ENVIRONMENTAL IMPACT ASSESSMENT FOR THE IMPROVEMENT OF THE NAIROBI – MOMBASA ROAD. A CASE STUDY OF THE PROPOSED RE-ALIGNMENT OF THE SECTION BETWEEN THANGE TO MTITO- ANDEI RIVER BRIDGES.

BY

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DECLARITION

This thesis is my original work and has not been presented for award of a degree in any other university.

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DEDICATION

To my mother Wambui, my wife Albreta and my daughters Sharon and Rosetta for their love, sacrifices, inspirations and support which they have given me throughout my study.

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ABSTRACT

This study set out to examine the most likely impacts of the construction of a proposed road re-alignment. The construction of the proposed re-alignment of a section of the Nairobi – Mombasa Road starting from Thange River Bridge to just a few kilometers before reaching Mtito Andei River. The study established that several townships among them Machinery, Kambu and Hillside will be by-passed by the construction of the proposed alignment.

From the field study and more so from the history of Machinery and Kambu it emerged very clearly that the economic base of the townships along the existing road depends highly on the traveler customer. It was found out that 87.9% of the drivers would not enter the by-passed townships for services after the construction of the by-pass which is likely to lead to decline of these township.

The by-pass is proposed to pass through a settled rural area and it was established that several private properties including houses, churches and even graves will be destroyed. The government intends to invoke the Compulsory Land Acquisition Act Cap 295 of the laws of Kenya to acquire the affected private land.

The valuation and hence the compensation procedures have left out some important aspects of the affected people's culture. The Compulsory Land Acquisition Act does not compensate for a grave and so the graves were not valued. At least 80% of the respondents felt that the graves should not be interfered with but instead the road should be re-aligned further to avoid graves. At least 150 Ha.of agricultural land will be taken by transportation after the implementation of the proposal which is sure to reduce agricultural production by about Kshs. 2 Million per year. Fragmentation of the agricultural land parcels will even reduce agricultural production even further.

The construction of the proposed re-alignment will interfere with the ecosystem by clearing the bushes to pave way for the proposed road and at the same time in the destruction of vegetations if spoil material is not handled in an environmentally friendly

manner. The local streams are likely to be polluted as a result of soil erosion during and after the construction process.

To come up with a sustainable road improvement project it is imperative that mitigation measures be put in place to stop or reduce negative socio-economic and ecological impacts arising from the proposed re-alignment. In a situation where mitigation is not adequate, then compensation measures should be put in place. Among the aims of the study is to ensure that the people affected maintain the same standard of living or even better and at the same time not compromising the chances of the future generation to use of the resources in the area.

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LIST OF ACRONYMS

BOQ	Bill of Quantities
EIA	Environmental Impact Assessment
GNP	Gross National Product
GOK	Government of Kenya
Ha	Hectare
KR	Kenya Railway
KRB	Kenya Roads Board
MOTC	Ministry of Transport and Communication
MRP	Minor Roads Programme
MRPW	Ministry of Roads and Public Works
PER	Public Expenditure Review
RARP	Rural Access Roads Programme
RMLF	Roads Maintenance Levy Fund
STD	Sexually Transmitted Diseases

CHAPTER 1: BACKGROUND TO THE STUDY

1.1 INTRODUCTION

Travel and transport have been of fundamental importance throughout history in the development of human society. The movement of people has brought great benefits and has been associated, too, with great disasters. It has stimulated the development and exchange of new ideas, new philosophies and new technologies. It has also broadened the potential for human conflict, oppression and war.

No less than the movement of people, the ability to transport goods has been central in affecting patterns of economic development. It was the invention of the wheel that began the process of steady increases in the size and speed of loads. It made trade easier, which in turn led to the specialization in human skills and occupations, hence to continuing economic diversification and growth. It was on transportation that the great trading empires relied to overcome the limitations of their own natural resources and of their own markets.

Without travel and without this ability to transport goods, it is likely that most human settlements would have remained trapped as self-contained islands with standards of living at, or only marginally above that of basic subsistence. To be physically stationary, in other words, is also to imply unchanging social and economic conditions.

Against this historical background, it is hardly surprising that transport has often been seen as the factor in the development process. Over 60 years ago, for example, Lord Lugard maintained that: "the prospects for development may be summed up in one word: transport" (Villar, 1999; Lugard, 1922). Lugard may have been correct – or at least may have been correct about the particular countries he had in mind or that particular time he was writing.

As Hailey (1957) correctly observes, there seem to be no other type of development (than investment in transport) which can affect so speedy a change in the economic and social conditions of a less developed country. The assumption of a still more categorical and automatic linkage between transport and development was exemplified by Chisholm, who observed "if you drive a road through a cultivable area, you automatically stimulate development (Villa, 1999).

In conceptual terms, transportation is a service, which enables people, firms and other various activities to carry out activities at sites selected for these purposes in separated locations. In which, case, by providing accessibility, people and goods or products are able to move from one place to another. Improving transportation increases the rate and frequency of movement and if this takes place in rural areas then the development innovations are likely to reach the rural areas much faster and thereby enhance rural development.

1.2 STATEMENT OF THE PROBLEM

1.2.1 Overview

The road transport remains a dominant mode of transport in Kenya. The road transport network in Kenya currently accounts for over 80 per cent of the country's total passenger and freight traffic. As at July 1999, the classified road network covered about 63,000 km representing 42.2% of the country's road network of about 151,000 km (GOK, 2000). These road networks facilitate production activities and mobility. Good and well-maintained road network encourage investments and employment creation in the economy. In other words, it is key to economic growth, industrialization process and poverty reduction. In rural areas, accessible roads facilitate marketing of farm produce and development of small-scale enterprises, hence contributes significantly towards, poverty reduction. At regional scale, a good road reduce travel time, lower cost of vehicle use, increases access to regional centers and reduces travel costs for both freight and passengers.

The Nairobi-Mombasa Road contributes to the economy of Kenya as well as that of neighbouring countries. This road links Mombasa, Kenya's sea port and second largest urban area and Nairobi to neighbouring countries such as Uganda, Tanzania, Sudan, Burundi, and Congo. Transportation of cargo along this route is an important activity. However, over the last 10 years and more, particularly following the El Nino rains, the condition of some sections of the road, particularly the section between Sultan Hamud and Mtito Andei have deteriorated due to lack of maintenance. The poor state of the road has led to high production and transportation costs thus discouraging investments.

The government with the support of her development partners continues to rehabilitate

and maintain roads in various parts of the country and strengthening the management of the road sub-sector. In its effort to improve the condition of the Nairobi-Mombasa road, a number of sections were earmarked for rehabilitation, all aimed at improving the efficiency of road transport. One such section for rehabilitation was the Sultan Hamud –Mtito Andei section. During the design stage, it became necessary to re-align the road project in three sections; namely re-alignment Nos 1,2 and 3, hence altering the existing road alignment completely in these areas.

1.2.2 Road Re-alignment

The road re-alignment will involve the procurement of privately owned land. While it is sometimes possible to negotiate a price for voluntary sale of a property, governments often have to use their rights to compulsory acquisitions (expropriation) of properties for public projects. In Kenya, the state is empowered to acquire land compulsorily from its owners for public use and pay a fair compensation for such land. The principal legislation that confers powers of acquisition on public bodies includes the Kenya Constitution, Land Acquisition Act Cap 295 of 1968, the Water Act Cap372 and Electric Power Act Cap314.

By it's nature, expropriation may include the loss of houses, or businesses, or the loss of business income either temporary or permanently. These can be estimated and costed. However, the actual valuation of these losses often proves to be difficult and protracted process. Timing of compensation may not reflect market rates at the time of payment. This consideration is especially important when high inflation characterizes the national economy, like in Kenya, and delayed payments may result in depreciated compensation.

The manner in which compensation is paid can be significant for the long-term welfare of the recipients. People not used to money or with insufficient resources to meet current needs will typically spend the compensation payment to meet other basic needs thus becoming vulnerable to landlessness or homelessness.

New roads can split a community. The introduction of faster traffic, access controls, and median barriers generally will cut traditional lines of travel or communication. The alternative routes for local movements can sometimes substantially be longer, directly affecting businesses, pedestrians, animals and other road users of non-motorized transport. The burden of accommodating these changes can generally be greater for the poor, the aged and disabled.

In rural areas, the normal links between villages and their farmlands, their economic space, may be cut by a new road or increased traffic. On the scale of the individual farm, the same phenomena may disrupt existing farming patterns and connection between fields. The ensuing impact on economic activity could be loss of agricultural productivity or increased travel time.

The social and psychological impacts and associated costs can be complex and devastating. Neighbourhoods can be disrupted and, in the worst instances, broken up completely by the construction of a new road. People who meet on a daily basis and who constantly do each other small but important favours may be left deprived when separated by physical barriers or long travel distances. The business community may find their established clientele cut off from their shops or experience changes in business practice they neither anticipated nor like. These kind of social and economic changes can often find personal expressions in a variety of physical or psychological disorders. The manifestation of these impacts is heavily

influenced by the linear nature of road projects because road projects cut across communities as opposed to affecting the entire community equally.

The presence of squatters on the proposed right-of-way can present a particular challenge. More often than not, road projects tend to displace those persons whose very presence signifies their need for special attention. National legislation, which determines the categories of land ownership, often recognizes only formal, registered title.

The rural community where the re-alignment is proposed to pass may have lived there for a long time and hence the construction of the new road is likely to disrupt some cultural property such as shrines, grave yards, monuments as well as spiritual and religious structures. The community is also likely to own other natural goods such as rivers, forests, hills and mountains, which are likely to be disrupted by the construction of the road. What value does the community attach to the above non-quantifiable wealth and how will they be compensated for this? It should be noted here that a socially stable development requires societies to retain and keep alive ties to their past and cultural traditions.

A new road construction involves clearing of vegetation, earthworks and finally the laying of the pavement and drainage channels. These processes of new road construction alter the existing patterns of surface runoff. The results of this may include local ponding and flooding, increased flood frequency and/or magnitude downstream, lowered water table, diminished ground water recharge and decrease in low flows in stream. Changes in natural flow patterns can modify or eliminate wetlands and affect agriculture that depends on seasonal flooding for

irrigation and maintenance of soil fertility. Increased flood frequency, in sloping terrain can become a major source of soil erosion, which can result in silting of channels or dams.

Road construction involves the use of big volumes of water, especially in concreting and in compaction processes. To reduce the cost of transporting this water, the contractor may be tempted to rely on the local sources of water, hence competing for the scarce commodity with other local users. This will definitely reduce the overall flow of water in the local streams. The immediate impacts of these may include decline in water quality from diminished dilution of pollutants, seasonal or continuous shortfall in supply for downstream users, reduction in wetland area and increases in salinity. Each of these impacts can in turn have secondary impacts such as loss of revenue from water dependent activities like horticulture.

The re-alignment is to by-pass some townships like Kambu and Machinery and the rural community whose land parcels are currently abutting the existing alignment. While the re-alignment can overcome some problems of conflict between road use and community welfare, it may create other problems. On the positive side the re-alignment can reduce the immediate impacts of traffic in the community and local commercial activities sometimes can flourish as a result. On the negative side, the business communities may fear diversion of traffic and some community activities may "migrate" to the new route potentially changing existing land use patterns.

The diversion of traffic to the new route may make the land uses currently abutting the existing road "less accessible", with the potential of lowering the demand for this land. Less demand for this land can translate into stagnant or drop in land value. The drop in land value

along the existing alignment may be reflected as a rise in land value along the new alignment. The diversion of traffic to the new alignment may result in a drop in the number of road accidents along the existing alignment. Public utilities like telephone and electricity currently using existing road reserve may be re-routed along the new alignment.

1.3 RESEARCH QUESTIONS

The study set to answer the following questions:

1. Are there any socio-economic impacts the re-alignment of the existing road has on the rural and urban settlements?
2. Are there any socio-economic impacts the construction of the new road has on the rural settlements along the proposed alignments?
3. Are there any environmental impacts the construction of the new road has on the proposed alignment and surrounding settlements during and after its construction?

1.4 OBJECTIVES OF THE STUDY

i) To examine the likely socio-economic impacts of the construction of the new road on the rural and urban settlements along the existing road.

ii) To examine the likely socio-economic impacts of the construction of the new road on the rural settlements along the proposed alignment.

iii) To examine the likely ecological impacts the construction of the new road will have on the proposed alignment and in the surrounding settlements.

iv) To suggest mitigation measurers to maximize on the positive impacts and minimize on the negative impacts respectively.

v) To propose policy guidelines for the assessment of impacts /effects which should be considered for implementation of such similar projects/programmes.

1.5 ASSUMPTIONS OF THE STUDY

The new road will be constructed and it will have impacts on the settlements in the vicinity.

1.6 JUSTIFICATION

Within recent years, the general public has become more aware of the sophisticated nature of interaction between roads and their environment, which result into impacts\ effects on their well-being. In the crisis atmosphere, it is important that additional research effort be devoted towards the functional relationships which exist in this area that are crucial to the continuation of socially optimal decision making. In recognition of this need, this study is designed to form one link that is hoped will eventually be a long chain of empirically based investigations on the impacts of roads on settlements.

Proper planning calls for recognition that road projects can lead to modifications in the community environment surrounding the road, influencing various aspects of lifestyles, travel patterns, and social as well as economic activities. Further, such road projects may have ecological effects. The aim of this study is, therefore, to predict and evaluate those impacts before they happen. Unlike the more familiar "evaluation research" which gauges the

effectiveness of policies, programmes and projects already in operation, the task of this study is forward planning. It seeks to place the expectations and attainment of desired outcomes of the proposed re-alignment on a more rational and reliable basis.

The study is useful to decision makers like the Ministry of Roads and Public Works (MRPW) in determining whether or not to proceed with a given road project and how to implement the project efficiently basing the decision on the results of such a study. Moreover, the results of this study can be helpful in making decisions early in the project cycle. Some socio-economic and environmental issues not considered early in the project cycle can result in costly delays during the project implementation stage.

This study involved the community to be affected by the construction of the new road. This was in order to understand the nature and extent of potential impacts, these include socio-cultural, economic and ecological impacts and to assess the suitability and acceptability of various measures that might be used to prevent or mitigate these impacts, or compensate affected groups for unavoidable ones. Involving the community leads to projects that are more acceptable and more likely to be supported by the community. Community involvement is useful in the analysis of the distribution of project costs and benefits.

A government's right to expropriate should carry with it a responsibility to ensure that those affected do not bear an unfair share of the costs of a project which will bring benefit to others. In the simplest terms, this responsibility should be to ensure that the standard of living of all affected persons is restored to the level enjoyed before the commencement of the road project if not better. The development agencies may use the results of a study like this one to understand

the socio-economic status of the people to be affected by the road project before implementation and hence be able to restore their standard of living after the construction of the new road.

Due to it's national and international importance, the Nairobi-Mombasa Road is a very busy road with a big modal split and hence expected to have heavy impacts in the surrounding areas. Re-alignment No 3 was chosen for this study since it is the longest covering 25 Km. The re-alignment passes through the highest population density of the three and therefore, has the potential of serious positive and negative impacts. This alignment is also proposed to by-pass several townships among them Kambu and Machinery. It is expected that the re-alignment will have significant socio-economic impacts in these townships during and after the construction of the re-alignment. The proposed re-alignment is endowed with a varying ecological zone, making it a good study area.

1.7 SCOPE OF THE STUDY

The study is basically focused on the likely socio-economic and ecological impacts of re-aligning the Nairobi-Mombasa Road on the urban and rural settlements along the existing road and on the rural areas proposed to receive the new road. The study area begins at the start of the proposed re-alignment near Thange River and runs along the existing Nairobi-Mombasa road up to the end of the re-alignment near Mtito Andei River.

On the effects of re-aligning the road on the towns to be by-passed, the study chose Machinery, Kambu and Hillside, since they are the biggest townships along the existing road and therefore, are expected to receive the biggest impacts from re-aligning the road. On the rural areas away form the existing road, the study was narrowed to study the likely effects on the actual land parcels that fall along the proposed road.

1.8 RESEARCH METHODOLOGY

The research methodology was divided into three stages involving data collection, analysis and finally data interpretation. The data was divided into two, namely secondary and primary data.

1.8.1 Secondary data

A review of published and unpublished works, government publications such as development plans, relevant Acts of parliament, traffic census and road network maps from the MRPW were used.

1.8.2 Primary data

Primary data was collected through formal interviews by use of structured questionnaires (Appendix 3). Personal interviews and discussions were held with the relevant persons and authorities in charge of Provincial Administration, Local Authorities, Roads, Forests, Water, Agriculture, Physical planning among others. The design engineers of the re-alignment were also interviewed. Personal observation of the situation was also made and photography was taken.

1.8.2.1 Sample Frames

Three sets of questionnaires were administered.

a) The business sector questionnaire

This targeted the business community in the three townships proposed to be by-passed: Machinery, Kambu and Hillside.

b) The road users questionnaire

This targeted the drivers found in the three townships proposed to be by-passed.

c) Household Questionnaire

This was divided into two sets. One set targeted the households abutting the existing Nairobi-Mombasa road while the other set targeted households along the proposed new alignment.

1.8.2.2 Sampling Procedures

(a) Business Community

Three townships proposed to be by-passed were sampled. These three towns were chosen because they were the biggest and chances are that they would receive the biggest impacts. Simple random sampling was used to select the business respondents interviewed. Businesses on both sides of the road were sampled.

(b) Road Users

Drivers of buses, cars and lorries found stopping in the townships proposed to be by-passed were sampled. Simple random sampling procedures were used to select the drivers.

(c) Households

Simple random sampling was used to select the households along the proposed and existing alignments between the start and the end of the proposed re-alignment.

1.8.2.3 Sample sizes

Forty households each along the existing and proposed alignments were sampled. Forty road users in total were sampled in the three towns proposed to be by-passed. Fifteen each for Machinery and Kambu and ten for Hillside because it is smaller in size. The same number of business questionnaires were administered in the three townships.

1.8.3 Data Analysis

Closed-ended questions were coded before going to the field while open-ended ones were later coded after the different response to these questions were categorized.

Both qualitative and quantitative data analysis methods were used. Quantitative data was analyzed using SPSS (Statistical Package for Social Scientists). Various measures of tendencies such as the central tendency were generated. Others included the mode, mean and medium of the various variables used. Cross-tabulation of various variables was carried out, to establish how certain variables influence others.

The results were then represented in the form of frequency distribution tables, histograms and pie charts. Qualitative data was synthesized to vision the communities' feelings and expectations of the road project. Some of the recommendations and mitigation measures have been arrived at with consultation with the local community.

CHAPTER 2: LITERATURE REVIEW AND CONCEPTUAL MODEL

2.1 INTRODUCTION

Economic growth and the momentum at which it occurs depend among other things on the geography and location of activities. Within a nation, the development of a region is directly related to its ease of access to resources and to outside markets, or more generally to its physical position relative to other regions. Transportation systems are designed to overcome the frictions (distances, natural obstacles, etc) imposed by geography (Kraft, 1971). It should be noted here that, transportation is not an isolated phenomenon; its impact is enhanced by the interaction of a variety of other economic stimuli whose magnitude cannot be predicted with great certainity.

The relationship between transportation and growth is suggested in different aspects of economic theory, especially trade theory, location theory, development economics and regional economics; to a lesser degree, it has also been treated by welfare economics, geographers, city planners and highway engineers. With various degrees of emphasis, economists have recognized that a major impetus for growth comes from the ability of a region to produce goods and services demanded by the national economy and to market these at a competitive advantage with respect to other regions. This propensitivity to export obviously depends to some extent on the access that a region has to outside markets both for its imports and its exports. In the long run, growth becomes more self-sustaining when a region can achieve sizeable regional markets for activities other than those oriented directly towards export.

For regional economists the function of transportation extends beyond the more interregional exchange of commodities and services. Good interregional connections facilitate the convergence of the factors of production, labour in particular towards the centers of production. They contribute to the geographical concentration of activities originating in the advantages of large- scale production and help the cumulative process by which cities grow. Conversely they may relieve cities by inviting congested industries to disperse. The development of an extensive internal transport network permits regions to achieve sizeable internal markets by integrating sub-regions into larger geographical units.

2.1.1 Transportation and regional development theories

The theoretical relationship between transportation and regional economic development can be derived from two somewhat related application of international trade theory. The first one expresses the idea that the growth of a region is directly dependant on the strength of its exchanges with other regions and rests on the concept of the international trade multiplier. This aspect of the doctrine reveals little of the relationship between changes in transportation and shifts in interregional flow; however, once those are known, it permits us to measure the impact of such shifts on a regional economy. The second application refers to the fusion of trade and location theories and permits an analysis of the mechanism of interregional flows of goods and commodities when the transport cost structure is considered as a variable.

2.1.1.1 Economic base theory

Economic base theory may be considered as the first element of a theory of transportation and development. In its original formulation, the doctrine says that the growth of a small area is directly determined by its ability to market its products and services outside its boundaries.

During the 1930s Hoyt thought the ability of a city to sustain its economic activity depends on its ability to export goods and services to the rest of the world. He also thought that the total size of the economic activities of a city is a constant multiple of the export sector, implying a limit of export activity generates a certain number of activities, which are dependant upon, and serving the export activity. Therefore, it was reasoned that the only way to expand the size of the economy is to expand the export sector.

Being called the economic base theory, this theory prevailed among city planners until the 1950s when Andrews et al as reported by Kraft (1971), critically reviewed the underlying concepts. Blumefeld specifically challenged the causative assumption that determines the economy as a whole. He argued that what determines the export sector is the city or region's competitive position vis-à-vis other cities and regions, and what determines the competitive position of a city or region is the quality of the service sector. Therefore, he argued that what determines the economic as a whole is the service sector but not the basic or export sector. In the mid 1950s Tiebout extended Andrew's argument by adding that the quality of the service sector may determine the quantity of the export and that the quantity of the export sector helps determine the quality of the service sector. Therefore, Andrew's argument may not necessarily contradict base theory, but rather complement it.

Under a strict application of base theory, the role of transportation can be described but not economically evaluated; essentially it consists of providing the interregional geographical linkages on which the flows of export goods will be channeled. Transportation is not analyzed in terms of costs in the base doctrine. The base theory is limited in general by its descriptive rather than analytical nature. An inherent weakness of the base doctrine is that its

validity, both as a historical explanation of regional expansion and as a conceptual tool for implementing development programmes, dwindles when the sizes of regions increase. The base theory has little application to the problems of an underdeveloped region which is characterized, among other things, by a seemingly inability to develop an export base.

2.1.1.2 Trade theory

Trade economists have given empirical meaning to the concept of the export base by identifying the conditions under which movements of goods occur between regions. They have also explicitly recognized the role of transportation costs in such trade patterns.

Ricardo's model involves two nations (regions) and two commodities. Briefly stated, the theory states that two areas will exchange the commodities in which they have a comparative advantage. In a strict international framework, comparative advantage refers to the relatively greater efficiency that one nation has over another in producing a commodity when the price of such commodity is expressed in terms of the other commodities that a nation can manufacture. In the interregional context, comparative advantage implies the existence of absolute price differentials between different locations.

Once transportation costs are introduced into trade theory, the relationship between transportation and growth can be analyzed, and most theorems of location theory can be derived. The distinctions between trade and location theory depends almost solely on the way one looks at transportation costs as determinants of either location or of commodity flows.

In its present form, trade theory places the concept of comparative advantage in a system of geographical coordinates and considers interregional trade as resulting from price differentials that exist at the market place. What determines the volume and direction of a regions exchange is therefore, its efficiency in manufacturing and distributing its goods at an advantage over other regions. Comparative advantage should, therefore, be considered the resulting force of two components: a production advantage and a transportation advantage. Conceptually, the superimposition of transport differentials over production differentials will tend to specialize a region, say (i), in those activities for which:

$$P_i + Ti < P_j + T_j \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

$$P_i < Pj + (T_j - T_i) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$P_i - P_j < Tj - T_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where (P_i) and (P_j) represent costs of production in regions (i) and ($_j$) and (T_i) and (T_j) represent transportation costs from regions (i) and (j) to the market place.

In the absence of transport costs, each region would specialize in the production of the commodity of which ($p_i < p_j$). In the classical model, the existence of differentials in resource endowments creates interregional price differentials. While exchanges are stimulated by such price differences, they can be offset by the existence of high transport costs. In that sense, space creates frictions, and imposes a barrier on interregional trade very much as a tariff does in international trade.

The nature of regional transportation is dependent on the cost structure of the interregional transportation system. It is clear from inequality (2) that a transportation advantage or disadvantage $(T_i - T_j)$ can reinforce, cancel out, or reverse a production advantage $(P_i - P_j)$. To put it in another way, the role of transportation in economic development consists of advantage relative to other regions, enabling it to secure a larger share of the national demand for certain products.

2.2 THE ROLE OF RURAL ROADS IN DEVELOPMENT

Transport plays a pivotal role in promoting agricultural land use. Improved of transportation reduces the cost of transporting agricultural products to markets and extend the distance to break even-locations, thereby expanding the production of exports. Moreover, transport improvement reduce production cost by lowering the delivered price of imputs, including capital and information (the latter by facilitating increased speed of know-how and technological diffusion). This consequently increases net farm gate prices and raises farmer incomes, although the extent hinges on the competitiveness of the transport service market.

The localized benefits of labour-based methods extend beyond the savings in the cost of roadwork and creation of jobs. Other benefits include savings on foreign exchange, injection of cash into local economy and transfer of knowledge of road works to local communities. These reinforce the sustainability of road maintenance activity.

Improvement of rural roads has major socio-economic impacts in society. For example, a study in Morocco (Hernan, 1996) comparing conditions in areas of road projects, found that the

benefits of paving rural roads extended considerably beyond the improvement of road use efficiency in terms of lower cost and higher quality. The extended benefits included major changes in the agricultural economy, including higher outputs, transformation of the agricultural output mix from low value cereals to high value fruit orchards, and increased use of modern inputs, especially fertilizers. Moreover, improved access to education and health facilities increased enrollment rates in the rural schools as well as the frequency of visits to health care services and enabled the recruitments of professional personnel to schools and health facilities.

In the improvement of an existing road, the negative impacts are expected to be minimal since no properties (houses, graves) are being affected unlike in a new road, which is expected to pass where other improvements are standing.

A most recent study by Shahidur et al (1993) reported in Colin (1997) used data from eighty-five randomly selected districts of India to examine the role of rural roads, among other factors, in agricultural investment and output. The study found out that road investment contributed directly to the growth of agricultural outputs, to increased use of fertilizer and to commercial bank expansion. This study was one-sided; it only looked at the positive impact of rural roads but not the construction aspect. It went directly to look at the impacts of a finished rural road.

Another study by Ahmed et al (1990) as reported in Colin (1997) carried out a study, which was based on a survey of 129 villages in various parts of Bangladesh. The study categorized the villages into two groups based on an aggregate index developed to reflect the ease of access of a village to various services such as markets, schools banks and local administration

offices. Villages with better access were found to be significantly better off in a number of areas including, agricultural production, household incomes, health, and the participation of women in economic activities.

The World Bank experience suggests that the beneficial impacts of transport infrastructure on women can be profound. An ex post impact study of a World Bank financed rural road paving project in Morocco revealed that a major impact of the project was on girl's enrollment in primary education, which more than trebled in the project zones a few years after the completion of the project. Road improvement facilitated access to existing schools, made it possible for teachers to commute from towns to village schools, and enabled local authorities to establish new schools and recruit more teachers.

As a result the enrollment rates increased for both boys and girls, but the rates for girls which had been much lower than that of boys before the project, increased more. The project benefited women substantially, as the paved roads sharply increased the affordability of butane for cooking and heating, dramatically reducing women's daily chore of collecting fuel (Hernan, 1996).

2.3 THE ROLE OF TRANSPORT IN POVERTY REDUCTION

The process of poverty reduction is embedded in a broad range of socio-economic activities in which transport services provide intermediate inputs. Reduction of absolute poverty can be achieved either directly through income distribution or indirectly through per capita income growth. The direct approach focuses on the provision of basic education, nutrition, health and access to employment and product markets for the poor. It arises from recognition that the very

poor generally do not have sufficient resources to meet basic human needs and, because of their lack of human capital, in many cases they may not be able to take adequate advantage of the economic opportunities generated by national economic growth.

The indirect approach addresses poverty through investments and policies that foster economic growth, enhance the performance of markets, facilitate flexibility of adjustments, and increase the efficiency of resource allocation. Gains from overall growth of GNP and per capita income are expected to bring benefits to the populations as a whole including the poor in the informal sector and other economic and social opportunities. A large body of empirical evidence shows that sustainable national economic growth generally contributes to the alleviation of absolute poverty (World Bank, 1980).

A transport system contributes to poverty reduction through its indirect impact on economic growth or its direct impact on personal welfare of the poor. The exact impact the project would have on poverty reduction hinges on both the type of infrastructure services and the areas and the people it serves. It also depends on the operating environment of the project, particularly market structures and government regulations. In general, local access roads in poor rural areas make only a modest contribution to national economic growth, but they are likely to have a direct and significant impact on the daily life of the poor. On the other hand inter-city transport modes such as the Nairobi –Mombasa road are of strategic significance to a national economy. Since such a network stimulates and facilitate national income growth, their impacts on poverty reduction are likely to be indirect.

Investment in the transport sector improves access to economic opportunities by reducing transport costs provided transport market structures are reasonably competitive. This would be reflected in a reduction in price for both freight and passengers and services. Again, under competitive conditions, significant predictable consequences will result. This includes lower market prices for final products (both rural products and consumer goods), spatial extension of the market due to the transport -reduced changes in production and consumption pattern, higher personal mobility, and stimulation of socio-economic activities. In general, this dynamic process can be expected to benefit all income groups in society in the form of real income effect and increased opportunities (of course, this does not imply, that all individual members of all income groups benefits; the average income for each group may rise but real income for some individuals may fall).

The provision of transport services, including the construction and maintenance of transport infrastructure, generates demand for labour (often unskilled labour) and provides income-earning opportunities for the poor. If a transport project generates jobs for the poor who are otherwise unemployed or under-employed, it contributes to the reduction of poverty.

It must also be noted that transport may also have adverse impact on the poor. For example transport investment typically involves some environmental impacts. If the effect is negative, the poor are the least able to respond, adjust or compensate; they may be the most vulnerable and the most "at risk".

2.3.1 Government Policy on Poverty Alleviation in the Roads Sector, 2000-2003

The policy was to restore transparency, accountability and professionalism in roads sector. The measures include, strict and transparent contracting procedures, quality inspection, prompt auditing and accounting for road maintenance funds, improved payment and disbursement system, strict adherence to specified standards, strengthening the capacity of implementing agents and blacklisting defaulters and non-performing contractors.

The roads department was to implement the roads strategic plan and give priority to routine maintenance of the classified network, to focus on periodic maintenance of the main trunk roads and provide basic access by spot improvement of unpaved feeder roads. In areas where labour intensive techniques are appropriate, especially in rural and minor feeder roads, the government to sub-contract maintenance to communities which will use labour intensive methods. The use of local labour to provide employment to local communities, boosts the rural economies, and hence contributes significantly toward poverty reduction. The government to place attention on improving the unclassified roads networks, improving local infrastructure to promote further investment, growth and access to markets and local services. These strategies were to be implemented through the Kenya Roads Board (K.R.B), which will use central and local road agencies to deliver the construction and maintenance of road services. In addition, the government was to promote intermediate means of transportation (bicycles and animal drawn carts), which will increase poor peoples mobility. Emphasis will also be on construction and maintenance of rural tracks and footpaths that will increase rural access to service and market centers.

In order to attract the large investment and management skills needed to expand and modernize the main road corridors from the port to neighbouring countries, the government was to design appropriate road concession arrangement to attract the private sector to construct, maintain and manage the major highways as toll roads. The government to initiate this approach first on the Mombasa-Nairobi-Malaba Road.

2.4 GOVERNMENT POLICY ON TRANSPORTATION

(i) 1964-1970 National Development Plan

The government policy during this plan period was on continuous development of the trunk roads. The following five heavily travelled roads were to be improved by tar making: Embu-Sagana, Kisumu-Yala, Ahero-Kisii, Kiganjo-Nanyuki, and Mombasa-Malindi. Due to the envisaged high cost of tarmaking of the Nairobi-Mombasa Highway, the government started looking at the possibility of funding the improvements of trunk roads from revenue collected from toll stations.

The emphasis on trunk roads was not to be at the expense of programmes of road building aimed at fostering continued development of agriculture. The government spent K£ 21.5 million on secondary and minor roads in support of development programmes for agriculture, settlement, tourism and fisheries over the plan period. The central government was responsible for the construction and maintenance of all national and international trunk roads and made grants for the maintenance of all secondary roads. Improvement and maintenance of minor roads was the responsibility of respective local authorities. In the construction and improvement of national and international trunk roads, the government used private

contractors. In the construction and improvement of lesser trunk roads, secondary and minor roads, and the Nairobi–Addis Ababa roads, the government used its own resources in the MRPW and National Youth Service, and the resources of local authorities. The national construction company was to be established in order to participate in road construction.

ii) 1970-1974 Development plan

Major emphasis was on feeder and other minor roads in the rural areas. New roads were to be built to open up areas where no road communication existed. Total road expenditure for the plan period was to exceed K£43 million, based on 1967 price. The division of expenditure among the various road classes was 34% for feeder roads, 20% for special development road projects and 46% for trunk roads. The above ratios were based on recognition of the necessity of upgrading many existing bitumen trunk roads that were heavily trafficked and the broader needs of having the entire road system adequately serving a primary agricultural economy. The programme for the plan period included approximately 4,700 kilometers of high cost and 4,500 km of low cost or special development roads. It was the intention of the MRPW to increase its portion of the roads design work from 30 to 50%. The rest of the work was to be done by consultants.

iii) 1974-1978 Part 1 Development Plan

Over the previous five-year period 1968-1969 to 1972-73, some 30% of the total central government development budget was spent on new road developments. During the 1974-1978 plan period, the relative financial allocation for road construction drop from approximately 30 to 20% of total Development Expenditure. Greater emphasis was to be given to adequate maintenance of already existing roads. More emphasis was given to the improvement

and maintenance of secondary and rural access roads than has been the case before. The government was to encourage the development of small transport firms. Traffic rules to be strictly followed as regards overloading, over speeding and environmental conservation. More emphasis to be placed on new access roads in agricultural areas where communication is not possible in the wet seasons, or where the cost of road transport is excessively high.

On the longer term, all roads in the country whether included in the road classification or not to be regarded as part of the national road system and to be under the ministry of public works.

iv) ***1979 -1983 Part 1 Development plan***

In order to improve road maintenance during the plan period, definite maintenance targets to be established and the required manpower to be trained and equipped with the right type and amount of equipment.

To strengthen and expand the road maintenance capabilities, the government was to include the review of the road maintenance practice and financing and accounting procedures, and the assignment of qualified personnel to the district level, and the provision of additional maintenance plant and equipment. The level of recurrent funds for road maintenance was to be increased.

In order to implement effectively the various road programmes and to enhance safe efficient and economical use of the road network, the government undertook the following corrective measures:

- Enforced Axle Road Regulations. In order to safeguard road investments, the government reviewed the existing laws and vigorously enforce the traffic rules relating to axle-load and vehicle dimensions.
- Road safety. (i) The government expanded the number of vehicle inspection centers to deal with unroad-worthy vehicles, (ii) The number of police patrol bases to deal with speeding and other contraventions of the Traffic Act were increased, and (iii) Matatus were made to comply with the requirements of the traffic act as it is related to speeding, overloading, roadworthiness and insurance.
- The contractors, may they be public or private, were encouraged to use labour –based methods in order to create more employment and to use local raw materials

(V) 1984-1988 Development Plan

During the plan period emphasis was directed towards strengthening of paved roads and towards upgrading and maintenance of unpaved roads already in place. An earlier study of road user charges had found out that heavy goods vehicles did not cover the cost of the damage they caused on the roadways. It had been observed that vehicle combinations with more than 3 axles covered only between 67 and 82% of those costs. It was therefore government policy during this plan period to increase tax on heavy vehicles and that the axle load limit be increased from 8 to 10 tonnes.

(Vi) Development Plan 1989-1993

During the plan period, priority was accorded to the achievement of more cost-effective use of existing facilities. The government allocated the necessary funds for the maintenance,

improvement and rehabilitation of existing facilities. At the same time more toll stations was introduced to raise collection from user-charges that will complement budgetary allocations. Further expansion of the transport network and facilities was undertaken in areas where lack of such infrastructure was a bottleneck to development or to the meeting of other strategic needs. Priority was given to further enhancement of the Rural Access Roads Programme (RARP) and the Minor Roads Programmes. All opened up roads were graveled. Labour–intensive technologies were to be promoted in road construction and maintenance to lead to employment creation and foreign exchange conservation. On urban roads, the government concentrated efforts on both dualling and widening the network in addition to providing for fly-overs, tunnels, grids and by-passes, particularly in Nairobi, Mombasa and Kisumu.

(Vii) Development Plan 1994-1996

Government policy in this plan period was to give priority to provision of funds for maintenance, rehabilitation and modernization of the existing facilities for cost-effectiveness. Consideration for the provision of funds for additional transport facilities was done only where such addition would remove bottlenecks in development. The overall objective was to improve the efficiency and sustainability of the existing transportation system through mobilization of human and financial resources and the restructuring of its institutional framework.

Road tolls as a source of revenue were reviewed. Emphasis was placed on the development of an all-weather rural road system, selective upgrading of roads to bitumen standard, intensified use of the labour–based technologies and enhancement of environmental concerns, the promotion of road safety and research on appropriate road building materials and technologies. Encouragement of greater utilization of non-motorized transport particularly the use of

bicycles. To achieve a sustainable urban transport system, attention focused on increased investment in urban road network and an increased expenditure on the maintenance of urban roads. Facilities for use by the disabled were to be provided. Furthermore, measures were taken to strengthen and streamline the institutional framework in road transport at national and local levels, to strengthen the coordination of activities and responsibilities not only within the sub-sector but also within other modes of transport. The government also explored the posibility of the establishment of an autonomous Road Transport Authority with a view to streamlining the coordination and management of roads and road transport.

(Viii) National Development Plan 1997-2001

The government's policy aimed at increasing efficiency of road transport by:

- Give priority to the maintenance and rehabilitation of existing roads. New road development is to be undertaken only to remove bottlenecks to economic activities;
- Intensify efforts to provide adequate financial resources for road maintenance as a matter of first priority;
- Strengthen the management and the institutional framework for the management of roads. The government through the MPWH and Ministry of Transport and Communication (MOTC) to establish an autonomous Executive Roads Board to manage the Roads Maintenance Levy Fund (RMLF) and road maintenance. This Board to include the major stakeholders in the roads sector who would also constitute the majority of its member's. To ensure adequate funding of urban road maintenance, the board to ensure that a specified portion of the RMLF revenue rose in a particular local Authority is used exclusively for the maintenance of roads in that locality.

- Strengthen the technical and policy-making capacity of MRPW and MOTC. A strategic plan for roads sector management to be prepared .The strategic plan to provide for: (i) provision for adequate funding for road maintenance (including urban roads), (ii) establishment of guidelines for transparent management and use of road maintenance funds, (iii) modalities for setting priorities for road investment, (iv) establishment of additional dual carriageways and replacement of roundabouts with flyovers or traffic signals, and (v) make provisions for pedestrian and bicycles routes along future roads.
- To encourage the use of labour–based methods for road maintenance and construction, whenever they are cost-effective and also encourage both private sector and public sector road contractors to take advantage of these developments to minimize economic costs, save foreign exchange, while at the same time provide employment to Kenyans in their activities.

2.5 THE KENYAN ROAD SECTOR

The Kenyan economy is dependent on roads and road transport. High priority is attached to the improvement of the main road network hence the network of paved roads has increased from about 1800km at independence to over 8,600km in1994 (GoK, 1994). In addition to upgrading the main road network, a series of projects has extended and improved rural access roads in the most densely populated and agriculturally important areas of the country. Currently, Kenya has a classified road network, under the MRPW, of just over 63,000 km (Table 2.1).

Table 2.1: Kenya Classified Road Network, Km.

Road class	Bitumen	Gravel	Earth	Total
International Trunk (A)	2,667	783	241	3691
National Trunk (B)	1403	821	524	2748
Primary (C)	2503	3292	2160	7955
Secondary (D)	1171	6129	3921	11221
Minor and Special (E)	878	15069	21559	37507
Total network	**8621**	**26092**	**28406**	**63122**

Source: Ministry of Roads and Public Works, 1993.

In addition to the classified road network, there are estimated to be above 85,000 km of urban streets, and unclassified roads and tracks. Various agencies are nominally responsible for the unclassified road network; municipalities, county council, the Kenya Wildlife Service, and the forestry department. With certain exceptions, the responsible agencies have been unable to maintain the unclassified network and though information is extremely limited, the conditions on most of this network are in poor shape and may no longer be motorable. While most investment has been directed to upgrading the main road network, there has also been a significant expansion in the coverage of the classified rural road network through the special crop-oriented programs (tea, sugar and wheat roads) and RARP. The RARP was commenced in the early 1970s with the intention of constructing a very extensive network of all–weather rural access roads using labour- intensive construction methods. The full objective of the program (about 14,000 km of rural roads) was not realized but over 800 km of rural road were constructed. The roads under RARP have subsequently been maintained under the minor roads programme (MRP), which has extended the labour intensive approach to the improvement of existing minor roads. Overall, there are now over 12,000 km of rural roads, which have been improved and are now maintained under MRP (GOK, 1993).

2.5.1 Road network conditions

Coverage of the road network is generally adequate to support the present types \level of economic activity in Kenya. Roads are however concentrated in areas of high population and economic activity. The primary problem in the Kenyan road sector is not the quantity but the quality of the network. The inadequate quality of the network is the consequence of two rather different factors. One, road condition on most paved and unpaved roads have deteriorated significantly through a lack of maintenance and, on the main paved network, the overloading of vehicles. The other, traffic growth has resulted in a substantial network of unpaved road carrying traffic levels sufficient to justify paved roads; about 2,500 km of unpaved road carry over 200 vehicles per day (World Bank, 1995). Operating conditions are inadequate on large selections of the network and the situation is deteriorating.

A visual inspection of the paved network in 1989\90 indicated that 32% of the network was in good condition, 39%in fair conditions (requiring some periodic maintenance) and 28% in poor conditions (substantial amount of failure requiring major work). In 1993 the visual inspection classified only 12% in good conditions, 42% in fair condition and 46% in poor\critical condition. Funds for periodic maintenance of the unpaved network have been extremely limited and even routine maintenance is not fully undertaken (World Bank, 1995).

On some roads the deterioration has resulted from inadequate design and\or construction standards (World Bank, 1995). The shift in long distance heavy freight transport from rail to road clearly had a major impact along the main corridors. Several attempts have been made to control vehicle overloading through the introduction of fixed weighbridges and then, when these proved unsuccessful through random checks using mobile weigh bridges. There was also an attempt, in 1991 to limit tanker axle- loads by restricting the permissible volumetric size of

tanks but enforcement of the gazetted regulation was delayed to allow transporters time to adjust. The extension of the pipeline to Eldoret and later to Kisumu should significantly reduce traffic loading on part of the main road network, but would have no direct impact on the Nairobi –Mombasa road unless Kenya Railways (KR) capture a higher share of the heavy oil market, by converting its redundant light tanker wagons.

The expansion of the network has intensified the problem of inadequate maintenance funding. In the early 1980s, road tolls were introduced in the main paved network to supplement regular budgetary funding while the toll revenue provided funds outside the normal budget (in 1992\93 Kshs 326 million was collected in toll revenue and used for periodic maintenance and strengthening of the main paved road system), the net increase in funding was limited as the normal budgetary allocations, in real terms, declined (World Bank, 1995). Overall, there has been a significant reduction in maintenance funding since the 1970s and a major fall in total road expenditure in recent years. The extent of under funding of road maintenance in Kenya is not known with total precision, but it is very considerable.

A study in 1994 for the Public Expenditure Review (PER) estimated that the total annual spending by MRPW on the maintenance and rehabilitation of the network, was Kshs 1.72 billion (this included maintenance components within improvement projects). The study further estimated that adequate road maintenance for a rehabilitated and rationalized classified road network would cost in the order of Kshs 4.70 billion.

The present level of maintenance funding cannot even be optimally allocated, as a high proportion of the recurrent budget is needed to pay a large workforce of permanent labourers who cannot be productive because there are insufficient funds to provide the complementary materials, tools and transport. Unfortunately, neglect over the many years has resulted in much of the network deteriorating to the point where rehabilitation is necessary before maintenance is possible. Full rehabilitation of the system, to conventional standards, has been costed very approximately at Kshs 36 billion (World Bank, 1995).

2.5.2 Inter–modal distribution of traffic

Along most of the Northern Transport Corridor, road and rail run alongside. Table 2.2 provides indicative estimates of long distance freight along the corridor. Overall, trucks carry about twice the volume of rail freight. This shows the importance of the Nairobi –Mombasa road to Kenya's economic growth.

The consequent increase in heavily overloaded trucks has had a severe impact on Kenya's road network, which was constructed on the basis that long distance freight would be carried by rail. Data on passenger movement along the corridor are limited. A study by KR's passenger transport capacities on the Nairobi –Mombasa route (Table 2.3).

Table 2.2: Transport Corridor. Freight flows (Million Tones)

	Rail	**Road**	**Pipeline**
Mombasa-Nairobi	2.0	3.7	1.5
Nairobi-Eldoret	1.1	2.2	N/A
Nairobi-Kisumu	0.5	1.6	N/A

Source: Kenya Railways, Ministry of Roads and Public Works and Mission Estimates, 1995.

Table 2.3: Public Passenger Transport Capacity, Nairobi-Mombasa (seats per day)

	First class	Second class	Economy	Total
Rail	100	170	240	510
Air	670	-	-	670
Bus	-	120	2000	2120
Total	770	290	2240	3300

Source: Kenya Railways passenger service study, Swede Rail, 1995.

The road transport once more emerges as the dominant mode of public passenger transport and this makes the road transport, and more the Nairobi –Mombasa Road an important contributor to Kenya's economic growth.

2.5.4 Traffic flows: Nairobi-Mombasa Road

While the Nairobi -Mombasa Road may not have the highest traffic flow in Kenya, in terms of total, traffic flow, it is certainly the most heavily trafficked road. The available evidence suggests that the average daily flow of heavy commercial vehicle (three or more axles) increased from about 200, in the early 1980s to around 450 in the mid 1980s and to almost 600 vehicles in the early 1990s(Word bank, 1995). In the Nairobi direction, almost 100 per cent of the heavy commercial vehicles are loaded (over- loaded) and about 50 per cent of trucks are loaded in the Mombasa direction. The best estimates of average daily traffic, on the sections outside the immediate urban peri-urban areas of Nairobi and Mombasa (Table 2.4).

Table 2.4: Nairobi-Mombasa Road(Average daily traffic)

Road section Nairobi To	Km	Cars	Light goods	Medium goods	Heavy goods	Bus	Total Traffic
Athi River	27	-	-	-	-	-	-
Machakos	46	7.90	790	740	610	170	3100
Hunters lodge	159	280	530	210	590	100	1710
Mtito -Andei	238	270	410	220	590	80	1570
Voi	337	250	380	220	590	90	1530
Mariakani	462	280	410	270	590	130	1680
Miritini	484	330	680	340	590	120	2060
Mombasa	500	-	-	-	-	-	-

Source: Ministry of Roads and Public Works and Mission Estimates, 1995.

2.6 TYPES OF TRANSPORTATION IMPACTS

The earliest attempt at accounting for the total impact of the highway construction owes its origin to the welfare branch of economic theory. This area of research is directed towards the evaluation of changes in the existing economic system by viewing their desirability with respect to an established set of socially accepted goals. This marriage of ethics (or what should be) with fact (what really is) forms the heart of welfare analysis. In making these evaluations the goal that has been dominant for application in the field of highway analysis is the maximization of economic well being for society as a whole.

2.6.1 Impact types

Impacts arising from road development projects fall into three categories; direct, indirect and cumulative impacts. These three groups can be further broken down according to their nature into: (i) positive and negative impacts, (ii) random and predictable impacts, (iii) local and widespread impacts, (iv) temporary and permanent impacts, and (v) short and long-term impacts.

Direct impacts are caused by the road itself, that is to say, by road building processes. This include land consumption, removal of vegetation, and severance of farmland .The removal of gravel material from a borrow pit, for use in surfacing the road, is an indirect impact of road construction. In this case, the land area in which the pit is located has been directly affected by activities associated with the road project. Direct impacts are generally easier to inventory, assess, and control than indirect impacts, since the cause- effect relationship is usually obvious.

Indirect impacts are usually linked closely with the project and may have more profound consequences on the environment than direct impacts. Over time they can affect larger geographical areas of the environment than anticipated. Examples include degradation of surface water quality by the erosion of land cleared as a result of a new road and urban growth near a new road. Another common indirect impact associated with new roads is the decaying of a by-passed town, like Kibwezi in Makueni District, increased deforestation of an area, stemming from easier (more profitable) transportation of logs to market, or the influx of settlers. In areas where wild game is plentiful, such as Kenya, new roads can lead to depletion of animals due to poaching.

It is with indirect effects that impacts linkages between the natural and social environment often take place (Koji, 1997). For example, the appropriation of land to build a road may displace farmers and may interfere with their cropping pattern and force them to use another water supply. This change could lead in a depletion of a groundwater aquifer, intensification of new land clearing, erosion, water runoff contaminated with added fertilizers and pesticides

The cumulative impact, in the context of road development, might be the de-vegetation and eventual erosion of a roadside pullout. The scenario might unfold as follows: a road cutting through a mountain range offers some spectacular views, and in the absence of designated rest areas, motorist stops indiscriminately. Roadside vegetation is damaged by vehicle and foottraffic, and the soil is left unprotected. Subsequent rainfall causes erosion and siltation of nearby watercourses. The vegetation never has enough time to recover, (because of high traffic volume on the road), and the problem is exacerbated over time. An example of this kind of scenario in Kenya is found along tourist routes through the national parks.

Ecosystem function impacts, a subset of cumulative impacts, which disable or destabilize whole ecosystems, are the most dangerous and often the least likely to manifest themselves over a short period of time. One striking example is the highway constructed across a mangrove forest (100 ha in size) along the Caribbean coast. It was not fully understood at the planning stage to what extent the fresh and seawater needed to mix in order for the healthy forest to survive on both sides of the road. As a result, most of the forest has died because on one side the waters were not saline enough, and on the other there was not enough mixing with the fresh water. The effect on the ecosystem was devastating and the impact on the local population, which used the mangrove forest area, was severe. Almost certainly, no sign of this impact appeared until two to three years after the road was built (Koji, 1997).

Environmental impacts should be considered not only as they pertain to road rights-of-way, but also to sites associated with the road project, which include deposit and borrow sites, materials treatment areas, quarries, access roads and facilities provided for project workers.

Where roads bisect wildlife migration routes, the road inflict stress on the migratory population for many generations, or even permanently, and cause instability, increased mortality and possibly catastrophic decline.

Moreover if the traditional grazing areas of cattle farmers are cut off by new or re-constructed roads with raised-horizontal alignments, they may be forced to move their herds onto forest or park areas, which results in a rapid depletion of the under- story (grasses, etc). This destroys the forest edge ecotone and the basic forest ecosystem, as well as threatening the inhabitants with possible invasion from species better adapted to the newly created "grazing –forest" ecosystem. The invaded forest ecosystem is stressed further, users of the ecosystem are affected, and a chain reaction progresses throughout the system, feeding back to the social environment in the form of community disturbances and hardships.

2.6.1.1 Positive and Negative Impacts

Environmental impacts sometimes have positive and negative effects; some impacts can positively affect others in the same environment. Positive outcomes that occur as a result of project completion typically include improved access, reduced travel time and cost. Other positive outcomes can be designed into a project, for example, improving water retention for local use, flood control, or providing better facilities for pedestrians and bicycles. In some cases, positive impacts can appear without having been initially foreseen by the road agency, such as the use of borrow areas to water livestock in dry areas. However, rechannelling streams as part of a road construction might improve drainage for a roadside farmer, but wreak havoc on the livelihood of others who depend on the aquatic species disturbed by the rechannelling.

2.6.1.2 Random and Predictable Impacts

In the assessment of this nature, it is useful to distinguish between assured or highly probable impacts and more random or unpredictable ones, which have a low probability of occurring but which nevertheless, may have serious consequences for the environment. For example, in a densely settled population, it is reasonable to predict that the construction of a road in the area will result in property destruction whereas incidents such as accidental pollution, fire or spillage of toxic products are by nature, unpredictable. Well-understood and predictable impacts can usually be mitigated with remedial measures.

2.6.1.3 Local and Widespread Impacts

Local impacts include effects in the immediate vicinity of a road, such as destruction of a building, or restricted access to a farm. Widespread impacts can occur many kilometers from the project. These impacts are often linked to indirect effects that arise over the medium or long–term existence of the project and include the influx of settlers, deforestation and decay of by-passed towns. While the focus of most road effect studies has been on relatively narrow corridors measuring 100-500m in width, impacts can extend much further, particularly in new road projects (Koji, 1997). Major habitat conversion can take place up to 10km on either side of the cleared row. Transportation planners and other practitioners should be aware of this possibility and address it explicitly in the project design.

2.6.1.4 Temporary and Permanent Impacts

Temporary impacts are those whose occurrence is not lasting and which will eventually reverse themselves, the affected system having returned to its previous state. An example of

this type of impact might be the trampling of roadside vegetation during resurfacing to the point where no change from the original state is observable. Permanent impacts are those, which are irreversible –the affected system will not return to its previous state on a human timescale. It is important to note that "permanent" from the view point of Environmental Impact Assessment (EIA), is defined as "within one's lifetime". Therefore the destruction of a mangrove forest would be permanent.

2.6.1.5 Short-and Long-term Impacts

Short–term impacts are those, which appear during or shortly after construction; long-term impacts may arise during construction, but many of their consequences appear during the operation phase, and may last for decades.

2.7 TRANSPORT AND ECOLOGICAL IMPACTS

2.7.1. Impacts on Soils

Soil is an important component of the natural environment, and is a primary medium for many biological and human activities, including agriculture. In the road itself, in borrow pits, or around rivers for the road agency and streams, there are many places where damage might occur. Examples of these includes farmers losing crops and land, fishers losing income because of sedimentation in lakes and rivers, and road users being delayed when road embankments or structures collapse.

2.7.1.1 Loss of Productive Soil

The most immediate and obvious effect of road development on soil is the elimination of the productive capacity of the soil covered by roads. Unfortunately, the best sites for road development (flat and stable) also tend to be ideal for agriculture. The narrow, linear character of roads makes the impact of lost land seem minimal, but when the width of the right-of-way is multiplied by its length, the total area of land removed from production becomes much more significant. The removal of productive soil from the local economy can have socio-economic implications as well as habitat implications for flora and fauna. Soil productivity can also be reduced significantly as a result of compaction with heavy machinery during construction.

2.7.1.2 Erosion

When natural conditions are modified by the construction of a road, it marks the start of a race between the appearance of erosion and the growth of vegetation. Disturbance during construction can upset the often-delicate balance between stabilizing factors, such as

vegetation, and others which seek to destabilize, such as running water. In some cases erosion might result in cumulative impacts far beyond the road itself, affecting slopes, streams, rivers and dams at some distance from the initial impact.

2.7.1.3 Destabilization of slopes

Slope stability can be upset by the creation of road cuts or embankments. Excessive steepness of cut slopes, deficiency of drainage, modification of water flows, and excessive slope loading can result in landslides. Some sensitive soils, such as shale and "quick clays" are known for being difficult to drain and particularly unstable.

2.7.1.4 Side–tipping of spoil materials

Spoil material from road cuttings can kill vegetation and add to erosion and slope stability problems. Large amount of spoil can be generated during construction in mountainous terrain. Sometimes it is difficult to design for balances between cut and fill volumes of earth at each location, and houlage to disposal sites may be expensive.

2.7.1.5 Water flow diversions

Diversion of natural surface water flows is often inevitable in road projects. Diversion results in water flowing where it normally would not such as over vulnerable soils –and in concentration of flows; in both cases, the potential for erosion increases. Erosive flows can also arise from blocked ditches and damaged or inadequate water control structures.

2.7.1.6 Contamination *of soil*

Soil contamination can arise from daily traffic operation on very busy roads. Metals such as chromium, lead and zinc remain in the soil for hundred of years. Pollutants settling in roadside soil can impair the growth of vegetation and the success of soil organisms, thus increasing the likelihood of erosion. These effects are usually very localized, affecting only a narrow band on either side of the road.

In colder climates, salting of roads can lead to soil contamination and subsequent decrease of fertility. Pollution risks also arise from transportation of hazardous products during road construction and subsequent traffic operations.

2.7.1.7 Cumulative impacts

Cumulative impacts involving soil damage may affect many aspects of the environment. For example, development of a road could encourage bush fires and deforestation, which in turn could lead to erosion of bare slopes, re-channeling of rivers and streams, and possibly minor land slides.

2.7.2 Impacts on water resources

No matter where a proposed road may lie, it must intersect a drainage pattern, and where this intersection occurs, alteration of the local hydrology is inevitable. Road developments can lead to three types of modification to the natural hydrological environment.

2.7.2.1 Surface ***water flow modifications***

Roads that intersect drainage basins generally modify the natural flow of surface water by concentrating flows at certain points and, in many cases, increase the speed of flow. Depending on local conditions; these changes can contribute to flooding, soil erosion, channel modification and siltation of steams. These effects are often felt beyond the immediate vicinity of the road.

*2.7.2.2. **Ground water flow modification***

Road drainage and excavation can lower the water table in surrounding areas, while embankments and structures can raise the water table by restricting flow. The potential effects include deterioration of vegetation, increased susceptibility to erosion, loss of water for drinking as well as agricultural use, and habitat changes for fish and wildlife.

*2.7.2.3 **Water quality degradation (surface and ground water)***

Sedimentation, changes in biological activities in streams and on their banks, uncontrolled construction activities, and spills of chemicals and pollutants can have adverse effects on roadside water quality. Chronic pollution of surface runoff from exhaust emissions, pavement and tire wear, petroleum product drippage and corrosion of metals may be issues on some very busy roads. Where oil is applied to gravel roads to keep dust down, the likelihood of contamination is quite high. Seasonal pollution issues arise during salting of roads for winter maintenance and during periods of low stream flow.

2.7.3 Impacts on air quality

The emission of pollutants by vehicles has worldwide impacts and contributes greatly to the total atmospheric pollution generated by people. The use of passenger cars alone is responsible for 60 % of carbon monoxide emissions, 60% of hydrocarbon emissions, and more than one-third of the nitrogen released into the atmosphere (Koji, 1997).

2.7.3.1 Airmass contaminants

The main products of the combustion of motor fuels are carbon dioxide and water, but inefficiencies and high temperatures inherent in engine operation encourage the production of many other pollutants of varying effects: nitrogen oxide (No_x), sulphur dioxide (SO_2), hydrocarbons (Hc) carbon Monoxide (CO_2), lead (Pb), and particulate matter. Typical particulates include suspended airborne particles from diesel fuel combustion, materials produced by tire, brake and road wear, and dust.

Many primary pollutants are transformed into secondary and tertiary pollutants through various chemical reactions linked to meteorological factors, air temperature, humidity and the topography of the site. One example of this is the reaction of No_x and Hc in the presence of sunlight to produce ozone (O_3)which, although beneficial in the atmosphere, is well-documented nuisance at ground level.

In addition to emissions from vehicle exhaust, dust can also have major impacts on roadside air quality. This is especially true in the case of unpaved roads, which make up a large proportion of roads in developing countries like Kenya.

2.7.3.2 Human health

The health impacts of motor vehicle air pollution are difficult to quantify and hence difficult to value in economic terms. In many cases, establishment of direct cause –and- effect linkages between localized automotive air pollution and specific illness is problematic. However, evidence does strongly suggest that exposure to several of the major emissions constituents is responsible for certain health conditions e.g Asthma and skin diseases among others.

2.7.3.3 Built Environment

Objects in use by humans are vulnerable to air pollution on two fronts: staining and corrosion. Particulates are responsible for dirtying all manner of structures, including modern buildings, monuments and cultural heritage sites. Acid deposition associated with No_x and $S0_2$ is especially destructive to limestone, marble or lime mortar structures and is also blamed for deterioration of paints and accelerated corrosion of metals along busy highways.

2.7.4 Impacts on flora and fauna

The issue of impacts on flora and fauna is much broader than a concern for individual specimens, and any useful discussion in this area must be considered in the larger context of biodiversity conservation. Road development continues to be a major player in the overall reduction of biodiversity. Where new roads intersect habitat, the area occupied by the road, itself, borrow pits and quarries is subtracted from the total habitat area available to flora and fauna. Roads therefore tend to fragment an area into weaker ecological sub-units, thus making the whole more vulnerable to invasions and degradation. Nevertheless, roads and natural ecosystems can co-exist if the relationship is built on careful planning.

Ecosystems are characterized by complex, interdependent relations between complex species health and their physical environment, and the integrity of the ecosystem relies on the maintenance of those interactions. By slicing through habitat, roads affect an ecosystem's stability and health

When a road intersects or blocks a wildlife corridor, the result is either cessation of use of the corridor because animals are reluctant to cross the road, an increase in mortality because of collisions with vehicles or a delay in migration which may result in the weakening or disappearance of an entire generation of the population (Koji, 1997). Unfortunately, some animals are attracted to roads for various reasons, including protection from predators, good food supplies, better travel conditions, and so forth. This often leads to accidental death and poaching. On busy roads, the death rate for the local amphibian or other slow moving animal populations can be as high as one in ten (Koji, 1997).

2.7.5 Socio–Economic Impacts of Transportation

Communities owe much of their vitality to the ease with which economic and social interaction take place. Ironically, while roads are central to this continuing interaction, the introduction of a new road, or the widening of an existing road, may well cause disruptions to local interactions, which outweigh the benefits. With poor planning, this can be as true of the local road improvement as it is of the new highway. Properly planned, however, both should bring benefits to surrounding communities: lower transport costs, better access to markets, goods, jobs, or services such as health and education. Admittedly, in the case of some major highways, the benefits may accrue mainly to long-distance travelers and haulage companies and their customers while benefits to the local community may be minimal.

2.7.5.1 Intangible variables, which possess a non-market dimension

The inadequacy of current evaluation techniques in accounting for the intangible impacts of highway construction has led a number of people to device new types of measurement tools. It is difficult, on cost –benefit analysis, to practically assign monetary value estimates to intangible non- market factors. Any attempt in this direction is highly subjective and possesses the potential of significantly distorting the resulting value of net benefits. It is advisable that separate results be constructed for quantifiable and non-quantifiable factors.

To estimate the social impact, it is necessary to identify the community affected and to list or describe values with which the proposed facility is in conflict. A community value is understood to be any concept or norm that possesses an intrinsic worth for its own sake and which is accepted by recognizable segment of the area under investigation. This definition would eliminate perverse individual value while including those, which, even though they may be unpopular, are held by an established minority of the community. These values can be social, economic, political, historical, geographical, or aesthetic in nature. For instance a proposed transportation facility may have an impact on the structure of social values by altering the use and length of leisure hours, the pattern of neighbourhood residences, or the image that persons living in an area have for themselves and their community.

2.7.5.2. The split community

Both new roads and significant widening of an existing road can split a community. In rural areas, the normal links between villagers and their farmlands may be cut by a new road or

increased traffic. On the scale of the individual farm, this may disrupt existing farming patterns and connections between fields leading to a loss of agricultural productivity or increased travel time. The introduction of faster traffic, access controls, and median barriers generally cuts traditional lines of travel or communication. The alternative routes for local communication are sometimes substantially longer, directly affecting businesses, pedestrians, and users of non-motorized transport. However, on those roads, which are already difficult to cross, a proposed road improvement will have the potential of introducing considerable improvements to community interaction through such simple device as pedestrian bridges, underpasses and traffic signals.

2.7.5.3 The by-passed community

While by–pass roads can overcome some problems of conflict between roads use and community welfare, they may create other problems. On the positive side, by –pass roads reduce the immediate impacts of traffic on the community, and local commercial activities sometimes flourish as a result. On the negative side, communities may fear a loss of business from the diversion of traffic, and some community activities may "migrate" to the new route, potentially changing existing land use patterns and possibly undermining the objective of greater control of access on the new route.

2.7.5.4 Convenience of traditional modes of transport

Traditional modes of transport may be disrupted by changes accompanying a road project. Measures which impede road crossings, control bus stopping points, and restrict parking of informal public transport vehicles near busy markets and intersections may reduce the

attractiveness of these modes. The barrier effect of widened or new roads can increase travel time and distances for short local trips by foot, bicycle, and other non-motorized transport.

2.7.5.5 The gentrification effect

Gentrification is a term applied to situations in which the value of land in a particular area is increased by infrastructural improvements, leading to higher rental values, a turnover in occupancy and a replacement of lower–income tenants and residents by those who can afford the higher rents. Therefore, there is need to measure changes in land values resulting from an improvement in transportation network. Evidence supports the thesis that rising land values are associated with increasing accessibility. Indeed, additional traffic capacity implies that traffic redistribution leads to lower accident rates and lower vehicle operating costs.

Stroll (1967) has done a very limited study to show that overall trip length for a regions residents does not seem to change over time. However, he points out that salient socio-economic factors such as income, occupation, race, household size, auto ownership, and housing density directly affect the length and orientation of trips. This would indicate that changing characteristics of a region would affect the transportation needs.

2.7. 5 .6 Impacts arising from land acquisition and resettlement

Road development often requires the procurement of privately owned land. This land has to be acquired by the government from its current owners. While it is sometimes possible to negotiate a price for a voluntary sale of a property, governments often have to use their rights of compulsory acquisition (expropriation) of properties for public projects. By its nature, expropriation causes economic loss, and social and psychological disruption for the

affected individuals and their families. The economic impacts of expropriation may include the loss of houses or business, or the loss of business income, either temporary or permanent. Although this can be estimated, the actual valuation often proves to be difficult and protracted process.

2.7.5.7 Stresses in the "host" community

In regions where arable land is scarce, or where other basic resources such as fuel wood and water are in short supply, the impacts on the host community (community that receive and absorb the resettlers) from the influx of a new group of "users" can be severe. In some cases, the resettlers may be viewed as trespassers taking up resources in short supply. This kind of resettlement can become a major source of tension within the community and may end up being the basis for enduring conflict. If the people are resettled in totally foreign land, they may have considerable difficulty adjusting, e.g. having to learn new agricultural methods to apply on unfamiliar soils. Resettling may condemn these people to lasting poverty.

2.7.5.8 Impacts on cultural heritage

The term cultural heritage or cultural property, refers to sites, structures, and remains of archaeological, historical, religious, cultural or aesthetic value. Cultural heritage, often only partially known and studied, is a particular form of expression of human values, which serves to record past achievements and discoveries. Its identification and examination by specialists are helpful in understanding the significance of a site, according to its aesthetic, historic, scientific and social value, in addition to its amenity value. However, most road projects cause damage to: (i) the historic, scientific, social and amenity values and access to cultural heritage sites, (ii) aesthetic impacts on cultural monuments and archaeological sites, and (iii) positive

impacts on the amenity value arising from improved access to sites recognized for their cultural value; and on the scientific, historic, and social values arising from the addition of interesting sites previously unknown or overlooked; and the updating of the region's heritage.

A good example is the Zhejiang, multi-cities development project in China. The project aimed at improvement of urban infrastructure in the city of Ningbo through the widening of roads in the historic core of numerous historic structures including temples that were the center of activity for religious communities, specialists were called in to carry out an analysis of the cultural heritage assets, and they recommended alteration to the road in order to spare as many of the important structures as possible (Koji, 1997).

2.7.6 Impacts on aesthetics and landscape

It is now becoming more widely accepted that an understanding of ecology is essential for spatial planning. Stemming from that acceptance is a growing recognition of the fact that human respect for the biophysical determinants of any given physical setting is a major consideration in attaching aesthetic value to a landscape or to any structure, such as a road, that is introduced into that landscape.

A well-designed road fits well with its surrounding landscape because its design reflects the principle of spatial planning. These principles can and should be applied whether or not the area being considered in one of the special physical beauty. Their observation will serve to minimize not just the visual disturbance to the landscape but also the disturbance to the physical functioning of the natural and human ecosystems.

Negative aesthetic impacts can be expressed as resulting from lack of harmony between the road and various features of the landscape. Disharmony between the natural relief and morphology of the landscape can occur if the route does not follow the relief as closely as possible and causes the formation of major cut and fill zones, out of character with the terrain in height, length, and incline of slopes or if the route cuts transversely or diagonally across a system of parallel valleys ;or does not avoid landscape with an uneven relief. Also if the structure and pattern of landscape e.g. if road distorts the existing field system by, say, cutting obliquently through a rectangular farm system and creating numerous isolated plots which may be difficult to cultivate, out of place, and thus aesthetically disturbing.

2.7.7 Impacts on the noise environment

In many areas, noise is one of the most obvious impacts of daily road use. However, its effects are often given lower priority than economic or other environmental impacts, largely because they are rarely visible and are difficult to quantify monetarily. Yet most human and animals that suffer chronic exposure to severe noise pollution are keenly aware of its presence, and may experience a range of problems as a result of this exposure. Noise associated with road development affects the environment through which roads pass by degrading human welfare disrupting wildlife, by sonically vibrating structures, which are nearby.

2.8 COMPULSORY LAND ACQUISITION

Compulsory land acquisition is a process through which the government buys private land by force i.e., without due regard to negotiations and agreement with the landowners. The justification is that the land is needed to carry out public works for the benefit of the

community as opposed to the benefit the individual derives from his real property. Such works include: (i) provision of infrastructure (roads, railways and airports), (ii) social services facilities (schools, stadiums, public parks), (iii) health facilities (dispensaries, clinics, hospitals), (iv) defence installations (garrisons, military bases) (v) public administration facilities (police posts, Provincial Administration offices), (vi) water facilities (dams, boreholes, wells and Hydro-electric dams), and (vii) any other development in such a manner as to promote public benefit. This situation arises because unlike in the socialist countries, in Kenya people have the right to own real property privately.[1]

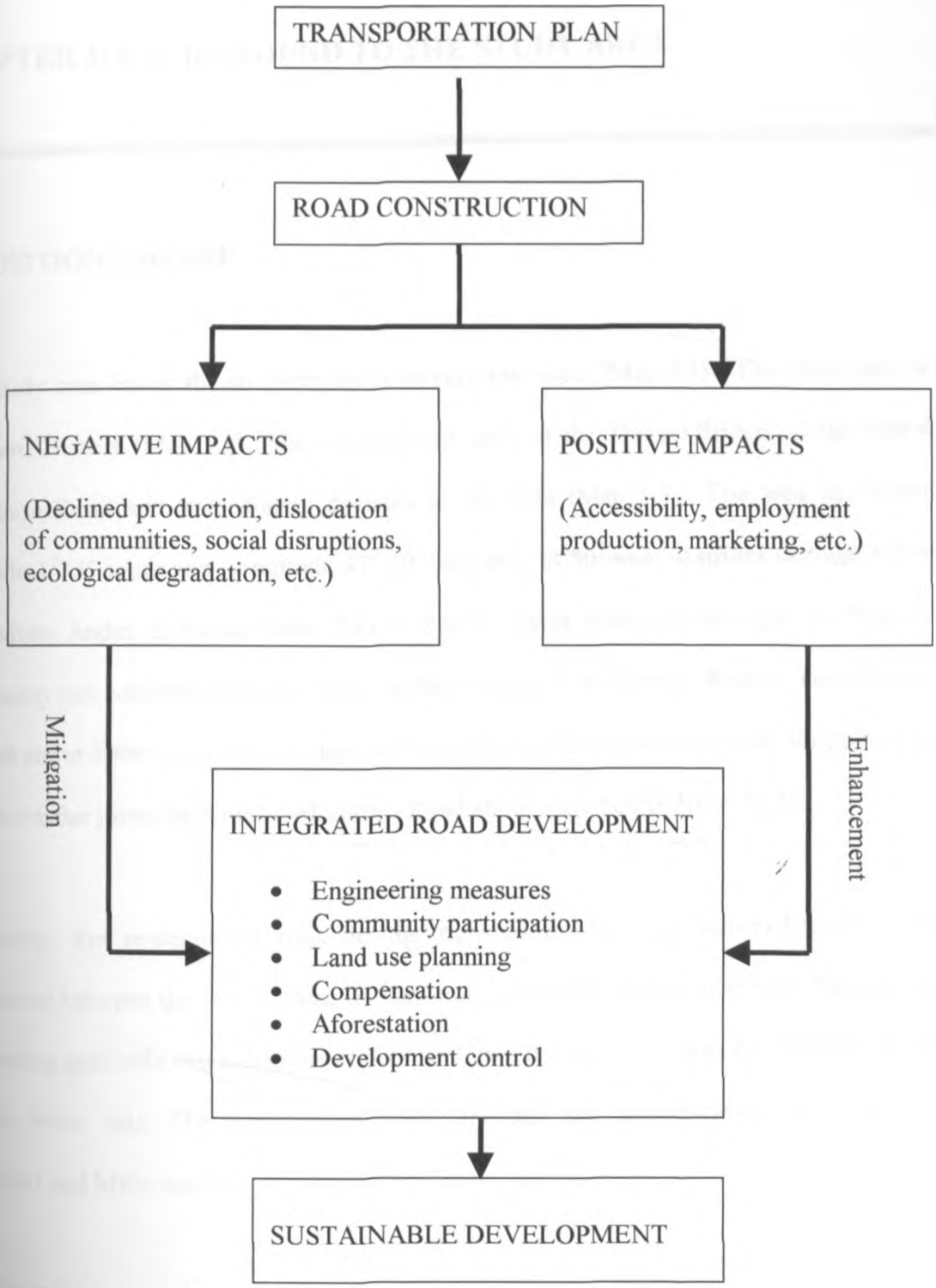
2.9 CONCEPTUAL RELATIONSHIP BETWEEN TRANSPORTATION AND DEVELOPMENT

A transportation plan starts with the making of a plan. The planning process involves among others the design of the vertical and horizontal alignment. This involves choosing of a suitable route after considering several factors among them the soils and the topography of the area. After the design implementation of the plan follows in the form of road construction. This may involve among other compulsory land acquisition and bypassing of some settlements. The process of road construction can therefore create employment to the local people with the result of increased incomes to the local people. It may also lead to the collapse of the by-passed townships, which would translate, into loss of incomes. Construction of the by-pass may also interfere negatively with the socio- cultural lives of the people in various ways. Clearing and disposal of vegetation and spoil materials may end up degrading the environment by destruction of the vegetation or increased soil erosion and pollution of the local water sources. Implementation of the road project adds to the existing road network. The use and

[1] Appendix 2 details the Kenyan land right ownership procedures.

Implementation of the road project adds to the existing road network. The use and management of the road network is governed by a regulatory system put in place by the Government. The road network interacts with other land uses in a spatial dimension. This may create positive and negative impacts. The construction of the new road increases accessibility and movement and hence regional linkages. Increased linkages between regions increase productivity and marketing within the various regions. This creates wealth and results in increased incomes. Unfortunately, economic development in the form of increased wealth is also accompanied by externalities in the form of negative socio-cultural, economic and ecological impacts. For a road development plan to achieve sustainable development then it is inevitable that mitigation measures be put in place. The mitigation measures will be more effective if the local community is involved from the plan preparation up to the operation and maintenance of the road project. These interrelationships are illustrated in Figure 2.1.

Figure 2.1: Linkages between transportation and development



Source: Research, 2001.

CHAPTER 3: BACKGROUND TO THE STUDY AREA

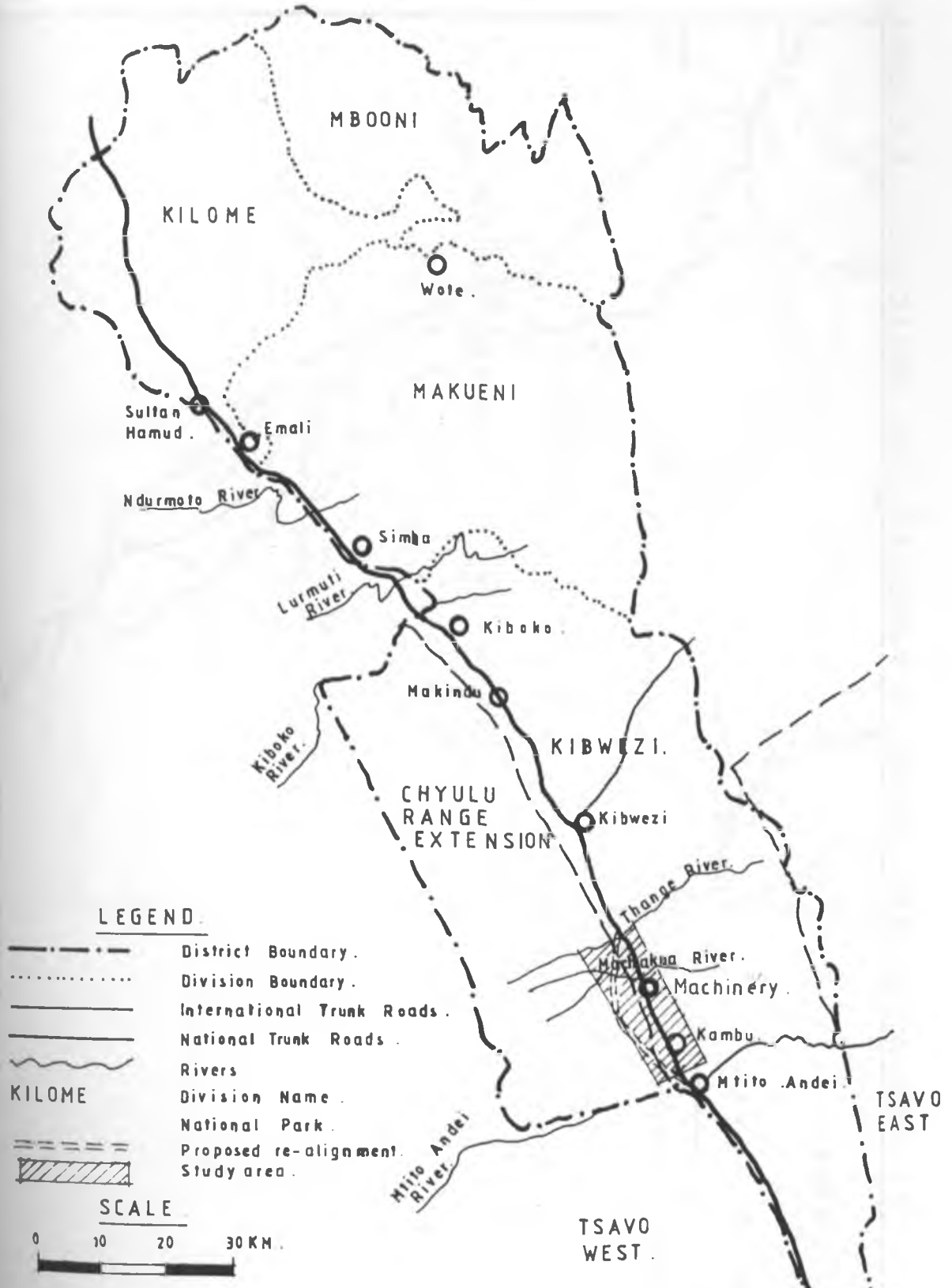
3.1 POSITION AND SIZE

The study area lies at the southern tip of eastern province, (Map 3.1). The study area is in Makueni District (Map 3.2). The re-alignment starts at the Thange Bridge on the Nairobi–Mombasa Road and immediately deviates to the right (Map 3.3). The area lies between Latitude $1^0 35'$ south and Longitude $37^0\ 10^1$ East and $38^0 30^1$ east. It strides through Kibwezi and Mtito Andei divisions (Map 3.4). It passes about 500m on the right of Machinery Township and continues towards Mtito Andei crossing River Kambu. Kambu Township is on the left about 300m away. The re-alignment continues and by-passes Hillside Shopping Center and thereafter joins the Nairobi–Mombasa Road about 3 km before Mtito Andei.

Generally, the re-alignment runs on the right of the existing Nairobi-Mombasa Road. Distances between the two alignments vary from zero at the intersection near Thange Bridge increasing gradually to a maximum of 4 km and then reducing to zero at the intersection on the Mtito Andei side. The re-alignment passes through two administrative divisions namely Kibwezi and Mtito Andei.

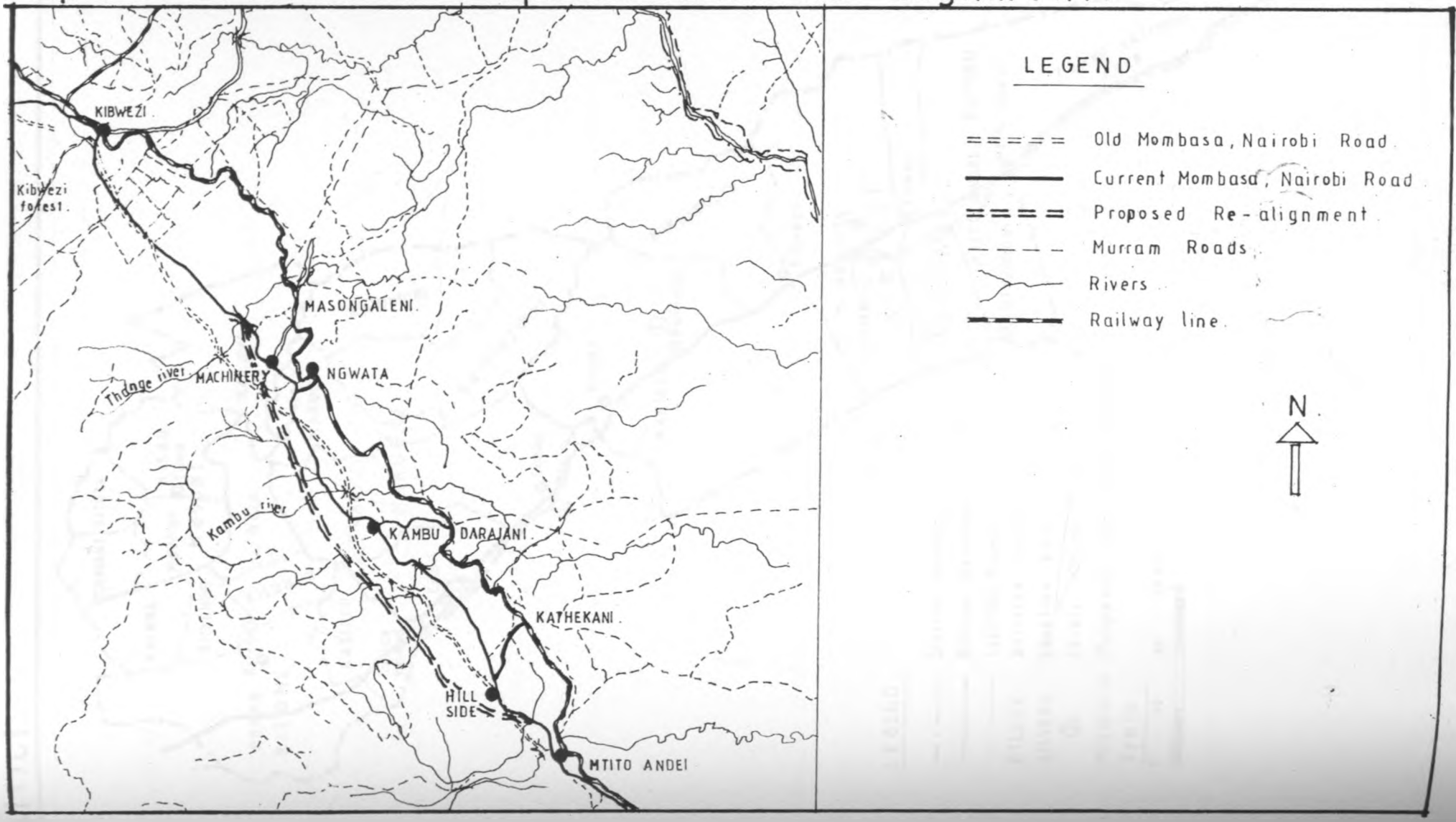
SOURCE : Adapted from Makueni District Development Plan 1997.

Map.3.2. Location of study area in Regional Context.

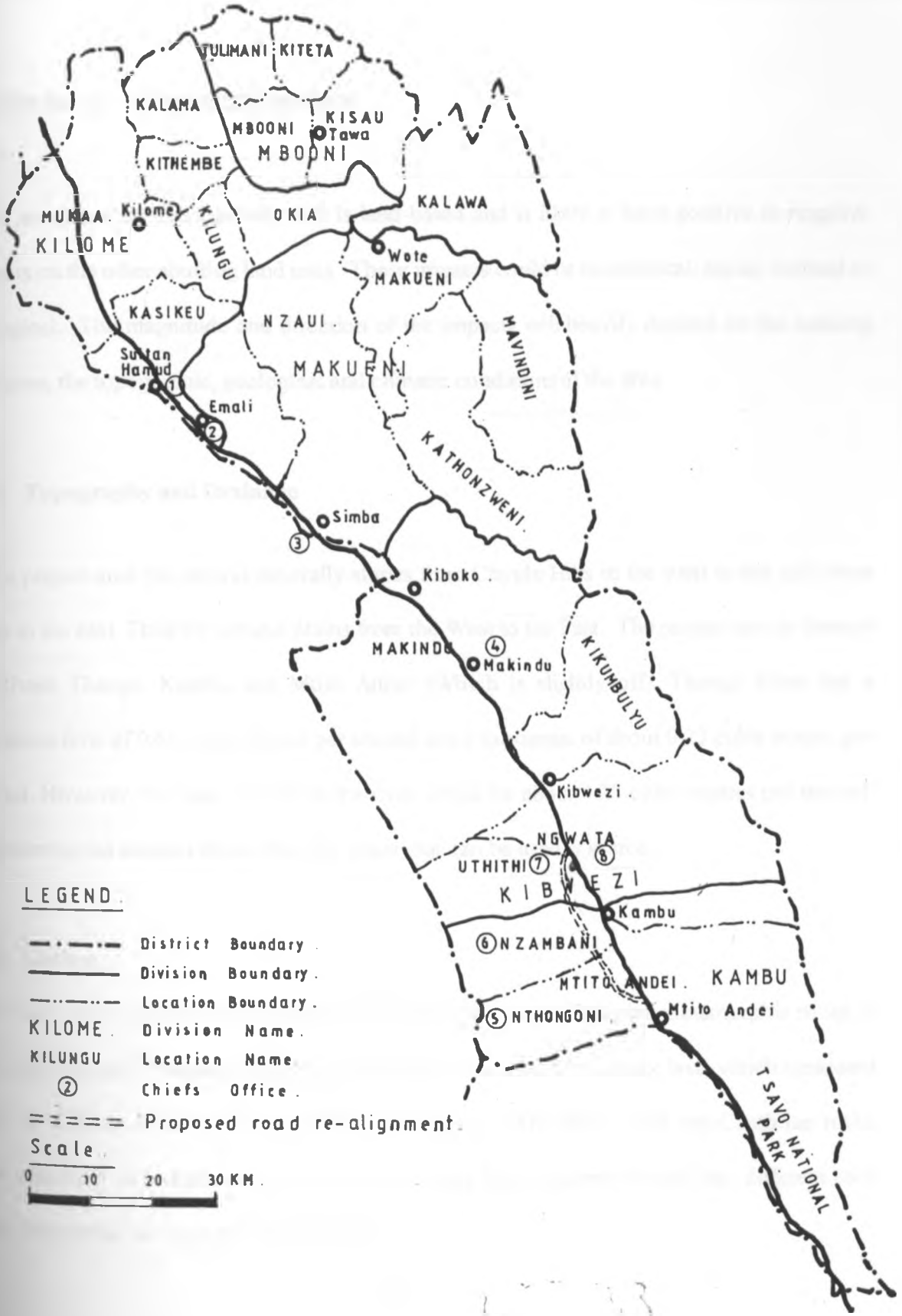


SOURCE: Adapted from Makueni District Development Plan 1997

Map 3.3. Location of Proposed Road Re-alignment.



Map. 3.4. Administrative Boundaries of Makueni District.



SOURCE: Adapted from Makueni District

32 PHYSICAL CHARACTERISTICS

Road transportation is an activity that is land based and is likely to have positive or negative impacts on the other abutting land uses. These impacts could be economical, social, cultural or ecological. The magnitude and direction of the impacts will heavily depend on the existing land uses, the topographic, geological and climatic conditions of the area.

3.2.1 Topography and Drainage

In the project area the ground generally slopes from Chyulu Hills in the west to the Athi-river basin in the east. Thus the ground drains from the West to the East. The project area is drained by Rivers Thange, Kambu and Mtito Andei (Which is slightly off). Thange River has a maximum flow of 0.65 cubic metres per second and a maximum of about 0.23 cubic metres per second. However, the safe yield from the river would be about 0.23 cubic metres per second. Considering the amount demanded, the water that can be used is scarce.

3.2.2 Geology

The study area is underlain by rocks of the basement system. These are metamorphic rocks of pre-cambrian age. They are overlain in some parts of the area by volcanic lava, which emanated from the Chyulu Hills to the west (Baseline Survey, AAK 1993). The pre-Cambrian rocks were originally of sedimentary origin but have since been metamorphosed into different rock types depending on degree of metamorphism.

3.2.3 Soils

The area has well drained, moderately deep-to-deep, dark red to dark reddish brown, friable to firm, sandy clay to clay soils. The soil characteristics, among others, of an area influence the spatial distribution of the various land uses. The soil characteristics influence agricultural production methods and costs, amount of surface run-off among others. Despite this characterization, the soils are well suited to growing of cowpeas, *Katumani* maize and fruits.

3.2.4 Climate and Rainfall

The study area is generally a semi-arid zone with a bi-modal rainfall pattern February to May being the long rains and October to December the short rains. Rainfall is not abundant with a mean annual precipitation of about 631 millimeter. The mean annual temperature of the study area is 26 degrees centigrade. During the dry season between May and October extreme heat is experienced in this area. The high temperature experienced causes high evapo-transpiration. While farming is not favored by this weather, ranching has benefited greatly.

3.2.5 Vegetation

Vegetation is affected by the relief and climatic conditions of an area. The study area is predominantly scrubland. Commiphora species, grewia spp, Boscia spp and several acacia species are the common woody components. The baobab trees (Ad Ansonia digitations) are commonly seen, they are very big trees. Most common grasses include chloris, Roxy burgh Ana, Eragrotis superba, cehens cilians and arstida species. The "Yellow fever" (Acacia Xanthoploea) is predominant a long the river line zones. Many of the common tree and grass species are becoming rare to get due to uncontrolled clearing of the vegetation for charcoal burning and agricultural farming.

3.2.6 Agro-ecological zones

The study area lies in Agro-ecological zone LMZ (livestock millet zone) (Map 3.5). Throughout the length of the realignment, potential for plant growth is medium to low, and risk of crops failure (Based on adapted maize) is high (25-75) per cent becoming very high near Mtito Andei and its immediate environs (75-90) per cent (Agro climatic zone map of Kenya, 1980)

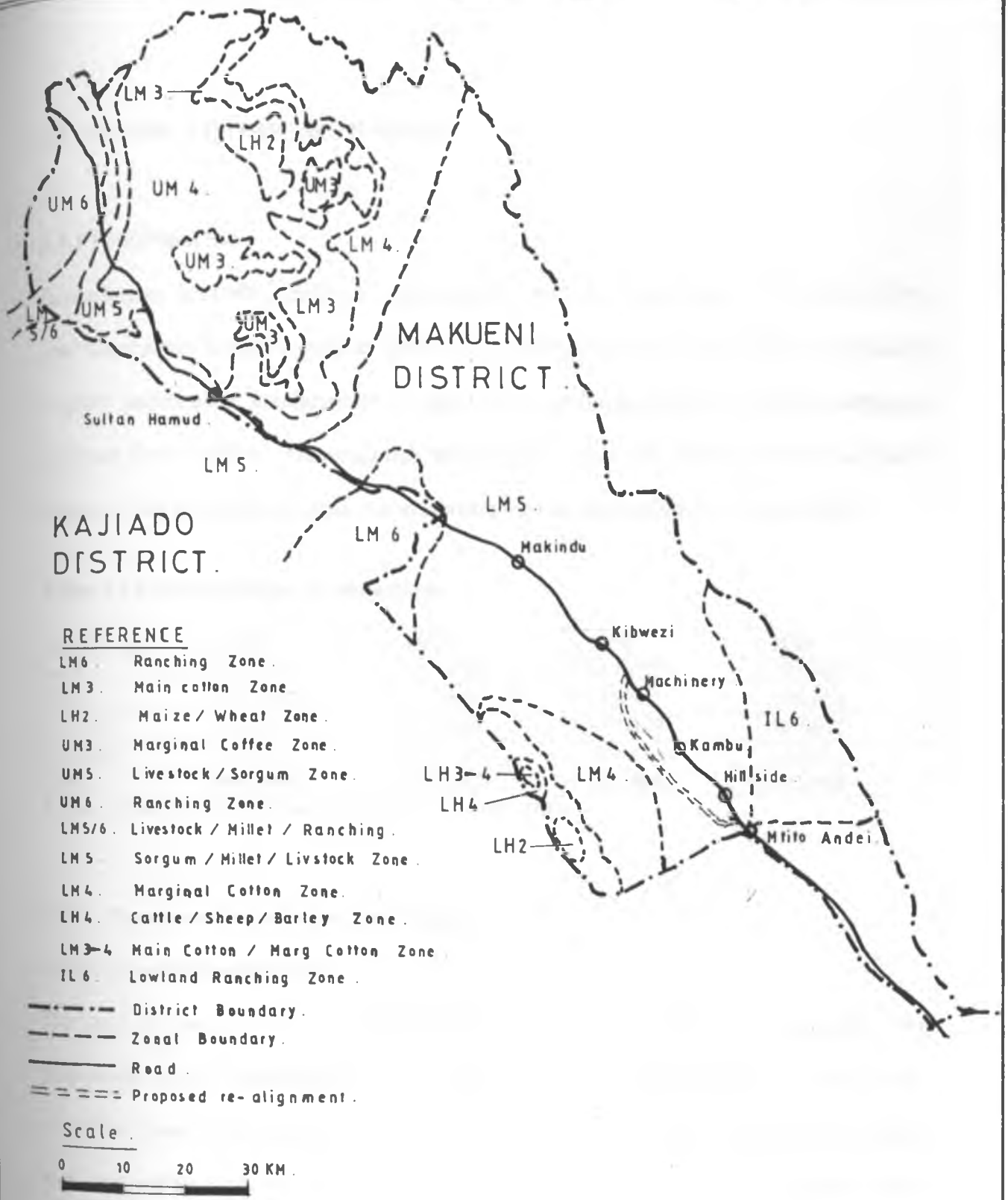
3.2.7 Current Land Use Pattern

From Machinery to Mtito Andei, there is a substantial amount of settlement with about 104 people per km^2. Subsistence farming is practiced, and plots vary from about 3 to 5 acres. The main crops grown include, maize, sorghum, pigeon peas, cowpeas, millet and beans. Many farmers place bee-hives on baobab or other large trees in order to collect honey. In the past, cotton was grown as the major cash crop, but due to low prices and irregular collection and payment schedules by the cotton board, the farmers became disillusioned and instead concentrated on food crops.

3.2.8 Wildlife

Much of the land through which the realignment passes is settled, and hence very few, if any, wild animals live here. The study area does not fall in the National park, however; approximately 100 M of the main project passes through Tsavo West National park as one enters Mtito Andei Township. The state lodge is located in this area. There is no wildlife movement across this section of the road because of its proximity to the town (Built Environment).

Map 3.5: Agro-Ecological Zones in Makueni District.



SOURCE Adapted from Makueni District Development Plan 1997.

3.3 SOCIOECONOMIC ACTIVITIES

3.3.1 Population Size

According to the 1999 population census, the District had a population of 771,545 in 1999, growing at a rate of 3.09 % per year (Table 3.1). This rapid increase of the district's population is partly attributed to immigration of people from neighbouring districts onto the settlement schemes in the district. Assuming that the population will grow at the same rate to that of Makueni, this population is projected to increase beyond one million by the year 2010.

Table 3.1 District population projections

Age Group	1989	1997	1999	2001
0-19	394,750	505,438	537,657	571,929
20-29	84,004	111,400	118,501	126,055
30 – 59	115,276	147,596	157,007	167,015
Over 60	39,965	51,173	54,433	57,902
Total	**636,994**	**815,607**	**867,598**	**922,902**

Source: Makueni District Development Plan, 1997-2001.

3.4.2 Population Distribution and Density

3.4.2.1 Population distribution

The study are has a population estimated at about 170,000 and is not evenly distributed. The population zones are discernible. The "hinterland" area running parallel to the Nairobi-Mombasa Road has less population densities owing to the subsistence farming. In the larger part, the middle zone and urban centers are heavily settled and run from Thange to Mtito Andei. This narrow strip houses over 80% of the population. The high density reflects the very intrinsic rate of growth in the area and location of many economic activities. On the other hand, the zone next to the Tsavo National Park is lightly settled.

Variations in population densities within the divisions occur because of the influence of the upcoming urban and market centers, such as Kibwezi, Kambu, Machinery and Mtito Andei which offer various investment and employment opportunities. The newly opened settlements schemes in Mtito Andei Division such as Masongaleni have caused a large influx of people from other districts thus increasing the population densities in this area.

3.5 URBAN POPULATION

In the area, commercial activities are found more in the small towns and market centers which have better social and physical infrastructure facilities. Kibwezi, Machinery, Kambu and Mtito Andei are up-coming urban centers with populations ranging between 15,000-20,000 people and above. These centers have piped water, electricity and Tele-communication services. They are potential industrial centers in the District.

3.6 ECONOMIC ACTIVITIES

The economic base of the area is mainly related to subsistence farming. However, the zone has a powerful business sector. The latter depends heavily on the travelers. Most of these activities are located at the urban centers along the Nairobi-Mombasa Road. Major business types include hotels, retail shops, bars and restaurants, and jua kali activities, particularly handicrafts, barbers, motor vehicle repairs, tailoring and carpentry.

The predominant farming pattern is subsistence agriculture and seems to be more of a supplementary source of family livelihood rather than a strong element in local market

economy. The major crops grown are maize, beans, pigeon peas, and cowpeas. Irrigated horticulture cropping is undertaken but in small holdings along the local streams.

Livestock rearing is another major economic activity in the area. The livestock reared include beef and dairy cattle, sheep, goats, rabbits, pigs and bees. The livestock products realized in order of the economic importance are milk, beef, hides, and skins, chicken and eggs, and honey. For all the products except for milk, there exist no organized marketing system.

3.7 INCOMES

3.7.1 Income from Livestock and Agriculture

Data on income is not readily available. However, in a bid to assess the districts income, values have been attached to the livestock and agricultural products to give an overall impression of production values which have been added to the wage earnings of the district's employees to give the estimated district income (Table 3.2).

Table 3.2 Income Earning for Makueni District 1995(K£'000)

Source	**1994**	**1995**
Wage earnings	31,809.9	32,168.8
Agriculture	14,484.4	18042.3
Livestock	3461.2	4283.5
Total	**49,755.5**	**54,494.6**

Source: Makueni Development Plan (1997-2001).

3.7.2 Employment Earning

The main formal employers in the District is the civil service and commercial activities in the urban areas (Table 3.3). A few people are also employed by NGOs. The average wage earnings increased steadily over the period 1991-1995 reflecting stability in the district wage employment.

Table 3.3 Wage Earnings 1991-95 (K£)

Item	1991	1993	1995
Earnings in K£'000	30,124.4	31450.3	32168.8
Number of wage Employees	21,685.0	21801.0	22150.0
Average wage (K£)	1389.2	1442.6	1452.3

Source: Makueni Development Plan (1997-2001)

Distribution of incomes in Makueni District is unequal both in the urban and rural areas due to varying levels of potentialities in the various geographical areas. The lower divisions of Kibwezi and Mtito Andei are low potential. These divisions receive low and unreliable rainfall most of the year and droughts are prevalent. Agriculture, which is expected to provide employment to the majority of the residents, is unreliable and food deficits are often experienced. The incomes in these areas is therefore low. In comparison, the high potential divisions of Mbooni, Tulimani and Kilome have relatively sufficient rainfall and earn their livelihood by growing both cash crops and food crops as well as rearing livestock. This provides constant and high incomes to the residents of these divisions. This provides employment both in the urban and rural areas. However, pockets of poverty exist among the landless and jobless people in the urban areas.

3.8 PHYSICAL INFRASTRUCTURE

3.8.1 Roads

Roads which provide the means of accessibility and linkage are barely enough in the area. The principle major road is the Nairobi-Mombasa Road covering about 25km and it is the only tarmacked road. The other roads are gravel and earth roads that are maintained by MRPW. Most of them are not in good conditions. But as rapid development takes place, there is need to open up the interior area by constructing feeder roads.

3.8.2 Water Facilities

The rising population growth creates increased demand for fresh water. The main water sources in the area include river, boreholes and wells. Also there is piped water in all the urban centers. Since the area is semi-arid, most of the water facilities are over-utilized because they cater for domestic, livestock and industrial use.

3.8.3 Power and Telecommunications

This area has only one major power line along the Nairobi-Mombasa Road which is of high voltage and a single phase which serves a few of the urban centers, namely Kambu and Hillside. Machinery is not served with electricity. The other major sources of energy are kerosene, fuel wood and charcoal. The use of solar energy and biogas is not very common.

As regards communication, the networks originate from Mombasa. All the urban centers along the Nairobi-Mombasa Road are served with telephone facilities. Given the recent increase of population and businesses establishment, there is need to add more connection lines.

3.8.4 Social Facilities

The area has 151 pre-primary, 141 primary, 14 secondary schools and 5 youth polytechnics. There are more girls enrolled in both primary and secondary schools than boys. This is because boys drop out in schools early to look for employment to support their families. Both secondary and primary schools are normally utilized with exception of town schools which are over-utilized.

3.9 SUMMARY

This chapter summarizes the general picture of the situation in the study area. Land in the area is used mainly for subsistence agriculture. Land next to the urban centers is used for housing and other business-oriented activities. In the immediate interior, land is used for wildlife conservation purposes, especially in the Chyulu Hills and Tsavo National park.

CHAPTER 4: IMPACTS OF ROAD RE-ALIGNMENT

4.1 IMPACTS ON ECONOMIC \PRODUCTION SYSTEM

4.1.1 Shift in Land Values

According to the field survey as indicated in Table 4.1, the average price per acre of land abutting the existing Nairobi –Mombasa Road is Kshs 30,000, whereas the average price per acre along the proposed alignment is Kshs 20,000. At least 65 % of the people interviewed along the existing alignment expressed their fear that the land values would go down to an average of about Kshs 20,000 per acre after the construction of the new realignment. This marks a projected drop in land values along the existing road of 33%. They attributed this to the fact that most vehicles, if not all, will stop using the existing route. According to them, this will make their plots less "accessible" than now and this will lower the demand for land along the existing alignment. The remaining 35% were not sure of the effects of the re-alignment on the land values.

Table 4.1 Current versus projected land values

Location	Current value (Kshs)	Projected value (Kshs)	% change
Along existing alignment	30,000	20,000	-33
Along proposed alignment	20,000	70,000	250

Source: Field survey, February 2001

On the other hand, 87% of the people along the proposed alignment were optimistic that the land values along the proposed alignment will go up from an average of Kshs 20,000 to Kshs

70,000 per acre. This represents an expected increase of 20%. The remaining 13% were not sure of the effects of the construction of the new road on the land values. The compensation value by the government per acre along the proposed road is Kshs 40,000. This indicates a sharp difference between the compensation and the expected value by the landowners. This can lead to dissatisfaction and result in conflict between the landowners and the government. As indicated by recent developments, discrepancies between amount paid for land compensation has caused uncertainty in the future of the project.

About 59% of the business community expressed their wish to shift their businesses to the proposed route after the construction of the road. This will result in high demand for land along the new route and will result in high land values. Improved accessibility is expected to lead to an increase in land values for plots along the proposed alignment due to their locational advantage of being next to the road.

4.2 DECLINE OF BY- PASSED TOWNSHIPS AND THE GROWTH OF NEW ONES

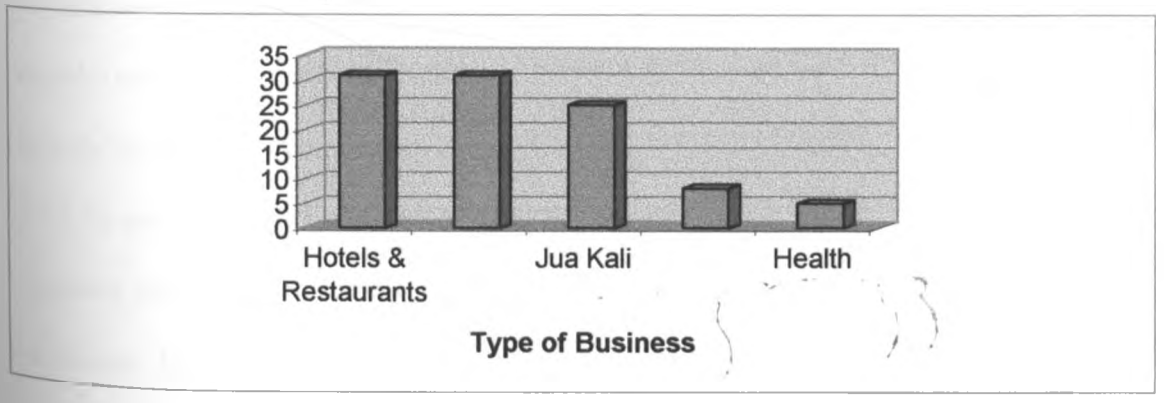
Several townships, including Machinery, Kambu, Githokoi and Hillside lie along the proposed alignment. These townships, did not exist before Nairobi-Mombasa Road was constructed. The oldest of them, Machinery (Plate 1) was developed in 1962 to take advantage of the increased number of customers who were using the road. The most common businesses operated in the townships include hotels, bars and restaurants, garages, shops, among others.

Plate 1.Machiinery Township showing types of businesses and stopping lorries

4.2.1 Type of business

Figure 4.1 indicates that majority of the business, accounting for about 70% were started with the sole aim of serving the travelers. These include hotels, bars and lodgings, vehicle garages and laundry services. In the absence of the travelers, most of these businesses would close down or operate at a lower capacity. This would negatively affect the economic base of the businesses, their employees and people depending on them.

Figure 4.1. Types of business



Source: Field Survey. 2001.

Plate 2. Filling station in Kambu

4.2.2 Business operations

Field survey in the townships to be by-passed showed that 44.8% of the customers served in the businesses are travelers, the remaining 55.2% of the customers come from the townships or surrounding areas. This shows that the businesses are heavily dependent on travelers for their survival. The absence of traveler customers would mean the businesses would have to close down or look for ways of cutting down expenses like retrenchment of staff or relocation to suitable areas. The field survey further established that 65%of the income to the businesses per month come from traveler customers. This once again shows that the businesses depend very heavily on travelers. On average each business in the townships employs two people, of which 37.2 % are females. The employees plus their employers and their families depend on the incomes they get from these businesses. Business decline in the townships would mean an economic loss to a large number of people who directly or indirectly depend on these businesses.

4.2.3 Investments in the townships.

The average investment per business is approximately Kshs 370,000 (Table 4.2). This is a heavy investment considering that it is in the rural area. The survey found that 60 per cent of the businesses got their initial capital from credit, while the rest either started the businesses through savings, or retirement benefits. Declining profits to these businesses as a result of declining traveler customers would mean permanent closure of these businesses. Considering that most of these businesses got their initial capital from credit or retirement benefits, it would be difficult to raise money from the same sources to start new businesses.

Table 4.2 Investment in business

Amount (Kshs)	Frequency	Total Amount(Kshs)
0-100,000	3	150,000
100,001-200,000	5	750,000
200,001-300,000	5	1,250,000
300,001-400,000	4	1,400000
400,001-500,000	2	900,000
500,001-600,000	1	550,000
600,001-700,000	2	1,300,000
700,001-800,000	1	750,000
800,001-900,000	2	1,700,000
Over 900,001	1	900,000
Total	**26**	**9,650,000**

Source Field survey, 2001.

4.2.4 Business Establishment

Table 4.3 indicates that a number of business in the townships were set up not more than 10 years ago. However, some businesses in the towns including Machinery and Kambu were started in the 1960s. This gives them an average age of 37 years. There is a difference of about 30 years between the ages of the towns and businesses. This shows that most of the old businesses must have closed down and given way to new ones. The current businesses are generally not old businesses and it can be safely concluded that they have not saved enough capital to start other businesses incase they wait until the existing ones collapse after losing income. Such young businesses have not most likely recouped back what was used to start them and relocating to another site might not be possible.

Table 4.3 Historical set up of the businesses in the townships

Year set up	Frequency	Percentage
1995 – 2000	18	46.2
1990 – 1995	10	25.6
1985 – 1990	7	17.9
1980 – 1984	3	7.7
Before 1980	1	2.6
Total	**39**	**100**

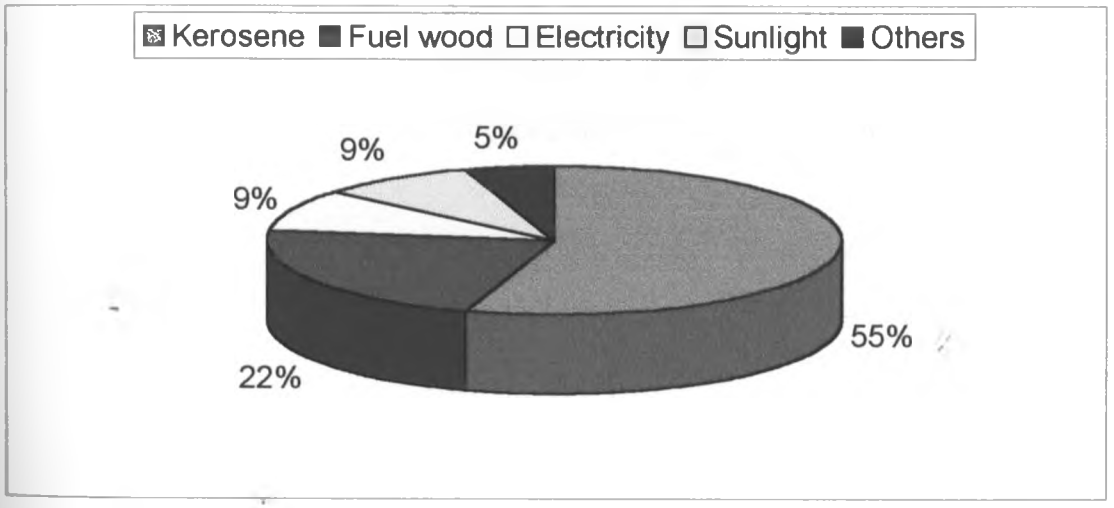
Source: Field survey 2001

4. 2.5 Source of Energy in Townships

Kambu and Hillside are connected to electricity grid, while Machinery is not. Despite the connection, 55% of the people in the above townships were found to use kerosene as a source of energy for cooking and lighting (Figure 4.2). The 9% who depend on natural sunlight

particularly Jua Kali artisans close their businesses early before darkness as they have no other sources of energy for lighting. At least 9% of the businesses use electricity for lighting. The percentage of businesses using electricity is low because the charges for electricity installation are beyond the reach of majority of the business people. The other reason is that most of the informal business are housed in temporary structures and therefore cannot be connected to the power. The presence of electricity in the townships provides the much-needed light for security.

Figure 4.2 Source of Energy for Lighting and Cooking



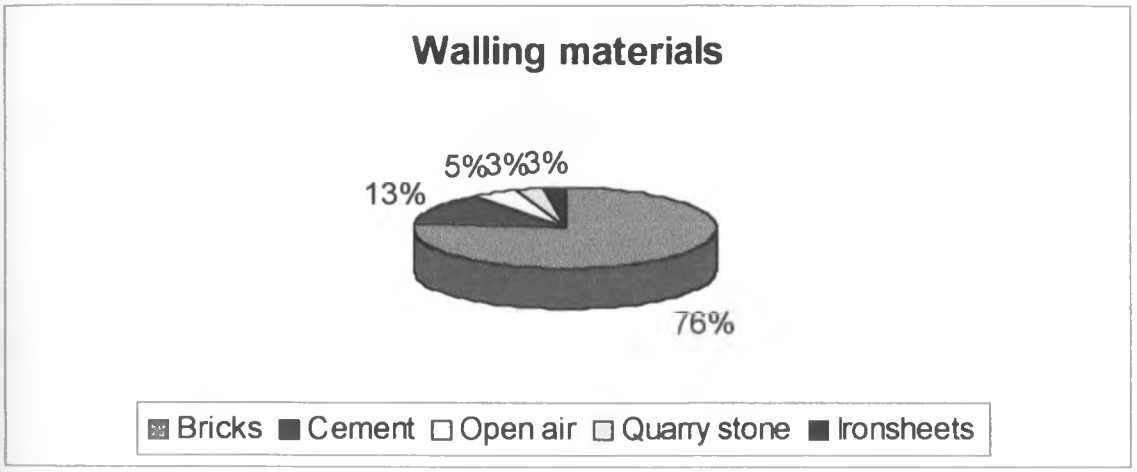
Source: Field survey, 2001.

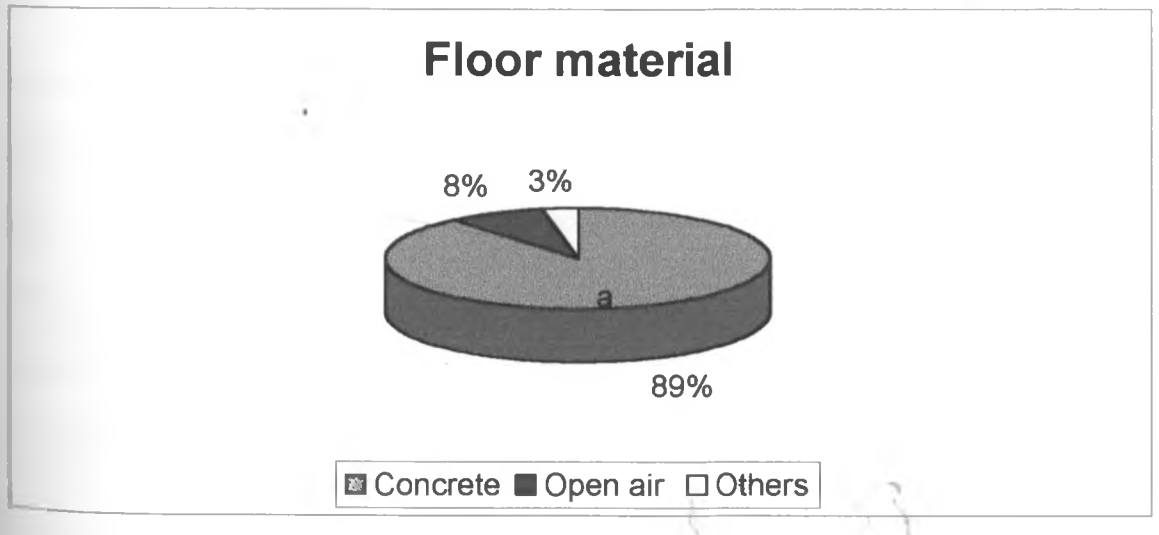
On the other hand, 22% of the business people use wood fuel as a source of energy for cooking. The destruction of the vegetation by the construction of the road will have a negative impact on firewood and charcoal supply in the area. The relocation of the businesses to the proposed alignment would be very expensive to the business communities because they would be required to spend more money on electricity connection and to other services like water.

4.2.6 Business premises

About 95% of the business premises have iron sheets on the roof while 70% have brick walls. Moreover, 90% of them have concrete floors (Figure 4.3). This is a heavy investment and the decaying of the townships would have enormous financial losses to the owners. This would mean a loss of earnings to the owners of these premises.

Fig 4.3 Building materials for business premises

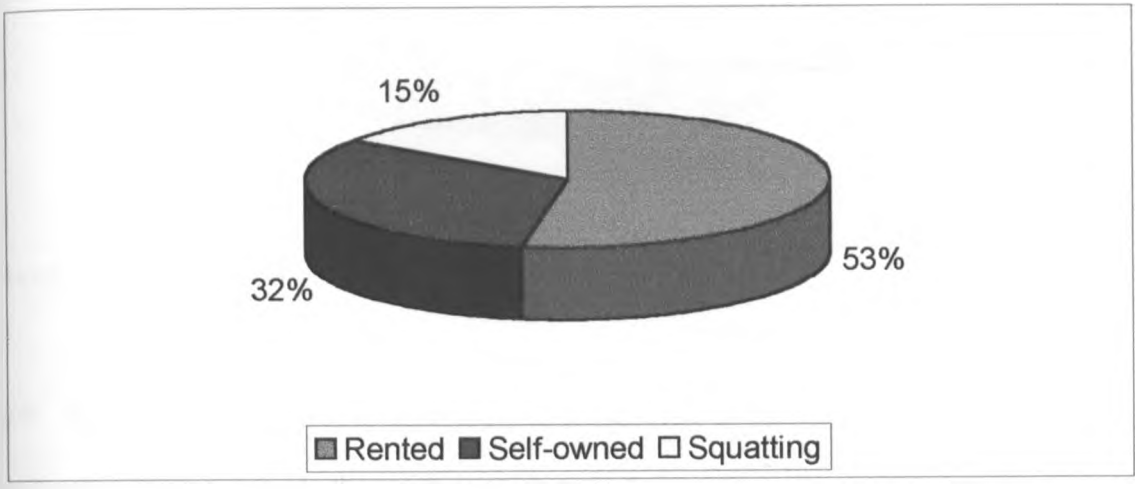




Source: Field survey, 2001

squatting (Figure 4.4). This shows that not only the business people would be affected by the decaying of the townships, but also the landlords and their dependents. The decay will affect a large number of people directly or indirectly.

Figure 4.4 Building Ownership

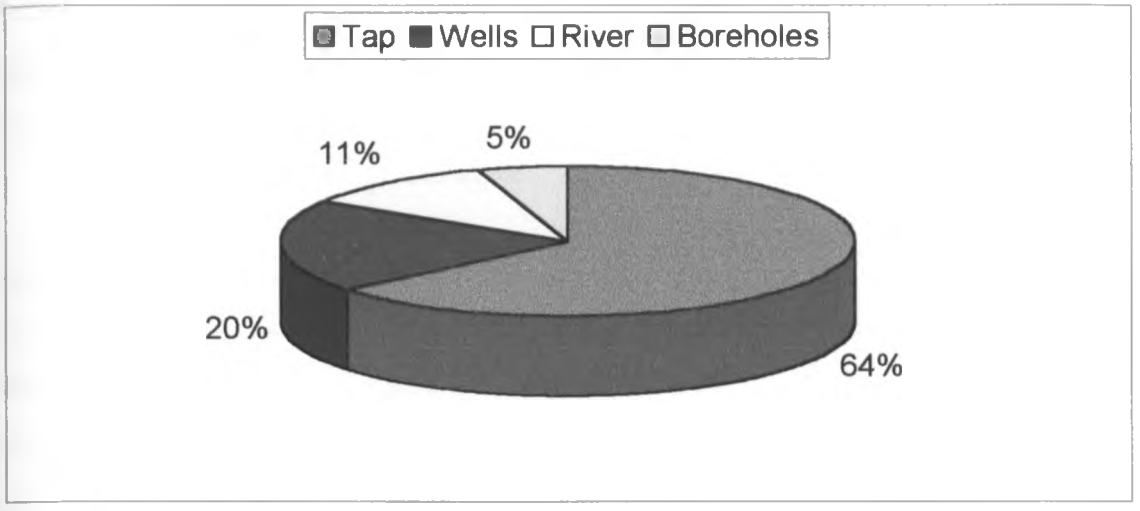


Source: Field survey, 2001.

4.2.8 Source of water for domestic use in townships

At least 64% of the business premises use tap water while 11% use river water, 20% wells and the remaining 5% use water from bore holes (Figure 4.5). A lot of investment has been put in the provision of water for the townships and this would be a waste if the towns were going to decay. More investments will be required to provide the new centers with the same facilities. Some of the landlords in the existing townships will relocate to the proposed alignment to construct business premises after the existing ones have been abandoned. They will be forced to spend more money on provision of utilities like water.

Figure 4.5 Sources of water



Source: Field survey, 2001.

4.2.9 Services and goods obtained from townships by road users

The road users found in the three townships were interviewed. Over 90% of the respondents were drivers while the remaining 6% were turnboys (Table 4.4). It was found out that the drivers stop an average of six times in a month in the townships. An average of 1423 vehicles passes through the township in a day. At least each of the vehicles stops in one or more of the townships for food, accommodation or other services. Survey results indicate that 63% of the travelers entered the townships for food, 30% for accommodation and the remaining 6% for other services. The travelers include vehicle drivers, passengers and a few business people

The average amount spent by a driver for accommodation and food in a month in the townships is Kshs 1510 and Kshs 1780 respectively. In total the amount spent by a driver for both food and accommodation in a month in the townships is Kshs 3290. Assuming that each vehicle has two other people to assist the drivers then the total amount spent in the township in a month by a single lorry crew is Kshs 9870. In addition, the drivers also buy petrol from Kambu. From the

above figures it emerges very clearly that the survival of the business in the townships depend heavily on the travelers.

Table 4.4 Type and number of vehicles

Year	Mtito Andei				Thange Side			
	Cars	Buses	Commercial vehicles	Total	Cars	Buses	Commercial vehicles	Total
1986	186	85	785	1056	132	96	915	**1143**
1988	217	95	844	1156	161	71	873	**1105**
1990	159	114	889	1162	191	129	904	**1224**
1992	230	60	905	1195	216	104	1423	**1743**
1994	273	130	**1310**	1713	295	164	**1440**	**1899**
AVERAGE	**213**	**97**	847	**1256**	**199**	**113**	1110	**1423**

Source: Ministry of Public Works and Housing,1995.

When asked whether they would continue stopping in the townships after the construction of the proposed road, 87.9% of the drivers said they would not. They felt that entering the by-passed townships would be a waste of time and fuel and they would therefore prefer to stop in the next nearest township along the new route. Most of them felt that Mtito Andei would be the most ideal township for such services. When the drivers were asked whether they were aware of any by-passed townships along the Nairobi-Mombasa road, they gave the names of Kibwezi and Voi.

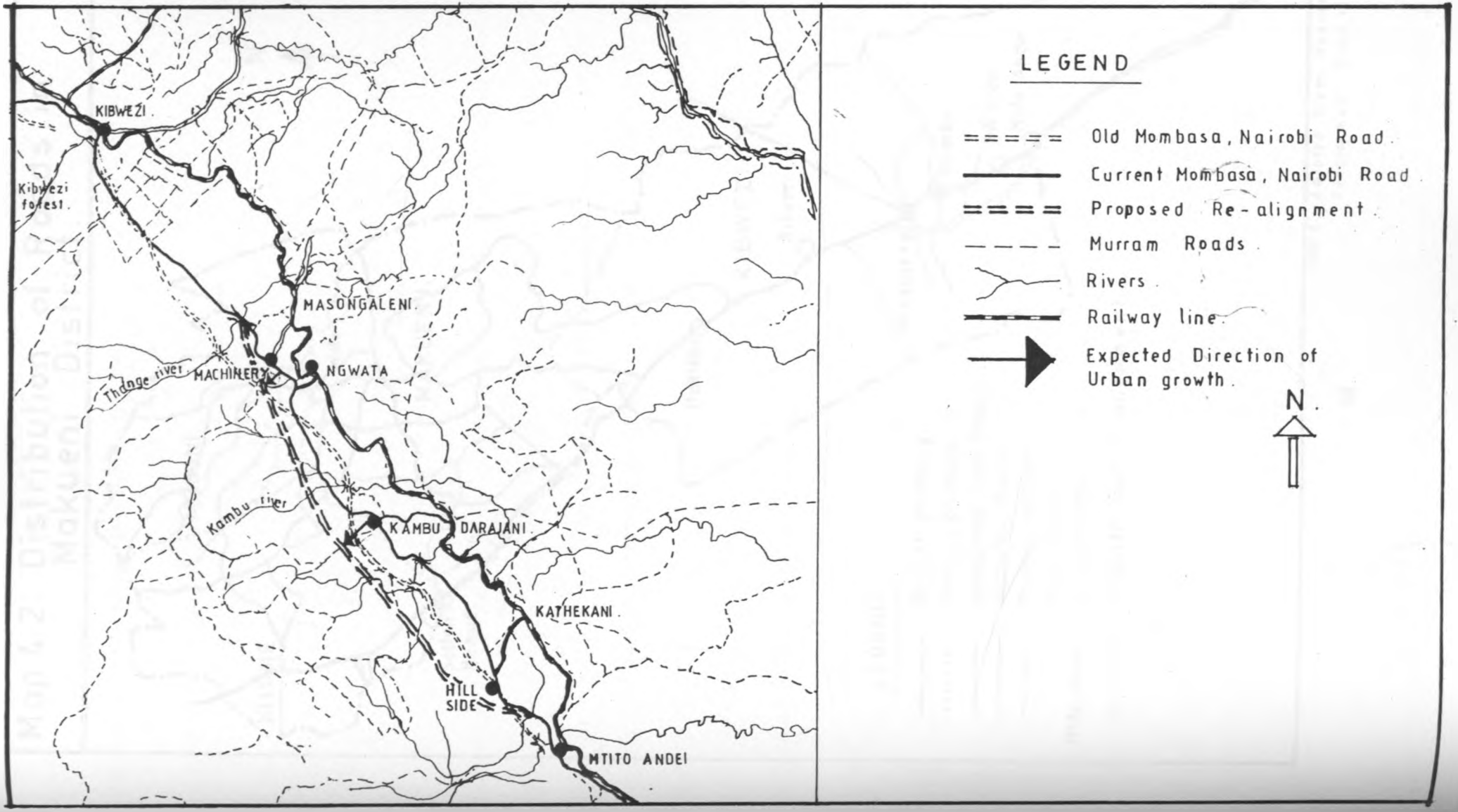
When asked what they intended to do after the construction of the by-pass, 59% of the business people indicated that they would shift their businesses to the proposed alignment. An issue of concern is that none of the business people were consulted in the planning of the re-alignment. Most of them came to learn about the proposal from people along the proposed alignment. This has made the business people very uncertain about the future of their businesses.

On the other hand, 87% of the respondents with land parcels along the proposed alignment indicated that they would wish to construct business premises and start businesses to take advantage of the construction of the new road. It is likely that the demand for goods and services along the new route will result in the mushrooming of scattered developments along the route. It is likely that the townships of Machinery and Kambu will grow in an east to west direction along the existing gravel roads with higher concentration of developments being at the junctions with the proposed new road (Map 4.1). These uncontrolled and hence scattered developments will be difficult to provide with essential services like water, electricity, security, and telephone among others. The people along the proposed route are happy that they will start businesses and earn an income from it. To them the proposed alignment will have a positive impact on their income and hence raise their living standards.

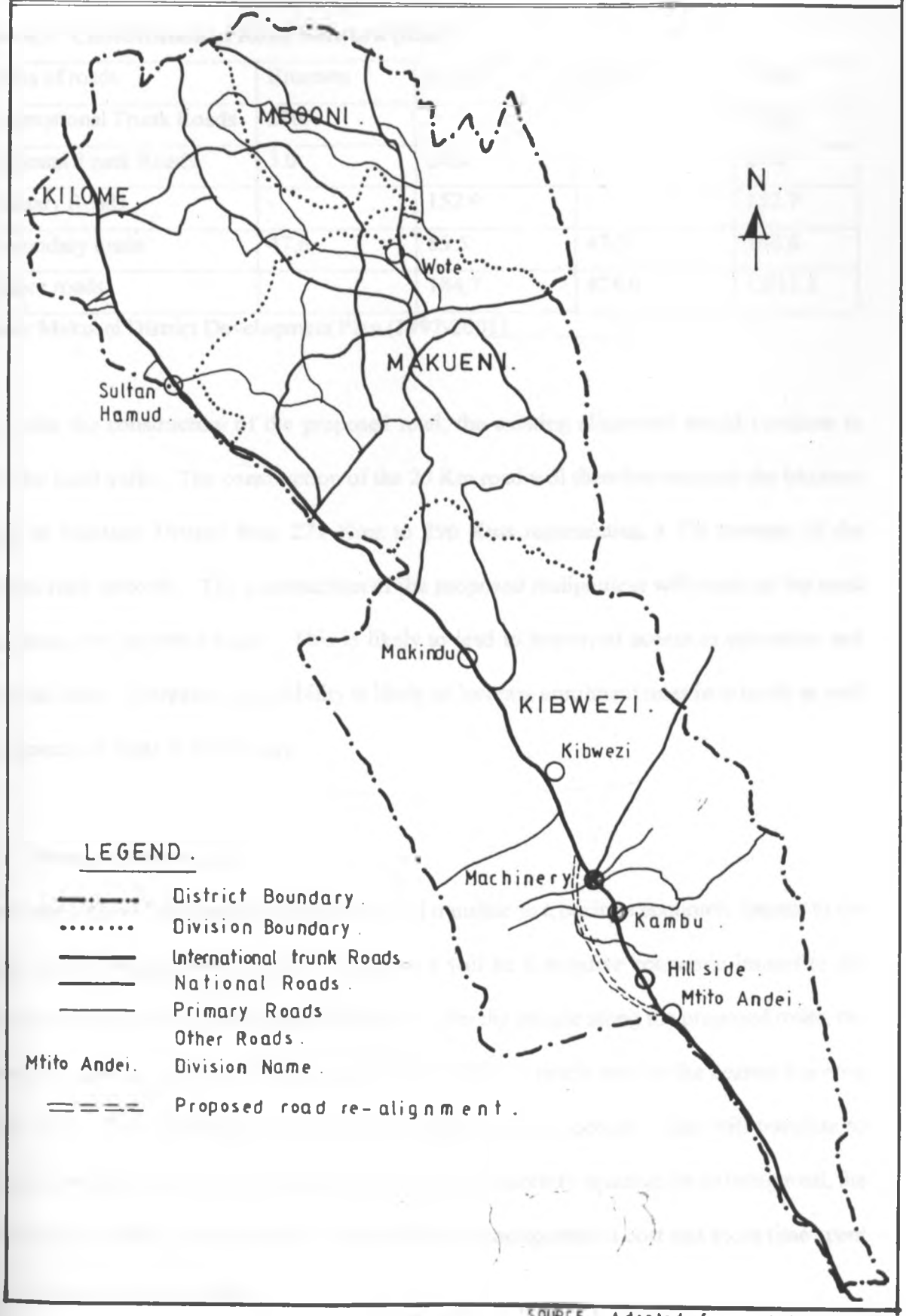
4.3 Improved Transportation

The district has a total of 1,593 km of classified and unclassified roads. Map 4.2 shows the distribution of the road network in the district. Kibwezi and Mtito Andei Divisions are poorly served with the road network. At least 271km are of bitumen, 447.9km are graveled and 874.1km are earth roads (Table 4.5). The only bitumen road in the district is the Nairobi – Mombasa Road section measuring 220.4km.

Map 4.1. Proposed road Re-alignment & the Expected Direction of Urban growth.



Map 4.2. Distribution of Roads in Makueni District.



SOURCE Adopted from Makueni District Development Plan 1997.

Table 4.5: Classification of Road Network (Kms)

Class of roads	Bitumen	Gravel	Earth	Total
International Trunk Roads	220.4	-	-	220.4
National Trunk Roads	3.0	24.8	-	27.8
Primary Roads	-	152.9	-	152.9
Secondary roads	47.6	85.5	47.5	180.6
Minor roads	-	184.7	826.6	1,011.3

Source: Makueni District Development Plan (1997-2001).

Even after the construction of the proposed road, the existing alignment would continue to serve the local traffic. The construction of the 25 Km road will therefore increase the bitumen length in Makueni District from 271 Kms to 296 Kms representing a 1% increase of the bitumen road network. The construction of the proposed realignment will open up the rural areas along the proposed route. This is likely to lead to improved access to education and health facilities. Increased accessibility is likely to increase enrolment rates in schools as well as frequency of visits to health care.

4.3.1 Distances to services

The construction of the proposed alignment will translate to a positive economic impact to the people along the proposed alignment whereas it will be a negative economic impact to the people currently abutting the existing alignment. For the people along the proposed route, the distance to service centers will be reduced from 4.3 Km to nearly zero to the nearest bus-stop (Table 4.6). This will bring improved accessibility to these people. This will translate to savings in transportation cost and time. For the people currently abutting the existing road, the construction of the proposed road would mean extra transportation cost and more time spent on journeys to other areas.

This will be so because they will be forced to travel to the expected new bus-stops along the proposed alignment for journeys outside the area.

Table4.6 Current distances to the nearest bus-stop along proposed alignment.

Distance(Km)	Percentage of respondents
0-1	7.7
1.1-2	12.8
2.1-3.0	10.3
3.1-4.0	12.8
4.1-50	15.4
5.1-60	12.8
6.1-7.0	12.8
7.1-8	20.5
Total	**100**

Source: Field Survey, 2001.

Similarly, a number of community services may fall along the proposed road and this would make it easier to access them (Table 4.7). By use of the new road it will be easier to access some of these community facilities, hence saving time which can be used for other economic activities.

Table 4.7. Current distances to other community services along proposed alignment

Community services	Average distances (km)
Worship place	1.7
Primary school	2.0
Secondary school	3.2
Shopping center	2.3
Administration office	3.9
Cattle dip	2.7

Source: Field Survey 2001.

4.4 TRAFFIC MOVEMENT

4.4.1 Traffic movement along existing alignment

Drivers using the section to be re-aligned cited a number of problems, as indicated in Table 4.8. Some of these problems have contributed to many accidents in this section especially at the Kambu and Kwa Kinyuti Bridges. Available statistics indicates that between 1985-1995 a total of 85 accidents took place at the Kambu Bridge of which 22 were fatal, 35 were serious injuries and 28 were slight injuries. During the same period 26 accidents occurred at the Kwa Kinyuti Bridge of which 12 were fatal, 8 serious injuries and 6 were slight injuries (Figure 4.6). The traffic police attributed this high incidence of accidents at these spots to the narrow bridges combined with steep gradients at the bridge approaches.

Table 4.8 Problems along existing alignment

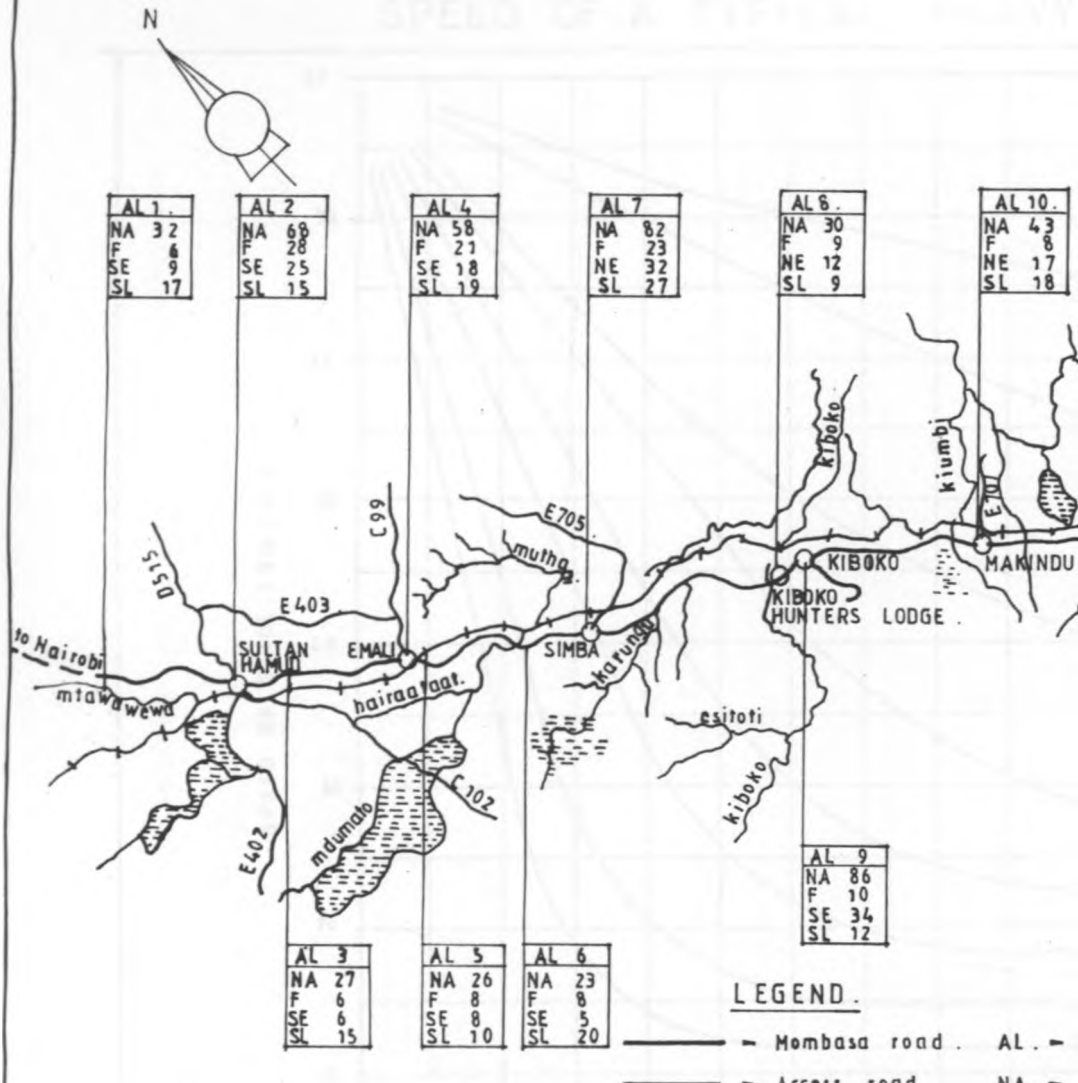
Problem description	Percentage of respondents
Pot holes	33.3
Insecurity	27.3
Narrow road	21.2
Narrow bridges	12.1
Steep gradients	6.1
Total	**100**

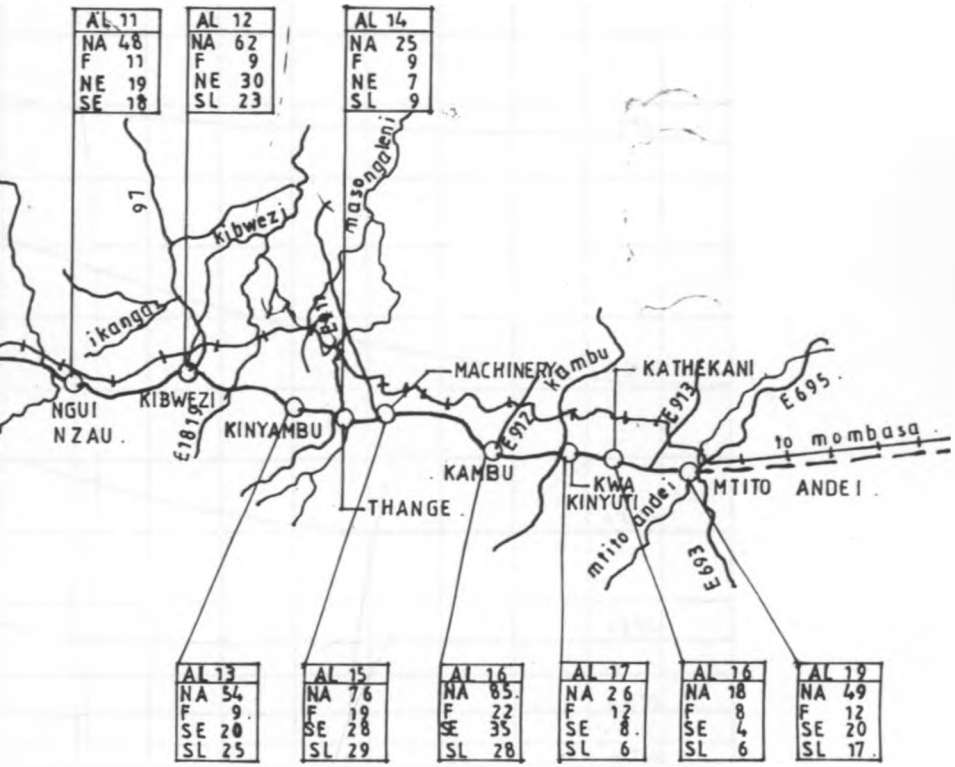
Source: Field survey, 2001.

4.4.2 Effects of length and steepness of grade on the speed of a vehicle

The construction of the proposed road will reduce the vertical gradient by 4% (Table 4.9). Figure 4.7 shows the change in speed of a heavy vehicle on a steep gradient. The reduction of vertical gradients, will go along away in reducing traffic road accidents. Apart from saving lives, it is expected that reduced accidents will also reduce medical bills and other accompanying losses such as damage to cargo and motor vehicles.

Figure 4.6: ACCIDENT LOCATION PLAN





Accident location .

Number of accidents 1985 - 1995 .

Facilities .

Serious injuries .

Slight injuries .

FIGURE 4.7: EFFECT OF LENGTH AND STEEPNESS OF GRADE ON THE SPEED OF A TYPICAL HEAVY VEHICLE. (90 kg. / hp.).

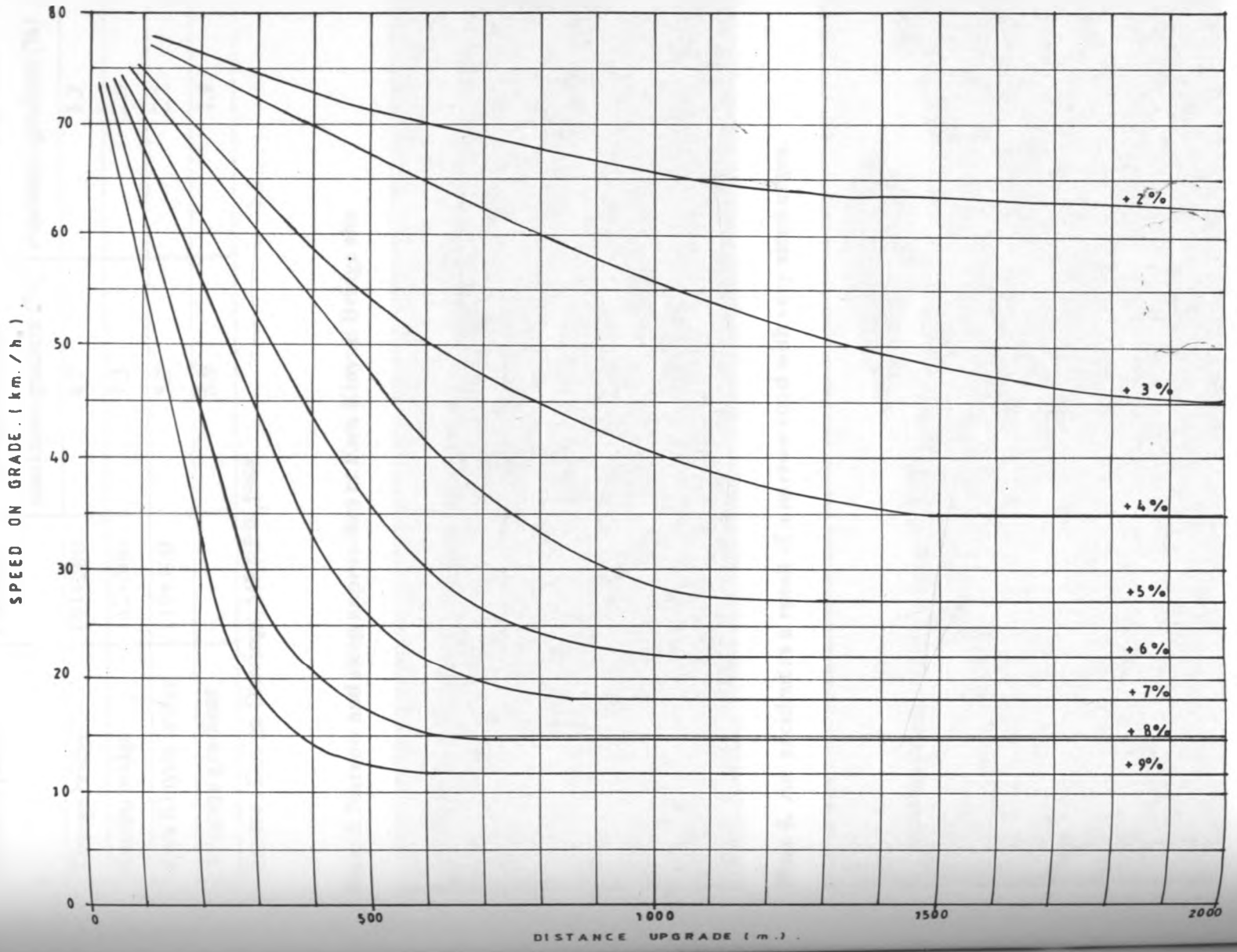


Table4.9. Maximum vertical Gradients along existing and proposed alignment

Name of place	Chainage	Existing alignment maximum gradient (%)	Proposed alignment maximum gradient (%
Thange bridge	103+200	4.7	1.2
Kambu bridge	112+500	7.3	2.3
Kwa Kinyuti bridge	119+100	5.7	2.1
Average gradient		**5.9**	**1.9**

Source : Design Drawings, MR&PW,1998.

Plate 3. Narrow and steep approaches at Kwa Kinyuti Bridge site

Plate 4. An accident as a result of a narrow road with very steep edges.

Where the proposed and new alignments meet, on the Mtito Andei side junction, kilometer 128.084 on the proposed alignment coincides with kilometer 127.45 on the existing alignment. This shows that the proposed alignment is longer by 634m. This increase of 634m along the proposed alignment will have a tendency of increasing vehicle-operating cost. This is likely to be counter balanced by the reduced gradients, which will translate to reduced vehicle operating costs and at the same time allow heavy goods vehicles to maintain reasonable speeds on uphill section.

Reduced vehicle operating costs (less fuel consumption, less likely accidents, less travel time) can translate to lower transportation cost to travelers, haulage companies and their customers. This can lead to higher profits to exporters and importers or reduced prices to their customers. Therefore, the proposed alignment has a positive economic and social impact on its users.

4.5 RELOCATION OF PEOPLE

4.5.1 Problems likely to result from relocation

The construction of the re-alignment will bring many changes to the community (Table 4.10). The study found that 30% of the people along the proposed road are considering relocating after compensation. The relocation of these people would have a negative impact on community life. At least 40%of the respondents indicated physical separation of the members by the road and fast traffic as the major problem. The latter group felt that the road may later be used to divide them further into separate administration areas, which could separate them, even further. A small percentage of the respondents could not tell what problem the road would bring to them.

Table 4.10. Problems likely to be brought to the groups by the proposed road.

Problem description	% of respondents
Relocation of members	42.8
Physical separation of members by the road and fast traffic	40.5
Not sure of expected problem	16.7
Total	**100**

Source Field Survey, 2001

From discussions in the field it was found out that traditionally, the Kamba kinsmen have strong cultural network ties, this specifically applies to brothers and sons, who help one another with labour, during financial difficulties, in sickness and during ceremonies. This is easy when they live close to each other. When separated by relocation to distant places, it becomes difficult to extend such help to each other. Those who move may find neighbors who are not necessarily willing to relate to them in such a manner. If they relocate to far off places they can be perceived as strangers who come to use up resources in short supply. Others might end up settling in areas which are totally foreign to them. In the former case, the resettlement can become a major source of tension within the community and may end up being the basis for enduring conflict. In the latter case people who settle in unfamiliar environments may have considerable difficulty in adjusting, like having to learn new agricultural methods to apply on unfamiliar new soils. These may condemn these people to lasting poverty.

Although 90% of the people planning to relocate prefer to do so within the district, land scarcity will force them to relocate elsewhere. Those who will relocate outside the district, will

find themselves in an environment of a different culture from theirs. This may create a cultural disintegration within families as well as the community in general, which can result in breaking up of kinship ties. This can negatively affect family cohesion, cooperation and support. This may cause social and psychological disruption for the affected individuals and their families. The children of the affected families may be forced to change schools. The new environment coupled with other negative factors can lower the standards of education for the affected children. Local trading centers may witness decreased business as a result of the migration of some of the clientele who will relocate.

4.5.2 Average Distances to communal facilities along the proposed alignment

Table 4.11 indicated the distances to the communal amenities for the people along the proposed alignment. Most of the community facilities were put up by the community through self help initiate under the " harambee spirit". The people relocating will lose these facilities and may be forced to pay afresh to be allowed the use of communal facilities in their newly resettled areas.

Table 4.11. Distances to community facilities

Description	Average distance km
Worship place	2.0
Primary school	2.0
Secondary school	3.0
Shopping center	3.0
Administration office	3.0
Cattle dip	3.0
Health facilities	3.0

Source: Field survey,2001.

4.6 DESTRUCTION OF PROPERTIES

4.6.1 Building materials along proposed alignment

The re-aligned road passes through a rural setting. About 60% of these houses are iron sheet roofs while the remaining 40% are grass thatched. The evaluation of these properties was done in early 2000, but they have not received their compensation. During this time the rate of inflation rose from 3.5% to 6.2%. The property owners have already been shown the value of their properties and made to sign against the indicated payment as a sign of acceptance of the value given. While the compensation has delayed, inflation rate has risen and this translates to higher prices for construction materials for new residences. By the time the payment is made, the property owners might find that the money compensated might not buy building materials to build the same number or quality houses they were staying in before the project.

The other scenario would arise if after the payment of compensation for the destroyed properties, the owners divert the money to other needy uses like school fees and they are left with very little or nothing at all to build the same number or quality of destroyed property.

4.7 LAND FRAGMENTATION

4.7.1 Uneconomical Farming.

The proposed route has cut across the farms obliquently without considering the physical layout of the boundaries. Sixty-six farms have been affected by this proposal. Some of the farms have been divided into portions that are too small to be economical for agriculture. This kind of fragmentation is likely to disrupt the existing farming patterns and connections between

farms. Land fragmentation of this kind will result in land that is unviable and inefficient. The result will be a loss in agricultural production.

4.8 LOSS OF LAND

4.8.1 Complaints about land acquisition

At least 24% of the people along the proposed alignment complained of being compensated for less land than what was actually going to be taken by the road. At least 18% of the people complained that their names were omitted in the Kenya Gazette notice of intention to acquire land compulsorily by the Commissioner of Lands dated 14th June 1999. On the contrary, 8% of the people whose names appeared in the list of landowners affected by the proposed alignment had their farms outside the proposed alignment.

4.8.2 Land Acquisition Maps

Further investigations found out that the land acquisition maps were prepared by superimposing the proposed alignment on Registry Index Maps (RIMs) prepared from un-rectified aerial photographs. The design engineers then computed the affected areas from those maps. The names of the owners of the affected plots were taken from the Land Registrars records.

The study found out that the method used for the preparation of the land acquisition maps and accompanying lists had several shortcomings. The land acquisition maps were prone to locational (position) errors since the aerial photographs were not rectified for errors during photography. There are chances of more errors occurring during the process of superimposing the proposed road on the RIMs. The combined effect of these errors can displace

the proposed alignment relative to the correct position on the ground implying that the correct position of the proposed road on the ground will not be the same as it appears on the land acquisition maps.

The use of the land acquisition maps prepared this way will give different impression of the correct position of the road on the ground and this may lead to a list of affected people which is not absolutely correct. The computed areas appearing in the list will also be affected in the same way. This has created dissatisfaction with the land acquisition process. For the affected people, receiving less than what they are entitled to is an economic loss.

4.8.3 Land Disputes

Since ownership of land is not a static affair but a dynamic one; the list of affected people that appeared in the Kenya Gazette notice was bound not to reflect the correct position on the ground. Adjudication has been done in this area but the land owners have not been given titles to their land. Since no titles have been issued, land transaction in this area does not have to be registered with the Land Registrar and hence the list of land owners in the Registrar's Office does not reflect the correct ownership on the ground. The list only reflects land ownership during the time of adjudication. This was found to be another reason why some of the affected peoples names did not appear in the Gazette notice. The above problems were found to have contributed to an increase in land disputes in the area and dissatisfaction with the acquisition process. This may lead to delay in project implementation and break-up of social relations.

4. 9 REDUCED AGRICULTURAL PRODUCTION

4.9.1 Agricultural Activities

Crop farming in the two divisions of Kibwezi and Mtito Andei is mainly for subsistence purposes. The major crops grown are maize, beans, pigeon peas and cowpeas (Table 4.12). Irrigated horticultural crop farming is also undertaken but in smallholdings on individual farmer bases along the river valleys. The mostly grown horticultural crops are tomatoes, kales, onions, beans, biringanyas and okra.

From the table, maize is the main crop grown in the area followed by beans and then cowpeas. Maize is the main crop that is grown in the area taking about 58.2% of the total crop production in the area. Generally it can be seen that the area under these crops have been increasing. Unfortunately the construction of the re-alignment will take 149.7 Ha from agriculture to transportation. This will reduce the total acreage under crop production. Maize takes 50.2% of all the area under agriculture, followed by beans taking 22.3%. Millet covers the least area of 2.6%. This shows that maize production in the area will be the most reduced by the construction of the proposed road.

Table 4.12 Crop Production Trends in Makueni District, 1992-1995

	1992			1993			1994			1995		
Crops	Ha.	Average yield (ton\ha)	Yield (Ton)	Ha.	Average yield (ton\ha)	Yield (tons)	Ha.	Average yield (ton\ha)	Yield (tons)	Ha.	Average yield (ton\ha)	Yield (tons)
Maize	89.446	0.6	53.667	72.905	1.1	80.196	143.500	0.565	81.042	53.700	0.584	80.000
Sorghum	8.070	0.55	4.438	6.685	0.4	2.674	5.562	0.45	2.503	8.316	0.3	2.500
Millet	3.322	0.55	1.827	1.810	0.45	815	1.894	0.5	947	7.942	0.3	2.200
Beans	47,700	0.45	21,465	49000	0.55	26,950	71,720	0.6	43,032	68,200	0.41	27,800
Pigeon peas	20,700	0.73	15,110	17,150	0.6	10,290	55,660	065	36,179	29000	0.43	12,400
Cowpeas	42,280	0.45	19,026	35,084	0.5	17,542	4748	0.5	23,704	39,100	0.33	12,750
Green grams	2111	0.35	74	186	0.4	75	1318	0.4	527	750	0.4	300
Cassava	298	9.5	-	124	9	-	399	-	3591	460	-	4000
Sweet potatoes	695	9.5	6600	750	9	6750	595	9	5335	500	10	5000
Cotton	3200	0.35	-	4500	0.3	-	992	-	2976	6250	-	5000
Coffee	-	-	-	1805	1.6	2888	1805	1.5	2708	1810	2.9	5249
Castor	10	12	120	15	9	135	143	9	1287	250	9	2250
Irrigated Horticultural Crop	-	-	-	-	-	-	2000	-	-	2000	-	-

Source: District Agricultural officer, Wote

4.9.2 Loss in agricultural production

By using the figure of 149.7 Ha to be consumed by transportation from agriculture, and the percentages from Table 4.13, maize will loss the largest land of 75.2 Ha, followed by beans 33.4 Ha and millet the least to loose 3.9ha. By use of the average yield (Ton\Ha) figures and the areas to be taken away from agriculture we find that maize production will go down by 53,357 kg, followed by beans with 16,700kg (Table 4.14). The change of use from agriculture to transportation will result in a loss of 90,619kgs of subsistence food per year. If these figures are translated in monetary terms, then agriculture as a land use will loss approximately a total of Kshs 2 million every year. The design period of this road is 15 years. This will translate to an equivalent loss of 1361163 kg of subsistence food, equivalent to Kshs 30 millions in monetary terms.

Table 4.14: Loss in agriculture production.

Crop	Average yield (ton\ha)	Crop area (%).	Area taken by road (Ha)	Yield lost (Kgs)	Cost per Kg	Cost of yield lost (Kshs)
Maize	0.71	50.2	75.15	53357	16.70	891,062
Sorghum	0.43	2.7	4.04	1737	13.30	23102
Millet	0.45	2.6	3.9	1755	24.40	42822
Beans	0.50	22.3	33.4	16700	31.10	519370
Pigeon peas	0.60	9.5	14.2	8520	45.00	383400
Cow peas	0.45	12.7	19.0	8550	17.80	152190
Total		100	149.7	90619		2011946

Source: Field survey 2001

The government has already valued the land and developments there on to approximately Kshs 20m. This is a very low figure considering that during the design period agriculture alone will lose kshs30 million. It can therefore be concluded that the construction of the proposed road will reduce agricultural production in the area equivalent to Kshs 30 million for the 15 years design period of the road.

4.10. CREATION OF EMPLOYMENT BY ROAD CONSTRUCTION ACTIVITIES

One of the benefits of the proposed road that seemed to be agreed on by the most of the people was creation of employment. A bout 80% of the respondents felt that the construction of the proposed road would bring with it opportunities for employment to the local people. The remaining 20% of the people felt that most of the jobs would not benefit the local people but rather outsiders.

4.10.1 Construction Works

Overall, the construction of the re-aligned road will involve a number of activities (Table 4.13). Most of the activities to be carried will require skilled and semi-skilled personnel. It is estimated that the construction of the road will create approximately five hundred jobs for both skilled and unskilled labour.

Table 4.13 Summary of activities that will be carried out during construction

Description of Activity	Estimated Quantity
Site clearance and topsoil stripping	50,520m^3
Earth works	1,185,000m^3
Excavation and filling for structures	1500m^3
River Training Works	400m
Culverts and drainage	599045m^3
Removal and installation of pipe culverts.	11400m
Passage of traffic	90 km
Gravel wearing courses	114500m^3
Over haul of gravel	572,500m^3/km
Natural material sub base and base	128,000m^3
Over haul	7,200m^3/km
Graded crushed stone sub base and base	232,450m^3
Cement and lime treated sub grade, sub base and base (a) lime stabilizer (b) mix-in lime stabilizer	 852,200m^3
Bituminous surface Treatment and surface Dressing	1,032,750litres 475000m^2 400m^2
Bituminous mix bases, binder (a)courses and wearing courses (b) (c)	 130650m^3 600 tonne 125,000 litre
Concrete works	358m^3 593m^2 17.6 tonne
Road furniture	-
Miscellaneous bridge works	2,745m^2
Day works (a) plant (b) labour	 2870 hours 42600 hours

Source:MR&PW, Tender document Mtito Andei –Sultan Hamud road.

The semi-skilled personnel can be found within the project area and could be cheaper for the contractor since they can provide their own accommodation. Chances are very high that the contractor would therefore prefer to use the local people to provide labour for manual work. This would definitely create temporally employment to the local people. As such, it will be a positive effect by creating employment and increasing incomes.

4.11 HEALTH AND SOCIAL DISRUPTIONS

The construction of the proposed road will create employment for the local people. However, not all the project workers will come from the local area. The workers will comprise of professionals, tradesmen and laborers. The concentration of salaried people is likely to create demand for goods and services from the informal sector. This will bring some of these people from within and without the local area. The sudden change of the socio-economic set up of the area is likely to cause an increase in marital problems such as family breakdown, increased immorality and teenage pregnancies. This can also lead to an increase in sexually transmitted diseases and alcohol abuse. Some of the outsiders might be people of questionable character and insecurity might increase in the area.

4.12 SOIL EROSION

The construction of a new road will involve the clearing of the new route of trees, vegetation and rubbish including the grubbing of stumps and roots. According to the Bill of Quantities (BOQ) for item no 401B, site clearance of the above items will amount to 100 hectares.

Vegetation reduces the speed at which raindrops hit the ground and hence reduces

the amount of erosion. The roots of the vegetation bind the soil particles together and hence reducing the chances of soil erosion. The right amount of moisture in the soil binds the soil particles together thereby reducing the rate of soil erosion. Vegetation cover reduces the rate of loss of moisture from the soil.

To allow for enough space for driving, the proposed road will have a 7.0m carriageway. Considering that the length of the realignment is 25km, then the total surface area covered by the pavement will be 17.5 hectares. These area covered by the pavement is impervious to rain water and therefore the construction of the road will increase surface runoff. This increase in surface runoff is likely to increase the rate of soil erosion in the area. The construction of the proposed alignment will therefore mark the beginning of the race between soil stabilizing factors such as vegetation cover and others which seek to destabilize the existing balance such as increased surface runoff and evaporation.

4.13. SPOIL MATERIALS

4.13.1 Destruction of vegetation.

Large amounts of spoil materials can be generated during the road construction process. These materials are generated from stripping of topsoil containing humas and roots. Some unsuitable materials on roads like clay soils are also cut and spoiled. According to the BOQ of items No. 402B, 504B, 703B and 708B, the following materials will be spoil materials (Table 4.14).

Table 4.14 Top soil stripping

Bill of quantity number	Description	Estimated quantity
402b	Removal of topsoil	45,000m^3
504b	Spoil in soft material	50,000m^3
505b	Spoil in hard material	5,000m^3
703b	Excavate for structures	1500m^3
708b	River training works	400m^3
403b	Removal of top soil	5000m^3
Total		**106,900m^3**

Source: MR&PW ,Tender document , Sultan –Hamud to Mtito Andei Road.

The total spoil material on the re-alignment will be 115,000m^3. If one lorry was to carry 5m^3 per trip, then to haul the above material would require 23000 trips. It would not be to the contractors benefit to dump the material far away from the source even if he was to be paid for it. The haulage of the spoil material would consume time and money to the contractor. Chances are that the contractor will dump the material next to where it has been generated. The materials if not disposed off well can end up covering vegetation. If the above 115,000 m^3 of spoil material is disposed off on an area covered with vegetation and the spoil material height is 2m, then the area that will be covered is 57,500m^2. This translates to approximately 15 acres of vegetation destroyed.

4.13.2 Collapse of steep slopes or escalation of soil erosion

The spoil material if disposed off on steep slopes on the sides of the new road will block surface runoff forcing the runoff to percolate into the steep slopes thereby destabilizing the slopes. This can cause the slopes to collapse or cause soil erosion. Moreover, the spoil materials can be washed by surface runoff into the local streams thereby contaminating the

local surface water sources. Local streams pollution can be seen in the form of changed water colour and increased sedimentation in the river beds.

4.14 NOISE POLLUTION

4.14.1 Noise from construction activities

Road construction generally requires the use of heavy machinery. According to BOQ items 2201B to 2228B, the project will use heavy machinery of varying engine capacities (Table 4.15). A lot of noise is expected to be generated from the engines, exhaust and suspension of these equipments. For example, the earth scrappers carrying $25m^3$ of material is a huge machine that is expected to make loud noises from the engine, exhaust and from its suspension. The use of vibrating rollers and compressors will definitely affect the environment by sonically vibrating the structures near the road.

Table 4.15. Selected equipment to be used

Item no	Description	Estimated day work
2201B	Crawler Dozers with Hydraulic Ripper Attachments	
	(i)100-135kw rated fly wheel power	30hrs
	(ii)186-250kw fly wheel power	60hrs
2203B	Scrappers: motorized, rubber tyred twin engine	
	(a) up to $16m^3$ eaped capacity	110 hrs
	(b) 17-$25m^3$ eaped capacity	15hrs
2205B	Roller –Towed Vibrating including tractor	
	(a) 6.5-8.8 tonne (unballasted wt	15hrs
	(b) 8.9- 11.7 tonne (unballasted wt.)	10hrs
2211B	Compressors	
	(a) 19.8-25.5 m^3\min	60hrs

Source: MR&PW, Tender document, Sultan Hamud- Mtito Andei road

4.14.2: Traffic noise

According to the traffic census, on the average, about 3,000 vehicles pass through the existing road per day in the area proposed for re-alignment (refer to Table 2.4). This comprises of 206 cars, 250 light goods, 137 medium goods, 59 heavy goods and 105 buses. This is a clear indication that this is a very busy road. According to the field survey, 5.4% of the respondents along the existing road sited noise as the main problem they face from the existing road. However, this small percentage of respondents identifying noise from vehicles as a problem does not mean that the vehicles were not producing noise. The majority of the respondents did not see noise from vehicles as a problem. From the statistics indicating the number of years the respondents had lived there, only 5.4% of them had stayed there for less than 10 years. Some had lived in that place for 37 years and this can explain why they did not see noise as a serious problem, having lived with it for so long. Getting used to the noise does not mean that the person has become immune to its negative impacts to his health.

The noise created during construction and during the use of the road after completion of construction will therefore have negative impacts on the people along the proposed route while reduced negative impacts are expected along the existing alignment and townships to be by passed. This is so because 87.9% of the drivers indicated that they would not continue using the existing alignment after the construction of the proposed route.

4.15 SURFACE WATER FLOW MODIFICATION

The proposed road intersects a drainage basin. This will modify the natural flow of surface water by concentrating flow at certain points. This concentration will be at the

culverts). This section of the road has been designed to have 2,200m of 900mm diameter pipe culverts, 1000m of 600mm diameter pipe culverts and 100m of 1200mm diameter pipe culverts. This concentration of flow can increase the speed of flow. These changes can contribute to flooding, soil erosion, channel modification and siltation of streams. These effects may be felt well beyond the immediate vicinity of the road.

4.16 CULTURAL, TRADITIONAL AND RELIGIOUS SITES

Cultural heritage is legally protected in almost every country. The conviction for the protection of the world cultural and National Heritage of 1972 has become the foundation for national and other legislation. In many countries, religious laws also addresses cultural heritage.

The study found that 34% of the households along the proposed alignment have graves falling within the proposed alignment. Physical counting of the graves found that thirty graves and two churches fall within the proposed alignment. When asked what should be done to the graves falling along the proposed alignment, 80% of the households felt that the graves should not be disturbed while 13 per cent felt that the graves could be relocated to another place within the farm but only after a ceremony. The remaining 7% were not sure what could be done.

As far as the phenomenon of dying, the Akamba use the following terms to describe the actual act of dying " to follow the company of the ones grandfather", to "go home", to "be called", to "reject people", to "reject food", to "return or go home". From the above expressions we can draw a number of conclusions. Death is conceived of as a departure and not a complete annihilation of a person. He moves to join the company of the departed, and the only major change is the decay of the physical body, but the spirit moves to another state of existence.

Some of the words describing death imply that a person goes "home" which means that this life is like a pilgrimage: the real " home" is in the here after, since one does not depart from here.

Death becomes a gradual process which is not completed until the same years after the actual physical death, he is neither alive physically, nor dead relative to the corporate group. His own "sasa" period is over, he enters fully to the "zamani" period; but, as far as the living who knew him are concerned he is kept " back "in the "sasa" period, from which he can disappear only to keep them in the "sasa" period in reality " die" immediately.

The ground on which people walk is therefore the most intimate point of contact between the living –dead and their human relatives. It is the ground (graves) which "buries" them from the site of their kinsmen, and which in effect erases physical existence as far as human beings are concerned. Yet it is the same ground through which offerings, libation and even divination enable human beings to contact the living–dead. Therefore, family shrines for the living –dead are found generally at or near the spot where the dead or oldest member of the family homestead is buried; the actual burial place for the family.

Human beings keep the relationship going between them and their living –dead, chiefly through libation, offerings of food, and other items, prayers and the observation of proper rites towards the departed or instructions from them. This process continues on a personal level as long as someone who knew the living –dead is still five generations. By that time, the living- dead has sunk further and further into the "zamani" period with only loose strings of memory still holding him feebly in the human "sasa" period. When the last person who knew him dies, the living–dead is entirely removed from the state of personal immortality and he sinks

beyond the horizon of the "sasa period". He is now dead, as far as human being are concerned, and the process of dying is know completed. The living dead is now a spirit, which enters the state of collective immortality. It has "lost "its personal name, as far as human beings are concerned, and with it goes also the human personal name, as far as human beings are concerned, and with it also goes the human personality. It is now an it, and no longer a "he "or "she "; It is now one of the myriads of spirits who have lost their humanness. This, for all practical purposes, is the final destiny of the human soul. From the above cultural believe it emerges very clearly that the Akamba people attach a lot of importance to a grave of a relative. The construction of the proposed road and hence the destruction of the graves falling within the proposed road reserve would interfere with the socio-cultural live of the people.

CHAPTER 5: FINDINGS, RECOMMEDITIONS AND CONCLUSION OF THE STUDY

5.1 SUMMARY OF FINDINGS

The study has found out that Nairobi-Mombasa Road is a busy and important road to the economic development of Kenya and its neighbours. In recent years the road has deteriorated due to inadequate maintenance. This has led to high vehicle operating costs and unstable delivery schedules coupled with high accident rates.

The road users cited the presence of potholes, steep gradients, and narrow road and bridges as the main problems with the section proposed for re-alignment. These problems have contributed to high accident rates especially at the Kambu and Kwa Kinyuti Bridge sites. The design engineers decided to look for an alternative route where they have reduced the vertical gradients from a maximum of 7.3% to a maximum of 2.3% on the proposed route. The proposed route carriage –way has been widened from 5.0m on existing road to 7.0m. Reduced vertical gradients coupled with carriage-way widening will go along way in increasing traffic efficiency resulting in reduced costs of operation and reduced accidents.

Majority of the drivers stated that they would not enter in the by-passed townships but rather seek for the same services in the nearest township outside the section to be re-aligned. Mtito Andei is likely to cater for these travelers before new developments emerge along the new route before new developments to cater for these demand develop along the proposed route.

The townships of Kambu and Machinery will grow in an east–west direction along the existing murram roads with the highest concentration of business in the junctions of these murram roads and the proposed alignment. The demand for land for new developments will raise the land values along the new route with the highest value being at the junctions.

The shifting of the traffic to the new route will make the plots abutting the existing route less "accessible" and this will make the land values stagnate or drop. Most business people in the townships to be by-passed expressed their wish to shift to the proposed new route or close down with a few remaining in these townships operating at lower capacities. This will negatively affect the business people and the landlords as they will loose a lot of income.

The construction of the proposed road will improve accessibility in the study area. However, the construction of the proposed alignment will cause the relocation of about 80% of the people belonging to either socio-cultural or economic group. Relocation will have a negative socio-economic impact to both the people relocating and the ones to be left behind. The construction of the proposed route will destroy properties in the form of houses among others. If compensation is delayed then the affected people will not be able to construct the same number or quality of houses as before the destruction. The construction of the road will cause land fragmentation. Some units will not be economical for agriculture and this will lower agricultural production. The method used to arrive at the areas of land acquired is not accurate. This has brought conflict in the valuation process with some people whose land is not affected at all appearing in the list of people to be compensated, while some people whose land is affected not appearing in the list gazetted by the Commissioner of Lands.

The construction process will involve a lot of activities and hence the use of various machinery. The activities require the services of skilled and semi-skilled personnel. This will create employment to the local people and outsiders. The presence of outsiders is likely to increase insecurity, social disruption and an increase of sexually transmitted diseases (STDs) as a result of increased immorality.

The construction of the road is a change of use from agriculture to transportation. At least 149.7 hectares of land will be taken from agriculture to transportation. This will reduce the area under agriculture with the likely result of reduced agricultural production.

A total of approximately 115,000m^3 of spoil material will be generated in this project. If not spoiled in the right place, these materials may end up covering vegetation and will result in the dying of this vegetation. Some of the spoil material may find its ways in the local streams polluting the water.

The construction process will use equipments of various types and sizes. Vibrating rollers will also be used in compaction processes. These equipments will produce noise and are likely to sonically vibrate the surrounding structures.

5.2 IMPACT MITIGATION MEASURES

5.2.1 Soil Conservation

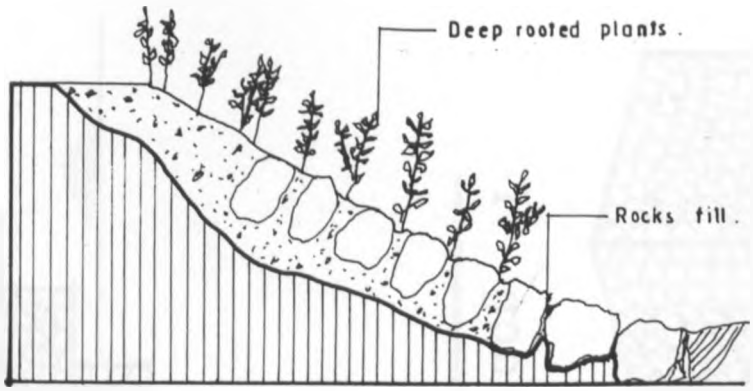
The likelihood of serious environmental impacts on soil as a result of road projects can be reduced by: (i) minimizing the area of ground clearance, (ii) avoiding sensitive

alignments, such as those which include steep hillsides, (iii) balancing filling and cutting requirements through route choice, so as to avoid the production of excess spoil material and reduce the need for borrow pits, (iv) avoiding the creation of cut slopes and embankments which are of an angle greater than the natural angle of repose for the local soil type, and (v) replanting disturbed areas immediately after disturbance has stopped, not after construction has been completed.

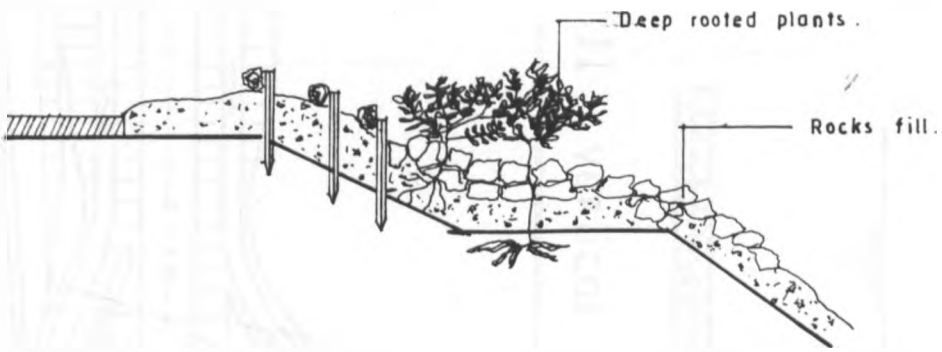
Replanting cleared areas and slopes is the most effective action to be taken in reducing erosion and stability problems. It should be undertaken as early as possible in the construction process, before erosion becomes too advanced. To be most effective it should be done immediately after the disturbance takes place. Vegetation should be selected to serve a specific engineering function. However, a short–lived engineering structure, such as a woven wattle fence should be installed, along with vegetation that can take over the function of the structure in time. The vegetation will help catch and retain material moving over the surface and support the slope by propping from the base. Grasses can effectively limit surface erosion.

In many cases, vegetation alone may not be enough to prevent erosive damage to slopes, and various engineering measures may be needed to complement or replace it. These measures include: (i) intercepting ditches at the tops and bottoms of slopes. Gutters and spillways may be used to control the flow of water down a slope, (ii) terraced or stepped slopes to reduce the steepness of a slope (Figure 5.1.) (iii) retaining structures, such as gabions (rectangular wire baskets of rocks) usually battered back against the slope (Figure 5.2). Some important drainage mitigation measures include: (i) cut off drains to catch water before it reaches critical areas, and diverging drains, which avoid excessive concentration of flow (Figure 5.3).

Figure 5.1: Proposed Soil-Erosion Mitigation Measures.



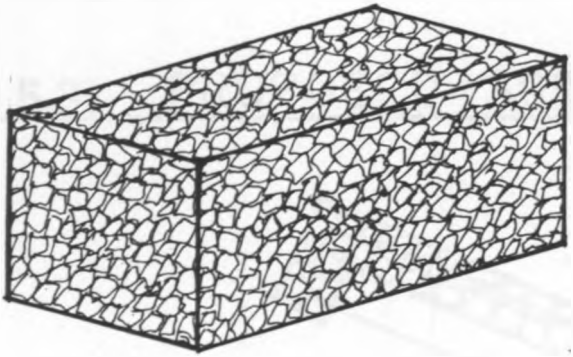
I. planting over riprap.



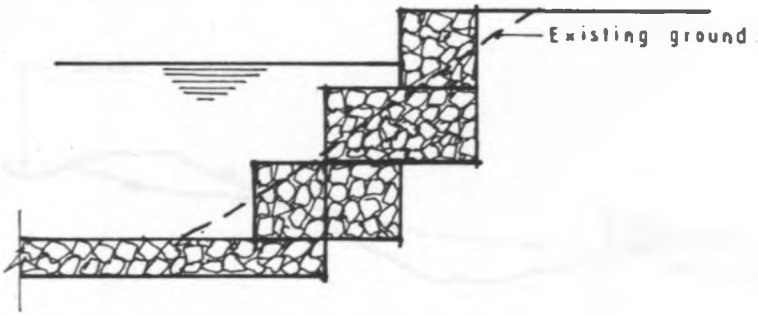
II. a berm on slope face.

SOUREE: Researcher, 2001

Figure 5.2: PROPOSED SOIL-EROSION

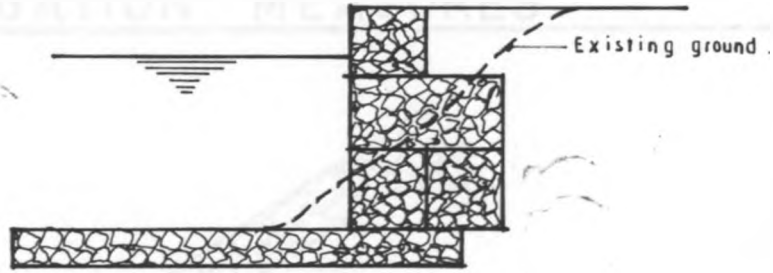


I. gabion box.

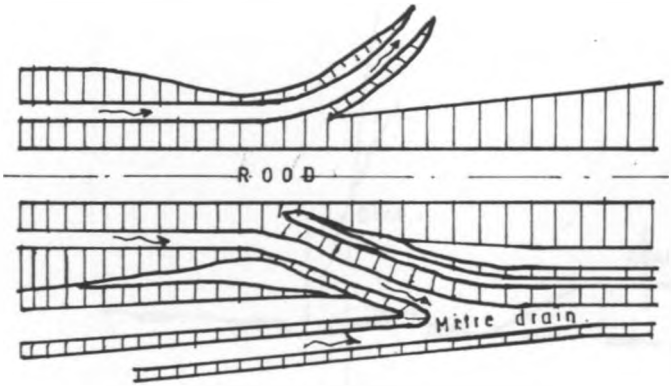


III. stepped embankment.

MITIGATION MEASURES

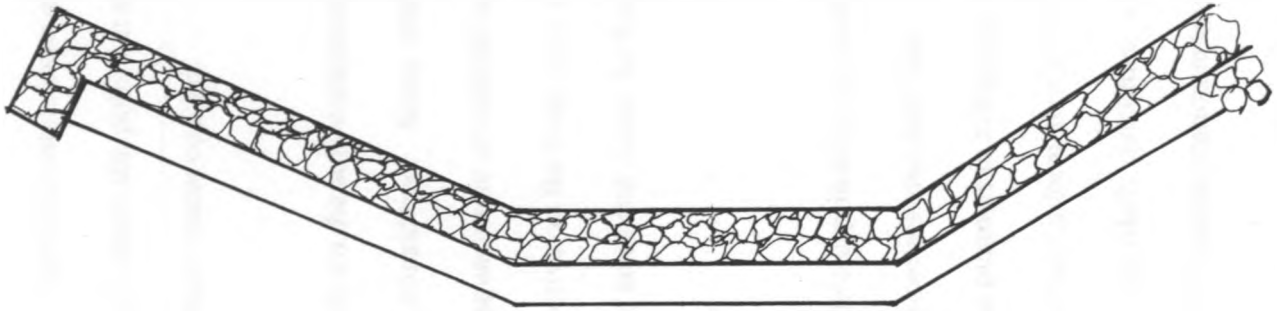


II. vertical embankment.

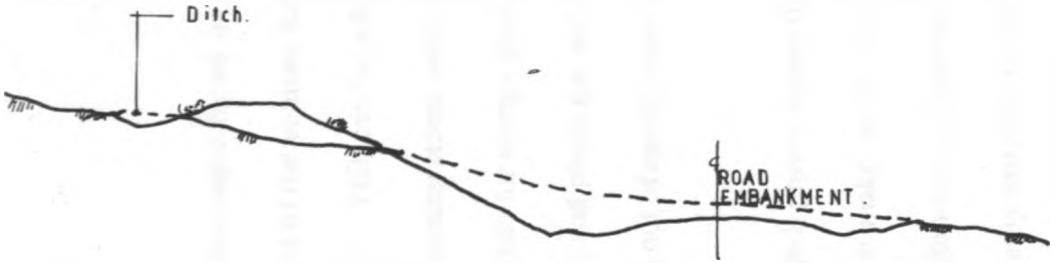


IV. plan of cutoff Ditch.

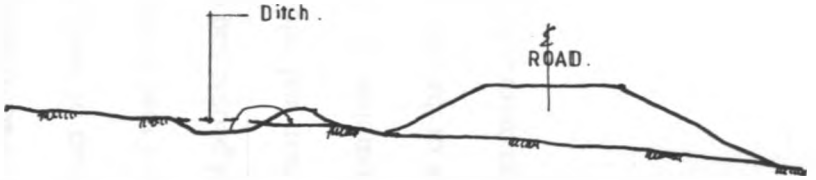
Figure 5.3: PROPOSED SOIL-EROSION MITIGATION MEASURES.



I. stone pitched drain.



II. cut-off ditch at top of cut.



III. cut-off ditch

Another major factor in the prevention of soil erosion and siltation of watercourses is the control of the volume, location, and speed of water flows in the vicinity of exposed soils and slopes. This can be achieved by use of: (i) concrete dissipation structures designed to slow fast-running storm water drains, and hence reduce its downstream erosive potential; (ii) natural materials for energy dissipation in drains, including various combinations of sticks, hay bales, rocks, and plantings, and (iii) settlement basins, which allow silt, pollutant and road rubbish to settle out of runoff water before it flows into downstream water courses.

Where it proves impossible to avoid negative impacts on the soil, compensatory measures that aim to make up for losses or damage should be considered. Some examples include: (i) transformation of quarries into lakes for recreation, aquaculture or wildlife habitat; (ii) terracing of nearby marginal farmland to make it more productive on the long term; (iii) conversions of borrow pits and spoil dumpsites into roadside picnic areas and scenic lookouts.

5.2.2 Land Acquisition and Resettlement

Mitigation of land acquisition impacts can be achieved primarily by modifying the route or design of road to minimize its effects on nearby properties and land uses. Consultation with affected people and other interested parties can assist planners in mitigating the impacts of land acquisition and relocation by providing clear and timely information as well as opportunities for a complete discussion of options, preferences, and likely outcomes. Thus, by taking full account of the needs of those affected, the design of implementation arrangements should be based on more solid information.

Since disruptions to livelihoods will occur, a comprehensive assistance strategy is required. This should go beyond financial compensation to include social and commercial rehabilitation or replacement. Such rehabilitation may require additional financial, technical, and organizational assistance, which is not provided for in the legislation.

5.2.3 Human Health and Safety

The construction of the road will bring visitors to the study area. There is likelihood that the visitors who will be separated from their families for long will start social relationships with the area's residents. It is therefore important to educate the people about STDs including AIDS.

On the other hand, the dust during the construction period will cause human health problems. The same is true of the contaminated water. The people need to be taught basic hygienic practices such as boiling drinking water. The construction company can reduce the amount of dust by sprinkling the road during the compaction process.

5.2.4 Community Participation

Public involvement entails a dialogue with interested parties before key project decisions are made. It should cover such issues as the choice of alternative routes, and methods of limiting or compensating for negative impacts. While the final decisions on project options generally remain with the road agency, public impacts should be seriously considered and identified. If used in reaching road-planning decisions, participation does not imply complete sharing of decision-making power, but recognizes shared responsibility for both negative and positive aspects of the project.

5.2.5 Traffic Accidents Involving Animals

Animal crossings can be used to reduce collision rates between animals and vehicles. Animal underpasses are suitable at the major junctions of the proposed road and existing non-motorized transport (NMT) paths.

5.2.6 Flora and Fauna

One common compensatory measure is to replace damaged or lost biotopes with others of equal or similar characteristics and ecological significances. Environments damaged by a road project can be restored, and nearby biotopes of the same significance can be protected as parks or reserves. Preservation, restoration, enhancement, or even creation of valuable habitat areas to compensate for unavoidable loss of similar resources elsewhere should be done. This is known as environmental resource "banking".

Before a road is designed, baseline data should be collected to identify areas of ecological interests within the study area. Potential impacts of road development proposals and analysis of the various route alternatives in terms of their respective consequences for the natural environment should be carried out. The preferred design should be the one that interferes the least with the ecosystems.

5.2.7 Communities and their Economic Activities

The splitting of the community can be minimized by taking account of local movements at the road design stage and by making provision for improved crossings or alternative access routes. The latter can be achieved through the use of intersections, pedestrian underpasses, overpasses, service roads, and alternative arrangements for local traffic. At the junctions between the

proposed road and the two murram roads from Kambu and Machinery, it is advisable to construct underpasses to allow people, animals and other NMT to cross the proposed road to and from the above two townships. This will go a long way in minimizing road traffic accidents between vehicles and the other road users.

5.2.8 By-Passed Townships

To mitigate the negative economic impacts of by-passing the existing townships can be achieved by re-aligning the section through the bridges but making sure that the townships are not by-passed. To reduce the negative impacts of the steep gradients at the bridges on vehicles, climbing lanes should be introduced for slow moving vehicles.

This alternative will save money compared to the proposal to re-align the road because there will be no compensation payment for land acquisition and/or destroyed properties; as well as no clearance of bushes and removal of top soil since this is an existing alignment and would require very little if any bush clearing and top soil removal. Furthermore, this proposal will ensure that there will be no consumption of agricultural land thus same agricultural production will be maintained and this would save approximately two million shillings per year. On the other hand, only two bridges will be constructed instead of five, while the construction length will reduce by close to a kilometer.

The other alternative is to by-pass the townships but maintain the existing road to a high standard. Combined with this, the existing murram roads joining Kambu and Machinery to the proposed road should be tarmacked and widened enough to accommodate two trucks moving in the opposite direction at the same time. Parking space should be created along these

access roads. The parking space and the tarmac road and the good conditions of the existing road will encourage the drivers to enter the existing townships proposed to be by-passed. In fact 60% of the drivers proposed this as a remedy to save the decay of Kambu and Machinery townships.

The other mitigative proposal is to control development at the junctions of the existing murram roads from the townships of Kambu and Machinery with the new road. Care should however be taken to discourage the migration of businesses that are not essential for the passing traveler since such movements can drain the existing townships of much of their vitality. This can be achieved by planning the existing townships and the areas around the junction as a single unit. These should see to it that businesses that are not catering for the urgent need of the travelers should be prevented from migrating to the new road. Lodgings, bars and some hotels should remain in the existing townships. A few hotels can be allowed to develop at the new sites to cater for travelers who are in a hurry. This would ensure that the existing townships continue to cater for travelers who are not in a hurry and hence continue operating.

5.2.9 Cultural, Traditional and Religious Sites

As has been earlier mentioned, thirty-one graves and two churches fall within the proposed alignment. Where possible, road construction should avoid any alignment that cuts through cultural, traditional or religious sites like graves and churches. During the design stage, important sites should be avoided. This can be done by involving the local community at the design stage.

In exceptional cases, if it proves impossible for an alignment to avoid a cultural site of value, like a grave or a church, public consultation should find an acceptable solution. Dialogue between the road agency and the affected people need to be frequent and continuous to avoid delay in the project implementation. In this specific project, some ceremonies need to be performed before a body is excavated. The road agency should meet the expenses for the ceremony. All this suggests that if the mitigation plan is to be effective, then the legal framework governing land acquisition and valuation must be broadened to include cultural compensation for cultural heritage of the affected people. The institutional capacities for the management of the new legal framework must be strengthened. This calls for the amendments of all legislation that deal with the land acquisition to include compensation for cultural heritage of the people affected unlike it is currently.

5.2.10 Conservation of Water Resources

Measures that can be used to avoid severe impacts on local hydrological environment include: (i) avoiding alignments, which are susceptible to erosion, such as those crossing steep slopes; (ii) using only "clean" fill materials around water courses, such as quarried rock containing no fine soils; and (iii) leaving buffer zones of undisturbed vegetation between road sites and bodies of water. On the other hand, water speed reduction measures such as grasses, riprap, and other devices in water channels can substantially reduce potential impacts. Settling basins should be used to remove silt, pollutants, and debris from road runoff water before it is discharged to adjacent streams or rivers. They are most appropriate where the downstream environment is particularly sensitive or where the levels of silt or pollutants are particularly high. On going maintenance may be required where large volumes of silt are deposited to clean the basins in readiness for a coming rainny season.

5.3 CONCLUSION

The study has shown that increased road capacity and improved pavements can reduce travel times and lower the costs of vehicle use, while increasing access to the markets, jobs, education, and health services and reducing transport cost for both cargo and passengers. Roads are agents of change and can be responsible for both benefits and damage to the existing balance between people and their environment. People may be in the direct path of road works and may be affected in a major way. People may also be indirectly affected by new road projects, through the disruption of livelihood, and accustomed travel paths and community linkages. Disturbance to the natural environment may include soil erosion, changes to streams and interference with animal and plant life.

All these concerns will rarely arise in relation to a single project, but it is common to find at least some even in relatively minor road projects. Much can be done to avoid, mitigate, or compensate for the negative socio-economic and ecological impacts of a road project, but it is important to identify potential impacts early in the road planning process and to make provisions for avoiding or mitigating these effects wherever possible. Failure to identify potential impacts may result in delays and cost increases later in the projects development.

Neglecting to account for impacts early in the planning stage may cause the road agency to adopt solutions that compromise the environment. Poor planning and management of road projects may reduce negative public perception of road projects. Poor environment management in road projects may create additional problems for those yet to come.

A truly sustainable approach to road transport development calls for a substantial change in attitude towards the environment as it relates to the preparation and management of road projects. Costs of the indirect effect of pollution and disruptions must be examined. Change to the health and socio-cultural well being of communities, and impacts on the biophysical environment must be considered. The needs of the poor, and the future generations, need to be taken into account.

5.4 AREAS OF FURTHER RESEARCH

1. Economic valuation of the impacts of the proposed road re-alignment by a team of multidisciplinary professionals. .A cost benefit analysis of the proposed realignment is necessary to come out with an overall analysis of the gains and loss to the various affected people.
2. A detailed study of the impact of the road re-alignment project on the values of land and human settlement pattern should be undertaken. The findings of such as study will be useful in the compensation of the affected parties.
3. A detailed study quantifying the socioeconomic, cultural, and ecological effects should be carried after the project has been implemented. The findings of such study will be useful in measuring if the road construction agency implemented the proposed policies to reduce the projected impacts.

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(b) Trust land Act sections 7 to 13.

(c) The Registered land act cap 300, section 30.

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APPENDIX 2.

Land ownership rights in Kenya

- Freehold Interest: Also known as a free simple. It is the longest interest over land. It is ownership and therefore confers ownership over land.
- Leasehold interest:-interest over land for a fixed duration. It is a terminal interest, the term can be for either 33, 66,or 99 years.
- Customary land tenure:- here the individual or group interests over land have not been established. The land is vested to local authorities to hold it in trust for the people until specific rights can be defined and titles issued. The land here is referred to as trust land.

The government owns a very small percentage of the land either in the form of already developed land i.e., land with Government buildings or in the form of unalienated land reversed for future use by the Government itself or made available to the general public for various uses. Due to shortage of land for development, sometimes the Government gets it by compulsory acquisition.

Legal bases of compulsory acquisition

The right of compulsory acquisition is derived from several principals:-

- The principle of Dominant Interest:- whereby the territory is owned by the state and it is the state that owns the Dominant Interest.
- Principle of Escheat: - states that it does not matter how many heirs one has, whenever this line of heirs is completed the state is the final inheritor.
- Principle of bona *vacantia* (vacant interests) states that any time any piece of land is vacant; it reverts back to the Government.

Apart from the general principles, there are legislations which empower the Government to acquire land viz: -

(a) The Kenya constitution:

In section 75 the Government is authorised to acquire land but only after satisfying 3 conditions namely:-

- The land is required for defence, public safety, public order, morality, Health, town and county planning or any other use which will benefit the public.
- The necessity for acquisition is such as to afford reasonable justification for the hardships caused to the affected people.
- Full and prompt payment of compensation is done to the affected persons.

(g) The constitution of Kenya sections 117 and 118. It deals with trust land and empower the county councils to set apart land for use or occupation of either the Government, Corporate Bodies, Registered Companies for extraction of minerals and mineral oils or for use by any other person for a purpose beneficial to the people resident in the area.

(h) Trust land Act sections 7 to 13: Gives out the procedure to be followed when setting apart land.

(i) The Registered land act cap 300, section 30. All registered land is subject to overriding interests even though such interests might not be noted in the register. Rights of compulsory land acquisition is one of the overriding interests.

(j) The land acquisition(Act cap 295).

This is the main legislation on land acquisition in Kenya; it sets out the procedures for land acquisition in Kenya; it sets out the procedures for land acquisition and the principles on which compensation is to be based. This act deals primarily with land that has been registered and titles issued either in freehold or leasehold tenure as opposed to the Trust Land Act which deals with the trust land. The act was enacted in 1968 to replace the Indian acquisition Act of 1894 which was introduced by the colonial Government in Kenya and operated up to 1968. It has been revised severally since then i.e. in 1970, 1972, 1983 and the amendment act of 1990.

Application of the land acquisition Act cap 295 procedures

The person empowered to acquire land under this act is the Commissioner of Lands on behalf of the Minister of Lands and Settlement or the Government.

APPENDIX 3. QUESTIONNAIRES

UNIVERSITY OF NAIROBI

DEPARTMENT OF URBAN AND REGIONAL PLANNING

HOUSEHOLD QUESTIONNAIRE (A)
(HOUSE HOLDS ABUTTING EXISTING ROAD)

This is purely an academic research. The interviewer is a second year Masters of Arts student at the above named institution. As part of his course-work, he is required to conduct a research and write thesis. He is therefore carrying out a study on the "assessment of the effects of the Nairobi-Mombasa Road re-alignment on existing rural and urban settlements" The information provided here will enable him meet the degree requirements. Your views and contribution will be treated with respect and confidentiality.

Date of Census_____ Start time_____ end time_____

Division_____ Location_____

Sub-location_____

Name of research assistant_____

Plot No (*Optional)*_____

Respondent's name *(optional)*

1. Are you aware that there is a proposal to re-align the existing Nairobi-Mombasa Road from here to another place? Yes=1 No=2
   _____ ☐
2. If yes, how did you know?
   Kenya Gazette notice = 1, provincial administration = 2, political leaders = 3
   Others = 4 Incase of any other specify_____
3. Were you consulted during the design for the proposed re-alignment? Yes = 1, no = 2
4. If yes, what part did you play?_____ ☐
5. What benefits do you get by virtue of abutting the existing, Nairobi-Mombasa Road? (*Name three in order of importance)*

Better access =1, Cheaper transport cost = 2, High land values = 3, proximity to public utilities = 4, proximity to customers = 5, other = 6, incase of other specify.

6. What losses\ disturbances do you get by virtue of abutting the existing Naorobi-Mombasa Road? (*Name three in order of importance)*
   Accident to members of household = 1, Accident to domestic animals = 2, Noise pollution = 3, air pollution = 4, insecurity = 5, other = 6,
   In case of other specify_____

7. What benefits, if any, do you hope to get by re-aligning the *road* away from here? *(Name three in order of importance).* Less noise pollution =1, less air pollution = 2, less insecurity = 3, less accidents to domestic animals = 4, less accidents to members of household = 5. Other = 6, Incase of other specify.

8. What losses, if any, do you hope to get by re-aligning the existing road from here? (*Name three in order of importance*) loss of customers=1, High transport cost= 2, Drop in land values = 3 Other = 4, in case of other specify_____

9. In your opinion, what mitigation measures can be put in place to reduce the above losses of re-aligning the road away from here_____

10. What is your main sources of water for domestic use? (*choose three in order of importance*). Pipe=1, River = 2, Dam = 3,Well = 4, Bore hole = 5, other = 6 incase of other specify _____

11. Have you been crossing the existing road when fetching water for domestic and livestock use? Yes = 1, No = 2

12. If yes, what problems have you been facing?_____

13. What is the size of your plot (acres) ?

14. How did you get this land_____
    Buying from open market = 1, allocation by government = 2, inheritance= 3, other = 4, incase of other specify_____

15. Household information

16.

(A) Name of person	(B) relation ship to head of household	(C) sex	(D) Age	(E) Religio n	(F) Educational level	(G) Primary occupatio n	(H) Secondary occupation	(I) Monthly income

Relationship to head of household Self = 1,Spouse = 2, Parent = 3, Son/Daughter = 4, other = 5, incase of other specify.
Sex : Male = 1, Female = 2.
Marital status : Married = 1, Unmarried= 2, Divorced = 3, Separated= 4 Wdowed= 5
Religion : Christian =1, Muslim =2, Hindu =3, other=4 , incase of other specify
Educational level : Illeterate =1, Primary school= 2, secondary school = 3, Graduate = 4, Technical college= 5, university = 6 Other = 7, incase of otherspecify.
Occupation : Agriculture worker = 1, manual labourer= 2, private sector salary=3, public sectos salied=4, self employed= 7, pensioner= 8, other=9, incase of otherspecify
Special skills : Handcrafts= 1, pottery = 2, Artisan = 4, Technical = 5, Traditional medicine = 6, literature

17. Distance to water source for domestic use (km)

18. Source of water for livestock *(choice in No.10)*

19. Distance to source of water forlivestock (km)

20. What is the total cost of water (domestic+ livestock) per month Kshs

21 What is the source of energy for lighting? (Name three in order of importance)
Electricity = 1, Kerosine = 2, Solar energy = 3, other= 4 incase of other specify

22. What is the source of energy for cooking? (name three in order of importance)
Electricity = 1, Kerosine=2, Charcoal =3, Gas = 4, Fire wood= 5, other=6 incase of other specify

23. What is the total cost of energy (both for cooking and lighting) per month Kshs

24Livestock Assets(please record number)

Classification	Type	Young	Mature
Cow			
Sheep\ goats			
Poultry			
Other			

Type: Grade = 1, indigenous= 2

24. For how many years have you lived in this area?

26. What is the current price of land per acre?

27. What do you think would be the price of an acre of land after construction of the new road and why? (Kshs).

UNIVERSITY OF NAIROBI
DEPARTMENT OF URBAN AND REGIONAL PLANNING

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ROAD USERS QUESTIONNAIRE
Date of Census_____start time_____ end time_____

Name of interviewer_____ _____

Township Name_____

1. Name of respondent *(optional)*_____

2. Occupation of reaspondents_____

3. Vehicle registration No. *(optional)*

4. Type of vehicle private = 1, Matatu =2, Bus= 3, Light truck = 4 Heavy truck=5, other =6 incase of other specify_____

5. On average. How many times do you stop here for services \ goods in a month? ☐

6 .What services \ goods do you get from this township? Give three in order of ☐ importance

Accomodation =1, food =2, motor vehicle servicing =3, business =4 other =5, if any other specify _____

7.What is your approximate monthly expenditure in this township on above services\goods

Service \ goods	Approx. Annual Expenditure Kshs

8. What makes you choose this township for above services?_____
cheap services=1, availability of quality services =2, no other provider =3, proximity to the existing road = 4, other =5, incase of other specify (choose three in order of importance)

9. What can be done to improve on the delivery of these services? Choose three in order of importance. Electricity provision =1, water provision =2, better solid waste management= 3,

better waste water management=4, other= 5, if any other specify_____

10. Are you aware that there is a proposal to re-align the road, hence, by-passing the township? Yes = 1, No=2

11. If yes, how did you come to know about it?
Kenya gazette notice = 1, from other drivers=2, from service providers in the township=3 other =4. incase of other specify_____

12. Will you continue stopping \ deviating your vehicle to this center for the above services after the construction of the proposed re-alignment? Yes =1, No=2

13. Give reasons for the above answer_____

14 Do you think there are any advantages for re-aligning the road? Yes =1, No=2

15 If yes, what are the advantages? (give three in order of importance) reduced accidents in the townships=1, reduced travel distance =2, reduced gradient=3
open up the interior=4, other =5, if other specify

16. What do you think are the disadvantages of the proposed re-alignment? (Give three in order of importance) relocation of people=1, waste of agriculture land=2, by-passing of the township =3, Negative ecological impacts =4, other=5, incase of other specify

17. Are you aware of any other constructed by-pass on the Nairobi-Mombasa High-way? Yes=1, No =2
18. If yes, which one?_____

19.Do you enter the by-passed town for services? Yes =1, no =2

20. Give reasons for above answer._____

21. What can be done so that you may continue stopping in this township for services\ goods even after the construction of the by-pass

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22. What problems do you face on the existing road re-alignment between Mtito-Andei to Machinery? (Give three in order of importance) steep gradient-1, sharp curves=2, narrow bridges=3, narrow road=4, insecurity\theft=5, potholes=6 other =7. Incase of other specify_____

23.Apart from re-aligning this section, what can be done to minimize or eliminate the above problems?

Problem	Proposed solution

27. How long have you used this road?

UNIVERSITY OF NAIROBI

DEPARTMENT OF URBAN AND REGIONAL PLANNING

BUSINESS QUESTIONNAIRE

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Date of census_____start time _____ end time _____

Name of interviewer _____

Township Name_____ Division name_____

Location _____ sub location_____

Name of respondent (optional) _____

Plot no. (optional)

BUSINESS DETAILS

1. Type of business_____

Type of construction material			No. of employees		No. of customers per day(average)		Daily turnover		Investment in business	Net month income fr Kshs	
Roof	Wall	Floor	Male	Female	Local	Travelers	Travelers	Local	Kshs	Local	Tr

Type of construction materials: roof: corrugated iron sheets=1, tiles =2, grass thatched=3,Asbestors= 4, other=4, incase of other specify_____
Walls: Quarry stones =2, Bricks =3 mud and wattle =3, other = 4, incase of other specify_____
Floor: mud –1, concrete=2, other =3. incase of other specify_____
Sex: male =1, female =2
Tenure status: own =1, rented =2, other =3, incase of other specify_____

SOURCES OF COMMODITIES (GOODS)

Commodities	Source (town)	Mode of transport	Approximate expenditure per month on transport Kshs

2. Mode of transport: public motorized =1, private motorized=2, non-motorised =3, other =4. Incase of other specify.

3.Main source of energy for lighting (name three in order of importance)
Electricity =1, kerosene=2, solar energy=3, other=4. Incase of other specify

4. Main source of energy for cooking (name three in order of importance)
Electricity = 1, kerosene = 2, charcoal =3, gas =4, firewood =5, other =6. Incase of other specify_____

5.Name three main source of water for domestic use (arrange in order of importance)
Tap =1, river=2, Dam=3, Well=4, Bore hole=5, Other =6. Incase of other specify_____

6.What benefits do you get from the existing Nairobi- Mombasa high-way by virtue of it passing through the township? Name two in order of importance_____
it provides customers=1, provides access to the township=2, transportation cost cheaper=3, other=4. Incase of other specify_____

7.What problems do you get from the Nairobi-Mombasa high-way by virtue of it passing through this township? (name two in order of importance) frequent accidents =1, high rate of STDs =2, noise pollution=3, none =4, other=5. Incase of other specify_____

8. In your opinion what can be done to reduce mitigate these problems?_____
By-pass the township =1, construction of bumps on the roads =2, other =3. Incase of other specify_____

9. In your opinion what can be done to enhance the above mentioned benefits

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10 Are you aware that there is a proposal to by-pass this township? _____
Yes =1, No=2

11. If yes, how did you know about it?_____
Kenya gazette notice=1, other electronic\print media=2, provincial administration =3, local leaders=4, other =5. Incase of other specify_____