UNIVERSITY OF NAIROBI

"PROVISION OF APPROPRIATE RURAL TRANSPORT SYSTEM: A CASE OF NYABIOSI SUB-LOCATION IN RIGOMA DIVISION OF NYAMIRA DISTRICT, KENYA"

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DECLARATION

I hereby declare that this thesis is my original work and to the best of my knowledge has not been presented for a degree in any university

Signed _____ 6/8/2006

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This thesis has been submitted for examination with my knowledge as the university supervisor

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DEDICATION

This thesis is dedicated to my wife Janes and son Jared for their love, patience and understanding during the trying times of my studies. Surely, no amount of regards can be commensurate to your support. God bless you.

ABSTRACT

Many third world countries (Kenya included) have historically devoted a fair share of their development budgets on expansion of rural road networks as the prime means of enhancing accessibility and personal mobility of the rural dwellers. The rationale for transport infrastructure was, and continues to be, predicated on the concept of vehicular traffic. However, this has not necessarily translated to tangible benefits, as the roads in themselves have not accommodated the full diversity of demand for transport by the rural households that in most instances is not related to either a road, or the use of a motorised vehicle.

This inadequacy has ensured that majority of rural inhabitants remain captives to a walking and head/back carrying mode of travel and moving goods. Transport activities continue to take up an inordinate amount of time and effort of the rural residents as they try to access activity centres. This negates rural poverty eradication efforts as households can only move from subsistence to higher levels of production and earnings if first they are able to meet basic needs by ideally spending less time and effort. Thus there is need to direct public investments to appropriate transport interventions that would reduce the unproductive time and effort spent by households on transport.

This research recognizes that rural transport is directly related to rural access problems, and it impacts negatively rural socio-economic development. However, lack of perception of local-level transport problems by policy makers has resulted to unresponsive rural transport systems. This research set out three objectives: to (i) establish the nature of the transport system in Nyabiosi Sub-Location, (ii) establish the nature and extent of access and mobility needs of the households in the study area, and (iii) propose appropriate interventions to increase accessibility and mobility capacity of the households in the study area and in other rural areas in Kenya with similar set ups.

The study took the household as the generator of rural travel and transport patterns. It also considered rural transport as the movement of rural people and their goods to meet their domestic, economic and social needs, by any means, along any conceivable infrastructure (including undesignated roads, tracks, trails and paths). Rather than analyzing the needs of transport system from the point of view of a particular function to be performed, the study focussed on the transport needs of individual households.

Questionnaires were used to capture the travel patterns of the households. To explore the local travel situation in a context beyond everyday needs of the household, data on transport services and infrastructural needs were obtained by holding interviews with public transport providers and users. Secondary data were obtained through literature review.

An analysis of field data revealed that: vehicle ownership levels are very low; the village infrastructure is in poor condition, there are no local-level transport services, available public transport services are unaffordable to most households; although women are the main transporters, they make little use of low-cost vehicles due to factors ranging from cultural constraints to lack of financial capacity to own any form of IMT; a major proportion of household transport time (62.6%) and effort (77.8%) is spent on accomplishing subsistence activities - collecting water, fetching firewood and travelling to grinding mill; and water collection is the single most important transport activity consuming 52.5% and 59.1% of total transport time and effort respectively. These findings support the study hypothesis that transport for subsistence activities consume considerable household time and effort and therefore jeopardises its ability to engage in more productive activities.

The transport constraints established in the study cut across various sectors and are relevant to a range of key development issues. They extend the subject outside the transport sector to encompass broader rural planning issues and argue the case for an integrated approach to rural transport planning. Accordingly, in addition to development of the rural road network, the study recommends other interventions involving three key elements:

(i) Improvement of local-level infrastructure such as paths, tracks, and water crossings to facilitate travel on foot and or use of low-cost means of transport.

(ii) Provision of adequate and affordable rural transport services, and promotion and use of intermediate means of transport

(iii)Siting of services closer to the communities, thereby obviating the need for lengthy travel.

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LIST OF ACRONYMS

CBS	Central Bureau of Statistics
CDF	Constituency Development Fund
DDC	District Development Committee
DFRD	District Focus for Rural Development
GDP	Gross Domestic Product
GoK	Government of Kenya
HH	Household
IFAD	International Fund for Agricultural Development
ILO	International Labour Organization
IMT	Intermediate Means of Transport
IRR	Internal Rate of Return
KIPPRA	Kenya Institute for Public Policy Research and Analysis
KCC	New Kenya Cooperative Creameries
KRB	Kenya Roads Board
KMDP	Kenya Market Development Programme
KTDA	Kenya Tea Development Agency
MoRPW	Ministry of Roads & Public Works
MRP	Minor Roads Programme
NMT	Non-Motorised Transport
RARP	Rural Access Roads Programme
RTI	Rural Transport Infrastructure
RTS	Rural Transport Services
SOC	Social Overhead Capital
SPRP	Special Purpose Roads Programme
SSA	Sub Saharan Africa
SSTP	Sub Saharan Transport Programme
UN	United Nations
WB	World Bank
WMS	Welfare Monitoring Survey

CHAPTER ONE

INTRODUCTION

1.1 Background to Problem Statement

The crucial role of transport in stimulating growth is universally acknowledged. The rural-urban linkages and the pull effects of urban growth centres have long been recognized to be essentially dependent on transport linkages. Empirically, there is a strong correlation between modern transport and higher levels of income, with causation operating in both directions. A cross-country comparison done by Owen (1987), relating the levels of passenger and freight to per capita income demonstrated that the level of mobility in a country reflected its wealth. Drawing from von Thunen's experiences in the Mecklenburg region in Germany, Misra (1972) observes that transport improvements facilitate the diffusion of agricultural technology by reducing the cost of moving agricultural products to market and thereby encouraging cultivation.

Although poverty is increasing in urban areas, it remains predominantly a rural phenomenon in many developing countries. According to World Bank (1996), about 70% of the population in the African region, are resident in the rural areas with rural poverty significantly higher than urban poverty. In his seminar paper entitled '*Rural Poverty Unperceived*'; Chambers (1980) identified isolation as one of the core dimensions of poverty. Kasuku (2003) observes that deficiencies in accessibility [a by-word for isolation] cause high production costs, low profits, problems in networking, and difficulties in access to social services. It is on this background that many development specialists and planners in developing countries have considered improvement of rural transport as an entry point in poverty alleviation.

Rural Africa walks and carries its burden – goods, possessions, produce, crafts and other items. Household surveys done in the early and mid 1990s indicate that 87% of trips take place on foot with women bearing more than 65% of the household transport burden (Malmberg, 1994). The relatively dispersed population and few facilities that are far between, difficult terrains and more dramatic weather conditions causes the rural dwellers to spend considerable amount of time in trying to reach basic socioeconomic service centres. This is time and effort spent unproductively since transport is a derived

demand. It is merely a means to an end - the ultimate aim is to obtain access to a specific basic service or facility. This scenario makes the time budget of the rural inhabitants who are mainly involved in labour intensive production activities quite constrained (Howe, 1996). Thus reducing the time spent on transport would increase the time available for other economic and social activities of benefit to the rural household.

The rural transport network in the SSA consisting of more than 2 million kilometres of undesignated paths, trails and tracks serves over 70% of the population in their daily productive activities and chores (Gaviria, 1991). The network supports the generation of a third of the region's GDP coming from agriculture and 40% of its export revenues (Malmberg, 1997). In spite of the enormous economic and social significance of rural tracks, trails and paths have historically been omitted from national consideration of transport infrastructure because they are often considered as separate, unidentifiable network, which is outside national interests in transportation (Beenhakker et. al, 1987). Even as concern for the rural poor has increased, many governments have attempted to improve rural transportation mainly through increasing conventional roads for motorized traffic.

In pursuit of Kenya's post-independence objective of achieving balanced rural development, the government has since 1970s, implemented a number of transport programmes aimed at enhancing rural accessibility and mobility. These interventions include the Rural Access Roads Programme, Minor Roads Programme and Roads 2000 Programme. All rural transport interventions have been principally defined in terms of roads. The track/trail/path segment of the infrastructure, which is critical in facilitating rural mobility, has seldom been acknowledged. A fuel levy fund that was established in 1993 to arrest the rapid deterioration of the transport network (including rural access roads) is not only inadequate but also ignores the track/trail/path segment of the infrastructure.

Consequently, rural poverty in the country continues to be exacerbated by inaccessibility to those social and economic services necessary to the well being of the population. The rural transport problem manifests itself in a variety of ways. Rural Kenya has a less than 1% level ownership of personal motorization (Howe, 1995). A 1990 study in 12 locations in Kajiado District, showed that in 7 of them, no household owned a car,

whereas in the other locations, the number of cars did not exceed five (Njenga, 1996). In the year 1994/5, relief food distribution effort to some drought stricken rural areas was hampered by the inability of the motorized transport to go beyond the district headquarters.

The low ownership of motor vehicles combined with the poor condition of the rural transport infrastructure makes the use of motor vehicles in rural areas very limited. According to Gaviria (1991), non-motorized transport users dominate the traffic on most Kenyan rural access roads with up to 92% of the traffic consisting of pedestrians. Rural dwellers remain wedded to a unimodal system of transport – walking and if they are to get anywhere beyond their walking radius, they depend most entirely on public transportation (Riverson et al., 1991).

Although a high level of motorization is desirable for many economic activities, expanding and improving road networks would not necessarily meet the unique access and mobility demands of rural Kenya. This is because of the inflexibility and inappropriateness of the motorised vehicle services to many rural transport tasks. A study by Howe et al (1979) on small farm transport needs and constraints revealed that due to insufficient loads, time taken in loading and unloading and the long waiting time in the market makes a whole-hire pick-up *"matatu"* transport probably the most expensive form of transport. Majority of rural transport activities involve short and repetitive household trips to farm work on small plots, water collection, moving food and cash crops to the market and agricultural inputs from local trading centers, trips to grinding mills, collection of firewood, etc. In most instances, these transport tasks take place off-road along narrow footpaths, trails and tracks.

1.2 Problem Statement

Poverty has been steadily increasing in Kenya despite efforts made by the government to address the problem. Kenya is currently categorised the twentieth poorest country in the world by the United Nations Capital Development Fund. The UN agency indicates that as of the year 2006, about 47% of Kenya's rural population and 29% of the urban population live under conditions of absolute poverty. A World Bank poverty assessment report observed that two thirds of Kenya's poor live in the high-and medium potential

agricultural areas in central and western regions of the country (World Bank, 1995). In Nyanza province, the percentage of people living below absolute poverty line has rapidly increased over the last decade. The overall poverty level in the province has risen from 42% (second lowest in the country) in 1994, to 63% in 1997 and 64.6% in 2006 - highest in the country (RoK, 1997; 2006). The province's Nyamira, Kisumu and Homa Bay Districts have consistently been registering the highest percentage of people living in absolute poverty in the province (RoK, 2002).

Currently, the absolute poverty level in Nyamira District stand at 66.74% up from 63% in 1997 and its ranked number 38 out of 46 nationally with its contribution to national poverty standing at 2.25%. This is despite the high agricultural potential of the district. According to the Farm Management Handbook, 82% of the area is in the lower midland agro ecological zone suitable for daily farming, while the remaining 18% falls in upper midland zone suitable for tea farming (Raetzoid & Schmidt, 1983).

Various development plans for the district have attributed the high poverty levels to the *'inadequacy of the area's road infrastructure'*. To alleviate poverty in the area, the plans have prioritised the improvement and expansion of the road infrastructure. A number of issues emerge:

(i) The development plans have recognized the transport problem in general terms but the scale and nature of the problem has not been established. Whilst the government is well aware that a major problem exists in the area's transport system, there seems to be lack of adequate data on the actual nature and volume of transport workload of the people and how that workload might feasibly be reduced.

(ii) The development plans focus narrowly on rural roads rather than approaching rural transport as a whole. The problem is limited to mobility instead of the wider concept of accessibility. The plans focus only on the needs of agriculture, marketing and long distance motorized personal travel while ignoring the primary reasons of travel in rural areas.

Research findings by Howe (1996) indicate that most transport activities in rural areas are for subsistence purpose, and are mainly carried on foot along off-road transport infrastructure. Therefore this focus does not recognise the diversity of demand for rural

transport. Dawson and Barwell (1993) and Howe (1996), observe that rural transport problem should be seen in terms of the scale and nature of the transport task rather than the inadequacy of the transport system *per se*. They further note that rather than analysing the needs of the transport system from the point of view of a particular function to be performed, the focus should be on the transport needs of communities and of individual households within them.

The plans do not acknowledge the existence of transport unrelated to roads and motor vehicles. The transport problem is identified with what Johnston (1990) describes as a *'fixed mind-set'* – whereby only 'the narrow, technical option of all-weather roads and motor vehicles is seen as the only feasible way of improving transport in rural areas'. He notes that although rural transport problems have their solutions in transport interventions, using cheaper non-transport interventions such as the appropriate sitting of services can solve many of these problems. Moreover, depending on the specific physical, cultural and socio-economic characteristics, rural access needs vary from region to region and hence useful solutions cannot be generalized (Owen, 1964).

While there is need to have better rural road network, this has to be complemented by other measures to ensure effective functioning of the entire transport network. According to Beenhakker et al. (1987), for the rural poor, transport problems begin at the homestead and frequently end at the local market place, which may well be the terminus of the conventional road network. Therefore full utilisation of a rural road network will only be realized by considering what happens beyond the road network in terms of tracks, trails, and paths feeding it.

The purpose of the study was to establish the scale and nature of the transport problems facing residents of the study area with a view of proposing appropriate transport and non-transport interventions to address their needs. The study examined the transport conditions and problems from the perspective of rural people rather than the modern transport system by paying attention to transport activities taking place remote from the motorable road system. It sought to establish the nature of household transport needs and the physical and other constraints within which these are being satisfied.

The research was motivated by the fact that despite the government's initiatives to address the transport needs of rural dwellers, poor accessibility continues to be a major obstacle towards sustainable rural development, and poverty alleviation. Although, more than two thirds of the poor reside in the rural areas, their unique transport needs are rarely considered in the formulation of rural transport interventions.

1.3 Research Questions

(i) What is the nature of the transport system in Nyabiosi Sub-location?

(ii) What is the nature and extent of transport needs of the households of the study area?

(iii) What are the appropriate interventions necessary to promote accessibility for households in the study area and in other rural areas with a similar set ups in Kenya?

1.4 Research Objectives

(i) To establish the nature of the transport system in Nyabiosi Sub-location.

(ii) To establish the nature and extent of access and mobility needs of the households in the study area.

(iii) To propose appropriate interventions to promote accessibility of households in the study area and in other rural areas with a similar set ups in Kenya.

1.5 Research Hypothesis

- Inadequate transport system for subsistence activities is a constraint on household productive capacity.

1.6 Study Assumptions

- The household is the generator of rural travel patterns and therefore by focussing on the household could identify transport needs of the rural population.

1.7 Study Area

1.7.1 Regional Location

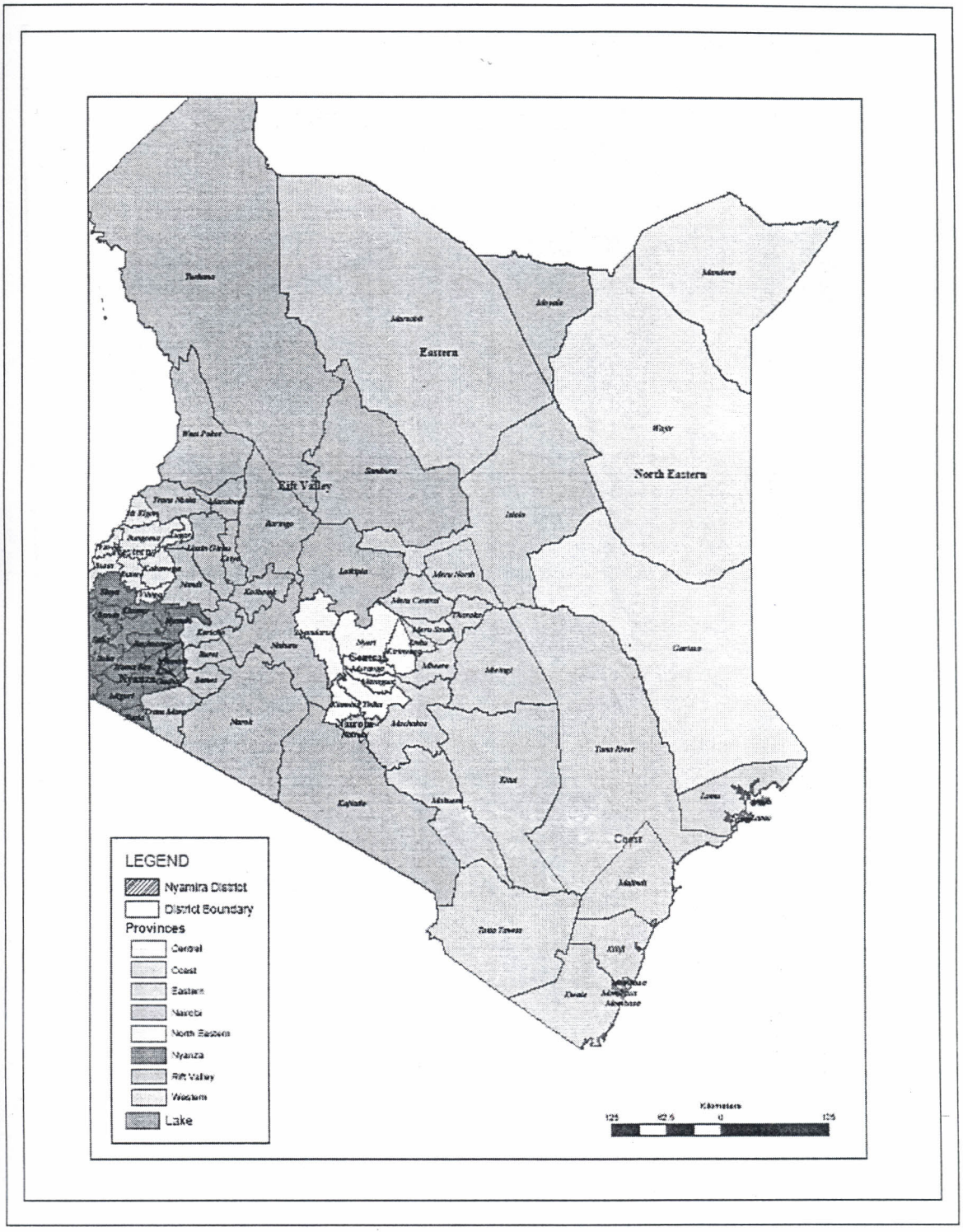
Nyamira District is situated in Nyanza province and it lies between latitudes 0° 30' and 0° 45' south and longitudes 34° 45' and 35° 00' east – covering an area of approximately 896.4km^2. It borders Transmara District to the south, Buret District to the East, Bomet District to the southeast, Kisii Central District to the West and Rachuonyo District to the

North (see Map 1-1 and Map 1-2). Five divisions namely; Nyamira, Ekerenyo, Borabu, Manga and Rigoma form the District.

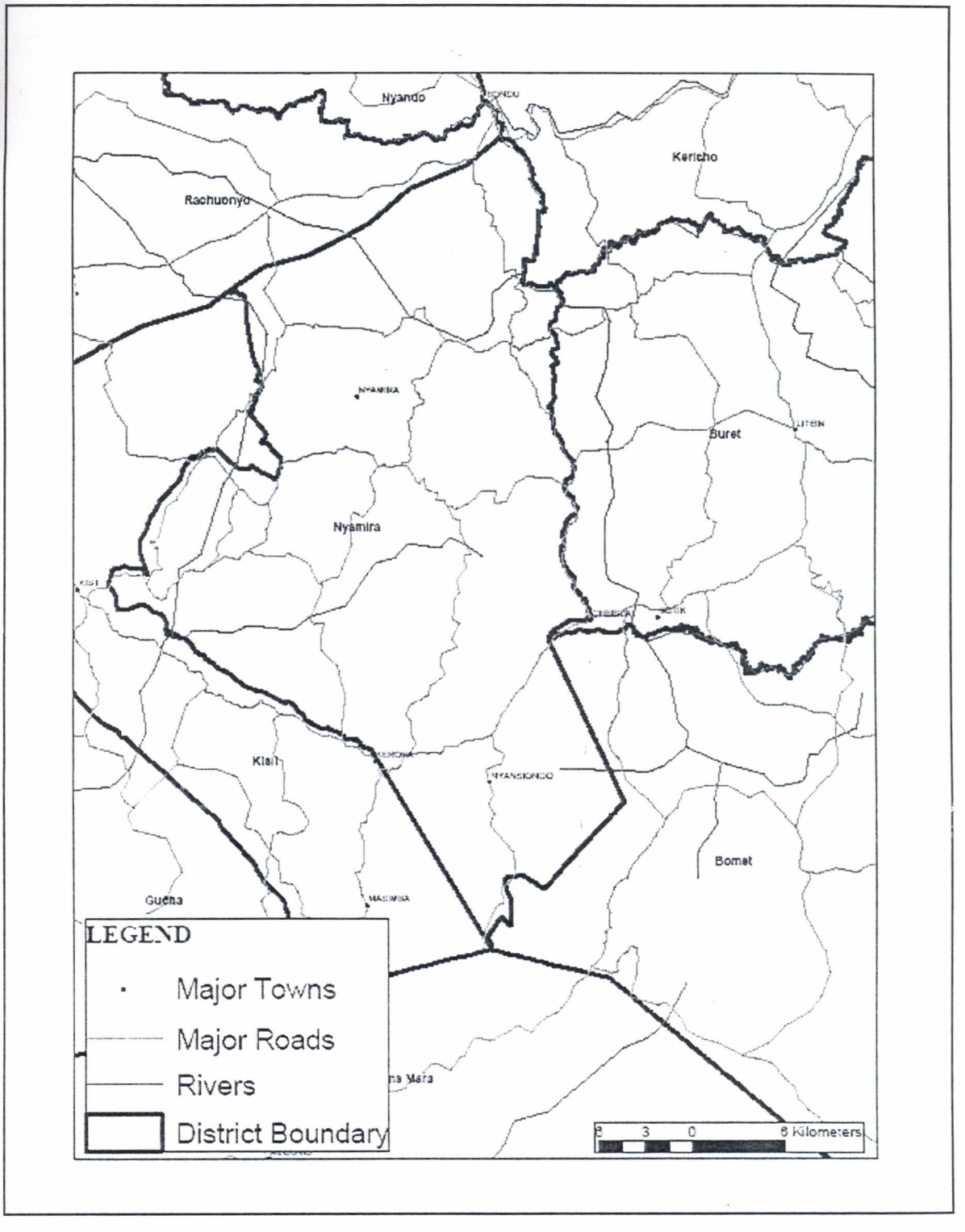
1.7.2 Location of the Study Area

The case study area is Nyabiosi Sub-Location, which is one of the twelve sub-locations forming Rigoma Division of Nyamira District (see Map 1-3). The sub-location is the largest in the division covering an area of 16.1km^2. Six villages namely; Mwabosire, Mwamokia, Mwomurwa, Bonyamondo, Bogetario, and Botana constitute the sub-location.

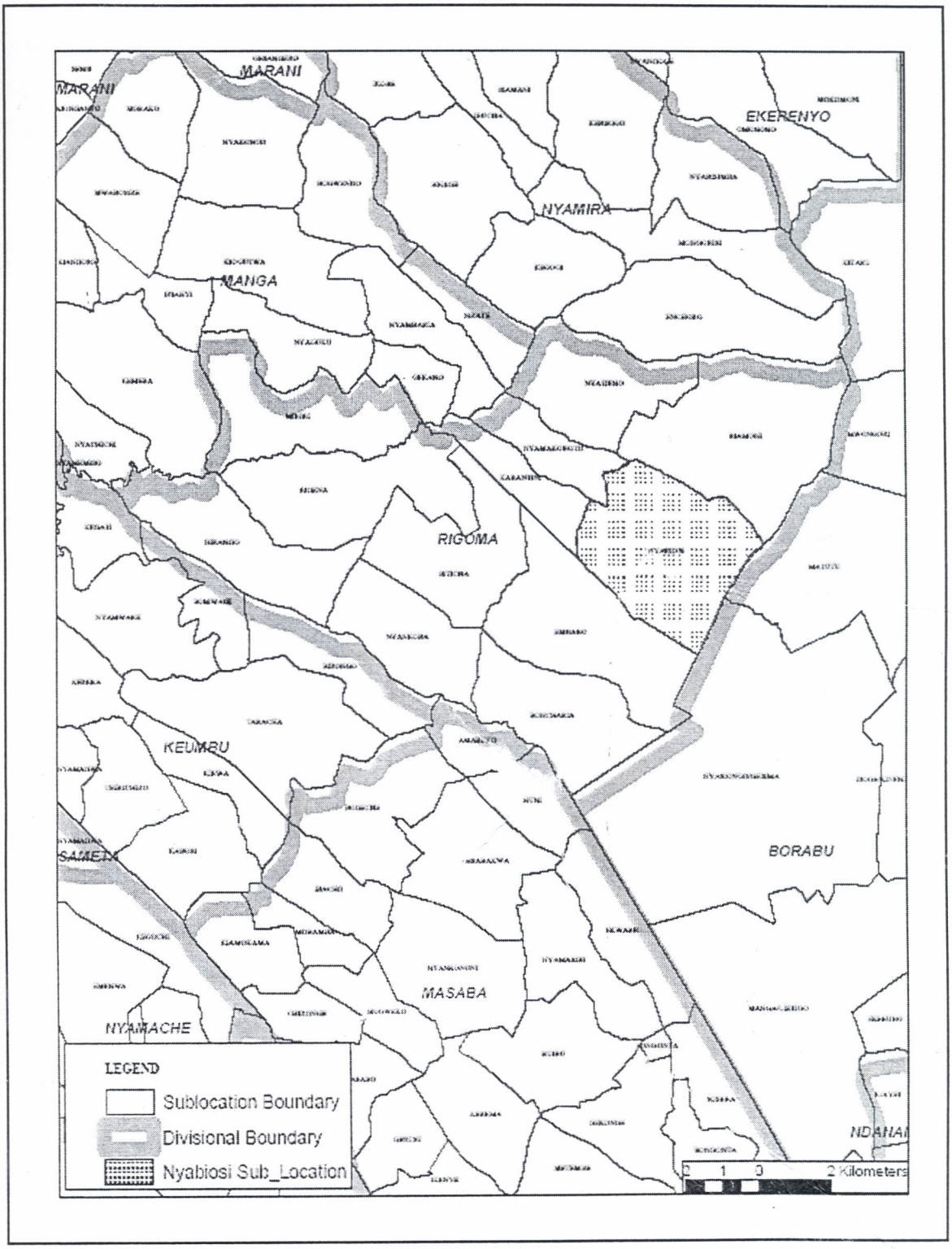
Map 1-1: Nyamira District in the National Context



Map 1-2: Nyamira District in the Regional Context



Map 1-3: Nyabiosi Sub-Location in Rigoma Division



1.8 Limitations of the Study

Due to inadequate time and financial resources, only a sample of households in the study area was selected for interviewing. The measurement of rural incomes, time spent in gaining access to various facilities and services posed many problems. A number of people were reluctant to reveal the full extent of their household characteristics because of socio-cultural beliefs. To overcome this problem the data were obtained indirectly from questions about indicators of income and levels of expenditure.

The research also encountered some other methodological problems particularly regarding the precision of information requested:

(i) Some respondents found it difficult to estimate distance travelled. To overcome this problem, the question was posed, "how long to get there" since it is easier to estimate. This time was then converted to distance of travel.

(ii) The amount of grain taken to the grinding mill was given in local measure, *omotoriro*. This was then converted to kg as part of the coding process.

(iii) It was difficult for people to estimate volume of water and firewood carried. To overcome this problem, the respondents were asked only about the number of trips made. For water, the amount carried each trip was estimated from the type of container used. For firewood, a simple survey was done to determine typical bundle weights.

Due to the nature of any village-level interview surveys, and the need to make certain assumptions in analyzing the data, there is inevitably a margin of error in the figures presented. Thus the figures cannot be regarded as precise quantitative data, but rather as indicating the magnitude and significance of transport in daily life, and the characteristics and relative importance of different transport activities.

1.9 Significance of the Study

The national goal of meaningful reduction in poverty is more relevant and urgent in the rural areas where about 80% of the Kenyan population resides. According to the Poverty Reduction Strategy Paper for the period 2001–2004, three quarters of Kenya's poor live in rural areas. Compared to their urban counterparts, rural people with a much lower average income, have vastly inferior access to basic social services and the economic

mainstream. The segment of the nation's population that most critically needs basic socio-economic services is the same segment that tends to have the least physical access to these services. Since the rural poor form a large segment of the disadvantaged in they need appropriate transport interventions to strengthen the social efforts aimed at reducing the gap between them and the rest of the population.

As earlier observed most trips made in rural areas are in and around the community, a way from the conventional road network and are mainly for accomplishment of subsistence tasks. According to Edmonds (1998), these are the trips that drain time and energy resources of the rural households. The fact that so much time is spent in gaining access to basic needs means that there is little time left for other productive activities. For rural households to be able to move from subsistence to higher levels of production and earnings, they must first be able to meet their basic needs, and ideally by spending less time and effort in doing so. Understanding the nature and extent of local-level travel demand characteristics of a population is a prerequisite to formulation of appropriate interventions to improve access to rural activities and facilities.

Despite the mounting evidence of the enormous rural transport burden, Kenya is yet to articulate an explicit rural transport policy that looks at more than roads. NMT and IMT are often the "forgotten modes" in transportation planning - especially in rural areas. The lack of a comprehensive planning system means that the government addresses many of the basic access needs of rural households only peripherally. The findings of this study can feed into the process of formulating a rural transport policy for the country.

Many roads serving rural areas are either not classified or fall in the lower categories. The pragmatic necessity to maintain road hierarchies means that the infrastructural needs of remote poor communities are unlikely to be a priority for many years. Furthermore, the small clusters of poor users and or the low population densities are especially problematic since they cannot support either the cost of infrastructure or conventional transport services. In such circumstances, simple mobility enhancements that do not need expensive infrastructure facilities may be a more practical proposition for enhancing livelihoods. This study has come up with proposals that besides conventional road system will address the mobility and accessibility needs of the people in the study area.

1.10 Research Methodology

This section provides an insight into the types and sources of data used in the study, and the data collection procedures employed to obtain the data. It also articulates how the data was analysed and presented in light of the set research objectives and hypothesis.

1.10.1 Types and Sources of Data

To achieve the research objectives both primary and secondary data were collected. Primary data were collected at local level through household and key informant interviews, and by holding impromptu interviews with public transport users at the terminus. More primary data was collected through field observations and photography. Secondary data was obtained by reviewing existing literature in libraries and government offices.

1.10.2 Methods of Data Collection

This section describes the data collection methods that were employed to obtain both the required primary and secondary data for the study.

1.10.2.1 Household Questionnaires

Taking the household unit as the generator of rural travel patterns, household surveys were conducted to establish the rural transport demands and constraints. The household questionnaires were used to capture baseline data about the socio-economic characteristics of the household, the access needs, travel patterns (specifically their magnitudes, frequency, duration, purpose, gender differentiation and the modes used), loads moved, and infrastructure needs, and prioritized possible interventions for improvement.

Since the household questionnaire was primarily concerned with understanding travel patterns of the household, it concentrated more on those aspects of the household which are relevant to its travel patterns – size, age structure, land holding, ownership of transport, and sources of income and level of wealth. The questionnaire was only concerned with travel patterns of household members who are regularly present in the household. It did not for example; capture travel information on children who are away at boarding schools for prolonged periods and for short-term visitors, as these were

considered as being of minor significance in the overall transport characteristic of the household. The base data about the composition and economic characteristics of the household characteristics was kept to the minimum required.

To make the questionnaire easy for villagers to respond to, some data required was obtained indirectly. For example, since many people find it difficult to estimate distance, it was found necessary to ask "how long to get there" since time is easier to estimate. Data on household incomes was obtained indirectly from questions about indicators of income and levels of expenditure. Some of the data obtained therefore required interpretation, or conversion to different units, to compile information on travel information on travel patterns. Since its women who are usually responsible for many transport activities, the questionnaires were whenever possible completed through interviews with one senior male and female members of the household responsible for the farm. The questionnaire was designed so that the answers were easy to codify for data compilation and analysis.

Unlike key informant interviews, the household interviews have the advantage of eliminating the possibility of social biases intruding into the resulting data set. Furthermore the substitution of public for private information collection may severely limit the degree of representativeness of the informants. However, administering the household questionnaires proved to be very expensive in terms of the time and financial resources required.

1.10.2.1.1 Sample and Sampling Frame

This study took the household as the generator of rural travel patterns and therefore a fundamental unit of analysis. Consequently the sampling frame comprised of households in Nyabiosi sub-location. The total number of households in the study area constituted the universe. A 1999 Population and Housing Census Survey indicate that there were 1433 households in the sub-location. It would have been appropriate to interview all the households in the study area but due to limited resources only a sample of households was picked for interviewing. Initially the study intended to use the Registry Index Map (RIM) in picking the sample. However, on obtaining the map it was found that it did not

reflect the actual situation on the ground in terms of distribution of households. This is due to

(i) Rapid land subdivision as a result of population pressure. According to the Gusii customs, once the son gets married, the father is supposed to allocate land to him to start his own household.

(ii) Most of the residents (particularly the young generation) do not register their lands due to the costs and bureaucracy involved. Moreover, due to population pressure many of the land parcels are below the minimum size, which can be registered as agricultural land.

To overcome this difficult, the researcher used the local records of households available with the village leaders. A total of 54 households were picked through simple random sampling procedures from all the six villages making up the sub-location. The sample size picked from each village was proportional to the number of households in the village (see Table 1-1).

Table 1-1: Size & Distribution of Sample Households

Village	Number of Households	Size of Sample
Mwabosire	287	9
Mwomokia	253	8
Mwomurua	345	12
Bonyamondo	217	8
Bogetario	198	7
Botana	327	10
Total	**1627**	**54**

Citing Roscoe, Sekaran (2003) notes that sample sizes larger than 30 and less than 500 are appropriate for most research and therefore a sample size of 54 can be considered as adequate for this particular research. Simple random sampling procedures were used to pick the households for interviewing. The method was preferred in order to pick information on the variations in travel characteristics and transport problems of different types of household (in terms of size, age structure, wealth, access to means of transport, etc.).

1.10.2.2 Key Informant Interview

Still at local level, a key informant interview with the chairman of the association of owners of the public service vehicles operating on the main arterial route traversing through the study area was held. The purpose of this interview was to explore the local travel and travel situation in a context beyond the everyday needs of the household. Information about the nature of operation of the passenger transport services offered in the area (types, numbers, routes, frequencies, fares and infrastructure needs) was also obtained from this interview. The key informant interview was less labour intensive and the analysis less time consuming.

1.10.2.3 Impromptu Interviews

Interviews and discussions with public transport users, taxi and public transport operators at end points were used to collect data regarding their opinion on the affordability of the services, vehicle operation costs and regularity of the services. The purpose of these interviews was to assess the potentials and limitations facing the provision of transport services in the area.

1.10.2.4 Field Observations & Photography

Field observations and photography were used to capture data on the type and quality of transport infrastructure, the modes of transport used, economic activities and some of the facilities available in the area.

1.10.2.5 Survey of Existing Literature

Secondary data was obtained by reviewing existing literature. These include government records and past research work on transportation planning and management. Data on the general economic, geographic and demographic information of the area was obtained from Poverty Reduction Strategy Papers, Census Reports and other documents in public domain.

1.10.3 Data Analysis

Data from the field was systematically analysed qualitatively and quantitatively to throw light on the research questions and objectives. The data from the questionnaire were cleaned, coded, entered into the SPSS software and checked for data entry errors.

Descriptive statistical analyses were carried. The socio-economic characteristics were defined in terms of demography, economic conditions, agricultural patterns and transport characteristics. The household movements quantified in terms basic transport parameters such as trips; load carried, time spent travelling and distance travelled to various facilities such as supplies of water, firewood, health clinics, grain grinding mills and markets.

Using the methodological approach adopted by Intermediate Technology (IT) Transport consultants of UK in collaboration with International Labour Organization (ILO) for rural transport analysis in Makete region of Tanzania in 1986, the basic parameters (outlined above) were accumulated to define household travel patterns, on per annum basis, in terms of: time spent in hours per annum; and load carrying effort in tonne-km per annum. Each of these aspects of travel patterns was analysed in terms of allocation to different trip purposes.

Tonne-km refers to the total transport effort expended per household per year. Tonne-km is the standard method of expressing the magnitude of any load carrying transport activity. 1tonne-km is the transport effort involved in the movement of 1 tonne load over distance of 1km. Thus if a transport activity involving the movement of a 25kg load over a distance 5km is repeated 100 times during a year, the total transport effort is calculated as: LCE = 25 X 5 X100/1000 = 12.5tonne-km.

The following formulae were adopted in calculating the household time and load carrying effort spent on transport:

(i) Load carrying effort

LCE = LM × DIST × TRP

Where,

LCE = Load Carrying Effort per annum

LM = Load moved (expressed in tonnes)

DIST = Distance the load is moved (expressed in kilometres)

TRP = Number of trips per annum

(ii) Time Spent on Activity *X* per annum

TTS = TT × TRP × 2

Where,

TTS = Total Time travelling to and from facility/service *X* per annum

TT = Time for a one-way journey to facility/service *X*

TRP = Number of trips made to facility/service *X* per annum

Since it was difficult for most respondents to state the distance travelled, the time travelled was used to establish the distance as follows:

(iii) **DT = Travel Time × SPD**

Where,

DT = Distance travelled

Travel Time is expressed in hours

SPD = Speed of travel, assumed to be 4km per hour for walking and 10 km per hour for cycling

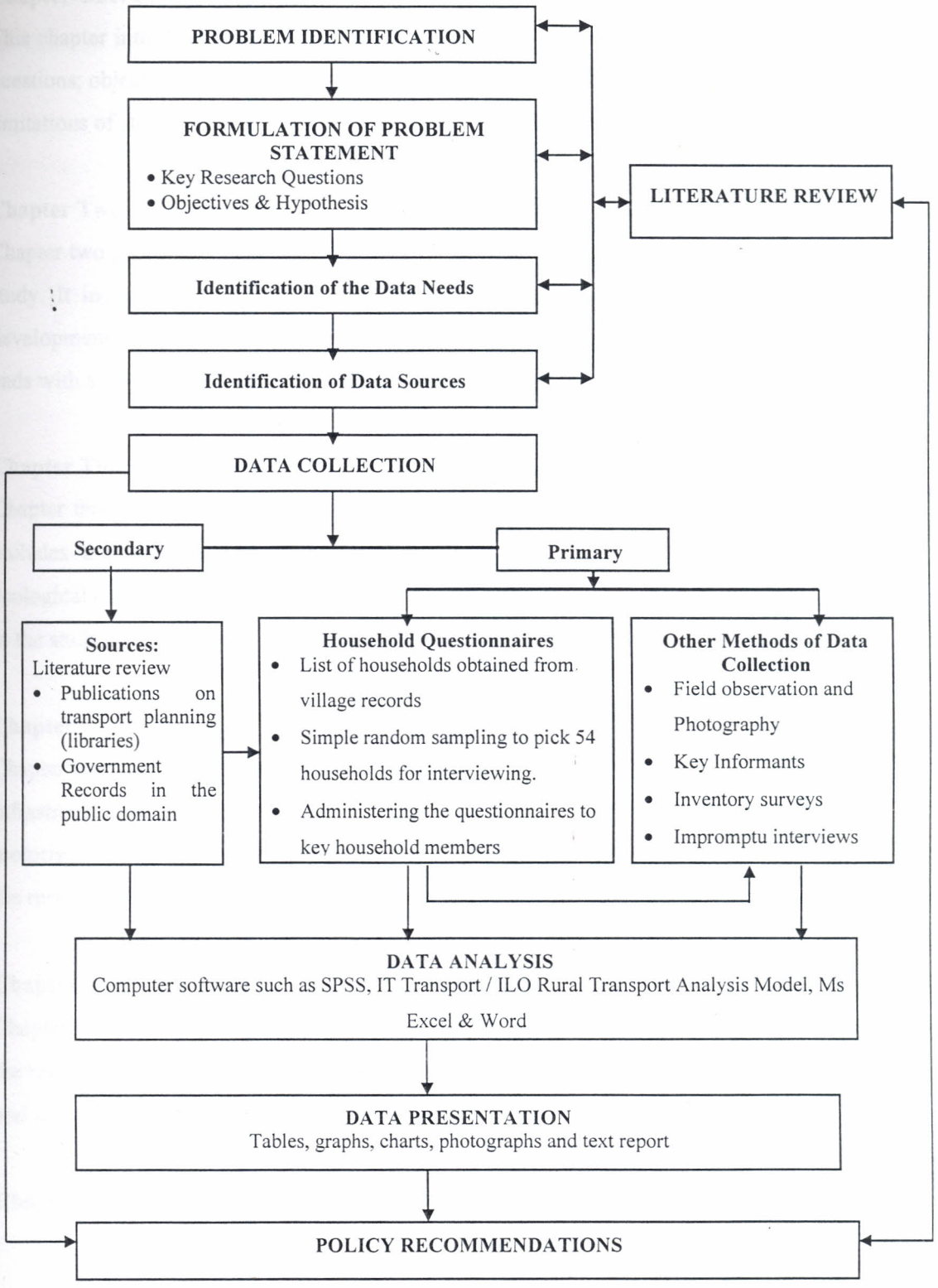
The results of the survey were presented as tables, charts and in text format. Other data were analysed using other computer software such as Excel and Access. Computerised analysis was preferred because it is faster, more accurate and easier to extract useful information from the data.

The results of these analyses indicated the scale and nature of the transport burden facing the rural households in the study area. The analysis also provided an understanding of the share of the different tasks in the total household transport time and effort. These formed the basis of identifying and recommending a number of areas of intervention which could usefully be explored, to complement the development of rural road networks with a view to reducing the scale of the transport burden which currently imposes so heavily on the time and energy of the rural poor.

Table 1-2: Summary of Methodology

Type of Data	Source	Method of Data Collection	Method of Analysis	Presentation
Population characteristics Age, HH size, Sex, cultural attitudes	Primary sources: Local records, Household surveys Secondary sources: Census reports, Govt publications	Household questionnaires Literature review	Descriptive Quantitative	Pie charts, tables and text
Economic Base Income, expenditure, agricultural patterns; production, marketing	Primary sources: Household surveys field observations	Observations, household questionnaire, photography	Descriptive Quantitative	Text and photographs
Physical Base: Physical location, Terrain, soils, rainfall, drainage	Primary sources Field observation Secondary sources: Meteorological records, govt bluebooks, Kenya Atlas	Photography, Field survey, Literature review,	Descriptive	Maps, bar charts, text, line graphs
Transportation System:				
Infrastructure: type, condition, , water crossing, drainage system	Primary sources Field observation Secondary sources: Relevant Govt ministries	Photography, Field Observations	Descriptive Quantitative	Text, photographs
Transport services: modes of transport, cost, reliability, safety, capacity	Primary sources Household questionnaire Key Informants	Household questionnaires, Photography	Descriptive Quantitative	Text, photographs
Support system: institutions, regulations transport association, cartels	Primary sources Key informant Secondary sources: Existing Literature	Key informant interviews, Literature review	Descriptive	Text, Photographs
Land Uses: Settlement patterns, land ownership, location of facilities; Household Travel Patterns	Primary sources Household questionnaire	Household questionnaires	Descriptive, Quantitative- IT Transport consultants & ILO approach	Text, Tables, bar and pie charts, Photographs

Figure 1-1: Summary of the Research Process



1.11 Organization of the Report

Chapter One: Introduction

This chapter introduces the study by articulating the statement of the problem; research questions; objectives; hypothesis, study assumptions, justification of the study, scope and limitations of study, research methodology and definition of operational terminologies.

Chapter Two: Literature Review

Chapter two provides a review of the relevant literature, which provides guidance to the study. It includes a review of the historical role of transportation in the process of development and rural transport interventions in Kenya since independence. The chapter ends with a conceptual framework, which forms the basis of the research methodology.

Chapter Three: Study Area

Chapter three provides the physical and demographic analysis of the study area. These includes the location, physical characteristics (topography, climate, drainage, agro-ecological classification), economic base i.e. production systems and demographic trends in the study area.

Chapter Four: Transport System in Nyabiosi Sub-Location

Chapter four focuses on the transportation system in the study area. This will include the infrastructure networks, transport services (modes of transport: motorized and non motorised transport); and finally the support system (management and organisation of the rural transport system).

Chapter Five: Transport Needs at Household Level

Chapter five elaborates the nature and extent of on farm and off farm transport needs of the residents of the study area (access to services and goods, markets, human settlements and linkages to service centres).

Chapter Six: Summary of Major Findings, Conclusions and Recommendations

1.12 Definition of Operational Terms and Concepts

For the purpose of this study, the following terms and concepts would be defined as follows:

(i) Rural Transport

Bryceson and Howe (1992) define rural transport as the movement of people and goods in rural areas for any conceivable purpose (including collection of water or firewood), by any conceivable means (including walking and head loading) a long any conceivable infrastructure (including unproclaimed roads, tracks and footpaths). This implies that a wide variety of mode choices and trip purpose has to be considered during rural transport planning and service delivery.

(ii) Mobility Vs Accessibility

Barwell (1992) observes that mobility is a reflection of the ease or difficulty with which people move themselves and their goods. It is a measure of the opportunity cost of transportation of people and their goods. Mobility is dependent on the availability and quality of transport infrastructure, means of transportation and their level of efficiency. Mobility is increased by improvements in the transport system that allows people to travel more quickly, and to carry their goods with less effort.

Accessibility on the hand refers to the ease or difficulty with which land-use activities can be reached. The level of physical accessibility depends on the level of mobility and proximity (the sitting and quality of facilities). Sitting of facilities relates to the location (distance, route and travel time) of places for dwelling, economic, medical, recreational and similar other activities. According to Falcocchio et al. (1974), accessibility improvement is generally the central goal of transportation improvement. Thus the provision of mobility and accessibility are the main outputs of a transport system.

(iii) Farm Transport and Off-Farm Transport

Barwell et al, (1985) and Carapetis et al, (1994) state that on-farm transport comprises movements related to domestic needs, such as water and firewood collection, smallholder cultivation, grazing of animals and transport of farm inputs and outputs between house and fields.

Off-farm transport, on the other hand, comprises of trips to the market to visits friends or to reach certain social amenities, e.g. schools and health clinics. Off-farm transport often relates to the conventional perception of transport because at least some of it takes place on recognisable road, and sometimes with motorized vehicles.

(iv) Poverty

Poverty can be defined as inability to meet basic minimum requirements of life. It is the lack of access to basic needs including food, shelter, education, health services and movement or travel for essential purposes. Improved accessibility to goods, facilities and services involves a three-pronged action concerning their affordability, availability and reachability. Affordability is basically a question of prices and cost (a question of production and distribution technology). Availability involves the location of goods and services. Reachability is largely a question of mobility. It is a matter of the state of transport development. Transport, therefore, enables one to reach goods that are not located in his/her immediate environs.

In Kenya, absolute poverty refers to the minimum amount of money, necessary to afford an adult equivalent their basic minimum food and non-food requirements (GoK, 1998). The absolute poverty line was estimated in 1997 by the Welfare Monitoring Survey (WMS) to be Kshs. 1,239 per adult equivalent per month in rural areas and Kshs. 2,648 for urban areas.

(v) Household

According to RoK (2003), a household is a person or a group of persons who normally reside in the same compound and stay under one roof or several roofs have a common source of food or income and have one person who is acknowledged by all as head.

CHAPTER TWO

LITERATURE REVIEW & CONCEPTUAL FRAMEWORK

2.1 Introduction

Although the role of transport in development has occupied researchers for over four decades, there is still hardly a consensus. Howe (1996) observes that while the role of transport as a key element in the development process is widely acknowledged, there is a great deal of misconception regarding the form in which transport should be provided. Edmonds (1998) points out three key questions, which have remained contentious: to whom? by whom? and to what extent should it be integrated into the development process? This section looks at the historical development of the theory surrounding the role of transport and development to understand why there is confusion.

2.2 Role of Transport in Economic and Social Development - Theory and Practice

Citing Lord Lugard's study on the British mandate in Tropical Africa, Dawson and Barwell (1993) notes that the attitude of transport researchers to transport has evolved from simple conclusion by the former that the prospects of development can be summed up in one word – *"transport"* to the present customary phrase that *"transport is necessary but not sufficient for the development process"*.

Lord Lugard's view was upheld until the 1950s and 1960s when Hirschmann, Owen and Wilson made the first theoretical and empirical assessments of the role of transport in development. Hirschmann (1958) saw transport as a facilitator or a promoter and not an initiator in the process of economic growth. He noted that changes in the productive sector lead to changes in another and that transport is often the means by which such changes take place. He asserted that investment in transport infrastructure, just like any other type of social overhead capital (SOC), was costly and unpredictable. An advocate of development by shortage, he suggested that the most effective way of promoting economic growth is through investing directly in productive activities, which in turn could lead to increase in SOC when it is clear that such investments are necessary.

On his part Owen (1964), observed that contrary to what had earlier been assumed, transport might have not played a catalytic role in development. This observation was

later confirmed by Wilson (1965), who after assessing the social and economic impacts of the massive investments in transport that were taking place in many developing countries, concluded that the "role of transport investment in economic growth is not unique".

2.2.1 The Shift to Rural Development

In the years that followed, the focus of development financing shifted a way from the primary infrastructure towards rural development more generally, including rural transport (the latter being seen synonymously as rural roads). In the 1970s and 1980s, integrated rural development became the key thrust of international assistance. According to Dawson and Barwell (1993) and Howe (1996), this shift was based on the premise that most people lived in rural areas and there was a general belief that rural areas represented a vast, largely untapped potential for generating agricultural surplus and foreign exchange. It was also due to the fact that many developing countries had already put in place the basic skeleton of transport infrastructure (Njenga, 1996).

Rural development came to be seen as a key issue in tackling poverty and the major international development assistance agencies adapted their policies accordingly. This was reflected in the emergence of a new approach in the focus of World Bank lending after the 1970 Conference in Nairobi, the launching of the '*Planning for Basic Needs*' by ILO in 1976 and the creation of the International Fund for Agricultural Development (IFAD) in the late 1977. All this signified a common concern that the focus on rural development and rural poor was to be a guiding principle for development planners and financiers (Edmonds, 1998).

As the development discussion became wider, the key concern shifted from aggregate growth in per capita income to human development. This was as a result of the realization that the people were indeed, and still are living barely at subsistence level (UN-Habitat, 1985). The UN agency observes that even internationally agreed basic needs were and are not being met and therefore it was no longer sensible to discuss 'economic development' in terms of output income and other 'hard' economic indicators when people had no food, no water supply, limited health services and pitiful poor education.

Despite the shift in focus, road transport was still seen as unique and a prime mover of rural development in developing countries. This was evident from the primacy transport investments commanded. The WB lending for transport investments doubled between 1977 and 1984 with the per cent of roads financed from the bank rising from 38% in 1966 to over 93% in 1977 (Riverson et al., 1990). Interventions were carried out by the public sector under the assumption that improved infrastructure would stimulate activities in the private sector, resulting in improved transport services, increased production, distribution and consumption. The scepticism of Hirschmann, Owen and Wilson regarding the catalytic role of transport in development process and more particularly Wilson's central conclusion that transport infrastructure was permissive and responsive, not causal, was largely ignored (Howe, 1996).

2.2.2 The Emergence of a New Rural Transport Planning Paradigm

In the beginning of the 1980s, it became increasingly apparent that the conventional approach to rural transport did not correspond to the actual transport needs of the majority of rural population. A debate emerged over the socioeconomic impact of the traditional rural transport model on local communities, particularly the poor. Many researchers doubted the effectiveness of motorized transport in accommodating the full diversity of demand for transport in the rural areas where a great majority of rural dwellers continued to make little or no use of motorized vehicles (Carapetis et al, 1984). This followed the mounting evidence that indicated that major investment programmes in rural roads had not achieved the hoped – for increases in either agricultural production or more generally in the living standards of the rural population (Howe & Richards, 1984; Dawson and Barwell., 1993). The studies indicated that the primary beneficiaries of road investments were only the richer of the poor, thus underlining the urgent need to address the imbalance by simultaneous investment in other sectors.

This may have resulted, partly, from what Chambers (1980), had earlier described as "lack of time or inclination amongst governments and even international development assistance agency staff to go to the off-road areas where the really poor people live". This situation, he argued, resulted in the rural transport system being viewed and analysed – almost entirely from the perception of outsiders. Conventional data collection method for rural transport analysis depended heavily on interviews with road users,

effectively ignoring transport unrelated to roads and motor vehicles (Kaira, 1983; Barwell et al., 1985). The existing transport planning framework remained tilted towards roads and motorized vehicles. Very few, if any studies had been done to assess the actual nature and volume of the transport workload of most people, or how that workload might be feasibly reduced (Howe, 1996).

In the mid 1980s a series of studies were carried out under the ILO programme in several countries in Africa and Asia to transform the way in which rural transport was seen and to effectively link provision of transport and other rural infrastructure into a single framework. The studies showed a rather different picture than one that was being hypothesised by transport planners. The illuminating studies, which took the household, as the generator of travel patterns, were concerned not with transport demand as seen from the outside but with transport need as seen by household members. These field studies revealed that:

(i) Transport in the rural areas is generally carried out on foot;
(ii) Most journeys involve carrying small loads over short distances;
(iii) The majority of journeys are for purposes which do not involve buying or selling anything;
(iv) Vehicle ownership of any sort is very low;
(v) The transport burden falls disproportionately on women;
(vi) The majority of journeys are to meet basic needs such as water, fuel wood and food; and
(vii) The amount of time and effort spent by households is considerable amounting to several hours and kg-km per day.

These results showed that if transport was to contribute more effectively to rural development, it would have to move a way from the view that the transport needs would solely be dictated by market forces (Howe, 1996; Edmonds, 1998). The results also indicated to the policy makers on the urgent need to redefine the concept of rural transport in order to selectively address the actual needs of the rural population. These findings led to the emergence of a new approach of identifying the transport needs at the local level. The new approach incorporates a wider range of interventions such as paths and tracks, low cost means of transport and transport services. The new paradigm presupposes that the best way to approach the rural transport problem is by starting

identifying the problem at grass-root level and then building the needs into the planning framework.

2.3 Kenya's Rural Transport Initiatives since Independence

The specific objective of Kenya's regional development policies is to promote rural development. To achieve a balanced rural development, the government of Kenya has initiated a number of programmes aimed at improving transport and communication in the rural areas (Wasike, 2001). At independence, the pattern of road infrastructure development was mainly guided by the general rationale that it would stimulate growth in productive activities such as in industry and agriculture. This belief was been conditioned by a number of historical factors; foremost among these was the need to facilitate and speed up the journey of primary products to export markets. Additional functions of an improved road network were seen as the movement of food to growing urban centres, and the establishment of a nationwide system of judicial and administrative services.

The mid 1970s marked the beginning of a shift in investment resources from arterial roads to secondary and feeder roads. In part, this was largely a reflection of the view that the basic skeleton of transport network was already in place. In addition it was in response to the increased priority being attached to small scale agriculture production, and opening up of rural trading activities. Within this overall thrust, the government has implemented a number of programmes, among them the colonial Special Purpose Roads Programme, the post independence Rural Access Roads Programme, Minor Roads Programme and the Roads 2000 Programme.

2.3.1 Special Purpose Roads Programme

The Special Purpose Roads Programme (SPRP) was started towards the close of colonization in Kenya in response to Swynnerton Plan of 1954, which was a blue print for modernising agriculture in the African Reserves. The plan recognized infrastructure investment as an important ingredient in promoting rural and agricultural development.

Under this programme, the central government had an overall responsibility of constructing roads in all areas of the country while district councils were charged with

the responsibility of developing rural roads using cess deductions from the sale of agricultural commodities. Some agricultural marketing boards such as the KTDA (now an agency) had the mandate of developing roads in small-scale tea growing areas. For the convenience of the public and the farming community, the cess was levied at only a single stage of sale and collected by the development of excise and taxation on behalf of the MoTC (Kasuku, 2003).

Overall, the SPRP involved the construction and or improvement of those roads that served specific development objectives. These roads included agricultural access roads to areas that produced cash crops such as wheat, tea, sugar, rice and coffee; roads to regions for tourism and fisheries; and those that served settlement and other rural development efforts. Under this programme, the various ministries and agencies, which required specific road improvements to support their activities, financed the needed improvements. The Ministry of Transport and Communications (MoTC) acted only in an advisory and or contractual capacity.

2.3.2 Rural Access Road Programme and Minor Road Programme

The Rural Access Roads Programme (RARP) was started in 1974 and was renamed as Minor Road Improvement and Maintenance Programme (MRP) in 1985. The RARP was started in response to the increased priority being attached to small scale agriculture production, and opening up of rural trading activities. The program involved the construction of new all weather farm-to-farm market roads in high agricultural potential districts whilst MRP consisted of improvement of the existing roads through gravelling, improving bridges and building culverts.

The two programmes employed labour intensive construction methods and thus played an important role in the development of rural areas in terms of employment creation. According to a RARP and MRP Progress Report, by 1985 the two programmes had constructed 7,600 km of access roads and created 72,000 person-years of employment, against targets of 14,000 km and 80,000 person-years (RoK, 1990).

A World Bank report on *"Kenya's employment growth for poverty alleviation"* (1993) attributed the failure to meet targets by the rural roads programmes to waning donor interest, government's bureaucracy, shortage of labour in the high-potential agricultural

areas, particularly during peak agricultural seasons; shortage of middle-level staff such as inspectors and overseers; lack of transport; failure of the government to fully honour its part of the co-financing agreement made with donors; and, in some cases, technical construction problems attributed to soil conditions, structure and topography.

Planning criteria in the RARP

Before 1980, each District Development Committee (DDC) selected between 150 and 200 kilometres of roads for improvement. The selection process was done in accordance to the criteria set by the Rural Roads Branch of the Ministry. The preliminary selection was given to the MoTC in Nairobi where the internal rate of return (IRR) was calculated for each road package submitted by each district. If approved, the package and plans were submitted to the funding agencies and the construction units. Three main problems affected the outcome of the selection process: (1) lack of reliable agricultural production data which led to fabrication of data and consequently overestimation of supply response, (2) livestock production changes accounted for, and (3) IRR analysis in Nairobi was made for each group of roads as a whole and included roads which otherwise would not have been justified in economic and rural access terms. However, the inclusion of the DDC as a planning body had an important spin-off creating planning capacity at district level.

After 1980 the RARP was reformulated and the road selection process based on an analysis of data, which suggested that the main determinants of feasibility were the size of the impact area and the population served. The criteria used for the successful RARP included: the road length, present state of the road, type and state of connecting roads, degree of connection to markets and social services, density of population and small farmer holdings, degree of cultivated area that would be expanded in road impact area, number of related development programmes in the impact area, availability of appropriately priced labour for road construction, degree to which development constraints would hinder road impacts, cost of road and technical feasibility. The road selection process de-emphasized the production-oriented approach and expanded the criteria to include social and political variables.

RARP and MRP under the Kenya Market Development Programme

Both the RARP and MRP strategies continued to be pursued even after a strategic and comprehensive development policy document on 'Economic Management for Renewed Growth' was published as Sessional Paper No. 1 of 1986 (RoK 1986). The tempo of the two programmes was accentuated through the Kenya Market Development Programme (KMDP). The KMDP was designed to enhance agricultural productivity and farm incomes by alleviating production and marketing constraints in high-potential areas. This goal it was then argued would be achieved at the farm level through higher yields, lower input prices, or higher output prices by public investments in agricultural infrastructure that boost the return to private investments.

The road rehabilitation component of the KMDP aimed at reducing transportation costs incurred in moving agricultural commodities from rural producers to markets by improving to all-weather standards some selected rural roads in eight districts: Kakamega, Kisii, Kitui, Nakuru, Narok, Nyamira, Nyeri and Uasin Gishu. All-weather roads are roads that can be used daily by agricultural transporters to deliver commodities to markets in a timely fashion even during periods of heavy rainfall. District development officials helped the KMDP in road selection during the initial stages of the programme.

2.3.3 Road 2000

Although, the implementation of RARP and MRP generally met their immediate objectives of improving rural access roads, they failed to provide Kenya's rural areas with the level and quality of access required for sustained agricultural and social development. The Roads 2000 programme was initiated by Ministry of Roads and Public Works in conjunction with the Kenya Roads Board. The programme (an expansion of the labour-intensive Minor Roads Programme) was formulated to quickly bring back other roads in the network to acceptable level of accessibility and maintainable standard through partial rehabilitation, spot gravelling and improved drainage. The initial vision was to have the strategy implemented by all districts by the year 2000 hence the term Roads 2000.

In essence, the Roads 2000 strategy is expected to:

(i) Provide basic transport conditions for faster agricultural growth and social development by rehabilitating the rural road infrastructure and improving the roads within the rural areas for all-weather access;

(ii) Increase rural employment directly through the extension of labour-based road works (wherever conditions permit), and indirectly through faster agricultural growth;

(iii) Remove the constraints to private sector initiatives and development in general imposed by the deteriorating road infrastructure;

(iv) Support the development of small domestic contractors through the provision of contractor training and small construction contracts; and

(v) Support increased efficiency within the civil service through a substantial reduction in force account activity in the road sector and increased capability in district planning and contract administration

2.4 Conceptual Framework

2.4.1 Rural Transport

Bryceson and Howe (1992) define rural transport as the movement of people and goods in rural areas by any conceivable means for any conceivable purpose along any conceivable route. This implies that rural transport in its totality encompasses the movement of rural people and their goods to meet their basic domestic, economic and social needs, by any means (the mode of travel does not necessarily need to be motorised or conventional), along paths, both undesignated and designated roads, and foot bridges. Thus a wide variety of mode choices and trip purposes have to be considered during rural transport planning and service delivery.

2.4.2 Elements of Rural Transport System

A transport system consists of infrastructure, transport services and management (support) system. Real improvement in access and mobility can only be brought about by a systems approach dealing with means of transport and development of transport

services as equal facets as physical infrastructure, regulatory framework and institutional responsibilities.

Mobility relates to the ease or difficulty with which rural people can move themselves and their goods (Cloke & Park, 1985). According to Porter (1988; 1997), mobility has two components. The first of these depends on the performance of the transport system in connecting spatially separated locations. The second component depends on the characteristics of the individual i.e. the extent to which a particular individual is able to make use of the transport system. Porter continues to observe that the mobility of men, women, children and goods depends on the availability, affordability and efficiency of a transport system. Mobility is increased by improvements in the rural transport system that allows people to travel more quickly, and to carry their goods with less effort.

Accessibility is the ease with which one reaches a desired land use. Mitchell et al. (1977) and Tolley et al. (1995) assert that the true aim of transport is to provide accessibility and not movement. According to Jones (1981), accessibility is concerned with the opportunity, or potential, provided by the transport and land-use system for different types of people to engage in activities. It also implies that some accessibility problems can be addressed by non-transport interventions. For example, land use interventions such as efforts to bring water supply and fuel supply to houses (instead of forcing women to walk long distances for them) can greatly increase accessibility.

2.4.2.1 Rural Transport Infrastructure

Rural Transport Infrastructure (RTI) includes all transport-related infrastructure, ranging from proclaimed feeder roads and rural access roads, to the undesignated village-level roads, tracks, trails, paths and footbridges. The RTI network is the lowest level of the physical transport chain on which the rural population performs its transport activities, which include walking, transport by non-motorized and motorized vehicles, and haulage and transport of people by animals. It connects the rural population to their farms, to their farms, local markets, and social services, such as schools and health centres.

A minimum level of service of the RTI network, referred to as basic access, is therefore one of the necessary building blocks of poverty reduction. Basic access interventions are

the least-cost interventions (in terms of the total life-cycle cost) for providing reliable, all-season passability by the prevailing motorized and non-motorized means of transport. Thus, in line with the poverty focus of RTI investments, a basic access approach is preferred which gives priority to the provision of reliable, all season access to as many villages as possible over upgrading individual links to higher than necessary standards, thereby giving priority to network equity.

2.4.2.2 Rural Transport Services

Rural transport services (RTS) are the means by which people transport themselves and their goods. RTS include services provided by users themselves (e.g. head loading, private vehicular transport) and by operators of all means of motorised and non-motorised transport. Transport infrastructure is largely devoid of mobility enhancement in the absence of modes of transport (Riverson et al., 1990). Individual utility is derived from transport infrastructure when modal choice is exercised within the transport system to gain access to the required goods and services.

The adequacy / level of transport services in an area can be evaluated in terms of routes served, frequency of services, capacity offered and in particular the charges offered (Hathway, 1985). The affordability, quality and quantity of rural transport services profoundly affect the daily lives of residents of rural communities. Efficient transport services in rural areas are needed for speedy delivery of agricultural inputs to the village and household levels, as well as transportation of farm produce to consumption areas such as markets. Even social interactions generally require significant level of transport services. Rural transport services fall in two broad categories i.e. Non Motorized Transport (NMT) and Motorized Transport Services.

(i) Non-Motorized Transport Services (NMT)

Guitink et al. (1994) define NMT as any form of transport that provides personal or goods mobility by methods other than the combustion motor. Walking (human porterage) is the most familiar form of NMT. The intermediate between head loading and motorized transport is referred to as Intermediate Means of Transport (IMT). IMTs such as bicycles/tricycles; handcarts/wheel barrows; animal drawn carts; and other

human powered vehicles, play an important role in bridging the gap between motorized transport and demand for travel in rural areas.

NMT/IMT provides a flexible form of transport especially in meeting activities that are essential to the basic quality of life. It is a multi-purpose tool that can be used for the door-to-door transport of persons and goods with improved travel time and route options. Transport has to be affordable to users otherwise with dwindling cash; people are left with no choice but to walk (Riverson et. al. 1990). Affordability of IMT is a function of purchase price in relation to income. Although operational costs are rarely a constraint, high retail prices can suppress the potential demand for IMT, such as bicycles, carts and spare parts.

(ii) Motorized Transport Services

Ron (1994) observes that widespread use of road motor transport in SSA is limited due to low ownership of motor vehicles, poor transport infrastructure and lack of critical mass as a result of low levels of affordability. The intermediate and motorized modes of transport may be owned on individual or group basis e.g. the delivery of farm inputs, and the evacuation of crops by private or parastatal transport services, or accessed through 'fee for service payments' e.g. 'for hire' taxi services, public transport services and informal transport services provide an opportunity to travel on passing vehicles.

2.4.2.3 Support System

Improvements to the transport system in the rural areas will not occur without deliberate managerial intervention. The institutional framework (i.e. the organization of the transport industry, physical control, enforcement of laws and regulations) for the management of transportation system determines, to a very high degree, the efficiency of the whole transportation system. The key actors involved include: the central government; local authorities; transport association and transport users or consumers. The presence of transport cartels is capable of distorting the supply of transport services.

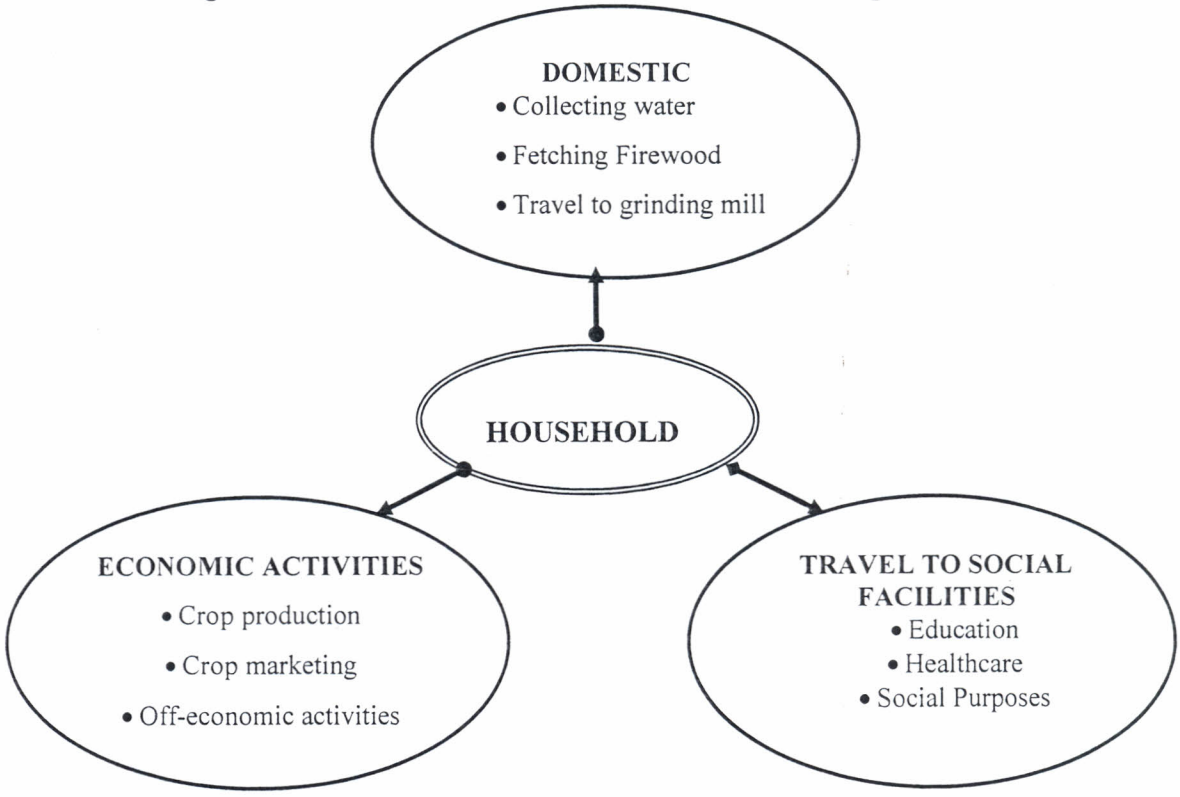
Besides the procurement or contracting of rural transport infrastructure and services, the scope of government intervention in rural transport system also includes transport planning; the auditing, classification and proclamation of the road network; and the auditing, and regulation of rural transport services. Provision of fiscal incentives by the

government affects the type, supply level, cost and quality of transport services. These improve information flows and the general operation of the market for rural transport services and ultimately influence the trip making behaviour and safety of travel.

2.4.3 Activity-Based Model of Rural Transport & Travel Demand

Rural people experience a transport problem due to a discrepancy between their transport opportunities and their transport needs. According to Hathway (1985), Barwell (1992), and Howe (1996) the typical transport problems confronting rural dwellers in developing countries include: water and fuel wood collection; crop production and marketing; non-agricultural income generation; and access to basic social and economic services (see Fig. 2-1). The diagram is not necessarily limited to these sectors. Possibly other (important) sectors may be considered. The figure is schematic: the arrows do not necessarily relate to distance or time.

Figure 2-1: Main Elements in Rural Travel and Transport



Source: Literature Review

Unanimously, they single out the collection and movement of fuel wood and water as tasks, which dominate domestic work for many rural households. Dawson and Barwell, (1993) points out that the exact nature of transport tasks, frequency of such trips and places visited depend on the type and cost of the available transport and the location and circumstances of specific rural areas.

2.4.3.1 Water and Firewood Collection

Transport problem of water and fuel wood collection can be viewed as the one related to exchange in relation with the nature. The magnitude of the problem to a large extent depends on the natural resource endowment of an area. As priority transport tasks requiring inordinate amount of time and effort, the collection and transportation of water and firewood, significantly limit the household female labour resource available for other, beneficial reproductive and productive activities. The transport time and effort devoted by women to collect water and firewood are determined by the distance to the sources, the size of container used (in case of water), the size of the household and number of women among whom the burden can be shared (Hathway, 1985).

The opportunity costs of collecting water and fuel wood in terms of time and physical labour can be reduced through improved provision of appropriate means transportation. This will in turn free the rural poor to use their endowment of time and physical energy for more productive and remunerative works.

2.4.3.2 Crop Production

In many developing countries, agriculture remains the main source of livelihoods for many rural dwellers. Agricultural production in rural areas can be increased through increasing the area of land under cultivation; adoption of 'modern' input-intensive agricultural system or crop substitution to increase output of higher value crops. However, when a more intensive agricultural system is introduced, an increase in agricultural production tends to generate a greater than proportional increase in the on-farm agricultural transport demand because:

(i) Adoption of an input-intensive farming system at whichever level, introduces an additional task of transporting inputs from source of supply to the fields via the homestead.

(ii) The cultivation of more distant fields increases the time and effort needed to travel to the fields for production activities and transporting the harvested output back from the fields.

The efficiency of the means of transport used has therefore a very important effect on overall productivity. Barwell (1992) claims that on-farm agricultural transport becomes a constraint to increased crop production when the level of agricultural output reaches a stage where the transport time and effort required exceeds the available household labour resource especially at periods of peak activity.

2.4.3.3 Crop Marketing

A subsistence sector gradually transforms into a commercialized sector when the subsistence farmers acquire both the means to produce a surplus and the desire to exchange the surplus produce for other goods and services produced by other sectors. Borpujari (1977) observes that production of surplus will depend on the farmer's ability to exchange this surplus for the other sectors' products. He argues that a subsistence farmer will start producing a surplus only when the accessibility to market is guaranteed. It must be feasible to market the crop at an acceptable price and in this case the level of mobility and the siting and quality of facilities become important considerations.

Ideally, farmers relying only on household labour can transport to market only small amounts of produce over relatively short distances if they have to. However if household labour is complemented by IMT, there is a possibility of increasing the volume of marketed crop. The marketing of large quantities of crops is dependent upon their transference to a motorised means of transport relatively close to homestead. Just as with crop production, transport becomes a constraint to crop marketing when the time and effort needed to market the crop exceeds the household labour resource available for this purpose (Barwell, 1992).

2.4.3.4 Access to Facilities and Social Travel

A range of social facilities – grinding mills, health centres, schools, and markets, exist in rural areas. The level of access determines the frequency of usage of these facilities and

hence the level of benefits that are derived. The poor access results from a combination of long distance to the facilities, and lack of transport services.

Education

Education involves the provision of access to information and learning facilities to people. Whether these resources are taken to where people live, or whether people travel to a central school, a need for transport still exists. The level of access to a school, and the means of transport available, have a crucial influence on the effectiveness of educational service – on school attendance, on the supply of teaching materials, on the provision of management and support services and on the willingness of teachers to work at a particular place.

Healthcare

In SSA, the problem of providing access to medical facilities and personnel is acute particularly in rural areas where people are spatially far from one another. It is difficult for people who are ill to travel far, particularly if walking is the only means of transport available. With a trend towards decentralization of facilities, and greater use of paramedical staff to visit patients in their home or village, the importance of transport in providing health care increases.

Social Activities

Regardless of the level of development, in all societies, people attach great importance on personal mobility. The ability to travel freely to visit friends and relatives may not be a 'basic need', but is clearly desirable, particularly in societies where family ties are strong.

2.4.4 Nature of Rural Transport

Based on the geographic extent of the transport tasks, rural transport can be broadly classified into two levels: on-farm and off-farm transport.

2.4.4.1 On-farm Transport

On farm transport activities facilitate the accomplishment of domestic needs, such as water and firewood collection, smallholder cultivation, grazing animals and movements

in support of farm production such as transporting farm inputs and outputs between house and fields. On-farm transport tasks are normally carried out off-road and at a much local level enabling people to interact with the local economy and society (Barwell, 1992).

2.4.4.2 Off-farm Transport

Unlike on-farm transport, off-farm transport relates more to the conventional perception of transport in that at least some of it takes place on recognisable road, and sometimes, with a motorised vehicles. Off-farm transport enables rural people to connect to the wider regional and national economy and society. Off-farm transport tasks include trips to the market to obtain household consumables, to purchase goods and services to support farm production, trips visits friends or to reach certain social amenities, e.g. schools and health clinics.

2.4.5 Factors Influencing Supply and Demand for Transport

2.4.5.1 Spatial Structure of Settlement

Nucleated unlike scattered settlement patterns facilitate the provision of services and facilities that are accessible to people. However, people living in diffused or scattered patterns are more likely to have better access to land and firewood than those living in clustered settlements. Thus the type of settlement patterns and system of land ownership affect transport patterns.

2.4.5.2 Composition of the Household

The size of the household, ages, sexes of the members affects the household consumption needs and the distribution of transport responsibilities within the household. In the African setting, older children, particularly girls may help a lot with transport tasks. Women's freedom of mobility is often affected by whether they are in monogamous, polygamous or female-headed households. An individual's role or ranking in the household determine his/her access to vehicle use (de Boer, 1996).

2.4.5.3 Income Characteristics of the Household

Income levels influence people's ability to afford means of transport and availability obviously affect usage. These in turn influence the opportunities people have for transporting and marketing goods and for accessing services.

2.4.5.4 Agricultural Characteristics

The distance to field, the type of crops produced and extent of usage of farm inputs influence the rural transport characteristics. Nature of goods i.e. the perishability, weight, bulk and value of the goods determines the frequency and mode of transport required to get the goods to the market.

The cultivation of more distant fields increases the time needed to travel to the fields for production activities and to transport a unit of harvested output back from the fields. An increase in level of crop production generates an increase in the transport demand because input-intensive farming increases on-farm agricultural transport from the source to the field and off-farm agricultural transport to market.

2.4.5.5 Culture and Gender

Division of Labour

Studies carried out in rural Africa reveal that division of household transport tasks is based on age and gender. Different household members, women, men and children carry out tasks including transport and have different levels of ownership and access to the means of transport including IMT.

Preferences for Goods and Services

The choice of staple food influences travel associated with animal or crop production and need for food processing. Attitudes to western medicine affect the use of services such as health facilities.

2.4.5.6 Physical Base

Topography

Topography influences the route alignment. It is cheaper and technically less complex to build and maintain transport infrastructure on a flat terrain than a mountainous terrain.

Topography also determines the limits of zones of influence of transport infrastructure. Physical obstructions such as steep slopes normally delineate the effective boundaries of the zones of access of rural infrastructure. There is greater scope for use of NMT/IMT in flatter terrains. A steep or hilly land makes the use of some modes of transport such as bicycles and animal carts difficult.

Soils

In the rainy season clay soils become slippery and offer poor traction unlike laterite gravel, which has high structural strength. Surfaces of roads and tracks whether stony, clay, black cotton soil and sand will influence what transport can be used and whether there is all weather access.

Climate and Drainage

Rainfalls beyond the 25milimeter-per-hour intensity have an erosive effect on the infrastructure (Carapetis et al, 1984). Poor drainage causes erosion of infrastructure itself and can cause cut slope slides or structural failure.

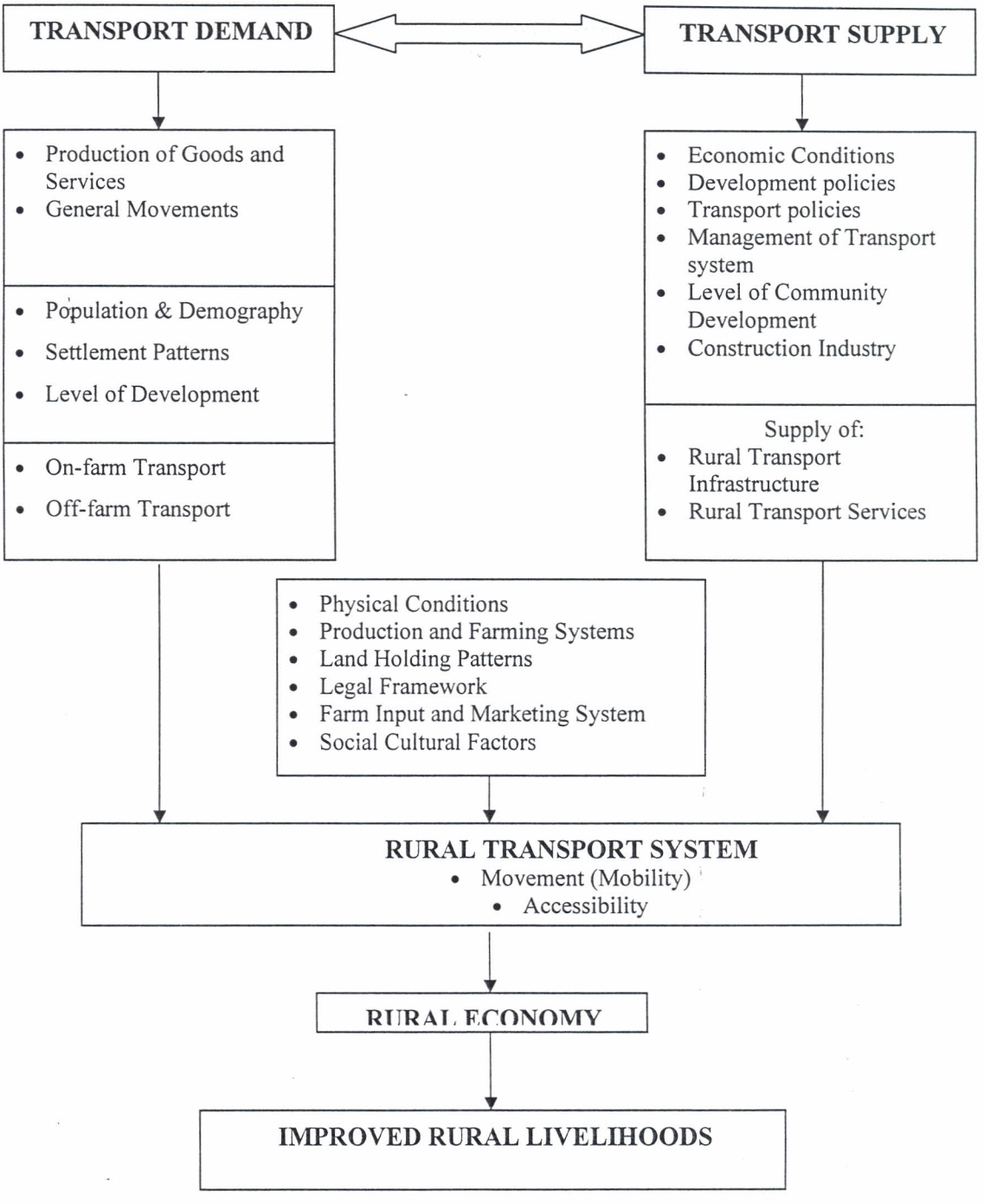
Natural Resource Endowments

The natural resource endowments determine, for example, the extent of access to land and distance to sources of firewood.

2.4.5.7 Institutional Framework

Government policy, planning and capacity influences people's access to land and goods and services such as provision of improved water supply, health facilities, distance to sources of farm inputs and to marketing facilities. Availability of credit and extension services to communities is also partly determined by government policy.

Figure 2-2: Conceptual Framework - Relationships of Rural Transport Factors



Source: Literature Review

CHAPTER THREE

BACKGROUND TO THE STUDY AREA

3.1 Introduction

The area of study is Nyabiosi Sub-Location in Rigoma Division of Nyamira District. This chapter provides a detailed description of the relevant physical, socio-economic and demographic characteristics of the area.

3.2 Position and Size

Nyamira District is one of the twelve districts that make up Nyanza province. The district lies between latitudes 0° 30' and 0° 45' south and longitudes 34° 45' and 35° 00' east – covering an area of approximately 896.4km^2. It borders Transmara District to the south, Buret district to the East, Bomet district to the southeast, Kisii Central district to the West and Rachuonyo District to the North (see Map 3-1).

3.3 Administrative and Political Boundaries

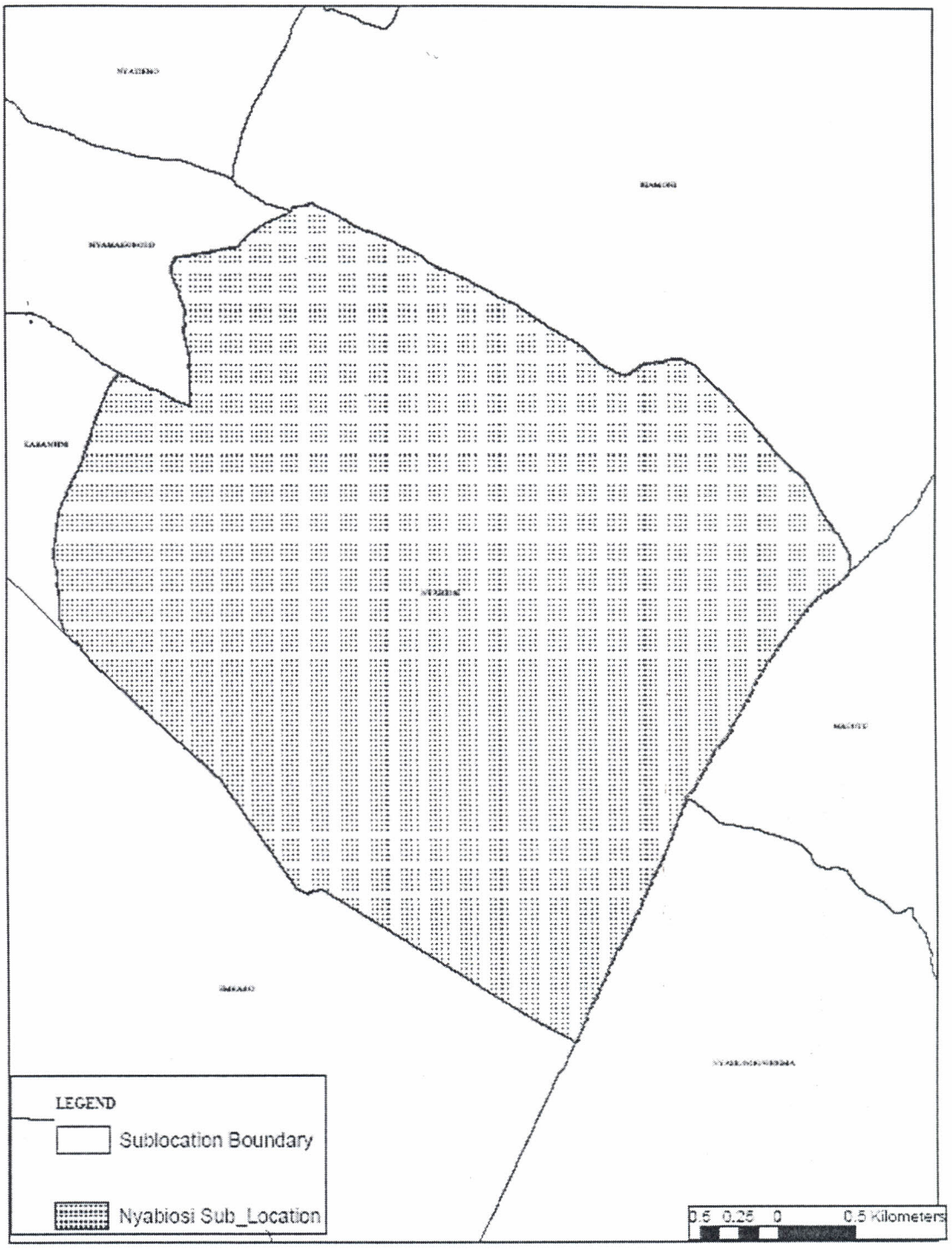
Five administrative divisions constitute Nyamira District. The divisions are; Rigoma, Manga, Nyamira, Ekerenyo and Borabu (see Table 3-1) Rigoma and Manga form Kitutu Masaba constituency. The study area is Nyabiosi sub-location - which is the largest of the twelve sub-locations forming Rigoma Division (see Map 1-3 and Map 3-1). The study area covers an area of 16.1km Square.

Table 3-1: Administrative Units

Nyamira District		
Division	**Area (km^2)**	**Political Unit / Constituency**
Nyamira	180.1	West Mugirango
Ekerenyo	216.1	North Mugirango / Borabu
Borabu	247.4	
Manga	111.5	Kitutu Masaba
Rigoma	141.3	
Total	**896.4**	

Source: CBS (1999)

Map 3-1: Nyabiosi Sub-Location in the Local Setting



3.4 Physical Characteristics

3.4.1 Topography

There are two main topographical zones corresponding closely to the altitude. The first zone covers areas whose altitude ranges from 1,500m to 1,800m above sea level. This zone covers northern parts of Nyamira and Ekerenyo Divisions. The study area falls in the second zone, which covers areas lying above 1800m. The topography is mostly hilly with a series of ridges. The hilly terrain causes serious erosion, which aggravates road construction and maintenance problems due to high surface runoff. The terrains make supply of water costly as it has to be pumped up steep slopes before being released for distribution.

3.4.2 Agro-Ecological Zones

According to the Farm Management Handbook, the area falls in the lower highland (LH1 and LH2) agro-ecological zone. These agro-ecological conditions permit the growing of cash crops, such as coffee, tea and pyrethrum and food crops such as maize, bananas, beans, finger millet and horticultural crops (see Plate 3-1).

Plate 3-1: Typical Crops Grown in the Study Area

Source: Field Survey, 2006

3.4.3 Geology and Soils

Sedimentary rocks of ironstone origin underlie the study area. The top layer comprises of soils, gravel and laterite ironstones. These rocks are characterized by faults, joints, fractures that allow passage of rainwater into lower strata that enables availability of reservoir for exploitation. In some places, water is available by digging hand-dug wells while in other areas; water is found by drilling deep boreholes.

The major soils found in the area are the red volcanic (Nitosols), which are deep, fertile and well-drained accounting for 75%. Though the red volcanic soils are good for farming they make construction and road maintenance expensive. The remaining 25% are those found in the valley bottoms and swampy areas suitable for brick making. However, these soils have high clay content and therefore cannot be appropriate for the riding surface especially after raining.

3.4.4 Water Resources

The water resources in the area consist of both ground and surface water. The surface water resources found in the area consist of springs and streams. The rivers supply clean water for use by the people. Although the water resources are reliable and accessible, only 38.3% of the population has access to safe drinking water. Some streams gradually being polluted by human activity such as farming which extends right to the banks of the streams, destroying the catchment areas. Moreover, continuous planting of eucalyptus trees along the water sources has adversely affected the level of water flow (see Plate 3-2). The water from streams is sometimes used to construct fishponds and even irrigate gardens during the dry seasons.

3.4.5 Forestry Resources

The area is covered with evergreen with manmade forests. These forests are not gazetted. The forests are on hilltops meant to conserve soil and water. Emphasis is being placed on agro-forestry development to raise the forests cover for the provision of wood fuel and timber. There exists potential for eucalyptus, pines and cypress for timber exploitation. The current supply of timber and wood fuel in the area is inadequate. There exists room for expansion of forest cover on the hilltops.

Plate 3-2: Eucalyptus Trees Planted Along Water Courses

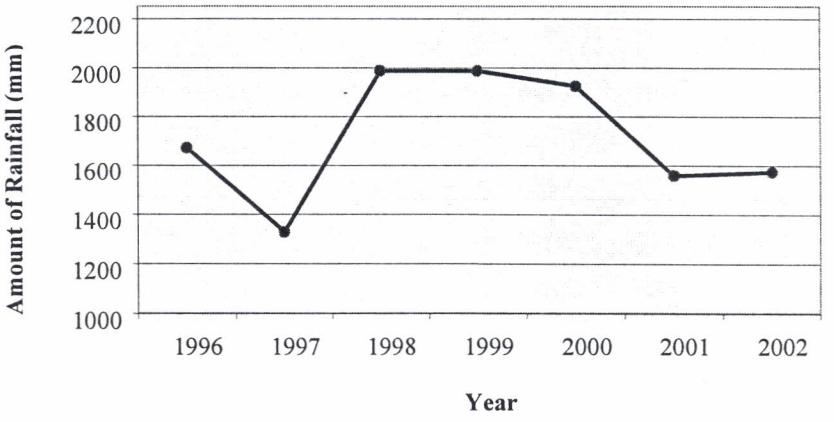
Source: Field Survey, 2006

3.4.6 Rainfall

The area has a highland equatorial climate with a bimodal pattern of annual rainfall that is well distributed, reliable and adequate for a wide range of crops. Annual rainfall ranges from 1,200mm to 2,000mm per annum. The rain is received in long and short rains seasons. The long rains come in March to June while the short rains are received in October to December while dry season is experienced on December to January. Most of the rainfall is received in April when over 300mm is received while least precipitation is received in January and February (100mm). On average, the district receives an annual rainfall of 2000mm.

The high and reliable rainfall received promotes a wide range of agricultural activities, which has made the division the largest tea producer in the wider Gusii land. Both crop farming and livestock keeping are practiced. Although the area receives high rainfall, actual amounts received in the long rains season has been declining as shown in Figure 3-1.

Figure 3-1: Mean Yearly Rainfall Trend Between 1996-2002



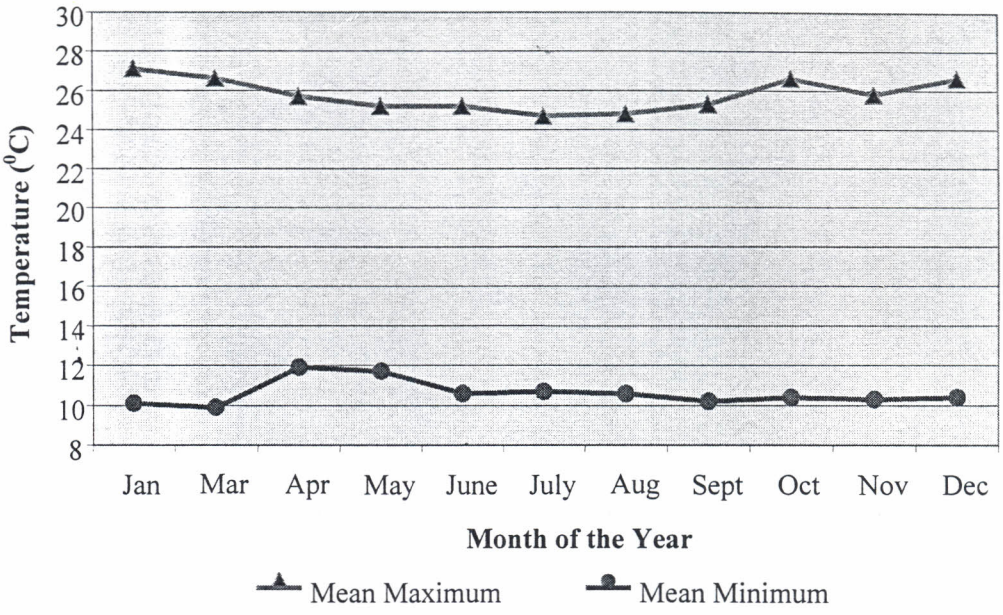
Source: Kenya Meteorological Department, 2006, Sotik Tea Estate Station

3.4.7 Temperature

The maximum day and minimum night temperatures are normally 28.7°C and 10°C respectively, with an average of temperature of 19.4°C (See Fig. 3-2). The area does not experience extreme temperature variations largely due to its altitude. The graph indicates that the high mean maximum temperature recorded in 1992 to 2000 was 27.1°C while the lowest was 24.8°C.

The lowest mean minimum monthly temperature recorded over the same period was 9.9°C with a range of 2°C. The range for the mean monthly maximum and minimum temperatures was 2.4°C. The overall temperature range (maximum and minimum) for the period was 17.3°C. The cool temperatures promote the growing of cash crops, like tea, coffee, pyrethrum as well as food crops like maize, beans and millet and livestock production.

Figure 3-2: Long Term Monthly Temperature (1992-2000)



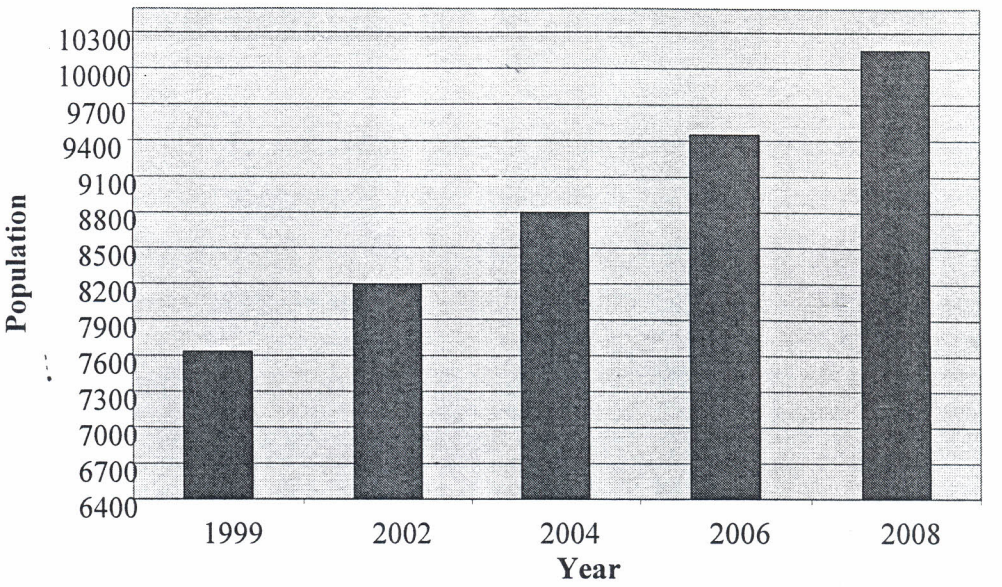
Source: Kenya Meteorological Department, 2006, Sotik Tea Estate Station

3.5 Population

According to the 1999 Population Census, the District had a population of 498,102 people at the time of the census, with an intercensal growth rate of about 2.4%. The district has the third highest population density (of 556 persons per square kilometre) in the province. During the same census, the Nyabiosi sub-location had a population of about 7630 (3,608 male and 4,022 female) people in 1433 households.

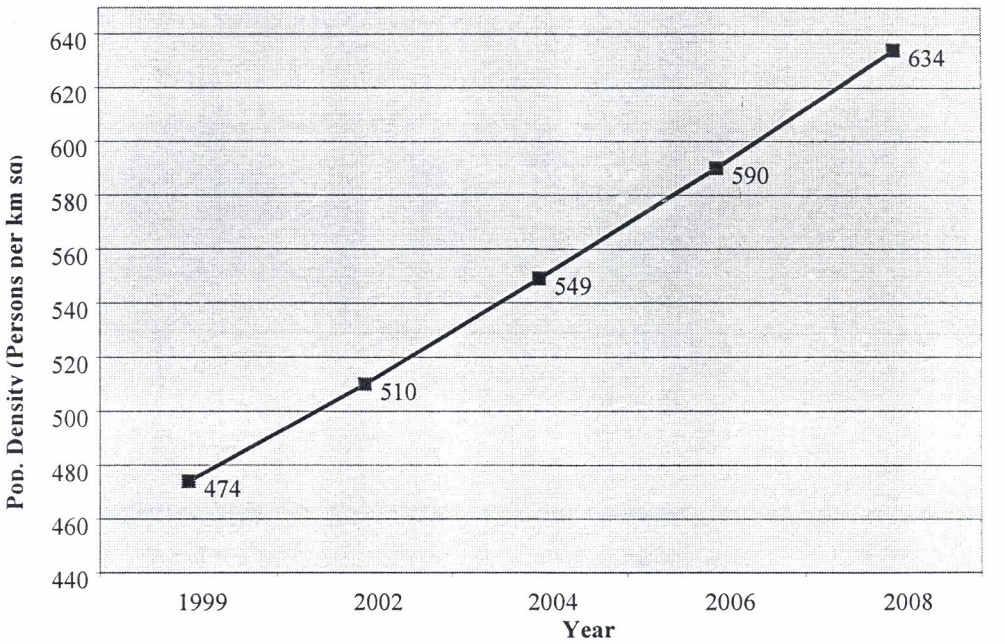
This translates to a population density of 474 persons per Kilometre Square. It is projected that the sub-location will be having a population of over 10,000 in the year 2008 (see Fig. 3-3). In the same year the population density is expected to be 634 persons per square kilometre (see Fig. 3-4). This projection is based on the growth rate of 2.5% per annum. Due to high population densities, there is a lot of land fragmentation in the area.

Figure 3-3: Projected Population in Nyabiosi Sub-Location



Source: Adopted from 1999 Population Census Report

Figure 3-4: Projected Population Densities in Nyabiosi Sub-Location



Source: Adopted from 1999 Population Census Report

CHAPTER FOUR

TRANSPORT SYSTEM IN NYABIOSI SUB-LOCATION

4.1 Introduction

This chapter deals with a situational analysis of the transport system in the study area. The key elements of the transport system discussed in this chapter include the motorized and intermediate transport services, the village and "conventional" road infrastructure and the transport support system.

4.2 Vehicle and Transport Services

Transport services are a key component of a rural transport system. It is the transport services, which enable people to move around with or without their accompanying goods. This section examines the ownership levels of motorized and intermediate vehicles by households in the study area. It also presents the usage of the various modes of transport.

4.2.1 Ownership and Working Condition of Vehicles

The ownership levels of motorized means of transport are very low. Of the households surveyed, only one owned a four wheeled motor vehicle (see plate 4-1).

Plate 4-1: A 1200cc pick-up found in the study area

Source: Field Survey, 2006

The main intermediate means of transport vehicles found in the study area are bicycles, wheelbarrows, donkeys and animal drawn carts. The wheelbarrows are the most popular vehicles – 23.8% of the households surveyed own either a home-made or a formal type of wheelbarrow. The home-made wheelbarrows are built to very crude designs out of local timber and a steel wheel. However, a significant part (38.8%) of the wheelbarrows was not in a working condition. The home-made wheelbarrows formed the majority of those which were not in a working condition (see Table 4-1). Bicycles are owned by 18.5% of households surveyed. However, 10% of these bicycles were not in a working condition. 20.4% of the households own donkeys. 9.1% of the donkeys were in sick health and therefore would not be used for transport tasks. The ownership level of animal drawn carts compares poorly with that of donkeys.

Table 4-1: Ownership and Condition of Vehicles

Type of Vehicle	Number of Households	Percentage of Households	Condition	
			% Working	% Not Working
Motorized				
Pick-up 1200cc	1	1.9*%	100%	0%
Intermediate				
Bicycle	10	18.5%	90%	10%
Wheelbarrow	21	38.8%	76.2%	23.8%
Animal-drawn cart	1	1.9%	100%	0%
Donkey	11	20.4%	90.9%	9.1% sick

* This figure over-estimates the availability of the motorized vehicles because of small size of sample

Source: Field Survey, 2006

Despite animal-drawn carts having a potential of increasing the carrying capacity of donkeys, only one (1.9%) household was found having an animal-drawn cart compared to 20.4% ownership of donkeys. Donkeys are used in conjunction with gourds hung over the back, for transport, but quantities are very small. The use of donkeys individually for transport seems restricted by their limited carrying capacity and the absence of efficient load carrying panniers. Therefore households owning donkeys have not fully unexploited their load carrying capacity.

The study found out that 55.8% of households cultivating more than one farm, own at least one donkey. The donkeys enable the household expand their cultivation radius by facilitating transportation of the farm produce from these farms to the homestead.

4.2.2 Transport Services

This sub-section discusses the types and usage of motorized and non-motorized transport services in the study area.

4.2.2.1 Motorized Transport Services

1. Private Motorized Transport

As already indicated above, the ownership of motorized means of transport amongst households in the area is very low. The one four-wheel motor vehicle found (see Plate 4-1) is mainly for private use. However, during times of emergencies especially at night, the pick-up is hired by villagers to deliver sick persons to health facilities. During the survey, many of the villagers interviewed had personal knowledge of the owner of the pick-up, indicating the important role the pick-up plays in providing ambulance services to the residents.

2. Public Motorized Transport

There is a wide range of public transport services available in the study area. They are particularly important to households whenever they want to travel distances beyond their walking radii.

Passenger Transport Services

Due to low ownership of motor vehicles, travel using passenger vehicle services provide almost the exclusive mechanism by which households are linked to the wider regional and national economy. The services are primarily provided by pick-ups plying along the main feeder road where demand is greatest. Non-residents of the study area own all these vehicles. All the vehicles operate from Keroka – the main urban center. This implies that the residents of the study area cannot hire these vehicles for emergency services especially during the odd hours of the day.

The vehicles do not operate on a scheduled timetable – they depart only when they are full and the vehicles do not have fixed stopping points - depending on the demand, the

vehicles continue picking short-distance passengers enroute. Since these vehicles do not operate on the tracks and trails most households are remote from the services. Sometimes even households located along or near the route have limited access when the pick-up fills up such that it is impossible to pick more passengers.

Frequent users of public service vehicles (PSVs) are the local government officials, local traders, teachers and people engaged in paid employment outside the locality. Public transport services are crucial in supporting the delivery of agricultural inputs. 46.3% of the households use public transport services to deliver fertilizers and seeds from source to the drop-off point nearest the homestead. The services are also used by households in accessing health facilities outside the area which are perceived to provide high quality services. However, under ordinary circumstances, many households do not make use of the public transport services due to:

(i) High fares charged

The vehicles charge exorbitant fares, which are unaffordable to most households. The local passenger transport operators charge an average of Kshs 4 for every kilometre travelled. This is almost 100% higher than what is charged by PSVs plying along main highways. It is for this reason that most people opt for walking and head loading (non-motorized) to accomplish their transport activities.

(ii) Shortage of vehicles

There are a total of fifteen PSVs plying on the feeder road traversing through the study area. However, the number of vehicle in working order and available for use at any given time is substantially below the total stock. For instance, when this survey was carried out, only eight vehicles were in a working condition. The reasons cited for the shortage of vehicles include:

- the older vehicles in the fleet require frequent repair; and
- limitations in supply of spare parts keep some vehicles off the road.

Due to these factors, the demand for public transport services outstrips the supply particularly during market days resulting to overloading and scramble for the few available vehicles by traders who frequently need these services (see plate 4-2).

Plate 4-2: Overloaded Public Transport Vehicle

Source: Field Survey, 2006

(iii) Lack of Critical Demand

The demand for public passenger services is quite low to sustain the operation of vehicles. Most of the household transport activities are carried far away from the main road. Public passenger transport services are therefore inappropriate to support household transport needs. The lack of critical demand makes the public transport services very irregular. It is because of the same reason that large public transport vehicles have not been attracted to operate on the route.

(iv) Poor road infrastructure

The road network becomes impassable during the wet season. The operation of motor vehicles becomes uneconomical due to increased vehicle operation costs.

Cooperative/Parastatal Agricultural Transport Service

51.9% of households surveyed, are members of a local cooperative society. The society provides transport services to evacuate milk produce to Sotik Factory of Kenya Cooperative Creameries (KCC), which is over 30km away from the area. Tea producers

deliver their produce to the buying centers from where it is evacuated to the factory by the KTDA trucks. However, just like passenger transport services, cooperative / parastatal transport services are limited during the wet season due to the poor state of roads.

Informal Transport Services

There is informal use of government and cooperative/parastatal vehicles in the area. People hitch lifts from such vehicles to transport themselves and limited quantities of goods, often paying agreed fares to the driver. However, this is a case of people taking opportunities when vehicles pass by. They have no control over when they travel, the route that the vehicle takes, or indeed whether the driver will be prepared to carry them since carrying unauthorized passengers is often illegalised by most organizations.

Hire Transport Services

Hire transport services are usually required by households, which require personalized transport services to move crops to market, move building materials such as bricks.

Plate 4-3: Brick-Making in the lower parts of the Sub-Location

Source: Field Survey, 2006

Vehicles for hire (mostly a light pick-up) are available in the local urban centre (Keroka) and thus hiring of a vehicle will normally involve a trip to the centre. The standard method of vehicle hire is to pay for the whole vehicle rather than the load carried, and to pay the cost for the two-way journey. Although hire transport services are expensive to most households, the service is frequently used by those engaged in brick-making as an economic activity (see Plate 4-3).

4.2.2.2 Intermediate Means of Transport Services

The low-cost vehicles available in the study area are bicycles, donkeys, animal drawn carts and wheelbarrows. With the exception of bicycles, the modal characteristics of the other IMTs are predominantly for load carrying rather than for personal travel. Bicycles are used to support small enterprise activities. Thus they are common with men who engage in non-farm economic activities such *jua-kali* artisans such as masons, mechanic and carpenters. Bicycles are also used to support agricultural production by transporting farm inputs from source to the homestead. However the use of bicycles to travel to hospitals is non-existent, because the facilities are beyond the cycling range and therefore inappropriate.

One common characteristic with all the IMT vehicles is that they provide an interface between the public transport system and the homestead. For instance they are widely used to deliver farm inputs to the homestead from the nearest motorable road. IMTs are also used in the first transport stage of the marketing chain. Where crops cannot be sold in the village, wheelbarrows and donkeys are used to transport marketed crops to local points of sale. The level of usage of wheelbarrows exceeds the level of ownership, indicating a significant degree of borrowing at periods of increased agricultural input transport demand. There are no short distance, local level transport services provided by intermediate means of transport.

4.3 Transport Infrastructure

4.3.1 Village Transport Infrastructure

There is a myriad of intra-village and inter-village network of paths, trails, tracks, which are cleared narrow passages, which enable households to access basic needs, socio-economic services and for social visits on foot, by bicycle etc. Villagers often use shortcuts to join roads and to reach their destinations. Generally these footpaths and trails

are in poor condition because they have no proper formation and drainage system (see Plate 4-4). They therefore become slippery and dangerous during the wet season.

Plate 4-4: A trail in poor condition due to lack of drainage

Source: Field Survey, 2006

Footbridges are mostly made of locally available materials like ordinary logs; timber, poles etc (see Plate 4-5). Problems with water crossings came up many times during the survey. Almost all community built footbridges are in poor condition. The poor conditions of crossing make the use of IMTs along the paths difficult. Many of the paths also lack river crossings, or at least crossings, which can be negotiated safely during the wet season. During the rainy seasons some are washed away and some are over-flown by water thereby posing a danger for people to cross over (see Plate 4-6). Lack of water crossings forces people to make long detours in the wet season and can prevent among others women from reaching grinding mills and prevents children from getting to school.

Plate 4-5: A Water crossing made of locally available material

Source: Field Survey, 2006

Plate 4-6: A Dangerous Temporally Water Crossing

Source: Field Survey, 2006

4.3.2 Conventional Road Transport

4.3.2.1 Road Classification

A road network constituting of earth and gravel roads covers Nyabiosi sub-location. These roads fall in class D, E and below. Due to low level of classification, the roads have not received adequate attention for maintenance leading to inaccessibility of major market centres, particularly during the rainy season. The distribution of the road network by type of surfacing in the Nyamira District, Rigoma Division and in Nyabiosi sub-location is as shown in Table 4-2. The classified road network traverses along the sub-location boundaries (Map 4-1) - making it hard for households situated at the centre of the sub-location to access the network.

Table 4-2: Distribution of Road by Type of Surfacing

	Type of Surfacing											
	Gravel						Earth					
Class	C	D	E	R	T	**Total**	C	D	E	R	T	**Total**
Nyamira District	78.7	143.8	58.6	89.8	27.3	398.2	0	0	173.3	50	33.8	257.1
Road Density	0.44km per km^2						0.29km per km^2					
Rigoma Division	-	29.0	16.1	2.0	1.3	48.4	-	22.5	27.9	18.2	17.5	86.1
Road Density	0.34km per km^2						0.58km per km^2					
Nyabiosi sublocation	-	4.9	-	-	-	4.9	-	-	3.8	4.2	2.8	10.8
Road Density	0.30km per km^2						0.67km per km^2					

Key: *R=Rural Access Roads *T=Tea Roads

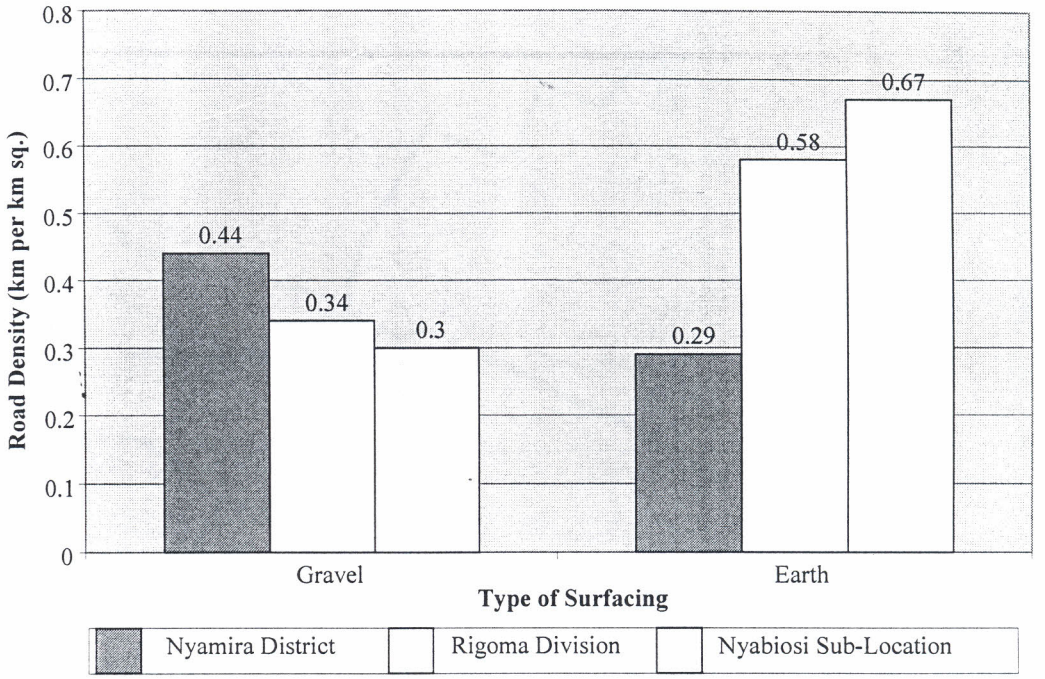
Source: District Works Office, Nyamira, 2006

4.3.2.2 Road Densities

The road density in an area has a bearing on the extent to which residents are connected. The density of gravel roads in is 0.30km per km square compared to 0.34 and 0.44km per km square for Rigoma Division and Nyamira District respectively (see Fig. 4-1).

This implies that the study area is slightly disadvantaged in terms of gravel road distribution in the district. The sub-location has a higher density of earth roads compared

Figure 4-1: Comparison of Road Densities



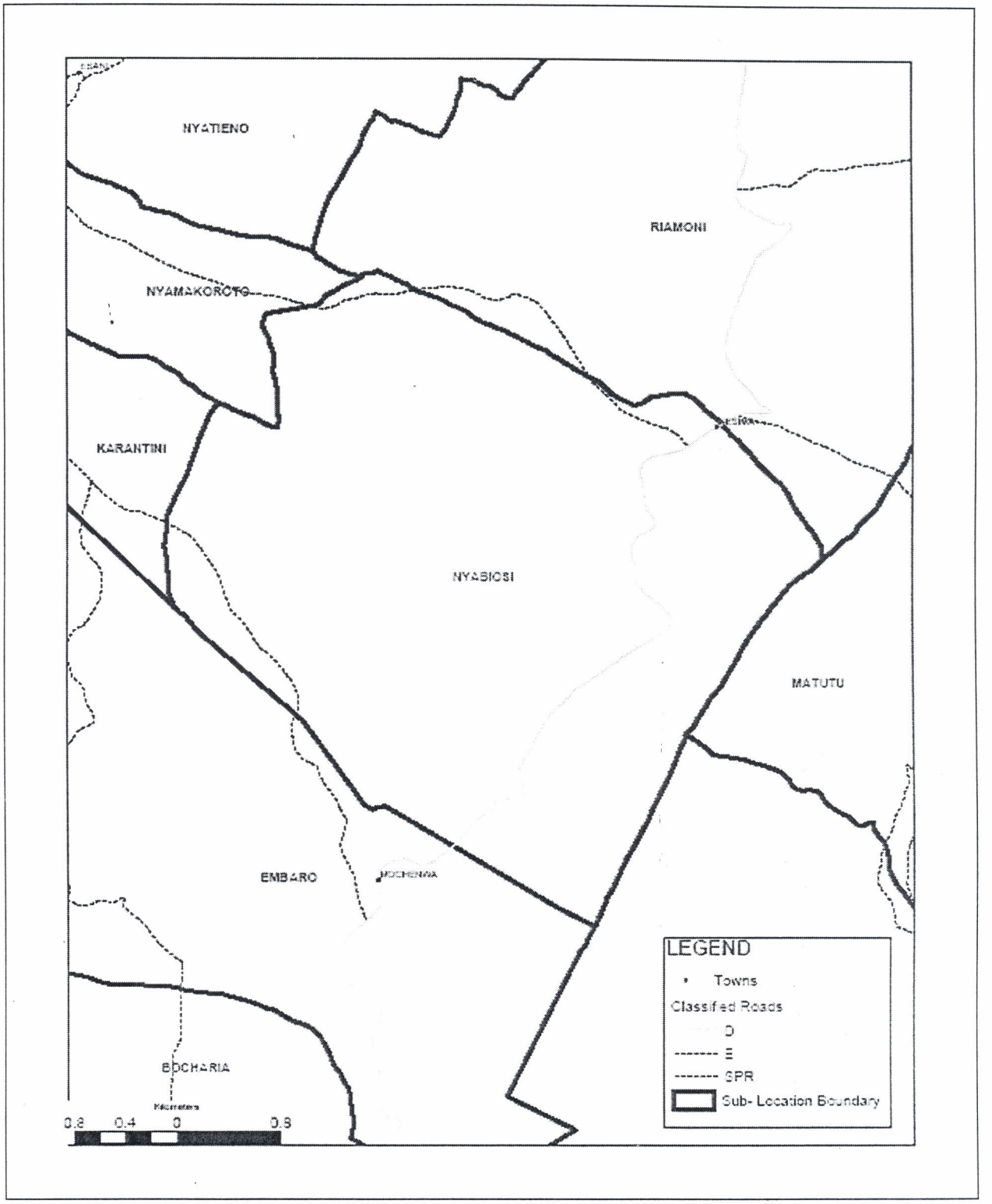
Source: Field Survey, 2006

to that of the division and the district (see Plate 4-7). However, this implies that the maintenance requirements for the road network in the study area are high. Compared to gravel roads, earth roads require more frequent maintenance to keep them in a motorable condition.

Plate 4-7: Earth Roads Dominate the Transport Infrastructure

Source: Field Survey, 2006

Map 4-1: Road Network in Nyabiosi Sub-Location



4.4 Transport Support System

4.4.1 Public Transport Services

There is an association of vehicle owners which control the operations of the passenger service vehicles *"matatus"* linking the main commercial center with the hinterland (including the study area). The cartel is unregistered and it main role is to lobby for the interests of its members. It ensures orderly picking of passengers at the terminus. However, it does not regulate the fares charged by its members. The fares charged are determined by the market demand-supply conditions. New entrants into the association are required to pay minimum of Kshs.7000 in order to be allowed to operate on the route. There is also a daily fee of KShs 60, which is paid to the association by each *matatu.* The money is periodically banked and lent to members in case of emergency repairs.

Vehicle repair and maintenance services are provided by the private garages and workshops situated in local urban center. The services provided range from tyre puncture repairs to a complete engine overhaul. The operations in these workshops are sometimes hampered by unavailability of spares parts in the local hardware shops. In such situations, the owners of the vehicles under repair have to travel to major towns in the region (such as Kisii, Kisumu, Kericho and sometimes even Nakuru) to obtain the spares. Delays in obtaining spare parts reduce the number of vehicles operating on route.

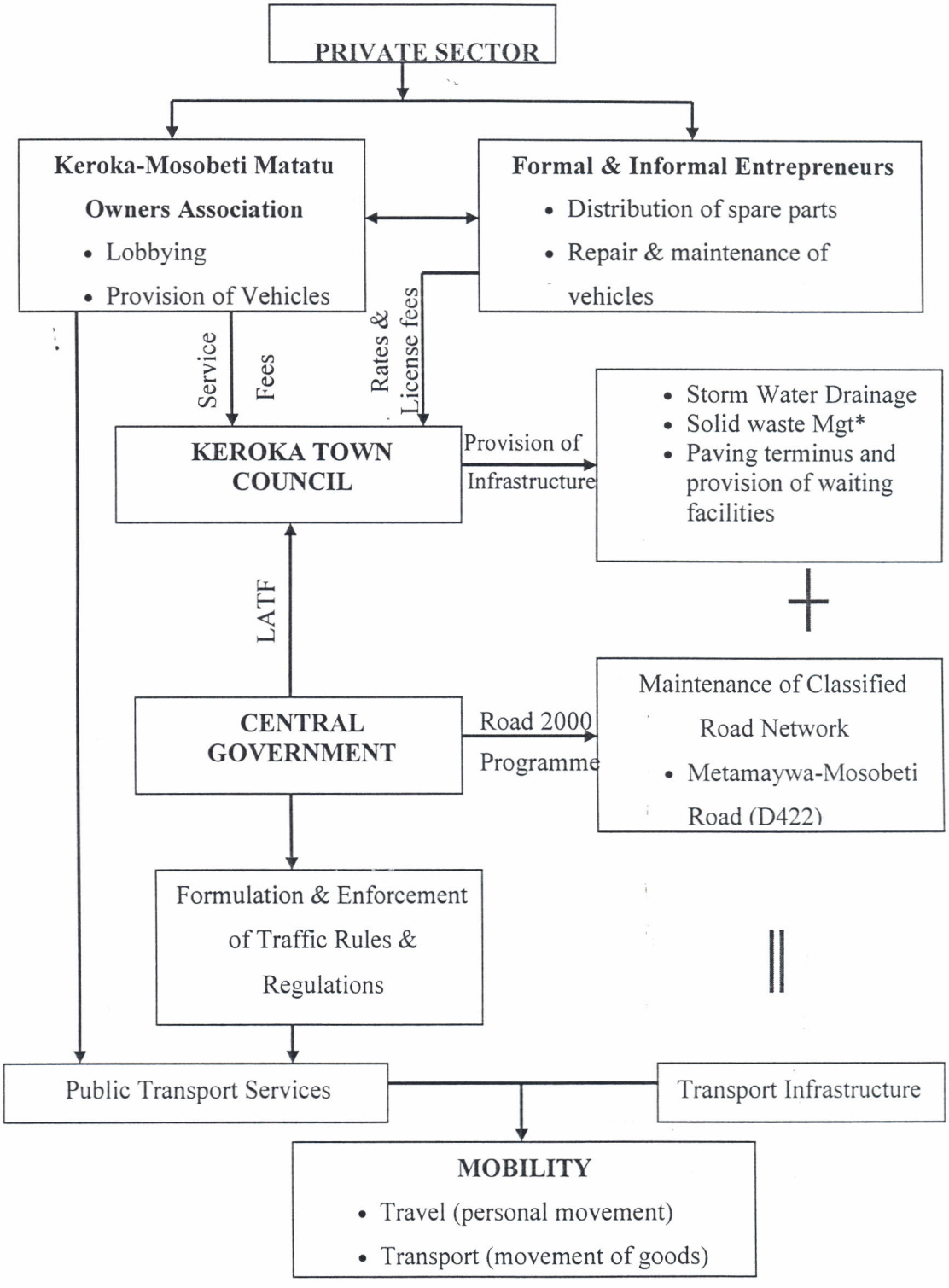
Public agencies also play a key role in the operation of public transport services in the area. At the local level, the Town Council of Keroka levies a service fee of Kshs 40 on each matatu. In return, the Council provides solid waste management services within the terminus. The council also provides other infrastructural services such as drainage, repair of terminus pavement and erecting sheds for the passengers waiting to board the vehicles.

At the national level, the central government formulates traffic rules and regulations, which are enforced by the Kenya Police. The route leading to the study area has two police roadblocks. The police officers manning these roadblocks ensure that the public service vehicles operate in accordance with the Traffic Act. However, cases of extortion and corruption are rife at these roadblocks as the law-enforcing officers openly solicit for

bribes from the matatu operators. On average each matatu owner parts with Kshs 400 daily – making the provision of motorized passenger transport unprofitable. This is a major source of frustration to the PSV owners whose net daily collections hardly exceeds Shs 750.

The roads on which these PSVs operate are classified and are therefore under the management of the Ministry of Roads and Public Works (MoR&PW). However, due to budgetary constraints, the maintenance of the Class D Metamaywa-Mosobeti road has been irregular. Although the road was in fairly good condition during the survey it was established from the road users that the situation changes drastically for the worse during the rainy season

Figure 4-2: Summary of the Public Transport Support System



Notes: Mgt = Management*

Source: Field Survey, 2006

4.4.2 Village Transport

4.4.2.1. Maintenance of Village Infrastructure

Generally in Kenya, all categories of the formal road network for motorized transport have institutions responsible for their construction and subsequent maintenance. However, there is no legal body responsible for path/trail/track segment of infrastructure and there is practically no maintenance on them except what community members may do as a temporarily measure to secure access. This means that roads, which very few people use, get attention and resources from government organs; whilst footpaths, trails, tracks and footbridges used intensively by the overwhelming majority of rural households are given neither attention nor resources.

In Nyabiosi sub-location, the village infrastructure is developed and maintained through community efforts especially those leading to community facilities. This work is mainly accomplished through the use of local resources (labour and materials). The village leadership plays a key role in mobilizing the residents. Places where "spot" improvements are often required include:

- Poor condition of paths or trails such as rocky sections making paths too narrow or overgrown making them difficult to use as the surface is hidden and the low branches hurting people behind especially babies on women's backs (see Plate 4-8).

Plate 4-8: A path covered by overgrown vegetation

Source: Field Survey, 2006

- River crossings where, especially in the wet season, streams are a barrier and crossings are hazardous or people must take long detours; and
- Footpaths over steep terrain or poor soil, which become dangerous to pass along in the wet season, particularly if people are carrying heavy loads.

The financing and implementation of important tracks leading to key facilities such as health centres and schools are now receiving greater attention through the newly created constituency development fund (CDF) (see Plate 4-9).

Plate 4-9: Use of CDF in rehabilitating important tracks in the sub-location

Source: Field Survey, 2006

4.4.2.2 Maintenance of Intermediate Vehicles

Maintenance and repair services for intermediate transport vehicles (wheelbarrows and bicycles) are available in the local market centers. The "fundis" for bicycles show considerable ingenuity in refurbishing scrap parts such as making the inner tube from two old ones for bicycles. Homemade wheelbarrows are often repaired at home. Since repair works for the formal wheelbarrows often involve welding, they are only repaired at the main urban center since where there is electricity connection.

CHAPTER FIVE

TRANSPORT NEEDS AT THE HOUSEHOLD LEVEL

5.1 Introduction

The present research presumes the household to be the generator of the travel patterns. Thus this chapter presents household access and mobility needs to destinations varying from life sustaining basic needs to life enhancing social visits accomplished both on and off the motorized service network. The chapter starts by an analysis of the socio-economic characteristics of the sample households and then proceeds to give an analysis of the data collected for different purposes are given, including that for water, fuel wood, grinding mills, health facilities, education, farm inputs, crop production and harvesting, marketing, and social visits.

The chapter assesses the magnitude and patterns of household transport demand in terms of:

(i) Distance, or time of travel to the facility/service;
(ii) Frequency of trips to a facility/service;
(iii) Modes of transport used for different trip purposes; and
(iv) Distributions of various transport responsibilities within the household.

The chapter closes with a quantification of the time and carrying effort spent by households on transport. This analysis is based on the methodological approach adopted by Intermediate Technology Transport Consultants (UK) and International Labour Organisation (ILO) in rural transport analysis in Makete region of Tanzania in 1986 (see page 17).

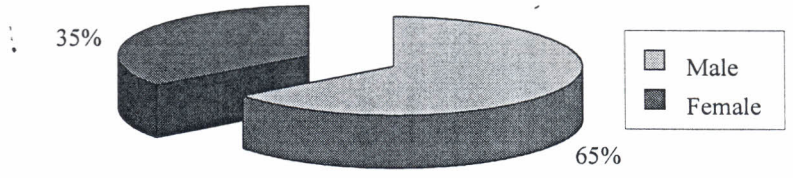
5.2 Socio-Economic Characteristics of Households

This section presents with baseline information about the composition and economic characteristics of the sampled households. Under household composition the items discussed include the size, a dult/child split, and sexes of the members. These factors have an effect in the household consumption needs (and hence access and mobility needs) and the distribution of transport responsibilities within the household.

5.2.1 Head of Household & Marital Status

Presently both male and female members head households in the study area. Male household members head 65per cent of the households surveyed. The remaining 35 per cent are headed by female members (see Figure 5-1).

Figure 5-1: Present Head of Household



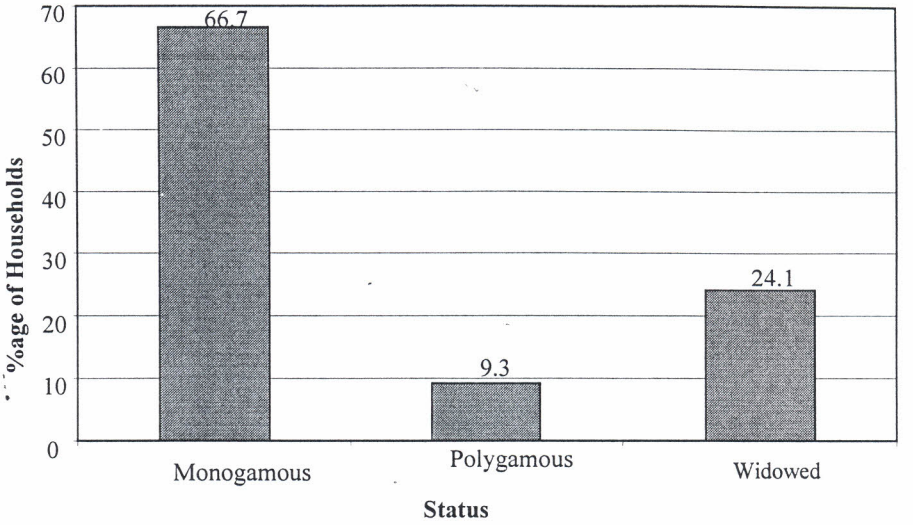
Source: Field Survey, 2006

Majority (66.7per cent) of the household heads are monogamous, 9.3per cent polygamous and the remaining 24.1per cent widowed (see Figure 5-2). Among the households surveyed, no male household head was widower. Husbands marry after the demise of their spouses. Analysis of the present household heads and marital status reveals that there is a significant out-migration of the male spouses to seek non-farm employment outside the sub-location. This explains why there is a difference between the percentages of female- headed households (35per cent) and that of household heads that are widowed (24.1per cent).

5.2.2 Household Size

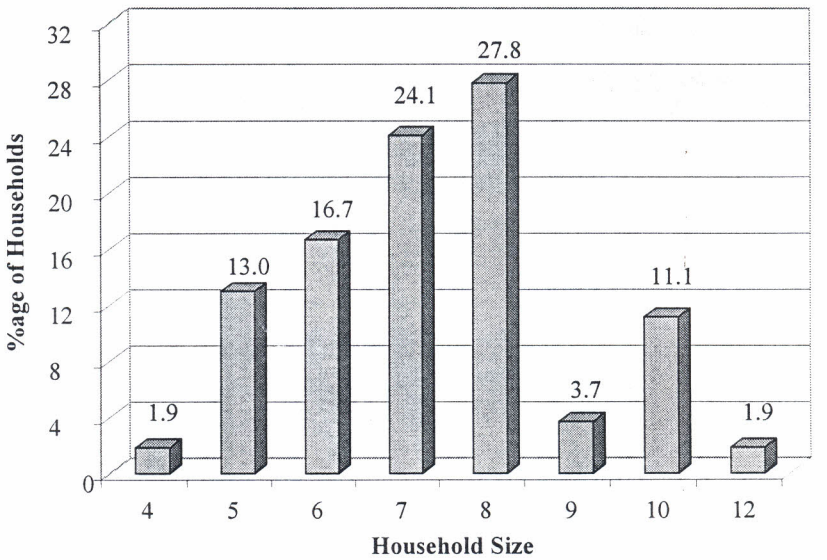
Results from the household survey indicate that the average household size is seven members. This is a fairly large number when compared to that of the Rigoma Division that stands at five. The large household size implies that the household consumption needs are high and therefore increased transport activities. The household size ranges from four to twelve (see Figure 5-3). These figures relate only to members of the household who are regularly present in the household. It ignores those who are away for prolonged periods because these are assumed to be of minor significance to the overall transport characteristics.

Figure 5-2: Marital Status of the Household Head



Source: Field Survey, 2006

Figure 5-3: Household Size Distribution



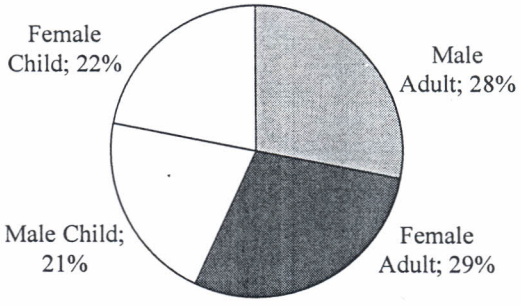
Source: Field Survey, 2006

5.2.3 Household Adult/Child Split

Children of secondary school-going age and below constitute 43per cent of household members in the area. This figure relates to only those children who are consistently living at home and therefore figure does not include children who are studying in boarding schools rather only those who attend local day schools. This means that about half of the household members are dependants. The percentage of adult female household members (29per cent) is slightly higher than that of their male counterparts

(28per cent). This again is attributed partly to the outward migration of able-bodied to seek farm and non-farm employment opportunities in areas outside the sub-location.

Figure 5-4: Household Adult/Child Split

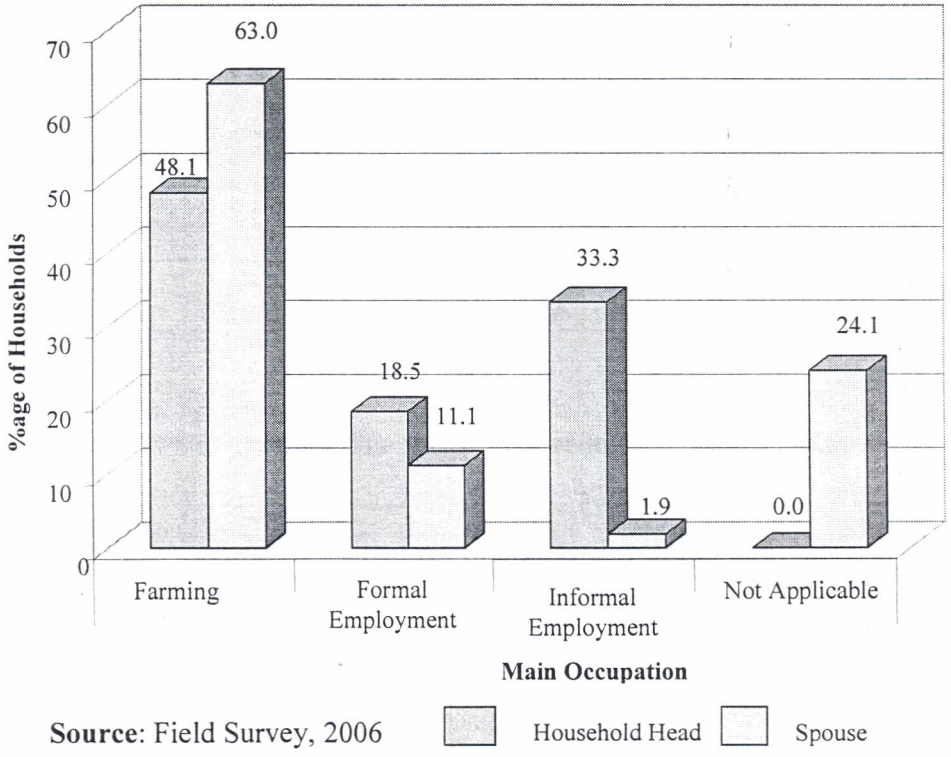


Source: Field Survey, 2006

5.2.4 Main Occupations of Key Household Members

Farming is the main occupation for 48.1per cent and 63.0per cent of household heads and spouses respectively (see Figure 5-5). These results are consistent with the known fact that the contribution of women to agricultural development is enormous. Household heads (who are mainly males) dominate the non-farm economic activities - 18.5per cent and 33.3per cent engaged in formal and informal employment respectively.

Figure 5-5: Occupations of Key Household Members

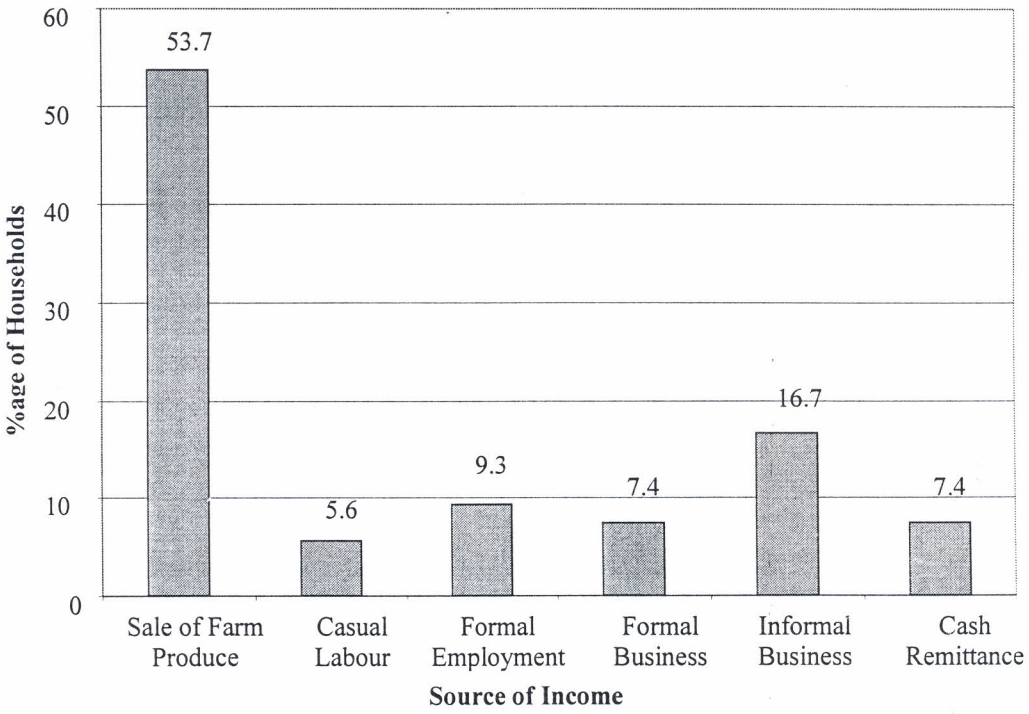


Source: Field Survey, 2006

5.2.5 Income and Expenditure

All households in the survey reported some form of cash income (see Fig. 5-6). For 53.7per cent of households, agriculture is the main source of income. Informal business activity is the main source of income for 16.7per cent of households, regular paid employment for 9.3per cent, and formal business activity for 7.4per cent. Cash remittances from relatives are also a significant source of income – they are the main source of income for 7.4per cent of households. This confirms the subsistence nature of agriculture in the sub-location and the out-migration from this area.

Figure 5-6: Main Sources of Income for the Households



Source: Field Survey, 2006

92.6per cent of households in the study area require on and off-farm transport to accomplish economic activities, which are the main sources of income for the household. For instance, a household that is engaged in informal business activity require efficient and cost-effective transport services to ensure that the business remains profitable (see Plate 5-1).

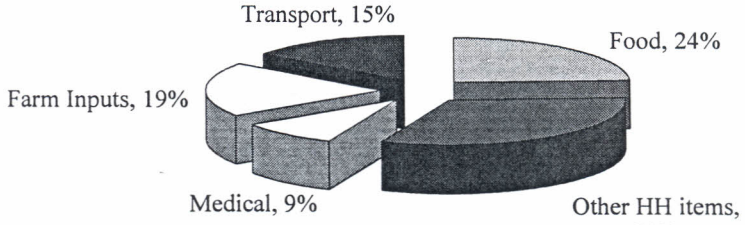
Plate 5-1: Young men engaged in small enterprise activities

Source: Field Survey – 2006

The average monthly household expenditure is Kshs 2010. According to WMS (1997), any adult person in the rural areas spending less than Kshs 1239 is considered to be poor. Since the household survey indicated that there is an average of four adults per household, residents in the study area can be considered as being poor. This average monthly expenditure for the sub-location is relatively higher than previous cash estimates for the district. The relatively high level of expenditure most probably reflects cash income from tea. (Nyabiosi sub-location is in Rigoma Division, which is the leading tea producer in the district). It may also be due to the significant number of households in the sample who are engaged in non-farm economic activities.

Transport expenses constitute 15per cent of the total household expenditure (see Fig. 5-7). There are variations in the level of expenditure in transport. This is attributable to the variety of sources of income for the households. Households that depend on non-farm economic activities, particularly business spend substantial amounts on public and hired transport.

Figure 5-7: Key Household Expenditure Items

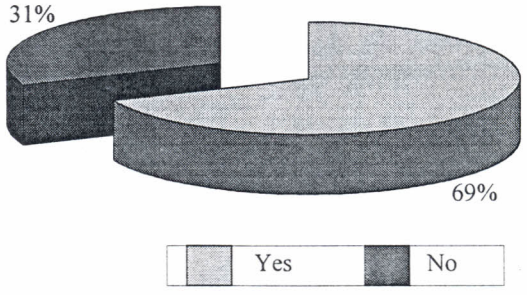


Source: Field Survey, 2006

5.2.6 Household Assets

Only 11.1per cent of households have kerosene stoves, indicating that cooking and heating of water are primarily dependent on use of firewood. 33per cent of households have charcoal stoves indicating a significant demand for charcoal amongst these households. Radios are common – available in at least 90per cent of the households. About 69per cent of the households own houses with corrugated roofs, the remainder using traditional roofing materials.

Figure 5-8: Ownership of Corrugated Roof



Source: Field Survey, 2006

The ownership of corrugated roof does not necessary indicate higher standard of living. Due to population pressure, land that used to be under the traditional thatch material has been converted to agricultural use. The scarcity of the thatch material has caused escalation of the cost of the material to an extent that it is comparable to the cost of

corrugated iron sheets. However the ownership levels indicate the potential of a household to harvest rainwater during the wet season hence reducing the transport task involved in fetching water from sources outside the farm. All households with corrugated roofs had at least a facility for rainwater harvesting. However the capacity of these facilities varied so much.

5.2.7 Agricultural Characteristics

Given the importance of agriculture, data on this subject is also relevant to the economic characteristics of the households

5.2.7.1 Land Holding Patterns

Due to population pressure, land fragmentation characterizes Nyabiosi sub-location. The majority of households own only one field (57.4 per cent). The maximum number of fields owned is 3, which are owned by less than 4per cent of the households. The results indicate that a significant number of farmers in the neighbouring sub locations hire out parts of their farms to make ends meet. Figure 5-9 shows the distribution of land owned by households. The farm sizes ranges from 1.0 to 3.5 acres.

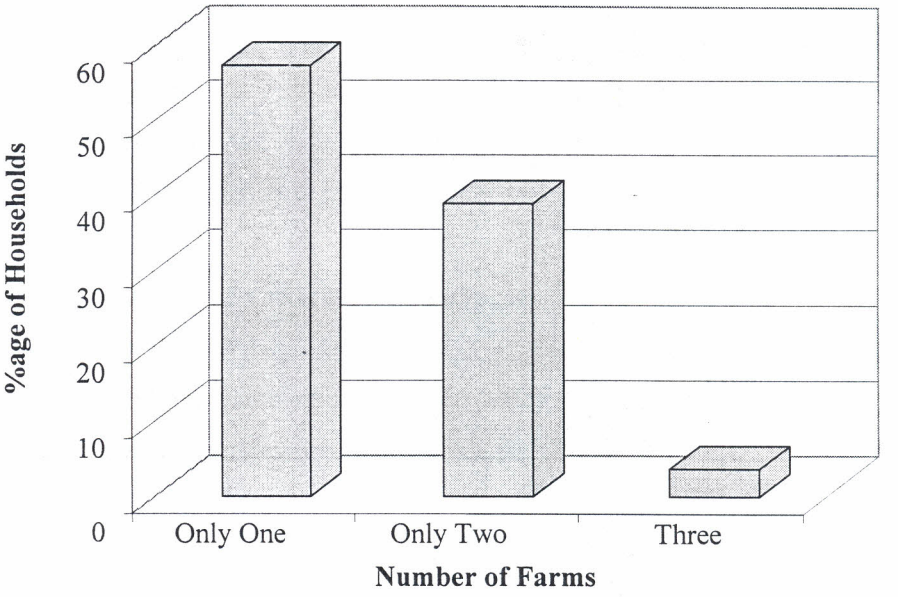
The cultivation of more distant fields means that more time is needed to travel to the fields for production activities. It also means more time and effort is needed to transport a unit of harvested output back from the fields. 100 per cent of the households surveyed cultivate all land available to them. The acreage to household size ratio is less than 0.28. These findings are consistent with the known pressure for land in the wider Gusii region. This pressure has resulted in land degradation in some areas.

5.2.7.2 Crops Grown

The predominant crop grown by all households surveyed is maize. Other food crops grown include beans, sweet and irish potatoes, bananas and finger millet. Over 75 per cent of household grow tea - a cash crop invariably for generation of income. Maize is grown for both domestic consumption and marketing. The amount of marketed is considerably higher for those households with more than one farm. It was not possible to accurately ascertain the percentage of each crop grown as no one field is devoted for one crop. All the households surveyed own an average of three cattle. The cattle are kept

basically for milk production. Households with oxen use them to provide draught power for ploughing land.

Figure 5-9: Farm Holding Patterns



Source: Field Survey, 2006

5.2.7.3 Farm Inputs

There is widespread use of farm inputs by farmers in the area. Due to small size of the farms, 96per cent of households have embraced input-intensive farming to increase the yields. The farm inputs used include fertilizers, improved seeds, animal feeds and farm implements. The fertilizers are mainly applied to maize and tea. The input-intensive farming means that there is an additional task of transporting those inputs from source of supply to the fields. The use of input-intensive farming techniques increases the likelihood of households operating at near subsistence to produce a surplus above its consumption needs. An increase in production will therefore increase the household demand for transport to market the surplus output.

5.3 Travel and Transport Patterns of Households

The above section has presented the socio-economic characteristics of the households in Nyabiosi sub-location. This section deals with the travel and transport patterns of the

households. The study has classified the household trips on the basis of the purpose of travel. The broad purposes used to classify the trips are as follows:

(i) Trips for subsistence and domestic needs: these include trips to fetch water and firewood and trips to grinding mills.

(ii) Trips for in support of agricultural production (farm cultivation, crop harvesting and harvesting).

(iii)Trips to access services and social purpose: these include trips to health facilities (dispensary and hospitals), and trips to market

5.3.1 Transport for Subsistence and Domestic Purposes

5.3.1.1 Water Collection

The sub-location has no piped water supply. Natural water sources outside the farms are the main sources of water for a majority of households (see Table 5-2).

Table 5-1: Water Sources for the Households

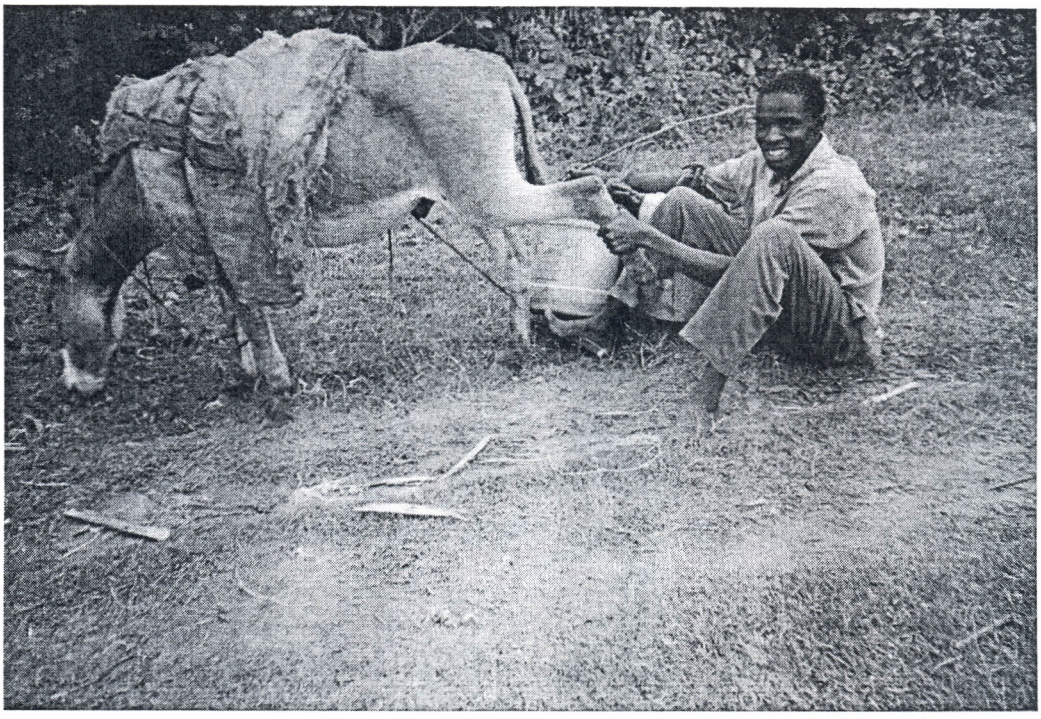
Source	Season	
	Dry	Wet
Within the Farm	5.6%	11.1%
Outside the Farm	92.5%	31.5%
Sources in and outside farm	1.9%	57.4%
Total	**100%**	**100%**

Source: Field Survey – 2006

Due to high ownership of houses with corrugated iron roofs, there are seasonal patterns of trips to water sources and hence the amount of water collected in dry and wet seasons. During the dry season, over 90% of the households obtain water from sources outside the farm. This percentage reduces to 31.5% during the wet season. Water collection is a daily activity for the households. During the dry season, households make an average of seven trips – with a one-way journey taking nine (9) minutes. Although the number of trips decreases to four during the wet season, the trip duration slightly increases to eleven. This was attributed to the poor condition of the paths leading to the water sources.

In over 77% of the households, water collection is an activity for women and children. The main mode of transport is head loading. There is some evidence of young men contributing to the task particularly in households owning donkeys or wheelbarrows or where one is paid to transport the water (see Plate 5-2).

Plate 5-2: A young man on the way to a water source



Source: Field Survey, 2006

An examination of the survey sample reveals that the usage of IMTs by women and children to fetch water is very low. A cross tabulation of the mode of transporting water indicates that 91.3% of the children and women carry water through head loading compared to only 2.2% of men (see Table 5-2). 97.8% of the male household members who contribute to the task of collecting water use either donkeys or wheelbarrows compared to only 8.7% of their female/child counterparts.

Table 5-2: Cross tabulation of who collects water and mode of transport used

Who Collects Water?	Mode of Transport			
	Head loading	Donkey	Wheelbarrow	**Total**
Children/Female	91.3%	6.5%	2.2%	100%
Male	2.2%	42.8%	55.0%	100%

Source: Field Survey, 2006

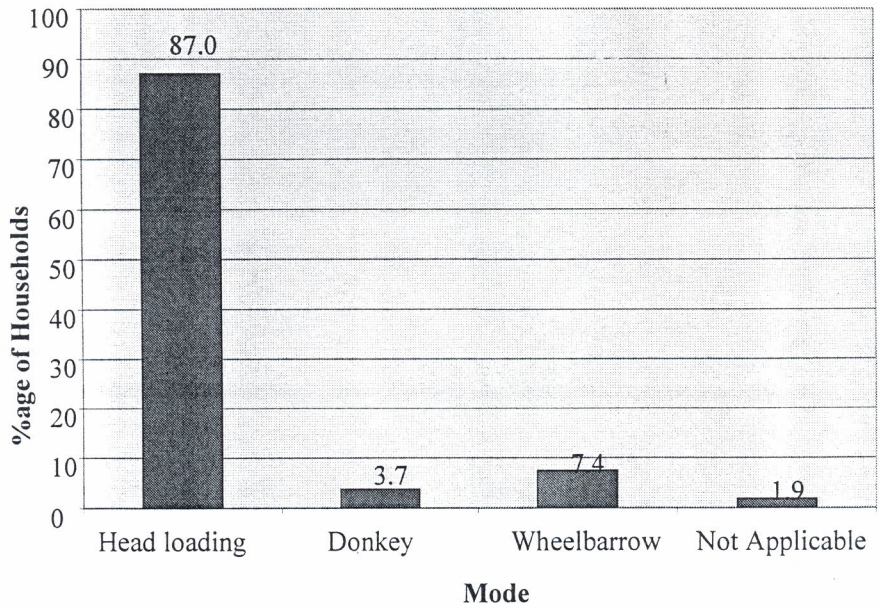
Over 60% of the households use at least four number-20liter jerry cans for carrying water from streams. In the house, the water is transferred to large vessels. This implies that the households can benefit from using simple low-cost vehicles e.g. wheelbarrow, which can carry several containers.

5.3.1.2 Firewood Collection

98% of the households surveyed rely on firewood as the main source of cooking fuel. Majority of households collect firewood from sources other than their own cultivated land (*shamba*). This implies that majority of household have to make special trips to collect firewood; they cannot be combined with trips to the fields. The sources of firewood include the forest cover on the hilltops and in swampy places.

Firewood is collected less frequently than water because the amount of household consumption is smaller and can be stored. To satisfy its energy requirement, a typical household makes an average of 2trips per week compared to 7trips per day for water during the dry season. On average a household are 1.5km away from the firewood sources. This means that averagely a household spends about 1.5hours travelling to and from firewood sources every week.

Figure 5-10: Mode of Transporting Firewood



Source: Field Survey, 2006

89% of the households indicated that it is the responsibility of the female/child household members to fetch firewood. This task is mainly accomplished through walking / head loading (see Fig. 5-10). Due to high population density, the area has been denuded of fuel wood resources. The available woodlots cannot adequately meet the needs of the villagers. This has caused women and children to travel far to collect the firewood. The search for firewood has brought about many conflicts – over 50% of the households indicated that in the course of collecting firewood they on some occasions accused of trespassing somebody's property.

As a surviving strategy during times of severe shortage of fuel wood, many households revert to using after harvest crop residues (e.g. maize stalks, millet husks and pruned tea branches) as inferior substitute cooking fuels (see Plate 5-3). Although this helps to reduce household time spent in collecting firewood, it has detrimental effects on land productivity since it reduces the amount of humus in the soil and exposes the soil to the agents of erosion. Moreover, these substitutes are not effective cooking fuel.

Plate 5-3: Dry pruned tea branches used as inferior fuel wood substitute

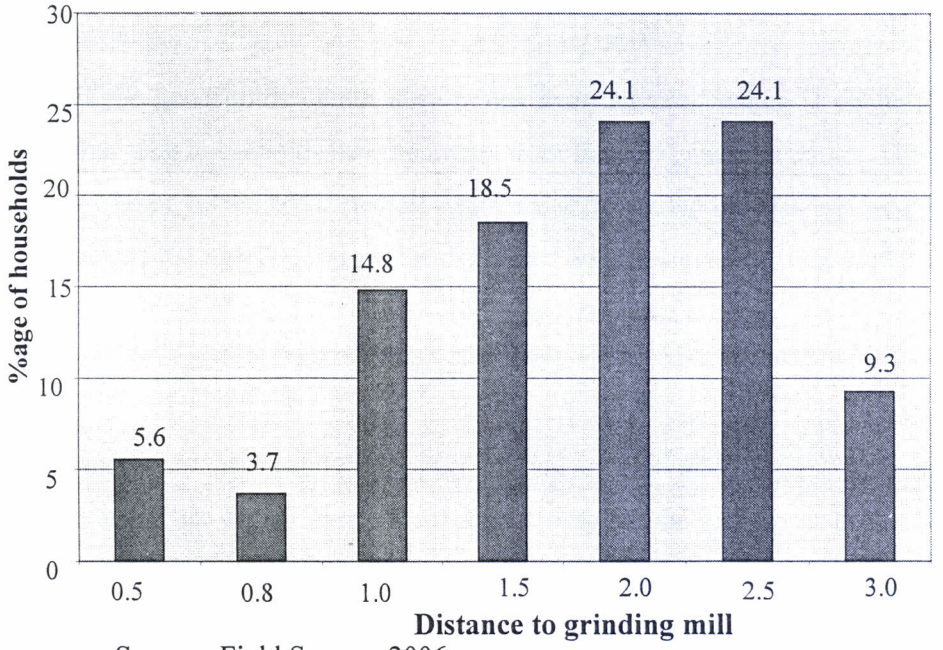
Source: Field Survey, 2006

5.3.1.3 Travel to Grinding Mills

Most people in the region eat *"obokima"* (a thick porridge made from flour of maize a rather hard grain). Thus most households use grinding mills for primarily grinding maize grains to flour. However, to a small extent the same mills are also used for other grains such as finger millet, cassava and wimbi. The grinding mills are privately owned and their location depends on the catchment area. In some instances, households travel to more distant grinding mills in order to get the quality of flour they desire. This contributes to unnecessary waste of a lot of time and effort for grinding.

In 89% of households surveyed, the task of taking grains for grinding is for women and children. In these households there was no evidence of using IMTs to the grinding mill. In the remaining 11% of the households, men contribute to the responsibility of going to the grinding mill by using wheelbarrows. On average a household is 1.84km from grinding mills. But this distance varies from one household to another (see Figure 5-11). Each household makes an average of 1.1trips to the grinding mill per week, each trip carrying a load of 16.2kg. Maize grinding is frequent activity because the flour becomes bitter within a few days if stored. This implies that there is little potential of reducing the time and effort of travel to the grinding mill using means of transport with a greater payload than the 10 – 20kg that is possible by head loading.

Figure 5-11: Distance to Grinding Mills from the Households



Source: Field Survey, 2006

5.3.2 Travel & Transport for Agricultural Production

As already observed, agriculture is the mainstay of the economic well being of majority of the households in the study area. Therefore travel and transport related to agricultural production is of great importance. This section deals with movements made to support crop production and harvesting.

Crop Production and Harvesting

Crop production activities range from land preparation, planting to weeding. They involve regular travel to the field, often for a number of members of the household during the growing season. Agricultural production takes place both in the homestead and away. Thus the transport input in crop production depends on the extent of land cultivated, the number of fields used and their location in relation to the household.

Farm Inputs

Households that have adopted input-intensive agricultural systems to boost their yields have an additional transport responsibility of moving the inputs from source to the homestead and to field. The burden is even more for households with distant farms. The exact amount of input used varies with the size of farm under cultivation and financial status of the household at the planting time. However the amount of fertilizers and seeds used per household are 67.78kg and 20kg respectively.

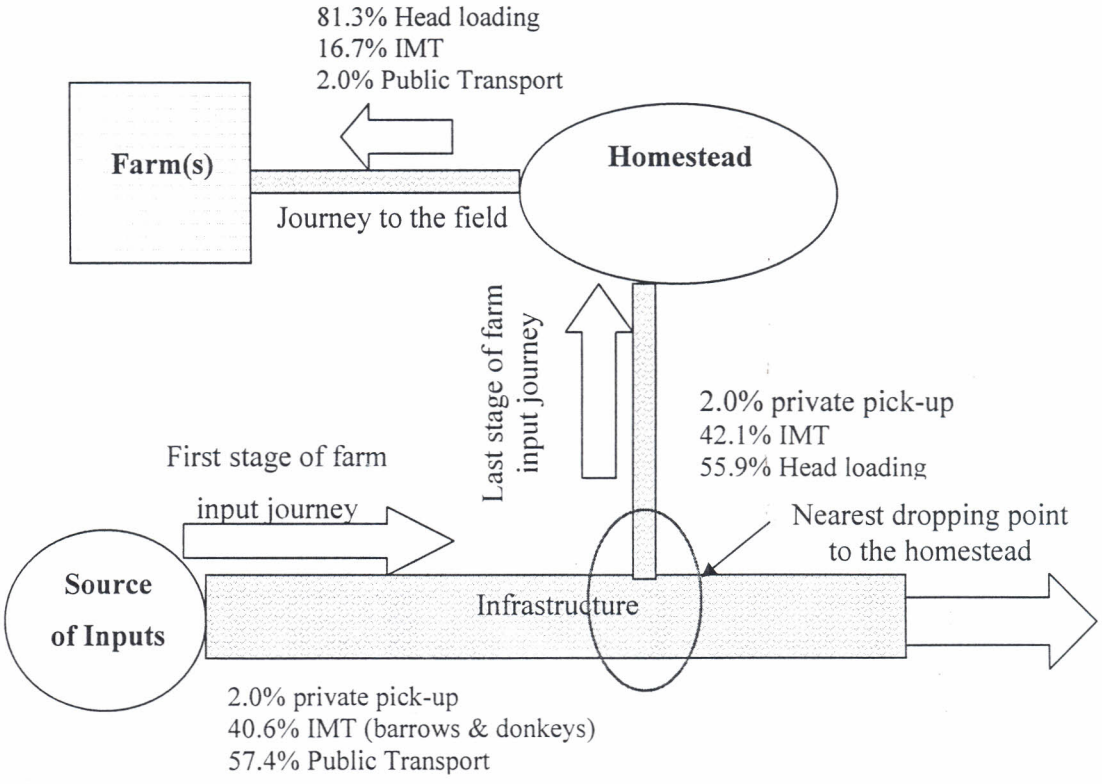
Over 57% of the households obtain farm inputs from Keroka, which is about 12.6km away. The remaining households buy the inputs from the local market centres. The prices of inputs are higher in the local market centres due to transport cost incurred by the traders. Moreover, the inputs obtained locally are of doubtful quality. This explains why most farmers prefer to obtain their inputs from appointed dealers who are only found in the main commercial centre.

57.4% of households use public transport to deliver the farm inputs from source. However they often use complementary modes to complete the journey as public service vehicles cannot reach everyone's home (see Fig. 5-12). Of particular significance, is the use of wheelbarrows by non-owners during the last stage of journey to the homestead.

This shows that there is some hiring of IMTs amongst households but the payment is not in cash rather in kind.

In 59.3% of households the delivery of inputs from source is an activity of the male members. However, this percentage drops to 38.8% when it comes to transporting the inputs to the fields. This is probably due to the fact that the main mode of transporting the inputs from source is public transport due to the bulkiness of the inputs compared to the small weights that can be "conveniently" carried by women/children to the fields by head loading.

Figure 5-12: Transport of Farm Inputs - Modal Split



Source: Field Survey, 2006

Travel to Cultivation

An Analysis of the survey sample indicates that 96.3% of the households are within 5min walk from the first farm, while the remaining 3.7% of the households are within 30min

walk from the first farm (see Table 5-3). This implies that the transport input to crop production on the first farm is not onerous to majority of household. Nearly 67% of households with a second or third cultivatable farm, a trip to the field involves more than 30minutes walking for the two-way journey. Considering that travel to and from the fields is almost a daily activity in the growing season, and that several households participate, the total time devoted to travel is significant.

Table 5-3: Time Spent Walking to the Farms

Time (T) to farm (Walking time- one way only)	Farm 1		Farm 2		Farm 3	
	No. of HHs	%age	No. of HHs	%age	No. of HHs	%age
T ≤ 5min	52	96.3	3	14.3	0	0
15min ≤ T >5min	2	3.7	4	19.0	0	0
30min ≤ T > 15min	0	0	7	33.3	0	0
T > 30min	0	0	7	33.3	2	100
Total	54	100	21	100	2	100

Notes: HHs = Households

Source: Field Survey, 2006

Crop Harvesting

While the transport for domestic and crop production activities is evenly distributed over the year, that of transporting farm produce (especially maize) from the fields is concentrated in a short duration. Female household members mainly carry out the former activities while the latter usually involve almost all family members. Households with farms outside the homestead have bigger transport task to and from the farms.

Harvesting normally involves the transport of crops by household members from the field back to the house. The varieties of crops grown in the study area have different harvesting transport patterns. Maize is the crop, which imposes the greatest transport burden. It is the main staple food, and is heavy and (as harvested) bulky. The harvesting season is concentrated so that a large amount of maize has to be carried from field to household over a short period of 1.33 weeks. At this time, the harvesting transport task

must be carried out in addition to the regular domestic transport activities. Bananas are the next most important food crops in terms of the households growing them and contribution to household diet. However the transport pattern is one of frequent collection of small quantities, often in conjunction with travel to the field for other purposes. Moreover in some cases bananas are sold to traders "in the field". In this case responsibility for harvesting and transporting the crop is transferred from the household to the trader.

Tea is the most important cash crop grown in the area. Tea is harvested through the year, rather than over a short season, so that the transport requirement is less concentrated than for maize. The average weight of tealeaves harvested per week is 47.8kg that is delivered to buying centres that are about 1.8km away from the farms.

In general the task of transporting harvested crops is shared between males and females. In the case of maize, probably because of the need to transport a large amount in a short period of time, the survey found that in most households both male and female members participate. There is limited evidence of labour being hired to carry crops from the field to the house.

5.3.3 Travel to Socio-Economic Facilities and Services

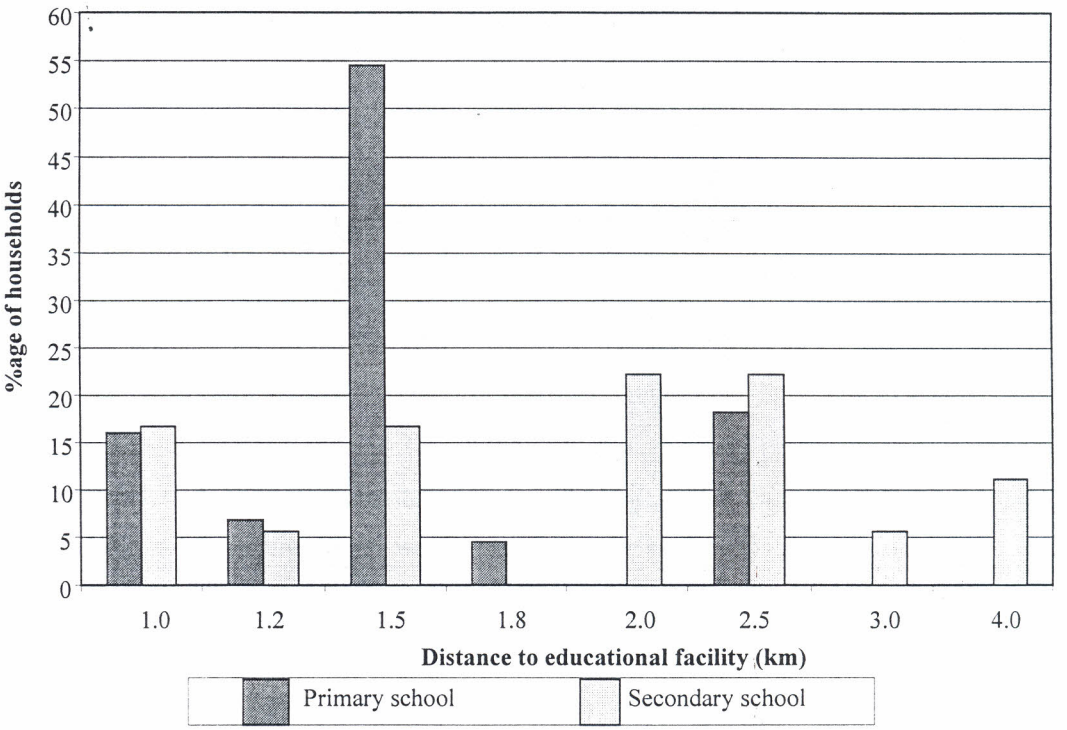
5.3.3.1 Travel to Educational Facilities

81.5% of households surveyed had at least one child going to the local primary school. This percentage reduced to only 33.3 for households with children going to the local secondary school. The difference is due to the fact that some parents send their children to boarding schools far from home after graduating from primary schools. Moreover, there are a substantial number of households, which do not send their children to secondary school due to lack of school fees.

Although all children walk to schools, this does not impose a lot of burden on them since primary schools are within 1.5km a way from the homestead while secondary schools are 2km away. However, these figures are only averages. There are a lot of variations in terms of access to education facilities (see Figure 5-13). Households do not necessary send their children to the nearest available educational facility. Some send their children

to schools which are far due to high academic standards in the said schools. 30% and 27.8% of households having primary and secondary school-going children respectively complained about the poor condition of the water crossings their children are using on the way to and form school. The problem becomes acute during the rainy season when the water level rises and the temporarily crossings are washed a way. In such situations the children have to use long detours to reach the school or their homes.

Figure 5-13: Distribution of Education Facilities



Source: Field Survey, 2006

5.3.3.2 Travel to Health Facilities

There is no dispensary in Nyabiosi Sub-Location. 70.4% of the residents travel to the neighbouring Sub-Locations of Gesima and Mochenwa, which are on average 2.7 and 1.9kms away respectively to access health facilities. The remaining 29.6% of households travel all the way to Keroka, which is over 13km away to obtain health services (see Table 5-4).

Because the need for medical treatment is not regular, the figures on Table 5-4 relates to trips made by households in the month prior to the survey. The time taken is for travel to

and from the healthy and does not include time spent queuing or receiving treatment. The dispensaries closer to the study area have only limited facilities, are sometimes short of skilled staff, and experience problems in the supply of drugs. This implies that the existence of a dispensary does not necessarily result to the availability of health facilities.

Table 5-4: Travel to Health Facility - Dispensary

Dispensary	%age of HH using the facility	Average Distance	Time Taken	Frequency (per month)	Average Cost of Travel (Kshs)
Gesima	46.3%	2.7km	33min	1.6	Nil
Mochenwa	24.1%	1.9km	26min	1.3	Nil
Keroka	29.6%	13.75km	27min	1.4	35

Source: Field Survey, 2006

Travel to the hospitals is less frequent but very significant especially during times of malaria outbreaks. An average household makes 3 trips to hospitals per year. Although both men and women travel to health care facilities, depending on who is ill, women use these facilities more frequently, for healthcare associated with pregnancy and because they are responsible for care of the young children. Although administratively the sub-location falls in Nyamira District, majority (67%) of the households travel to Kisii District Hospital for high-level health services (see Table 5-5). This is due to the better road network leading to the Kisii District Hospital compared to that leading to Nyamira District Hospital. Because of the long distance involved, people travel to hospitals by using the public transport services.

Table 5-5: Average Distances and Trips to Health Facilities

Health Facility	Weighted Average Frequency Trips	Weighted Average Distance to Facility	Mode of Transport
Dispensary	1.5 trips per month	5.4km	70.4% Walking
			29.6% Public Transport
Hospital	3 trips per year	50km	100% Public Transport

Source: Field Survey, 2006

5.3.3.3 Travel to Market

Marketing Agricultural Produce

Sale of agricultural produces is the main source of revenue for 53.7% of the households. Even households who engage in non-farm economic activities practice agriculture and on some occasions produce more than is required for household consumption. In such occasions the households require access to the markets and to dispose of the surplus. Several methods of marketing agricultural produce have been adopted. They include:

(i) Sale at small local market within the village: The local weekly markets provide an opportunity to for farmers to sell crops in small quantities of crops to meet local demand and for people to buy consumer items (see Plate 5-4). In general travel to local markets is frequent and often on foot or and head loading. Most households prefer to sell their produce in the village or local markets partly because it transfers the responsibility of transport to market to somebody else. However when the produce is sold locally it fetches little money compared to what is obtained when sold in the main market.

Plate 5-4: A woman on the way to a local market

Source: Field Survey, 2006

(ii) Sale to a middleman who comes to the village and arranges transport and marketing outside the village (this method is common after a bumper harvest); the use of informal marketing channels is widespread in the area. Sales to private traders at the homestead are important when the distance to alternative points of sale are too great.

(iii) The main markets serve large areas, provide an opportunity to sell crops to meet a wider demand, offer a wider range of consumer items, and are usually in the main centers where people can deal with other matters and meet socially. Thus travel to markets tends to be multi-purpose, with sale of crops only one and often not the most important reason for travel.

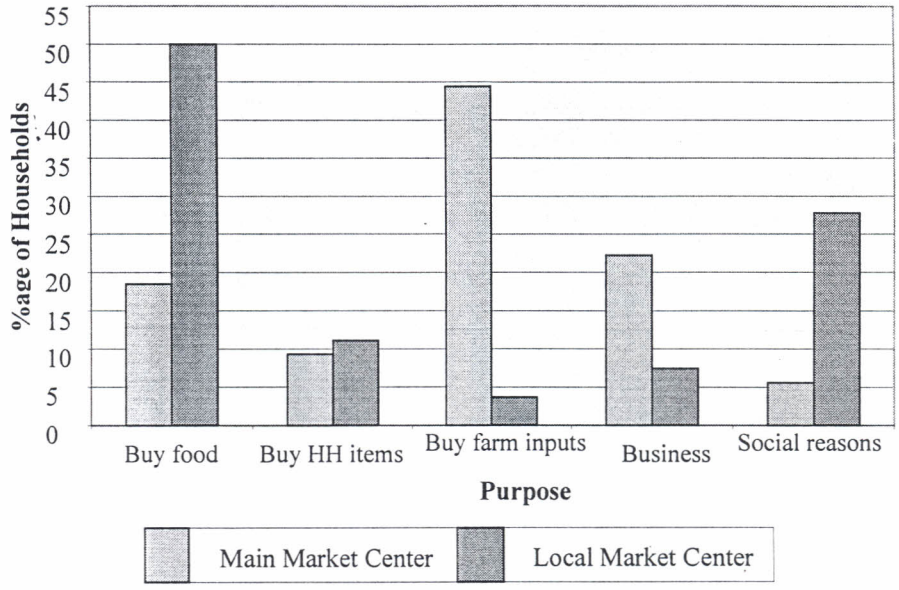
(iv) Sales through the cooperative (KCC for milk) or parastatal (KTDA for the case of tea leaves). For tea and milk, the cooperatives take full transport responsibility from buying point and their efficiency is influenced by the road condition, which changes with seasons. Therefore the main marketing problem is to carry the produce from the homestead to the buying center.

The first options are insignificant because they involve selling to the community for internal consumption. Traders who buy the agricultural produce from the study area adjust the price they are prepared to pay to the farmer depending on the cost they incur to transport it to the market. In most instances, these traders pay commercial market prices, which are however, usually lower than the official price. Cooperatives on the other hand, purchase the produce at official prices, which are often constant.

Trips to markets are often multi-purpose (see figure 5-14) Apart from going to sell agricultural produce; people visit the market centers for a variety of other reasons. Over 50% of the household indicated they visit local market center to buy food, which is not available within the farm. About 45% of the household travel to the main market center (Keroka) to obtain farm inputs, which are not normally available in the local market center or are sold expensively. Households also travel to market centers for social purposes.

The main mode of travelling to local market is by walking while travel to main market centre is mainly accomplished by using public transport. Due to this reason travel to local market is more frequent (at least 3times a week) than to the main market (2times a week), which is 12.5 kilometres away.

Figure 5-14: Purpose of Trips to Market Centers



Source: Field Survey, 2006

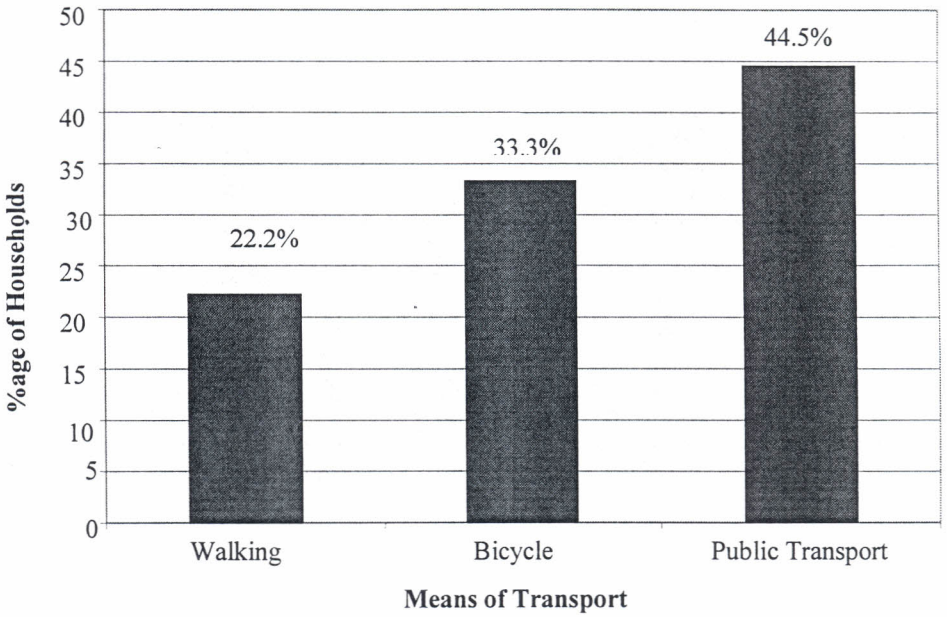
5.3.3.4 Social Travel to Other Places

Social interaction and the satisfaction of people's social needs at individual level put quite some pressure on travel, hence increasing the demand for transport. Occasions such as deaths, visits to friends/relatives and administrative activities are all reasons for rural dwellers to move out beyond the normal confines of village. Attendance at funerals especially those of the extended family members are socially obligatory. The great grand parents of most of the households in the study area migrated from Gekano area (see Map 1-2). Therefore whenever there is a funeral in the place the affected household has to be represented in the funeral

Travel outside the village is less frequent. A typical household makes an average of one social visit trip outside the village every month. These trips are on average 6.2km long. Because of the long distance involved in these trips, only adult household members are involved. In 62% of households it is the adult male members who make these long

distance social visits. The remaining 38% of households, it is the adult female members who make these visits. The modes of transport used are as shown in Fig 5-16.

Figure 5-15: Means of Transport for Social Visits



Source: Field Survey, 2006

5.4 Time & Effort Spent on Transport by Households

This section assembles the data on transport characteristics of travel to different places and for different purposes in order to develop the overall travel patterns of the households. The analysis of transport activities was concerned only with the transport element of a particular task. Thus for example, the calculation of time spent on water collection was only for travel to and from the source of water – and not the time spent at the source obtaining water.

Table 5-6 presents a summary of the characteristics of travel by the households surveyed. The figures presented are averages per household. The figures should not be regarded as precise quantitative data, but rather as indicating the magnitude and significance of transport in daily life and the characteristics and relative importance of different transport activities. It is important to note that what is presented here is only indicative and comprise an assessment of easily quantifiable trips, weights and time.

Table 5-6: Household Time and Effort Spent on Transport

Activity	Amount	%age of the total time	
Transport Time (hours per annum)		% of total time	Cumulative %age
• Water Collection	610.7	52.46%	52.46%
• Firewood Collection	76.3	6.55%	59.01%
• Travel to Grinding Mill	41.2	3.54%	62.55%
• Travel to Cultivation	98.7	8.48%	71.03%
• Crop Harvesting	80.4	0.52%	71.55%
• Travel to Dispensary	17.6	6.91%	78.46%
• Travel to Hospital	9.8	0.84%	79.3%
• Travel to Market	229.5	19.71%	100%
∑ HH Time Spent on Transport per Annum	**1164.2**	**100%**	
Average Household Size (Adults)	4		
Hours per Adult per Annum	291.1		
Transport Effort (tonne-km per annum)		**%age of the total effort**	
• Water Collection	16.38	59.07%	59.07%
• Firewood Collection	2.34	8.44%	67.51%
• Travel to Grinding Mill	2.84	10.24%	77.75%
• Crop Harvesting	6.17	22.25%	100%
∑ HH Effort per Annum	**27.73**	**100%**	
Effort per Adult per Annum (tonne-km)	6.94		

Notes: HH = Household

Source: Field Survey, 2006

The information presented in Table 5-6 together with information obtained from the interviews can be summarized in the following points:

(i) The meeting of essential rural transport needs imposes a significant burden on the time and energy of the households in the study area. In terms of time spent, a typical household spends over 1160hours per annum on transport, equivalent to 22hours per week. The household transport effort equate to 27.7tonne-km per annum, much of it

head loading, equivalent to carrying a load of 20kg over a distance of nearly 4 kilometres everyday. These figures in fact underestimate the total transport task since conservative assumptions have been made, and the data excludes transport of farm inputs to the homestead and to the field and use of education facilities.

(ii) Water collection is the single most important transport activity in terms of time and effort devoted for transport. 52.5% and 59.1% of household transport time and effort respectively are spent on water collection. Although trips to water sources are fairly short (0.6km), they are very frequent (4trips per day during the wet season 7 during the dry season) and involve more than one household member.

(iii) Water collection when combined with other domestic activities (firewood collection and travel to grinding mill), they constitute nearly 62.6% and 77.8% of the household transport time and effort respectively. ***The foregoing discussion support the study hypothesis which presupposes that transport for subsistence activities take an inordinate amount of household time and effort and therefore compromises the ability of households engaging in income-generating and welfare-enhancing, essential to the social and economic development of Nyabiosi Sub-Location***.

(iv) These findings imply that women shoulder a huge proportion of the entire transport burden in the household because they are the ones who are mainly involved in these domestic activities. The results highlight the need to reduce the time and effort devoted by rural households, and particularly by women, to transport at the local-level.

(v) Despite local transport (within and around the locality) constituting a major part of total household travel, it is noteworthy that when most men in the study area are asked to define the major transport problems, they focus on the tasks for which they are responsible and to which they contribute – transport of fertilizer and marketing agricultural produce.

(vi) After water collection, travel to markets is the next most important single activity in terms of time - accounting for nearly 20% of the household transport time. The time spent travelling to the market exceeds that spent to the crop production and harvesting.

This indicates how important trips to the market are to the household. This is probably due to the fact that household members travel to the market for a variety of purposes including selling agricultural produce, buying food that is not available within the farm, buying farm inputs and social purposes among others. However, travel to market to buy food, household items and for social purposes are much more significant than marketing crops. This is due to:

- Milk and tea are the main agricultural produce marketed in the area. Farmers for the two products benefit from cooperative/parastatal transport services. The cash obtained is then used to buy items from both local and distant markets.

- For most households, much of the produce from food crop farming is for domestic consumption. And even where there is a surplus – marketing is only concentrated at certain periods of the year (mostly after harvesting). Moreover trips particularly to the local market are more frequent.

CHAPTER SIX

SUMMARY OF MAJOR FINDINGS, CONCLUSION & RECOMMENDATIONS

6.1 Introduction

This study set to establish the nature of transport demands at the household level visa-vis the supply of transport facilities in Nyabiosi Sub-Location. This chapter presents a summary of the major findings and conclusions. Towards the end, the chapter deals with recommendations to address the mobility and access needs of rural households within the study area. These recommendations also provide important implications for the development of rural transport facilities elsewhere, particularly in other rural areas in Kenya with the same set ups.

6.2 Summary of Major Findings

The present transport facilities in Nyabiosi Sub-Location do not adequately cater for the mobility and access needs of the households. This applies to the condition of the village and feeder road transport infrastructure, and to the availability of vehicles, transport services and non-motorized means of movement. Motorized vehicle operations are concentrated on the main route with the highest demand and easiest access. There is a missing link between households and activity centres due to absolute lack of local transport services. Due to the above inadequacies, the residents continue to rely predominantly on walking and head/back loading to meet their transport needs. Much of these transport activities take place along the rudimentary transport network constituting footpaths, trails and tracks and water crossings.

The scale of household movement demands is substantial in terms of the time and physical effort involved. The magnitude of transport demand to meet essential household and domestic needs is substantially greater than in relation to agricultural production and marketing. Domestic activities related to fetching water, collecting firewood and going to the grinding mill consume a massive 62.6% and 77.8% of the household time and effort devoted on transport respectively. Water collection is the single most time consuming activity (taking 52.5% of household transport time) and also burdensome (taking 59.1% of household load-carrying effort).

The main transport burden primarily falls on women. The problem is compounded by cultural factors which limit the use of IMTs particularly bicycles by women. This not withstanding, the study found out that, women would benefit from wider availability and use of IMTs. There was evidence from the study that where IMTs are available there is some sharing of the workload, with men contributing to, or taking over the responsibility for, some transport tasks, that would otherwise be done by women. Other factors limiting the widespread use of IMTs by households include:

(i) Low ownership of IMTs: Due to high incidences of poverty, most households cannot afford to purchase any form of IMT.
(ii) The terrain is not conducive for the use of human-powered IMTs. This is a major problem particularly for households situated on the hills.
(iii) Poor state of infrastructure: The paths and trails which support majority of the household transport activities are poorly maintained. Moreover, some paths cannot allow the movement of IMTs such as the animal-drawn carts due to insufficient widths.
(iv) Lack of maintenance of the available IMTs. A substantial proportion of households possess IMTs were not in working condition during the survey.

6.3 Conclusions

Households in the study area face myriad transport and travel problems in their day-to-day activities. These problems are localized in nature and are characterized by a considerable amount of time and effort devoted on transport. Moreover, many of the transport and travel activities of the households are executed on the village infrastructure and therefore do not necessarily require the use of the conventional road network. The motorized means of transport are inappropriate to meet majority of household access needs, which consume most of their time and effort such as collection of water, firewood and travel to grinding mills.

The present transport methodologies have been found to be unresponsive to the transport and travel needs of the rural households. There is lack of perception of local level transport problems by policy makers. Continued emphasis on the development of rural road network will not by itself ensure that motor vehicles will operate along it in such a

manner as to address transport constraints on households. It is for this reason that the present research is emphasizing the urgent need to address the local-level transport system to improve mobility in and within the villages. Moreover the study underscores the importance of improving accessibility by non-transport interventions, which bring facilities and services closer to the households. Such interventions have a potential of reducing the time and effort devoted to transport and creating productive time and labour that can be applied to other more beneficial socio-economic development activities.

Finally it is clear from the study that the nature and scale of the transport problems in the study area are such that they cannot be solved by isolated local-level inputs alone. Many of the problems are directly linked to, and symptomatic of, the transport situation prevailing at the national level. Interventions to address these transport problems would be significantly enhanced by the adoption of an integrated approach – combining appropriate infrastructure improvements, low-cost devices and non-transport interventions – to address the problems of village-level transport in Nyabiosi Sub-Location.

6.4 Recommendations

The major conclusion of the study is that provision of an all-weather road network on it is own cannot adequately address the transport problems facing the household in the study area. The present research therefore proposes various transport and non-transport interventions to address the access and mobility constraints facing the households. The overall aim of these interventions is to reduce the time and effort currently devoted to meeting basic transport requirements by increasing the transport capacity available to the households.

A number of mobility and accessibility problems facing the households are fundamentally linked to the local socio-economic and cultural situation in the area and thus require interventions right at the local level. Other problems stem from the prevailing government rural development policies, which do not adequately, recognized the unique nature of transport problems facing rural households. Such problems have to be addressed at national levels by policy makers. Accordingly, the study offers suggestions to policy makers at national levels. The interventions provided here are not

mutually exclusive, rather are complementary. Implementing two or more other measures simultaneously can enhance the impact of one intervention.

6.4.1 Development of Rural Transport Infrastructure (RTI)

6.4.1.1 Village Level Infrastructure

The current institutional arrangements relegate community roads that feed into the higher levels of the road network. By mandate or by default local communities whose financing capacity is limited manage this infrastructure. External funding is commonly restricted to the national and regional roads with less emphasis on the path/trail/track segment of infrastructure. Given the importance of tracks and paths to households in meeting their transport requirements, improvements at this level would make a significant contribution to the local transport situation.

There is a case for official recognition of paths, trails, tracks and footbridges as a component of the rural transport infrastructure system. This would facilitate the provision of technical support for path and track improvements through the local government. The use of local resources and the involvement of local communities in the planning, design and implementation of activities could contribute to sustainability of village transport infrastructure development initiatives.

Any measure to address rural access problems can benefit from overwhelming willingness of the rural dwellers to contribute to village infrastructure development on self-help basis. However, such efforts are always limited to areas, which require monetary inputs. Lack of funds for procurement of materials required for the construction of drainage structures frustrates the efforts of the villagers and contributes to further deterioration of the infrastructure. Therefore this is an area in which the government and donors can help by providing funds for materials not locally available e.g. concrete pipe culverts and technical know-how required for the construction of paths, trails tracks, roads and drainage structures.

Considering the extensive network of the rudimentary village infrastructure that exists, it is not envisaged that complete walking routes would be upgraded immediately. A policy of spot improvement of tracks and paths should be adopted so that most important input

is concentrated on particular sections to eliminate particular obstructions or trouble spots that hamper the use and effectiveness of low-cost vehicles. The most urgent requirement around Nyabiosi villages involves the construction of basic water crossings and the removal of outcrops of rocks and stones and sections that become slippery or saturated in the wet season. Such low-cost interventions would make walking / head loading trips easier and, more important; facilitate the use of appropriate means of transport and to reduce the distance and effort on transporting water.

6.4.1.2 Conventional Road Network

This study does not underestimate the importance of development of the road network to the rural households. To the extent that improved road result in services being brought to the rural households, they improve accessibility and reduce the need for household travel. The conventional road infrastructure is crucial in linking the households to the urban market, where the agricultural inputs and products are transported to and from the farm gates respectively. The state of the existing roads is poor and can hardly be used especially during wet seasons due to inadequate maintenance. This leads to poor or unreliable transport services, which in turn contribute to agricultural production (e.g. tea) losses. The study recommends the pursuant of the following policy directions:

(i) Sensitize communities and villagers to realize their important role in contributing to infrastructure planning, design, construction and maintenance.

(ii) Contract local communities to manage the roads in their localities. The types of work the community can do include:

- Trimming the rocky sections of the paths or trails which make the use of IMTs difficult
- Cutting the overgrown and low branches along the village infrastructure which make their use difficult as the surface is hidden thus hurting people behind especially babies on women's backs;
- Constructing safe river crossings using local materials; and
- Filling potholes along the village infrastructure with gravel (spot improvements).

(iii) Develop a culture of routine maintenance among the rural communities.

(iv) Improve community capacity building in rural infrastructure maintenance.

6.4.2 Provision of Rural Transport Services (RTS)

Currently the government of Kenya has restricted herself mainly to provision of road infrastructure – hoping that the private sector will respond efficiently to the opportunities opened. However given the low ownership of motor vehicles by rural households, the mobility of rural dwellers can only be enhanced through the provision of adequate and affordable rural transport services. Promotion of both intermediate and motorized transport services is therefore crucial.

6.4.2.1 Intermediate Means of Transport

Due to inadequate transport facilities and low level of affordability, rural residents are captives to non-motorized modes of transport. The findings of the research reveal that low-cost, non-motorized vehicles can offer an important means of reducing the time and effort devoted to activities particularly those undertaken by women at the local level (e.g. water and firewood collection). IMTs have also the potential of reducing the burden on women by encouraging men to take up tasks formerly undertaken only by women. Moreover, IMTs can be used to link households (particularly those in remote parts of the Nyabiosi Sub-Location) to the feeder road served by motorized vehicles – effectively extending the impact of transport services provided by *matatus*.

Thus the measures proposed to increase the ownership and use of low-cost vehicles are aimed at increasing the transport capacity of households not only as an alternative but also as a complement to development of the motor vehicle system.

(i) Increasing Ownership of IMTs

There is a variety of IMTs in use in the study area. This is in recognition by the rural dwellers, of the fact that IMTs can save time and effort in carrying out activities that involve travel and transport (this can also be reflected by the use of IMTs by households which do not own one). However one of the obstacles hindering wide use of the IMTs is the high acquisition price, which is by far above the cash-income earning capacity of most households. With the size of farm holdings and consequently the incomes smallholder farmers get from sale of their crops, it is inconceivable for them to afford to buy IMTs by paying cash.

There are local institutions that assist in the area of enterprise development by providing credit to the residents (see Plate 6-1). These credit institutions should be encouraged to organizationally gear towards transport-related facilities such as IMTs. These credit schemes are better placed for the task because they impose less vigorous conditions and have more appropriate administrative procedures.

Plate 6-1: Office of a local Farmers' Savings & Credit Cooperative

Source: Field Survey, 2006

It's pertinent to note that the government has finally recognized the role IMTs (particularly bicycles) are playing in enhancing mobility in the rural and urban areas. The government has since the 2001/2002 financial year, zero-rated import duty on bicycles. However more benefits would be realized if the bicycles were manufactured locally. There is certainly a case for investigating the feasibility of local manufacture of components and spare parts. The study proposes that incentives should be given to investors who are willing to establish manufacturing plants locally. Kenya business registration procedures are very bureaucratic and expensive. A review of the tax structure for IMT manufacturers would go along way in reducing their price and hence make them more affordable to the poor.

(ii) Improving Local Expertise

Furthermore, it is evident from the field reports that there are some IMTs that are locally made and cost little in terms of cash except time and locally available wood. However, these technologies are still crude and require improvement in their design so as to increase their carrying capacity and reduction of effort to be applied by the user. Therefore it is recommended that local capacity to produce and maintain the improved IMTs be developed by giving training and providing tools to the rural inhabitants. This responsibility can be best done by NGOs.

(iii) Increasing Usage of IMTs

As established during the study, households owning IMT do not necessary use them to accomplish their transport activities. Although women are the main transporters, men are the main users of IMTs. Gender-related constraints have limited women is access to local transport solutions as most the IMTs in place are for the exclusive use of men. Widespread use of IMTs is hampered by the poor condition of rural transport infrastructure (paths/tracks, roads, etc.). Generally the paths are too narrow and rugged for the animal cart, rugged for the bicycle and slippery and muddy when wet. The terrain, too, is a major constraint to the use of IMTs.

To address the above situation the following policy directions should be pursued: -

(i) Create awareness on the use of IMTs by women (to change positively the attitude of the people towards the use of IMTs by women).

(ii) Encourage the use of IMT to ferry both passengers and goods as an alternative means to supplement the motorized transport facility.

(iii) Research should be conducted to find friendly IMT technologies.

(iv) Improve transport infrastructure in the rural areas to cater for all transport modes including IMT

6.4.2.2 Public Transport

Although there is potential to improve mobility for rural people by promoting the use of IMTs, they cannot address the full array of rural transport problems. Public transport system offers the only means for the households to interact with the wider economy by facilitating long distance travel. It increases the crop marketing opportunities and options

available to the households. Thus the development of local-level transport facilities should be complemented by improvements in the motor vehicle system. It is not just the condition of the roads that inhibits rural people from travelling by motor vehicle. Widespread use of this service is limited due to inadequate vehicles and low levels of affordability.

To tackle afore stated issues, policy directions should gear towards mobilizing resources to enable acquisition of transport equipment. Specific policy measures should be formulated to increase the availability of credit for private sector capital investments in rural areas. There is also need to do away with regulatory constraints that hinder the provision of transport services. Regulations should be focussed only on safety and insurance measures and should not inhibit the routes on which they operate.

6.4.3 Non-Transport Interventions

6.4.3.1 Optimum Location of Facilities

The idea behind the interventions that have so far been proposed (i.e. improvement of infrastructure and provision of transport services) is to facilitate the mobility of the rural households. However, transport is a not an end in itself. The best transport solution would therefore be to increase accessibility by eliminating or minimizing the need for rural travel and transport. This can be achieved through expert location of facilities.

Efficient planning and sitting of services complements and for some facilities is more effective than measures to improve mobility. However, the current situation is that different ministries without transport considerations deal with facility location in the rural areas. Thus the Ministry of Water deals with water development; the Ministry of Health decides the location of health facilities and the location of grain milling facilities are largely left to the uncoordinated decisions of the private sector. This situation ignores the fact that facility location and transport should be handled concomitantly. Thus there is need to incorporate transport planning considerations into rural development programmes.

However non-transport interventions would be impeded by policies that guide the location of these services. For example the location of dispensary requires that there

should be not less than 20,000 people to use that service. Such policies may be outdated because of the level of development and variety of diseases currently attacking the communities that require a much higher level of service. To be able to introduce this kind of intervention it may require that the existing law regarding location of service, be amended to suit the needs and affordability of the poor.

6.4.3.2 Other Interventions

Subsistence activities (water and firewood collection) take a major proportion of household time (59.01%) and effort (67.51%) devoted for transport. Fetching of water and firewood are likely to continue remaining significant tasks for most households as pressure for land resources increase due to population growth. There is need to develop improved water supplies to reduce the time and effort devoted to this task. Concerted efforts are required to ensure environmental conservation particularly the catchment areas. In order to reduce the time and effort spent by women in searching and transporting firewood for household use, it is recommended that:

(i) Awareness campaigns on tree planting and environmental conservation be extended to every village in the country; and

(ii) Efforts should be intensified to enforce re-planting of trees. To ensure sustainability, the tree planting projects should be done on self-help basis with the government and donors only assisting in the establishment of nurseries in each village.

(iii) The use of fuel-efficient stoves should be promoted to reduce wood / charcoal consumption. Such stoves can reduce the transport burden on women of firewood collection.

(iv) Households face a great scarcity of firewood and it can be expected that the scale of the problem will increase in the future since trees are felled without marching planted seedlings. Afforestation programmes should be supported to arrest the scarcity of firewood in the rural areas in addition to checking environmental degradation. Planting appropriate indigenous trees a long watercourses and a round water sources should be emphasized so that water levels can be retained longer. Awareness

campaigns on tree planting and environmental conservation should be intensified in the rural areas.

6.4.4 Institutional & Planning Implications

Local-level rural transport as a subject and issue characterizing rural access problems is yet to be fully understood or appreciated. The first need is therefore to create awareness at the government level of the importance and role of rural transport in development. This is a necessary pre-requisite for putting in place the strategies, institutional structures and policies to address rural access problems effectively.

The findings from the research argue a strong case for a broader approach to rural planning at the local level. Local level movement needs are only likely to be addressed if the starting point of transportation planning analysis is a local level perspective. Thus rural transport planners and policy makers should move from the traditional method of transport analysis which principally consists of roadside surveys, involving interviews with vehicle owners and other road users. This is because the methodology ignores majority of rural dwellers who make little or no use of the motorized transport. The focus should be on the needs of the households. It is at the household level that one can collect information for planning interventions that relate to rural transport and access because the detailed nature of rural access problems, and the appropriate responses to them, is influenced by a range of local factors.

6.4.5 Formulation of Rural Transport Policy

The country is yet to develop a national transport policy, leave alone a policy to address rural transport. Government interventions have laid emphasis on infrastructure development and maintenance while the provision of rural transport services is left to the private sector.

6.4.5.1 The Need of Rural Transport Policy

There is need to formulate/develop a rural transport strategy to place proper balance between infrastructure development, and the availability of the right kind, quantity and quality of vehicles on that infrastructure, empower rural communities to develop and maintain their transport infrastructure and equipment, provide adequate information and

incentives for the private sector to participate effectively in providing rural transport, and address gender related issues.

6.4.5.2 Key Elements of the Rural Transport Policy

The policy should define national and local government responsibilities for aspects of rural transport, and appropriate institutional arrangements and capabilities to coordinate their work. As a priority issue there is urgent need to establish an effective management system for rural transport at the local level. At national government level, the elements of a fully developed rural transport strategy would include:

(i) A statement in national terms, of the role of local level transport in rural economic and social development. This is a necessary prerequisite for putting into place the strategies, institutional structures and policies to address rural access problems effectively.
(ii) A definition of the priorities for addressing rural access problem.
(iii) The allocation of rural transport responsibilities between ministries and between the central and local government, and the definition of the role of the private sector and NGOs
(iv) The identification of policy requirements to achieve rural transport objectives.
(v) A definition of approaches or operational guidelines, for addressing rural access problems.
(vi) A statement of the policy or funding of initiatives to address rural access problems

6.4.5.3 Stakeholders in the Rural Transport Policy Formulation

Because rural transport is a cross-sectoral subject and is relevant to a range of key development issues, it impacts upon a large number of actors at government level. Rural access problems cut across the standard responsibilities of ministries of public works, agriculture, local government, transport, trade and industry and health. Similarly they cut across the responsibilities of non-governmental and donor agencies involved in infrastructure, agriculture, forestry, water and health etc. Therefore there is no single agency whether in the public or private sector which can deal with rural transport in a

holistic manner as a single subject because they independently focus on partial identification of, and partial response to, particular access problem.

Government interventions in rural transport, which are often supported by official development assistance channelled through government, can neither be complete nor the most efficient means of addressing many rural development issues. The private sector has a key role to play especially in the repair and maintenance of IMT and motorized vehicles, the operation of rural transport services and the provision of social facilities e.g. clinics, grinding mills etc. The role of the private sector including NGOs notwithstanding, the public sector has a responsibility of providing an enabling environment that will facilitate the operations of the private sector. NGOs on their part have a role to play in mobilizing rural inhabitants to adopt new ideas and in implementing activities. It is on this backdrop that it is necessary for the involvement of all stakeholders in the preparation and adoption of the rural transport policy.

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APPENDICES

APPENDIX I: QUESTIONNAIRES

UNIVERSITY OF NAIROBI

SCHOOL OF BUILT ENVIRONMENT

DEPARTMENT OF URBAN AND REGIONAL PLANNING

HOUSEHOLD INTERVIEW QUESTIONNAIRE

Confidential clause: My name is Enock Ariga Kombo, M.A. (Planning) student in the above named institution. As a requirement of the academic programme, I am carrying out a thesis research on the *Provision of Appropriate Rural Transport System: The Case of Nyabiosi Sub-Location in Rigoma Division of Nyamira District.* Because you are the one who can give me a correct picture of the nature and extent of transport problems you experience, I request you to respond to the questions frankly and honestly. Your response will be kept with outmost confidentiality and used for academic purposes only.

Date..... Place of Interview (Village).....

Name of Interviewer.....

Name of the Interviewee (optional).....

A. HOUSEHOLD BASE LINE DATA

- **Household Composition**

1. The present head of household:

❑ Male ❑ Female

2. Marital Status:

❑ Monogamous ❑ Polygamous ❑ Widowed ❑ Single

3. Total number of people presently living in the household [ ]

4. Age structure (enter raw number)

❑ Adult Males [ ] ❑ Adult Females [ ]

❑ Male Children [ ] ❑ Female Children [ ]

Key: Children (below 18yrs)

5. **Main** occupation of the present head of household:

❑ Farming ❑ Informal employment ❑ Formal employment

6. **Other** occupation of the present household head:

❑ Farming ❑ Informal employment ❑ Formal employment

7. **Main** occupation of the spouse:

❑ Farming ❑ Informal employment ❑ Formal employment

- **Household Assets**

8. Transport vehicle owned by the household:

Vehicle	Ownership		Working Condition		
Motor vehicle	❑ Yes	❑ No	❑ Good	❑ Bad	❑ N/A
Bicycles	❑ Yes	❑ No	❑ Good	❑ Bad	❑ N/A
Wheelbarrow	❑ Yes	❑ No	❑ Good	❑ Bad	❑ N/A
Animal drawn carts	❑ Yes	❑ No	❑ Good	❑ Bad	❑ N/A

9. Livestock owned:

Livestock Type	No.	What are the animals used for?		
Cattle	[ ]	❑ Draught power	❑ Transport	❑ Income
Donkeys	[ ]	❑ Draught power	❑ Transport	❑ Income

10. Other Assets owned by the household

Asset	Ownership		Working Condition	
Charcoal Stove	❑ Yes	❑ No	❑ Good	❑ Bad
Kerosene Stove	❑ Yes	❑ No	❑ Good	❑ Bad
Radio	❑ Yes	❑ No	❑ Good	❑ Bad
Corrugated roof	❑ Yes	❑ No	❑ Good	❑ Bad

- **Land**

11. Number of plots of land (farm holdings) currently owned by the household [ ]

12. Number of plots of land currently under cultivation [ ]

13. For each plot of land under cultivation, obtain the following information.

Plot No.	Total area	Crops grown		Distant to farm	How long to get there
		Food crops	Cash crops		
1.					
2.					

14. Is there land that is fallow?

❑ Yes ❑ No

15. If yes, what is the **main** reason for leaving the land fallow:

❑ No Labour ❑ Infertile land ❑ Land is far ❑ No draught power ❑ N/A

B. FARM PRODUCTION

- **Farm Inputs**

16. Did the household use any fertilizer in the last year?

❑ Yes ❑ No

17. If yes, how much was used [ ] Kg

18. Where was it obtained (distance)? [ ] Km

19. How was it transported to the field?.....

20. And by whom?.....

21. Did the household purchase any seeds in the last year?

❑ Yes ❑ No

22. If yes, how much was used?.....

23. Where was it obtained?.....

24. How was it transported to the field?.....

25. And by whom?.....

- **Farm Implements**

26. Where do the household buy farm implements?

❑ Keroka ❑ Mochenwa ❑ Gesima

C. TRANSPORT ACTIVITIES

- **Collection of Water**

27. Main Source of water for the household during the wet season:

❑ Sources within the homestead ❑ Sources outside the homestead

28. Main Source of water for the household during the dry season:

❑ Sources within the homestead ❑ Sources outside the homestead

29. Who Collects?

❑ Male HH member ❑ Female HH member ❑ Children HH member

❑ Female & child members

Water supplies during dry season

30. How many trips / day? [ ]

31. How long to get there? [ ]

32. Waiting time (min)? [ ]

33. How carried (mode)?

❑ Head/Back loading ❑ Donkey ❑ Wheelbarrow

Water supplies during wet season

34. How many trips / day? [ ]

35. How long to get there? [ ]

36. Waiting time (min)? [ ]

37. How carried (mode)?

❑ Head/Back loading ❑ Animal ❑ Wheelbarrow

38. What container is used for carrying water?.....

39. How many containers does the household own?.....

40. How is water stored in the house?.....

41. What dangerous crossings do you encounter on the way?

❑ Hilly terrain ❑ Water crossings ❑ Inadequate space ❑ Trespassing ❑ None

Collection of Firewood

42. Type of fuel does the household use for cooking:

❑ Firewood ❑ Paraffin ❑ Charcoal

For firewood users

43. Where is firewood collected?

❑ Shamba ❑ Elsewhere

44. Who Collects?

❑ Male HH member ❑ Female HH member ❑ Children HH member

❑ Female & child members

45. How many trips per week [ ]

46. How long to get there [ ]

47. How carried [ ]

48. What dangerous crossings do you encounter on the way?

❑ Hilly terrain ❑ Water crossings ❑ Inadequate space

❑ Trespassing ❑ None ❑ Specify.....

- **Grinding Mill**

49. Does the household travel to hammer mill to grind its floor

❑ Yes ❑ No

For grind millers:

50. Where is the mill that is used most frequently? [ ] km a way

51. Who goes to the mill?.....

52. How often? [ ] times per two weeks

53. How long to get there? [ ] minutes

54. What means of travel?.....

55. How much is ground at one time? [ ] Kg

- **Education**

Primary

56. Are there any children in the household who attend school?

❑ Yes ❑ No

If yes, please give details as below

57. Name of primary school?.....

58. Number of children?

❑ Female [ ] ❑ Male [ ]

59. How long to get there? [ ] minutes

60. Distance in (km)? [ ]

61. Means of Transport?.....

62. What dangerous crossings do they encounter on the way?

❑ Hilly terrain ❑ Water crossings ❑ Inadequate space

❑ Trespassing ❑ None ❑ Specify.....

Secondary School

56. Are there any children in the household who attend school?

❑ Yes ❑ No

If yes, please give details as below

57. Name of secondary school?.....

58. Number of children?

Female [ ] *Male [ ]*

59. How long to get there? [ ] minutes

60. Distance to school [ ] km

61. Means of Transport?.....

62. What dangerous crossings do they encounter on the way?

❑ Hilly terrain ❑ Water crossings ❑ Inadequate space

❑ Trespassing ❑ None ❑ Specify.....

- **Crop Production and Harvesting**

For each of the following production activities:

Clearing, cultivation and planting

63. Who goes?

❑ Male HH member ❑ Female HH member ❑ Children HH member

❑ Female & child members ❑ Hired labour

64. If HH members are involved, how many?.....

65. How often? (Per week).....

66. For how long? (Months).....

67. What mode of travel?.....

Weeding

68. Who goes?

❑ Male HH member ❑ Female HH member ❑ Children HH member

❑ Female & child members ❑ Hired labour

69. If HH members are involved, how many?.....

70. How often? (Per week).....

71. For how long? (Months).....

72. What mode of travel?.....

Harvesting

73. Who goes?

❑ Male HH member ❑ Female HH member ❑ Children HH member

❑ Female & child members ❑ Hired labour

74. If HH members are involved, how many?.....

75. How often? (Per week).....

76. For how long? (Months).....

78. What mode of travel?.....

79. What is the busiest month in crop production in the year?.....

80. Why?.....

Crop harvesting

81. For harvesting of each crop listed above:

Crop	Amount harvested (last year)	Who collects?	How carried?

82. Did the household hire any labour for carrying crops from the field last season?

❑ Yes ❑ No

83. If yes, how many people?.....

84. For how many days?.....

85. For how much? KShs.....

86. Did the household hire any transport last year to carry crops from the field?

❑ Yes ❑ No

87. If yes, what means of transport?.....

❑ Motorized ❑ Donkey

88. How much did it cost; KShs.....

- **Health**

Dispensary (normally used)

89. Name ....

90. How far ..... (Km)

91. What is usual the main means of transport used?

❑ Walking ❑ Public Transport

92. Approximate time..... (Minutes)

93. Cost of travel, (if applicable).....

94. How often do household members get treated in the dispensary or health centre per month?.....

- **Hospital**

95. Name .....

96. How far? .....

97. The usual means of transport used?

❑ Walking ❑ Public Transport

98. Approximate time.....

99. Cost of travel, if applicable; KShs.....

100. How often do the household members get treated in a year (last year)?.....

• **Commercial Centres**

101. Which main commercial centre does the household visit regularly? .....

102. For each commercial centre, give details (put the most important first).

Commercial centre	Who goes?	Means of transport?	Purpose			Travel time or cost?	How often?
			1st	2nd	3rd		
1.							
2.							

Key

A- Buy food
B- Buy HH items
C- Buy agricultural inputs
D-Business
F-Social Reasons
G-Others specify.....

D. MARKETING OF AGRICULTURAL PRODUCTS

103. Determine the pattern of marketing each of the agricultural produce sold by the household last year

Agricultural produce	Amount marketed	Where sold?	To who sold?	How transported?	By Who?	Sold at what cost?
1.						
2.						

E. HOUSEHOLD INCOME AND EXPENDITURE

104. Does any household member travel outside the village for paid employment:

❑ Yes ❑ No

105. If yes: Where.....

106 How often?

❑ Daily ❑ Weekly

107 What means of transport.....

108 Who goes?.....

109. Identify the sources of cash income for the household (tick)

❑ Sale of farm produce ❑ Casual Labour ❑ Regular employment

❑ Formal business activity ❑ Informal business ❑ Cash remittance

110 Please identify the main source of household income with a circle

111. Estimate the household expenditure in the last one-month:

Item	**Ksh**
Food	.....
Household items	.....
Medical expenses	.....
Farm inputs	.....
Transport	.....
TOTAL	.....

F. HOUSEHOLD PERCEPTIONS

112. What is the major access problem faced by the village?

Sector	**Access problem being experienced is attributed to**				
Water	❑ Distance	❑ Terrain	❑ Quality	❑ Mobility	❑ Trespassing
Education	❑ Distance	❑ Terrain	❑ Quality	❑ Mobility	❑ Trespassing
Health	❑ Distance	❑ Terrain	❑ Quality	❑ Mobility	❑ Trespassing
Grinding Mill	❑ Distance	❑ Terrain	❑ Quality	❑ Mobility	❑ Trespassing
Firewood	❑ Distance	❑ Terrain	❑ Quality	❑ Mobility	❑ Trespassing
Roads	❑ Distance	❑ Terrain	❑ Quality	❑ Mobility	❑ Trespassing
Markets	❑ Distance	❑ Terrain	❑ Quality	❑ Mobility	❑ Trespassing
Farm Inputs	❑ Distance	❑ Terrain	❑ Quality	❑ Mobility	❑ Trespassing
Crop Production	❑ Distance	❑ Terrain	❑ Quality	❑ Mobility	❑ Trespassing
Crop Marketing	❑ Distance	❑ Terrain	❑ Quality	❑ Mobility	❑ Trespassing
Public Transport	❑ Distance	❑ Terrain	❑ Quality	❑ Mobility	❑ Trespassing

113. Rank three sectors of concern using the indicators below

Rank	Sector
1	.....
2	.....
3	.....

Key:

1=Biggest Problem 2=2nd Biggest Problem 3=3rd Biggest Problem

114. What would be the most beneficial transport / access improvements to the three problems identified above?

Rank	Most Beneficial Intervention
1	.....
2	.....
3	.....

115. Would villagers be prepared to contribute on self-help basis, to infrastructure improvement and maintenance?

❑ Yes ❑ No

116.Comment.....

.....

.....

.....

*****THANKS FOR SPARING YOUR TIME TO RESPOND TO THE QUESTIONS****

UNIVERSITY OF NAIROBI

SCHOOL OF BUILT ENVIRONMENT

DEPARTMENT OF URBAN AND REGIONAL PLANNING

KEY INFORMANT INTERVIEW

Chairman - Keroka-Mosobeti Matatu Association

Confidential clause: My name is Enock Ariga Kombo, M.A. (Planning) student in the above named institution. As a requirement of the academic programme, I'm carrying out a thesis research on the *Provision of Appropriate Rural Transport System: The Case of Nyabiosi Sub-Location in Rigoma Division of Nyamira District.* Because you are the one who can give me a correct picture of the nature and extent of transport problems you experience, I request you to respond to the questions frankly and honestly. Your response will be kept with outmost confidentiality and used for academic purposes only.

LEAD QUESTIONS

1. A brief introduction, touching on the mission and objective of the study
2. How many matatus operate on the Keroka-Mosobeti Route?
3. What is the capacity of one vehicle?
4. Do your members own all matatus plying on the route?
5. How does one become a member of the association?
6. How do you operate at the terminus? (1^{st} come 1^{st} served or a fixed time table for the day)
7. How much, (if any) does a member pay to the association per day?
8. Do you have a saving cooperative or a merry go round arrangement to assist needy members especially during vehicle breakdowns?
9. What happens when a vehicle of a member is involved in an accident?
10. Do you control / regulate the fares charged by your members?
11. Are there incidents of robbery / thuggery meted on your members?

12. How do you relate with the traffic police?
13. Where do your members obtain vehicle/maintenance services?
14. What is the concern of your members about the daily provision of transport services on the route? (Lack of critical mass / Poor infrastructure / High Vehicle Operation Costs, HVO)
15. What do you think can be done to improve the situation?
16. Are there any there any regulatory constraints that you consider unnecessary or hinder in the provision of transport services?
17. Is the Keroka-Mosobeti Matatu Association registered?
18. How do you discipline errant members of the association?

*****THANKS FOR SPARING YOUR TIME TO RESPOND TO THE QUESTIONS******

APPENDIX II: COMPUTATION OF HOUSEHOLD TIME & EFFORT SPENT ON TRANSPORT

1. Water Collection

Season	Duration of the Season	No. of Trips	Time to Source(min)
Wet	8 ÷12=0.67	4	11
Dry	4 ÷12=0.33	7	9

Average distance to water source during the dry season:

Assumption: Walking speed = 4km per hour

Therefore, distance = (4km × 9) ÷ 60

= 0.6km

Time spent on transport of water:

Dry Season: [7trips × 7days × 52 weeks × 0.33 × 2 × 9min] ÷ 60 = 254.8 hours

Wet Season: [4trips × 7days × 52 weeks × 0.67× 2 × 11min] ÷ 60 = 355.9 hours

Total Hours Spent on Transporting Water per Year = 254.8 + 355.9 = 610.7 hours

Effort spent on transporting Water:

Average weight of water carried = 15kg

Dry Season: [15kg × 7trips × (4÷12) × 52 weeks × 7days × 0.6km] ÷ 1000 = 7.64tonne-km

Wet Season: [15kg × 4trips × (8÷12) ×52 weeks × 7days × 0.6km] ÷ 1000 = 8.74 tonne-km

Total Effort Spent on Transporting Water per Year = 7.64 + 8.74 = 16.38tonne-km

2. Fetching Firewood

Average Time Spent travelling to source = 22.02 min.

Assumption: Walking speed = 4km per hour

Therefore, distance = (4km × 22.02) ÷ 60

= 1.468km say 1.5km

Average number of trips to source per week = 2

Time Spent: = [22.02min × 2trips × 2 × 52 weeks] ÷ 60 = 76.34 hours

Effort Spent in Transport:

Average weight of firewood carried = 15kg

Effort on Firewood = [15kg × 2 trips × 52 weeks × 1.5km] ÷ 1000 = 2.34tonne-km

3. Grinding Mill

Average Time Spent travelling to source = 21.56 min.

Assumption: Walking speed = 4km per hour

Therefore, distance = (4km × 21.56) ÷ 60

= 1.437km say 1.5km

Average weight of flour or grain carried = 16.5kg

Average number of trips to grinding mill per week = 1.102

Time Spent: = [21.56min × 1.102trips × 2 × 52 weeks] ÷ 60 = 41.18 hours

Effort Spent in Transport:

Effort on grinding = [16.5kg × 1.02 trips × 52 weeks × 2 × 1.5km] ÷ 1000 = 2.84tonne-km

4. Travel to Cultivation

Weighted average of time taken to farm:

100% of households spend less than 5 minutes to reach their first farm.

38.9% have more than one farm and spend an average of 23 min to reach them

Weighted average time to reach farm = [5min × 100 + 23 × 38.9] ÷ 138.9

= 10.04 min

Land Preparation

Average duration of the activity = 4.61 weeks

Average frequency (per week) = 4 days

Average number of members involved = 5

Tilling at least twice before ready

Time Spent Travelling to Field: = [2times × 4.61weeks × 4days × 5 × 10.4 × 2] ÷ 60 = 63.93 hours

Weeding

Average duration of the activity = 3.09 weeks

Average frequency (per week) = 3.52 days

Average number of members involved = 4.61

Weeding is done twice

Time Spent Travelling to Weeding: = [2times × 3.09weeks × 3.52days × 4.61 × 10.4 × 2] ÷ 60 = 34.77 hours

Total Time Spent to Cultivation: 63.93 + 34.77 = 98.7 hours

5. Travel to Crop Harvesting

Maize

Average duration of the activity = 1.33 weeks

Average frequency (per week) = 3 days

Average number of members involved = 4

Transport Time Spent in Harvesting = [1.33 × 10.4 × 2 × 3 × 4] ÷ 60 = 5.53 hours

Average production 2100kg per acre

Average land size: 3 acres, assume 60% under cultivation

Total production: = [3 × 60] ÷ 100 × 2100 = 3780kg

Effort = [3.78 × 10.04 × 4] ÷ 60 = 2.53 tonne-km

Tea

Average distance to tea buying centre = 1.8km

Time to buying center: Assume 4km per hour

= [1.8 × 60] ÷ 4 = 27 min

Trips to center per week = 2, Assume 80% of the year spent in harvesting

Total time to buying center = [2per week × 27 × 52 × 80 × 2] × 60 ÷ 100 = 74.88 hours

Average production per week = 47.82kg

Distance = 1.831km

Trips per week = 2

Transport Effort on Transport = [47.82 × 52 weeks × 1.831 × 80] ÷ 100 = 3.64 tonnes-km

Total Time in harvesting = 74.88 + 5.53 = 80.41hours

Total Transport Effort = 3.64 + 2.53 = 6.17tonnes

6. Travel to Dispensary

Distance to dispensary = 5.4km

Average time spent to dispensary = 29.34min

Frequency per month = 1.5trips

Total Time to Dispensary = [2 × 29.34 × 1.5 × 12] ÷ 60 = 17.6hours

7. Travel to Hospital

Time to Hospital = 98.06min

Frequency per year = 3

Total Time = [3 × 2 × 98.06] ÷ 60 = 9.8hours

8. Market

- Main Commercial Center

Time to main commercial center = 25.93min

Frequency (per week) = 2.57

Time to main commercial center = [2.57 × 52 × 25.93 × 2] ÷ 60

= 115.51hours

- Second Commercial Center

Time to Second Commercial Center = 25.28min

Frequency (per week) = 2.602

Time to Second Commercial Center = [2.602 × 52 × 25.28 × 2] ÷ 60

= 114.02hours

Total Transport Hours to Market = 114.02 + 115.51 = 229.53hours