Role of Walking and Cycling in Promotion of Mobility in Kenya: A Case Study of Laikipia County

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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 hypothesis tested was: walking and cycling are independent of distance travelled in Laikipia County. A questionnaire survey was used to interview 384 respondents from the area of study. Data was analyzed using both descriptive and inferential statistics.Data was randomly selected from the individuals from 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. The strata in this case were 15administrative wards within which proportionate sampling were carried out.

The study revealed that; income and distance, age, marital status had a weak positive correlation of 0.205, 0.260 and 0.250 respectively. 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. This also implies that business location determines the distance travelled by the respondents in the County. The study also revealed that there was a significant positive correlation between education level and distance travelled in the 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.

Key findings were: (i) there was no statistical significance in the difference between both cycling and walking and promotion of mobility and in Laikipia County. The calculated value of $\chi 2$ was less than the critical $\chi 2$, the study concluded that, there was no enough evidence to reject the null hypothesis and therefore a conclusion was drawn that, promotion of mobility was independent of cycling and walking in Laikipia County; (ii) the study also found out that a correlation between the respondents' income and occupation had a significant correlation of 0.421. A conclusion was drawn that income and economic activities significantly determines the distance travelled in Laikipia County.

A multiple linear regression between walking and cycling showed a weak positive relationship which was denoted by $R^2 = 0.015$. This implies that the relationship between walking and cycling was independent of the distance travelled. The study recommended that: (a) Research on effect of car journeys' reduction be carried out in the county. (b) Interrogation of the non-motorized transport technologies adopted in Laikipia County should be done. (d) 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.

Keywords: NMT, Intermediate Modes, Mobility, Mobility indicators, Side walk

I. INTRODUCTION

In rural Africa, 90 per cent of transport is non-motorized with most journeys made on foot. A similar scenario exists in Asia and Latin America. While cities in developing countries have too much traffic, resulting in congestion, rural areas face the opposite problem: too little transport infrastructure and few affordable mobility options (Perschon, 2018). The lack of local public transport and poor access to markets can have fatal consequences: in remote areas of Africa (Karema, and Irandu, 2017 b). In South America and Asia, maternal and infant mortality rates have stabilized at a high level or, in some cases, are still rising, mainly due to difficulties in reaching medical facilities. The food supply in these regions is unstable and breaks downs when challenged by even minor droughts, poor harvests or flooding. Many rural communities also lack adequate access to education. In Africa, for example, children often have to walk for hours to reach their primary school and by the time they arrive, they are often too exhausted to learn. Studies show that distance to school is a determinant of learning achievement. Secondary schools are even more thinly dispersed in developing countries' rural regions and can only be accessed with great difficulty, often at great expense. In short, rural poverty reduction is directly dependent on people's ease of access to their own fields, a safe and reliable water supply, and markets, schools and health facilities. Conversely, the lack of efficient mobility structures dramatically worsens rural poverty (Perschon, 2018).

It should be realized that a good transport system does not only rely on road infrastructure but also the availability of suitable vehicles. These vehicles are expected to be at the right place and the right time, so as to serve the needs of the people or the purpose for which the road was constructed (Porter et al, 2012; 2013). One such alternative is the use of Non Motorized Means of Transport (NMT). Non motorized

means of transport refers to non engine vehicles such as walking, cycling, wheelchair, scooter and handcart use. They play unique role in the sense that they are efficient and also part of green transport system. They provide basic mobility, affordable transport, access to motorized modes, physical fitness and enjoyment (Litman, 2012).Social exclusion is closely linked with lack of mobility (Ohnmacht*et al*., 2009, Lucas, 2012). IMT includes all non motorized transport and small engine vehicles like motorcycles, three-wheelers which have higher goods carrying capacity that benefits the operators and the users. NMT facilitates intra-village and inter-village trip making in Africa.

Several studies have identified different types of NMTs which are suitable for Sub-Saharan Africa. These include wheelbarrows, hand-drawn carts, animal-drawn carts, bicycles, motorcycles and others (Starkey et al., 2002; Starkey, 2001). These same studies have indicated that despite the suitability of the NMTs identified above, the use of NMTs have been very low in most parts of Africa. Countries such as Ghana, Angola, Nigeria, Kenya and Zambia have attempted to adopt NMTs but have been faced with many challenges. According to Okoth (2005; and Gauthier & Hook(2005),the low patronage may be due to but not limited to, low economic activity, lack of expertise in design, high seasonality of cash flows and transport demands, inadequate supply of components among others. Most people in rural areas do not have the means to own a car and, therefore, mobility is synonymous with walking or non-motorised means of transport (NMT) or, better still, public transport. Available literature seems to indicate that NMT as a means of transport is often ignored even though it plays a critical role in the mobility of rural people. While providing access to markets, healthcare facilities and educational facilities, NMTs also provide employment to the operators of bicycle, handcarts, and wheelbarrows (Okoth, 2005).

According to Law (1999:570), security issues affect people differently. High cost of bicycles inhibits rural farmers in developing world to transport agricultural produce to the market. Farmers sell their produce at a throw-away price. Farmers end up paying high transport cost to cater for health care, and education (Karema, *et al.*, 2017a). This calls for an urgent need for affordable modes of transport to promote rural mobility. The main objective of this paper is to determine the extent to which availability of NMT has affected access to schools and market centers in Laikipia County. The hypothesis to be tested in this paper is that, there is no significant relationship between socio-economic factors and NMT usage 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.

Another interesting finding from distance decay model emerged. From the data the curve indicates that the distance walked in kilometers increases steeply for the first 5 kilometers and decreases much more gradually from 10kilometers onwards (Figure 1).
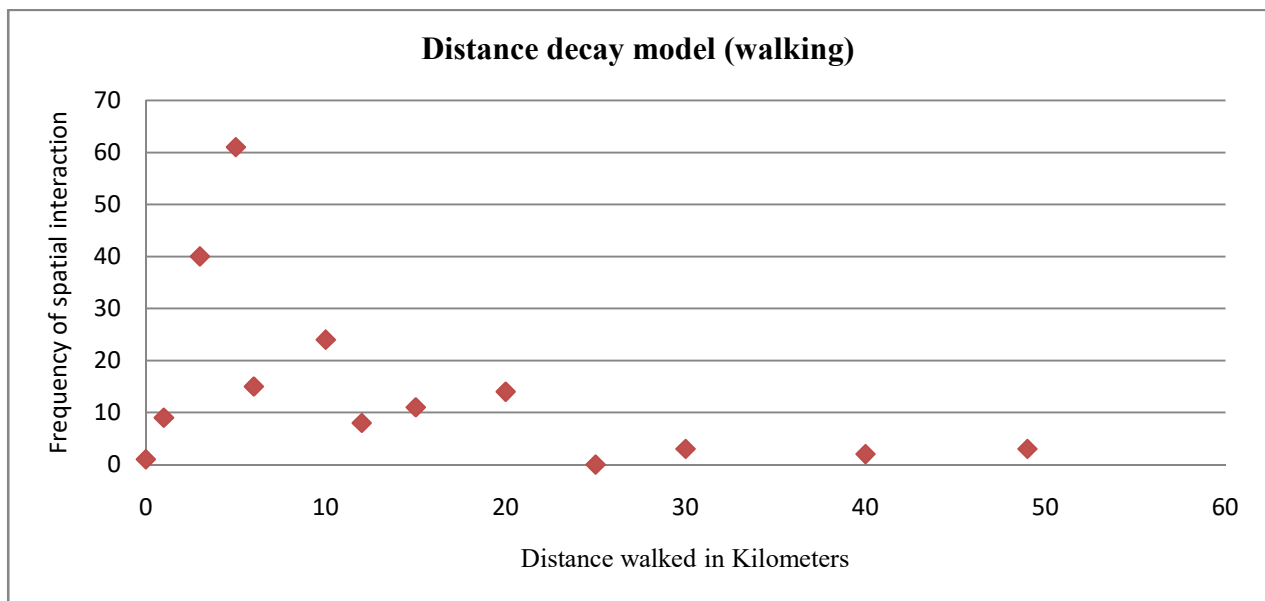
Source: Fieldwork (2018)

Figure 1: Distance Decay Curve for Walking Trips in Laikipia County

This is in tandem with the Distance decay concept which illustrates the effect of distance on cultural or spatial interactions which is grounded on the principle of the spatial interaction between two locations which reduces as the distance increases.

II. LITERATURE REVIEW

This section aims at establishing different approaches that have been used in previous Non-Motorized Transport studies; and, the key findings of the previous Non-Motorized Transport studies. The section also explores the gaps in literature and conceptualizes on the relationships between research variables.

According to World Bank report (2005), emphasis is not laid on Non-Motorized Transport or planned for in Sub-Saharan Africa. For example, improvement of roads and fresh constructions do not consider infrastructure like overpasses for non-motorized transport operators. Lisa (1996) argued out that sound policy options for several transportation problems are necessitated by inaccurate and irrelevant data. About 98 per cent of the people who use public transport in Scandinavian cities start their journey on foot or on bike.Consequently, cars and other motorized modes are favoured hence, disadvantaging the poor. Non Motorized Transport (NMT) users are exposed to fast, aggressive and at times careless motorized transport users resulting to high number of road crashes involving pedestrians or cyclists. According to National Transport and Safety Authority (NTSA), an estimated 3,000 deaths occur annually as a result of road crushes and 40% of these are pedestrians.

Theoretical and Conceptual Consideration

This study is an exploratory study aiming at seeking knowledge on usage of NMT. It is grounded on Positivist's theory - a philosophical theory stating that certain knowledge is based on natural phenomena and their properties and relations. Thus, information derived from sensory experience, interpreted through reason and logic, forms the exclusive source of all certain knowledge. Positivism values that valid knowledge is originated only in this *a posteriori* knowledge, i.e, linking to or derived by reasoning from practical facts.

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. 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. 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.

According to Ronis, *et. al.*, (1989) behaviour can be predicted by rational decisions or unreasoned influences. The theory of repeated behavior 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. 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.

## III. MATERIALS AND METHODS

Study Location

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 roam freely on the rangelands of Laikipia. It shares boundaries to the North with Samburu County, in the North East there is Isiolo County, in the East there is Meru County, in the South East is Nyeri County, in the South West there is Nyandarua County and Nakuru County while in the West there is Baringo County. It lies within latitudes 0° 18" and 0° 51" North and within longitude 36^0 11" and 37^0 24' East. It is the 15th largest county in Kenya and occupies an area of $9,462km^2$of land. It experiences an average of 400mm and 750mm annually. Its annual mean temperature ranges between 16^0C and 26^0C.

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 tertiary institutions - Laikipia University and Karatina University College - Nanyuki Campus. 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.
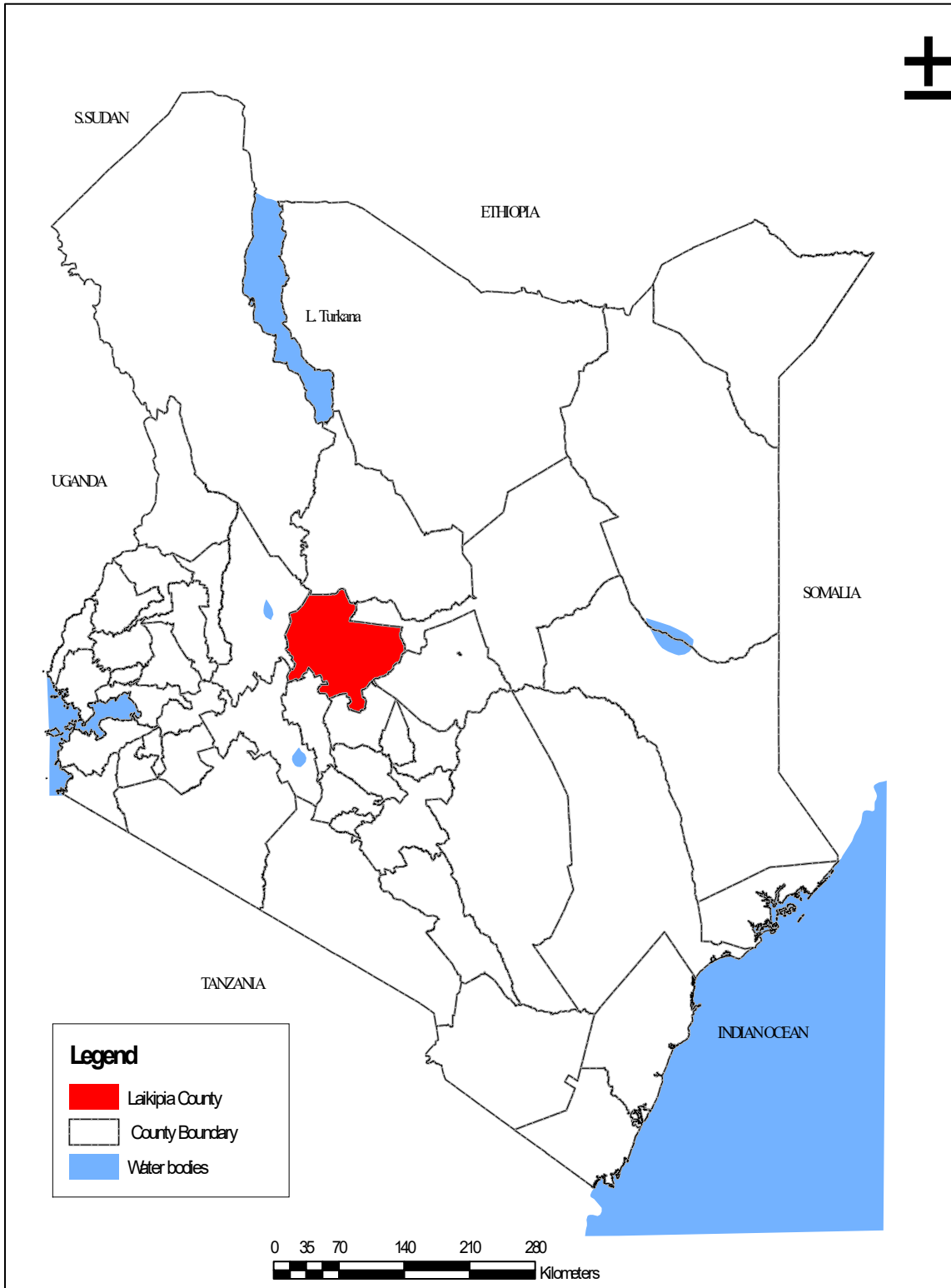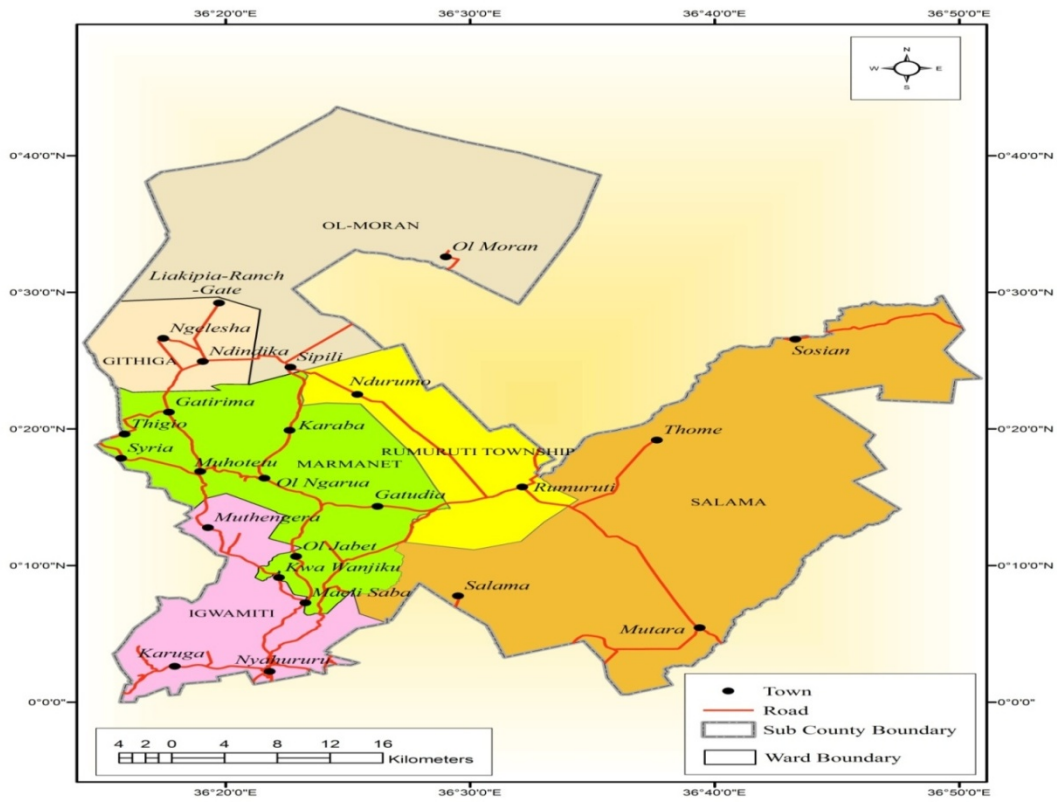
Source: Survey of Kenya 2011
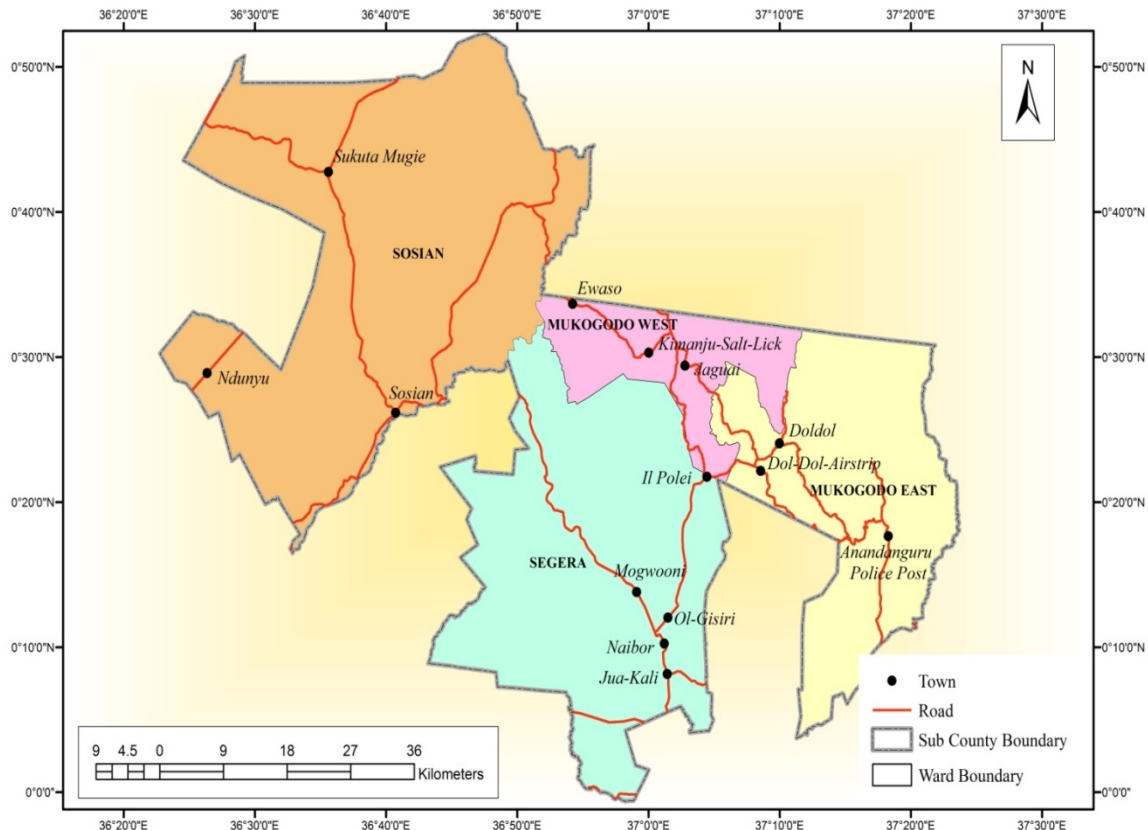
Figure 1: Map of Laikipia County in Kenyan Map
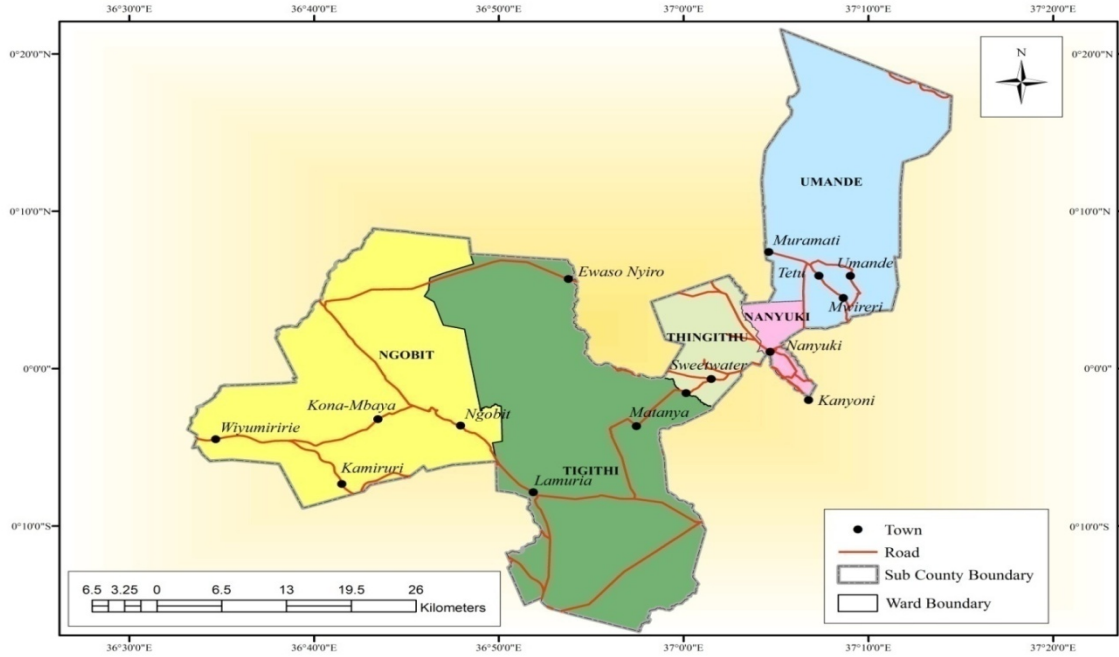
Source: Field work (2018)

Figure 2: Laikipia East Sub- County Road Network

Source: Field work (2018)

Figure 3: **Laikipia West Sub-County Road Network**

Source: Field work (2018)

Figure 4: Laikipia North Sub-County Road Network

Research Design

Slife and Williams (1995) identified two important components in research that is the philosophical assumptions as well as distinct methods or procedures. 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 was identified by (1) the introduction of the household as the unit of analysis rather than a focus on the region or the country, (2) the movement of rural people and their goods to meet their domestic, economic and social needs, by any means, along paths, tracks and roads (Dawson and Barwell, 1993).

Sampling

According to (Sudman, 1976), the best practice in sampling is to randomly select a large sample. Simple random sampling was done where individuals in the target population were given equal chance of being sampled. This involved random selection of the individuals from a complete list of the population. Stratified sampling was also carried out in the study. 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 population of the stakeholders was unknown. Therefore, the sample size was derived by computing the minimum sample size required for accuracy in estimating proportions 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 formula is:

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

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).

Data Collection Procedures

Data was randomly selected from the individuals from 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 questionnairesin 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 1.

Table 1: 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 Tigithi Thingithu Nanyuki Umande	23,978 27,062 20,836 28,485 16,201	26 30 23 31 18	
	Total	116,562	128	128
Laikipia West Sub-county	Igwamiti Marmanet Githiga Salama Rumuruti-Township Ol-Moran	66,466 42,422 27,958 23,824 21,265 17,556	51 33 22 18 16 14	
	Total	199,491	154	154
Laikipia North Sub-County	Sosian Mukogondo West Segera Mukogondo East	25,848 23,362 15,911 13,702	33 30 21 18	
	Total	78,823	102	102
	Total sample size			**384**

Source: Kenya Population and Housing Census (2009)

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.

Data Analysis

Table 2: Contingency Table 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)

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

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

Since there was no sufficient evidence to reject the null hypothesis, a conclusion was drawn on the basis of correlation coefficient r = 0.0003, that walking and cycling are independent of distance travelled in Laikipia County.

IV. RESULTS AND DISCUSSION

Characteristics of Walking Commuters in Laikipia County

The age of respondents was classified into 8 age categories and a bar chart was drawn using Excel programme for visual comparison (Figure 5).

Source: Fieldwork (2018)

Figure 5: Frequency of Age Category of Walking Commuters

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.

The study found out that several purposes were achieved through walking. Such purposeincludes access to physical exercise which cut across the age categories (Table 3).

Table 3: Distribution of walking trips frequency 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)

Walking trips by purpose 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. Majority of respondents felt that walking enabled them to exercise which is associated with important health benefits for healthy and vulnerable or diseased populations.

Marital Status of bicycle operators in Laikipia County

The research found out that 45 percent of the respondents were single and had a frequency of 44.9 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 those who were unmarried in terms of provision for 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.
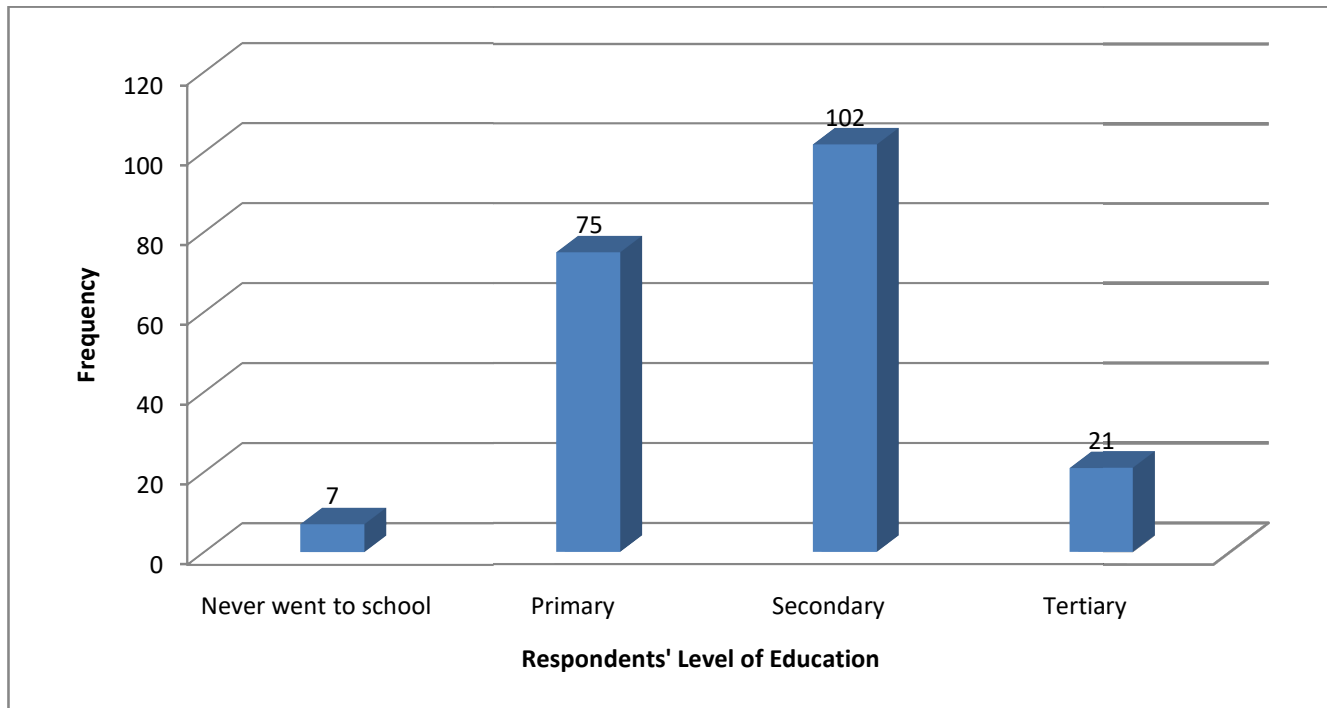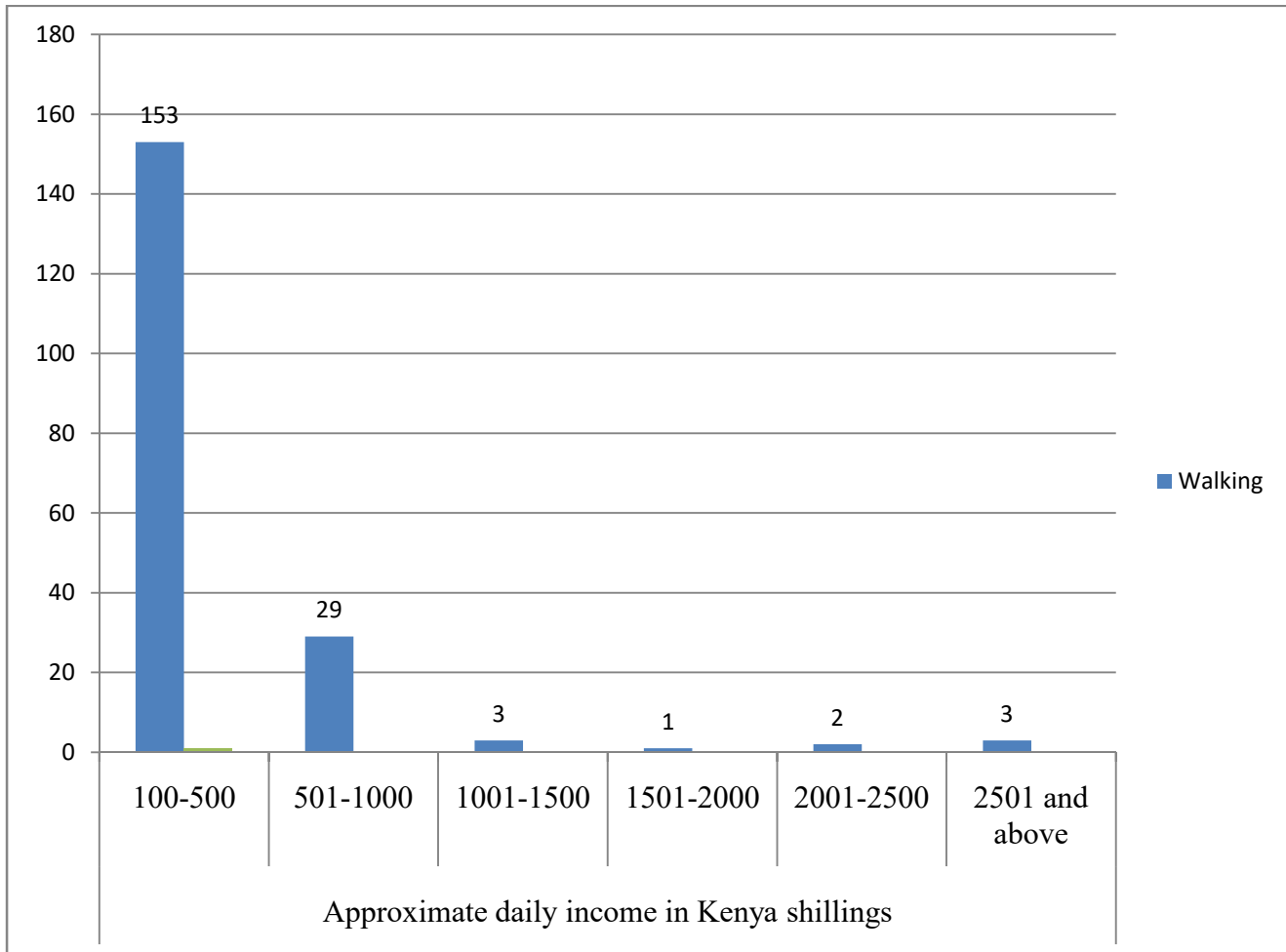

Source: Fieldwork (2018)

Figure 6: Respondents' Level of Education

This implies 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 up to 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.

Approximate Daily Income of the Respondents in Laikipia County

Majority of the walking commuters in Laikipia County are poor. The bar graph (Figure 4) suggests that respondents' approximate daily income were in the range of Kshs.100-500 and had a percentage of 79.
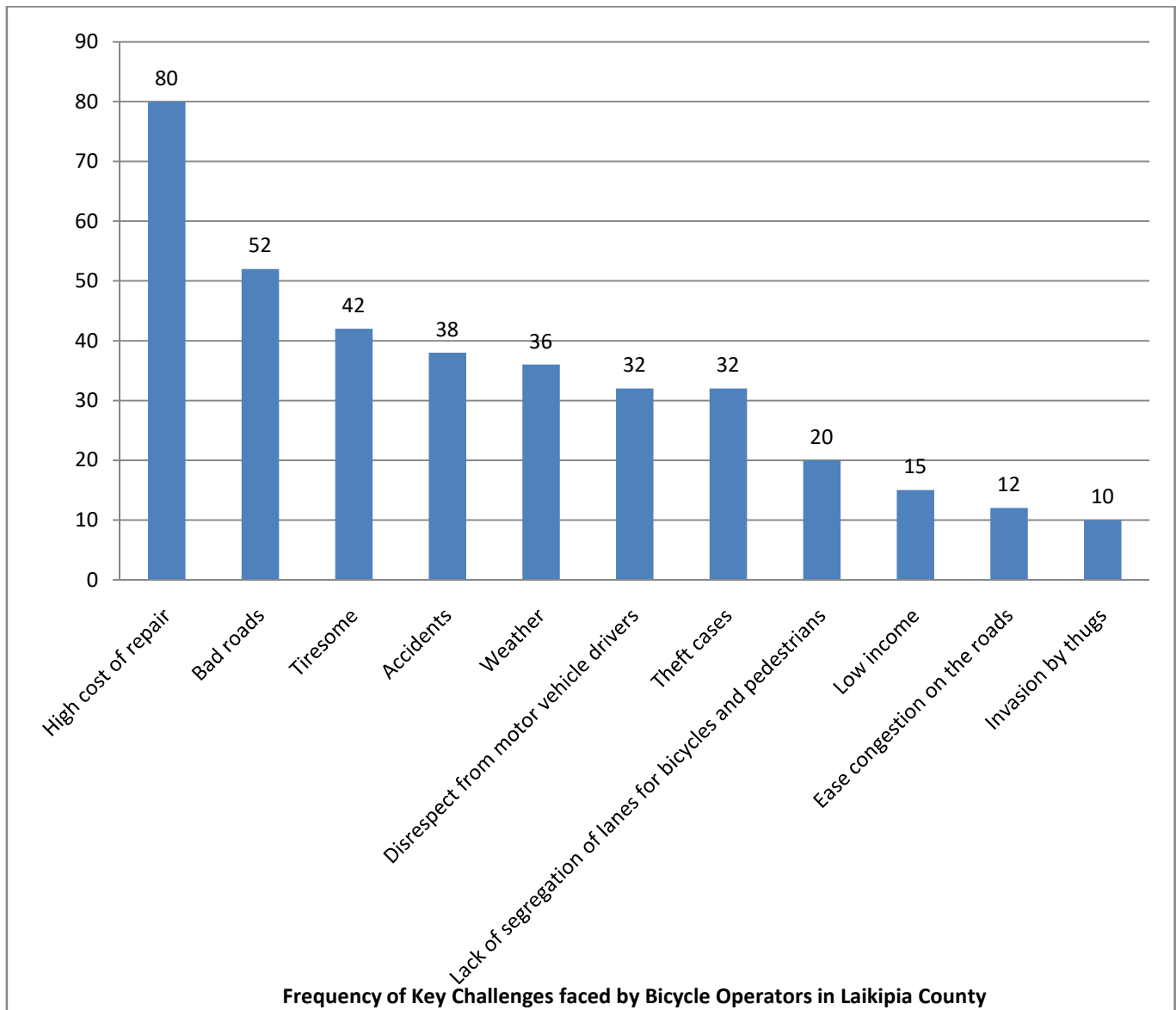

Source: Fieldwork (2018)

Figure 7: Frequency of income and use of walking as NMT mode in Laikipia County.

Walking commuters who earned Kshs.501-1000 had a percentage of 15.6. The study found out that majority of walking commuters were self employed or employed in the informal sector where earnings were low and unsustainable.

The study found out that bicycle operators in Laikipia County were faced by numerous problems (Figure 8). 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 8: Frequency of Key Challenges faced by Bicycle Operators in Laikipia County

However, literature review indicate that economic activity, lack of expertise in design, high seasonality of cashflows and transport demands, inadequate supply of components constitute some of the challenges affecting the adoption of IMTs in most developing countries (Starkey, 2001; Okoth, 2005; Gauthier & Hook, 2005).

Gender disparities and biases manifest themselves in a number of ways in Kenya. They occurmainly in control and limited access to resources by women. Women's partial access and ownership to factors of production such as land, jobs and credit facilities is quite limiting. Laws and policies tend to follow deep rooted cultural practices which restrict women from full access to empowerment. This contributes to

women's discrimination and dependency on their husbands (Rahman, 1999).Some of the gender roles allocated to women and girls include fetching water and firewood, going to grinding mills and taking care of vulnerable groups especially school going children, the weak and old. This explicit allocation of gender roles has been changed by introduction of non motorized transport modes in Laikipia County. For example, bicycles are used by men to transport children to school, fetching firewood, going to market centers and taking ambulance role in Laikipia County. Access to agricultural fields and to market centers was a night mare before introduction of NMTs in the county. Presently, access to schools, clinics and markets has been simplified by use of non motorized transport in Laikipia County (Table 4).

Table 4: 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 and firewood	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)

V. CONCLUSION AND POLICY RECOMMENDATIONS

The study recommended that reduction of prices for bicycle spare-parts was a key solution of overcoming bicycle operators' challenges mentioned by respondents in Laikipia County which accounted for 18.2 percent. 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 prompted the need for further research on factors other than those considered in the study area. Segregation of lanes for cyclists and pedestrians was floated as solution to bicycle operators' challenges by respondents as a second alternative and had 16.4 percent.Murraming of weather roadswas ranked as a third solution of overcoming bicycle operators' challenges with a percentage of 15.6.

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. However, 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.

Avoid-Shift-Improve strategy is considered by the international community as a measure of NMT conditions improvement. However, Avoid-Shift-Improve (A-S-I) strategy may succeed only if transport users' behavior is factored in transport policy and also in the implementation stage. The truthofthe matter is that no thought is put to the forms of mobility negative impacts. Cars are regarded as a status symbol in today's society. In this connection a lot of effort is required to convince people on usage of sustainable forms of mobility as an alternativeto the motor vehicles.The research paper concludes that small and medium loads transportation is impacted positively byNMTs.Human beings find it difficult and cumbersome to carry such loads and equally expensive to transport such loads by other means of transport.

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