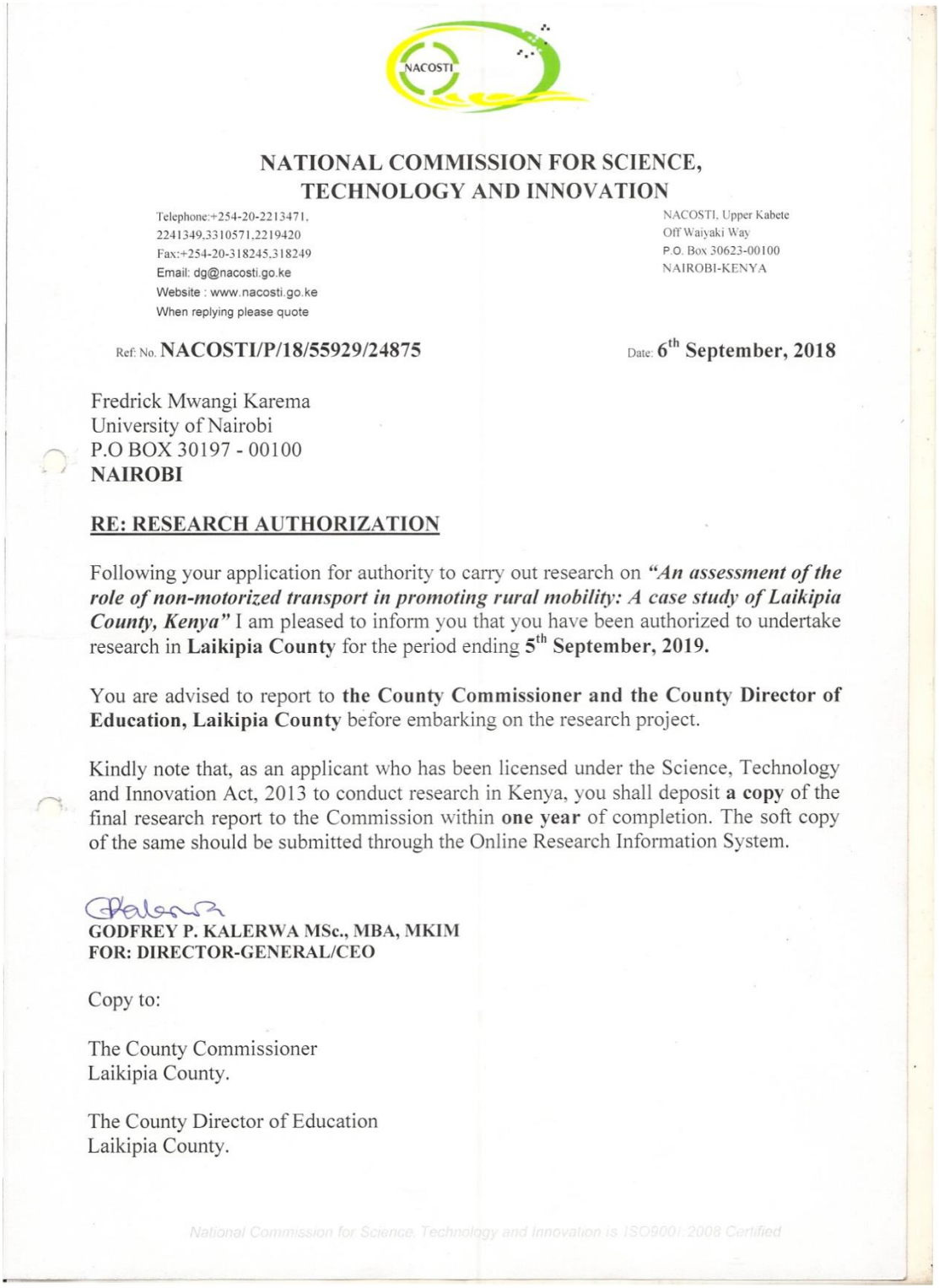
Activities	**Time Frame**		
	2016	2017	2018
Preparation for the Ph.D. Proposal/project			
Submission of Proposal			
Inclusion of seminar comments			
Data Collection from the field			
Data Analysis and Interpretation			
Writing the first draft			
Submission of the first draft			
Correction of the first draft			
Submission of the final draft report			
Defence of the project			

APPENDIX XVII: RESEARCH BUDGET

Items	Number of items	Cost per item (Kshs)	Total cost (Kshs)
Research Assistants' employment for 10 days @ 1,000/- per day	2	10,000.00	20,000.00
Acquisition of GPS	2	40,000.00	80,000.00
Transport cost for the researcher and two research assistants	3	10,000.00	30,000.00
Printing 100 questionnaires of 6 pages each	600 pages	10.00	6,000.00
Purchasing portable tablets (mini computers)	3	15,000.00	45,000.00
Buying a pocket canon camera	1	20,000.00	20,000.00
Drawing cartographic maps for Laikipia County	3	5,000.00	15,000.00
Accommodation for the researcher and two research assistants @ 1,500/= per night	3	1,500.00	4,500.00
Stationery		40,000.00	40,000.00
Data capture	3	10,000.00	30,000.00
Data coding, data entry and Data analysis			50,000.00
Printing the first draft (spiral) of the project	2 copies of 100 pages each	10.00	2,000.00
Binding (spiral) the first draft of the project	2 copies	50.00	100.00
Printing the final draft of the project	7 copies of 100 pages each	10.00	7,000.00
Binding the final draft of the project	7 copies	500.00	3,500.00
Total Cost			**353,100.00**

APPENDIX XVIII: LETTER OF AUTHORIZATION: REF. NO.

NACOSTI/P/18/55929/24875



NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

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When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No. **NACOSTI/P/18/55929/24875**

Date: **6th September, 2018**

Fredrick Mwangi Karema
University of Nairobi
P.O BOX 30197 - 00100
NAIROBI

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"An assessment of the role of non-motorized transport in promoting rural mobility: A case study of Laikipia County, Kenya"*** I am pleased to inform you that you have been authorized to undertake research in **Laikipia County** for the period ending **5th September, 2019.**

You are advised to report to **the County Commissioner and the County Director of Education, Laikipia County** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

GODFREY P. KALERWA MSc., MBA, MKIM
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Laikipia County.

The County Director of Education
Laikipia County.

National Commission for Science, Technology and Innovation is ISO9001: 2008 Certified

APPENDIX XIX: RESEARCH CLEARANCE PERMIT FROM NACOSTI

CONDITIONS

1. The License is valid for the proposed research, research site specified period.
2. Both the Licence and any rights thereunder are non-transferable.
3. Upon request of the Commission, the Licensee shall submit a progress report.
4. The Licensee shall report to the County Director of Education and County Governor in the area of research before commencement of the research.
5. Excavation, filming and collection of specimens are subject to further permissions from relevant Government agencies.
6. This Licence does not give authority to transfer research materials.
7. The Licensee shall submit two (2) hard copies and upload a soft copy of their final report.
8. The Commission reserves the right to modify the conditions of this Licence including its cancellation without prior notice.

REPUBLIC OF KENYA

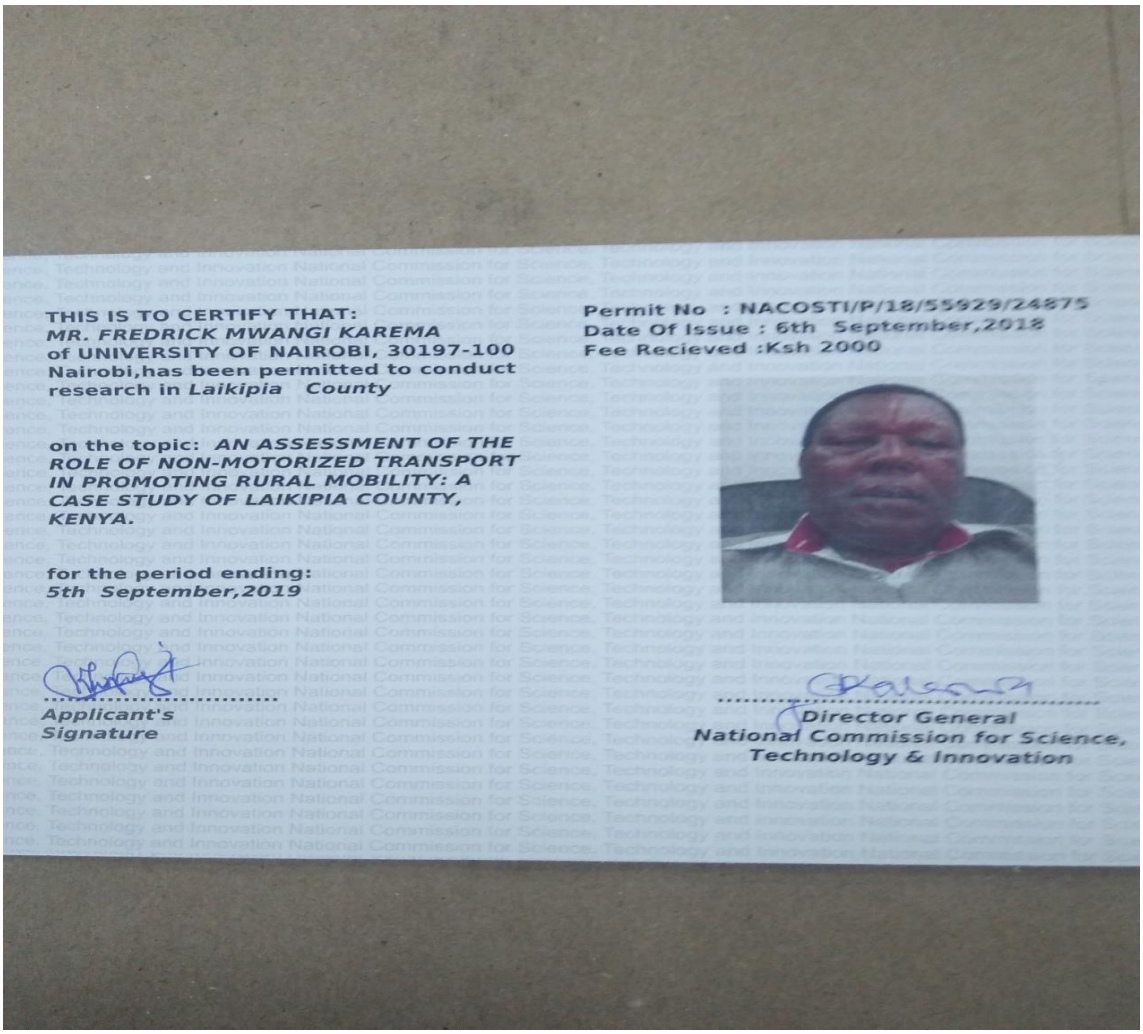
NACOSTI

National Commission for Science, Technology and Innovation

RESEARCH CLEARANCE PERMIT

Serial No.A 20406

CONDITIONS: see back page



THIS IS TO CERTIFY THAT:
MR. FREDRICK MWANGI KAREMA
of UNIVERSITY OF NAIROBI, 30197-100
Nairobi,has been permitted to conduct
research in *Laikipia County*

on the topic: *AN ASSESSMENT OF THE ROLE OF NON-MOTORIZED TRANSPORT IN PROMOTING RURAL MOBILITY: A CASE STUDY OF LAIKIPIA COUNTY, KENYA.*

for the period ending:
5th September,2019

.....
Applicant's Signature

Permit No : NACOSTI/P/18/55929/24875
Date Of Issue : 6th September,2018
Fee Recieved :Ksh 2000

.....
Director General
National Commission for Science, Technology & Innovation

APPENDIX XX: PLAGIARISM REPORT

APPENDIX XXI: DECLARATION OF ORIGINALITY