REPUBLIC OF KENYA

A ROAD NETWORK DEVELOPMENT MASTER PLAN STUDY

FINAL REPORT

SUMMARY

MAY 1995

JAPAN INTERNATIONAL COOPERATION AGENCY

MINISTRY OF PUBLIC WORKS AND HOUSING

PACIFIC CONSULTANTS INTERNATIONAL (PCI)
CONSTRUCTION PROJECT CONSULTANTS (CPC)

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The following foreign exchange rate is applied in the study:
US$1.00=60.15Ksh (as of November 1994)

Preface

In response to a request from the Government of the Republic of Kenya, the Government of Japan decided to conduct "A Road Network Development Master Plan Study "in the Republic of Kenya and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to the Republic of Kenya a study team headed by Mr. KIYOSHI YASUKAWA, and composed of members of Pacific Consultants International, and Construction Project Consultants Inc., three times between January 1994 and January 1995.

The team held discussions with the officials concerned of the Government of Kenya and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Kenya for their close cooperation extended to the team.

May 1995

Kimio Fujita
President
Japan International Cooperation Agency

May 1995

Mr. Kimio Fujita

President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

Dear Sir:

We are pleased to formally submit herewith the final report of "A Road Network Master Plan Study in the Republic of Kenya".

This report compiles the results of the study which was undertaken in the Republic of Kenya, form January 1994 to January 1995 by the Study Team, organized jointly by Pacific Consultants International and Construction Project Consultants.

We owed a lot to many people for the accomplishment of this report. First, we would like to express our deep appreciation and sincere gratitude to all those who extended their kind assistance and cooperation to the Study Team, in particular, officials concerned of Ministry of Public Works and Housing, the Republic of Kenya, and Kenyan Counterpart Team.

We also acknowledge the officials of your agency, the JICA Advisory Committee and the Embassy of Japan in the Republic of Kenya.

We wish the report would be able to contribute really to Kenya's people and socio-economic development in the future.

Very truly yours,

Kiyoshi Yasukawa

Team leader
The study Team for
A Road Network Master Plan Study
in the Republic of Kenya

Master Plan Study on Road Network Development in the Republic of Kenya

Study Period : January 1993 - May 1995
Counter Agency : Ministry of Public Works and Housing

Summary

1. Background

In Kenya, road, railway, harbour, air transport and pipelines serve passengers' travels and commodity movements. Among these modes of transport, road transport plays the most significant role in volume. Despite the importance of road transport, the pavement ratio is still low and road system has not been adequately developed. In view of the present situation, it is vital to establish a long-term road development master plan to support nation-wide development in the future.

2. Objective

The study aims to establish a long-term arterial road development plan to support nation-wide development in Kenya as well as its implementation program, reviewing the on-going short-term road facility maintenance program.

3. Study Area

The study area covers the whole nation of Kenya, with area of 580,000 square kilometers.

4. Summary of the Master Plan

4-1. Basic Policy

1) National Development Policy

To achieve sound and stable economic development and to deal with expected population growth, regional nucleus cities should be selected as centers in the regions and intensive investments are required around the selected cities as a countermeasures for controlling urbanization and for achieving efficient national development.

2) Road Network Development Policy

To maintain continuous economic development, the road network plan has been examined from the viewpoints of agricultural, manufacturing, and tourism development.

4-2. Master Plan

In line with the basic policy, high-standard super-highways should be developed in Mombassa, Nairobi, and the Uganda axis. Furthermore it is recommended to develop bypasses and major road projects for accelerating economic development listed in the table below;

PROJECT	Length (km)	COST 1995-1999 (m.ksh)	COST 2000-2004 (m.ksh)	COST 2005-2009 (m.ksh)	COST 2010-2013(m.ksh)	TOTAL COST (m.ksh)
(I) SUPER HIGHWAY	896.3	4,305	5,588	7,949	2,295	20,137
(II) SUPER HIGHWAY DUAL CARRIAGEWAY	350.7		4,487	11,292	1,159	16,938
(III) BYPASS CONSTRUCTION	152.0	1,447	2,680	2,626	5,594	12,347
(IV) DUAL CARRIAGEWAY ROADS	80.0			652	3,212	3,864
(V) MISSING LINK /ALTERNATIVE ROUTE	774.1	4,691	1,768	607	890	7,956
(VI) SUPPORT TO AGRICULTURAL DEVT	169.5	2,059			79	2,138
(VII) SUPPORT TO TOURISM DEVELOPMENT	334.4	4,009		447		4,456
(VIII) ACCESS TO MAJOR PORTS	78.3	585			577	1,162
(IX) OTHER EXISTING ROADS	6368.0	693	11,170	12,938	26,992	51,793
TOTAL	9203.3	17,789	25,693	36,511	40,798	120,791

The road development master plan has been established, including ordinary road maintenance projects to improve the existing road condition.

5. Project Cost

5-1. Premises for Cost Estimate

Classifying road projects into new road construction, major road improvement, and ordinary road maintenance, units costs have been set by type of road project.

5-2. Total Project Cost

The relationship between the total project costs including major projects and the road development budget are shown below;

Table Project Cost and Road Development Budget

Unit:MKsh

Item	1995-1999	2000-2004	2005-2009	2010-1013	Total
Required Investment	17,789	25,693	36,511	40,798	120,791
Development Budget	17,952	25,809	36,708	40,344	120,813

5-3. Exchange Rate

USD1.00 = 60.15 Ksh(\102.2 Yen) as of November 1994

6. Project Evaluation

Item	Evaluation
6-1. Economic and Financial Evaluation	The project life is set to be twenty years. Vehicle operating costs and time costs are estimated by comparing "with" and "without projects. Road development costs and maintenance were also estimated. Based on these costs, the projects have been evaluated by B/C ratios. The Super Highway development project and widening to four-lane-road projects indicate low B/C ratios due to the high development costs. Pavement projects of the unpaved roads with high traffic volume show high B/C ratios.
6-2. Environmental Evaluation	Environmental impacts on natural parks, natural forest, division of communities, have been examined for the proposed projects which incorporate large-scale construction. In addition, aspects which should be taken into consideration during implementation stages have been consolidated. It is necessary to take environmental consideration on natural forests and Mangroves in Mombasa due to the bypass constructions .
6-3. Technical Evaluation	Employing the IRI, which is internationally utilized to indicate road condition, deterioration of road has been evaluated and necessary improvements and implementation periods have been planned. Since pavement has been deteriorated on a considerable number of roads at present, many road sections require immediate repair.

7. Recommendation

7-1. Privatization of Road Projects

It is inevitable to privatize road construction projects in accordance with the on-going institutional reform. The capability of private enterprises, however, varies from region to region, thus gradual privatization is recommended, for instance, by establishing public road development corporation.

7-2. Fuel Levy

It is required to raise fuel levy gradually up to three times of the present level in 2013 to secure financial sources for road development.

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1 OBJECTIVE OF THE STUDY

The objective of the Study is to formulate a master plan for the road A, B, and C (class D and E are out of scope of this study) network in Kenya. The target year of the study is 2013.

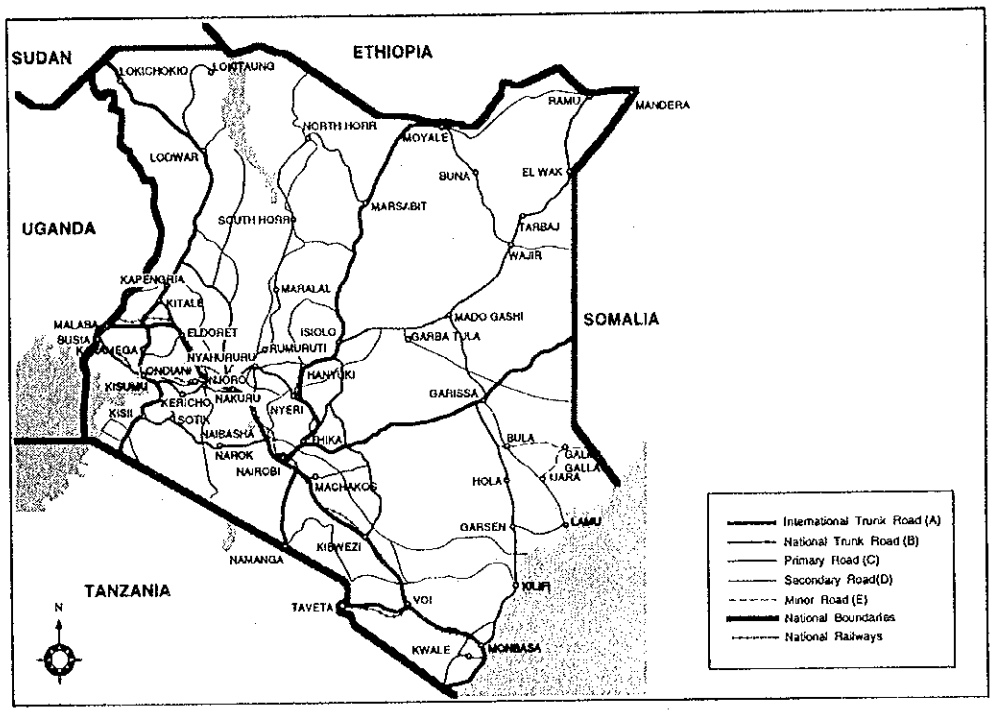


Figure 1.1 Study Area

2 STUDY OVERVIEW AND RECOMMENDATIONS

2.1 General

2.1.1 Study Features

(1) Execution of Surveys to Comprehend Existing Situation

A shortage of the road budget in Kenya has led to a development policy that more emphasis should be put on the maintenance of the existing roads rather than the capital investment for new roads. Although new capital projects are enumerated in a priority project list of this Study, the importance of the road maintenance should remain unchanged. In order to realize an effective road maintenance it is imperative to keep records of the existing road conditions and to update a traffic data and a future traffic projection as well. The road inventory of MOPWH*1 is not satisfactory for such needs to study a future road maintenance and management system. As to the traffic data there exists no traffic projection but periodic traffic counts, though current ones are not available yet at present time.

From the outset of this Study, it was considered inevitable to investigate the existing road conditions to the utmost extent for the establishment of a road master plan. Accordingly, the following three surveys were undertaken.

Table 2.1 Field Surveys Conducted in the Study

Name of Survey	Purpose of Survey
Road Inventory Survey	Inventory data were gathered to enable the MOPWH to utilize the HDM*2 program, and to evaluate the existing road conditions for studying future road maintenance and development plan. The survey covered paved roads of which the total length is about 5,200 km and unpaved roads were surveyed through existing-maps and so forth.
Axle Load Survey	Overloading by trucks were examined at three survey sites for planning countermeasures.The survey results were also utilized to evaluate the pavement design standard.
Origin-Destination Survey	Roadside interview survey was conducted at 27 locations to mainly analyze a future traffic demand.

*1: Ministry of Public Works and Housing

*2: Highway Design and Maintenance Standard Model

These surveys eventually brought about a great contribution not only to updating the old data but also to making new data available. Based on the above survey results, the existing road conditions were evaluated and the road master plan was prepared in this Study. It is expected that the data obtained from the surveys will be able to help donor countries, consultants as well as MOPWH to further various studies more accurately.

(2) Implementation Plan for Road Development and Maintenance

The objective of the Study is to formulate a road network development plan targeting the year 2013, and this plan, as a matter of course, includes such an additional investment as widening from a 2-lane to 4-lane road. In Kenya, as remarked previously, the road maintenance and management problem is a vital issue that can not be separable from the road development plan. Therefore, an implementation plan proposed for a future road development includes not only the additional investment plan but also maintenance and management plan.

2.1.2 Major Study Results

(1) New Roads

Aside from quality matters of existing road facility, the Class A, B and C roads network shows a good shape to meet the present as well as future pattern of traffic demand. Therefore, no new roads are proposed except for bypasses surrounding such major cities as Nairobi, Mombasa and Nakuru.

(2) Major Development Plans

1) Super Highway Development

There are some backbone roads, which serve not only Kenya, but also neighboring countries such as Uganda. They are the Mombasa - Nairobi - Kisumu/Eldoret - Uganda routes, including the A109, A104 and B1 roads (a part of A1 is included). These roads should be improved to a higher design standard with an access control measure and service area facilities. This Super highway would have impacts on nation-wide traffic on the arterial road network and encourage industrial development.

2) Super Highway Dualization

Sections of a super highway with a large future traffic volume, such as Mombasa - Mariakani (A109), a road adjacent to Machakos - Nakuru - Londiani (A104 and B1, except the present dual carriage way section between the international airport and Limuru) are expected to be improved to dual roads. This super highway would give considerable impacts for supporting nation-wide traffic on the arterial road network and for encouraging industrial development.

3) By-pass Development

By-passes will soon become necessary in Kenya around major towns and cities. Nairobi, Mombasa and Nakuru by-passes, among others, were selected in the recommended implementation plan.

4) Widening to Dual Carriage Way Except Super Highway

In conformity with the estimated future traffic demand, selected 2-lane roads should be widened to 4-lanes (dual road). Among the roads required to be widened is the Nairobi - divergent point to B6 on the A2 route (excluding the present dual carriage way section between Nairobi and Makutano).

5) Road Development for Regional Development

Regional roads should be developed to form a wide area network and to provide alternative routes in emergency. Also the roads should be developed to promote regional development from the viewpoint of agricultural, tourism and other development aspects.

6) Other Development Plan

It is recommended to standardize the existing sub-standard roads on the occasion, when road surfaces are deteriorated and repair works are required.

7) Urban Transport Development

It is quite apparent that the urban transport problem has become increasingly an important issue in major cities. Since the scope of this study was limited to the inter-city road network, some by-pass roads only could be proposed, as mentioned previously.

2.1.3 Study Approach

(1) Industrial Development Concept

For the time being, Kenya's industrial structure that the agricultural development is given more importance is not likely to change drastically. However, the development emphasis is expected to gradually shift to the manufacturing sector in future. Additionally, it is anticipated to further promote the tourism sector for attaining higher exchange earnings.

1) Agricultural Development

Agricultural sector accounts for a dominant share in GDP and it has been playing a leading role in a whole industry of Kenya. The sector is also imposed to secure foods for sustaining a growing population. The arterial road development will enable agricultural related commodities to effectively move in and out of the production site. The arterial road does not only support the existing agricultural activities but also contribute to developing a new agricultural exploitation in a semi-arid area.

From the viewpoint of the above agricultural development, the arterial road development will be required in the present agricultural area adjacent to Nairobi and in the semi-arid area of high development potential around Naroku.

2) Manufacture Development

The development of an expected future leading sector of manufacturing industry will inevitably entail the urbanization. Large scale manufacturers at present are concentrated along the Mombasa - Nairobi - Kisumu/Eldoret corridor. This brings about the necessity to further strengthen a transport linkage of the corridor.

3) Tourism Development

Kenya is abundant in such a tourism resource as wild life, and it is earning a large proportion of the foreign exchange. The promotion of the tourism development will require the improvement of roads to access the tourism resource and to create a new tourism demand as well.

(2) Countermeasures to Urbanization Pressure

1) Urbanization Control

Excessive urbanization and population concentration to Nairobi and Mombasa should be avoided by developing other primary cities in a context of regional development planning.

2) Formulation of City Hierarchy

In a frame of reference to properly control the urbanization and to effectively develop the national land, it is necessary not to disperse a scarce budget throughout the country but to concentrate the investment to selected regional core cities that are planned to function as development centers of the regions. For this purpose, regional core cities were selected in this Study, applying the analytical method of City Ordering System.

Furthermore, a new classification of road functions is proposed incorporating features of both the regional core cities and traffic linkages among these cities. However, it should be noted that the proposed road classification does not intend to change the existing road classifications such as Class A, B and C but to employ it as a tool to analyze the road network.

2.1.4 Future Road Network

A future road network is based on study results derived mainly from the future traffic demand analysis, industrial development prospect and clarification of road functions. The proposed road network is presented in Figure 2.1.

2.1.5 Recommended Projects

Projects were identified from the proposed future road network and listed by project type as presented in Table 2.2.

Table 2.2 Aggregated Road Projects

No.	Aggregated of Projects	Distance (km)
1	Upgrading to 2-lane Super Highway	896
2	Widening to 4-lane Super Highway	351
3	Development of Bypass Roads	152
4	Widening to 4-lane Arterial Roads	80
5	Missing link / Alternative Roads	774
6	Agriculture Development Roads	170
7	Tourism Development Roads	334
8	Access roads to Major Facilities	78
9	Improvement of Class A Roads	1,728
10	Improvement of Class B Roads	1,034
11	Improvement of Class C Roads	3,607

2.1.6 Investment Plan of Projects

A total investment cost required to implement the recommended projects is estimated as shown in Table 2.3.

Table 2.3 Estimated Costs of Development Projects

Unit: Million KSh

No.	Projects	Cost (M.Ksh)
1	Upgrading to 2-lane Super Highway	20,138
2	Widening to 4-lane Super Highway	16,939
3	Development of Bypass Roads	12,347
4	Widening to 4-lane Arterial Roads	3,864
5	Missing link / Alternative Roads	7,955
6	Agriculture Development Roads	2,138
7	Tourism Development Roads	4,455
8	Access roads to Major Facilities	1,162
9	Improvement of Class A Roads	9,641
10	Improvement of Class B Roads	10,054
11	Improvement of Class C Roads	32,098
	Total	120,791

Since a fiscal budget allocated to the road development is limited, a new policy to raise funds will be required as presented below:

- To increase the present fuel levy more than threefold

- To increase a financial aids from donor countries, since it is now hard to anticipate a greater increase in the fiscal revenue.

- To revive the currently abandoned toll system in future in order to diversify fiscal revenue resources, and apply it to supplement the road maintenance budget.

2.1.7 Others

A basic policy to privatize such a Government's undertaking as the road maintenance will urge the MOPWH to gradually decrease its personnel and to assign the undertaking to the private sector. However, since the capacity of private enterprises differs among districts, it is important, when the privatization becomes an issue, to take into accounts their ability, particularly those in remote areas.

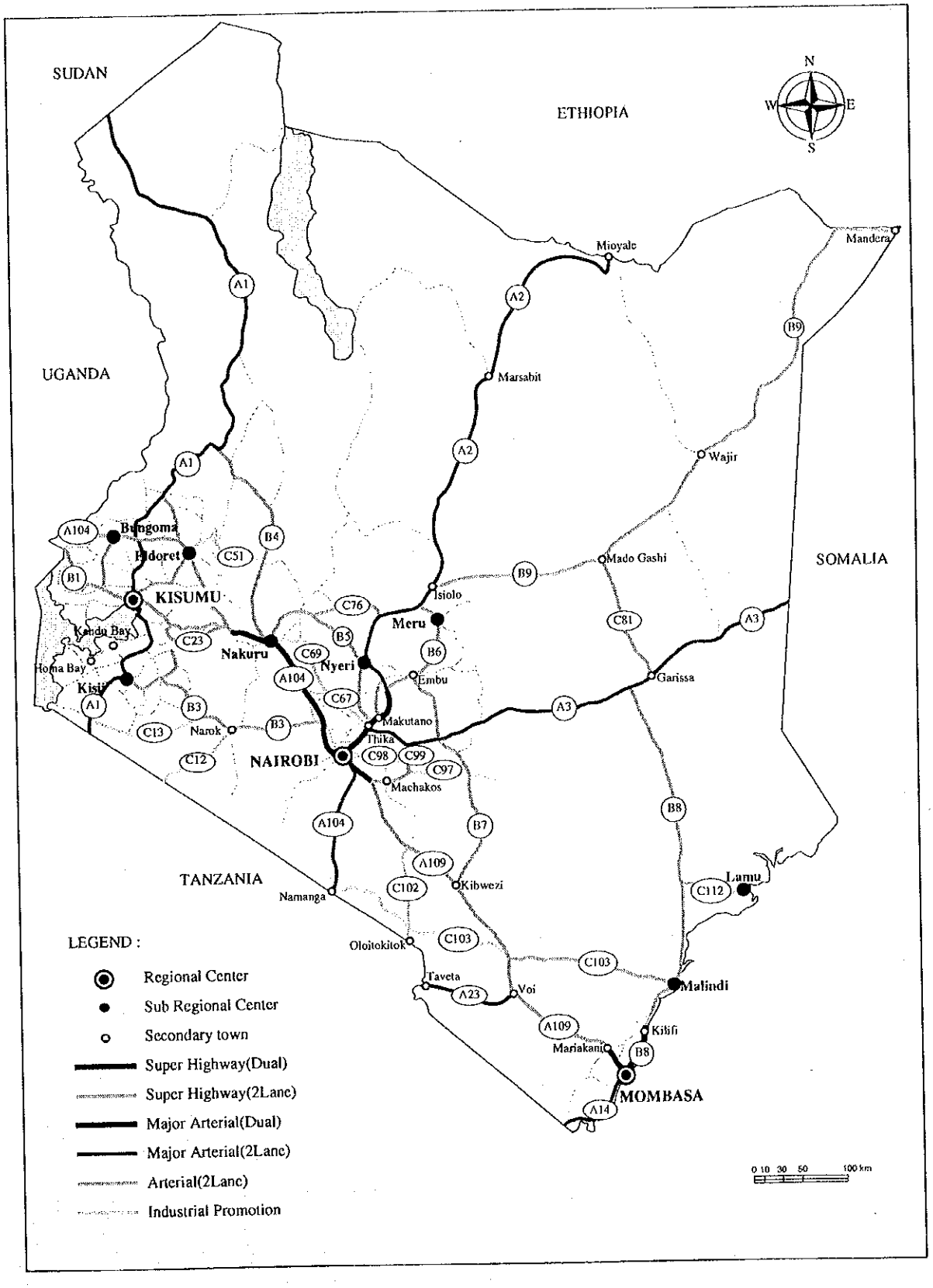


Figure 2.1 Integrated Future Road Network Plan

2.2 Future Socio-Economic Framework

2.2.1 National and Regional Profiles of Economic Structures

(1) Population Growth

The results of past population census in Kenya is presented in Figure 2.2, and it shows that the population grew from 8.6 million in 1962 to 21.4 million in 1989 at a rate of 3.40% per annum. The population growth in Kenya is relatively high compared to other African countries.

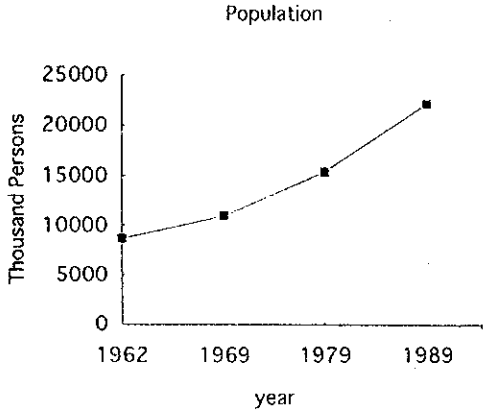


Figure 2.2 Population Growth in Kenya

From a regional viewpoint, Rift Valley Region of comparatively high rainfall exhibits a higher population growth rate of 4.7% p.a. Adversely, the North East Region adjoining to the neighboring countries presents a lower rate of the population growth.

(2) Employment Structure

A wage employment by industrial sector is presented in Figure 2.3. The total wage employment is divided almost even to both private and public sectors. The tertiary sector accounts for more than 60% of the total employment, and the remaining is allocated equally to the primary and secondary sectors. The total wage employment amounts only to 1.4 million, which is very low compared to the total population. This implies that there exists a significant number of such a self-employment as in the agricultural sector, which does not appear in the statistics.

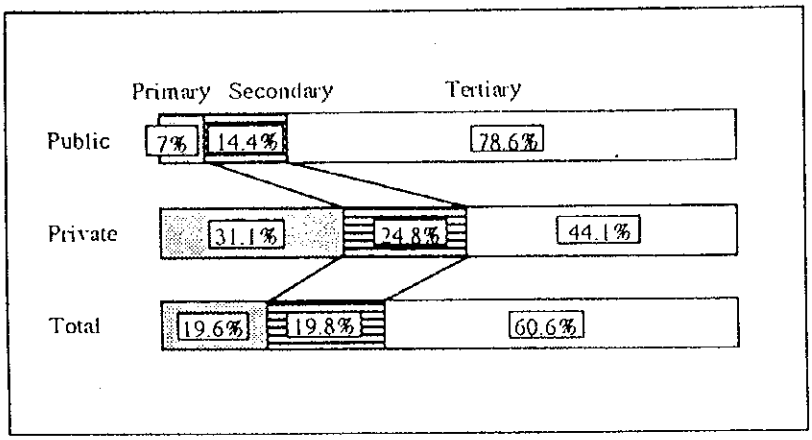


Figure 2.3 Wage Employment by Industrial Sector

The private sector dominates the primary and secondary industries at percentage shares of 83% and 65%, respectively, but the public sector dominates the tertiary industry, which includes a service sector, at a share of 62%.

(3) Gross Domestic Product (GDP)

Figure 2.4 presents a relationship between GDPs of industrial sectors and their growth rates, in which it is prominent that the agricultural sector accounts for a major portion of the GDP but it increases at a very low rate; and the manufacturing sector still remains immature.

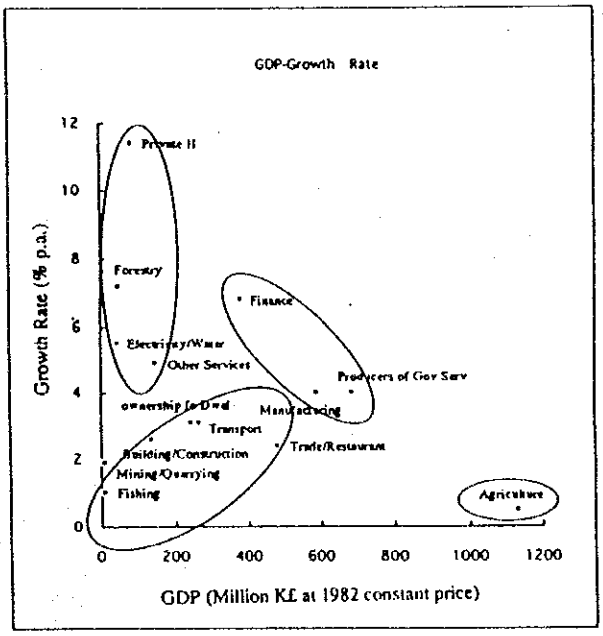


Figure 2.4 GDP by Industrial Sector

(4) Characteristics and Problems

During the last 30 years the population growth in Kenya keeps a high rate over 3.4% per annum, but a current GDP growth could only attain 3.1% p.a., which implies a decrease in per capita GDP and aggravation of living quality. A high share(26.0%) and low growth (0.5% p.a.) of agricultural sector characterize Kenya's economy and it eventually brings about a generally lower growth of the total economy. This is a typical feature of the economy in developing countries where the substantial economy relies much on the agricultural industry. Accordingly, a surplus population in the employment is inevitably absorbed by the Government Service sector of the tertiary industry.

The above phenomena is mainly caused by a poor status of the present manufacturing industry. The manufacturing industry, which is centered in the secondary sector, accounts for 13.6% and 13.2% of the GDP and the total wage employment, respectively. The manufacturing activity still maintains a large share in such primary and traditional export products as agro-industrial produces, where labor force exceeds the demand. A policy towards industrialization is a key to the economic development of Kenya.

2.2.2 Future Socio-Economic Framework

(1) Development Background

Since National independence in 1963, Kenya experienced several economic crises incurred by drastic rise and fall in coffee price, rises in oil prices that happened twice in the past and such a natural disaster as drought. Economic boom and recession have been repeated and this as a whole brought about unstable economic situation in Kenya. In order to cope with a shortage in the foreign exchange and the economic stagnation in the mid 1980's, the Government accepted the structural adjustment proposed jointly by IMF and IBRD. The adjustment policies agreed were summarized in the Sessional Paper No. 1 of 1986 on Economic Management for Renewed Growth. The paper suggests various privatization and liberalization policies, and among others, an economic growth over 5.0% per annum, which should overcome a high rate of population growth. The paper intends to attain the target of the economic growth by the year 2000.

(2) Basic Development Policy

The development theme of "Resource Mobilization for Sustainable Development" attempts to realize a balance between the progressive population growth and a

sustainable economic growth with a steady increase in per capita GDP. Under the above theme, the following six planning issues were identified:

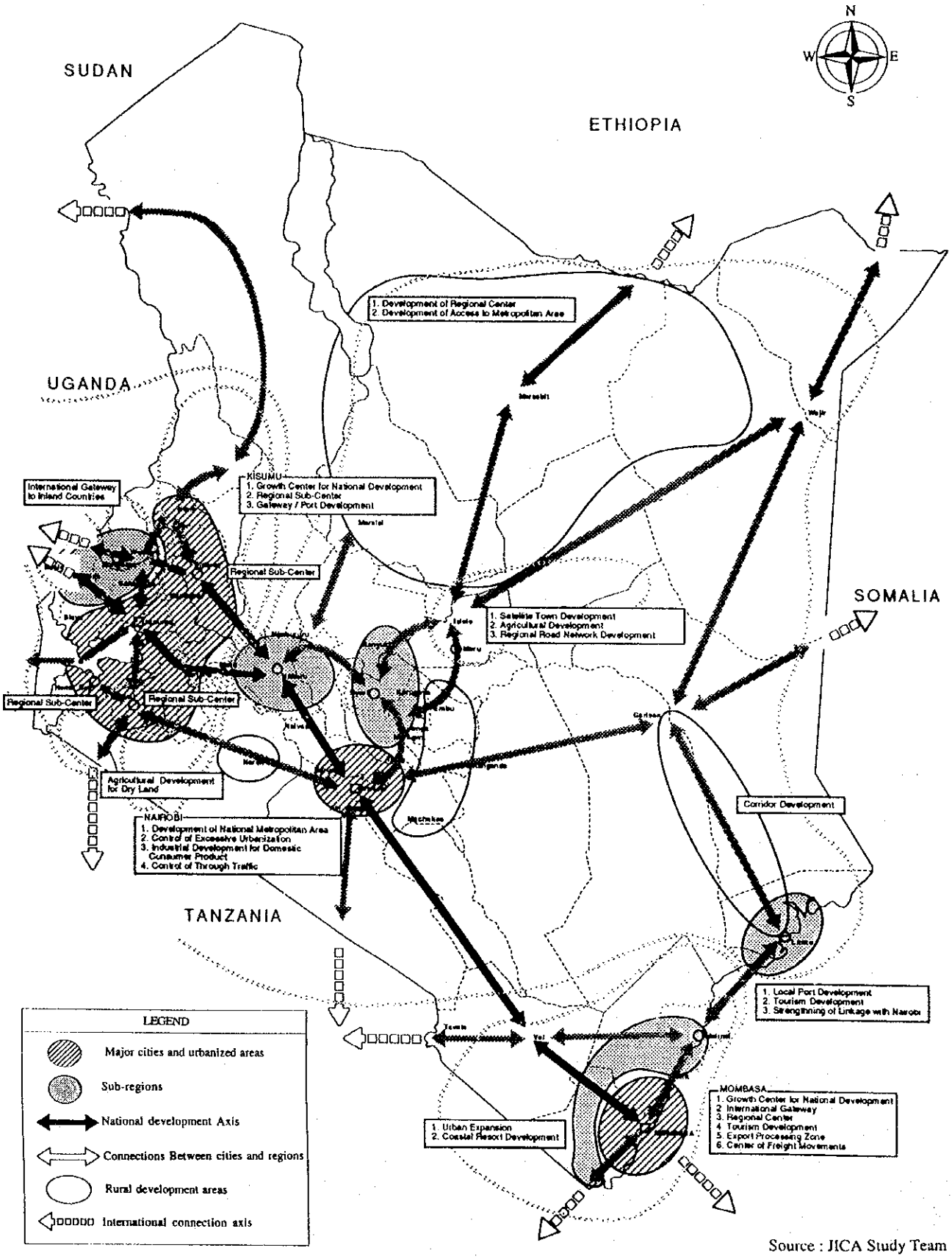
- Countermeasures towards progressive urbanization
- Improvement of regional unbalance
- Creation of greater job opportunities
- Increase in foreign exchange earnings
- Ensuring transport services
- Environmental conservation

The "Resource Mobilization" suggests to effectively utilize scarce resources for national development. The national development plans that are now available up-to 7th define growth centers in different names, and the development is planned to intensively take place in those centers.

Major regional development policies are presented in Figure 2.5 and the details are explained as follows:

a) A population growth in the Rift Valley Region has been remarkable in the past years. To attain the balance of regional development, dispersion of industrial development and human settlement should be promoted, and particularly the development be encouraged in the Coastal and Western Regions.

b) The Coastal Region centering around Mombasa should be developed to promote the export oriented manufacturing industry. The region as a consequence should grow as an industrial center of Kenya. Furthermore, Mombasa - Nairobi - Eldoret/Kisumu corridor should be designated as an industrial development axis to



Source : JICA Study Team

Figure 2.5 Development Concept of Road Network

foster a future urbanization and industrialization where employment opportunities be created.

c) The Central Region should be developed to strengthen metropolitan functions of Nairobi and to raise productivity of suburban farming and to contribute to attaining the self-sufficiency of foods.

d) Productivity of the existing agricultural activity should be improved in the Western Region.

e) Excessive urbanization and regional development unbalance should be avoided and a regional core city development be enhanced to realize effective capital investment.

(3) Future Socio-Economic Framework

A future socio-economic framework adopted in this Study is based on the projection made by the Ministry of Planning and National Development, which incorporates various policies of the structural adjustment program, and its values are presented in Table 2.4.

Table 2.4 Future Socio-Economic Framework

Socio Economic Parmeter			1994	2000	2005	2010
Population (x1000)			25,501	29,706	33,305	36,898
	Urban Population	(%)	(19.78)	(23.37)	(26.82)	(30.45)
		(x1000)	5,045	6,941	8,933	11,235
	Regional Population	(x1000)	20,456	22,765	24,732	25,663
GDP* (Mil.K£)	Non-Monetary		245.8	320.4	394.6	460.5
	Monetary		4,235.7	5884.3	7,860.2	10,306.1
		Agriculture	1,204.6	1,621.6	2,018.8	2,411.6
		Manufacturing	617.8	856.6	1,169.1	1,641.2
		Services	1,707.0	2,494.8	3,479.2	4,739.8
		Government	704.7	908.8	1,191.2	1,513.0
	Total		4,479.9	6,202.0	8,252.9	10,766.2
GDP* Per Capita	(K£)		175.7	208.8	247.8	291.8
	Growth Rate(%p.a.)			3.05	3.48	3.32

*At 1982 Constant Price

2.3 Transport Sector: Present Characteristics and Future Road Network Concept

2.3.1 Present Characteristics of Transport Modes and Traffic

(1) Transport Modes

1) Railway

The Kenyan railway was constructed to transport agricultural products from Ugandan to Mombasa which covers 1083 km in length and constitutes a backbone of the existing railway network. The total length to include branches extends to 2740 km. Existing railway facilities are generally deteriorated and need to be replaced.

The railway provides services dominantly for freight transport but little for passenger transport. A total freight volume transported in 1990 was 3.5 million tons which mainly includes cement, oil, grains and containers. A recent transport volume is decreasing to 2.8 million tons in 1992, which is considered attributable to various advantages of road transport.

2) Roadway

a) Road Facility

A total road length that MOPWH is responsible to manage extends about 63,000 km, in which Class A, B and C roads, to be covered by this Study, total 14,400 km and they account for 23% of the total MOPWH roads.

Pavement ratios of the Class A, B and C roads are summarized in Figure 2.6, and the Class A road is totally paved except for the arid northeast region.

The Class B road has a function to supplement the Class A road, but it is not always paved in such an important region as Highland Area, though needless to mention in the remote area. As a whole, the pavement ratio of Class B road is considered low, despite its importance in its location and function.

Besides areas around major cities, the Class C road is scattered throughout the country. The road function is to supplement other road functions and to mainly provide access function with areas. The existing pavement ratio of this road class shows low.

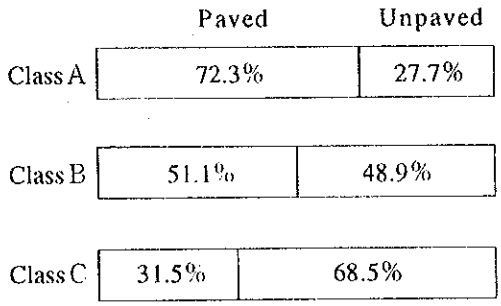


Figure 2.6 Pavement Ratios by Road Class

b) Comparison with Rail Transport

The comparison between railway and roadway was made for freight and passenger transport as shown in Figure 2.7, in which superiority of the road transport prevails.

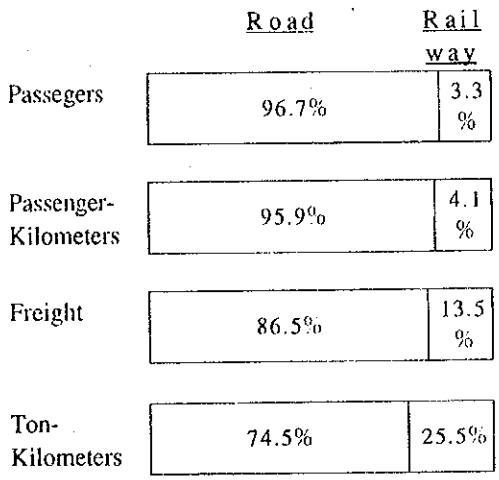


Figure 2.7 Comparison of Transport Shares between Railway and Road

3) Maritime Transport

Mombasa Port is a principal deep sea port in the East Africa furnished with 16 berths including oil and container berths. A total freight throughput at the port was 7.9 million tons in 1990 as presented in Figure 2.8, and it shows a slight increasing trend as a whole. A breakdown of the port throughput is that an oil

import amounts to 3 million tons, which accounts for 38% of the total throughput(refer to Figure 2.8), and a container handled amounts to 136,000 TEU, which means an average annual increase of 5% in the last 5 years. Recently, the capacity of the present port facility hampers the growth of freight throughput.

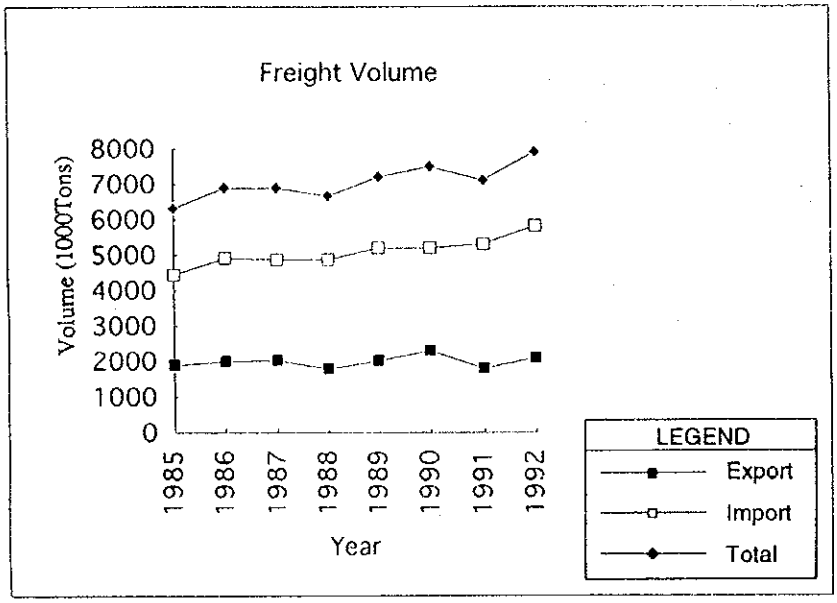


Figure 2.8 Freight Throughput at Mombasa Port

4) Pipeline Transport

The pipeline transport service has been operational between Mombasa and Nairobi, and it was extended quite recently from Nairobi to both Eldoret and Kisumu directions to mainly transport oil products from Mombasa to the country's inland area. The competitive oil transport market reveals that the pipeline dominates the market along the above mentioned transport corridor, that is, transport shares of the pipeline, railway and road are 76%, 16% and 8%, respectively.

5) Tourism Traffic

Figure 2.9 shows a number of the tourist arrival in Kenya. In 1990 the number of tourist arrival reached a peak volume of 814,000, and the recent volume falls between 700,000 and 800,000. The average length of stay ranges from one week to 10 days, and the total number of tourists who stayed in Kenya averages 5.5 to 6.5 million persons per year. The number of visitors to major tourism facilities, primarily in national parks in Nairobi and adjacent areas, Amboseli, Masai Mara, and Mombasa area amounts to 1,367 thousand persons per annum.

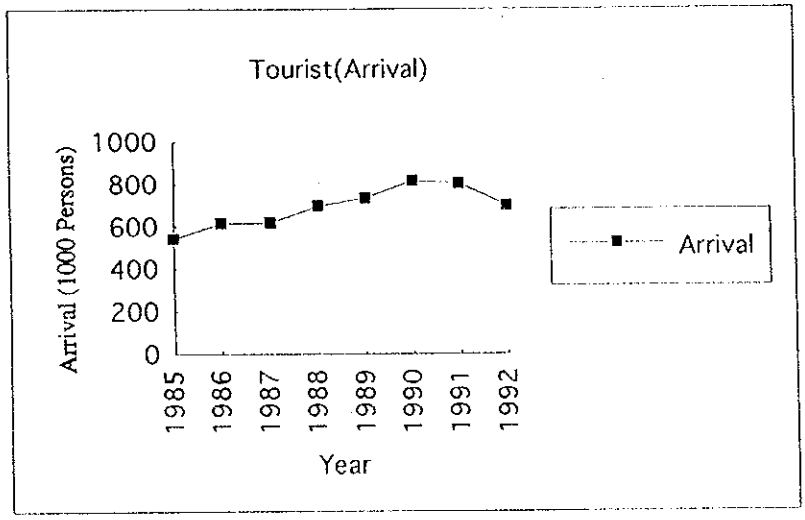


Figure 2.9 The Number of Tourist Arrivals in Kenya

(2) Road Traffic

1) Vehicle Traffic Volume on Major Road

According to the survey results of the MOPWH, the traffic is concentrated into Nairobi, Mombasa and their surrounding areas, and also to major arterial roads between Nairobi and the Western Region of Kenya.

2) Distribution Pattern of Vehicular Traffic

The O-D (Origin - Destination) pattern of vehicular traffic is compared between 1983 and 1994 in terms of PCU (Passenger Car Unit) as presented in Figure 2.10. The comparison exhibits that the vehicular movement is generally expanded, and the increase of inter-regional movements is noticeable, among others, along Nakuru - Nairobi - Mombasa corridor and a coastal corridor extending north and south from Mombasa.

3) Freight Movement

The freight movement along Uganda - Nakuru - Nairobi - Mombasa corridor is outstanding as shown in Figure 2.11. The vehicular freight concentrating into Nairobi and Mombasa accounts for about 19% and 18% of the total freight movement in Kenya respectively.

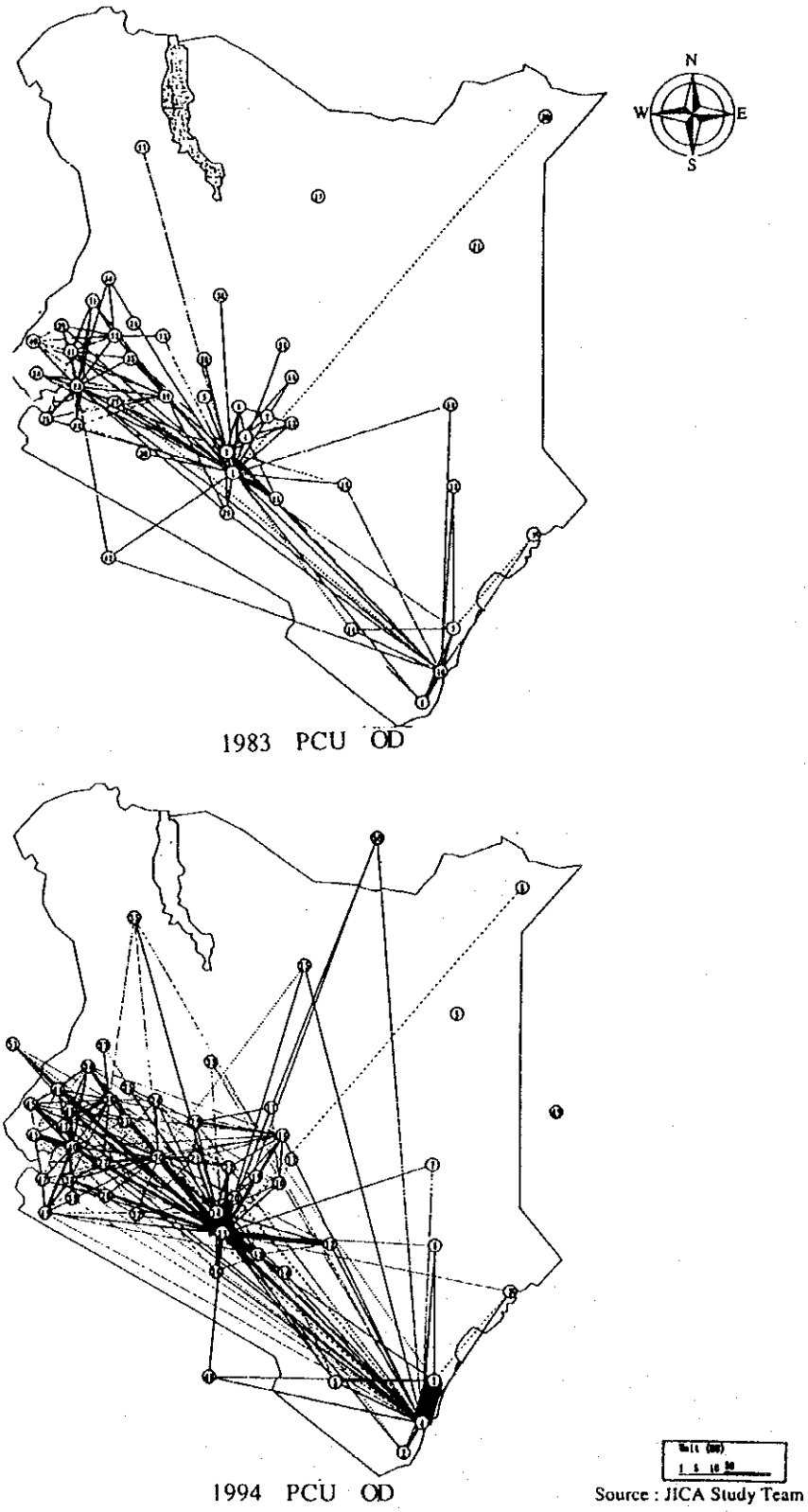


Figure 2.10 Comparison of Traffic Distribution (OD) Patterns in 1983 and 1994

The traffic concentration to Mombasa is caused by such reasons that the country's import and export commodities are handled mostly at Mombasa port, and also Mombasa surroundings are a semi-arid area where the self-sufficiency of foods is so poor as to depend on other regions for its supply.

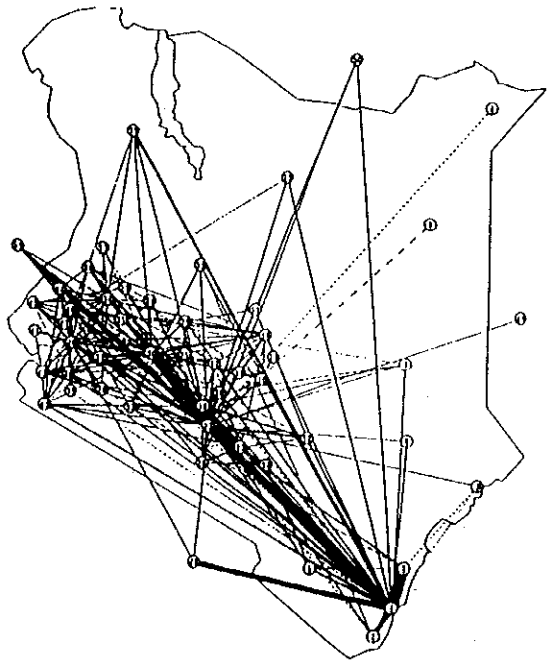


Figure 2.11 Distribution Pattern of Vehicular Freight in 1994

2.3.2 Evaluation of Existing Road Network

(1) Existing Road Facilities

1) Geometry

Existing roads in Kenya have little problems, except for some limited sections, of horizontal and longitudinal alignments that conform to the present geometric design standard in Kenya.

2) Cross Section

There exist many road sections that a little bit lack in a width of the carriage way and the shoulder. Road sections that can satisfy the design standard is rather limited, but in most of cases the shortage of those widths ranges only from 0.5 to 1.0 meter. Actually, a lack of the cross section width is not a major problem at present that cause a degradation of road capacity.

3) Traffic Congestion

Besides city roads, a road section to exceed the congestion ratio 1.0 is not found at present. Roads with large traffic volumes, such as Nairobi - Limuru and Nairobi - Thika sections, were already widened to 4-lane roads.

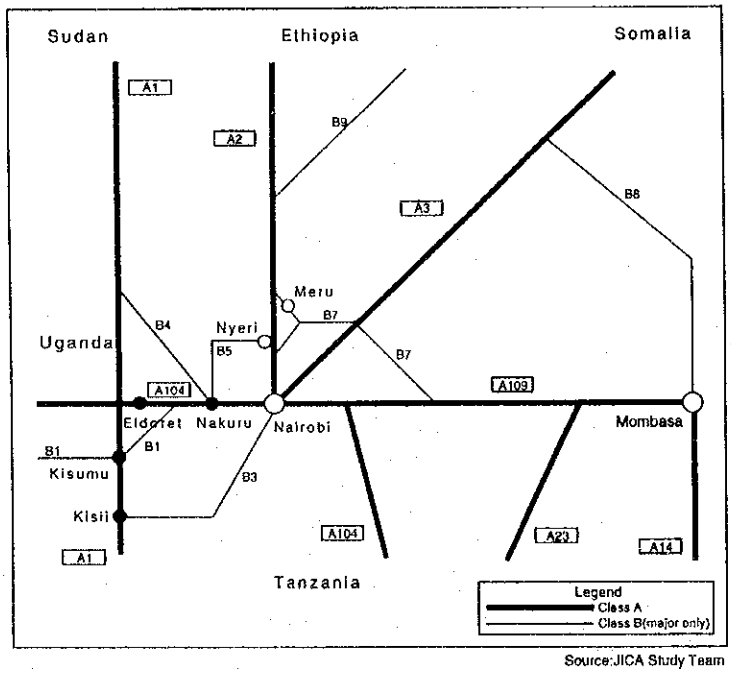
4) Surface Conditions of Paved Roads

Of the total length of Class A, B and C roads, 46% is the paved road and the remaining 54 % is either earth or gravel roads. The surface condition of the paved road is generally bad to indicate an IRI (International Roughness Index) over 8.0. Many of the paved roads await the rehabilitation or reconstruction.

(2) Road Network

1) Network and Traffic Distribution Pattern

Principal modes of the inland transport are roads and railways in Kenya, and the road shares dominant in both passenger and freight transport markets. The road network in Kenya is presented in Figure 2.12, and which is characterized relatively simple by such major constituents as a backbone route of Mombasa - Nairobi - Uganda, the Class A roads (International Trunk Road) extending from the backbone route to the neighboring countries, and major Class B roads that supplement the Class A roads.



Source:JICA Study Team

Figure 2.12 Present Major Road Network Pattern

Figure 2.13 presents a traffic territory defined by the analysis result of the traffic distribution pattern. The diagram shows that Nairobi, Mombasa and Kisumu are the major transport centers to cover the respective traffic territories, and in which Eldoret, Nakuru, Nyeri, Meru and Embu form sub-territories or sometimes they function independently as regional centers to seek communications with other territories. Since the identified traffic territories can aggregate to some major ones it is relatively easy to figure out the gap between the existing network and a potential traffic demand. As a consequence, it was concluded that the present network is sufficient, though simple, to cope with the potential traffic distribution pattern.

2) Regional Traffic Problems

Traffic problems identical to different regions can be summarized as follows:

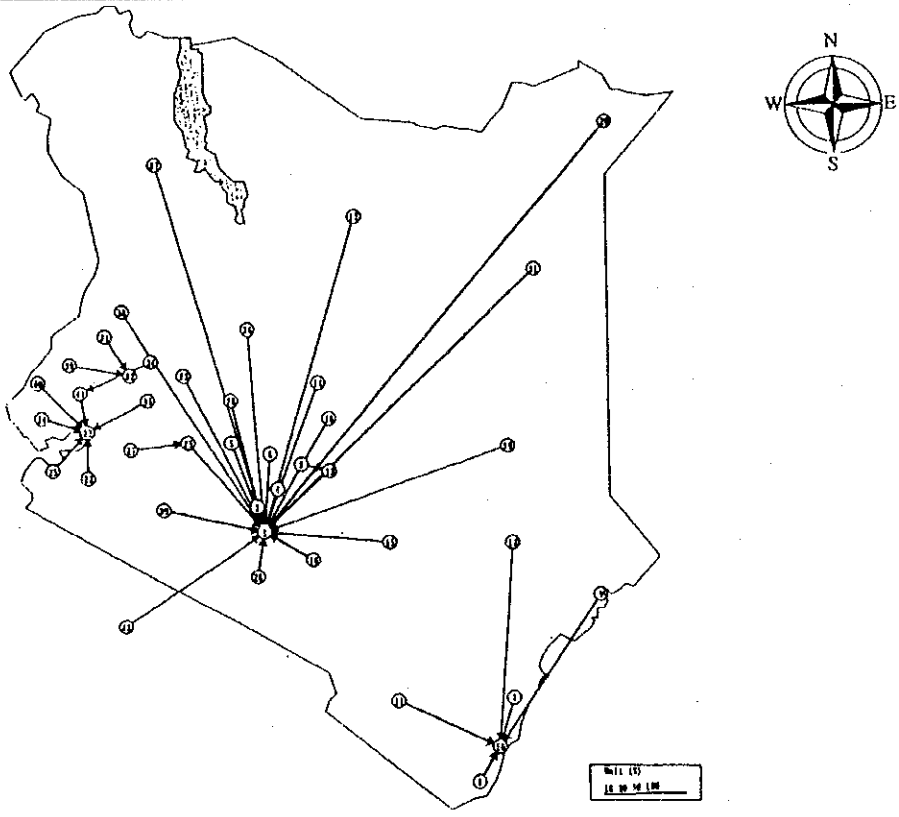
- The Western Region is a developed area, so that the road network is well distributed to correspond to the demand. There are little problem in the network pattern, though some sections still remain unpaved.

- In the Central Region located between Nairobi and Mt. Kenya is a farm land of high productivity, and where mountain ridges lie in the east-west direction to inevitably develop roads in the same direction. Accordingly, a connection between C70 and C64 that links directly Nyeri and Kiambu (Nairobi) is missing at present. (A missing link in terms of inter-regional connection is discussed in section 2.3.4 (4))

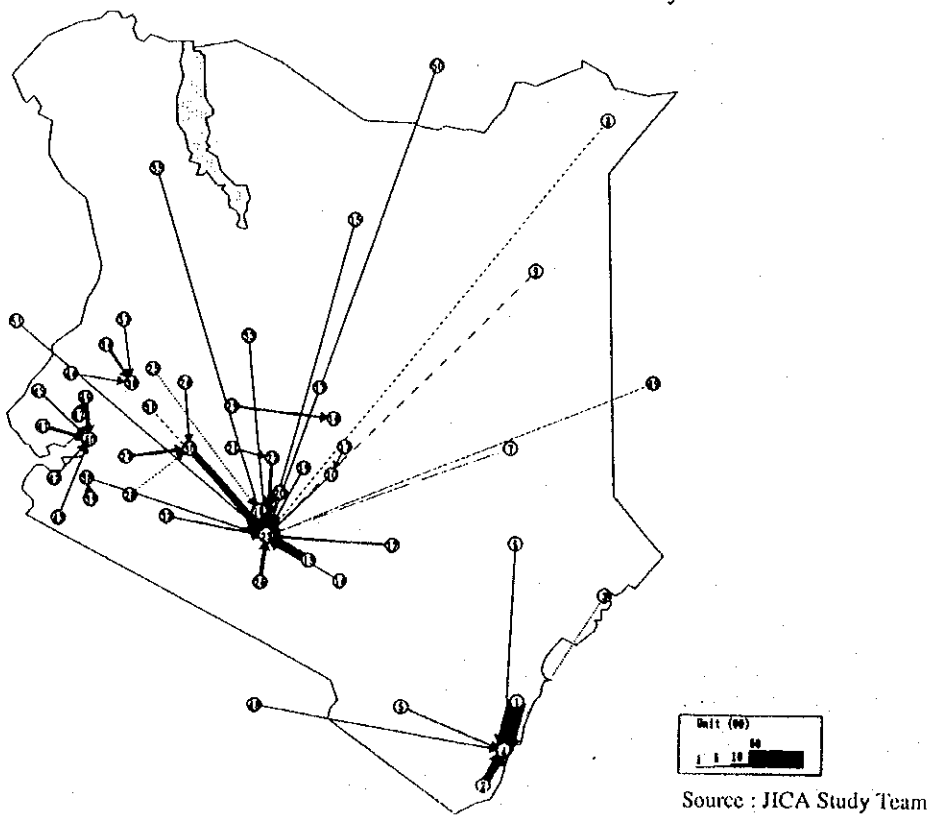
- In the Coastal Region, the road network is comprised of a spine route of A18 and B8 roads, and access roads to this route are developed in the region. The network has no particular problems in its configuration.

(3) Environmental Viewpoints

The Ministry of Environment & Natural Resources lists several environmental complaints caused by road projects. According to this list, a case is introduced, aside from dust and fumes from asphalt mixing, that separation of community was brought about by the wall built along the median of the dual carriage way near Nairobi. Furthermore, the list introduces such problems as the disturbance of migratory routes and habitat of wildlife, collisions between vehicles and wildlife, and discharge of accumulated water into agricultural land causing soil erosion and loss.



1983 Traffic Territory



Source : JICA Study Team

1994 Traffic Territory

Figure 2.13 Comparison of Traffic Territories in 1983 and 1994

Since there have been few projects of the new road construction in Kenya the environmental consideration should not be confined to the past experience in Kenya but explore potential problems more extensively.

2.3.3 Future Traffic Demand

(1) Estimated Future Traffic Demand by Vehicle Type

Based on the future socio-economic framework established in section 2.2.2, a future traffic demand was estimated by respective vehicle types as presented in Table 2.5.

Table 2.5 Future Traffic Demand by Vehicle Type (Inter-zonal)

Vehicle Type	2013 Vehicle Trips/Day		1994 Vehicle Trip/Day	
	Number	Share (%)	Number	Share (%)
Car	57,919	34.4	20,345	33.4
Motor Cycle	2,913	1.7	1,040	1.7
Light Goods	45,761	27.2	16,346	26.8
Medium Goods	13,724	8.1	5,011	8.2
Heavy Goods	8,123	4.8	2,973	4.9
Tanker	8,649	5.1	1,583	2.6
Buses	6,835	4.1	1,663	2.7
Matatu	24,599	14.6	11,925	19.6
Total	168,523	100.0	60,886	100.0

(2) Method and Results

The future traffic demand was estimated to follow the steps summarized in Table 2.6 and Figure 2.14. The estimated traffic volume is presented as a diagram in Figure 2.15.

Table 2.6 Methodological Steps for Traffic Demand Forecast

Work Step	Major Work
Step 1	Establishment of road network and socio-economic framework
Step 2	Model building for zonal trip production/attraction
Step 3	Estimation of zonal trip production/attraction based on zonal breakdown of socio-economic framework, and calibration of distributed traffic (O-D table)
Step 4.	Assignment of the O-D traffic to road network to estimate traffic volumes on road links

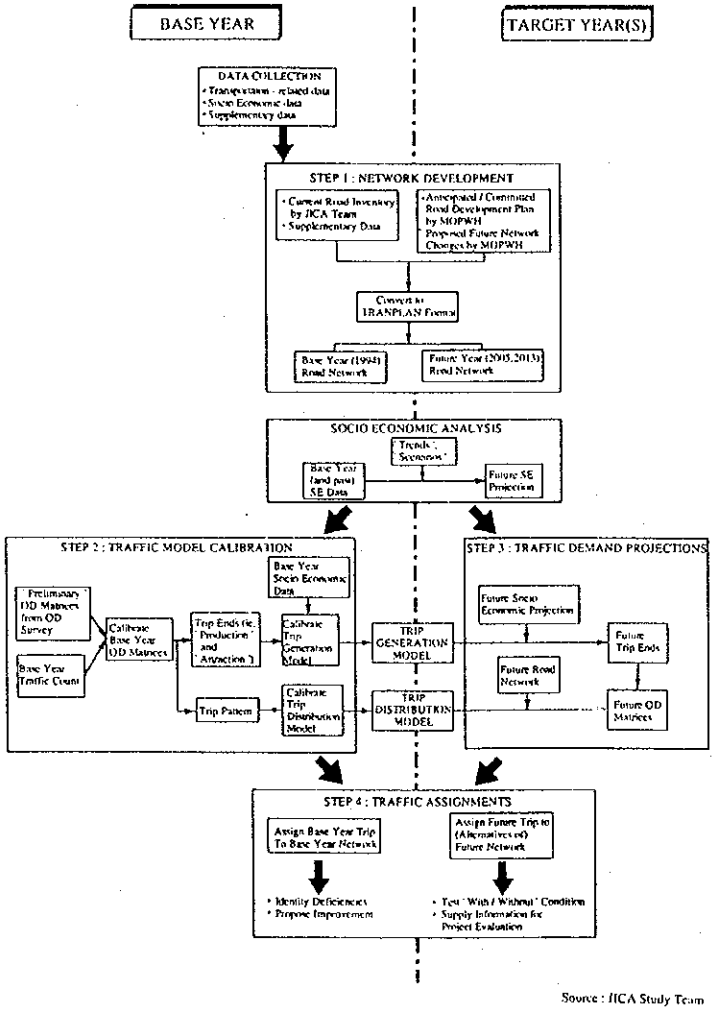


Figure 2.14 Overview of Simulation of Road Transport Model

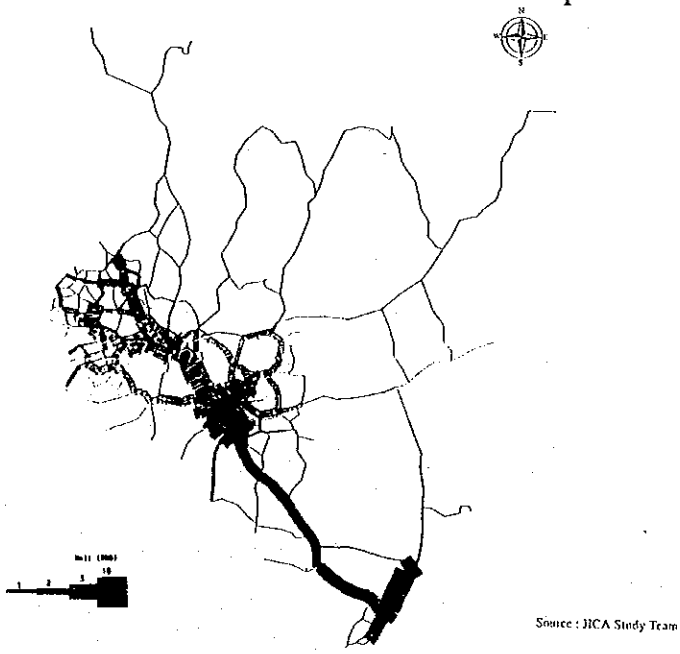


Figure 2.15 Estimated Future Traffic Volume in 2013

2.3.4 Development Policy for Future Road Network

(1) Basic Policy

A basic policy of the road development was established to conform with the national and regional development policies as presented in Figure 2.16.

National and regional development policies have been examined to deal with problems caused by high population growth and to attain continuous economic growth. Furthermore the road network development policy was consolidated by examining how to support the national and regional developments.

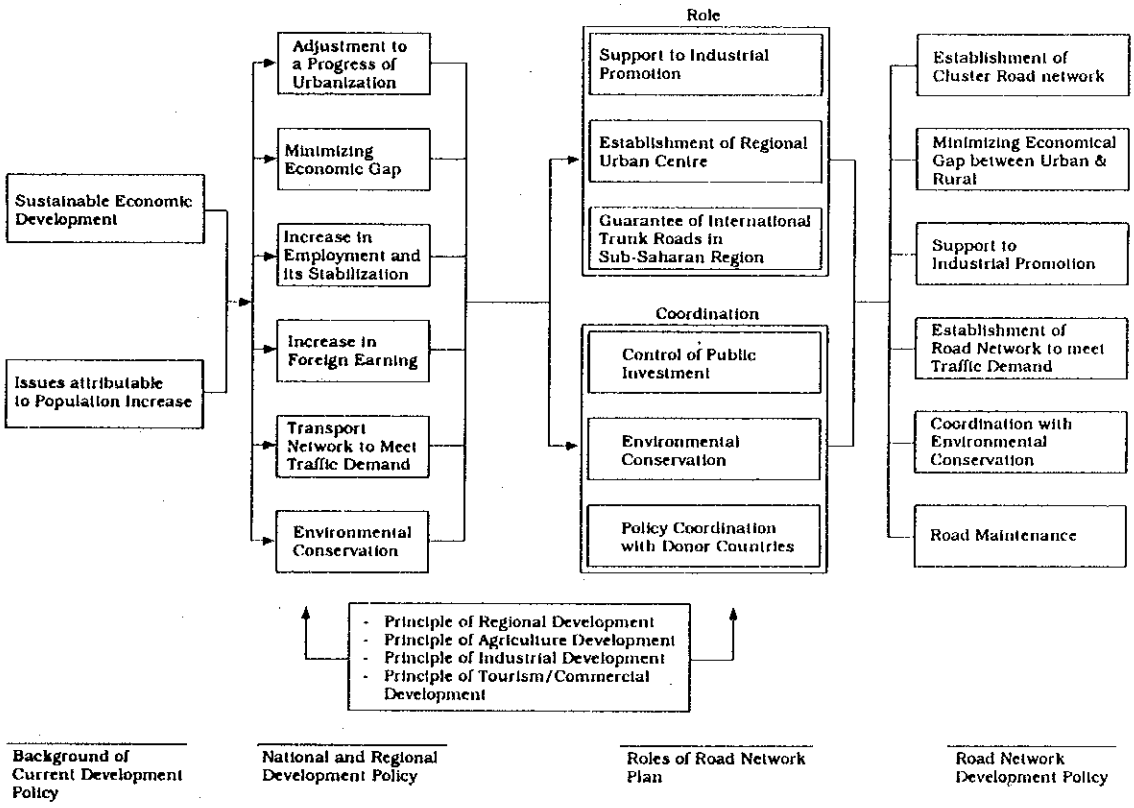


Figure 2.16 Socio-Economic Development Issues and Road Development Policies

To be more concrete, development issues on both national and regional levels can be summarized to include the social and economic adjustment to cope with the prospective urbanization, minimization of regional economic gap, promotion of employment opportunity, increase of foreign exchange earnings, development of

transport facilities, and environmental conservation. Road development policies compatible with these socio-economic issues will be summarized as follows:

1) Establishment of Cluster Road Network

In order to realize an optimal investment choice within the insufficient budget it is imperative to select either cities or regions where the investment should be made intensively. This policy requires to develop an ordering system of regions or cities, and a cluster road network is suitable to foster the regional/city orders.

2) Improvement of Regional Gap in Economy and Support to Industrial Promotion

To improve economic imbalance between urban and rural regions and to support the promotion of industrial development, the following policies will be proposed :

- Support to Agricultural Development

In the national development context, a priority should be given to the agricultural industry to provide a growing population with foods by self-sufficiency. From this viewpoint, a development priority of roads should be determined.

- Strengthening of Manufacturing Industry

It is indispensable for a stable economic growth, in a long term, to further promote the existing manufacturing industry. This, as a consequence, will ensure increasing job opportunities in future. The road network, therefore, should be prepared to support such strengthening policy of the manufacturing industry.

- Support to Tourism Development

The tourism industry in Kenya is an essential industry to earn foreign exchanges. A road development policy should be formed to support the expansion of potential tourism resources and markets.

- Accommodation to Traffic Demand

A road facility should be developed to accommodate the traffic demand. Besides the necessity to clarify road functions, a 4-lane widening will be also required where the appropriate traffic demand exists. Further, the improvement of the pavement structure will be required corresponding to the traffic volume.

- Environmental Conservation

It is imperative to preserve local or tribal communities, and also to conserve such natural resources as fauna and flora.

(2) Classification of Road Functions

1) Necessity of Functional Road Classification

Existing road classifications by MOPWH are based on a level of transport linkage such as the connection with neighboring countries and access to major cities. From the viewpoint of road network planning, it is essential for the road classification to quantify such indicative features as traffic characteristics and urban influence areas that are closely related to the formulation of the cluster road network.

Before going further, it should be noted that the road classification proposed here does not intend to change the existing road classification, but it is only used as an analysis tool to study the necessity of the road development.

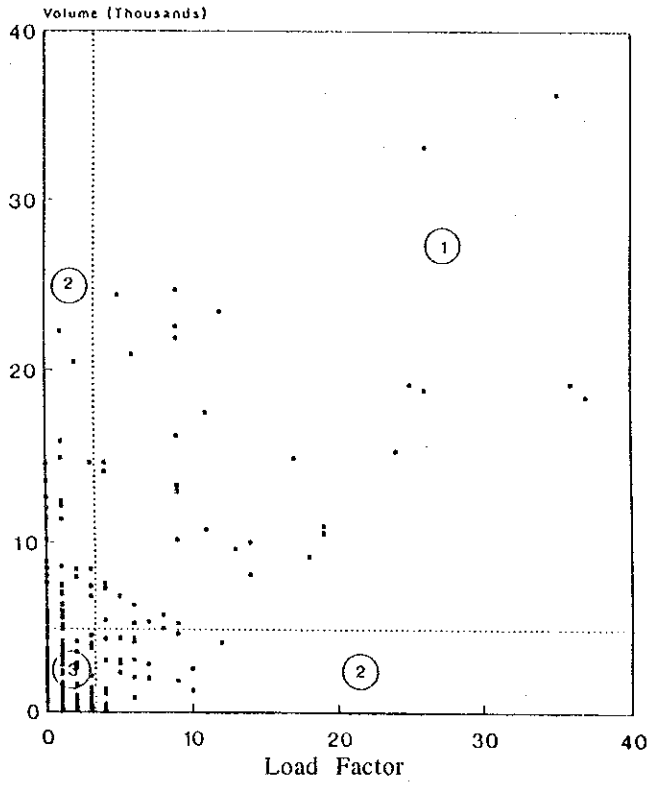
2) Classification and Study Method

Road functions will be categorized in three classes and their definitions are described in Table 2.7. As a consequence of the study the road network is functionally defined as shown in Figure 2.17.

Table 2.7 Classification of Road Functions

Class	Function	Major Criteria
Major Arterial Road	International trunk roads and roads to connect with regional centers each other	Traffic volume is more than 5000 pcu/day, and City-Pair Load Factor* is more than 3.
Arterial Road	Roads to connect with regional sub-centers each other or with regional centers, and to supplement/ substitute for Major Arterial Road	Either traffic volume is more than 5000 pcu/day or City-Pair Load Factor is more than 3.
Minor Arterial Road	Roads to connect with local centers each other or with sub-regional centers, and to provide access to upper class roads	Traffic volume is not more than 5000 pcu/day , and City-Pair Load Factor is not more than 3.

Note*: The number of accesses counted on a specific road section when approaching various regional centers.



Note: (1) to (3) corresponds to road function classified in Table 2.7.

Figure 2.17 Classification of Road Network by Function

(3) Solicitude for Environment Problems

Since a new road construction has not been executed recently environmental problems caused by the existence of roads are mainly prevailing. The environmental issues to be considered in the road planning include soil erosion, deforestation, deserting, conservation of wildlife and other environmental pollution along roads. The road planning should clarify whether a control measure or a counter measure be taken to these issues.

(4) Proposed Future Road Network

1) Super Highway

Characteristics of the road network configuration and traffic movements indicate a substantial importance of the Mombasa - Nairobi - Uganda corridor as a spine of the road network in Kenya. Industrialization is a key in a long term economic run

the road network in Kenya. Industrialization is a key in a long term economic run to stabilize the economic development and to cope with the progressive urbanization pressure. Many of the large scale manufactures are located along this corridor, and the number will further increase in future.

The Mombasa - Nairobi - Uganda corridor is so vital to the Kenya's future economy that the route should be developed as a "Super Highway" with higher design standards to assure a high speed, safe and comfortable transport services.

The Super Highway will have the following facilities:

- Widening to dual carriage way

Widening will be required to cope with a future traffic demand on such road sections as:

• Machakos - Nakuru(A104);• Mombasa - Mariakani (A109)

- Access Control Facility

A full access control facility should be provided at intersections between the 4-lane Super Highway (the dual carriage way sections proposed above and the existing dual carriage way section between Nairobi - Limuru) and major roads inclusive of Class A, B and C roads.

Intersections with other roads should be provided with exclusive right and left turn lanes.

- Ancillary Facilities

Provision of service facilities and its operation by private sector should be considered to cover such facilities as parking area, gas station and restaurant.

Lighting facilities should also be provided in the vicinity of cities.

2) Widening to 4-lane Arterial Roads

Other than the Super Highway and the existing 4-lane road section between Nairobi and Makutano(A2), arterial roads that require the widening from the existing 2-lane to the 4-lane roads are as follows:

• A104 - Londiani (B1)

- Mombasa - Kilifi (B8)
- Makutano - B6 (A2)

3) Missing Link/Alternative Route

- Inter-regional Network

Desired traffic lines superimposed on the existing road network indicate macroscopic missing links of such inter-regional connections as shown in Figure 2.18 :

- A : Mombasa - Marsabit/Samburu
- B : Nairobi - Lamu
- C : Garissa - Mado Gashi

To cope with these missing connections, it is not recommended to construct new roads, but to improve their adjacent roads.

- Local Network

There exists a missing link from the viewpoint of local network in the suburban agricultural area near Nairobi, that is a road section between C70 and C64. A local network in this section should be constructed to support the development of the surrounding agricultural land.

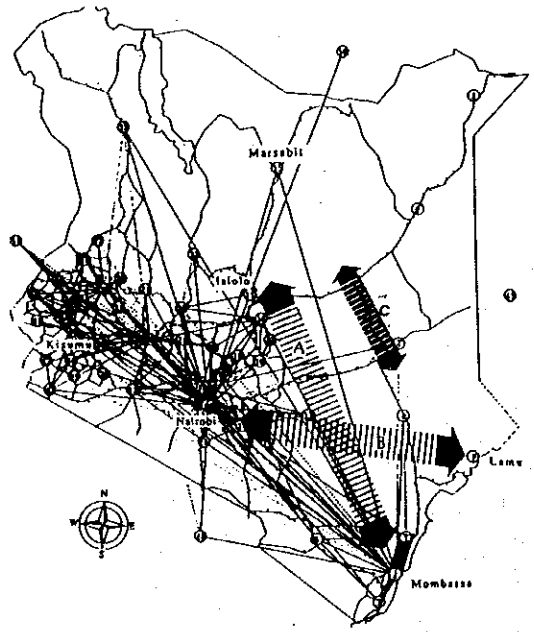


Figure 2.18 Inter-regional Missing Links

4) Development of Bypass Roads

Although the scope of the Study does not include the urban transport problems it is imperative to stress the necessity of bypasses not only to cope with the growing urban traffic problems but also to ensure the mobility of through traffic.

Based on the relationship between urban population and traffic volume, Figure 2.19 was drawn, and three cities, Nairobi, Mombasa and Nakuru, were selected as high potential areas to require bypasses.

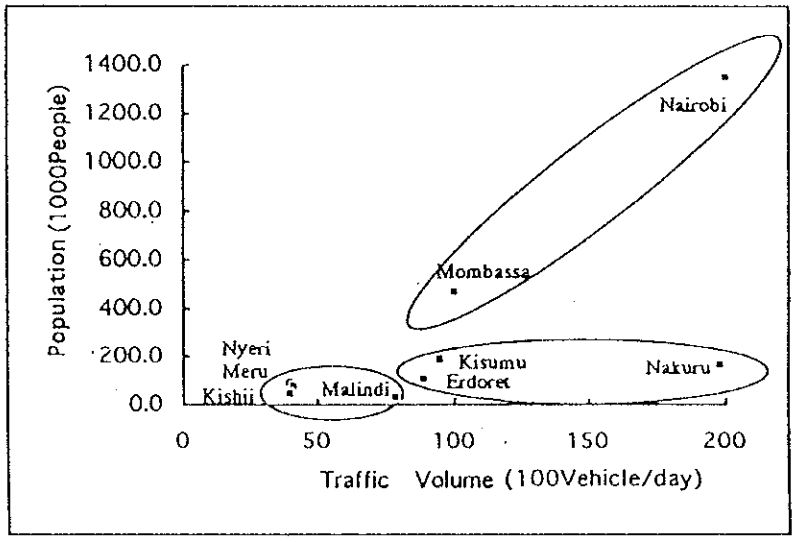


Figure 2.19 Urban Population and Traffic Volume in Major Cities

5) Support to Industrial Activities

- Agricultural Development

The development emphasis since before has been put on the agricultural industry in Kenya, and most of the potential land were already cultivated. The population will keep growing in future to demand more and more foods. Therefore, the road development should help to support not only the improvement of the existing agricultural land but also pursuing the agricultural development in a suitable Semi-arid area. In this accord, it is recommended to develop arterial roads and related necessary road network in the following areas:

- Machakos, Kitui and their surrounding areas
- The area encompassed by Kiambu, Nyeri and Nakuru

- Narok and its surrounding area

- Tourism Development

In order to assure the access to potential as well as existing tourism resources road sections tabulated in Table 2.8 should be improved.

Table 2.8 Important Road Accesses for Tourism Development Promotion

Road Section	Route No.	Particulars
Lamu - Nairobi	C112, B8, A3	Support to the tourism development in Lamu, and a formation of the tourist course.
Narok - Masai Mara	B3, C11, C12, C13	Assurance of the access to Masai Mara
Tsavo - Amboseli - Namanga /Emali	C103, C102	Assurance of the access to Amboseli
Voi - Taveta	A23	Formation of the international tourist course involving Tanzania

- Manufacturing Development

The Mombasa - Nairobi - Kisumu/Eldoret - Uganda Corridor is a key to support the manufacturing development in Kenya (refer to the previous section of Super Highway plan)

6) Recommended Future Road Network Plan

Aggregating all the factors discussed previously, a future road network plan was formulated as exhibited in Figures.2.20 and 2.21. Figure 2.20 shows the expected functions of road sections as a background necessity for road network development. Based on the background necessity, road functions, which is determined by order of cities in urban hierarchy and traffic demand such as major arterial roads, arterial roads, supplementary arterial roads are indicated as a future road network in Figure 2.21.

2.3.5 Road Maintenance and Management Plan

(1) Existing Problems

The evaluation result of existing roads by IRI (International Roughness Index) suggests the necessity to improve considerable amount of the roads immediately. This implies that the present roads were poorly constructed in the structural point of view or the road maintenance has been poorly conducted in the past time.

Regarding to the road maintenance and management, the shortage of funds and skilled labor are often pointed out.

(2) Present Movement

Currently, the Third Highway Project is under execution, and the improvement of Mombasa road, minor road repair and other road projects have been either

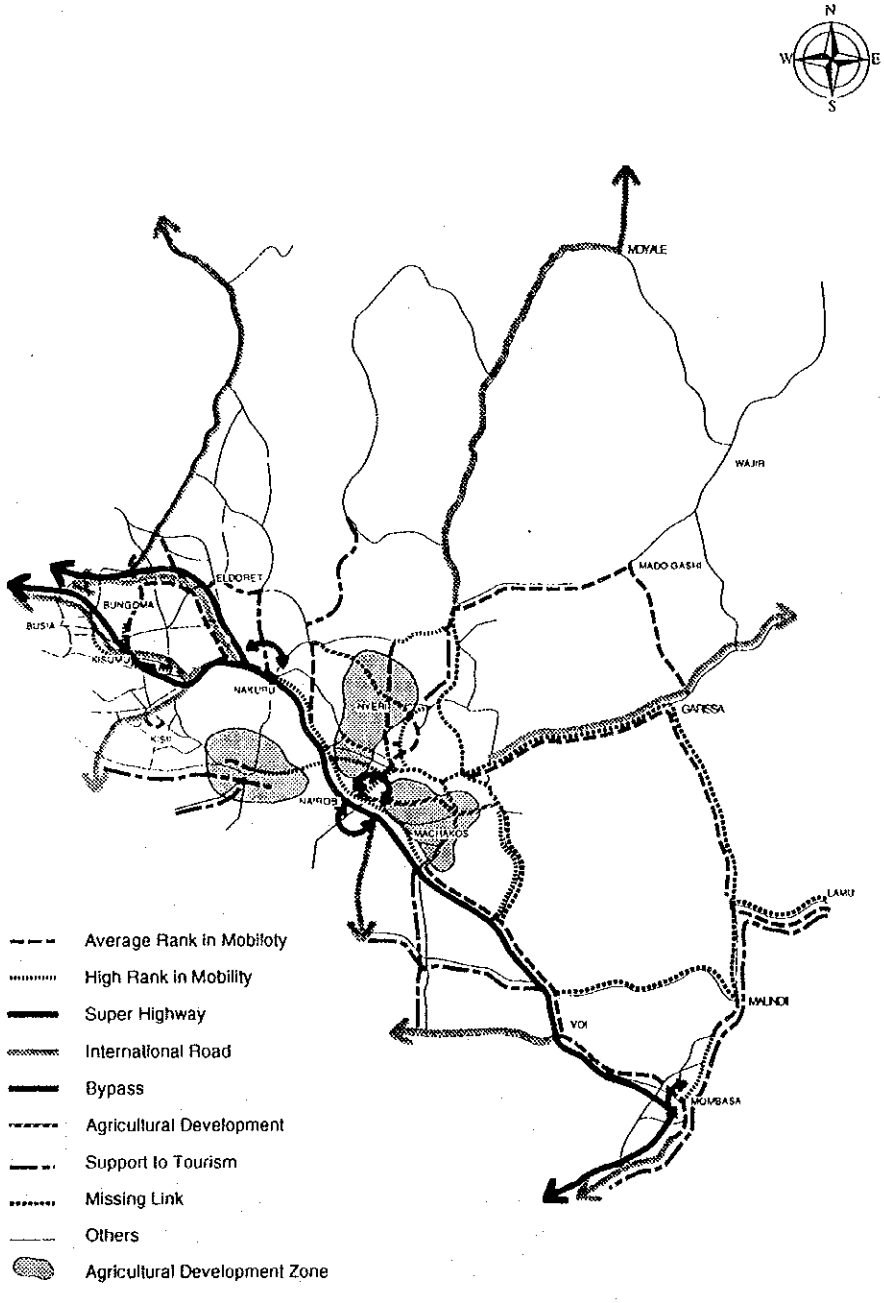


Figure 2.20 Background Necessity for Road Network Development

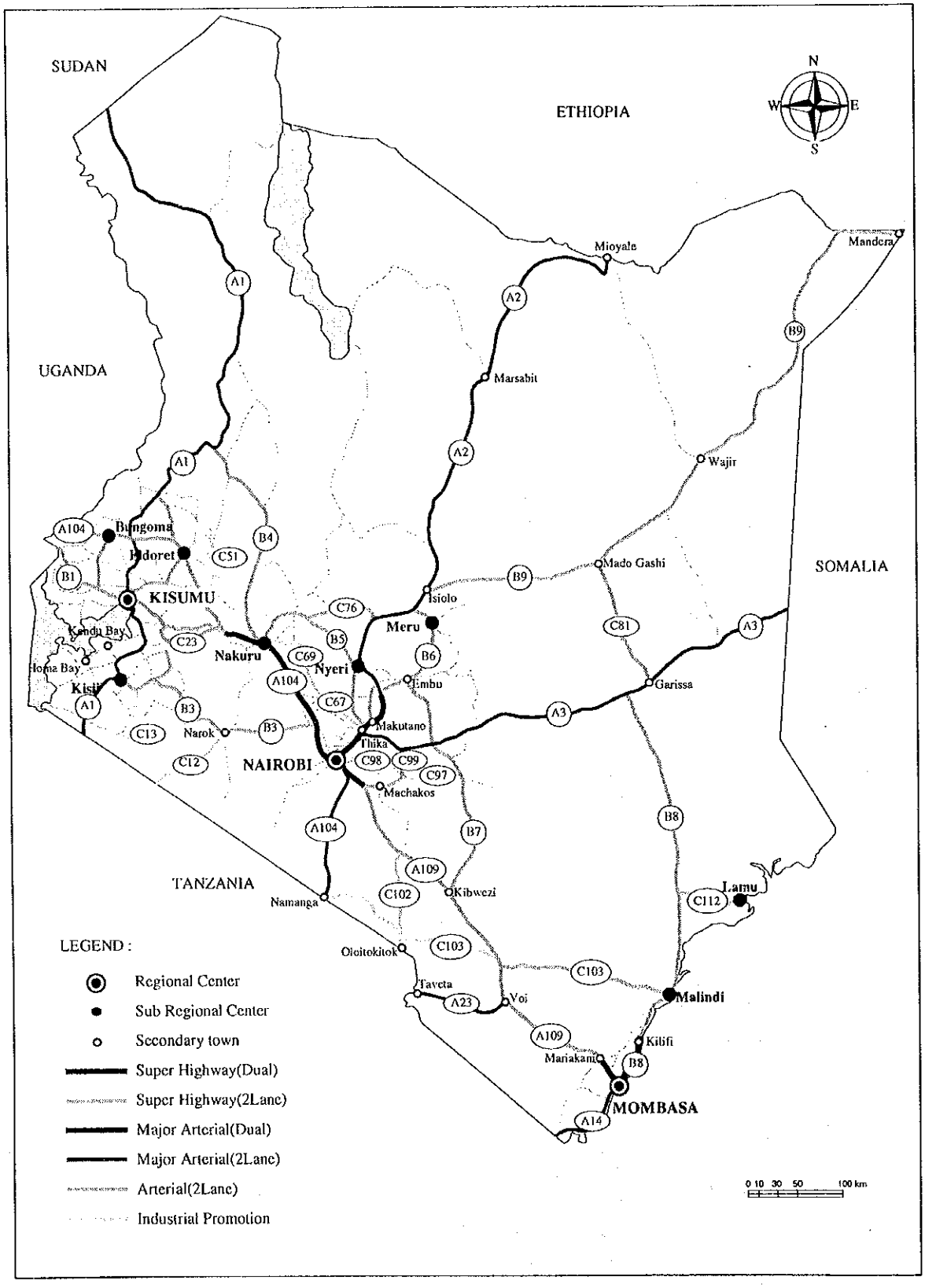


Figure 2.21 Integrated Future Road Network Plan

planned or underway at present time. Kisii Training Center was also constructed to foster the skilled labor.

Despite these efforts, it is hard to soon accomplish a complete maintenance of Kenya's classified roads extending over 60,000 km. Furthermore, inventory data of the existing roads are not satisfactory to prepare a road maintenance and management plan.

Under the structural adjustment program, an execution system of the road maintenance is to be changed from the direct control system by the Government to the contract system with a private company, which is a current movement of reducing the Government personnel.

(3) Future Prospect

It is now impossible for the MOPWH to manage by itself the maintenance of total length of the classified road. Urgent issues responsible by the MOPWH are to transfer the maintenance authority to regional jurisdictions and provide them with guidelines of maintenance priority and implementation. This eventually will help effectively allocate the road budget.

Regarding to the contract system with a private company, it is not always possible in regions where such private companies neither exist nor have sufficient capacity to conduct the maintenance work. In compliance with the Government policy to reduce its personnel, it is recommended to transfer the experienced government staff to the private company.

2.3.6 Environmental Conservation Plan

Looking into the recommended future road network, project types to influence the present environment will be (1) new road construction, and (2) widening or improvement of existing roads. Areas that are likely to incur environmental problems will be as follows:

- National Parks and Preserves, and their vicinity:
- Forest area:
- Areas of critical soil erosion;
- Densely inhabited area; and

- River and Coastal areas.

The new road construction is only confined to the bypasses. Particularly, since Mombasa Bypass is located near the coastal area it is necessary to pay attention to such a special area as the forest area and mangrove that may be influenced by discharged water.

The southern Nairobi Bypass is planned to pass a fringe of the Nairobi National Park. The environmental aspect of this plan was thoroughly investigated and its alignment was determined as it is available at present.

The northern Nairobi Bypass, however, was proposed in this study to pass near the residential and forest areas, so that a further environmental investigation is required before determining its alignment.

Nakuru Bypass was previously planned to lie to the south of the city, but as a result of the study it is recommended to shift it to the north, though the forest area exists nearby. Therefore, a detailed environmental investigation will also be required before finalizing the alignment..

3 ROAD PROJECTS OF FUTURE NETWORK PLAN

3.1 Components of the Projects

3.1.1 Project Long List

Individual section of future road network have various development backgrounds as shown in Figure 2.20. Although some sections have multiple background, development projects were consolidated by the most significant factor as shown below;

(1) Super Highway

The Super Highway Mombasa - Nairobi - Kisumu/Eldoret - Uganda (route A109, A104 and B1) should be developed with a high design standard to secure a high mobility and safety. The facility construction and improvement will include:

- Widening to dual carriage way

Mombasa - Mariakani and Machakos - Nairobi - Nakuru (Airport - Limuru section is already a dual carriage way) and A104 - Londiani (Route B1) sections

- Access Control Facilities

  Access control facilities should be provided at intersections between a 4-lane Super Highway and Class A, B and C roads. Intersections on a 2-lane Super Highway should be provided with exclusive right and left turn lanes.

(2) Bypass Roads

Three bypass roads are recommended, that is, Mombasa, Nairobi both in north and south circumferences, and Nakuru.

(3) Widening to 4-lane Arterial Roads

The arterial 4-lane widening will be required in the following sections:

- Mombasa - Kilifi (Route B8)
- Makutano - B6 (Route A2)

(4) Road Improvement from Regional Development Aspects

Road improvement is required from the viewpoint of regional development as follows :

- Missing link and alternative route
- Agricultural development
- Tourism development, and
- To secure access to major important facilities.

Please refer in this context to Table 3.2, Implementation Plan of Major Projects, for the respective projects.

(5) Other Projects

Projects for road maintenance were also enumerated in the long list. Such projects cover the following types of works :

- Pavement of unpaved roads

- Upgrading from SD (surface dressing) roads to AC (asphalt concrete) roads
- Pavement overlay, and
- Improvement to standard geometric design.

3.1.2 Criteria of Development Priority

The development priority for every 5-year period was determined taking into account the following criteria:

(1) Widening to 4-lane Road

The widening will be required when a future traffic demand exceeds the existing 2-lane road capacity.

(2) Maintenance Project

IRI (International Roughness Index) changes as the surface condition of roads deteriorates. A future IRI was estimated to identify required maintenance works by the criteria presented in Table 3.1.

Table 3.1 IRI Criteria to Determine Timing and Type of Maintenance Work

Surface	Grading	Regraveling	Resealing	Overlay	Rehabilitation	Reconstruction
A/C Paved				IRI 6	IRI 8	IRI 10
SD Paved			IRI 6		IRI 8	IRI 10
Gravel Roads	Twice a Year	5 Years				
Earth Roads	Twice a Year					

IRI : International Roughness Index

(3) Economic Evaluation

Economic B/C ratio were analyzed by using the HDM (Highway Design and Maintenance Standard Model) program to compare the priority of the above various maintenance work. Exogenous input data to the program were prepared that include maintenance costs of various work types, present IRI's, elements of vehicle operating costs, and the existing and future traffic volumes.

3.1.3 Timing of Project Implementation

Additional to the above priority criteria, the necessity of roads to the regional development was evaluated to finalize the development priority of the listed projects. Since many of road sections are heavily deteriorated they need to be improved as soon as possible. However, a budgetary shortage in Kenya can not afford to urgently implement in a limited short period. Accordingly, it is inevitable to shift relatively lower priority projects to a later time and to adjust the total project scale to the prospected budgetary framework of a 5-year period.

The implementation plan of the major projects is summarized as shown in Table 3.2.

Table 3.2 Implementation Plan of the Major Projects (1/3)

Project ID No.	[1] S.L. No.	MOPW District	ROAD CLASS	CODE No.	SEC.	Length km	[2] EXISTING ROAD SURFACE TYPE	[3] PLANNED CROSS SECTION TYPE	COST 1995-1999 (m.ksh)	COST 2000-2004 (m.ksh)	COST 2005-2009 (m.ksh)	COST 2010-2013(m.ksh)	TOTAL COST (m.ksh)
(I) SUPER HIGHWAY													
1	8	620	A	1	31	20.0	SD	Type-2	429.0	---	---	---	429.0
2	10	620	A	1	31	17.5	SD	Type-2	375.4	---	---	---	375.4
3	11	620	A	1	31	5.0	SD	Type-2	107.3	---	---	---	107.3
4	75	740	A	104	41	13.5	AC	Type-2	289.6	---	---	---	289.6
5	79	770	A	104	51	43.0	AC	Type-2	922.4	---	---	---	922.4
6	80	770	A	104	51	24.4	AC	Type-2	523.4	---	---	---	523.4
7	80	770	A	104	51	7.1	AC	Type-2	---	---	---	152.3	152.3
8	81	770	A	104	51	16.0	AC	Type-2	---	---	---	343.2	343.2
9	82	770	A	104	51	16.8	AC	Type-2	---	---	---	360.4	360.4
10	83	770	A	104	51	37.6	AC	Type-2	---	806.5	---	---	806.5
11	84	930	A	104	61	34.0	AC	Type-2	---	---	---	729.3	729.3
12	85	910	A	104	71	30.0	AC	Type-2	---	643.5	---	---	643.5
13	86	910	A	104	71	20.8	AC	Type-2	---	446.2	---	---	446.2
14	87	910	A	104	71	1.0	AC	Type-2	---	21.5	---	---	21.5
15	88	920	A	104	81	14.1	AC	Type-2	---	302.4	---	---	302.4
16	89	340	A	109	11	6.2	AC	Type-2	---	---	---	133.0	133.0
17	90	310	A	109	21	23.1	SD	Type-2	495.5	---	---	---	495.5
18	90	320	A	109	31	54.2	SD	Type-2	1,162.6	---	---	---	1,162.6
19	90	350	A	109	41	49.0	AC	Type-2	---	1,051.1	---	---	1,051.1
20	91	310	A	109	21	25.0	SD	Type-2	---	536.3	---	---	536.3
21	92	350	A	109	41	36.0	AC	Type-2	---	---	772.2	---	772.2
22	93	350	A	109	41	14.0	AC	Type-2	---	---	300.3	---	300.3
23	94	350	A	109	41	6.0	AC	Type-2	---	---	128.7	---	128.7
24	95	440	A	109	51	21.5	AC	Type-2	---	---	461.2	---	461.2
25	95	470	A	109	52	64.4	SD	Type-2	---	---	1,381.4	---	1,381.4
26	97	470	A	109	52	88.0	SD	Type-2	---	---	1,887.6	---	1,887.6
27	98	470	A	109	52	68.0	SD	Type-2	---	---	1,458.6	---	1,458.6
		Sub-total				713.7			4,305.2	3,807.5	6,390.0	1,718.2	16,220.9
28	2	120	B	1	10	12.5	SD	Type-2	---	268.1	---	---	268.1
29	4	120	B	1	10	19.0	SD	Type-2	---	407.6	---	---	407.6
30	5	120	B	1	10	6.9	SD	Type-2	---	148.0	---	---	148.0
31	6	620	B	1	21	16.6	SD	Type-2	---	356.1	---	---	356.1
32	7	620	B	1	21	5.5	SD	Type-2	---	118.0	---	---	118.0
33	8	620	B	1	22	6.9	AC	Type-2	---	---	148.0	---	148.0
34	8	620	B	1	23	13.1	SD	Type-2	---	---	---	281.0	---
35	9	620	B	1	23	4.3	AC	Type-2	---	---	---	92.2	---
36	10	620	B	1	23	8.8	AC	Type-2	---	---	188.8	---	188.8
37	11	940	B	1	31	3.0	AC	Type-2	---	---	64.4	---	---
38	12	940	B	1	31	6.5	AC	Type-2	---	---	---	139.4	---
39	13	940	B	1	31	3.0	AC	Type-2	---	---	---	64.4	64.4
40	13	630	B	1	41	29.0	SD	Type-2	---	---	622.1	---	622.1
41	14	630	B	1	41	4.0	SD	Type-2	---	85.8	---	---	85.8
42	15	630	B	1	41	2.0	SD	Type-2	---	42.9	---	---	42.9
43	15	630	B	1	41	14.5	SD	Type-2	---	311.0	---	---	311.0
44	15	920	B	1	51	2.0	SD	Type-2	---	42.9	---	---	42.9
45	16	920	B	1	51	20.0	SD	Type-2	---	---	429.0	---	429.0
46	17	920	B	1	51	5.0	SD	Type-2	---	---	107.3	---	107.3
		Sub-total				182.6			.0	1,780.4	1,559.6	577.0	3,917.0
		Total				896.3			4,305.2	5,587.9	7,949.6	2,295.2	20,137.9
(II) SUPER HIGHWAY DUAL CARRIAGEWAY CONSTRUCTION													
1	9	620	A	1	31	20.0		Type-1	---	---	966.0	---	966.0
2	63	440	A	104	10	15.3		Type-1	---	---	739.0	---	739.0
3	65	210	A	104	31	4.8		Type-1	---	---	231.8	---	231.8
4	68	210	A	104	31	10.0		Type-1	---	---	483.0	---	483.0
5	69	210	A	104	31	14.0		Type-1	---	---	676.2	---	676.2
6	70	210	A	104	31	22.0		Type-1	---	---	1,062.6	---	1,062.6
7	71	240	A	104	32	4.3		Type-1	---	---	207.7	---	207.7

Table 3.2 Implementation Plan of the Major Projects (2/3)

Project ID No.	[1] S.L. No.	MOPW District	ROAD CLASS	CODE No.	SEC.	Length km	[2] EXISTING ROAD SURFACE TYPE	[3] PLANNED CROSS SECTION TYPE	COST 1995-1999 (m.ksh)	COST 2000-2004 (m.ksh)	COST 2005-2009 (m.ksh)	COST 2010-2013(m.ksh)	TOTAL COST (m.ksh)
8	71	740	A	104	41	26.0		Type-1	---	---	1,255.8	---	1,255.8
9	72	740	A	104	41	32.0		Type-1	---	---	1,545.6	---	1,545.6
10	73	740	A	104	41	5.0		Type-1	---	241.5	---	---	241.5
11	74	740	A	104	41	45.3		Type-1	---	2,188.0	---	---	2,188.0
12	74	740	A	104	42	7.4		Type-1	---	---	357.4	---	357.4
13	76	740	A	104	41	27.5		Type-1	---	1,328.3	---	---	1,328.3
14	77	740	A	104	41	7.0		Type-1	---		338.1	---	338.1
15	78	740	A	104	43	5.2		Type-1	---	251.2	---	---	251.2
16	89	340	A	109	11	17.8		Type-1	---	---	---	859.7	859.7
17	89	340	A	109	12	6.2		Type-1	---	---	---	299.5	299.5
18	96	440	A	109	51	26.0		Type-1	---	---	1,255.8	---	1,255.8
19	1	120	B	1	10	45.0		Type-1	---	---	2,173.5	---	2,173.5
20	3	120	B	1	10	7.0		Type-1	---	338.1	---	---	338.1
21	18	740	B	1	61	2.9		Type-1	---	140.1	---	---	140.1
		Sub-total				350.7			.0	4,487.2	11,292.5	1,159.2	16,938.9
(III) BYPASS CONSTRUCTION													
1		Mombasa Bypass				50.0	---	Type-1	---	2,680.0	---	---	2,680.0
2		East Nairobi Bypass				27.0	---	Type-1	1,447.2	---	---	---	1,447.2
3		West Nairobi Bypass				49.0	---	Type-1	---	---	2,626.4	---	2,626.4
4		Nakuru Bypass				26.0	---	Type-1	---	---	---	1,393.6	1,393.6
5		Likoni Bridge First Stage							---	---	---	4,200.0	4,200.0
		Sub-total				152.0			1,447.2	2,680.0	2,626.4	5,593.6	12,347.2
													.0
													.0
(IV) DUAL CARRIAGEWAY ROADS CONSTRUCTION													
1	33	230	A	2	20	13.5	AC	Type-1	---	---	652.1	---	652.1
2	34	230	A	2	30	10.0	AC	Type-1	---	---	---	483.0	483.0
3	34	220	A	2	20	26.5	SD	Type-1	---	---	---	1,280.0	1,280.0
4	52	310	B	8	20	30.0	SD	Type-1	---	---	---	1,449.0	1,449.0
		Sub-total				80.0			.0	.0	652.1	3,212.0	3,864.1
(V) MISSING LINK /ALTERNATIVE ROUTE													
1	47	430	B	7	20	114.8	E	Type-4	---	1,767.9	---	---	1,767.9
2	47	470	B	7	10	24.8	G	Type-4	---	---	---	381.9	381.9
3	48	430	B	7	20	3.0	SD	Type-3	24.4	---	---	9.5	33.9
4	47	470	B	7	10	3.0	SD	Type-3	---	---	---	46.2	46.2
5	49	430	B	7	20	13.4	E	Type-3	---	---	206.4	---	206.4
6	50	430	B	7	20	26.0	E	Type-3	---	---	400.4	---	400.4
7	51	410	B	7	40	45.5	SD	Type-3	143.3	---	---	---	143.3
8		210,230	C	64/70		60.0		Type-4	2,213.0	---	---	---	2,213.0
9	133	510	C	81	1	157.5	E	Type-4	---	---	---	242.6	242.6
10	160	310	C	103	30	136.0	G	Type-4	---	---	---	209.4	209.4
11	161	310	C	103	10	32.0	G	Type-4	492.8	---	---	---	492.8
12	161	310	C	103	10	80.0	G	Type-4	1,232.0	---	---	---	1,232.0
13	161	310	C	103	20	38.0	G	Type-4	585.2	---	---	---	585.2
		Sub Total				774.1			4,690.7	1,767.9	606.8	889.6	7,955.0
(VI) SUPPORT TO AGRICULTURAL DEVELOPMENT													
1	98	210	C	64	10	5.5	SD	Type-2	88.6	---	---	17.5	106.1
2	98	210	C	64	20	6.2	SD	Type-2	99.8	---	---	19.7	119.5
3	99	210	C	64	20	13.2	G	Type-2	203.3	---	---	---	203.3
4	1	210	C	64	20	15.5	SD	Type-4	249.6	---	---	---	249.6
5	8	740	C	67	30	11.0	SD	Type-4	89.4	---	---	---	89.4
6	8	740	C	67	30	6.9	SD	Type-4	56.1	---	---	---	56.1
7	13	230	C	70	10	23.0	G	Type-3	354.2	---	---	---	354.2
8	14	230	C	70	10	33.0	SD	Type-3	268.3	---	---	---	268.3
9	14	250	C	70	20	23.0	SD	Type-3	187.0	---	---	---	187.0
10	153	440	C	100	1	27.2	G	Type-4	---	---	---	41.9	41.9
11	154	440	C	100	1	27.2	G	Type-4	437.9		---		437.9
12	154	440	C	100	1	5.0	G	Type-4	25.0	---	---	---	25.0
		Sub Total				169.5			2,059.2	.0	.0	79.1	2,138.3

Table 3.2 Implementation Plan of the Major Projects (3/3)

Project ID No.	[1] S.L. No.	MOPW District	ROAD CLASS	CODE No.	SEC.	Length km	[2] EXISTING ROAD SURFACE TYPE	[3] PLANNED CROSS SECTION TYPE	COST 1995-1999 (m.ksh)	COST 2000-2004 (m.ksh)	COST 2005-2009 (m.ksh)	COST 2010-2013(m.ksh)	TOTAL COST (m.ksh)
(VII) SUPPORT TO TOURISM DEVELOPMENT													
1	1	750	C	13	10	29.0	E	Type-4	---	---	446.6	---	446.6
2	1	750	C	13	10	44.0	G	Type-4	677.6	---	---	---	677.6
3	1	750	C	13	10	21.0	G	Type-4	323.4	---	---	---	323.4
4	28	730	C	77	30	15.6	G	Type-4	240.2	---	---	---	240.2
5	128	730	C	77	30	57.7	G	Type-4	888.6	---		---	888.6
6	59	710	C	103	10	52.0	G	Type-4	800.8	---	---	---	800.8
7	59	350	C	103	20	70.0	G	Type-4	1,078.0	---	---	---	1,078.0
		Sub Total				334.4			4,008.6	.0	446.6	.0	4,455.2
(VIII) IMPROVEMENT OF ACCESS TO MAJOR PORTS													
1	12	620	C	19	10	25.3	SD	Type-4	74.0	---	---	74.0	148.0
2	12	640	C	19	20	20.6	SD	Type-4	60.3	---	---	60.3	120.6
3	13	640	C	19	20	27.5	G	Type-4	423.5	---		442.8	866.3
4		340	C	110	1	4.9	AC	Type-4	27.0	---	---	---	27.0
		Sub Total				78.3			584.8	.0	.0	577.1	1,161.9
(IX) OTHER EXISTING ROADS						6367.6			693.0	11,170.4	12,938.0	26,991.9	51,793.3
		GRAND TOTAL				9,202.9			17,788.7	25,693.4	36,512.0	40,797.7	120,791.8

Note : [1] S.L.No. : Link Numbers which are provided for the convenience of traffic demand analysis and projection.

[2] Existing Road Surface Type

AC : Asphalt Concrete

SD : Surface Dressing

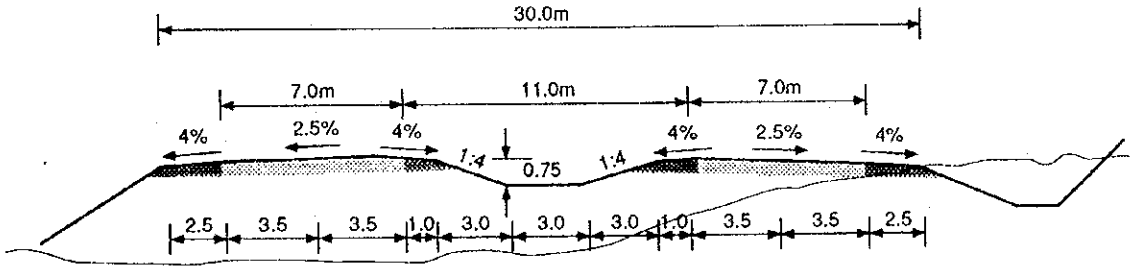
G : Gravel

E : Earth

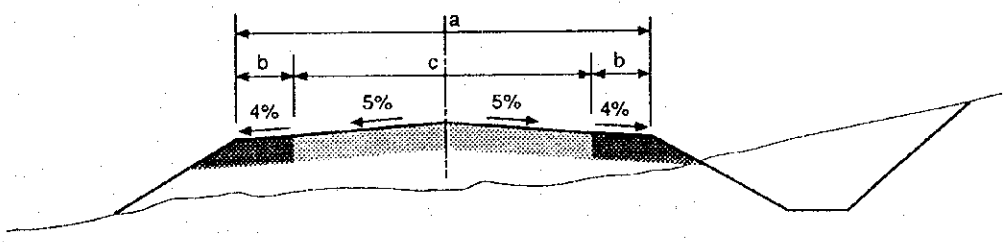
[3]Planned Cross Section Type

Project Category	Planned Cross Section Type*	Pavement Design **	Dimensions in Meters		
			a	b	c
I. Super Highway	Type-2	(A)	10.0	1.5	7.0
II. Super Highway (Dual)	Type-1	(A)	As Shown below		
III.By pass	Type-1	(A)	As Shown below		
IV. Dual Carriageway (Arterial) Road	Type-1	(B)	As Shown below		
V. Missing Link / Alternative Route	Type-3/ Type-4	(B)	8.5/7.0	1.0/0.5	6.5/6.0
VI. Support to Agricultural Development	Type-2,/Type-3, Type-4	(B)	10.0/8.5 7.0	1.5/1.0 0.5	7.0/6.5 6.0
VII. Support to Tourism Development	Type-4	(B)	7.0	0.5	6.0
VIII. Improvement of Access to Major Ports	Type-4	(B)	7.0	0.5	6.0

* Cross Section Type:



Cross Section Type 1 (Dual Carriage Way)



Cross Section Type 2~4 (Single Carriage Way)

** Pavement Design

(A) Super Highway : Initial pavement life is designed to be 20 years,
provided that routine and periodic maintenance is dully executed as necessary.

(B) Arterial AC : Initial pavement life is designed to be 10 to 15 years,
provided that routine and periodic maintenance is dully executed as necessary.

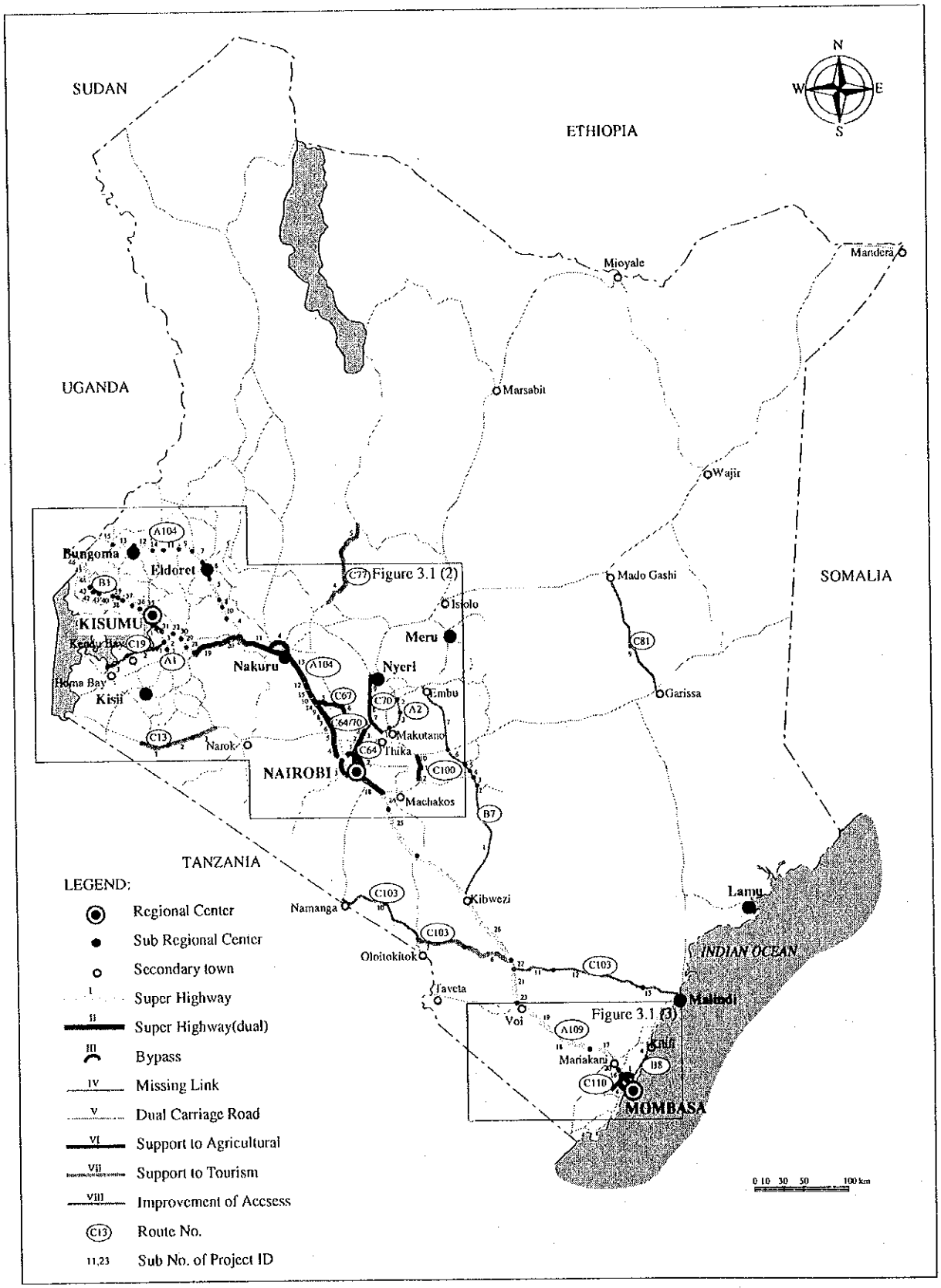


Figure 3.1(1) Major Projects

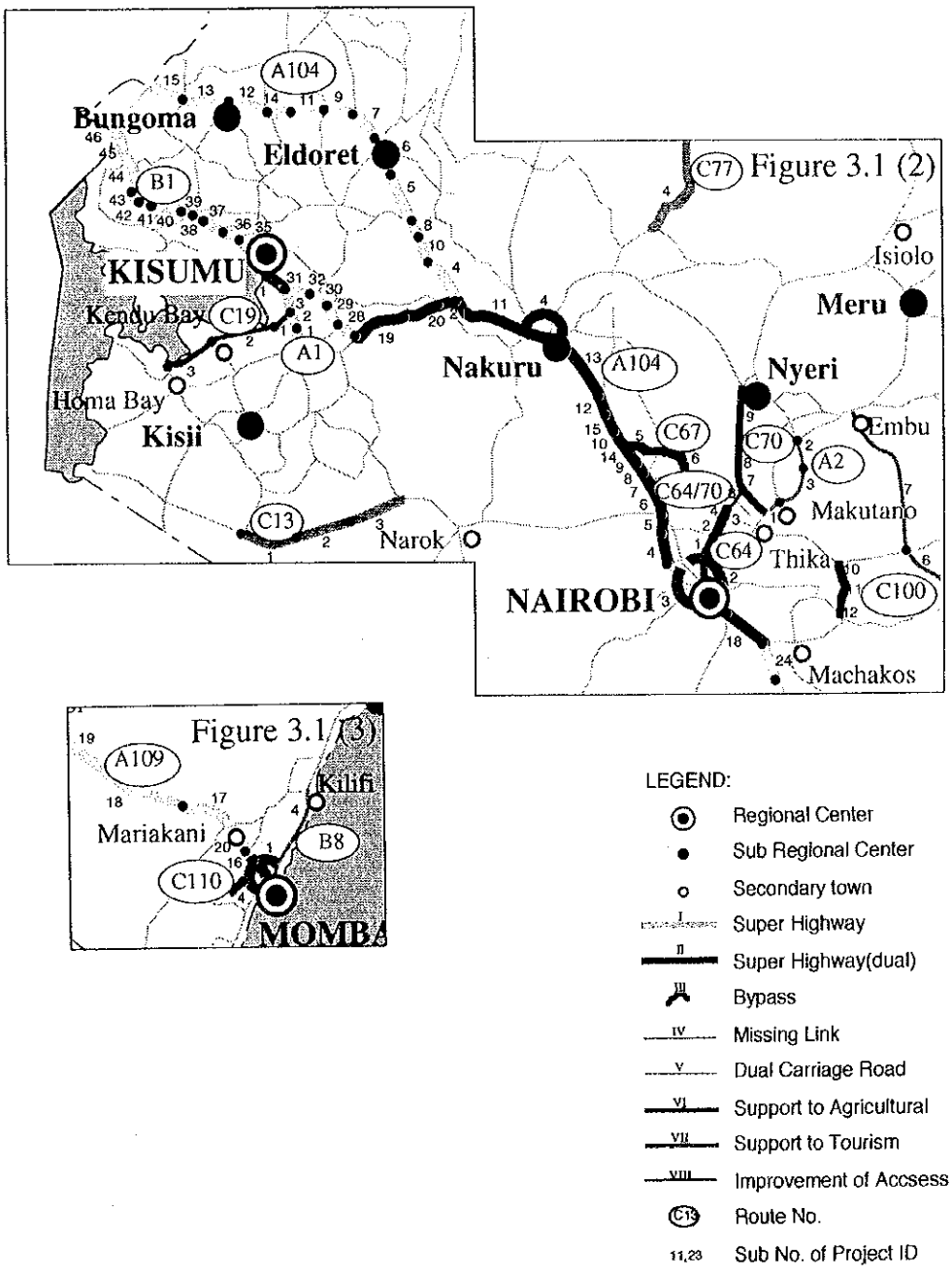


Figure 3.1(2) and (3) Major Projects

3.2 Development Fund and Cost

3.2.1 Fiscal Planning

(1) Present Budgetary Situation

The road sector budget in Kenya is mainly divided into a recurrent cost and a development cost. The former covers such routine works as plucking up the weeds and cleaning roads and ditches, while the latter involves such construction work as required to cope with the deterioration of road conditions.

Although a nominal road budget seems to be increasing a real one is often recorded to adversely decrease in several years in the past. A current feature of the road sector budget is that the financial resource depends almost evenly upon the domestic fund and financial aids from donor countries.

(2) Fiscal Plan

According to the current statistics of the road sector budget, it is hard to tell the most likely range of the financial revenue in future. Therefore, the financial study proceeded focusing on how much is required for funds and how to raise them under some assumptions described below:

1) Study Premises

a Basic Assumptions in Forecasting Future Budget

Since the budget of the road sector is drastically fluctuating, the future forecast was only based on the figures during 1985 - 1995 (the 1995 figure is a planned one).

b Fuel Levy and Other Fund Sources

The fuel levy, Kshs 1.5/liter and 1.0/liter for regular gasoline and diesel oil respectively, was newly introduced in 1994, and it is expected to raise the levy in future. Therefore, it was intended to analyze the fuel levy separately from other fund sources which are most likely to grow as the GDP increases in future. An increase of the fuel levy was assumed to make the financial revenue comparable with the required total project fund. The assumed increase of the fuel levy was as follows:

• The rate will become double by the year 2005, and

• The rate will become three-fold by the year 2013

2) Estimated Future Budget

Based on the assumptions above a scale of the future budget and its allocation were estimated as shown in Table 3.3. Table 3.4 exhibits the growth of budgetary funds derived from the fuel levy and other sources.

Table 3.3 Estimated Future Budget

Unit: Million Ksh

Year	Excluding Fuel	Fuel Levy	Total
1995	3,564	1,500	5,064
1996	3,702	1,869	5,571
1997	3,842	2,238	6,081
1998	3,988	2,608	6,595
1999	4,139	2,977	7,116
2000	4,305	3,346	7,651
2001	4,478	3,715	8,193
2002	4,657	4,084	8,742
2003	4,844	4,454	9,298
2004	5,039	4,823	9,861
2005	5,226	5,192	10,418
2006	5,421	6,002	11,424
2007	5,623	6,813	12,436
2008	5,833	7,623	13,456
2009	6,050	8,434	14,484
2010	6,275	9,244	15,520
2011	6,509	10,055	16,564
2012	6,752	10,865	17,617
2013	7,003	11,676	18,679
Total	97,249	107,520	204,769

Table 3.4 Estimated Budgetary Allocation

Unit: Million KSh

	1995 - 1999	2000 - 2004	2005 - 2009	2010 - 2013
Development	17,952	25,809	36,708	40,344
Recurrent	12,475	17,935	25,509	28,036
Total	30,427	43,744	62,217	68,380

The budget of in terms of development in this table has been mainly allocated to road projects on class A, B, and C. With respect to class D and E roads, a part of the recurrent budget which has been appropriated to routine maintenance works will be applied as it is.

Note: In Kenya the road "development" budget includes new road construction and periodical road maintenance. "Recurrent" in budget classification corresponds to ordinary light routine maintenance work.

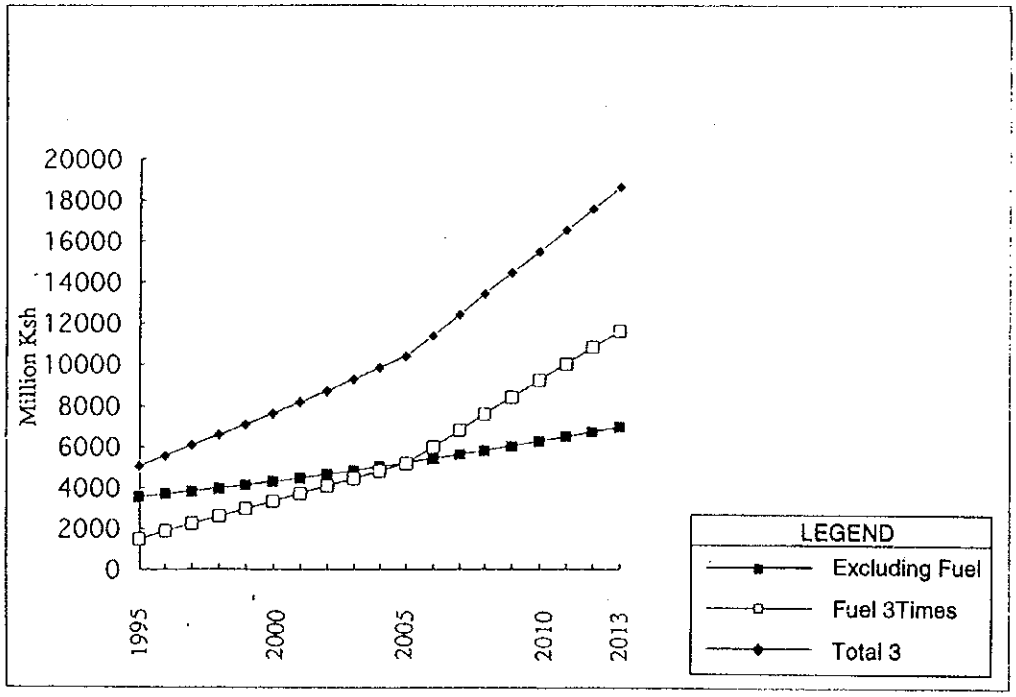


Figure 3.2 Estimated Future Growth of Budgetary Funds

3.2.2 Estimated Project Costs

Project costs required for the Class A, B and C roads are summarized for every 5-year period in Table 3.5 which totals about Kshs 111.8 billion by the year 2013.

Table 3.5 Schedule of Project Expenditure by Five Years Period

PROJECT	Length (km)	COST 1995-1999 (m.ksh)	COST 2000-2004 (m.ksh)	COST 2005-2009 (m.ksh)	COST 2010-2013(m.ksh)	TOTAL COST (m.ksh)
(I) SUPER HIGHWAY	896.3	4,305	5,588	7,949	2,295	20,137
(II) SUPER HIGHWAY DUAL CARRIAGEWAY	350.7		4,487	11,292	1,159	16,938
(III) BYPASS CONSTRUCTION	152.0	1,447	2,680	2,626	5,594	12,347
(IV) DUAL CARRIAGEWAY ROADS	80.0			652	3,212	3,864
(V) MISSING LINK /ALTERNATIVE ROUTE	774.1	4,691	1,768	607	890	7,956
(VI) SUPPORT TO AGRICULTURAL DEV'T	169.5	2,059			79	2,138
(VII) SUPPORT TO TOURISM DEVELOPMENT	334.4	4,009		447		4,456
(VIII) ACCESS TO MAJOR PORTS	78.3	585			577	1,162
(IX) OTHER EXISTING ROADS	6368.0	693	11,170	12,938	26,992	51,793
TOTAL	9203.3	17,789	25,693	36,511	40,798	120,791

As a consequence, the comparison was made between the required project cost and the development budget as presented in Table 3.6.

Table 3.6 Comparison between Project Cost and Development Budget

Unit:MKsh

Item	1995-1999	2000-2004	2005-2009	2010-2013	Total
Required Investment	17,789	25,693	36,511	40,798	120,791
Development Budget	17,952	25,809	36,708	40,344	120,813

The above comparison suggests that the development projects of Class A, B and C roads can be implemented, if the assumed conditions of the budget are secured. However, the toll road system is expected to revive in future in order to diversify resources for prompt road improvement and construction.

3.2.3 Implementation Policies

(1) Privatization of Road Project

Based on the structural adjustment program in Kenya, an administrative reform is now underway. In line with this program, it is also now proceeding to reduce the Government personnel as well as to transfer road projects to the private sector by the contract system. This movement in a long term view will largely contribute to the creation of job opportunities in the private sector. However, in a short- term view it is not practicable, except for Nairobi and its metropolitan area, to pursue the Privatization outside Nairobi. Actually, there are many regions where no private organisations exist to receive such transfer, or private organisations are still immature.

Therefore, it can be recommended as an intermediate step to make a semi governmental organization such as a public corporation where the experienced Government personnel will move, and then the public corporation should be privatized after the organization undergoes enough experiences.

(2) Fuel Levy

About half of the road budget depends on the financial aid of donor countries at present time. Efforts should be made to get rid of the external aid in a long term plan, and further, as discussed previously the fuel levy will need to increase at least three-fold to furnish the required development budget. The levy will have to be raised even faster, if the Kenyan economy grow at a higher speed. In order to

enable such a rise in the fuel levy, it is imperative to reveal the necessity of the road development all the Kenyan people as well as road users.

(3) Other Policies

The implementation of the road development is based on the planning study which requires various data and information. For the future planning, it is quite important to maintain and manage such fundamental road data as inventory of existing facilities, traffic count data and updated future traffic projection data. Planing efforts to adjust short-term or medium-term plans, which undergo changes as required by reality, to a long-term plan will finally promise a most effective implementation of the road development.