3.3 Future Performance Prospects

3.3.1 Structural Adjustment Measures

(1) Background

"Sessional Paper No. I of 1986 on "Economic Management for Renewed Growth" was prepared with a view to provide a more fundamental and long-term development perspective. Kenya's development has experienced some difficulties through a series of economic crises and 1986 presented a good opportunity to look towards the end of the century at the year 2000. The Sessional Paper aimed at providing the long-term framework for the 6th development plan covering 1989 to 1993 and the present 7th development plan for 1994 to 1996.

(2) Outline of Sessional Paper

The Sessional Paper recognizes a progressive pressure caused by the population increase and the scarcity of productive land, other resources and investment capital. The creation of job opportunities for the increasing population and labor force, without entailing excessive urban concentration in a few cities, is defined as a final goal of the paper. In order to achieve the development goal, rural oriented development policies are established.

Key areas of concern are to raise *productivity in agriculture* to feed the nation, raise rural incomes, and provide export revenues; to promote *widespread rural non-farm activity* to provide jobs and good living standards outside the central cities; a *dynamic informal sector* that creates jobs at low cost and caters to the needs of people at all income levels; and a *restructured industry*, capable of employing more workers at high productivity levels and also capable of creating export markets for Kenyan manufactured goods.

The Sessional Paper stipulates the following imperatives :

- Economic growth becomes the prime concern of economic policy and an average annual real GDP growth rate of 5.6 % up to the year 2000 is targeted
- Agriculture remains a leading sector in stimulating economic growth and job creation

- The great majority of new jobs will have to be created on farms and in small-scale industries and services, both rural and urban; and not in the cities or large scale industry

- Most investment should be directed to create a prosperous agriculture, to build rural market centers and towns, and otherwise to support informal sector growth

- What investment does occur in modern industry must be highly productive, capable of employing workers at low cost and of competing in world markets, with only modest protection or subsidy; and

- Government policies and budget allocations must be moved decisively and soon in these directions.

(3) Rural-Urban Balance

It is important for Kenya's development process that economic growth accelerates, but such growth should take place in rural as well as in urban areas. The objective of a development balanced between rural and urban areas implies the promotion of productive interaction between rural and urban area. For this end, an excessive concentration of population in a few large cities of the country has to be avoided, the growth of secondary towns and smaller urban settlements has to be promoted, and it has to be ensured that migration from rural areas does not exceed the absorptive capacity of the cities to accommodate new residents.

(4) Growth Centers and Infrastructure

The first element in the strategy for rural-urban balance is infrastructure development, which would promote the further expansion of small rural centers, the larger towns and small cities serving rural areas. Given the limited resources available for new investment, hard choices will have to be made about which towns, which parts of the country, and what kind of infrastructure should be given priority.

Greater emphasis will be placed on building infrastructure that helps the private sector creating more productive employment in small towns and market centers. This guideline incorporates three general principles, firstly, giving priority to infrastructure that supports productive activities. Secondly, strengthening linkages between secondary towns and, thirdly, channeling resources to small urban centers, which have a high potential.

- *Infrastructure in support of productive activities*

  Priority will be given to infrastructure investments that promote the growth of production and employment in small-scale agro-industry, manufacturing and commercial enterprises.

- *Strengthen links between secondary towns*

  Urban growth in Kenya is concentrated along the Mombasa - Nairobi - Uganda highway. Cities and towns that are distant from this "main street" are handicapped in attracting productive, employment generating enterprises. To encourage the growth of these towns and to improve their access to larger regional markets, the Government will seek to expand this "main street" by up-grading highway links between a few selected secondary towns lying on either side, and by strengthening telecommunication linkages between growing urban areas throughout the country.

- *Channel resources to small urban centers with potentials*

  From the perspective of a strategy for rural-urban balance, it is vital that the limited resources available are not spread too thinly across many towns, but be concentrated on urban settlements with the best potential to support economic growth and to generate employment in their region over the long term.

(5) Rural Trade and Production Centers

The Government will launch a program entitled "Rural Trade and Production Centers (RTPCs)", in order to facilitate the growth of small towns in support of agriculture and other productive activities. Typically, a RTPC will be an existing town or village with a 1979 population size of below 5,000 inhabitants, constituted either as an urban center or simply as a trading center under the jurisdiction of the country council. Municipalities and town councils are already, or soon will be required to prepare, with the assistance of the Ministry of Local Government, their own Local Authority Development Programs.

(6) National Development Plan

1) Plan Overview

The Seventh National Development Plan, covering the period 1994 to 1996, was prepared at the outset of Kenya's fourth decade of independence. Kenya started

over the 5 years period 1986 to 1990 to implement structural adjustment measures as suggested in *Sessional Paper No. 1 of 1986 on Economic Management for Renewed Growth*. The Kenyan Government has assessed that the structural adjustment program was generating successfully the sustainable development needed to create employment, raise the standard of living of ordinary Kenyans, reduce the incidence of poverty and reduce the rate of population increase. It is, however, recognized by the Government that expansion of Kenya's economy has slowed down progressively since 1990. The highest priority should therefore be given to a strategy for recovery and the rapid restoration of economic growth.

The theme of the Seventh National Development Plan is "Resource Mobilization for Sustainable Development". The strategy is to mobilize resources by policies that encourage private sector savings and investment over the plan period 1994 to 1996. New policies and programs are introduced to promote the export sector and to reduce the dependence on donor aid as a source of foreign exchange. The public sector should contribute to savings and investment by maintaining a stable fiscal and monetary policy and a balanced current account. It is also set out in the plan that the divestiture of parastatals, civil service reform and the rationalization of the regulatory framework contribute to the mobilization of resources.

The development objectives stated in the plan are summarized below :

- Establishing a basis for mitigating the unemployment problem, which arises from high labor force growth rates

- Rejuvenating the economy to achieve higher growth rates in GDP, in order to improve and maintain per capita income, implying a GDP growth, which exceeds the annual population growth rate of 3.4 per cent per year

- Putting in place "safety nets" to mitigate the deterioration in the welfare of the poor, which results from the implementation of structural adjustment measures, and

- Planning for the achievement of development goals without undue reliance on foreign assistance, the prospects for which remain uncertain.

2) Spatial Dimensions of Development

It is a fundamental policy of the Government to pursue rural oriented development and to ensure a balanced pattern of rural-urban development through the District Focus Strategy for Rural Development. This strategy aims at an even

distribution of economic activities between rural and urban areas and establishing inter-linkages between them. This approach intends to promote the development of small scale enterprises, especially in the Rural Trade and Production Centers (RTPCs).

The Government's development approach is based on spatial dimensions of development. Therefore, emphasis is placed on factors that influence the geographical distribution of economic activities and their interrelationship with the natural resource endowment and the pattern of human settlements. The provision of basic physical infrastructure, such as transport and communication, water, energy and information facilities are key element for achieving the District Focus Strategy for Rural Development.

3) Transport System Development

The transport system occupies a central position in both, the development of all sectors of the economy and in facilitating the integration of the national economy internally and internationally. The Government is of the opinion that most of the strategic facilities are already in place, and that the further expansion of these facilities is constrained by scarcity of financial resources. Therefore, priority will be given to the provision of funds for maintenance, rehabilitation and modernization of existing facilities as well as for their cost-effective utilization.

a Road Transport

The total road network has expanded from 41,900 km at independence to 150,620 km in 1992, out of which 63,120 km are categorized as classified roads under the responsibility of the Ministry of Public Works and Housing. Some 87,500 km fall in the category of unclassified roads and are under the responsibility of various bodies and institutions.

A total of 8,120 km of rural access roads have been constructed up to June 1992 under the Rural Access Roads Program. Out of this total, 7,552 km have been graveled. Similarly, a total of 3,100 km of minor roads has been constructed up to June 1992, out of which 2,390 km have been developed to gravel standard. The principles of the Rural Access and Minor Roads Programs will be pursued over the plan period under the umbrella of the Minor Roads Transition Project, which will be formulated. Table 3.3.1 shows projections of Road development.

Table 3.3.1 Projections of Road Development by Surface Type

(kilometer)

Surface Type	1990	1994	1995	1996
Bitumen	7,943	9,000	9,240	9,490
Gravel	26,181	26,500	26,700	26,900
Earth	28,543	28,000	27,800	27,600
Total	62,667	63,500	63,740	63,990

(Source: National Development Plan for the Period 1994 to 1996, Ministry of Planning and National Development)

It is stressed in the plan that although the network will continue to be upgraded and rehabilitated, priority will be given to the provision of adequate funds for maintenance of the present road network so as to ensure sustainability of the existing roads.

Additional tax revenue will be raised especially from motor vehicles users, road taxes and fuel taxes, and channeled exclusively towards the financing of road maintenance. Emphasis will be placed on speedy and timely rehabilitation and reconstruction of deteriorating paved road sections, the development of an all-weather rural roads system, selective upgrading of roads to bitumen standard, the intensified use of labor-based technologies for road construction and maintenance, the enhancement of environmental concerns, the promotion of road safety and the research on appropriate road building materials and technologies.

b Rail Transport

The Government has been concerned with the need to ensure that Kenya Railway Corporation (KR) operates on sound commercial principles as required by the provisions of the Kenyan Railway Corporation Act of 1978. This objective has however, not been achieved previously, because of a lack of autonomy in decision making, inadequate equipment and over employment, which led to high overhead costs.

During the plan period, KR's restructuring will encompass the strengthening of its management, the enhancement of management information services and data banks, the exploration of more effective alternatives to current non-profitable operations, and the improvement of regional co-operation with inter-connected railways to promote a smooth flow of traffic.

c Marine Transport

Kenya's marine transport activities are concentrated in Mombasa on the Indian Ocean seaboard and in Kisumu at Lake Victoria. These ports provide useful services to the country and its hinterland, including Uganda, Rwanda, Burundi, Eastern Zaire, Southern Sudan, North-Eastern Tanzania, Somalia and Ethiopia. Efficient port operations at Mombasa would enhance the competitiveness of Kenya's exports, lead to lower import prices, while equally making the port attractive for trans-shipment. This would boost international trade, which is the hallmark of marine transport services.

The Kenya Ports Authority (KPA) is the sole operator of coastal port facilities and inland container depots. It has the responsibility of fulfilling this objective by ensuring faster turn-around time for sea vessels, without compromising safety and security of goods and operations.

Development issues to be addressed by KPA during the plan period include low availability of equipment and lack of spares, which has hampered efficient maintenance, unacceptable cargo dwell-time, caused by third parties including port users, the need to increase labor productivity, and the need to strengthen the information flow.

d Air Transport

The crucial economic function of air transport lies in its strong linkages with the promotion and facilitation of tourism and exports of horticultural products, both of which are major sources of foreign exchange earnings for the economy. Air transport is also a fast and reliable mode of transport, because it is convenient for travel and trade. Domestically, it provides access to isolated parts of the country, which hitherto would be inaccessible through other modes of transport. Moreover, Nairobi is already the hub of international air traffic connections and commercial activities attracting an increasing volume of tourist and aviation services. The Government has therefore made considerable efforts to foster economic growth through efforts aimed at improving the efficiency of the operations of airdromes, civil aviation facilities and meteorological information services.

e Pipeline Transport

Pipeline transport, which is currently confined to the transportation of "white" petroleum products from the oil refinery in Mombasa to the hinterland, provides the economy with a pollution-free, reasonably safe, cheap, and reliable mode of

transport. Pipeline transport contributes also to the reduction of road damage by limiting the use of heavy oil tankers on the roads. It is managed by the Kenya Pipeline Co. Ltd. (KPC), a wholly Government-owned parastatal under the Ministry of Energy. KPC operates the pipeline on a commercial basis, in order to ensure adequate supplies of "white" oil products, maintain the pipeline, and to make a reasonable rate of return on capital employed. KPC started its commercial operations in 1978 with the construction of the pipeline from Mombassa to Nairobi. KPC's current annual throughput stands at 1.9 million cubic meters. In accordance with the proposals made in the 1989 - 1993 Development Plan, the pipeline has already been extended to Western Kenya, that is from Nairobi to Kisumu and to Eldoret. The pipeline extension is expected to contribute towards reducing motor vehicle pollution and minimizing distribution losses associated with the transportation of petroleum fuels by road.

In view of the increasing use of Lake Victoria as a cheap route for international transit traffic by the land-locked neighboring countries, KPC will carry out a feasibility study on the construction of an oil jetty to be connected to the Kisumu pipeline terminal during the current plan period.

f International Road Transport

Kenya is a signatory to important regional and international conventions in the area of transportation, which aim at greater integration of African economies. Important programs are the Lagos Plan of Action, the Final Act of Lagos of the Organization of African Unity (OAU), and the Second United Nations Transport and Communications Decade in Africa (UNTACDA II). During the 1989 - 1993 plan period, the construction of the Lodwar - Lokichogio section of the Kenya - Sudan road was completed while the construction of the Thika - Garissa - Libooi road is yet to be completed. However, due to financial constraints, Kenya did not complete her section of the Gabarone - Cairo Trans-Africa Highway, which still requires upgrading to bitumen standards, especially in the Isiolo - Moyale section. Kenya is also a signatory to the Trans-Africa Highway Bureau. Moreover, the Government will complete the on-going construction of the Thika - Garissa - Liboi Road as well as upgrade to bitumen standards the Emalii - Oloitokitok road. This should improve land communication between Kenya and Tanzania.

4) Urban Land Use Policy

Population increase together with a progressive but also spontaneous urbanization process are real challenges for economic and/or social development. While the "District Focus" is an important instrument for achieving the goal of balanced development between rural and urban areas, it is nevertheless imperative to establish an urban development policy, which addresses the most likely future as well as existing urban problems. In line with the development theme of the current plan, several policies on urban land use are suggested :

- The Service Center Policy
- The Growth Center Policy; and
- The integrated Transport and Communication Network Policy.

Urban land use policy aims at ensuring that the urbanization process is guided in the desired direction and to avoid over-concentration in such a few areas as Nairobi and Mombasa.

a The Service Centers Policy

The policy has been enunciated already in past national development plans. It is basically rural oriented and aims at improving the quality of rural life by providing basic services such as education, health, sanitation, water, power and a variety of others. These services are to be provided and concentrated in over 1,700 designated country-wide centers. The rationale of this concentration of services is to ensure the most efficient use of limited resources available, and thus enhance sustainable rural development.

b The Growth Centers Policy

This policy has a number of designated urban centers and principal towns earmarked for intensified development of infrastructure and services. These centers are Mombassa, Kisumu, Eldoret, Nakuru, Nyeri, and Kakamega. The status of these centers will be upgraded to city status. The aim is to attract investment into commercial, industrial, tourism and residential development. This would promote these centers to become alternative focal points to Nairobi and Mombassa in terms of employment opportunities. The Sessional Paper No. 1 mentioned earlier stipulates that the Government's objective is to concentrate scarce resources for urban infrastructure in selected small towns designated as Rural Trade and Production Centers (RTPCs). The objectives of the program will

be harmonized with those of the Growth Centers Policy, in order to avoid duplication of infrastructure distribution and uncoordinated developments.

c Integrated Transports and Communication Network Policy

The policy is intended to complement the above policies by providing inter-linkages between various categories of centers and between different parts of the country. In this regard, all principal growth centers should be progressively linked by the national trunk road network, as a minimum. Designated urban centers are to be linked by secondary roads and market and local centers by minor roads, as a minimum.

5) Development of Tourism and Wild Life

The tourist sector is the single leading foreign exchange earning sector in the country. Since 1987, foreign exchange earnings from this sector have been slightly higher than the combined foreign exchange earnings from coffee and tea, the traditional foreign exchange earners. The sector generated more than 34% of the total foreign exchange earnings in 1993. In terms of employment, the tourism sector is estimated to have accounted for about 8% of the total wage employment in the same year. In addition, income from tourism related economic activities has become an important and reliable source of revenue to the Central Government and Local Authorities.

The current Seventh National Plan projects the number of tourists up to the year 1996 as summarized in Table 3.3.2. Emphasis is placed in the plan on shifting marketing from the promotion of mass tourism to the targeting of up-market based ecotourism.

Table 3.3.2 Projected Number of Tourists an Earning, 1993 - 1996

(thousands)

Year	1992	1993	1994	1995	1996
Tourists arrivals	699	783	822	863	907
Earnings (K£ Million)	713	749	786	825	867
Bed-nights:-					
Residents	656	692	727	763	802
Non-Residents (over 30 days)	123	129	125	142	150
Foreigners	4,747	5,693	5,978	6,277	6,590
Total Bed-nights	5,526	6,514	6,830	7,182	7,542

Source: The Seventh National Development Plan for the period 1994 - 1996

Ecotourism has a potential of becoming a moderately useful tool for locally directed and participatory rural development based, which is based the on rational utilization of environmental and cultural resources.

In addition, JICA has carried out The National Tourism Master Plan. The following if a brief summary of the main points of this plan.

a Tourism Development Strategies

- Diversification of Tourism

  Kenya is well known as a beach and wildlife tourism destination. To differentiate Kenya from competitor destinations, more attractions, such as the cultural, historical and archaeological tourism should be developed. Even a different type of wildlife tourism should be created to meet the market needs.

  Kenya should seek new tourism originating markets. Prospective new markets are identified to be the Pacific Rim (Far-East and South-East Asia), South Asia, North America and the domestic tourism market.

- Distribution of Tourism Benefits

  Kenya should distribute tourists geographically, in order to protect the environment of over-crowded parks and reserves from deterioration, to give tourists more satisfaction, and to spread tourism benefits to remote areas.

- Improvement of Travel Conditions

  Congestion in parks and reserves should be resolved. This could be achieved not only by spatial distribution, but also by the efficient use of existing wildlife areas. It is proposed to increase the road density . The designation of "tourist areas" in urban and rural area is also proposed to improve the level of amenities.

  It is important for Kenya tourism to improve the quality of tourist services. The quality of services is one of the most significant factor for future tourism development prospect.

- Conservation of Natural and Cultural Heritage

  Nature and wildlife are the essentials for Kenya tourism. Kenya should protect and improve them through better management of tourism development.

Traditional culture would serve greatly to diversify tourism types and source markets. Unique landscapes and townscapes also represent attractions for tourists. The conservation of towns with Swahili architecture deserve particular consideration.

b Development Framework

Target numbers of tourists are estimated covering foreign as well as domestic tourists. The future socioeconomic framework applied in this Road Master Plan is also used in the tourism development plan. The number of foreign tourist' arrivals are estimated at 1.1 million people in the year 2000, and 2.1 million people in the year 2010. Figure 3.3.1 shows the tourism regions identified in the tourism master plan. Table 3.3.3 shows the estimated number of visitors to the tourism regions.

c Spatial Development Concept

A spatial development concept for the whole nation in the year 2010 is illustrated in Figure 3.3.2. The development concept for each tourism region and the proposed plan for the road development are as follows :

- Central and Nairobi Tourism Region

  Nairobi should be developed as a Gateway to East Africa. Mt. Kenya tourism circuit improvement and the enhancement of the Rift Valley Lake resort development are proposed. Upgrading and improvement of the road network, which form the tour circuits are proposed as part of infrastructure development.

- Masailand Tourism Region

  Masailand should form a part of The East African Great Safari Circuit. The circuit includes the Northern part of Tanzania. Improvement of accessibility is indispensable. Utilization of wildlife resources outside of Masai Mara are also proposed.

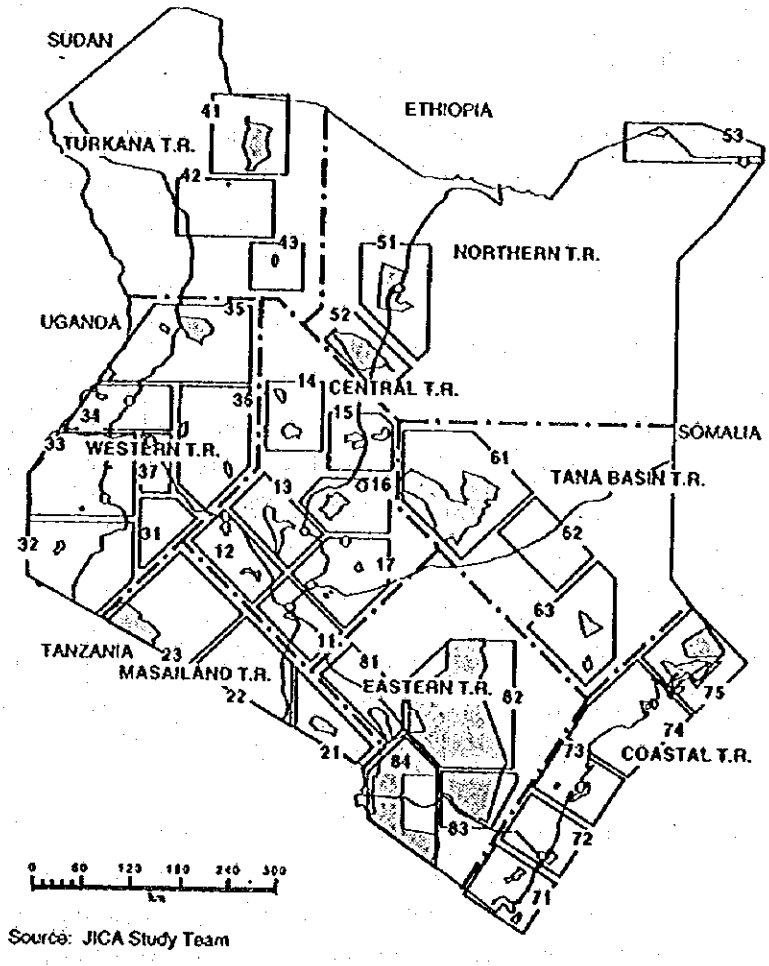


Fig. 3.3.1 Tourism Regions and Areas

Table 3.3.3 Estimated Number of Visitor to the Tourism Regions

Name of Tourism Region	Year 2000		Year 2010	
	Number of visitors ('000)	Average length of stay (days)	Number of visitors ('000)	Average length of stay (days)
*Nairobi	785	5.8	1,636	5
Central	261	4	684	4
Masailand	431	1.8	745	2
Western	191	4	415	5
Turkana	23	5	151	5
Northern	24	2	54	3
Tana Basin	11	2.5	109	5
Coastal	588	13	1,110	12
Eastern	367	1.5	691	2

Note: *Nairobi is a part of Central Tourism Region
Source: The National Tourism Master Plan, JICA

- Western Tourism Region

  The introduction of new types of wildlife watching safari and enhancement of cultural and historical tourism are proposed for diversification of tourists' destinations. Improvement of access roads to form the new circuits are proposed.

- Turkana and Northern Tourism Region

  Lake resort development in a unique atmosphere and the establishment of adventure type tour circuits are proposed. Improvement of travel conditions especially security and accessibility is most important.

- Tana Basin Tourism Region

  Adventure type tourism development, such as river safaris and rafting are proposed. Improvement of access roads to the Meru National Park and improvements of safari route roads are proposed.

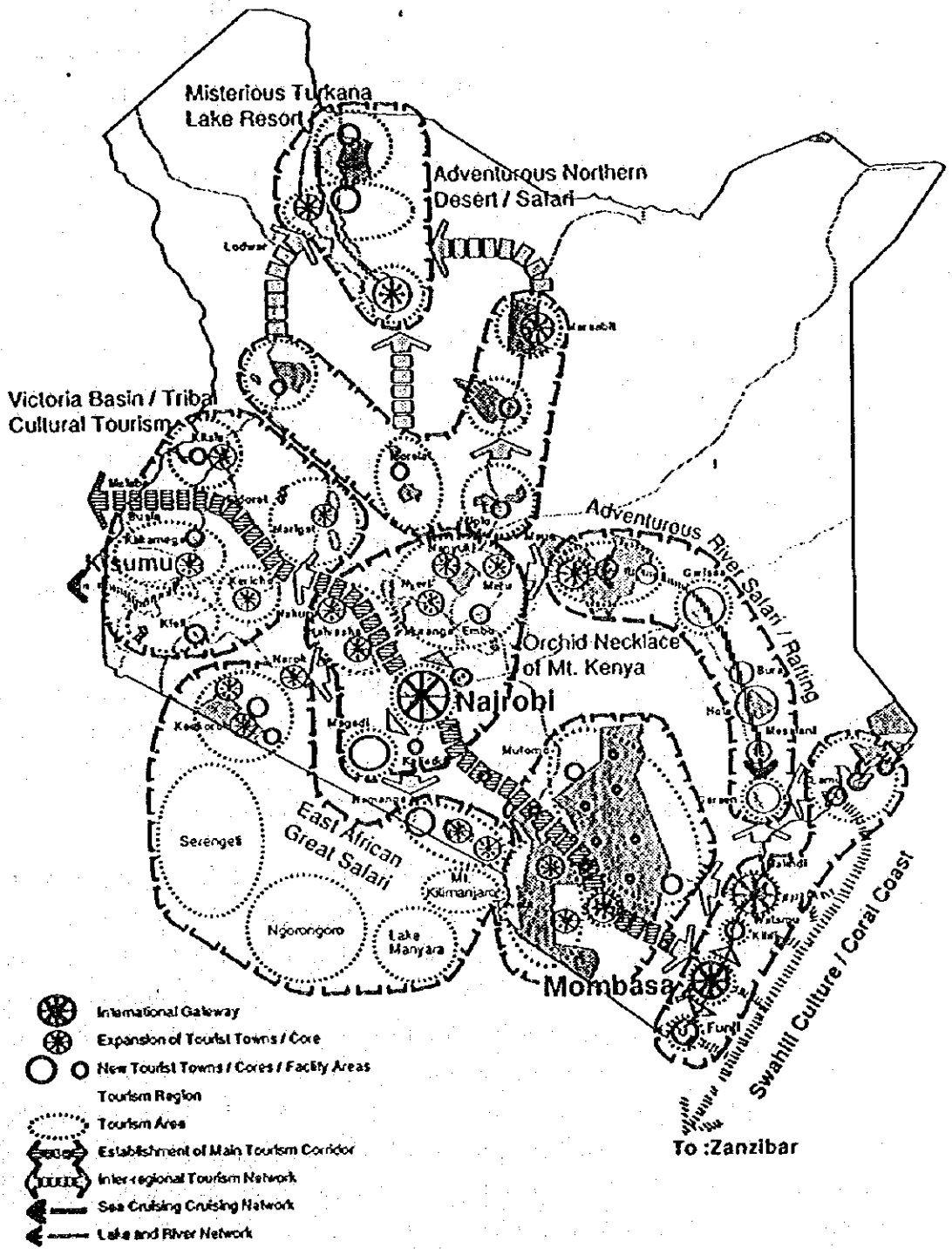
- Coastal Tourism Region

  This region continues to be the largest tourism base in Kenya. Improvement and expansion of the beach resorts along the coast and the utilization of cultural and historical tourism resources are proposed. Since Mombassa is the second largest gateway to Kenya, improvement of urban amenities and sub-gateway functions are also proposed.

- Easter Tourism Region

  This region is characterized by an attractive combination of beach resort and wildlife watching safari. Utilization of Tsavo National Park is proposed. Improvement of the main safari road network for Tsavo East and West is necessary.

As mentioned above already, the spatial development concept in the year 2010 for the whole nation is illustrated in Figure 3.3.2



Source : JICA Study Team

Road Network Development
Master Plan in Kenya

Figure 3.3.2
Spatial Development Concept

3.3.2 National Development Framework

The Ministry of Planning and National Development has undertaken some projections to forecast Kenya's long-term socio-economic framework. These projections form, inter alia, an input into the recently published "Sessional Paper on Recovery and Sustainable Development". The following numeric socio-economic projections are based on the Ministry's data and the sessional paper mentioned above. They are made for such parameter as the total national population, broken down into urban and rural population, the labor force, GDP, wage employment, and other macro economic factors.

(1) Population and Urbanization Framework

Kenya's population grew from some 15,237,000 people in 1979 to about 22,067,000 people in 1989, that is at an average annual growth rate of 3.7 %. The future projection estimate a gradual decrease in the annual growth rate. Population growth is expected to be an annual 2.9 % over the years 1989 - 1995, 2.55 % over the period 1995 - 2000, 2.31 % in the period 2000 - 2005 and 2.07 % over the period 2005 - 2010. Hence, total population size in 2010 is estimated at 36,898,000 people, which represents a 50 % increase in absolute terms from the estimated 1994 population of 25,501,000 (Table 3.3.2 refers).

The Sessional Paper No. 1 of 1986 estimated Kenya's total population in the year 2000 to be in the order of magnitude of some 34,800,000 people. The projections of the Ministry of Planning and National Development have lowered this expectation to a level of some 29,706,000 people for that year.

The Sessional Paper also assumed that the absolute size of the urban population would grow to about 9 to 10 million people in the year 2000. This would have represented about 25 % of the total population. The Ministry's latest projection, however, is at a level of about 7 million people in the year 2000, representing some 23 % of the total population. The Ministry's current framework estimates the urbanization level to reach some 11.2 million people in the year 2010, implying a urban ratio of 30 % as compared to 20 % in 1994 (Table 3.3.4 refers). In other words, the urban ratio as well as urban population are projected lower than those indicted in the Sessional Paper of 1986. A most challenging task for development planning will be the successful realization of population growth controls.

Table 3.3.4 Projected Future Population and Urbanization Framework

Year	Total Population		Urban Population		Rural Population		Urban Ratio
	Persons (x 1,000)	Growth Rate (% p.a.)	Persons (x 1,000)	Growth Rate (% p.a.)	Persons (x 1,000)	Growth Rate (% p.a.)	Urban/Total (%)
1979	15,327		2,313		13,014		15.09
		3.71		5.07		3.45	
1989	22,067		3,791		18,276		17.18
		(2.93)		(5.88)		(2.28)	
(1994)	(25,501)		(5,045)		(20,456)		(19.78)
		2.90		5.83		2.23	
1995	26,191		5,326		20,865		20.34
		2.55		5.44		1.76	
2000	29,706		6,941		22,765		23.37
		2.31		5.18		1.37	
2005	33,305		8,933		24,372		26.82
		2.07		4.69		1.04	
2010	36,898		11,235		25,663		30.45

Source: Ministry of Planning and National Development, 1994

(2) Gross Domestic Product and Per Capita GDP

The "Economic Survey 1994" shows the preliminary shares of major GDP sectors in 1993. The non-monetary economy maintains a 5.5 % share in total GDP, and agriculture, manufacturing, services and the Government sectors of the monetary economy accounted for 26.4 %, 13.8 %, 38.1 %, and 16.1 % of GDP in 1993, respectively (Table 3.3.5 refers).

Table 3.3.5 Projected Future Gross Domestic Product (GDP at 1982 Constant Price)

(unit: Million K£)

Year	Non-Monetary Economy	Monetary Economy					Total
		Agriculture	Manufac-turing	Services	Gov't	S-Total	
1993	239.6	1,147.2	599.2	1,652.5	699.1	4,098.0	4,337.6
(%)	(5.5)	(26.4)	(13.8)	(38.1)	(16.1)	(94.5)	(100.0)
1994	245.8	1,204.6	617.8	1,707.0	704.7	4,235.7	4,479.9
(%)	(5.5)	(26.9)	(13.8)	(38.1)	(15.5)	(94.5)	(100.0)
1995	255.4	1,280.5	647.4	1,794.1	728.7	4,452.6	4,706.0
(%)	(5.4)	(27.5)	(13.8)	(38.1)	(15.7)	(94.6)	(100.0)
2000	320.4	1,621.6	856.6	2,494.8	908.8	5,884.3	6,202.2
(%)	(5.2)	(26.1)	(13.8)	(40.2)	(14.7)	(94.8)	(100.0)
2005	394.6	2,018.8	1,169.1	3,479.2	1,191.2	7,860.2	8,252.9

(%)	(4.8)	(24.5)	(14.2)	(42.1)	(14.4)	(95.2)	(100.0)
2010	460.5	2,411.6	1,641.2	4,739.8	1,513.0	10,306.1	10,766.2
(%)	(4.3)	(22.4)	(15.2)	(44.0)	(14.1)	(95.7)	(100.0)

Source: Economic Survey 1994, Central Bureau of Statistics, and Ministry of Planning and National Development

The Ministry's projection of future GDP development are also presented in Table 3.3.5. Major characteristics can be summarized as follows :

- The share of the non-monetary economy is assumed to gradually decrease from 5.5 % in 1993 to 4.3 % in 2010
- The share of the agricultural sector is assumed to be more than 25 % in 2000, but to decline to 22.4 % in 2010
- The manufacturing sector keeps its share with 13.8 % by 2000 somewhat constant, but increases its share in GDP up to 15.2 % in 2010
- Industrialization is less emphasized as compared to agricultural development in the medium term planning, but is expected to increase substantially in the long-term planning
- The services sector is expected to occupy a major share of GDP in the future as well as in the past, and its growth rate is expected to be above GDP growth
- It is anticipated that the higher growth rate and share of the services sector are the consequence of intended higher creation of job opportunities in the informal sector, which requires less and effective use of the limited investment resources; and
- The Government sector is intended to reduce its share in GDP at a constant and steady pace.

The "Economic Survey 1994" quotes real GDP growth from 1992 to 1993 to have been 0.13 %. This would indicate a further decline as to the 0.48 % rate achieved from 1991 to 1992.

The Ministry of Planning and National Development, however, stresses a need to achieve a rapid economic recovery by the year 1995, as shown in Table 3.3.6. Real GDP growth rates (constant 1982 price base) are estimated at 3.28 %. from 1993 to 1994 and 5.05 % from 1994 to 1995. Future GDP growth is projected to

exceed population growth, in order to secure the improvement of income levels and people's living standards.

Table 3.3.6 Growth Rates of Future Gross Domestic Product (GDP)

(unit: % p.a.)

Year	Non-Monetary Economy	Monetary Economy					Total
		Agriculture	Manufac-turing	Services	Gov't	S-Total	
1993	2.59	5.00	3.10	3.30	0.80	3.32	3.28
1994	3.91	6.30	4.79	5.10	3.40	5.12	5.05
1995	4.64	4.84	5.76	6.82	4.52	5.73	5.68
2000	4.25	4.48	6.42	6.88	5.56	5.96	5.88
2005	3.14	3.62	7.00	6.38	4.90	5.57	5.46
2010							

Source : Ministry of Planning and National Development, 1994

It appears from these estimations that overall GDP growth is led by the agricultural sector in the short term perspective, by the services sector in the medium term perspective, and by the manufacturing sector in a long term perspective.

Kenya's economic development has been facing a difficult time in the early 1990s. This is reflected in the minus growth of per capita GDP, which was -1.2 % from 1990 to 1991, -0.1 % from 1991 to 1992, and a provisional -5.7 % from 1992 to 1993. This would translate into an annual average -2.4 %. over the period 1990 to 1993. Future per capita GDP growth is projected low by the year 1995, but it is anticipated to grow gradually to 3.48 %. over the years 2000 - 2005 and dropping slightly to about 3.32 % p.a. during 2005 - 2010 (Table 3.3.7 refers)..

Table 3.3.7 Projected Future GDP Per Capita Growth Rate

(at 1982 Constant Price)

Year	GDP Per Capita (K£)	Growth Rate (% p.a.)
1993	174.8	
		0.50
1994	175.7	
		2.28
1995	179.7	
		3.05
2000	208.8	
		3.48
2005	247.8	
		3.32
2010	291.8	

Source : Ministry of Planning and National Development, 1994

(3) Labor Force and Wage Employment

The total labor force in 1993 is estimated at nearly 11 million people, which is about 44 % of the total population. Wage employment is defined to include such employment as casual employees, part-time workers, directors and partners serving on a regular basic salary contract. Self-employed persons and family workers who do not receive regular wages or salaries and all activities the in rural non-agriculture sector are excluded from the category of wage employment. Total wage employment in 1993 is enumerated at nearly 1.5 million people, which is about 14 % of the labor force (Table 3.3.8 refers).

It is projected that over the period 1993 to 2010 the absolute population size will increase by some 12 million people. This would translate into an absolute increase of the labor force by about 8 million people. In other words, in a 17 years period job opportunities would have to be prepared for another 80 % of the labor force existing already in 1993. The proportion of labor force against the total population is estimated to rise from about 43.6 % in 1993 to some 51.1 % in 2010. Hence, growth of the labor force exceeds that of the population.

Table 3.3.8 Projected Future Labor Force and Wage Employment

Year	Population	Labor Force		Wage Employment	
	(x 1,000)	(x 1,000)	% over Population	(x 1,000)	% over Labor Force
1993	24,812.0	10,807.0	43.6	1,474.9	13.6
(G.R. % p.a.)	(2.78)	(3.89)		(0.89)	
1994	25,501.0	11,227.0	44.0	1,488.0	13.3
(G.R. % p.a.)	(2.71)	(3.82)		(3.84)	
1995	26,191.0	11,656.0	44.5	1,545.1	13.3
(G.R. % p.a.)	(2.55)	(3.65)		(5.52)	
2000	29,706.0	13,943.0	46.9	2,021.4	14.5
(G.R. % p.a.)	(2.31)	(3.29)		(6.32)	
2005	33,305.0	16,390.0	49.2	2,746.1	16.8
(G.R. % p.a.)	(2.07)	(2.85)		(5.95)	
2010	36,898.0	18,863.0	51.1	3,665.8	19.4

Source: Ministry of Planning and National Development

Wage employment, also called employment in the modern sector, is to grow from 1.5 million people in 1993 to about 3.7 million people in 2010. The share of wage employment in the total labor force is projected to increase from 13.6 % in 1993 to 19.4 % in 2010. It is anticipated that the growth of wage employment will accelerate after the year 1995 to about double the rate of labor force growth. It is therefore inevitable to prepare a proper plan for the growth center development and to encourage the achievement of the wage employment increase in a long term perspective.

3.3.3 Regional Development Framework

(1) Potential Development Scenario

District Development Plans (so called DDPs) for the period 1994 to 1996 have been prepared for the respective 47 districts in Kenya. In principle, the DDPs are based on the Seventh National Development Plan. A long-term perspective for district development is not deliberated in the national plan.

A regional development concept, which is based on the previous discussions, is presented in Figure 3.3.3.

(2) Distribution of Population and Wage Employment

The administrative area of "District" has been adopted as a unit for traffic zoning, taking into account the availability of statistics, survey data, planning information and also compatibility with the study purpose.

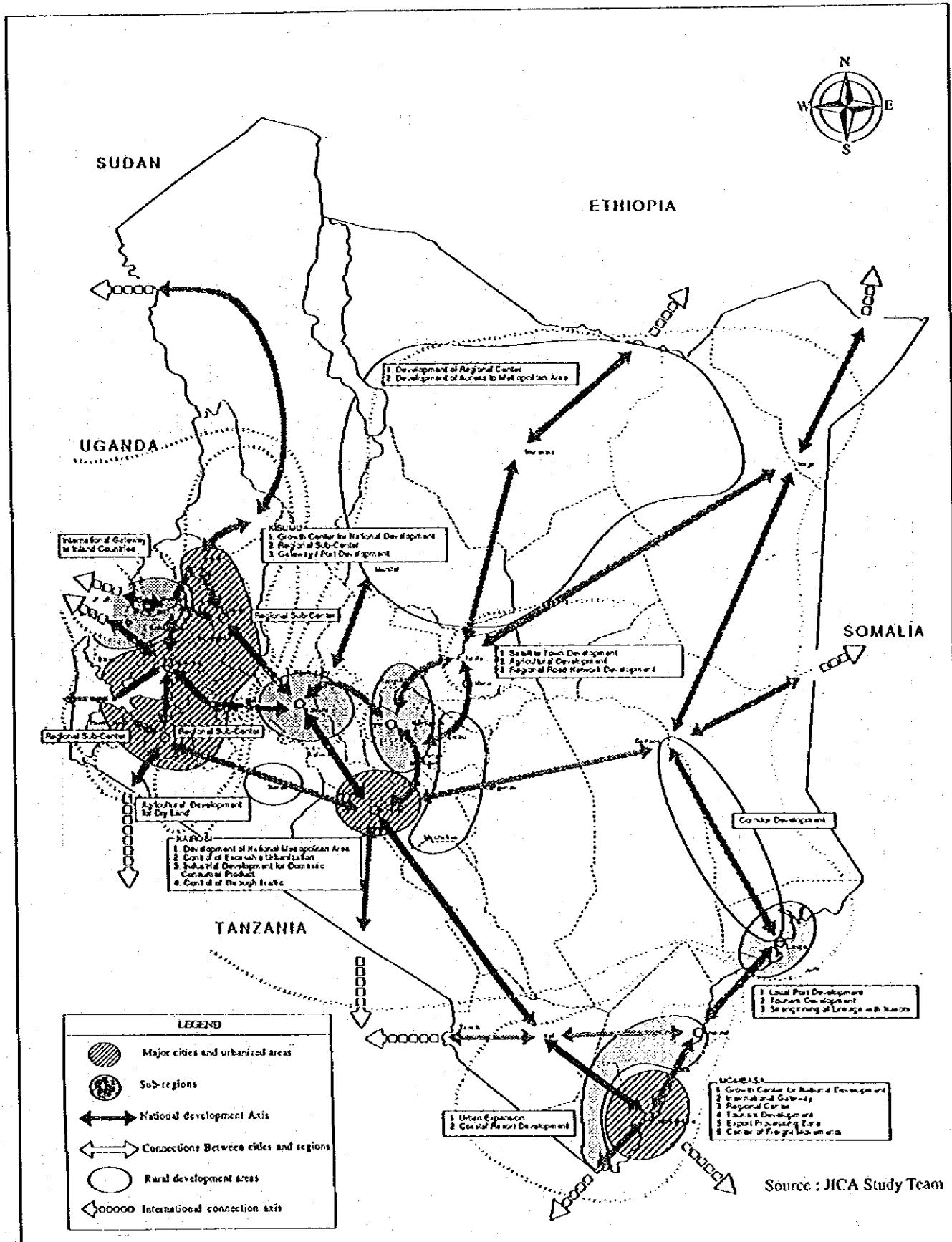
Planning parameters at the district level, which have been used for the analysis of traffic movements, have been size of the population, broken down into urban and rural population, and the wage employment in the modern sector.

The national level of these parameter were projected already for a long-term perspective, that is up to 2010, by the Ministry of Planning and National Development. They were introduced and discussed in the previous section 3.3.2.

1) Future Provincial Framework

a Total Population

The size of the national total population was about 15 million in 1979 and increased to some 22 million people in 1989, that is at an average annual growth rate of 3.71%. The Rift Valley Province held in 1989 the largest share, accounting for about 23.2 % (5.1 million) of the national population, followed by the Eastern Province with a share of 17.6 % (3.9 million), the Nyanza Province with 16.4 % (3.6 million), the Central Province, with 14.5 % (3.2 million) and the Western Province, with 11.9 % (2.6 million). The lowest population share was recorded in the Northeastern Province with a share of 1.7 % (0.4 million) followed by Nairobi Province with 6.2 % (1.4 million) and the Coastal Province with 8.5 % (1.9 million) (Table 3.3.9 refers).



Road Network Development Master Plan in Kenya

Figure 3.3.3
Regional Development Concept

Table 3.3.9 Estimated Future Population by Province

PROJECTED FUTURE PROVINCIAL POPULATION							
PROVINCE	1979	1989	1994	1995	2000	2005	2010
COASTAL	1,342,794	1,882,365	2,136,276	2,186,103	2,433,334	2,675,332	2,907,569
NORTHEAST	373,787	382,187	385,361	385,938	388,620	390,983	393,046
EASTERN	2,719,851	3,878,232	4,429,736	4,538,403	5,079,533	5,612,229	6,126,076
CENTRAL	2,345,833	3,207,305	3,605,800	3,683,537	4,067,209	4,439,640	4,794,364
NAIROBI	827,775	1,363,075	1,805,695	1,903,443	2,455,826	3,116,657	3,855,307
RIFT VALLEY	3,240,402	5,126,428	6,090,221	6,284,871	7,275,889	8,285,979	9,291,466
NYANZA	2,643,956	3,609,115	4,055,081	4,142,044	4,571,112	4,987,385	5,383,674
WESTERN	1,832,663	2,618,292	2,992,830	3,066,661	3,434,476	3,796,794	4,146,498
TOTAL	15,327,061	22,067,000	25,501,000	26,191,000	29,706,000	33,305,000	36,898,000
PERCENTAGE DISTRIBUTION OF PROVINCIAL POPULATION							
PROVINCE	1979	1989	1994	1995	2000	2005	2010
COASTAL	8.76%	8.53%	8.38%	8.35%	8.19%	8.03%	7.88%
NORTHEAST	2.44%	1.73%	1.51%	1.47%	1.31%	1.17%	1.07%
EASTERN	17.75%	17.57%	17.37%	17.33%	17.10%	16.85%	16.60%
CENTRAL	15.31%	14.53%	14.14%	14.06%	13.69%	13.33%	12.99%
NAIROBI	5.40%	6.18%	7.08%	7.27%	8.27%	9.36%	10.45%
RIFT VALLEY	21.14%	23.23%	23.88%	24.00%	24.49%	24.88%	25.18%
NYANZA	17.25%	16.36%	15.90%	15.81%	15.39%	14.97%	14.59%
WESTERN	11.96%	11.87%	11.74%	11.71%	11.56%	11.40%	11.24%
TOTAL	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
PROJECTED GROWTH RATE OF PROVINCIAL POPULATION							
PROVINCE	1979/1989	1989/1994	1989/1995	1995/2000	2000/2005	2005/2010	
COASTAL	3.44%	2.56%	2.52%	2.17%	1.91%	1.68%	
NORTHEAST	0.22%	0.17%	0.16%	0.14%	0.12%	0.11%	
EASTERN	3.61%	2.69%	2.65%	2.28%	2.01%	1.77%	
CENTRAL	3.18%	2.37%	2.33%	2.00%	1.77%	1.55%	
NAIROBI	5.11%	5.79%	5.72%	5.23%	4.88%	4.35%	
RIFT VALLEY	4.69%	3.51%	3.45%	2.97%	2.63%	2.32%	
NYANZA	3.16%	2.36%	2.32%	1.99%	1.76%	1.54%	
WESTERN	3.63%	2.71%	2.67%	2.29%	2.03%	1.78%	
TOTAL	3.71%	2.93%	2.90%	2.55%	2.31%	2.07%	

Nairobi shows the highest population growth. It was recorded at 5.1 % p.a. over the census period 1979 - 1989, while the national average was 3.7 % p.a. . This implies that more than 1.5 % p.a. is the net in-migration to Nairobi. The Rift Valley Province also shows with an annual average rate of 4.7% a high rate of population growth. The lowest population growth rate was recorded for the Northeastern Province with an average annual growth rate of 0.2 % during the same period. Other Provinces, namely the Coastal, Eastern, Central, Nyanza, and the Western Provinces showed rates at around the national average : 3.4 %, 3.6 %, 3.2 %, 3.2 %, and 3.6 %, respectively.

Since future population projections for the respective provinces are not available, the following method was adopted to determine the future population size :

- Nairobi is treated as an urbanized region, of which population should be analyzed separately
- Accordingly, Nairobi population is determined externally and deducted from the projected future national population
- The past trend of population growth in the provinces is adopted, and the resulting preliminary figures are adjusted to coincide with the previously determined national total, except for Nairobi.

Consequently, the future provincial population was estimated as presented in Table 3.3.9.

b Urban and Rural Population

The urban population in 1989 was 3.8 million people, accounting for 17 % of the national total population. As stated earlier, it is now estimated by the Ministry of Planning and National Development to have reached a level of about 5 million people, or about 20 % of the national population in 1994. During the inter-census period from 1979 to 1989, the urban population grew at an average annual rate of 5.1 %, and it was estimated to rise at a higher rate of 5.9 % p.a. over the period 1989 to 1994.

The highest growth among the provinces during the inter-census period was in the Central Province with 8.3% p.a., followed by the Western

Province with 6.6 % p.a., the Rift Valley with 6.4 % p.a. and Nairobi with 5.1 % p.a.

Nairobi takes a major portion, accounting for about 36 % of the total urban population in Kenya. The second is the Coastal Province with 18 %, followed by the Rift Valley Province, with 15 %. The Coastal Province holds the highest urban ratio of 31 %, which is defined as a proportion of urban population over the total population. This is apparently because of Mombasa. Other provinces are less urbanized than the national average of 15 % as shown in Table 3.3.10.

For estimating the future urban population by province, a distribution method of the projected national urban population is based on the previously established potential development scenario :

- The Central, Rift Valley and Western Provinces experienced a higher urbanization rate than the national average of 5.1 % p.a.

- The Central and Western Provinces are agricultural potential areas that require careful attention for a balanced development between rural and urban areas

- The Rift Valley Province has, except for the western part, a water problem. Therefore, it is not realistic to maintain the high urbanization rate until 2010

- Accordingly, it was assumed that the urbanization speed of those provinces would slow down

- The Northeastern Province had the lowest rate during the inter-census period. Taking into account development potentials of the Province, a low rate of urban settlement is realistic, and the situation is unlikely to change even in the long-term future. Therefore, the past trend which reflects a low rate of urban growth, was adopted for the Northeastern Province

- A growth rate of urban population in Nairobi shows a similar rate to the national average during the inter-census period. Nairobi is the largest urban region, which occupies 36.0 % of the national urban population and 6.2 % of the total population in 1989

Nairobi has an outstanding urban population of some 1.4 million people. To control its urban growth at a level of less than the targeted national average will require utmost efforts, though Nairobi's population in 2010 will still reach about 10 % of the national total. Therefore, it was assumed that the population growth in Nairobi will maintain the same correlation with the national average of future urban population growth

- The remaining three provinces, namely the Coastal, Eastern and Nyanza Provinces experienced comparatively lower urban growth at less than the national average. As the consequence of the slow-down of urbanization in the Central, Rift Valley and Western Provinces, it was assumed that they should absorb the excessive urban population from the Central, Rift Valley and Western Provinces.

The future urban population by province was thus estimated as shown in Table 3.3.9. The future rural population as shown in Table 3.3.11 was simultaneously derived from the previously estimated provincial population.

c Wage Employment

Wage employment is another district parameter imperative for analyzing the present and future traffic movements. This is so, because the modern sector employment generates more traffic, not only in terms of volume, but also in terms of travel distance than the traditional, small-scale or self-employed economic sector.

Future wage employment by province has been estimated based on past trends of urban population growth as well as wage employment growth. The preliminary figures derived from the trend analysis were adjusted to the national total set up as discussed in the previous sections 3.2.5 and 3.3.1. The estimated results are presented in Table 3.3.12.

Table 3.3.10 Estimated Future Urban Population by Province

PROJECTED FUTURE PROVINCIAL URBAN POPULATION							
PROVINCE	1979	1989	1994	1995	2000	2005	2010
COASTAL	413,327	594,714	730,142	758,712	913,162	1,194,792	1,530,548
NORTHEAST	43,951	57,907	67,649	69,643	80,118	91,266	102,436
EASTERN	241,801	341,041	414,019	429,310	511,436	662,748	841,664
CENTRAL	129,992	287,198	448,965	488,350	733,847	999,575	1,322,011
NAIROBI	827,775	1,363,075	1,805,695	1,903,442	2,455,826	3,116,657	3,855,307
RIFT VALLEY	343,164	639,211	907,680	969,466	1,333,196	1,669,106	2,044,543
NYANZA	225,370	342,463	433,586	453,170	560,951	753,631	988,685
WESTERN	87,196	165,390	237,264	253,905	352,464	445,225	549,806
TOTAL	2,312,576	3,791,000	5,045,000	5,326,000	6,941,000	8,933,001	11,235,000
PERCENTAGE DISTRIBUTION OF PROVINCIAL URBAN POPULATION							
PROVINCE	1979	1989	1994	1995	2000	2005	2010
COASTAL	17.87%	15.69%	14.47%	14.25%	13.16%	13.38%	13.62%
NORTHEAST	1.90%	1.53%	1.34%	1.31%	1.15%	1.02%	0.91%
EASTERN	10.46%	9.00%	8.21%	8.06%	7.37%	7.42%	7.49%
CENTRAL	5.62%	7.58%	8.90%	9.17%	10.57%	11.19%	11.77%
NAIROBI	35.79%	35.96%	35.79%	35.74%	35.38%	34.89%	34.32%
RIFT VALLEY	14.84%	16.86%	17.99%	18.20%	19.21%	18.68%	18.20%
NYANZA	9.75%	9.03%	8.59%	8.51%	8.08%	8.44%	8.80%
WESTERN	3.77%	4.36%	4.70%	4.77%	5.08%	4.98%	4.89%
TOTAL	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
PROJECTED GROWTH RATE OF PROVINCIAL URBAN POPULATION							
PROVINCE	1979/1989	1989/1994	1989/1995	1995/2000	2000/2005	2005/2010	
COASTAL	3.71%	4.19%	4.14%	3.78%	5.52%	5.08%	
NORTHEAST	2.80%	3.16%	3.12%	2.84%	2.64%	2.34%	
EASTERN	3.50%	3.95%	3.91%	3.56%	5.32%	4.90%	
CENTRAL	8.25%	9.35%	9.25%	8.49%	6.38%	5.75%	
NAIROBI	5.11%	5.79%	5.72%	5.23%	4.88%	4.35%	
RIFT VALLEY	6.42%	7.26%	7.19%	6.58%	4.60%	4.14%	
NYANZA	4.27%	4.83%	4.78%	4.36%	6.08%	5.58%	
WESTERN	6.61%	7.48%	7.41%	6.78%	4.78%	4.31%	
TOTAL	5.07%	5.88%	5.83%	5.44%	5.18%	4.69%	
PROJECTED URBAN RATIO BY PROVINCE							
PROVINCE	1979	1989	1994	1995	2000	2005	2010
COASTAL	30.78%	31.59%	34.18%	34.71%	37.53%	44.66%	52.64%
NORTHEAST	11.76%	15.15%	17.55%	18.05%	20.62%	23.34%	26.06%
EASTERN	8.89%	8.79%	9.35%	9.46%	10.07%	11.81%	13.74%
CENTRAL	5.54%	8.95%	12.45%	13.26%	18.04%	22.51%	27.57%
NAIROBI	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
RIFT VALLEY	10.59%	12.47%	14.90%	15.43%	18.32%	20.14%	22.00%
NYANZA	8.52%	9.49%	10.69%	10.94%	12.27%	15.11%	18.36%
WESTERN	4.76%	6.32%	7.93%	8.28%	10.26%	11.73%	13.26%
TOTAL	15.09%	17.18%	19.78%	20.34%	23.37%	26.82%	30.45%

Table 3.3.11 Estimated Future Rural Population by Province

PROJECTED FUTURE RURAL POPULATION BY PROVINCE

PROVINCE	1979	1989	1994	1995	2000	2005	2010
COASTAL	929,467	1,287,651	1,406,134	1,427,391	1,520,173	1,480,540	1,377,021
NORTHEAST	329,836	324,280	317,711	316,295	308,502	299,717	290,610
EASTERN	2,478,050	3,537,191	4,015,717	4,109,093	4,568,098	4,949,481	5,284,412
CENTRAL	2,215,841	2,920,107	3,156,836	3,195,186	3,333,362	3,440,065	3,472,353
NAIROBI	0	0	0	0	0	0	0
RIFT VALLEY	2,897,238	4,487,217	5,182,541	5,315,405	5,942,691	6,616,873	7,246,923
NYANZA	2,418,586	3,266,651	3,621,495	3,688,874	4,010,160	4,233,754	4,394,989
WESTERN	1,745,467	2,452,902	2,755,565	2,812,756	3,082,012	3,351,569	3,596,692
TOTAL	13,014,485	18,276,000	20,456,000	20,865,000	22,765,000	24,371,999	25,663,000

PERCENTAGE DISTRIBUTION OF PROVINCIAL RURAL POPULATION

PROVINCE	1979	1989	1994	1995	2000	2005	2010
COASTAL	7.14%	7.05%	6.87%	6.84%	6.68%	6.07%	5.37%
NORTHEAST	2.53%	1.77%	1.55%	1.52%	1.36%	1.23%	1.13%
EASTERN	19.04%	19.35%	19.63%	19.69%	20.07%	20.31%	20.59%
CENTRAL	17.03%	15.98%	15.43%	15.31%	14.64%	14.11%	13.53%
NAIROBI	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
RIFT VALLEY	22.26%	24.55%	25.34%	25.48%	26.10%	27.15%	28.24%
NYANZA	18.58%	17.87%	17.70%	17.68%	17.62%	17.37%	17.13%
WESTERN	13.41%	13.42%	13.47%	13.48%	13.54%	13.75%	14.02%
TOTAL	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

PROJECTED GROWTH RATE OF PROVINCIAL RURAL POPULATION

PROVINCE	1979/1989	1989/1994	1989/1995	1995/2000	2000/2005	2005/2010
COASTAL	3.31%	1.78%	1.73%	1.27%	-0.53%	-1.44%
NORTHEAST	-0.17%	-0.41%	-0.41%	-0.50%	-0.58%	-0.62%
EASTERN	3.62%	2.57%	2.53%	2.14%	1.62%	1.32%
CENTRAL	2.80%	1.57%	1.51%	0.85%	0.63%	0.19%
NAIROBI						
RIFT VALLEY	4.47%	2.92%	2.86%	2.26%	2.17%	1.84%
NYANZA	3.05%	2.08%	2.05%	1.68%	1.09%	0.75%
WESTERN	3.46%	2.35%	2.31%	1.85%	1.69%	1.42%
TOTAL	3.45%	2.28%	2.23%	1.76%	1.37%	1.04%

(3) Estimation of Future District Parameters

Within the provincial frameworks set up previously, such planning parameters as provincial population, urban and rural population and wage employment were broken down into districts pertaining to the province. The past trend derived from the statistical data is a main stream for the breakdown, and further the growth centers designated in the National Plan were given special attention as elaborated on in section 3.2.4 "Urbanization Pattern and Rural Balance". Consequently, the future district parameters were estimated as presented in Tables A2-1 through A2-4 (refer to Appendix 2).

Table 3.3.12 Estimated Future Wage Employment by Province

PROJECTED FUTURE PROVINCIAL WAGE EMPLOYMENT

PROVINCE	1989	1994	1995	2000	2005	2010
COASTAL	170,100	188,305	191,965	230,088	314,105	424,549
NORTHEAST	12,200	13,707	13,834	15,899	18,764	21,891
EASTERN	111,500	129,126	130,648	155,531	210,814	282,541
CENTRAL	199,300	211,533	225,625	333,625	482,697	679,098
NAIROBI	367,800	377,203	393,298	500,984	663,300	863,439
RIFT VALLEY	298,000	320,856	336,216	456,918	602,633	779,103
NYANZA	127,900	147,616	150,457	185,752	262,137	364,303
WESTERN	81,600	99,703	103,057	142,602	191,650	250,874
TOTAL	1,368,400	1,488,049	1,545,100	2,021,400	2,746,100	3,665,800

PERCENTAGE DISTRIBUTION OF PROVINCIAL WAGE EMPLOYMENT

PROVINCE	1989	1994	1995	2000	2005	2010
COASTAL	12.43%	12.65%	12.42%	11.38%	11.44%	11.58%
NORTHEAST	0.89%	0.92%	0.90%	0.79%	0.68%	0.60%
EASTERN	8.15%	8.68%	8.46%	7.69%	7.68%	7.71%
CENTRAL	14.56%	14.22%	14.60%	16.50%	17.58%	18.53%
NAIROBI	26.88%	25.35%	25.45%	24.78%	24.15%	23.55%
RIFT VALLEY	21.78%	21.56%	21.76%	22.60%	21.95%	21.25%
NYANZA	9.35%	9.92%	9.74%	9.19%	9.55%	9.94%
WESTERN	5.96%	6.70%	6.67%	7.05%	6.98%	6.84%
TOTAL	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

PROJECTED GROWTH RATE OF PROVINCIAL WAGE EMPLOYENT

PROVINCE	1989/1994	1989/1995	1995/2000	2000/2005	2005/2010
COASTAL	2.05%	2.04%	3.69%	6.42%	6.21%
NORTHEAST	2.36%	2.12%	2.82%	3.37%	3.13%
EASTERN	2.98%	2.68%	3.55%	6.27%	6.03%
CENTRAL	1.20%	2.09%	8.14%	7.67%	7.07%
NAIROBI	0.51%	1.12%	4.96%	5.77%	5.42%
RIFT VALLEY	1.49%	2.03%	6.33%	5.69%	5.27%
NYANZA	2.91%	2.74%	4.30%	7.13%	6.80%
WESTERN	4.09%	3.97%	6.71%	6.09%	5.53%
TOTAL	1.69%	2.04%	5.52%	6.32%	5.95%

PROJECTED PERCENTAGE OF WAGE EMOLOYENT OVER POPULATION BY PROVINCE

PROVINCE	1989	1994	1995	2000	2005	2010
COASTAL	9.04%	8.76%	8.72%	9.32%	11.48%	14.15%
NORTHEAST	3.19%	3.56%	3.58%	4.09%	4.79%	5.56%
EASTERN	2.88%	2.90%	2.86%	3.02%	3.67%	4.46%
CENTRAL	6.21%	5.83%	6.08%	8.09%	10.64%	13.75%
NAIROBI	26.98%	22.75%	22.88%	24.60%	27.94%	31.72%
RIFT VALLEY	5.81%	5.23%	5.30%	6.16%	7.06%	8.05%
NYANZA	3.54%	3.62%	3.61%	4.01%	5.15%	6.57%
WESTERN	3.12%	3.31%	3.34%	4.09%	4.93%	5.85%
TOTAL	6.20%	5.84%	5.90%	6.80%	8.25%	9.93%

Chapter 4 Transport Sector Conditions and Development Needs

Chapter 4 Transport Sector Conditions and Development

4.1 Prevailing Condition of Different Transport Modes

4.1.1 General Conditions

There are five major traffic and transport modes in the Republic of Kenya, namely road and railway of the land transport, the maritime transport, the pipeline transport and the air transport. The heaviest concentration of transport facilities is along the 1,000 km corridor, ranging from the port of Mombasa through the capital Nairobi to the western region at the Kenya/Uganda border. Among these modes, road transportation is the prime mode for freight and passenger transportation.

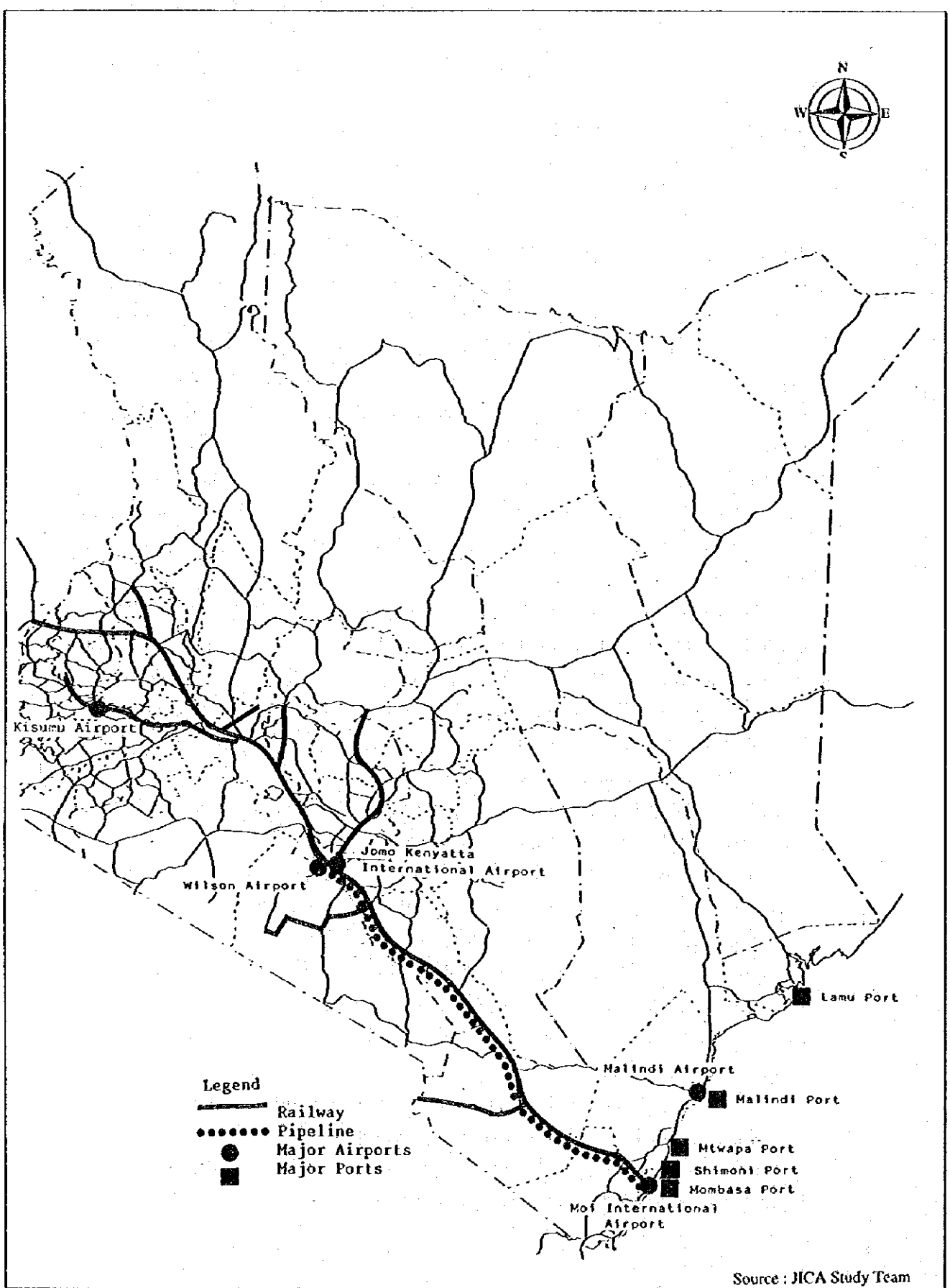
The railway network comprises some 1,083 km of main line, 345 km of principal line and 490 km of minor branch line. The main line connects the Mombasa port with the capital Nairobi and extends to the Uganda border, including the Lake Victoria region.

The classified road network has a total length of 63,120 km. The network comprises 3,691 km of international trunk roads (class A), 2,748 km of national trunk roads (class B), 7,955 km of primary roads (class C), 11,220 km of secondary roads (class D) and some 37,506 km of minor roads, including the special purpose roads (class E). Paved roads cover 8,621 km, equivalent to 13.7 % of the total length of the classified road network.

The Mombasa port is Kenya's principal port facing the Indian Ocean. There are minor ports at Shimoni, Mtwapa, Malindi and Lamu. The Mombasa port handles most of country's imports and exports as well as transit traffic for Uganda, Rwanda, Burundi, parts of eastern Zaire and the southern Sudan.

The pipeline, which has a total length of 425 km, was installed for the transportation of white petroleum products from Mombasa to Nairobi. White petroleum is distributed from pipeline stations nationwide by road and rail. The pipeline is currently being extended from Nairobi to western Kenya, to Kisumu and to Eldoret (442 km).

There are two international airports : Jomo Kenyatta International Airport at Nairobi and Moi International Airport at Mombasa. There are also three other major domestic airports located in Nairobi (Wilson), Kisumu and Malindi. The current transport facilities are shown in Figure 4.1.1.



Source : JICA Study Team

Road Network Development Master Plan in Kenya

Figure 4.1.1
Current Transport Facilities

4.1.2 Land Transport

(1) Railway

1) Network and Rolling Stock

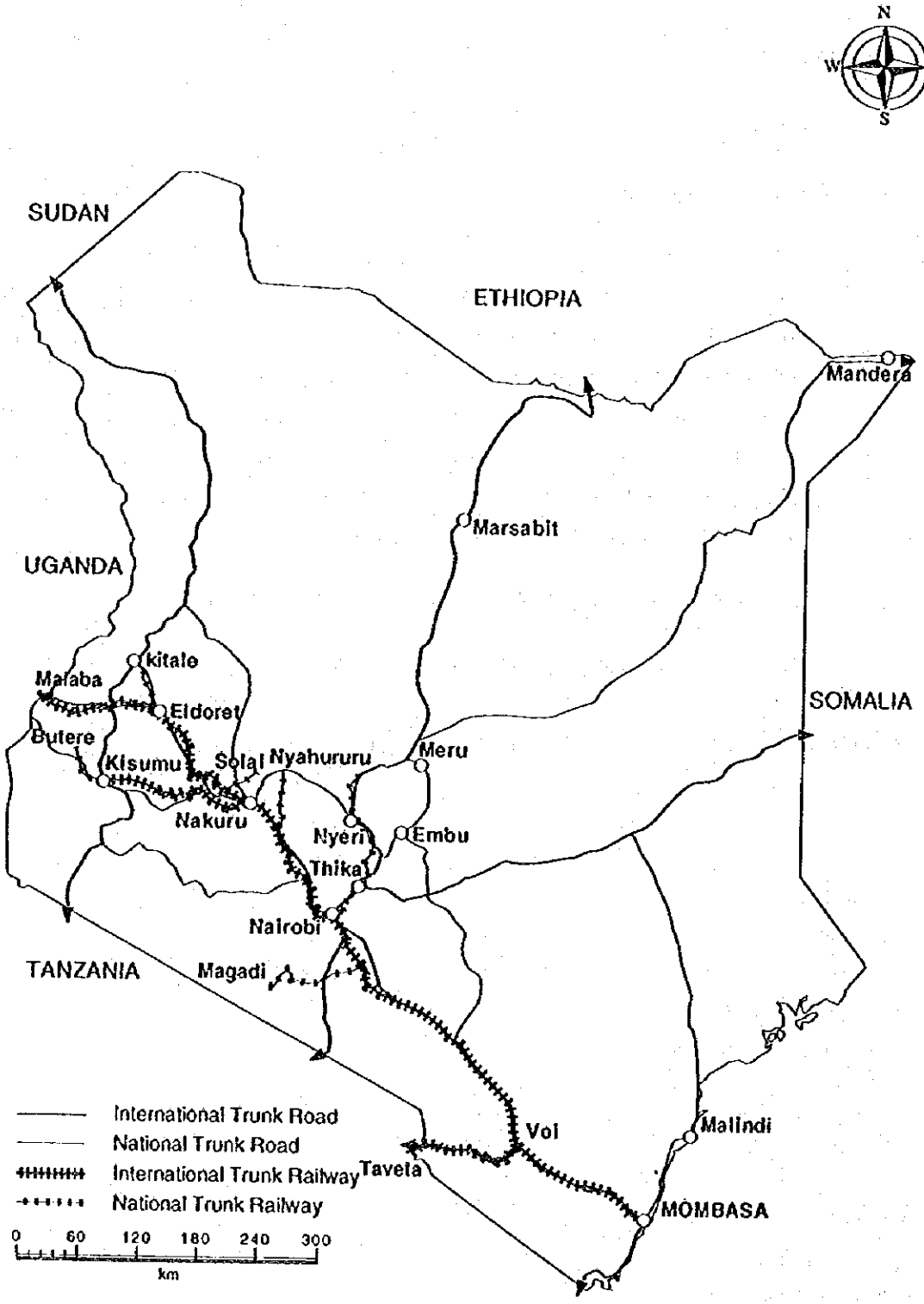
- The railway system is operated by the Kenya Railway Corporation, a government parastatal. The system covers about 2,100 km of tracks, which are shaped like a tree branching out from the seacoast (Figure 4.2.2 refers). The railway network comprises 1,083 km of main lines, 345 km are principal lines and 490 km are minor branches. The main lines extend from the port of Mombasa via Nairobi to Malaba on western border with Uganda, linking principal lines to Nakuru at Lake Victoria, and at Taveta, which borders with Tanzania. Table 4.1.1 shows the configuration of each line

- The number of rolling stock held in 1990 is shown in Table 4.1.2.

Table 4.1.1 Railways - Kilometrage of Track 1991/92

Main Lines	Route km of running lines	km of siding reduced to single track	Total km of single track including siding
(Railway Lines)			
Mombasa to Malaba	1083.33	-	1,083.33
(Principal Lines)			
Nakuru West to Kisumu	217.00	-	217.00
Voi to Taveta (boundary)	128.60	-	128.60
(Minor Branch Lines)			
Nanyuki Branch	235.79	-	235.79
Nyahururu Branch	77.30	-	77.30
Solai Branch	42.80	-	42.80
Kitale Branch	64.95	-	64.95
Lela-Butere Branch	69.30	-	69.30
(Lines without ownership)			
Magadi Branch	146.3	-	146.3
Private Sidings		674.38	674.38
Total Track	2,065.37	674.38	2,739.75

Source: Kenya Railways Annual Report 1991/92



Source: Kenya Railway Annual Report 1991/92

Road Network Development Master Plan in Kenya

Figure 4.1.2
Railway Network in Kenya

Chapter 4: Transport Sector Conditions

Table 4.1.2 Rolling Stock in 1990

	No. of Rolling Stock
Locomotives	218
Coaching stock vehicles	583
Goods stock units	6,476

Source: Kenya Railways Annual Report 1991/92

2) Passengers and Freight Tonnage Handled

- Passenger and freight transportation over the last eight years are summarized in Tables 4.1.3 and 4.1.4. The number of passengers has been on the decline since 1989, dropping 15.2 % in 1991 with a further decline of 2.7 % in 1992. Absolute passengers traffic showed a total of 2.5 million passengers in 1992. From 1988 to 1992, the total number of boarding passengers decreased by 36.5 %. The average growth rate was 2.8 %.

  Passenger-kilometers also dropped by 32.7 % during the four years. This is probably due to the depressed demand caused high tariffs, and the increasing competition from passenger services.

- Freight tonnage handling dropped by 8.2 % in 1991, with a further decline of 14.2 % in 1992. After four years of steady rise, two years of decline followed. Since 1985, total freight tonnage handled decreased by 13.7 %, making it 2.8 million tones in 1992. Also freight-tone kilometers declined by 12.8 % in the same year.

  The decline in freight traffic may be attributed to reduced economic activity and increased competition from road transport, such as lorries and trucks. The principal commodities transported include grain, petroleum products, cement, sugar, coffee, fertilizers and soda.

Table 4.1.3 Passenger Traffic Handled

	Unit	1985	1986	1987	1988	1989	1990	1991	1992*
Passenger carried	1,000	2,102	3,563	3,757	4,037	3,347	3,109	2,635	2,563
Passenger-Km	Million	587	693	752	828	732	699	658	557
Revenue	K£ Million	4.82	5.68	6.28	6.99	8.09	10.3	11.73	12.57

Source: Statistical Abstract in 1991.
Economic Survey n 1993 - 1990.
Note: *Provisional

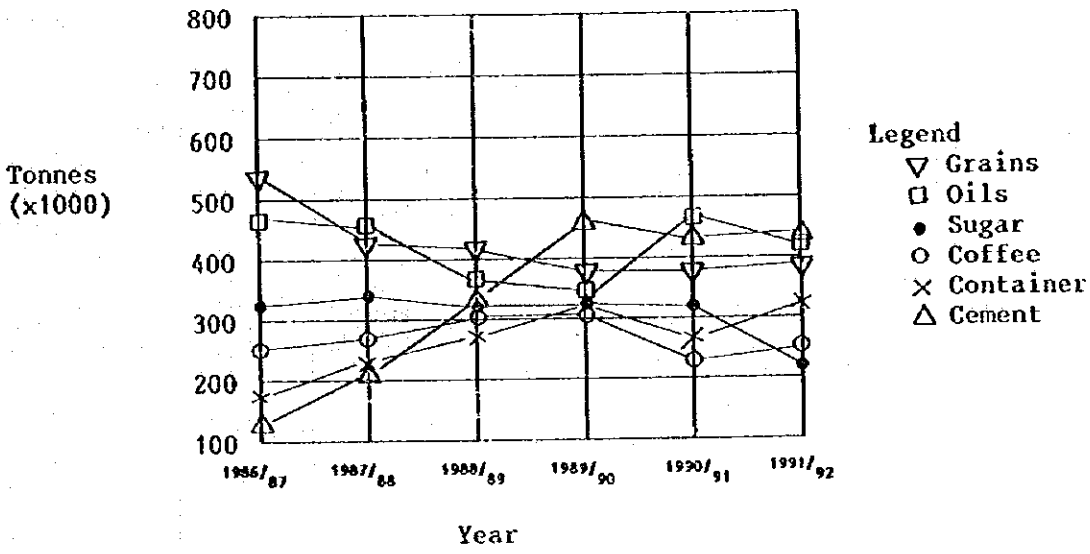
Table 4.1.4 Freight Tonnage Handled

	Unit	1985	1986	1987	1988	1989	1990	1991	1992*
Tonnage handled	1,000	3,269	3,230	3,302	3,255	3,317	3,581	3,286	2,821
Tone-Km	Million	1,860	1,831	1,702	1,755	1,910	1,808	1,865	1627
Revenue	K£ Million	50.07	50.21	49.28	55.69	66.94	81.78	92.11	102.46

Source: Statistical Abstract in 1991.
Economic Survey in 1993 - 1990.
Note: *Provisional

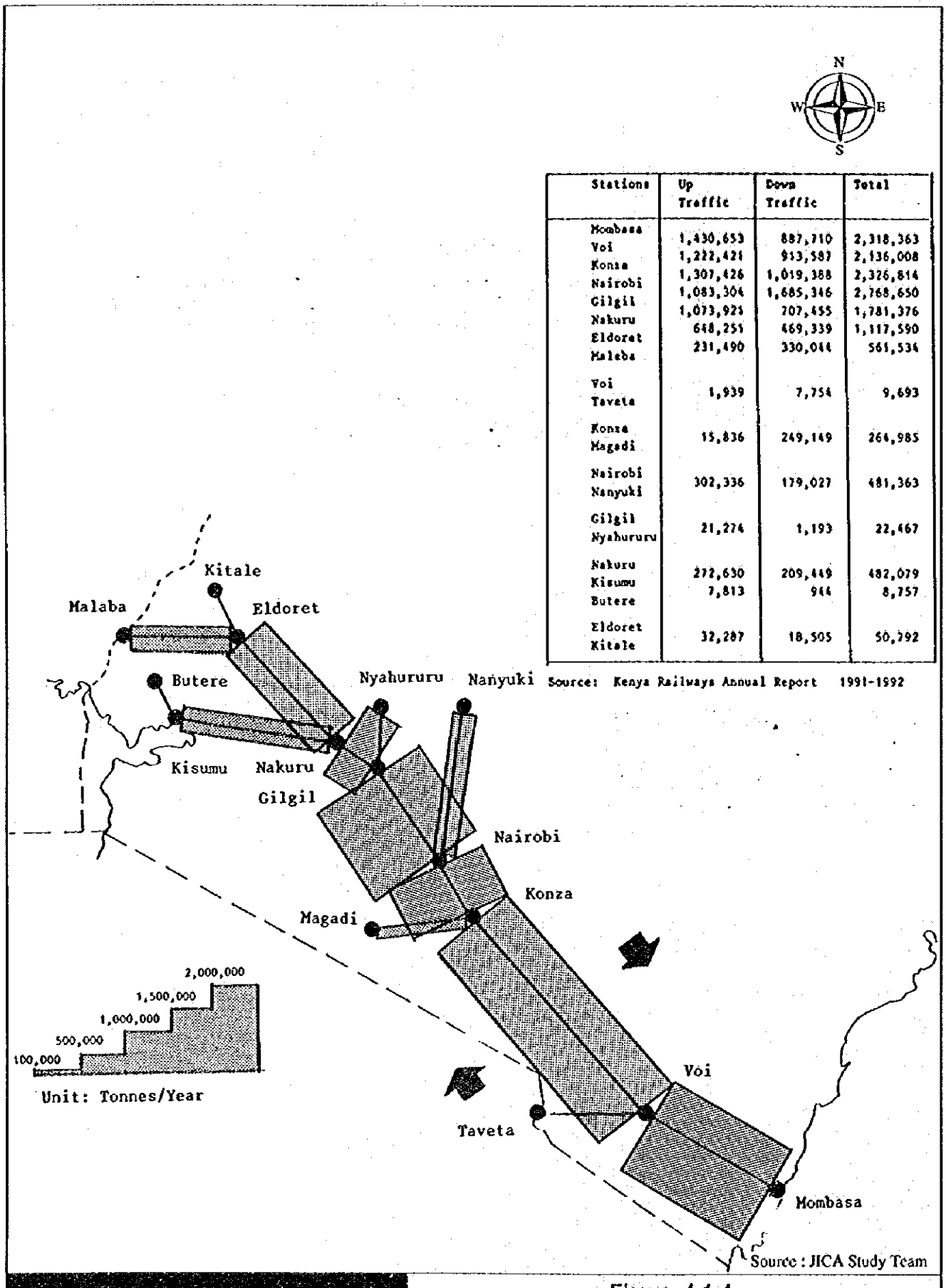
- Figure 4.1.3 shows freight tonnage handling for six principal commodities and over the last five years, beginning with 1986. The container and cement tonnage handled shows an increasing trend, others, however, a declining trend

- Figure 4.1.4 shows the annual freight net tonnage by railway in 1992 between Mombasa and Malaba Stations. Between Gilgil and Mombasa on the main lines, the freight tonnage handled show relatively high volume which ranged between 2.1 and 2.8 million tones. The freight tonnage handled on the principal lines and the minor branch lines ranged between 0.01 and 0.5 million tones. The highest freight tonnage handled was 2.8 million tones between Nairobi and Gilgil stations.



Source: Kenya Railway Annual Report 1991/92

Figure 4.1.3 Six Principal Commodities, 1986-1992



Stations	Up Traffic	Down Traffic	Total
Mombasa	1,430,653	887,710	2,318,363
Voi	1,222,421	913,587	2,136,008
Konza	1,307,426	1,019,388	2,326,814
Nairobi	1,083,304	1,685,346	2,768,650
Gilgil	1,073,923	707,455	1,781,376
Nakuru	648,251	469,339	1,117,590
Eldoret	231,490	330,044	561,534
Malaba			
Voi	1,939	7,754	9,693
Taveta			
Konza	15,836	249,149	264,985
Magadi			
Nairobi	302,336	179,027	481,363
Nanyuki			
Gilgil	21,274	1,193	22,467
Nyahururu			
Nakuru	272,630	209,449	482,079
Kisumu	7,813	944	8,757
Butere			
Eldoret	32,287	18,505	50,792
Kitale			

Source: Kenya Railways Annual Report 1991-1992

Source : JICA Study Team

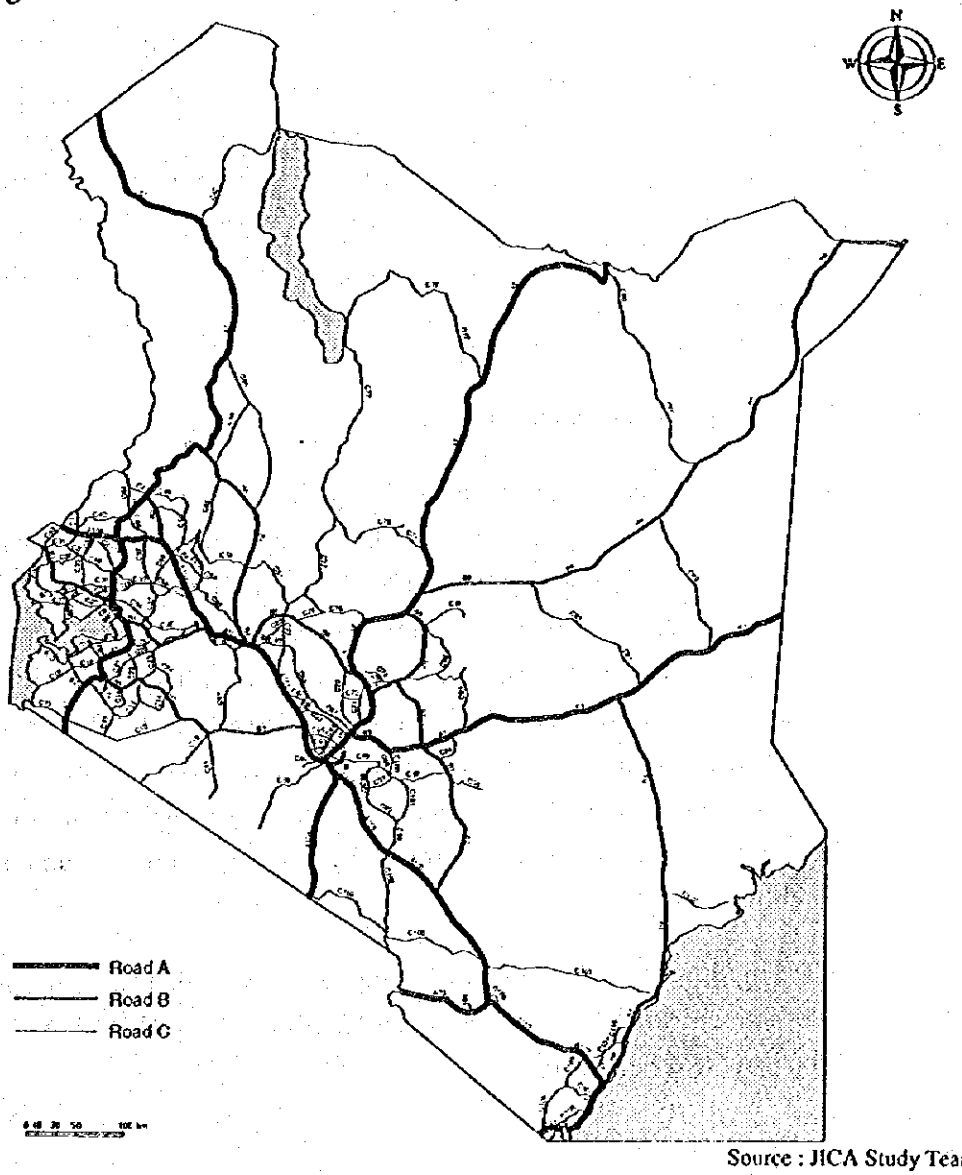
Road Network Development Master Plan in Kenya

Figure 4.1.4
Annual Freight Net Tonnage between Station in 1991/1992

(2) Roads

1) Road Network

The network is somewhat unevenly distributed throughout the country although it has generally followed areas of economic development with heavy concentration of roads along the Mombasa-Uganda border corridor. Two densely populated areas around Nairobi and the Western Highlands have the most developed infrastructure, and the east and north of the country have little road development. Figure 4.1.5 shows the road network system in Kenya.



Source : JICA Study Team

Figure 4.1.5 Road Network System in Kenya

2) Classified Roads

Table 4.1.5 shows the road length of the classified road network by classes and surface type. As of 1992, the total classified road network in Kenya covered 63,120.2 km. The condition of road class A, B and C are as follows :

Table 4.1.5 Road Length of All Classified Roads by Surface Type in 1992

Unit: Km

Class of Road		Surface Type			Total Km
		Bitumen	Gravel	Earth	
Internat. Trunk Rds.	A	2,667.1	782.8	241.0	3,690.9
National Trunk Roads	B	1,403.3	820.6	524.2	2,748.1
Primary Roads	C	2,502.9	3,292.2	2,160.3	7,955.4
Secondary Roads	D	1,170.5	6,127.8	3,921.8	11,220.1
Minor Roads + SPR	E+	877.6	15,069.0	21,559.1	37,505.7
ALL CLASSES		8,621.4	26,092.4	28,406.4	63,120.2

Source: MOPWH. Schedule of Classified Roads 1992 - 1993

a International Trunk Roads (class A)

The international trunk roads link the main international centers of importance, such as international boundaries and international ports. There are seven international trunk roads. They are 499.3 km of A109 and 650.1 km of A104, with routes from Mombasa to Uganda via Nairobi and Bungoma. These two form Kenya's arterial axis. The other five roads, namely 896.9 km of A1, 846.4 km of A2, 570.6 km of A3, 113.6 km of A14 and 114.0 km of A23, begin on this arterial axis and head north or south passing through to various destinations. Table 4.1.6 shows the total length of international trunk roads by the road number and surface condition.

The length of paved sections account for 72.3 % of the total length of international trunk roads. The paved length on A2, A3, and A23 shows less than 50 % coverage.

Table 4.1.6 Total Length of International Trunk Roads (class A)

Unit: Km

Road No.	Bitumen	Gravel	Earth	Total
A1	866.9	0	30.0	896.9
A2	348.3	498.1	0	846.4
A3	163.7	195.9	211.0	570.6
A14	113.6	0	0	113.6
A23	25.2	88.8	0	114.0
A104	650.1	0	0	650.1
A109	499.3	0	0	499.3
Total	2,667.1	782.8	241.0	3,690.9

Source: MOPWH, Schedule of Classified Road 1992-1993

b National Trunk Roads (class B)

There are 10 national trunk roads linking nationally important principal towns and urban centers. Of these, 783.9 km of B8 and 783.9 km of B9 are in eastern Kenya. The B8 road begins at Mombasa on A104 and links A3 along the coastal area. The B9 goes from Isiolo on A2 via Wajir to Mandera on the northern border with Ethiopia. 237.5 km of B1, 65.8 km of B2, 299.5 km of B3 (part of western Kenya) and 292.5 km of B4 in western Kenya have a function to link the international trunk roads of A1 and A104.

The other five roads, B3 (part of central Kenya), B5, B6, B7 and B10 in central Kenya encircle borders and linking up with the international trunk roads A2, A3 and A104. The length of these class B roads are : 181.7 km of B5, 166.6 km of B6, 272.5 km of B7 and 8.3 km of B10. The length of paved sections account for 51.1 % of the total national trunk roads. The paved length of B4, B7, B8 and B9 is below 50 %.

Thus, most of national trunk roads have a function of linking the international trunk roads. Further two routes of B8 and B9 have a radial road function, covering the territory of international trunk roads.

Table 4.1.7 shows the total length by surface conditions of the national trunk road system.

Table 4.1.7 Total Length of National Trunk Roads (class B)

Unit: km

Road No.	Bitumen	Gravel	Earth	Total
B1	237.5	0	0	237.5
B2	65.8	0	0	65.8
B3	258.5	41.0	0	299.5
B4	112.4	161.8	18.3	292.5
B5	181.7	0	0	181.7
B6	166.6	0	0	166.6
B7	90.5	24.8	157.2	272.5
B8	145.6	95.5	198.7	439.8
B9	136.4	497.5	150.0	783.9
B10	8.3	0	0	8.3
Total	1,403.3	820.6	524.2	2748.1

Source: MOPWH, Schedule of Classified Road 1992-1993

c Primary Roads (class C)

The primary roads link with each other provincial important centers, such as urban centers and rural centers, but also higher class roads, which are essential in supporting the social and economic activities of the areas. Table 4.1.8 shows the total length of primary roads by surface conditions and in high population density areas. The total length of primary roads is 7,955.1 km. The length of primary roads in high population density areas accounts for 51.8 % of this total. Some 79.6 % of the paved sections are in high population density areas. High population density areas are defined by district and as having a rate of over 100 persons per livable area (sq.km). Table 4.1.9 shows the total length of primary roads in agricultural potential areas and by surface conditions in agricultural potential areas. The length of primary roads in agricultural potential areas accounts for 74.1 % of total primary roads and 94.2 % of the paved sections.

Table 4.1.8 Total Length of Primary Roads (class C) by Surface Conditions in High Population Density

Unit: Km

	High Density Population Areas				Total			
Province	Bitumen	Gravel	Earth	Total	Bitumen	Gravel	Earth	Total
North Eastern	0	0	0	0	0	47.0	477.5	524.5
Coast	18.8	3.8	0	22.6	116.0	219.5	262.3	597.8
Eastern	202.6	346.8	8.3	557.7	228.1	492.5	539.7	1,260.3
Central	527.2	192.4	20.2	739.6	527.2	192.4	20.0	739.6
Nairobi	119.1	1.5	1.5	122.1	119.1	1.5	1.5	122.1
Rift Valley	647.2	499.2	123.2	1,269.6	1,035.0	1,517.2	746.0	3,298.2
Western	122.7	102.4	113.3	538.4	122.7	302.4	113.3	538.4
Nyanza	354.8	519.7	0	874.5	354.8	519.7	0	874.5
Total	1,992.4	1,865.8	266.3	4,124.5	2,502.9	3,292.2	2,160.0	7,955.1

Source: MOPWH, Schedule of Classified Road 1992-1993
The Study on the National Water Master Plan
GIS of JICA Study Team Statistical Abstract 1989.

Table 4.1.9 Total Length of Primary Roads (class C) by Surface Conditions in Agricultural Potential Areas

Unit: km

	Agricultural Potential Area				Total			
Province	Bitumen	Gravel	Earth	Total	Bitumen	Gravel	Earth	Total
North Eastern	0	3.3	13.4	16.7	0	47.0	477.5	524.5
Coast	88.3	114.9	213.1	416.3	116.0	219.5	262.3	597.8
Eastern	204.6	358.3	54.7	617.6	228.1	492.5	539.7	1,260.3
Central	527.2	192.4	20.0	739.6	527.2	192.4	20.0	739.6
Nairobi	119.1	1.5	1.5	122.1	119.1	1.5	1.5	122.1
Rift Valley	941.6	1,244.8	382.7	2,569.1	1,035.0	1,517.2	746.0	3,298.2
Western	122.7	302.4	113.3	538.4	122.7	302.4	113.3	538.4
Nyanza	354.8	519.7	0	874.5	354.8	519.7	0	874.5
Total	2,358.3	2,737.3	798.7	5,894.3	2,502.9	3,292.2	2,160.0	7,955.1

Source: MOPWH, Schedule of Classified Road 1992-1993
Agro-climatic Zone Map of Kenya, Ministry of Agriculture, 1980.

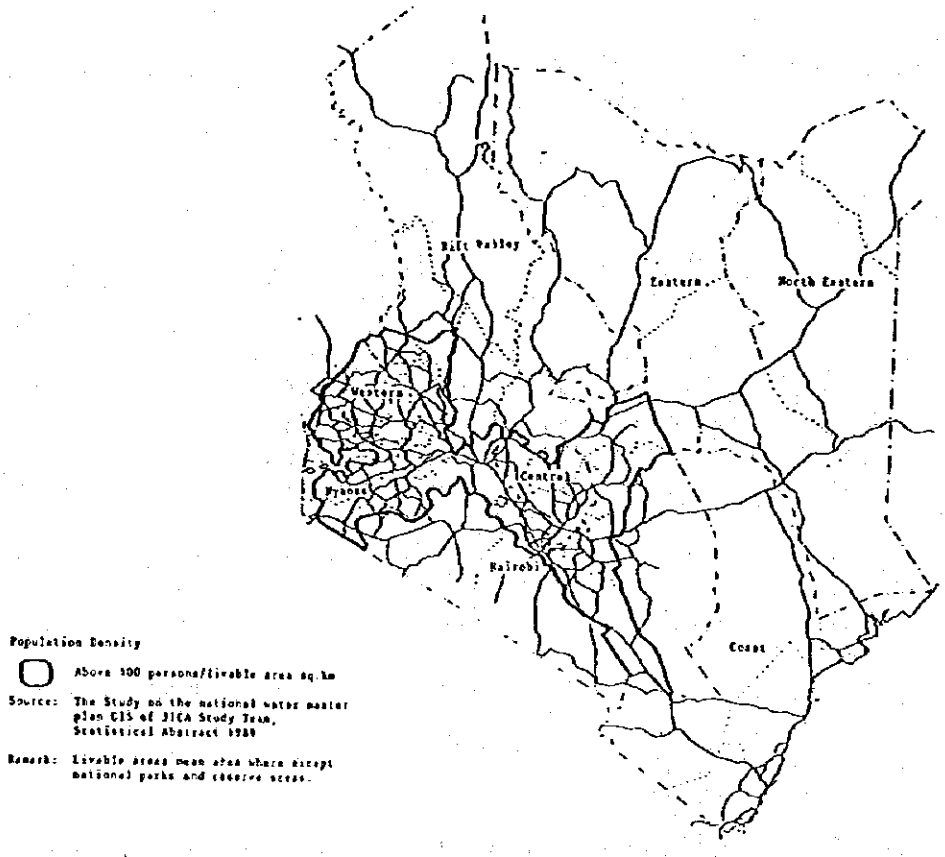


Figure 4.1.6 Population Density above 100 Persons/sq.km District in 1989

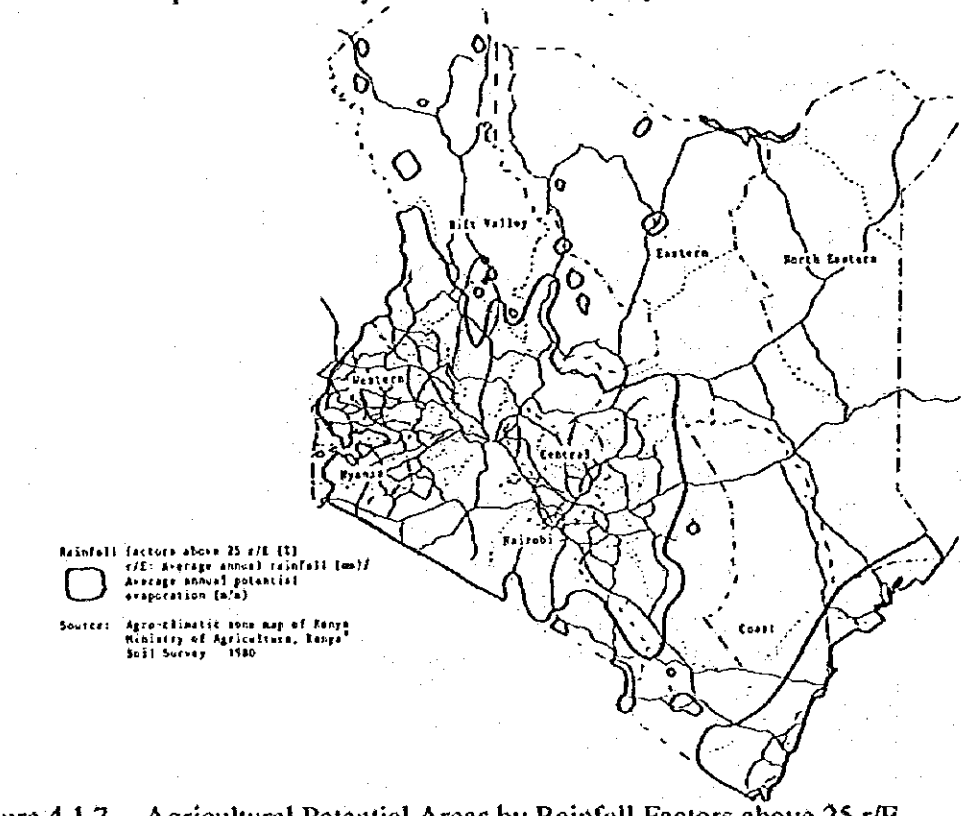


Figure 4.1.7 Agricultural Potential Areas by Rainfall Factors above 25 r/E.

3) Vehicle Registration

- Vehicle registration by vehicle type over the nine years period 1982 to 1990 are summarized in Table 4.1.10. The total number of registered vehicles is about 0.35 million vehicles with a composition of 44.7 % of cars, 25 % of small trucks, 9.2 % of medium trucks, 4 % of heavy trucks, 3.8 % of buses and mini-buses, 6.6 % of motor and auto cycles and 6.7 % others.

- The average growth rate in vehicles numbers over the last nine years is 4.5 %,, with an increase rate of 6.0 % from 1986 to 1990, due to the relaxed restrictions on vehicle imports.

  As regards the growth rate for different vehicle types, buses and mini-buses showed a high rate of 11.2 % as compared with other types. From 1986 to 1990 the rate was 13.0 %. The growth rate of total freight vehicles (utilities, panel vans, pick-ups, lorries, trunk/heavy vans, trailers and others) increased from 4.6 % to 6.0 % during the last five years.

Table 4.1.10 Vehicles with Current Licenses

Types of Vehicles	1982	1983	1984	1985	1986	1987	1988	1989	1990**
Motor cars	115,316	116,852	122,300	126,188	127,351	133,335	141,791	149,696	157,696
Utilities, Panel vans, Pick-ups, etc.	59,358	59,618	64,805	69,441	69,457	73,718	78,501	83,400	88,300
Lorries, trucks and heavy vans	23,634	23,335	24,769	26,186	25,190	27,916	29,706	31,183	32,583
Buses and mini-buses	5,724	5,959	7,001	8,217	8,218	9,172	10,756	12,006	13,382
Motor and auto cycles	16,870	16,823	17,944	18,987	18,990	20,121	21,252	22,347	23,447
Other motor vehicles*	17,367	17,493	18,454	19,415	19,415	20,345	21,582	22,347	23,843
Trailers	10,893	10,839	11,337	11,784	11,814	12,272	12,915	13,533	14,157
Total	249,162	250,919	266,610	280,218	280,435	296,879	316,403	334,808	353,408

Source: Central Bureau of Statistics
Statistical Abstract in 1991

* Includes road construction vehicles, farm tractors and three-wheelers

** Provisional

4) ADT and Vehicle-Km by Vehicle Type and by Road Class

- Table 4.1.11 shows A.D.T. and vehicle km by vehicle type and by road class in 1988. The vehicle km are derived from an analysis of the 60 point census data, following a method presently employed by the MOPWH. The total vehicle km in 1988 were surveyed at 12,151,868 vehicle km.

Table 4.1.11 Vehicle Km by Vehicle Type and by Road Class in 1988

	Car	Light Goods	Medium Goods	Heavy Goods	Buses	Total
Trunk	1,896,333	3,381,487	1,291,031	496,128	475,133	7,540,112
Primary	412,128	1,403,334	504,030	53,742	95,718	2,468,952
Secondary	134,562	561,222	202,865	4,376	35,008	937,558
Minor	134,748	838,432	205,865	14,972	11,229	1,205,246
Total	2,577,771	6,184,475	2,203,316	569,218	617,088	12,151,868
Total A.D.T.	7,326	15,619	5,822	1,713	1,807	32,287

Source:MOPWH. Traffic Statistics 60-Point Traffic Census 1988

(3) Modal Split Share of Land Transport

1) Passengers

Land transport comprises the railway and road modes. Passengers are transported on land via railway or roads. Table 4.1.12 shows the share of passengers transported on land. In 1994 the number of passengers transported by railway was 3.050 million persons, equivalent to a railway share of 3.3%. Passengers transported by road was 90.420 million persons, equivalent to a road share of 96.7%.

The modal split between railway and road transport based on passenger-kilometers was 4.1% and 95.9%, respectively.

Table 4.1.12 Share of Passengers Transported on Land Transport

Mode	Passengers		Passengers-Km	
	1000 person	%	millions	%
Railway*1	3,050	3.3	550*2	4.1
Road	90,420	96.7	12,980	95.9
Total	93,470	100.0	13,530	100.0

Source:JICA Stydy in 1994

Note:*1 Including inland waterway

*2 Excluding inland waterway

2) Freight

The freight tonnage transported in 1994 by means of railway was 2.700 million tones, equivalent to a share of 13.5%. The freight tonnage transported by means of road was 17.330 million tones, equivalent to a share of 86.5%.

The modal split between railway and road freight transport based on tones-kilometers was 25.5% and 74.5%, respectively. Table 4.1.13 shows the shares of freight transported on land.

Table 4.1.13 Share of Freight Transport on Land

Mode	Tonnes		Tonnes-Km	
	1000 tonnes	%	millions	%
Railway*1	2,700	13.5	1580*2	25.5
Road	17,330	86.5	4,608	74.5
Total	20,030	100.0	6,188	100.0

Source:JICA Study in 1994

Note:*1 Including inland waterway
*2 Excluding inland waterway

4.1.3 Maritime Transport

- The Mombasa Port is Kenya's principal port and it is administered by the Government-owned "Kenya Ports Authority - KPA", which also administers the minor ports at Shimoni, Mtwapa, Malindi and Lamu.

  The Mombasa Port has an extensive infrastructure with 16 deep water berths comprising 3 oil berths, 3 container berths, 2 cement berths, 2 lighterage berths and 6 others.

- The Mombasa port handles most of the country's imports and exports as well as transit traffic for Uganda, Rwanda, Burundi, and, to a lesser extent, parts of eastern Zaire and southern Sudan.

(1) Passenger Handled

- Table 4.1.14 shows the passengers handled at Mombasa harbor over the last eight years 1985 to 1992. From 1988 onwards, there has been a steady increase in passengers, with an average growth rate of 36.7 %. The total passengers traffic for those embarked and landed was about 12 thousand persons and the landed passengers were about 16 thousand persons in 1992. From 1985 to 1992, the passengers handled increased by 456.1 %. The average growth rate was 27.8%.

Table 4.1.14 Passenger Handled at Mombasa Harbor

Unit: Persons

No. of Persons	1985	1986	1987	1988	1989	1990	1991	1992
Embarked	1,852	1,693	659	3,215	5,388	8,261	7,270	12,028
Landed	3,148	3,631	2,739	4,749	6,976	10,527	10,188	15,779
Total	5,000	5,324	3,398	7,964	12,364	18,788	17,458	27,807

Source: Statistical Abstract 1991
Annual Bulletin of Port Statistics 1992

(2) Freight Tonnage Handled

- Table 4.1.15 summarizes the freight tonnage handled at the Mombasa port over the last eight years period 1985 to 1992. The total freight handled by the port in 1992 was about 7.9 million tones, 11.1 % higher than that recorded in 1991. From 1985 to 1992, the average growth rate of total freight tonnage handled was 3.2 %.

The volume of exports handled in 1992 was 16.2 % higher than in 1991 and the average growth rate over the above eight years period was 1.5 %. Total export freight tonnage in 1992 was about 2.1 million tones. The shares of dry cargo and bulk liquids in this total was 82 % and 18 % in 1992, respectively.

The volume of imports handled increased by 9.4 %, that is from 5.3 million tones in 1991 to 5.8 million tones in 1992. The average growth rate over the eight years period 1985 to 1992 was 3.9 %. The shares of dry cargo and bulk liquids in 1992 were 49 % and 51 %, respectively.

The average growth rate of total freight, that is exports and imports, handled was 3.2% over the eight years period 1985 to 1992.

Table 4.1.15 Freight Handled at Mombasa Harbor

Unit: 1,000 tones

	1985	1986	1987	1988	1989	1990	1991	1992
Exports								
Dry Cargo	1,482	1,600	1,656	14,86	1,466	1,907	1,483	1,692
Bulk liquids	396	388	354	297	529	390	309	391
Total	1,878	1,988	2,010	1,783	1,995	2,297	1,792	2,083
Imports								
Dry Cargo	2,256	2,070	2,134	1,980	2,096	2,193	2,082	2,829
Bulk liquids	2,181	2,839	2,747	2,887	3,104	2,999	3,228	2,981
Total	4,437	4,909	4,881	4,867	5,200	5,192	5,310	5,810
Total freight handled	6,315	6,897	6,891	6,650	7,195	7,489	7,102	7,893

Source: Economic Survey 1990 - 1993

* Provisional

(3) Vessels Entering Kenya Ports

- The vessels entering Kenya ports over the period 1983 to 1990 are shown in Table 4.1.16. In 1990, the number of steamships and sailing ships were 1,725 and 101, respectively.

(4) Container

The use of containers is becoming more popular in the world. Under such circumstances, the container traffic handled at the port of Mombasa shows a rapid growth and contributes to the speeding up of harbor activities. Container traffic in 1975, when container transportation started, was only 1,298 TEU's. In 1991, however, it reached 136,257 TEU's. Harbor-related facilities have gradually been improved, and 3 berth (810m) and a 20.2 ha back-up area are available now.(Table 4.1.17 refers).

Table 4.1.16 Vessels entering Kenya Ports, 1983 - 1990

Unit: Ships

Numbers	1983	1984	1985	1986	1987	1988	1989	1990**
Steamship								
Mombasa*	1,471	12,220	1,188	1,203	1,486	1,458	1,605	1,571
Other ports	180	132	349	238	104	134	150	154
Total	1,651	1,352	1,537	1,441	1,590	1,592	1,753	1,725
Sailing ships								
Mombasa	90	52	85	56	86	35	58	53
Lamu	47	59	37	46	80	93	93	38
Other parts	43	75	34	4	4	19	13	10
Total	180	186	156	106	170	147	164	101
Transshipments at Mombasa	10	17	25	32	26	22	43	36

Source: Statistical Abstract 1991, Kenya Ports Authority

* Ocean going and coasting vessels included both Kilindini and Old Port
** Provisional

Table 4.1.17 Container Traffic Handled 1975-1991(TEU's)

Year	1975	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
TEU's	1,298	57,645	83,849	92,461	103,363	117,547	112,099	121,750	134,072	134,440	136,257

Source:KPA, Annual report and accounts for the period 1992

4.1.4 Pipeline Transport

(1) Overview

The Government-owned Kenya Pipeline Company operates a 452 km pipeline for transporting white petroleum products from Mombasa to Nairobi. From pipeline stations, the white petroleum is distributed nationally by road and rail. At present, pumping units have been installed at 4 points and the current design capacity is 2.5 million tones per year. The pumping stations will ultimately be increased from four to eight, resulting in an increase to some 5.0 million tones per year. The model share for all oil products between Mombasa and Nairobi is estimated at 76 % by pipeline, 16 % by rail and about 8 % by road.

The pipeline from Nairobi to Kisumu and to Eldoret has be completed in April 1994. The design capacity is estimated at approximately 1.8 million tones. Figure 4.1.8 shows the pipeline routes.

(2) Pipeline Output of White Petroleum Products

Table 4.1.18 shows the volume of white petroleum products delivered by the Kenya Pipeline Company over the last eight years. Output during this period has ranged between 1.45 to 1.98 million cubic meter. The average annual volume is about 1.8 million cubic meters. The total pipeline output of white petroleum products was 1.86 million cubic meters in 1992, representing an increase by 1.6 % from the 1.83 million cubic meter in 1991. The average growth rate during eight years was 3.6 %.

Table 4.1.18 Pipeline Throughout of White Petroleum Products

Unit: 1,000 cubic meter

	1985	1986	1987	1988	1989	1990	1991	1992**
Motor Sprit Premium	238.4	279.4	299.8	334.3	227.0	351.8	328.5	322.0
Motor Sprit Regular	246.5	253.9	269.0	273.0	281.0	271.9	256.3	255.1
Kerosene Illuminating Oil	122.9	148.7	158.0	187.6	237.3	235.1	218.3	213.1
Light Diesel Oil	581.1	648.6	650.7	677.8	684.3	692.9	661.8	640.0
Jet Fuel*	263.9	262.1	244.7	245.7	268.0	372.2	308.9	383.5
Aviation Turbo	-	51.3	76.5	79.7	69.3	59.5	57.3	46.6
Total	1,452.8	1,644.0	1,698.1	1,798.1	1,876.9	1,983.4	1,831.1	1,860.3

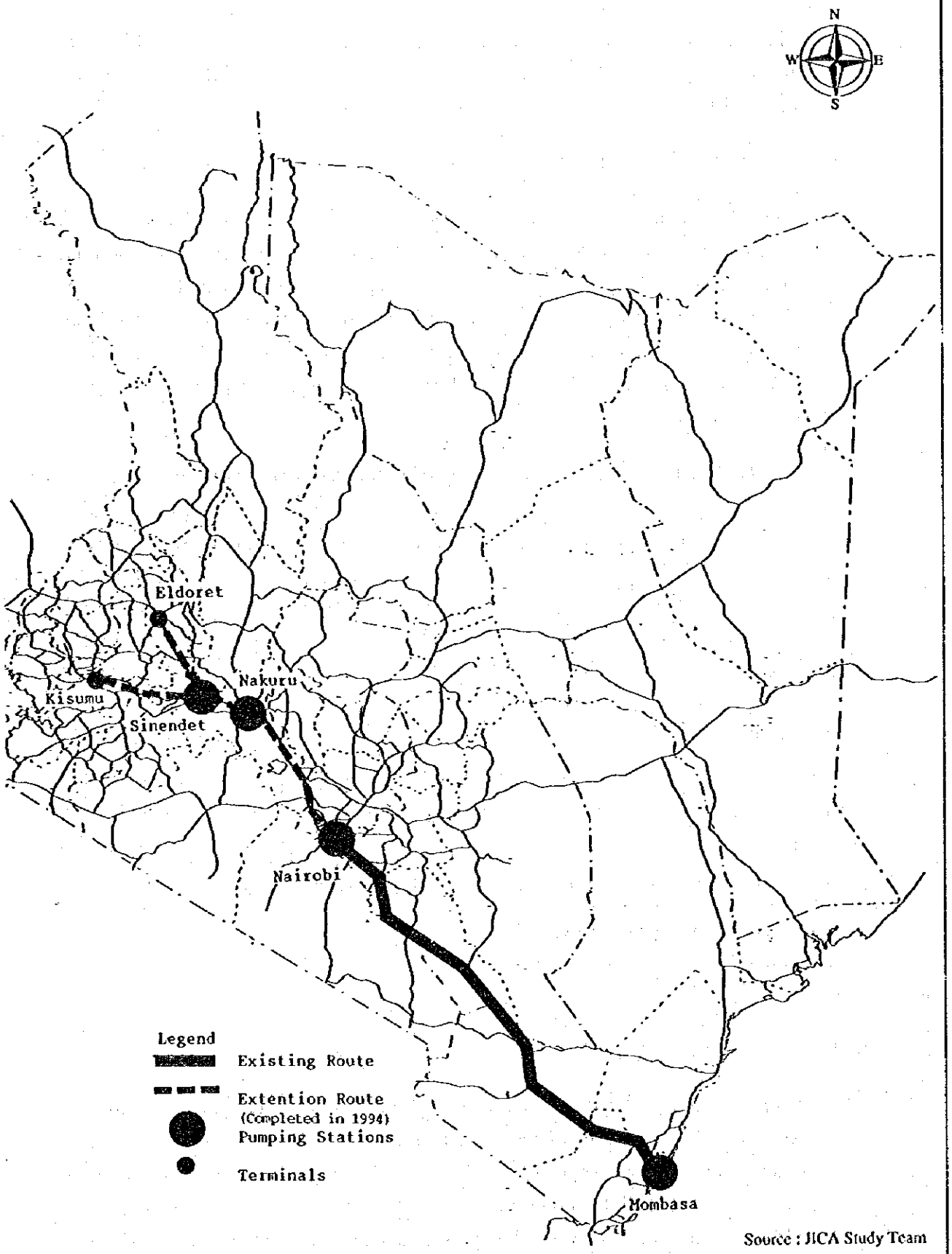
Source: Economic Survey 1990 - 1993

* Includes Jet Fuel in Mombasa from 1988

** Provisional

4.1.5 Air Transport

There are two international airports in Kenya; Jomo Kenyatta International Airport at Nairobi and Moi International Airport at Mombasa. There are also three other major domestic airports located at Nairobi (Wilson), Kisumu and Malindi They provide scheduled domestic services as well as to several game parks. In addition, there are many smaller public and private airstrips throughout the country, which are used for domestic and private purposes.



Road Network Development Master Plan in Kenya

Figure 4.1.8
Pipeline Route

(1) Traffic Handled

Table 4.1.19 shows the commercial traffic handled over the eight years period 1985 to 1992 at both, Jomo Kenyatta International Airport (JKIA) and Moi International Airport (MIA). The total number of passengers handled increased until 1989, and then continued to decline until 1992. Furthermore, the total number of passengers in 1992 was about 2.6 million, a 1.3% drop against the previous year. Those embarked; landed and in transit traffic were 1.2, 1.1 and 0.3 million persons, respectively. The average growth rate was 2.6 % during this period.

The total freight tonnage handled in 1992 was about 63 thousand tones, an increased of 11.0 % against 1991. The average growth rate was 0.1 % over the eight years period.

Table 4.1.19 Commercial Traffic at Jomo Kenyatta and Moi International Airports

	1985	1986	1987	1988	1989	1990	1991	1992*
Passengers (x 1,000 Ps)								
Embarked	776.8	856.7	921.7	987.1	1,055.6	1,056.4	1,119.2	1,147.8
Landed	776.4	859.7	916.	992.7	1,061.6	1,122.9	1,109.2	1,125.9
Transit	605.3	572.5	559.0	542.1	531.7	474.2	388.5	308.1
Total	2,158.5	2,289.1	2,396.7	2,521.9	2,648.9	2,653.5	2,616.9	2,581.8
Freight (x 1,000 tones)								
Cargo:								
Loaded	40.7	40.7	40.1	39.7	39.2	42.0	41.1	44.7
Landed	19.0	15.6	16.9	18.2	22.3	13.9	13.4	15.9
Mail:								
Loaded	0.9	0.8	1.1	1.6	1.8	0.9	0.7	0.7
Landed	1.6	1.4	2.0	2.5	3.1	1.3	1.2	1.3
Total	62.2	58.5	30.1	32.0	66.4	58.1	56.4	62.6

Source: Economic Survey 1990 - 1993

* Provisional

4.1.6 Inland Waterways Transport

Transport of inland waterways is operated by the Kenya Railways Corporation and the transport center of the lake transport is located at Kisumu. The railway's main line from Nairobi connects directly with the lake transport system. Most passengers and cargo to and from local lake ports make connections with the railway. Major local lake ports are Homa Bay and Kendu Bay, others are Mbita, Sena and Karungu.

(1) Inland Waterways Capacity

The lake transport has 3 streamers, 1 wagons' ferry, 2 tugs, 9 lighters, 1 dredging vessel and 1 motor boat. The capacity for passengers and cargo transport are shown in Table 4.1.20.

Table 4.1.20 Inland Waterways Capacity - Vessel in Service, 1991/92

	Passengers (Ps)	Cargo (tones)
Steamers	718	4
Wagon ferry	-	1,260
Lighters	80	805

Source: Kenya Railway, Annual Report 1991 - 92

(2) Passengers and Freight Tonnage Handled

Table 4.1.21 shows passengers and freight tonnage handled at the Lake Victoria inland waterways for the years 1990 to 1992. Passenger traffic was some 0.26 million persons in 1992. It grew at an average growth rate of 15.2 % from 1990 to 1992.

The freight tonnage handled in 1992 was 1.1 thousand tones, an increase of 50 % as against 1990. However, the average growth rate over the same brief period was 39.0%.

Table 4.1.21 Passengers and Freight Handled

Passengers	Unit	1990	1991	1992
Passenger carried	(x 1,000)	193.50	195.32	256.61
Revenue	K$ million	0.19	0.32	0.24
Tonnage handled	(x 1,000)	0.59	0.76	1.14
Ton-Kilometer	million	0.01	0.03	0.06
Revenue	K$ million	0.005	0.01	0.02

Source: Kenya Railways, Annual Report 1991 - 92

4.1.7 Tourism Traffic

(1) Resources

Figure 4.1.9 shows the tourism resources in Kenya. The important tourism resources and recreational areas such as Tsavo, Mombasa, Malindi and Lamu are located in Eastern Kenya. On the other hand, such National Parks and Reserves for wild life as Masai Mara and Amboseli are located in Central and Western Kenya.

(2) Visitors

Tourism provides an important means of foreign exchange income. Table 4.1.22 shows the number of visitor arrivals and departures by purpose of visit. Table 4.1.23 shows the number of days stayed by purpose of visit. Table 4.1.24 shows the number of visitors to national parks and game reserves.

- The number of international visitor arrivals in 1992 was about 699 thousand persons. The number of visitors has been declining since 1990. The average growth rate over the period 1985 to 1992 was 3.7 %. The purpose of visit was 84.2 % for holiday, 9.9 % for business, 4.7 % for transit and 1.2 % other.

- The total number of days stayed by departing visitors in 1992 was 8.9 million days. However, the total number of days stayed has declined by 12.9 % since 1990. The average growth rate during eight years was 0.8 %. The average duration of stay in days by purpose of stay were 14.6 days for holiday and 10.2 days for business visitors. The average duration of stay in days has declined over the period to a level of 13.4 days in 1992.

Table 4.1.22 Visitor Arrivals and Departures by Purpose of Visit

Unit: 1,000 persons

Purpose	1985	1986	1987	1988	1989	1990	1991	1992*
Arrivals								
Holiday	418.0	476.6	529.1	555.9	692.1	695.6	673.3	588.1
Business	59.5	65.7	66.1	69.5	53.8	73.7	77.6	69.2
Transit	52.0	59.1	58.9	61.4	34.5	35.6	38.3	32.5
Other	11.1	12.8	7.2	8.1	4.3	9.5	15.4	8.8
Total	540.6	614.2	616.3	694.9	734.7	814.4	804.6	698.6
Departures								
Holiday	413.9	464.5	510.4	522.6	548.4	598.0	559.5	546.8
Business	58.3	63.8	69.8	71.0	62.1	74.7	68.5	69.4
Transit	58.5	64.6	70.1	71.2	54.1	48.1	47.2	47.4
Other	10.5	11.1	11.8	12.1	2.8	7.5	6.3	6.0
Total	541.2	604.0	662.1	676.9	667.4	728.3	681.5	669.6

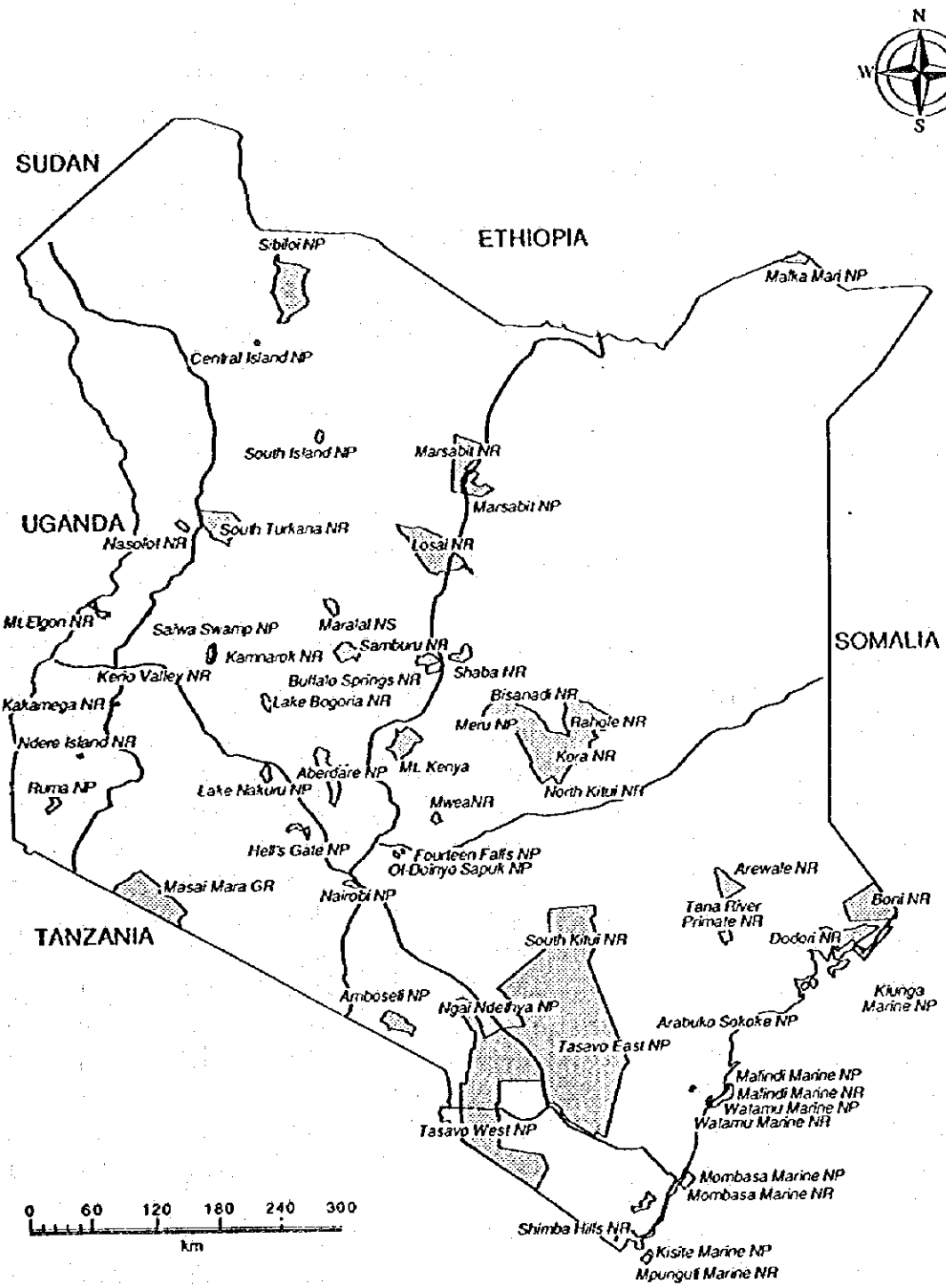
Source: Economic Survey 1990 - 1993

* Provisional

- The number of visitors to national parks and game reserves in 1992 were 1.37 million, representing a decline of 10.8 % against 1990. Animal Orphanages have had the highest number of visitors. Among other frequently visited national parks are Amboseli, Nairobi, Lake Nakuru and Masai Mara. The average growth rate of total visitors was about 4.8 %. Mombasa Marine, Watamu Marine, Hill's Gate and Kisite/Mpunguti had a high visitor growth rate. However, the absolute number of visitors is not high, being less than 0.06 million. A relatively high increase in visitors was observed in Animal Orphanage and the Nairobi National Park.

(3) Hotel Occupancy

The hotel bed night occupancy by area is shown in Table 4.1.25. The number of hotel bed nights available has increased from 9.0 million in 1985 to 11.4 million in 1992. The average growth rate of occupied hotel bed nights was about 3.5 %.. The Coastal-Beach area has the highest number of occupancy, accounting for 63 % of total occupied hotel bed nights in 1992. The share of other areas ranged between 10 % to 1 %.



Source : JICA Study Team

Road Network Development Master Plan in Kenya

Figure 4.1.9
Tourism Area of National Parks and Reserves

Table 4.1.23 Number of Days Stayed by Purpose of Visit

Unit: 1,000 persons

Purpose	1985	1986	1987	1988	1989	1990	1991	1992*
Holiday	7,480.3	8,569.2	9,364.3	9,747.4	8,255.7	9,276.8	8,366.2	8,004.8
Business	758.1	659.9	822.0	855.6	647.7	770.3	700.7	711.3
Transit	185.4	198.0	218.5	227.5	177.9	179.6	198.0	195.4
Total	8,423.8	9,427.1	10,404.8	10,830.5	9,081.3	10,226.7	9,264.9	8,911.5
Average length of stay in days	15.9	15.9	16.0	16.0	13.6	14.4	13.7	13.4

Source: Economic Survey 1990 - 1993

* Provisional

Table 4.1.24 Number of Visitors to National Parks and Game Reserves

Unit: 1,000 persons

Locations	1985	1986	1987	1988	1989	1990	1991	1992**
Nairobi	110.6	91.6	99.8	125.5	155.2	152.8	168.8	156.4
Animal Orphanage	102.5	73.0	82.1	84.8	43.3	213.8	217.6	173.2
Amboseli	151.5	157.0	148.5	137.7	140.4	237.2	189.2	168.3
Tsavo (West)	96.5	82.9	80.6	85.4	96.8	78.6	119.3	103.1
Tsavo (East)	173.3	75.3	89.6	87.3	101.1	127.7	135.9	125.5
Aberdare	43.1	42.5	54.0	59.9	57.5	66.6	56.3	63.6
Buffalo Springs	46.1	41.4	43.4	64.0	70.4	-	-	-
Lake Nakuru	135.5	127.9	127.9	138.6	167.4	174.2	174.4	139.6
Masai Mara	110.7	94.8	95.9	118.8	196.2	180.5	143.3	138.1
Malindi Marine	25.4	36.1	38.6	39.2	40.7	35.6	33.0	44.2
Lake Bogoria	23.8	25.6	31.2	32.8	46.2	53.8	53.0	39.4
Meru	18.9	20.4	26.8	23.7	17.4	11.1	9.1	7.1
Shimba Hills	13.0	10.9	13.4	16.7	21.5	60.0	38.2	31.9
Mount Kenya	13.2	16.6	19.2	18.0	13.3	18.7	14.6	15.5
Samburu	6.1	5.1	4.3	3.6	4.0	-	-	-
Kisite/Mpunguti	6.4	12.2	11.0	17.9	18.2	27.1	33.1	28.0
Mombasa Marine	6.5	4.7	4.5	-	16.5	29.1	54.6	57.8
Watamu Marine	2.6	1.7	1.9	16.9	17.3	20.5	22.0	27.0
Hell's Gate	2.0	3.2	2.2	14.5	18.2	31.1	41.3	34.2
Other*	0.7	1.2	1.7	10.5	13.4	13.8	14.8	14.0
Total	986.4	924.1	976.6	1,095.8	1,255.0	1,532.2	1,518.5	1,367.1

Source: Economic Survey 1990 - 1993

* Others include Mount Elgon, Ol-Donyo, Sabak, Marsabit, Saiwa Swamp, Sibiloi, Runa National Park, Mwea National Reserve, Central Island National Park and Nasolot National Reserve.

** Provisional

Table 4.1.25 Hotel Nightly Bed Occupied by Zone

Unit: 1,000 persons

Zone	1985	1986	1987	1988	1989	1990	1991	1992*
Coastal - Beach	2,127.8	2,353.0	2,316.5	2,404.2	2,521.3	3,200.3	3,881.7	3,482.5
- Other	316.2	336.0	314.0	308.3	298.4	304.3	269.7	181.8
Coast Hinterland	121.6	132.0	141.5	142.4	158.6	175.2	184.9	142.7
Nairobi-High class	612.0	548.9	564.8	577.5	605.1	649.9	544.0	569.1
- Other	874.9	841.6	864.9	843.3	861.8	780.2	733.1	385.6
Central	338.2	359.8	376.0	391.4	430.2	423.5	407.7	307.7
Masailand	241.6	248.6	259.8	268.2	270.6	291.4	273.2	272.4
Nyanza Basin	95.1	104.8	108.1	111.5	112.0	123.1	100.7	91.6
Western	83.1	76.7	77.0	78.9	79.6	81.3	85.3	85.0
Northern	7.9	8.6	8.7	8.8	8.9	10.0	38.3	7.4
Total Occupied	4,818.4	5,010.0	5,031.3	5,134.5	5,316.5	6,039.2	6,518.7	5,525.8
Total Available	9,024.8	9,370.2	9,479.2	9,704.3	9,630.8	10,494.7	11,036.7	11,464.5

Source: Economic Survey 1990 - 1993

* Provisional

4.2 Supplemental Surveys

4.2.1 Traffic Survey

(1) Conduct of Surveys

1) Survey Objective

The Origin/Destination (OD) traffic survey was carried out in order to obtain a 1994 OD table through updating the OD data of Kenya's nationwide OD traffic survey conducted in 1983.

2) Survey Method

The roadside interview and traffic count survey was undertaken on weekdays over 12 hours (from 7 a.m. to 7 p.m.) and at 27 interview stations. The survey stations are shown in Table 4.2.1 and in Figure A3-1 in Appendix 3.

a Roadside Interview Survey:

All vehicles sampled were stopped by the roadside and drivers were interviewed. The sampling rate was more than 30 % .

b Traffic Count Survey:

A manual traffic count was conducted every one hour for different vehicle types and recorded in the form shown in Figure A3-2, Appendix 3.

3) Survey Schedule

Three teams were formed and the surveys were conducted over the period February 23, 1994 until March 24, 1994 ; that is for a total of one month.

(2) Data Processing

1) General

Computers were used for data storage, retrieval and processing. A "Database" is a data file system used to facilitate processing of survey data, statistical data and so on. The process of making a database involves the following steps : compilation and arrangement of survey sheets, coding of survey data, entry, checking, and processing of data. This process is shown graphically as a flowchart in Figure 4.2.1.

Table 4.2.1 OD Traffic Survey Stations

Station No.	Survey Site	OD No. Site
1	Mariankani 5 km West to Voi	A 109
2	Tiwi	A 14
3	Shimo la Tema	B 8
4	Malindi 5 km North to Mambrui	B 8
5	Athi River 5 km West to Nairobi	A 104
6	Thika 5 km North to Embu	A 2
7	Thika 5 km West to Yatta	A 3
8	Embu 5 km West to Wanguru	B 6
9	Limuru 5 km North to Naivasha	A 104
10	Mau Summit 5 km North-West to Eldoret	A 104
11	Mau Summit 5 km West to Kericho	B 1
12	Soy	B 2
13	Sare	A 1
14	Ahero 5 km West to Kisumu	A 1
15	Kakamega 5 km South to Vihiga	A 1
16	Maseno	B 1
17	Webuye 5 km West to Bungoma	A 104
18	Kitui 5 km North to Kangonde	B 7
19	Kajiado 5 km North to Athi River	A 104
20	Timau	A 2
21	Nyahururu 5 km East to Nyeri	B 5
22	Mogotio	B 4
23	Kissi 5 km East to Keroka	B 3
24	Manyani	A 109
25	Narok 5 km East to Seyabei	B 3
26	Gilgil 5 km South to Naivasha	A 104
27	Kiambu 5 km South to Nairobi	C 64

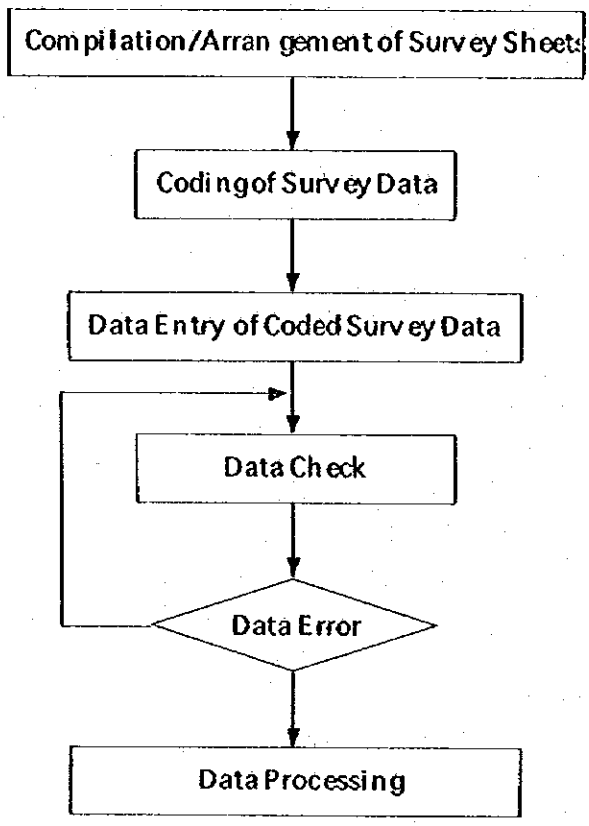


Figure 4.2.1 Overall Procedure of Database Development

2) Sampling Rate

After checking the data, a summary of the traffic count and sampled vehicles, was prepared and the sampling rate was calculated (Table A3-1, Appendix 3, refers).

3) Generation of OD Table

As the surveys were conducted in the daytime for 12 hours only, there is a need to convert from 12 hours to annual average day data, in order to generate the annual average day OD table.

Conversion factors to estimate the all day traffic volume are shown in the following formula:

$$T24 = t12 * \frac{\text{Day and Daytime Rate}}{\text{Monthly Variance}} / \text{Weekly Variance}$$

where

T24: annual average day data

t12 : 12 hours survey data on an ordinary day.

The adopted day and daytime rate was the same, or the nearest point in the latest MOPWH traffic statistics traffic census by survey station.

Monthly and weekly variances are compiled from the MOPWH toll station statistics and reliable data are from the following 3 stations : No. 2 (A104 Athi River), No. 5 (A1 Gambogi) and No. 15 (A2 Ruiru). Tables 4.2.2 and 4.2.3 show the monthly variance and weekly variance sampled at these three stations.

Table 4.2.2 Weekly Variance

	02 Point		05 Point		15 Point	
Month	Vol.	Rate	Vol.	Rate	Vol.	Rate
Mon.	5,664	0.937	1,529	0.953	4,414	0.975
Tue.	6,038	0.999	1,574	0.981	4,397	0.971
Wed.	6,092	1.007	1,577	0.983	4,314	0.953
Thu.	6,363	1.052	1,579	0.984	4,351	0.961
Fri.	6,420	1.062	1,811	1.129	4,576	1.011
Sat.	5,959	0.985	1,703	1.062	4,777	1.055
Sun.	5,794	0.958	1,455	0.907	4,868	1.075
Ave.	6,047		1,604		4,528	

Table 4.2.3 Monthly Variance

	02 Point		05 Point		15 Point	
Month	Vol.	Rate	Vol.	Rate	Vol.	Rate
Jan	5,528	0.926	1,757	1.094	3,796	0.836
Feb.	6,355	1.065	1,799	1.120	4,135	0.911
Mar.	6,458	1.082	1,644	1.024	4,649	1.024
Apr.	6,170	1.034	1,792	1.116	4,799	1.258
May	5,855	0.981	1,412	0.879	4,421	0.974
Jun.	6,282	1.053	1,506	0.938	4,478	0.987
Jul.	5,982	1.003	1,520	0.946	4,407	0.971
Aug.	6,141	1.029	1,520	0.946	4,769	1.054
Sep.	5,503	0.922	1,507	0.938	4,780	1.053
Oct.	6,062	1.016	1,484	0.924	4,948	1.090
Nov.	6,184	1.036	1,708	1.064	4,798	1.057
Dec.	6,086	1.020	1,628	1.014	4,476	0.986
Ave.	5,967		1,606		4,538	

In order to generate a nationwide OD table from the 27-station OD data, some duplicated data have to be checked and deleted.

4.2.2 Road Inventory Survey

(1) Objectives of the Survey

The main objective of the study is to formulate a long-term road development master plan for the entire country. To realize this objective, it is essential to have an updated, comprehensive and reliable data base of the road network. It is expected that the data collected shall give a broad overview of the present condition of the classified road network, classes A, B and C. They should also provide an input into planning, design, construction/reconstruction/overlay, cost estimates, other maintenance and other administration requirements.

(2) Survey Methodology

1) Field Survey

A survey of the pavement conditions for about 5,200 km of selected paved roads, was carried out by 3 teams, after dividing the country into 3 zones, namely :

Zone 1 - Central, Nairobi, Easter and Rift Valley Provinces
Zone 2 - Rift Valley, Western and Nyanza Provinces
Zone 3 - Rift Valley, Eastern and Coast Provinces.

None of the paved roads (although they are only a few) in the North Eastern Province were inspected, due to the remoteness from Nairobi and insecurity in the area.

Each of the field survey team was headed by an assistant engineer, supported by 2 road inspectors and a driver.

Before the 3 teams left for their respective zones, a trial survey was arranged under the guidance of the senior Highway Engineer on A104-1, Nammanga-Athi River section. Road sections with the various defects were recorded, selected and the teams were briefed on how to quantify each defect. The defects were :

- cracking, both narrow and wide cracks, narrow cracks being defined as all cracks with a width of less than 3 mm. All other cracks were grouped as wide
- Potholes
- Raveling

- Rutting
- Visual assessment of roughness using the IRI.

The above defects were studied from a slow moving vehicle with a speed less than 40 kph. Frequent stops were made to take physical measurements.

In addition to the above, cross-sections were taken at every 5 km on average for links with a length of 10 km or more. For shorter links, at least 3 cross-sections were taken.

2) Desk Study

a Environmental Data

The environmental data consist of mean monthly rainfall and altitude information. The mean monthly rainfall data were extracted from a 1992 report on "The National Water Master Plan Study" prepared by JICA in conjunction with the Ministry of Water Development.

A summary table of mean monthly rainfall for all the districts in Kenya is given in the JICA report. The average monthly rainfall given in Appendices B, C and D for all the links are means of the average monthly rainfall for January to December.

The altitude data were mainly obtained from topographic maps (1 : 50,000, 1 : 100,000 and 1 : 250,000 scales). In some cases, however, the information was extracted from blue prints or design drawings, where they were available.

b Road Geometry

- Rise and Fall

Rise and fall data were principally obtained from the above mentioned topographic maps. Along each link evaluated, "B" for bottom and "C" for crest are indicated. The heights were obtained from contours. Some of the maps used, particularly for the remote, semi-desert and undeveloped North Eastern part of Kenya, had no contours. As a consequence the data could not be extracted. In addition to the topographic maps, rise and fall data were obtained from blue prints or design drawings ,whenever these were available.

- Horizontal Curvature

Horizontal curvature data were obtained from topographic maps, blue prints and design drawings. When information was obtained from topographic maps, the horizontal distances were measured using curvimetres and the angles of intersection were measured with 360° and 180° protractors.

- Carriage Way Width

For the inspected paved road network, carriage way width were physically measured using a tape measure. For the paved roads, which were not inspected, the carriage way widths were obtained from records kept by the Materials Branch of the MOPWH. Carriage way width data for all unpaved roads were obtained from the Maintenance Section (UR) of MOPWH.

- Super Elevation

Super elevation data were obtained from blue prints or design drawings, whenever these were available. For most of the links evaluated, however, these drawings were not available. No information is therefore given, since it was impossible to deduce the same from the topographic maps.

- Shoulder Width

Shoulder width data were obtained from similar sources as for the above.

- Effective Number of Lanes

For the inspected paved network, the effective number of lanes were physically verified in the field. For all the other roads, the effective number of lanes are deduced from the given carriage way width, assuming the width of a single lane to be 2.5 m.

c Pavement Materials

For the paved roads network, all data with regard to pavement materials quality, thickness and age of various layers were obtained from the Materials Brach of MOPWH. The Maintenance Section (UR) provided all materials data recorded for gravel and earth roads. Materials' data for the unpaved roads were obtained mainly from provincial laboratories. In some instances, however, data for both paved and unpaved roads were not available.

d Serviceability of Gravel and Earth Roads

It was intended that information on serviceability of gravel and earth roads during the rainy seasons would be obtained from the Maintenance Section of MOPWH, or through telephone interviews of the PWO and DWO. This information was not available at MOPWH Headquarters. At provincial and district level, only minimal information was available.

4.2.3 Axle Load Survey

(1) Introduction

The JICA Study Team commissioned Norconsult, A.S., Consulting Engineers, Architects and Economists to carry out an axle load surveys on three survey stations located on international trunk roads A104 and A109 and on national trunk road B4.

(2) Objective of the Axle Load Survey

It is generally accepted that structural damage of road pavements caused by traffic is due mainly to the axle loads imposed by commercial vehicles. Information on the current distribution of the axle loads of vehicle on the country's international and national trunk roads are, therefore, required. The survey recorded axle loads of heavy goods vehicles passing through three survey stations over 24 hours.

(3) Execution of Survey

1) Survey Station

The axle load survey was carried out at three survey stations as depicted in Figure A2-3, Appendix 3, of this report, namely :

a On A104, near Gilgil Toll Station at a distance of about 130 kilometers from Nairobi
b On A109, near Konza Railway Station, which is about 70 kilometers from Nairobi
c On B4, near Mogotio, at a distance of about 205 kilometers from Nairobi.

2) Sampling Rate

The sampling rate was over 25 % , in cases where the traffic volume was less than 2,000 vehicles per day. It was not less than 15 %, in cases where the traffic volume was more than 2,000 vehicles per day.

3) Vehicle Weighing

The loading pads were placed on the wheel paths on one of the lanes. Traffic cones and hazard signs were placed on the carriage way centerline to physically separate the lanes near the loading platforms.

The weighing pads were connected to the readout units, which were placed inside a car.

When approaching the platform each vehicle was aligned so that the wheels for each of the axles to be weighed were positioned on the center of the bridge. As the wheels of the axles passed over the platform, the automatic data recorder unit registered the weight carried by each of the axles and when all weighing was completed, the gross weight of the vehicle was recorded.

Efforts were made to explain to the heavy goods vehicle operators that the axle load survey was for research only and that no prosecution for overloading would take place.

In spite of this information, there were incidences of vehicle operators camping for some hours about 300 meters from the weighing station, for some hours. There were cases of overloaded vehicles abandoning their trip and turning back.

4.3 Evaluation of the Present Road Network

4.3.1 Assessment of the Existing Road Network

(1) MOPW&H Road Inventory and JICA's Field Survey

1) Data Sources from MOPW&H

There are a number of statistical sources on the conditions of various parts of the Kenyan road network. However, no accurate and detailed information suitable for engineering assessment on the existing road conditions are readily available, even from MOPW&H.

Out of the different statistical sources available in MOPW&H, the "Schedule of Classified Roads 1993-1994", June 1993 (the Schedule), was adopted as a key reference document. The Schedule is the only official inventory in custody of the Ministry in form of a computerized database.

The format of the Schedule is shown in Table A4-3, Appendix 3, and the following items are detailed in the Schedule :

- Road Code
- Start/End Location
- Road Length
- Surface Type : Surface dressing, premix, gravel, earth
- Average Daily Traffic: Total vehicle numbers, heavy vehicle numbers.

The "Pavement Condition", January, 1993, by the Material Branch, MOPW&H (Pavement Condition), was available as a source for reference information. The Pavement Condition details the following :

- Road Class
- Road Section
- Section Length
- Year of Paving Construction
- Surface Thickness and Type
- Base Course Thickness and Type
- Subbase Course Thickness and Type
- Sub-grade Soil Type
- Pavement condition.

The format of the Pavement Condition Report is shown in Table A4-3, Appendix 3. The alignment of classified road links on the topographic map at a scale of 1:500,000 (Road Map), indicating the class and surface types (hard, gravel, earth) of each road was also available.

However, there are many data discrepancies among these three documents :

- Road Code
- Location
- Road Length
- Surface Type.

It is particularly difficult to judge, whether the information of the "Schedule" or that of the "Pavement Condition" is the most reliable.

Besides, these MOPW&H sources do not include the following information, which is necessary for an engineering assessment of existing road conditions :

- Environmental Conditions :terrain, altitude, rainfall
- Geometric Conditions :horizontal and vertical alignment, carriage way and shoulder width, super-elevation, numbers of lanes
- Surface Conditions :surface roughness, cracking, potholes, raveling, rut depth, history.

2) Axle Load Analysis

Firstly, all surveyed records were converted from kilogram into KN (Kilo-Newton), in order to avoid confusion of the figures of the analysis with those of the road design manual.

Secondly, the total weight per vehicle, weight per axle of each road and direction as well as their averages were calculated.

Thirdly, the weight distribution per vehicle and that per axle were analyzed. Finally, the number of vehicles and axles exceeding the legal limits as well as

their share in the total number were analyzed. The main results are summarized in Table 4.3.1.

3) Equivalent Standard Axle (E.S.A.) Analysis

E.S.A. analysis was carried out to convert all single axles weighed during the survey, applying the equation set forth in the Road Design Manual :

$$EF = (\frac{Ls}{80})^{4,5}$$

where, EF : the Equivalence Factor of the single axle,
Ls : the Load in KN on the single axle.

All axles including tandem and triple ones were converted to E.S.A., applying the above equation.
The results of E.S.A. analysis are as summarized below:

Table 4.3.2 Average Vehicle Equivalence Factors

Road	Direction	Buses	M.G.V	H.G.V. (Non-Oil)	Oil Tanker
A104	Mombasa-Nairobi	1.00	4.70	8.05	9.63
	Nairobi-Mombasa	1.22	1.57	3.38	0.44
A109	Nairobi-Uganda	1.23	1.23	2.11	9.75
	Uganda-Nairobi	1.35	1.83	1.78	4.25
B4	Both Lanes	0.74	0.63	-	0.17

SOURCE : JICA Study Team computations.

Table 4.3.1 Summary of Axle Load Analysis

		Axle Force					Nos of Sample					Over Loading Axle								Average Excess Force			
		Front Axle (kN)	Single Axle (kN)	Tandem Axle (kN)	Triple Axle (kN)	G.V.W. (kN)	Front Axle (Nos)	Single Axle (Nos)	Tandem Axle (Nos)	Triple Axle (Nos)	G.V.W. (Nos)	Front Axle (Nos)	(%)	Single Axle (Nos)	(%)	Tandem Axle (Nos)	(%)	Triple Axle (Nos)	(%)	Front Axle (kN)	Single Axle (kN)	Tandem Axle (kN)	Triple Axle (kN)
A-109	MOMBASA - NAIROBI																						
	BUS	53	74	-	-	126	56	56	-	-	56	3	5.4	8	14.3	-	-	-	-	1	7	-	-
	M.G.V.	43	100	-	-	143	119	119	-	-	119	4	3.4	96	80.7	-	-	-	-	3	36	-	-
	H.G.V.	56	97	169	228	298	231	63	231	39	231	60	26.0	48	76.2	180	77.9	31	79.5	6	0	52	84
	O.T.	59	105	170	228	363	32	22	32	4	32	11	34.4	21	95.5	31	91.2	4	100.0	6	32	31	105
	NAIROBI-MOMBASA																						
	BUS	54	77	-	-	131	46	46	-	-	46	3	6.5	22	47.8	-	-	-	-	8	9	-	-
	M.G.V.	34	62	-	-	97	148	148	-	-	148	0	0.0	50	33.8	-	-	-	-	0	29	-	-
	H.G.V.	45	62	115	145	227	304	116	304	112	304	25	8.2	32	27.6	12	3.9	25	22.3	7	31	40	71
	O.T.	38	40	63	148	153	45	16	45	10	45	0	0.0	1	6.3	0	0.0	2	20.0	0	14	0	57
A-104	NAIROBI - UGANDA																						
	BUS	53	74	-	-	128	74	74	-	-	74	6	8.1	29	39.2	-	-	-	-	2	12	-	-
	M.G.V.	39	65	-	-	104	346	346	-	-	346	0	0.0	119	34.4	-	-	-	-	0	19	-	-
	H.G.V.	49	75	137	216	226	130	54	121	32	130	20	15.4	29	53.7	70	57.9	23	71.9	6	29	41	72
	O.T.	51	87	159	268	395	31	30	30	10	31	3	10.0	20	66.7	25	83.0	10	100.0	19	29	29	94
	UGANDA - NAIROBI																						
	BUS	54	77	-	-	131	78	78	-	-	78	4	5.1	34	43.6	-	-	-	-	2	13	-	-
	M.G.V.	37	76	-	-	113	243	243	-	-	243	6	2.5	135	55.6	-	-	-	-	6	20	-	-
	H.G.V.	43	50	102	137	211	182	99	173	56	182	7	3.8	14	14.1	43	24.9	12	21.4	3	23	30	39
	O.T.	55	49	160	240	360	2	1	2	1	2	1	50.0	0	0.0	1	50.0	2	100.0	1	43	43	34
B-4	Both Direction																						
	BUS	50	60	-	-	110	50	50	-	-	50	2	4.0	1	2.0	-	-	-	-	6	31	-	-
	M.G.V.	25	52	-	-	77	25	25	-	-	25	0	0.0	4	16.0	-	-	-	-	0	22	-	-
	H.G.V.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	O.T.	24	21	-	-	65	4	4	-	-	4	0	0.0	0	0.0	-	-	-	-	0	0		

(2) Evaluation of Existing Conditions

1) Primary Assessment

The existing road links of road classes A, B and C were assessed from an engineering point of view on geometric conditions and surface conditions as mentioned in preceding sections of this chapter (4.2 and 4.3.1).

The engineering indicators reflecting the existing road characteristics adopted in the assessment are summarized in Annex3.1.

2) Evaluation Summary

The summary of the evaluation of both, geometry and pavement conditions, is as follows :

a Geometry

- Horizontal vertical alignment in all links are generally free from defect or deficiency
- Approximately 20% of class A roads, 30% of Class B and 20% of Class C have deficient cross sections both, in carriage way and shoulder width, against the design standard specified in the Road Design Manual, Part I
- Approximately 90% of Class A, B, and 80% of Class C of gravel roads as well as earth roads have the traffic (ADT) of bitumen surface standard in accordance with the Manual
- Traffic congestion is seen on a part of A2, A104, especially, in and around Nairobi.

b Pavement Condition

- Generally speaking, the pavement on class A, B and C roads are designed in a rather low structural number as against present traffic
- Except for a few links, periodic maintenance on pavement such as overlaying and/or strengthening has not taken place in last 20 years
- The roughness evaluation indicates that approximately 50% of all links of class A, B and C are in the range of requiring maintenance. Another

50% are in the range of requiring reconstruction, with the exception of some recently repaved or reconstructed links

- In 1998, more than 70% of all links of class A, B and C will be in the range of requiring reconstruction. This share will increase to more than 80 % in 2003, if no periodic maintenance takes place properly and timely.

(3) Assessment of Axle Load Survey

1) Vehicle Equivalence Factors

Table 4.3.3 below identifies the average vehicle equivalence factors set forth in "Design Manual, Part III".

Table 4.3.3 Average Vehicle Equivalence Factors of Design Manual

Road	Buses	Medium Goods	Heavy G. (Non-Oil)	Oil Tankers
Mombassa - Nairobi	1	3	10	25
Nairobi - Mombassa	1	2	10	1
Nairobi - Uganda	1	1	10	15
Uganda - Nairobi	1	1	10	1
Nairobi - Sagana (A2)	1	1	10	4
Mau Summit - Kisumu	1	1	7	15
Kisumu - Mau Summit	1	1	3	1
Other Bitumen Roads (Both Lanes)	1	1	4	4

There are significant differences between the above equivalence factors and those established in table 4.3.2 as a result of the axle load survey.

Below is an overview comparing the daily ESA, applying the respective equivalence factors from the design manual with the survey results on the A104 and A109.

a A104 Mombasa - Nairobi

	Bus	MGV	HGV	OT	Daily ESA
Nos of Vehicle	56	119	231	32	
Design Manual	56	357	2310	800	3523
Survey Results	56	559	1860	308	2783

b A104 Nairobi - Mombasa

	Bus	MGV	HGV	OT	Daily ESA
Nos of Vehicle	46	148	304	45	
Design Manual	46	296	3040	45	3427
Survey Results	46	232	1028	20	1336

c A109 Nairobi - Uganda

	Bus	MGV	HGV	OT	Daily ESA
Nos of Vehicle	74	346	130	31	
Design Manual	74	346	1300	465	2185
Survey Results	91	436	274	302	1093

d A109 Uganda - Nairobi

	Bus	MGV	HGV	OT	Daily ESA
Nos of Vehicle	78	243	182	2	
Design Manual	78	243	1820	2	1900
Survey Results	105	445	324	9	883

e A104 Both Direction

	Bus	MGV	HGV	OT	Daily ESA
Nos of Vehicle	12	25	-	4	
Design Manual	12	25	-	16	53
Survey Results	9	16	-	1	26

As can be seen above, the daily ESA based on the design manual largely exceeds those of the survey results.

The equivalence factors specified in the design manual, although they are prescribed for feasibility study stage or secondary road projects, are therefore considered to be in a sufficient safety range.

2) Overloading

A considerable number of overloaded vehicles were surveyed by the axle load survey :

- A104

  On average, there were 55% of overloaded axles in the Mombasa - Nairobi direction. Nearly 15% of vehicles exceeded 130KN.

  In the other direction, 23% of axles were overloaded and nearly 8% exceeded 130KN.

- A109

  In the Nairobi-Uganda direction, 27% of axles were overloaded and nearly 12% exceeded 130KN.

  In the other direction, 22% of axles were overloaded and 7% exceeded 130KN.

It is evident that the control of such overloading such overloading may increase the number of heavy vehicles on the road, but the damage to the pavement structure due to axle loads would be drastically reduced.

(4) Conclusions

The following broad but crucial conclusions may be drawn from the assessment of the present conditions of existing roads class A, B and C :

a Maintenance, including rehabilitation, strengthening and the reconstruction of pavement structures all over the country for class A, B and C roads will be the most serious issue to sustain smooth and safe road traffic and transportation

b Traffic congestion in and around Nairobi city should be mitigated by increasing traffic lanes or by construction of bypasses

c A considerable number of gravel and earth roads should be upgraded to bitumen surface standard

d Road sections with deficient cross-section, i.e. carriage way and shoulder width, should be improved to Design Manual standards

e Road condition data, traffic (ADT), geometry, pavement conditions should be updated and rearranged more accurately. This is necessary not only for engineering purposes, but also as an input into establishing a long term strategy by the Government

f Regulations for and control of heavy axle loading should be discussed by the Government.

The above issues shall be discussed in this study from a planning point of view.

4.3.2 Present Traffic Characteristics and Network Pattern

(1) Traffic Volume on the Road System

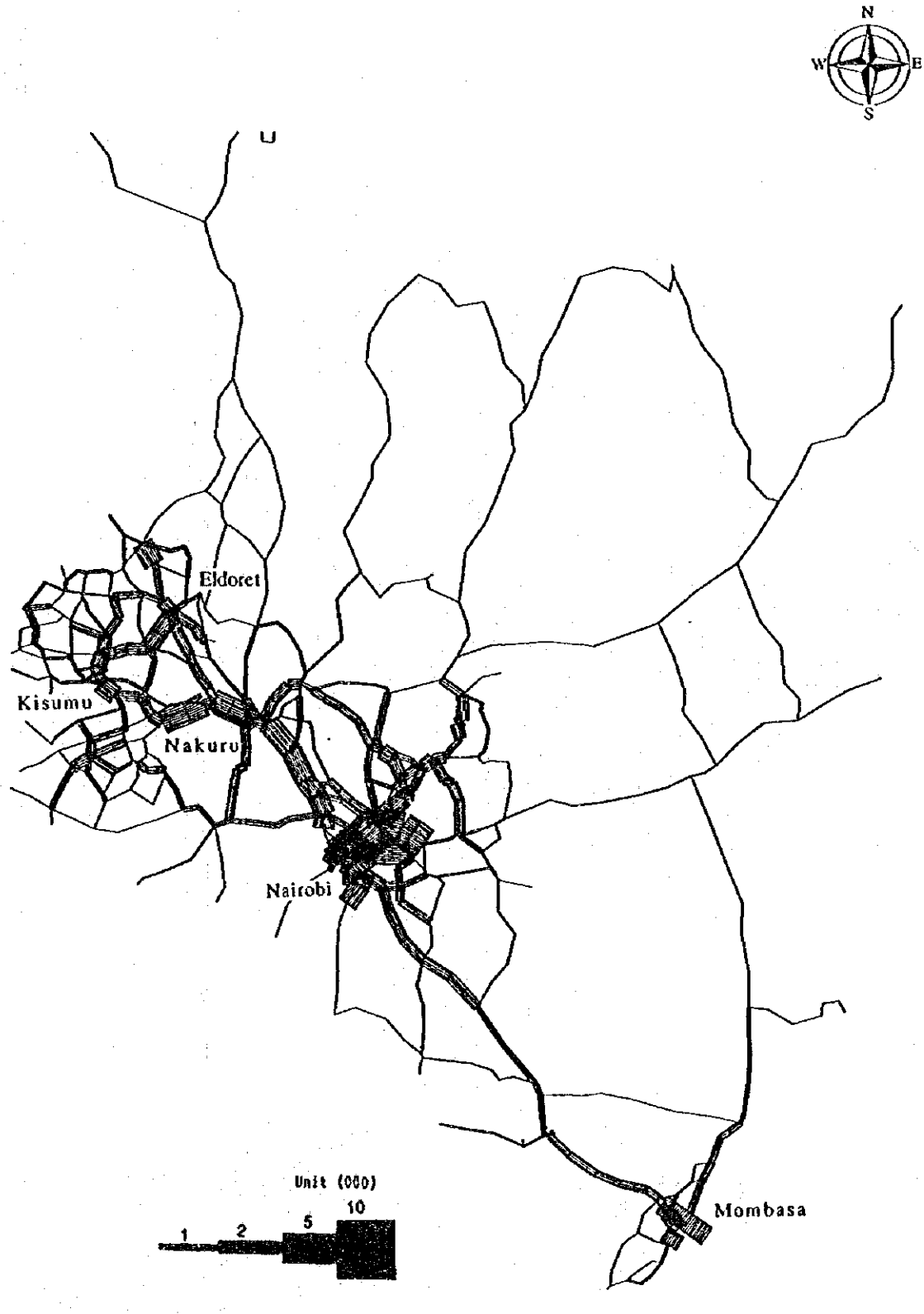
1) 24 Hours Traffic Volume

The graphic in Figure 4.3.1 shows the 24 hours two way traffic volume band derived from the survey, which was conducted by MOPW&H in 1989 at 60 points. The Mombasa-Nairobi-Kisumu/Eldoret axis proves to be the principal corridor. The section with the largest traffic volume is the road A104 near the city of Nairobi, counting 37,000 vehicle per day. Other road sections with a large traffic volume are Mombasa-Kilifi on B8, counting around 9,000 vehicles per day, Thika-Nairobi on A2, counting around 7,000 vehicles per day, and Nairobi-Athi River on A109, counting around 5,300 vehicles per day (the sections with such a new dual road as Thika-Kabati are excluded because the traffic counting was carried out in 1989).

The graph in Figure 4.3.2 depicts the 24 hours cross-sectional traffic volume (vehicles/24 hours two directions) at 27 points on main roads, which was surveyed by the JICA Study Team in 1994. The traffic volume of the Nairobi-Kiambu section on road C64 is rather large, counting around 8,500 vehicles per day. Other road sections of a large traffic volume are Nairobi-Athi River and Nairobi-Nakuru on A104, Thika-Nyeri on A2 and Malindi-Mombasa on B8, counting between 5,200 - 5,900 vehicles per day. The Thika section of the A3, the Nairobi-Nakuru section of the A104, the Lunga Lunga-Mombasa section of the A14 and the Kisumu-Kakamega section of the A1 count between 3,100 - 3,800 vehicles per day. The traffic volume of the other sections counted less than 2,000 vehicles per day.

2) Vehicle Composition

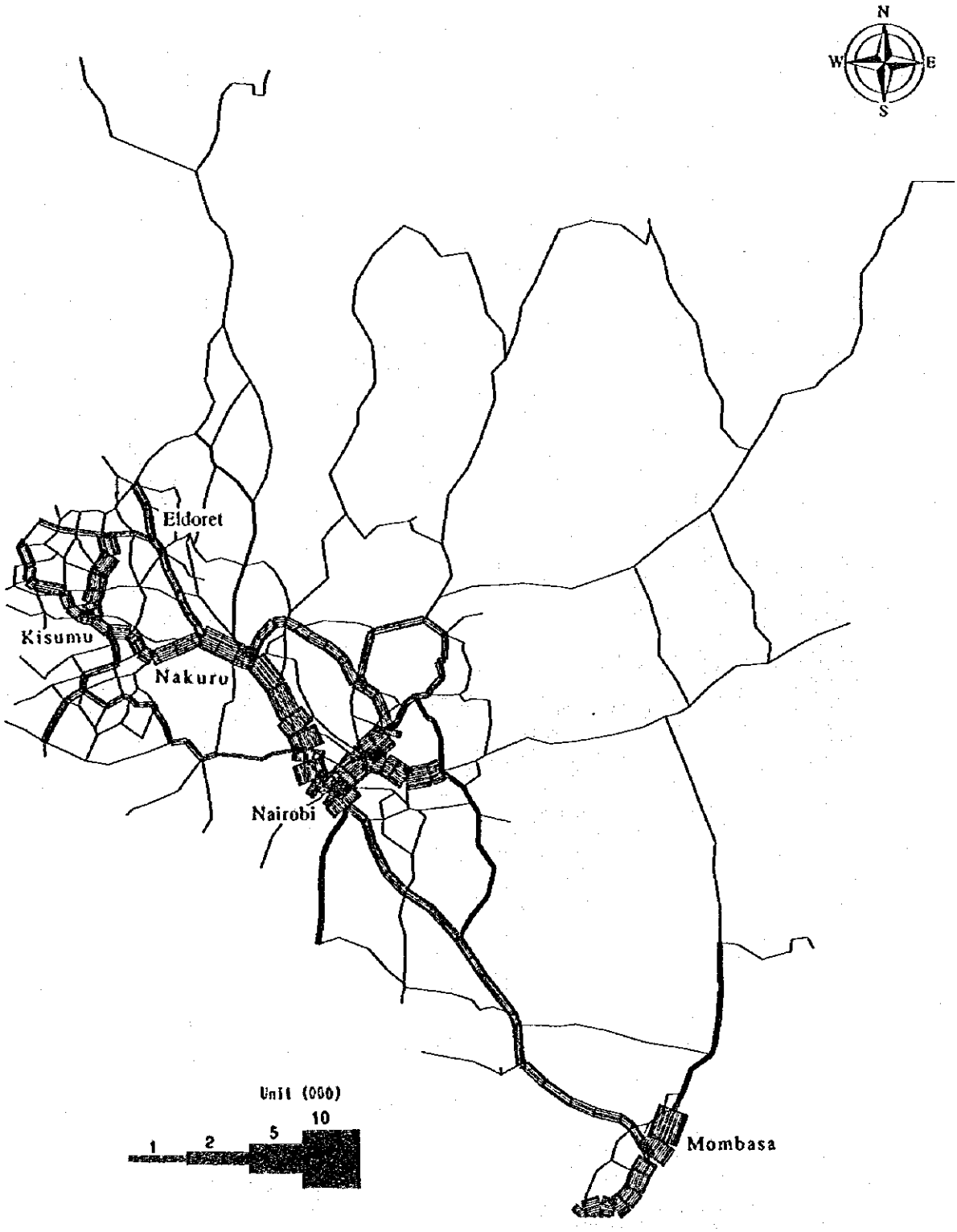
Table 4.3.4 shows the average vehicle composition (in percent) at traffic volume survey points in 1994. 'Passenger car' and 'Light goods' vehicles account each for a share of some 25%, 'Matatu' for 20%, 'Medium goods' vehicles for 11% and the 'Others' for 2 to 8%. The overall vehicle composition varies by location, the 'Passenger car' and 'Heavy vehicles' ratio varies around cities and rural areas. Table 4.3.5 shows the heavy vehicle ratio (in percent) by location. The average heavy vehicle ratio for all survey points is 49.4%. The ratio on roads class A have



Source: By MOPWH

Road Network Development Master Plan in Kenya

Figure 4.3.1
24 Hours Traffic Volume
(Vehicles/24 hours Two Directions) In 1989



Sourse: JICA Study Team

Road Network Development Master Plan in Kenya

Figure 4.3.2
24 Hours Cross-Sectional Traffic Volume
(Two Directions) of Principal roads in 1994

a range of 25.0% to 78.5% and the roads class B one of 27.1% to 69.1%. The ratio value is very high at the Nairobi-Thika section of A104 (78.5%), and somewhat high at the Nyahururu-Nyeri section of B5 (68.1%), the Bungoma-Eldoret section of A104 (67.8%), and the Kisii-Migori section of A1 (66.9%). The ratio drops to 17.0% at the Nairobi-Kiambu section of the C64 near Nairobi city.

Table 4.3.4 Average Vehicle Composition in 1994

Unit: %

Car	Motor -cycle	Light Goods	Medium Goods	Heavy Goods	Tanker	Bus	Matatu	Total
25.9	2.2	25.7	11.1	7.8	3.1	4.1	20.0	100.0

Source:JICA Study Team in 1994

Table 4.3.5 Heavy Vehicle Ratio by Survey Points in 1994

Survey point	Route No.	Section	Heavy vehicle ratio(%)
1	A109	NAIROBI-MOMBASA	61.2
2	A 14	LUNGA LUNGA-MOMBASA	25.0
3	B 8	MALINDI-MOMBASA	27.1
4	B 8	MALINDI-LAMU	42.8
5	A104	NAIROBI-MOMBASA	50.1
6	A 2	THIKA-NYERI	51.0
7	A 3	GARISSA-THIKA	49.5
8	B 6	MERU-EMBU	41.3
9	A104	NAIROBI-NAKURU	45.5
10	A104	NAKURU-ELDORET	49.1
11	B 1	NAKURU-KERICHO	55.3
12	B 2	ELDORET-KITALE	54.7
13	A 1	KISHI-MIGORI	66.9
14	A 1	KISUMU-KERICHO	62.8
15	A 1	KISUMU-KAKAMEGA	39.5
16	B 1	KISUMU-BUSIA	51.8
17	A104	BUNGOMA-ELDORET	67.8
18	B 7	EMBU-KITUI	38.4
19	A104	NAIROBI-KAJIADO	45.2
20	A 2	THIKA-MANYUKI	46.8
21	B 5	NYAHURURU-NYERI	69.1
22	B 1	NAKURU-KABARET	35.9
23	B 3	KERICHO-KISHI	55.9
24	A109	NAIROBI-MOMBASA	78.5
25	B 3	NAIROBI-NAROK	35.7
26	A104	NAIROBI-NAKURU	59.3
27	C 64	NAIROBI-KIAMBU	17.0
Average			49.4

Source: JICA Study Team in 1994
* See Figure A3.1 in Appendix3.

(2) Present Vehicle Traffic Demand

1) General

The 1994 calibrated vehicle trip matrices contain almost 97 thousand vehicle trips (Table 4.3.6 refers).

- The most dominant zone is Nairobi, accounting for some one-forth of total trips. Kiambu is the second biggest zone in terms of traffic demand, followed by Mombasa, Kilifi, Nakuru and Kisumu. Aggregated traffic demand of the above six zones is more than 60 % of total.

- Principal interchanges (in excess of 1,000 PCU's) are observed between the following zones :
  Nairobi - Kiambu (5,243 PCU's in each direction)
  Mombasa - Kilifi (3,669 PCU's in each direction)
  Nairobi - Machakos (3,169 PCU's in each direction)
  Nairobi - Nakuru (1,755 PCU's in each direction)
  Muranga - Kiambu (1,476 PCU's in each direction).

These findings indicate that Kenya is divided into two principal areas in terms of traffic demand; namely Nairobi, the capital city area and Mombasa in the coastal area.

- The vast majority of trips have both trip ends within 47 internal zones, i.e 95,819 vehicle trips or almost 99% of total demand (excluding intra traffic). Thus, the number of trips crossing the international border is very small.

- Passenger cars, light goods vehicles and Matatu constitute 32.7%, 25.9% and 19.8% of total vehicle trips, respectively. However, in terms of actual impact on road capacity, that is, demand in terms of PCU, the role of Matatus is much more pronounced.

Table 4.3.7 Comparison of Traffic Demand by Vehicle Type (excluding intra traffic)

Vehicle Type	Vehicle Trips		PCU Trips	
	Number	Share (%)	Number	Share(%)
Car	31,516	32.7	31,516	20.7
Motor Cycle	1,070	1.1	1,070	0.7
Light Goods	24,954	25.9	24,954	16.4
Medium Goods	7,974	8.3	19,935	13.1
Heavy Goods	5,634	5.8	19,719	12.9
Tanker	3,056	3.2	10,696	7.0
Buses	3,146	3.3	6,292	4.1
Matatu	19,156	19.8	38,312	25.1
Total	96,506	100.0	152,494	100.0

SOURCE: JICA Study Team

Table 4.3.6 Vehicle Trip Genaration and Attraction by Type in 1994

No.	DISTRICT	PROV.	Trip Ends (excluding intra traffic)									Relative Demand (%)								
			CAR	MC	LG	MG	HG	TNK	BUS	MTT	TOTAL	CAR	MC	LG	MG	HG	TNK	BUS	MTT	TOTAL
1	Kilifi	Coa	2,384	74	2,061	340	103	74	131	813	5,980	7.56	6.92	8.26	4.26	1.83	2.42	4.16	4.24	6.20
2	Kwale	Coa	1,281	104	780	225	61	23	110	194	2,778	4.06	9.72	3.13	2.82	1.08	0.75	3.50	1.01	2.88
3	Lamu	Coa	0	0	18	12	8	0	16	0	54	0.00	0.00	0.07	0.15	0.14	0.00	0.51	0.00	0.06
4	Mombasa	Coa	3,805	169	3,060	701	659	260	393	1,028	10,075	12.07	15.79	12.26	8.79	11.70	8.51	12.49	5.37	10.44
5	Taita	Coa	139	4	204	49	34	16	21	99	566	0.44	0.37	0.82	0.61	0.60	0.52	0.67	0.52	0.59
6	Tana River	Coa	0	0	9	12	4	4	14	0	43	0.00	0.00	0.04	0.15	0.07	0.13	0.45	0.00	0.04
7	Garissa	NE	7	0	8	9	6	0	17	6	53	0.02	0.00	0.03	0.11	0.11	0.00	0.54	0.03	0.05
8	Mandera	NE	0	0	0	5	0	0	0	0	5	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.01
9	Wajir	NE	0	0	0	3	0	0	0	0	3	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00
10	Embu	Eas	203	38	177	42	31	4	22	105	622	0.64	3.55	0.71	0.53	0.55	0.13	0.70	0.55	0.64
11	Isiolo	Eas	58	0	53	25	20	8	10	18	192	0.18	0.00	0.21	0.31	0.35	0.26	0.32	0.09	0.20
12	Kitui	Eas	168	24	207	96	142	18	115	261	1,031	0.53	2.24	0.83	1.20	2.52	0.59	3.66	1.36	1.07
13	Machakos	Eas	1,482	26	1,263	367	519	88	67	714	4,526	4.70	2.43	5.06	4.60	9.21	2.88	2.13	3.73	4.69
14	Makueni	Eas	85	2	113	45	66	14	1	113	439	0.27	0.19	0.45	0.56	1.17	0.46	0.03	0.59	0.45
15	Marsabit	Eas	8	18	0	18	18	1	0	2	65	0.03	1.68	0.00	0.23	0.32	0.03	0.00	0.01	0.07
16	Meru	Eas	370	46	334	176	71	38	57	290	1,382	1.17	4.30	1.34	2.21	1.26	1.24	1.81	1.51	1.43
17	Tharaka Nithi	Eas	30	10	22	4	1	0	2	11	80	0.10	0.93	0.09	0.05	0.02	0.00	0.06	0.06	0.08
18	Kiambu	Cen	4,622	62	3,127	520	384	292	76	2,145	11,228	14.67	5.79	12.53	6.52	6.82	9.55	2.42	11.20	11.63
19	Kirinyaga	Cen	110	0	132	35	16	104	5	32	434	0.35	0.00	0.53	0.44	0.28	3.40	0.16	0.17	0.45
20	Muranga	Cen	611	24	844	145	138	197	5	982	2,946	1.94	2.24	3.38	1.82	2.45	6.45	0.16	5.13	3.05
21	Nyandarua	Cen	124	18	260	106	8	4	64	375	959	0.39	1.68	1.04	1.33	0.14	0.13	2.03	1.96	0.99
22	Nyeri	Cen	463	2	255	164	57	34	50	546	1,571	1.47	0.19	1.02	2.06	1.01	1.11	1.59	2.85	1.63
23	Nairobi	NBO	8,301	148	5,615	1,375	1,521	898	886	4,274	23,018	26.34	13.83	22.50	17.24	27.00	29.38	28.16	22.31	23.85
24	Baringo	Rif	81	2	110	58	8	2	15	79	355	0.26	0.19	0.44	0.73	0.14	0.07	0.48	0.41	0.37
25	Elgeyo Marakwet	Rif	13	0	0	6	4	2	0	10	35	0.04	0.00	0.00	0.08	0.07	0.07	0.00	0.05	0.04
26	Kajiado	Rif	353	10	349	100	78	22	18	264	1,194	1.12	0.93	1.40	1.25	1.38	0.72	0.57	1.38	1.24
27	Kericho	Rif	741	19	504	180	157	50	34	406	2,091	2.35	1.78	2.02	2.26	2.79	1.64	1.08	2.12	2.17
28	Bomet	Rif	19	0	28	20	0	0	8	7	82	0.06	0.00	0.11	0.25	0.00	0.00	0.25	0.04	0.08
29	Laikipia	Rif	309	8	229	88	31	32	12	223	932	0.98	0.75	0.92	1.10	0.55	1.05	0.38	1.16	0.97
30	Nakuru	Rif	1,750	22	1,326	784	412	135	177	1,131	5,737	5.55	2.06	5.31	9.83	7.31	4.42	5.63	5.90	5.94
31	Nandi	Rif	58	0	39	25	11	0	2	18	153	0.18	0.00	0.16	0.31	0.20	0.00	0.06	0.09	0.16
32	Narok	Rif	206	2	268	49	15	18	10	118	686	0.65	0.19	1.07	0.61	0.27	0.59	0.32	0.62	0.71
33	Samburu	Rif	43	0	32	8	19	0	0	25	127	0.14	0.00	0.13	0.10	0.34	0.00	0.00	0.13	0.13
34	Trans Nzoia	Rif	214	12	226	232	54	37	36	340	1,151	0.68	1.12	0.91	2.91	0.96	1.21	1.14	1.77	1.19
35	Turkana	Rif	20	0	31	46	80	8	4	2	191	0.06	0.00	0.12	0.58	1.42	0.26	0.13	0.01	0.20
36	Uasin Gishu	Rif	408	8	359	250	92	69	39	520	1,745	1.29	0.75	1.44	3.14	1.63	2.26	1.24	2.71	1.81
37	West Pokot	Rif	17	0	17	21	0	6	6	20	87	0.05	0.00	0.07	0.26	0.00	0.20	0.19	0.10	0.09
38	Kisii	Nya	319	19	274	178	62	29	121	386	1,388	1.01	1.78	1.10	2.23	1.10	0.95	3.85	2.02	1.44
39	Nyamira	Nya	14	4	35	8	0	0	0	6	67	0.04	0.37	0.14	0.10	0.00	0.00	0.00	0.03	0.07
40	Kisumu	Nya	1,009	53	884	605	214	211	189	1,416	4,581	3.20	4.95	3.54	7.59	3.80	6.90	6.01	7.39	4.75
41	Siaya	Nya	212	16	200	89	4	8	42	388	959	0.67	1.50	0.80	1.12	0.07	0.26	1.34	2.03	0.99
42	Homa Bay	Nya	122	9	115	124	33	27	33	195	658	0.39	0.84	0.46	1.56	0.59	0.88	1.05	1.02	0.68
43	Migori	Nya	161	13	108	88	87	36	70	360	923	0.51	1.21	0.43	1.10	1.54	1.18	2.23	1.88	0.96
44	Bungoma	Wes	149	14	113	97	93	43	59	124	692	0.47	1.31	0.45	1.22	1.65	1.41	1.88	0.65	0.72
45	Busia	Wes	68	0	121	89	70	15	58	210	631	0.22	0.00	0.48	1.12	1.24	0.49	1.84	1.10	0.65
46	Kakamega	Wes	621	41	670	247	71	72	82	540	2,344	1.97	3.83	2.68	3.10	1.26	2.36	2.61	2.82	2.43
47	Vihiga	Wes	216	23	270	76	6	0	22	347	960	0.69	2.15	1.08	0.95	0.11	0.00	0.70	1.81	0.99
48	Tanzania	Out	107	24	80	15	65	53	35	9	388	0.34	2.24	0.32	0.19	1.15	1.73	1.11	0.05	0.40
49	Somalia	Out	0	0	0	0	4	0	0	0	4	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00
50	Ethiopia / Sudan	Out	0	2	6	4	16	0	0	0	28	0.00	0.19	0.02	0.05	0.28	0.00	0.00	0.00	0.03
51	Uganda	Out	35	0	18	13	81	104	12	4	267	0.11	0.00	0.07	0.16	1.44	3.40	0.38	0.02	0.28
	TOTAL		31,516	1,070	24,954	7,974	5,634	3,056	3,146	19,156	96,506	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

2) Zonal Trip Demand by Type of Vehicle

a Passenger Car

The volume of generation and attraction of 'Passenger cars' of the total zones accounts for about 31,500 vehicle trips. In terms of the distribution of each individual zone, Nairobi, Kiambu and Mombasa show 26.4%, 14.7% and 12.1% of the total, respectively. Consequently, the total of the three zones is 53.0%. Each of the other zones has a smaller share with less than 6%.

b Motor Cycle

The volume of generation and attraction of 'Motor-cycle' of the total zones is about 1,100 vehicle trips. In terms of the distribution over each individual zone, the Mombasa zone's share is high with 15.7%, followed by the Nairobi zone with 13.8% and the Kwale zone with 9.7%.

c Light Vehicles

The volume of generation and attraction of 'Light goods' of the total zones is about 25,000 vehicle trips. In terms of the distribution over each individual zone, Nairobi, Kiambu and Mombasa accounted for 22.5%, 12.5% and 12.3% of the total, respectively. Consequently the three zone's total is 47.0%. The Kilifi zone accounted for 8.9% and each of the other zones take a less than 6% share.

d Medium Goods

The volume of generation and attraction of 'Medium goods' of the total zones was some 8,000 vehicle trips. In terms of the distribution over each individual zone, Nairobi, Nakuru, Mombasa, Kisumu and Kiambu accounted for 17.2%, 9.8%, 8.7%, 7.5% and 6.5% of the total, respectively. Consequently the five zone's total is 50.0%. The Nairobi zone shows a particularly high figure, while the other 4 zones take a relatively even share. The zones with a high distribution are found concentrated around the Nairobi zone.

e Heavy Goods

The volume of generation and attraction of 'Heavy goods' of the total zones was about 5,600 vehicle trips. In terms of the distribution over each individual zone, the Nairobi zone showed the highest figure with 26.8%. This is followed by Mombasa, Machakos (No. 13), Nakuru and Kiambu accounting for 11.5%, 9.2%, 7.3% and 6.8% of the total, respectively. Consequently the five zone's total accounted for some 62.0%. Each of the other zones accounted for less than 4%.

f Tanker

The volume of generation and attraction of the 'Tanker' category of the total zones was about 3,100 vehicle trips. In terms of the distribution over each individual zone, the Nairobi zone accounted with 29.3% for the highest. Kiambu, Mombasa and Kisumu accounted for 9.6%, 8.4% and 6.9% of the total, respectively. Consequently the four zone's total is 54.0%.

g Bus and Matatu

The volume of generation and attraction of the 'Bus' category of the total zones was about 3,100 vehicle trips. In terms of the distribution over each individual zone, Nairobi and Mombasa were high, accounting for 28.0% and 12.3%, respectively. Each of the other zones accounted for less than 6%.

The volume of generation and attraction of 'Matatu' of the total zones was about 19,200 vehicle trips. In terms of the distribution over each individual zone, Nairobi and Kiambu take a high share, 22.3% and 11.2%, respectively. This is followed by Kisumu and Nakuru, accounting for 7.4% and 5.9%, respectively.

(3) Origin-Destination Pattern by Type of Vehicle

1) Status of Vehicle OD of All Types of Vehicle

Figure 4.3.3 depicts the vehicle OD pattern for all types of vehicle. The OD vehicle trips show high figures in the Nairobi, Mombasa, Nakuru and Kisumu zones, particularly in zone pairs connecting to surrounding cities. Among all, the traffic volumes of the zones surrounding Nairobi and Mombasa are particularly high. High OD vehicle trips are found in zone pairs such as Nairobi-Kiambu, Mombasa-Kilifi, Nairobi-Machakos, Mombasa-Kwale, Nairobi-Nakuru, Kiambu-Muranga, Nakuru-Kericho, Nairobi-Muranga and Nairobi-Kajiado, accounting for

16.5%, 11.8%, 8.3%, 5.3%, 4.2%, 3.8%, 2.3%, 2.1% and 2.0% of the total, respectively.

2) OD Pattern by Type of Vehicle

- Passenger Car

Figure 4.3.3 shows the vehicle OD flow by major type of vehicles. The OD vehicle trips of passenger car show high figures in the Nairobi and Mombasa zones, particularly in zone pairs connecting to surrounding cities. Among all, high OD vehicle trips are found in zone pairs such as Nairobi-Kiambu, Mombasa-Kilifi, Nairobi-Machakos and Mombasa-Kwale, accounting for 24.2%, 14.8%, 8.6% and 7.7% of the total, respectively.

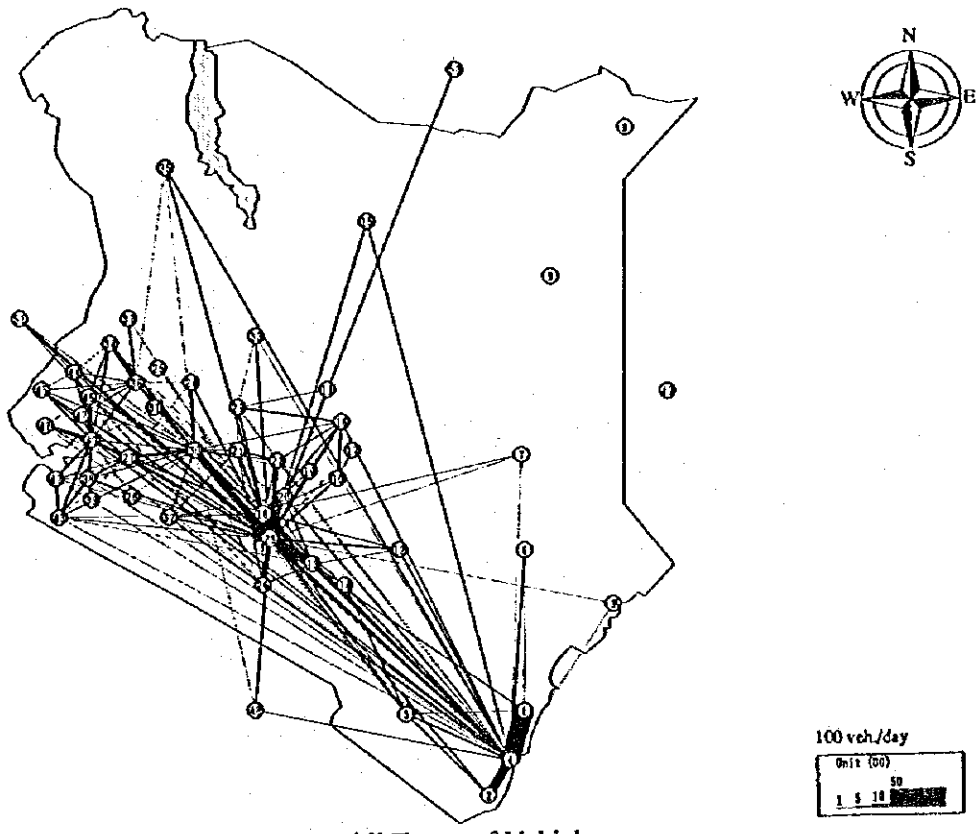
- Medium and Heavy Goods

The OD vehicle trips of 'Medium goods' are connecting the Nairobi and Mombasa zones and surrounding cities, but the traffic volumes are small. Main OD are Mombasa - Kilifi and Nairobi - Kiambu accounting for 7.5% and 7.3% of the total, respectively.

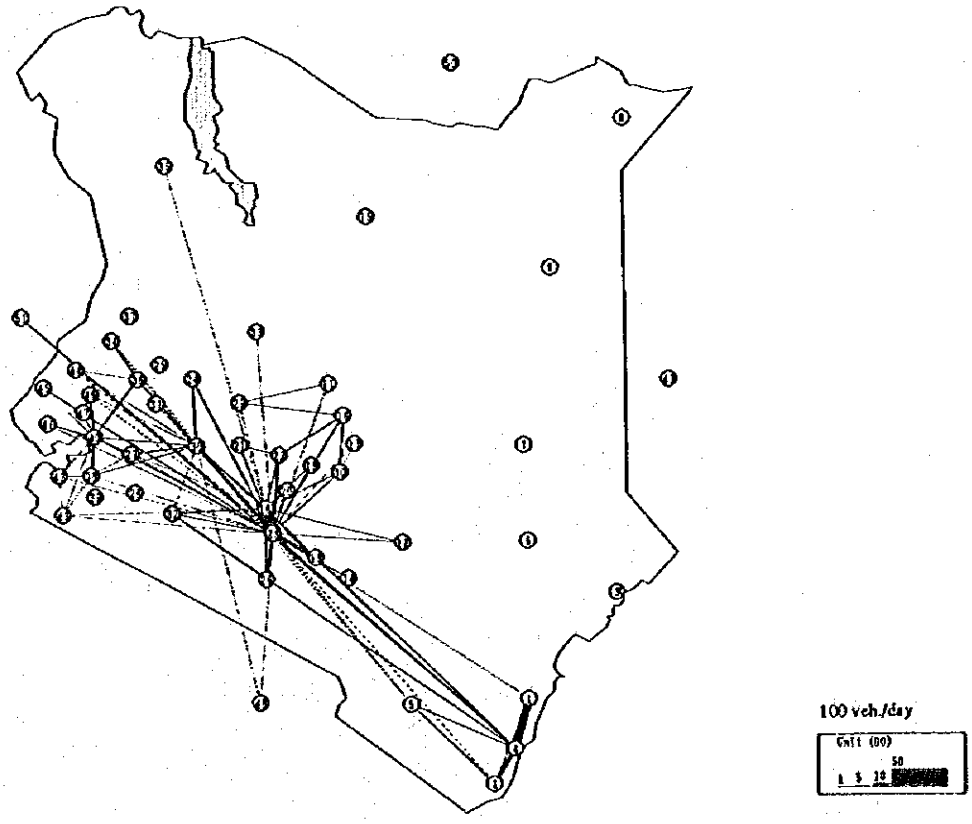
The OD vehicle trips of 'Heavy goods' is concentrated in zones such as Machakos, Mombasa, Kiambu and Nakuru around the Nairobi zone, showing small traffic volumes between other zones. The OD such as Nairobi-Machakos, Nairobi-Mombasa and Nairobi-Kiambu and Nairobi-Nakuru accounted for 14.6%, 5.1%, 4.6% and 4.0%, respectively.

- Bus

The OD vehicle trips of 'Bus' are connecting the Nairobi and Mombasa zones and surrounding cities, but the traffic volumes are small. The significant OD are Mombasa-Kwale and Mombasa-Kilifi showing 5.8% and 5.6%, respectively. The volume of generation/attraction connecting to Nairobi is as high as 28.2%, but each OD shows a distribution of 3.4% to 4.0% on average. The other main OD are Nairobi-Kitui, Nairobi-Kisumu, Nairobi-Kisii, Nairobi-Kirinyaga, Nairobi-Kakamega and Nairobi-Mombasa.



All Types of Vehicle

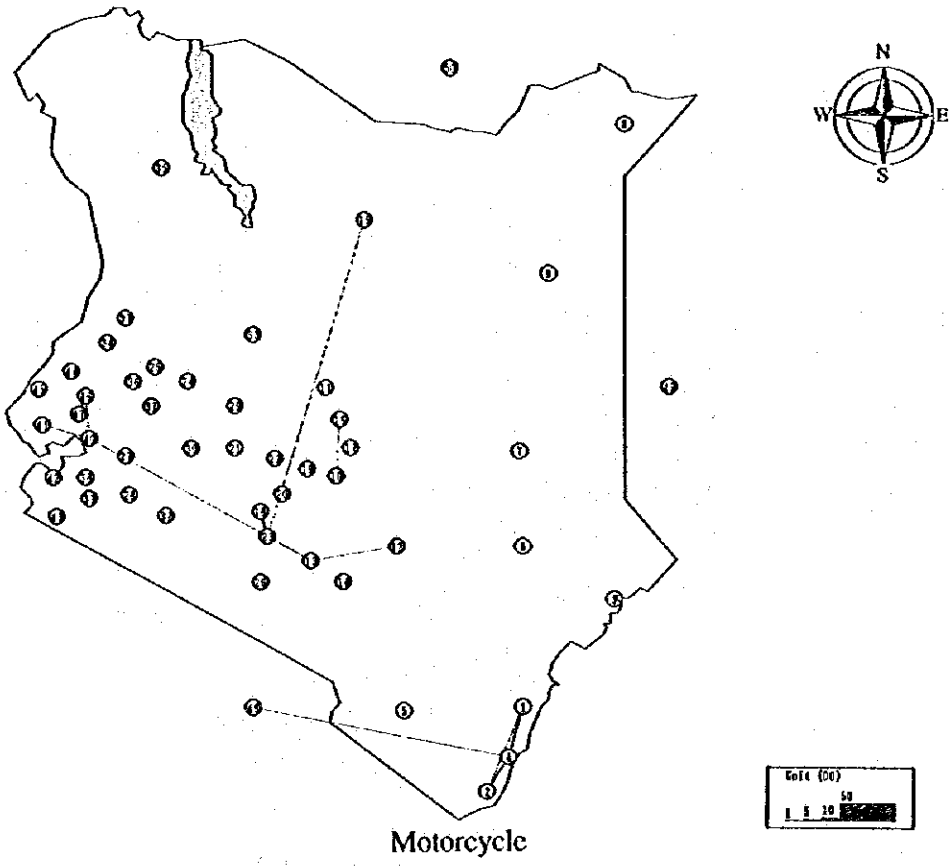


Car

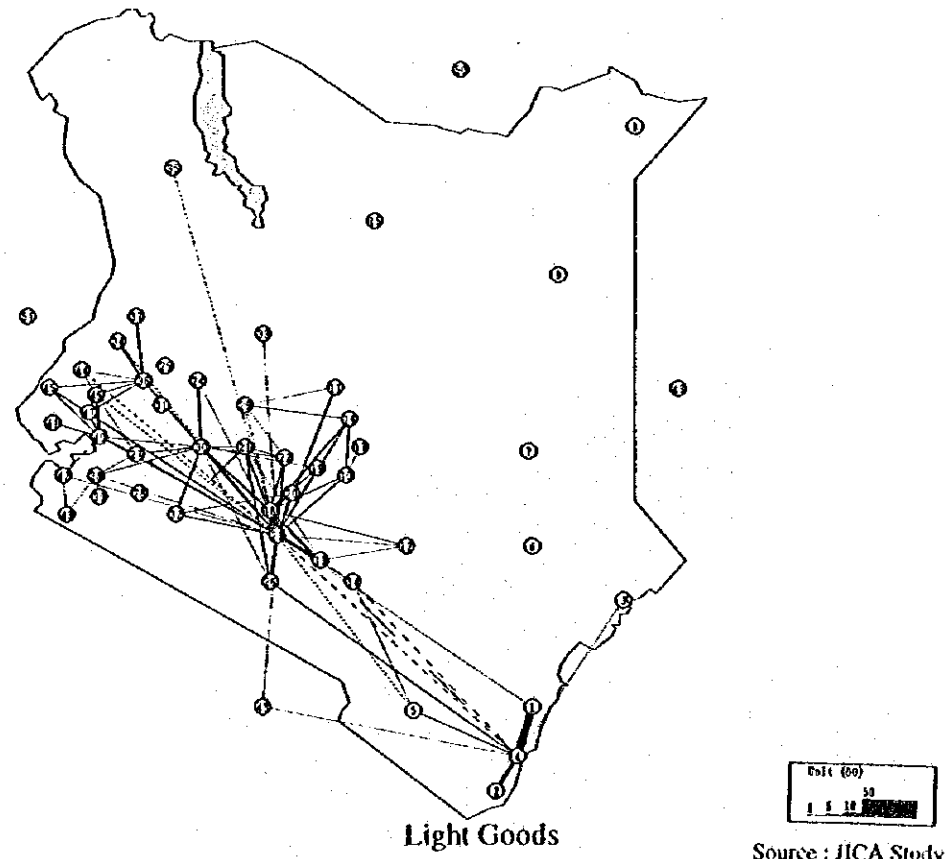
Source : JICA Study Team

Road Network Development Master Plan in Kenya

Figure 4.3.3(1)
Vehicle of Flow by Type of Vehicle



Motorcycle

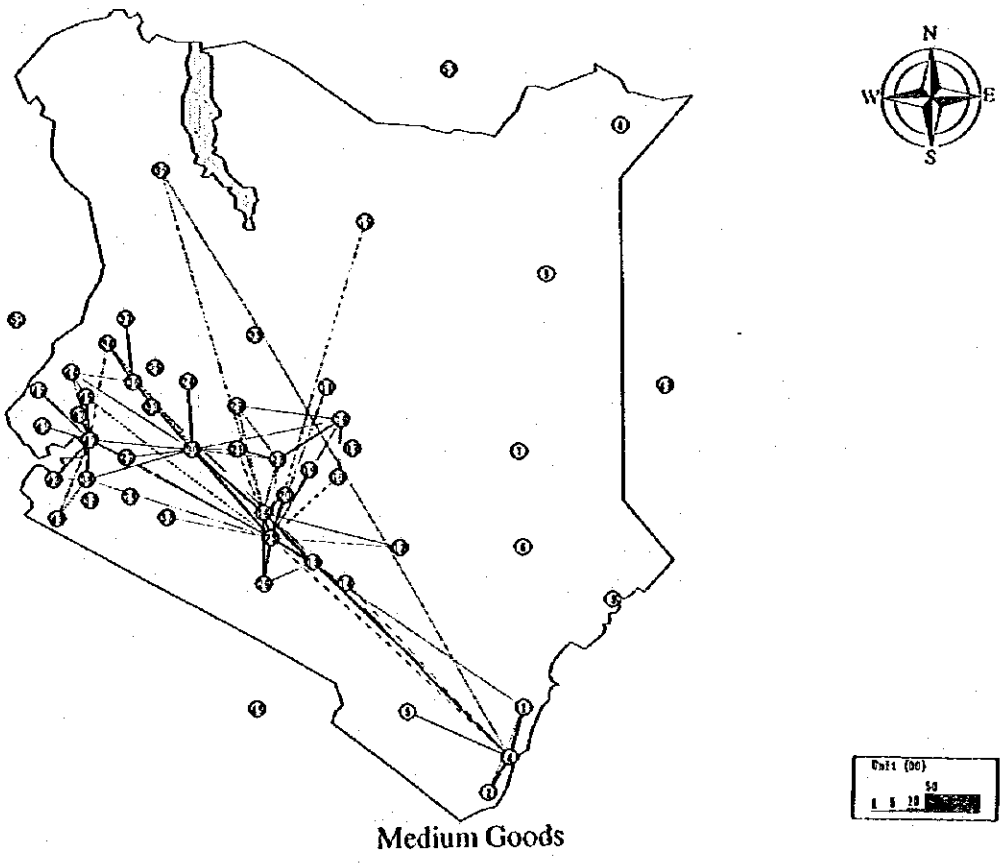


Light Goods

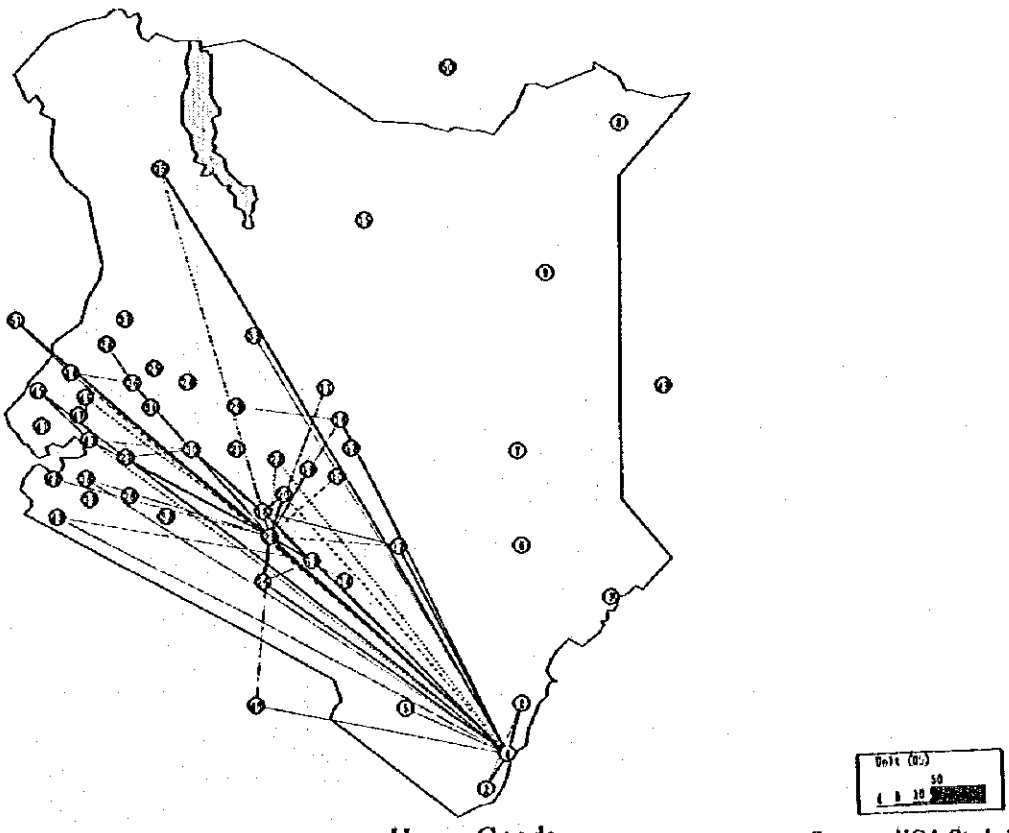
Source : JICA Study Team

Road Network Development Master Plan in Kenya

Figure 4.3.3(2)
Vehicle of Flow by Type of Vehicle



Medium Goods

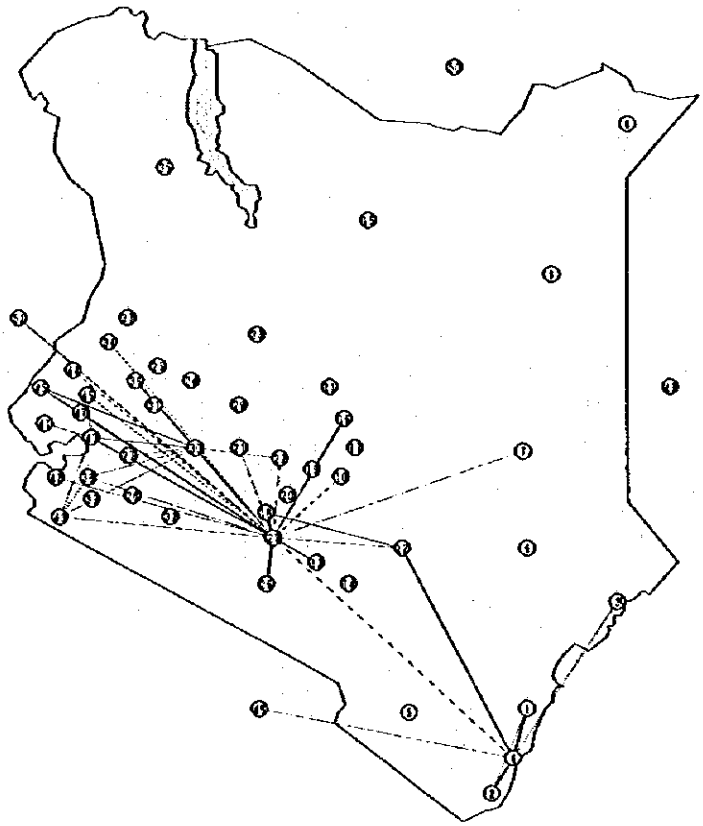


Heavy Goods

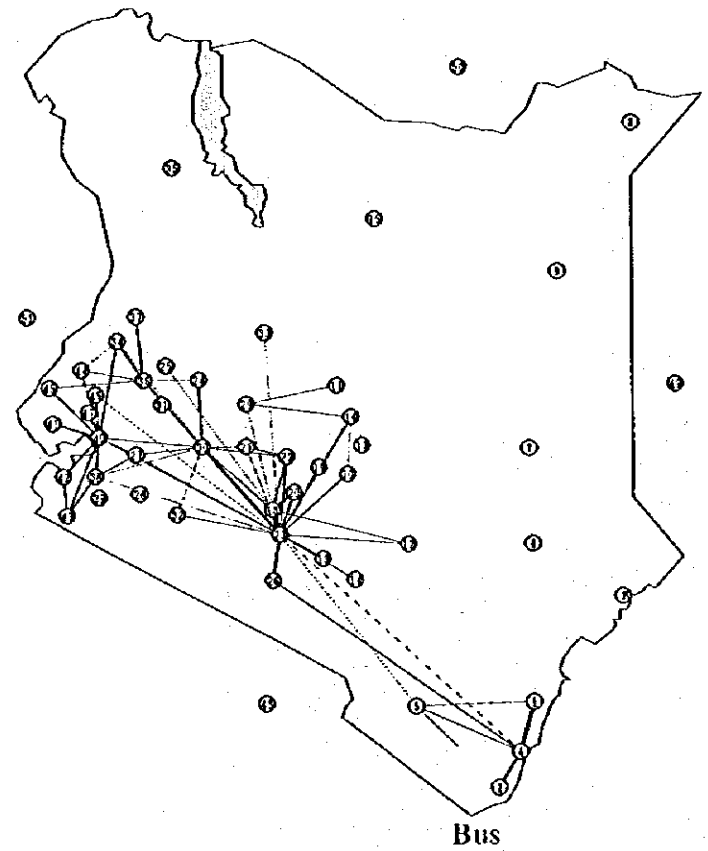
Source : JICA Study Team

Road Network Development Master Plan in Kenya

Figure 4.3.3(3)
Vehicle of Flow by Type of Vehicle



Matatu



Bus

Source : JICA Study Team

Road Network Development Master Plan in Kenya

Figure 4.3.3(4)
Vehicle of Flow by Type of Vehicle

The OD vehicle trips of 'Matatu' show high values in the Nairobi, Kiambu and Mombasa zones connecting to the surrounding cities. Among all zones, the vehicle trips are high in zone pairs such as Nairobi-Kiambu, Mombasa-Kilifi, Nairobi-Machakos, Kiambu-Muranga and Nairobi-Nakuru accounting for 14.3%, 8.1%, 7.4%, 6.6% and 5.1%, respectively.

3) Comparison of OD Pattern Over 10 Years

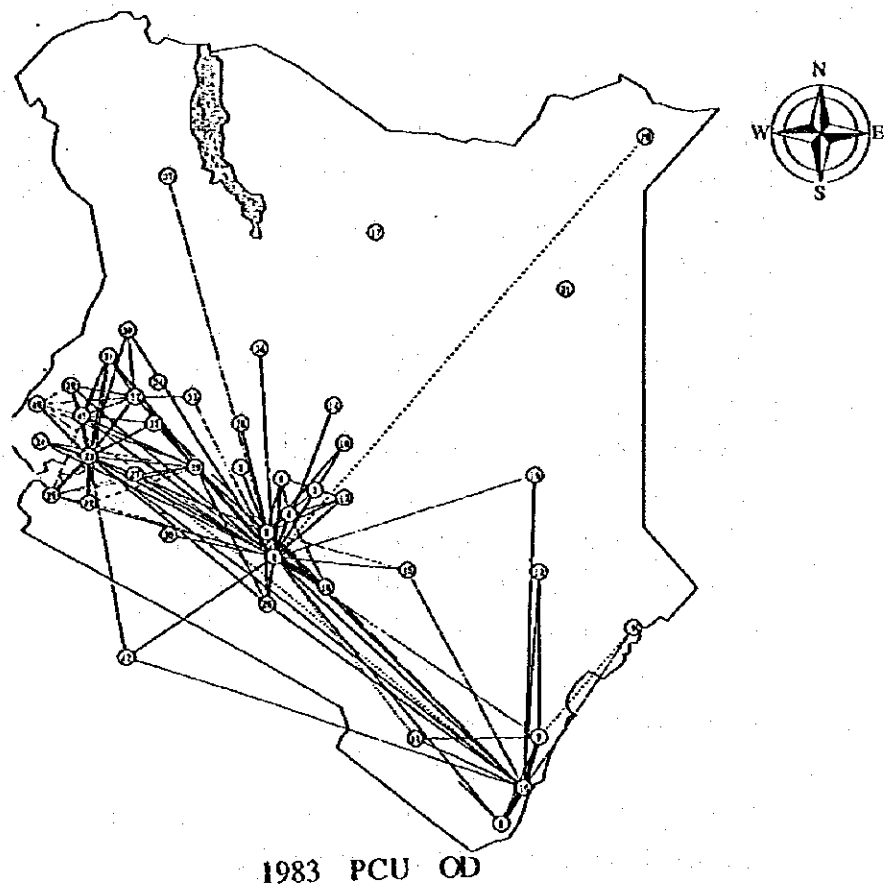
A comparison of the OD pattern in 1983 and 1994 is provided in Figure 4.3.4. This comparison shows no remarkable differences, except for traffic volumes between Mombasa and Nairobi. The overall traffic pattern seems to be resembled. However, the total traffic volume and traffic movement among districts has increased over this 10 years period.

(4) Trip Length

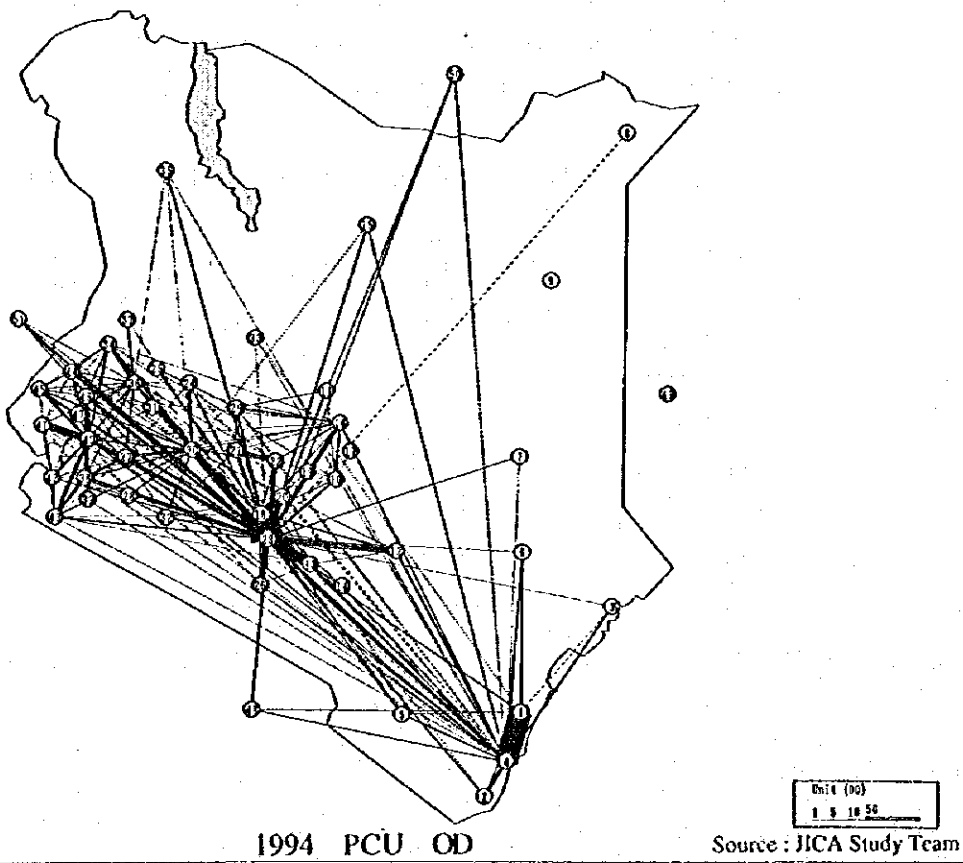
The calculated average trip length for interzonal trips within the study area is presented in Table 4.3.8. Heavy goods vehicle have the longest average trip length (almost 290km), followed by Bus (260km), Tanker (180km), and Medium goods vehicles(170km). The minimum average trip length is observed as Matatu trips, which are, however, still over 100km.

Table 4.3.8 Year 1994 Trip Length Distribution

Vehicle type	Total Trips(pcu) (both direction)	pcu x trip length (thousand km)	Average Trip length(km)
Passenger Car	15,758	1,734.5	110.1
Motor Cycle	535	66.9	125.1
Light Goods	12,477	1,418.9	113.7
Medium Goods	9,968	1,655.5	166.1
Heavy Goods	9,727	2,811.6	289.1
Tanker	5,270	949.4	180.2
Bus	3,133	820.9	262.0
Matatu	19,143	1,986.6	103.8



1983 PCU OD



1994 PCU OD

Source : JICA Study Team

Road Network Development Master Plan in Kenya

Figure 4.3.4
Comparison of OD Pattern in 1983 and 1994

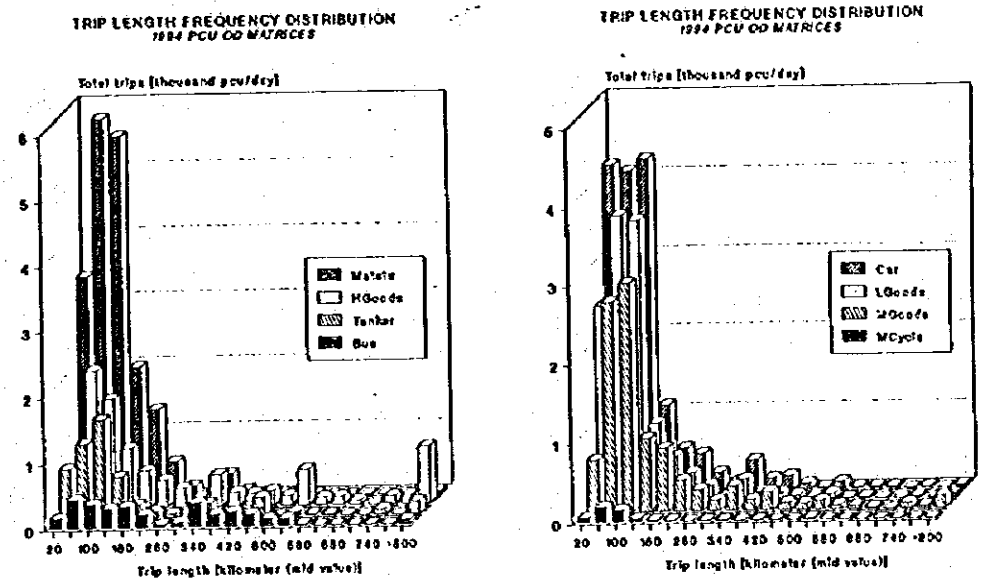


Figure 4.3.5 Year 1994 Trip Distribution by Type of Vehicle

(5) Zonal Freight Demand by Type of Commodity

1) Freight Tonnage by Commodity and by Zone

Table 4.3.9 shows the generation and attraction of freight tonnage handled by commodity type and by zone. The transported goods identified through the vehicle OD survey are maize, wheat, sugar cane, coffee, tea, other agricultural items, livestock, food & beverage, petroleum goods, construction materials, manufactured goods and others. The total freight tonnage generation and attraction of all total zones amounted to about 131,336 tons. The status of generation and attraction for the individual commodities is discussed below.

- Maize

The Mombasa zone accounted for some 57.5% of the total generation, while the Turkana (No. 35), Kajiado (No. 26), and Nairobi zones show 27.5%, 5.9% and 5.9% of the total attraction, respectively.

Table 4.3.9 Generation and Attraction of Freight Tonnage Handled by Commodity

(Unit:ton)

District	Maize Prod	Maize Attr	Maize Total	Wheat Prod	Wheat Attr	Wheat Total	Sugar Cane Prod	Sugar Cane Attr	Sugar Cane Total	Coffee Prod	Coffee Attr	Coffee Total	Tea Prod	Tea Attr	Tea Total
01 Kilifi	0	32	32	5	23	28	0	12	12	0	0	0	0	0	0
02 Kwale	3	8	11	0	0	0	0	1	1	0	0	0	0	0	0
03 Lamu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04 Mombasa	2178	50	2228	323	0	323	39	40	79	5	321	326	0	1445	1445
05 Taita Taveta	2	0	2	0	0	0	0	0	0	0	0	0	32	0	32
06 Tana River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07 Garissa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08 Mandera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09 Wajir	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10 Embu	0	16	16	0	0	0	0	8	8	0	0	0	6	6	6
11 Isiolo	0	16	16	0	0	0	0	0	0	63	0	63	0	0	0
12 Kitui	75	194	269	51	0	51	0	0	0	0	0	0	0	0	0
13 Machakos	0	57	57	0	0	0	0	0	0	0	0	0	0	0	0
14 Makueni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15 Marsabit	0	219	219	0	0	0	0	0	0	0	0	0	0	0	0
16 Meru	0	130	130	23	0	23	0	0	0	59	2	61	484	0	484
17 Tharaka-Nithi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18 Kiambu	69	55	124	0	130	130	0	50	50	31	13	44	0	5	5
19 Kirinyaga	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20 Murang'a	1	0	1	0	0	0	0	0	0	182	0	182	167	0	167
21 Nyandarua	71	23	94	0	0	0	54	14	68	0	0	0	0	0	0
22 Nyeri	0	140	140	0	47	47	0	52	52	101	0	101	0	0	0
23 Nairobi	194	256	450	109	70	179	24	10	34	38	376	414	100	297	397
24 Baringo	18	6	24	0	0	0	0	0	0	0	0	0	0	0	0
25 Elgeyo Marakwet	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26 Kajiado	0	448	448	0	0	0	0	0	0	0	0	0	0	0	0
27 Kericho	30	4	34	0	0	0	0	0	0	2	0	2	397	83	480
28 Bomet	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29 Laikipia	93	45	138	24	0	24	0	15	15	2	59	61	128	0	128
30 Nakuru	139	196	335	182	36	218	35	0	35	0	0	0	40	28	68
31 Nandi	0	16	16	0	0	0	0	0	0	0	0	0	65	0	65
32 Narok	24	0	24	0	0	0	0	0	0	0	0	0	0	0	0
33 Samburu	0	200	200	0	0	0	0	0	0	0	0	0	0	0	0
34 Trans-Nzoia	274	0	274	0	0	0	0	0	0	0	0	0	0	0	0
35 Turkana	0	1042	1042	0	110	110	0	0	0	0	0	0	0	0	0
36 Uasin Gishu	271	131	402	12	8	20	0	0	0	38	0	38	0	0	0
37 West Pokot	0	40	40	0	8	8	0	0	0	0	0	0	0	0	0
38 Kisii	63	25	88	0	0	0	53	53	106	8	0	8	114	16	130
39 Nyamira	0	0	0	0	0	0	1	1	2	0	0	0	2	0	2
40 Kisumu	152	107	259	15	217	232	61	109	170	15	28	43	9	27	36
41 Siaya	0	46	46	0	0	0	0	0	0	0	0	0	0	0	0
42 Homa Bay	50	0	50	0	0	0	196	72	268	0	0	0	0	0	0
43 Migori	55	0	55	0	0	0	10	5	15	80	0	80	0	0	0
44 Bungoma	74	83	157	0	0	0	10	5	15	0	38	38	0	0	0
45 Busia	15	89	104	0	57	57	0	5	5	0	0	0	0	0	0
46 Nakuru	3	39	42	0	0	0	0	16	16	0	0	0	0	0	0
47 Vihiga	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48 Tanzania	0	0	0	0	31	31	0	0	0	130	0	130	250	0	250
49 Somalia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50 Ethiopia	5	0	5	0	0	0	40	0	40	0	0	0	0	0	0
51 Uganda	17	100	117	0	0	0	40	0	40	80	0	80	120	0	120
Total	3797	3797	7594	744	744	1488	463	463	926	835	835	1670	1909	1909	3818

District	Other Agricultural Prod	Other Agricultural Attr	Other Agricultural Total	Livestock Prod	Livestock Attr	Livestock Total	Food & Beverage Prod	Food & Beverage Attr	Food & Beverage Total	Petroleum Goods Prod	Petroleum Goods Attr	Petroleum Goods Total	Construction Materials Prod	Construction Materials Attr	Construction Materials Total
01 Kilifi	202	186	388	90	14	104	101	156	257	39	325	364	1421	1103	2524
02 Kwale	27	54	81	23	13	36	12	78	90	24	63	87	282	289	571
03 Lamu	33	7	40	0	0	0	7	0	7	0	0	0	89	24	113
04 Mombasa	936	517	1453	50	328	378	504	218	722	3227	583	3810	2173	1880	4053
05 Taita Taveta	9	7	16	0	0	0	14	0	14	5	119	124	149	316	464
06 Tana River	0	0	0	0	0	0	0	0	0	0	16	16	0	70	70
07 Garissa	50	57	107	0	0	0	0	0	0	0	0	0	4	20	24
08 Mandera	0	0	0	15	0	15	0	0	0	0	0	0	0	0	0
09 Wajir	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10 Embu	45	64	110	0	0	0	10	58	68	18	0	18	307	314	621
11 Isiolo	0	11	11	120	0	120	0	18	18	16	20	36	0	28	28
12 Kitui	12	11	23	23	0	23	9	69	69	0	138	138	1032	69	1101
13 Machakos	41	32	73	20	60	80	58	275	333	205	101	306	1131	616	1747
14 Makueni	1	0	1	0	3	3	0	12	12	2	165	167	339	70	409
15 Marsabit	0	0	0	146	0	146	0	0	0	0	0	0	0	33	33
16 Meru	249	56	305	0	0	0	0	17	17	85	356	441	76	112	188
17 Tharaka-Nithi	0	0	0	0	0	0	0	0	0	0	0	0	0	22	22
18 Kiambu	642	399	1041	109	26	135	189	139	328	726	544	1270	991	2074	3065
19 Kirinyaga	7	8	15	19	0	19	0	0	0	101	478	579	44	15	59
20 Murang'a	59	79	138	0	106	106	55	142	197	157	633	790	105	325	430
21 Nyandarua	129	86	215	1	1	2	67	70	137	0	25	25	208	232	440
22 Nyeri	173	94	267	0	0	0	39	77	116	560	3	563	28	133	161
23 Nairobi	658	1521	2179	90	423	513	859	467	1326	3605	2345	5950	2878	2618	5496
24 Baringo	1	0	1	4	3	7	2	11	13	0	12	12	55	51	106
25 Elgeyo Marakwet	0	0	0	0	0	0	0	0	0	0	0	0	43	8	51
26 Kajiado	33	39	72	120	9	129	15	67	82	43	32	75	457	414	871
27 Kericho	82	8	90	0	0	0	132	17	149	138	216	354	165	116	281
28 Bomet	32	0	32	15	0	15	0	0	0	0	8	8	2	14	16
29 Laikipia	98	12	110	34	34	68	41	44	85	388	86	474	56	49	105
30 Nakuru	446	235	681	7	17	24	161	264	425	821	659	1480	722	750	1472
31 Nandi	0	4	4	0	0	0	3	0	3	0	0	0	0	27	27
32 Narok	0	46	46	15	15	30	7	48	55	0	62	62	5	47	52
33 Samburu	0	0	0	0	0	0	0	0	0	0	0	0	0	84	84
34 Trans-Nzoia	60	38	98	156	0	156	34	24	58	0	159	159	22	37	59
35 Turkana	0	273	273	0	0	0	0	11	11	0	20	20	0	46	46
36 Uasin Gishu	167	69	236	0	0	0	152	28	180	291	153	444	207	415	622
37 West Pokot	0	0	0	0	0	0	0	28	28	0	39	39	20	0	20
38 Kisii	43	96	139	1	0	1	72	33	105	61	248	309	135	224	359
39 Nyamira	0	0	0	0	1	1	0	0	0	0	0	0	0	1	1
40 Kisumu	113	169	282	17	3	20	388	297	685	793	453	1246	491	242	733
41 Siaya	4	3	7	0	8	8	9	21	30	0	0	0	54	60	114
42 Homa Bay	80	31	111	0	0	0	10	5	15	0	196	196	86	139	225
43 Migori	73	17	90	0	0	0	0	86	86	54	110	164	14	38	52
44 Bungoma	470	273	743	12	17	29	108	25	133	86	132	218	136	125	261
45 Busia	0	121	121	0	2	2	19	43	62	0	52	52	24	297	321
46 Nakuru	38	55	93	0	4	4	73	55	128	19	219	238	57	291	348
47 Vihiga	0	0	0	0	0	0	0	29	29	0	60	60	28	66	94
48 Tanzania	38	0	38	0	0	0	18	66	84	0	827	827	0	84	84
49 Somalia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50 Ethiopia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51 Uganda	0	383	383	0	0	0	0	178	178	187	1974	2161	60	36	96
Total	5061	5061	10122	1087	1087	2174	3167	3167	6334	11631	11631	23262	14089	14089	28178

Table 4.3.9 Generation and Attraction of Freight Tonnage Handled by Commodity (Continuation)

(Unit:ton)

District	Manufactured Goods Prod	Attr	Total	Others Prod	Attr	Total	Total Prod	Attr	Total
01 Kilifi	655	447	1102	964	264	1228	1477	2562	6039
02 Kwale	83	492	585	137	429	566	591	1417	2008
03 Lamu	4	0	4	53	1	54	186	32	218
04 Mombasa	3390	1459	4949	1853	1471	3337	14688	8315	23003
05 Taita Taveta	91	133	224	50	92	142	351	667	1018
06 Tana River	10	0	10	20	15	35	39	101	140
07 Garissa	0	14	14	8	15	23	62	106	168
08 Mandera	0	20	20	0	0	0	15	20	35
09 Wajir	0	0	0	7	0	7	7	0	7
10 Garu	33	82	115	184	81	265	598	619	1217
11 Isiolo	0	16	16	17	50	67	216	159	375
12 Kitui	35	64	99	66	113	179	1293	659	1952
13 Machakos	79	220	299	183	302	485	1717	1663	3380
14 Makueni	26	53	79	18	21	39	386	324	710
15 Marsabit	26	23	49	0	10	10	172	284	456
16 Meru	60	384	444	183	181	364	1219	1238	2457
17 Tharaka-Nithi	0	0	0	0	10	10	0	32	32
18 Kiambu	440	607	1047	955	708	1663	4152	4750	8902
19 Kirinyaga	8	24	32	0	83	83	178	608	787
20 Murang'a	34	190	224	90	492	582	850	1967	2817
21 Nyandarua	37	53	90	58	68	126	825	362	1187
22 Nyeri	144	82	226	251	177	428	1295	805	2100
23 Nairobi	1759	1871	3630	2482	1900	4382	12830	12114	24944
24 Baringo	11	58	69	55	52	107	146	193	339
25 Elgeyo Marakwe	0	0	0	3	1	4	43	11	54
26 Kajiado	333	45	378	390	129	519	1337	1183	2580
27 Kericho	267	196	463	255	679	934	1468	1319	2787
28 Bomet	8	1	9	5	0	5	59	59	118
29 Laikipia	41	47	88	89	96	185	994	487	1481
30 Nakuru	1294	688	1982	1013	489	1502	4560	3362	8222
31 Nandi	26	15	41	3	7	10	104	57	161
32 Narok	20	36	56	66	43	109	337	297	634
33 Samburu	0	2	2	0	21	21	21	293	314
34 Trans-Nzoia	97	441	538	115	112	227	758	811	1569
35 Turkana	0	81	81	6	133	6	6	1610	1616
36 Uasin Gishu	316	311	627	108	369	477	1562	1483	3045
37 West Pokot	4	44	48	0	0	0	24	153	177
38 Kisii	156	274	430	91	149	240	751	1118	1869
39 Nyamira	0	1	1	0	1	1	0	19	19
40 Kisumu	919	1091	2010	308	697	1005	3282	3433	6715
41 Siaya	4	27	31	11	13	24	65	208	273
42 Homa Bay	150	38	188	11	106	117	693	587	1280
43 Migori	112	634	1078	100	58	158	598	976	1574
44 Bungoma	395	237	632	81	101	182	1238	1031	2269
45 Busia	0	370	370	88	56	144	147	1088	1235
46 Nakamega	653	312	965	265	145	410	1110	1136	2246
47 Vihiga	13	66	79	31	30	61	75	251	326
48 Tanzania	91	257	348	0	532	532	527	1793	2321
49 Somalia	0	27	27	0	0	0	0	27	27
50 Ethiopia	0	279	279	0	20	20	5	299	304
51 Uganda	4	432	436	12	310	322	520	3413	3933
Total	12197	12197	24394	10688	10688	21376	65668	65668	131336

- Wheat

The Mombasa and Nakuru zones accounted for 43.4% and 24.5%, respectively, of the total generation. Kisumu, Kiambu and Turkana zones accounted for 29.2%, 17.5% and 14.5% of the total attraction, respectively.

- Sugar Cane

The Homa Bay (No. 42) and Kisumu zones show 42.3% and 13.8% of the total generation, respectively. Kisumu, Homa Bay, Nyeri and Mombasa zones accounted for 22.8%, 15.5%, 11.2% and 8.6% of the total attraction, respectively.

- Coffee

The Muranga, Tanzania (No. 48) and Nyeri zones accounted for 21.8%, 15.6% and 12.1% of the total generation; while the Nairobi and Mombasa zones accounted for 44.9% and 38.4% of total attraction, respectively.

- Tea

The Meru (No. 16), Kericho and Tanzania zones took a share of 25.4%, 20.0% and 13.1% of the total generation, respectively. Mombasa and Nairobi zones accounted for 75.7% and 15.6% of the total attraction.

- Other Agricultural Items

The Mombasa, Nairobi, Kiambu, Bungoma and Nakuru zones took a share of 18.5%, 13.0%, 12.6%, 9.3% and 8.8%, respectively, of total generation. Nairobi, Mombasa and Kiambu zones accounted for 30.1%, 10.2% and 7.9%, respectively, of the total attraction.

- Livestock

The Trans-Nzoia (No. 34), Marasabit (No. 15), Isiolo (No. 11) and Kajiado zones displayed a share of 14.3%, 13.4%, 11.0% and 11.0% of the total generation, respectively. The Nairobi and Mombasa zones accounted for 38.9% and 30.2% of the total attraction, respectively.

- Food & Beverage

The Nairobi, Mombasa and Kisumu zones accounted for 27.1%, 15.9% and 12.3% of the total generation. The Nairobi, Kisumu, Machakos and Nakuru zones accounted for 14.7%, 9.4%, 8.7% and 8.3% of the total attraction.

- Petroleum Goods

The Nairobi, Mombasa, Nakuru, Kisumu and Kiambu zones accounted for 31.0%, 27.7%, 7.1%, 6.8% and 6.2% of the total generation, while the Nairobi, Tanzania, Nakuru, Muranga, Mombasa and Kiambu zones accounted for 20.2%, 7.1%, 5.7%, 5.4%, 5.0% and 4.7% of the total attraction.

- Construction Materials

The Nairobi, Mombasa, Kilifi, Machakos and Kitui zones accounted for 20.4%, 15.4%, 10.1%, 8.0% and 7.3% of the total generation, while the Nairobi, Kiambu, Mombasa and Kilifi zones accounted for 18.6%, 14.7%, 13.3% and 7.8% of the total attraction.

- Manufactured Goods

The Mombasa, Nairobi and Nakuru zones accounted for 27.8%, 14.8% and 10.6% of the total generation, while the Nairobi, Mombasa, Kisumu, Nakuru, Migori (No. 43) and Kiambu zones accounted for 15.0%, 12.0%, 9.0%, 5.6% 5.2% and 5.0% of the total attraction.

- Others

The Nairobi, Mombasa and Nakuru zones accounted for 23.2%, 17.4% and 9.5% of the total generation. The Nairobi, Mombasa, Kiambu, Kisumu and Kericho (No. 27) zones accounted for 17.8%, 13.8%, 6.6%, 6.5% and 6.4% of the total attraction.

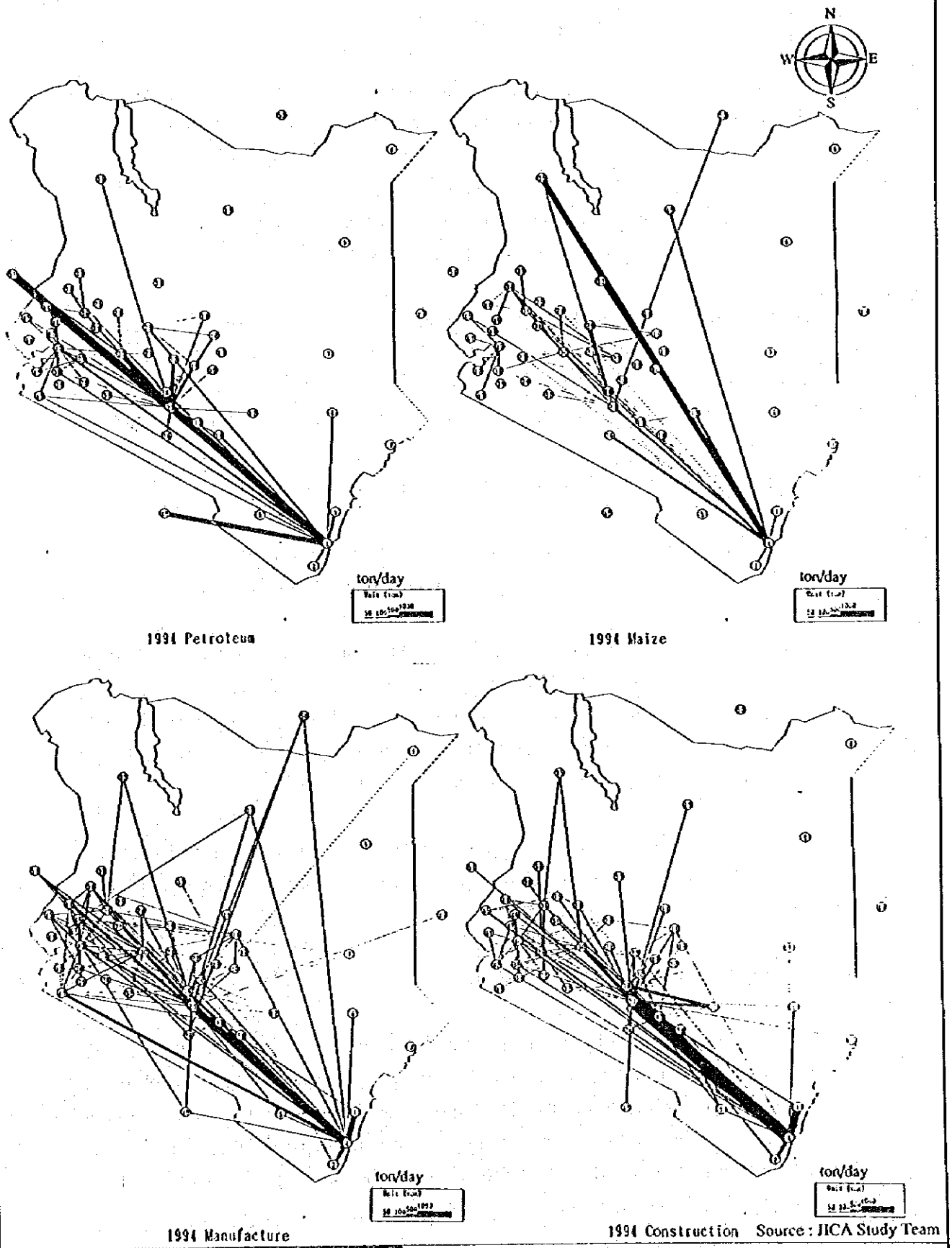
2) Freight Flow Pattern

Figure. 4.3.6 depicts the flow of freight tonnage OD handled by commodity. The OD freight tonnage shows high flow figures mainly from the east to the west direction, connecting the Mombasa region with Nairobi, Nakuru, Kisumu and the border of Uganda, and also the Turkana. There is a large freight tonnage flow connecting Nairobi with the surrounding cities in the eastern, western, southern, and northern directions.

The following are the major characteristic of these commodity flows :

- A remarkable flow volume to and from Mombasa is observed
- A large volume of petroleum flowing from Mombasa to Nairobi and further to Uganda is observed.

Mombasa holds a dominant position from a point of view of commodity flows and these commodities to and from Mombasa are transported over a long distance by heavy trucks. Since neighboring countries located to the west of Kenya like Uganda, have no deep seaport facilities, the Mombasa - Nairobi - Uganda connection becomes a commodity transport life line for these countries.



Road Network Development Master Plan in Kenya

Figure 4.3.6
Freight Tonnage OD by Commodity

(6) Traffic Movement Territorial Formation

Figure 4.3.7 shows a territorial formation of traffic areas, which are derived from the analysis of traffic movements of t(i, j), which is calculated as follows :

a calculate t(i, j)=T(i, j)/T(i) on every zone
b select the maximum t(i, j) from the overall t(i, j) calculated above, and
c draw this t(i, j) with direction from T(i) to T(j).

This calculation reflected in the graph indicates the strongest unique linkages of respective zone pairs, and eventually designates regional centers. The result, depicts a hierarchy relationship among districts in Kenya, and delineates traffic rates. The territorial relationships for 1983 and 1994 are shown in Figure 4.3.7.

A comparison between 1983 and 1994 reveals the following major changes :

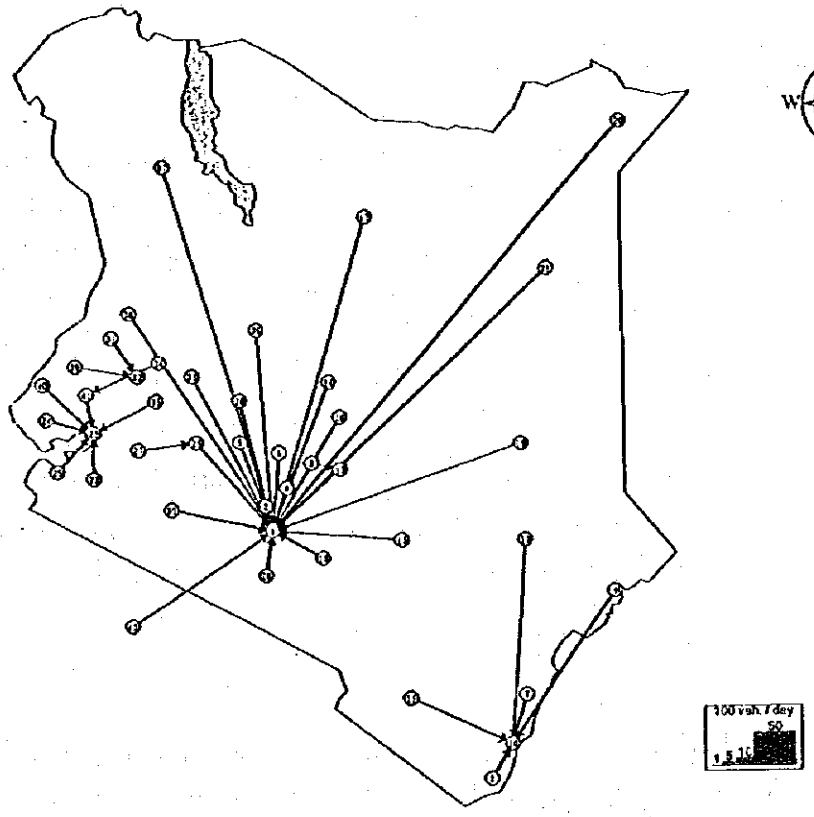
-Inter-regional and longer distant trips are observed in 1994
-Some additional sub-centers emerged around Nairobi in 1994.

The territorial formation in 1994 indicates that Mombasa maintains a relatively independent position, while Nairobi shows a remarkably wider territory, including other subordinate districts such as Nakuru, Meru and Nyeri. In addition, Kisumu seems to form an independent territory in this region, while Uasine Gishu including Eldoret city exhibits a sole small territory.

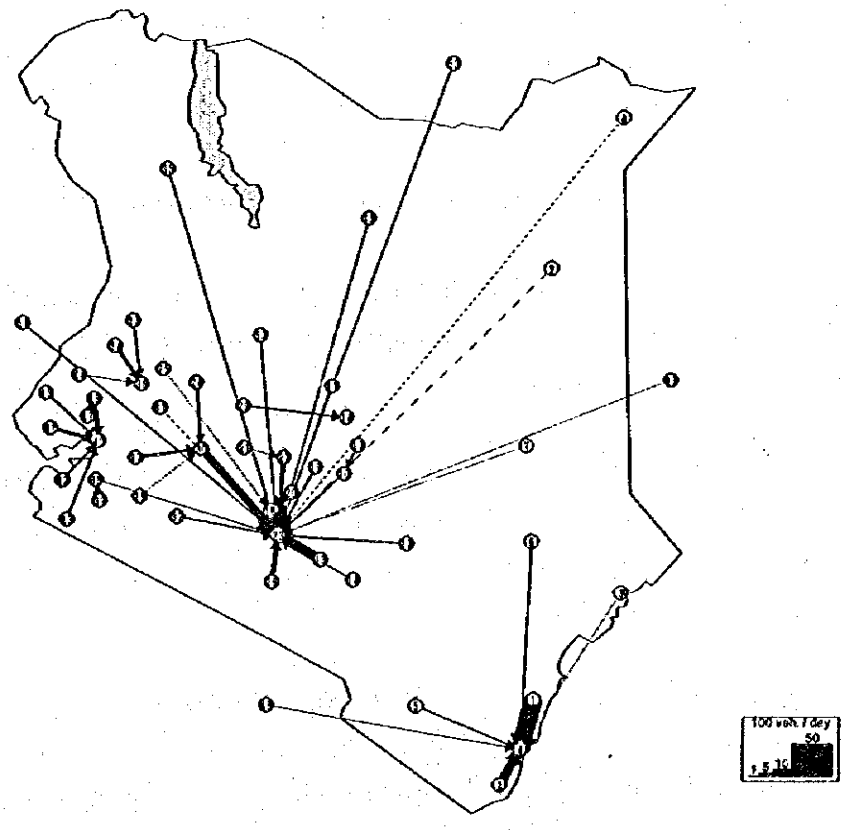
The concept of this territory implies a hierarchy of the cities and districts as mentioned above, and it also gives a framework to formulate a functional future road network.

(7) Present Arterial Road Network Pattern

The present major road network pattern is shown in Figure 4.3.8. The network pattern consists of all international trunk roads (class A) and major trunk roads (class B). According to the Kenyan standard, such road classification as "major arterial" road and "arterial road" are consistent with the road categories of "class A" and part of "class B". The followings are the some special features of the "major arterial" road network.



1983 Traffic Territory



1994 Traffic Territory

Source : JICA Study Team

Road Network Development Master Plan in Kenya

Figure 4.3.7
Territorial Formation in 1983 and 1994

a Backbone Road

The road from Mombasa to Uganda passing through Nairobi and Eldoret constitutes a principal backbone of the overall road network in Kenya. Other international trunk roads, namely class A roads, which are linked to neighboring countries, are connected this backbone road.

b International Access

Since the class A road functions as an international trunk road, all such neighboring countries as Somalia, Ethiopia, Sudan, Uganda and Tanzania are connected by this class A road.

c Arterial Road Network

Arterial Roads (part of class B roads) support as a supplemental function the major arterial road network, and important arterial roads are shown in Figure 4.3.8. The existing arterial road network seems to be well composed at present, despite the fact that the network pattern is rather simple.

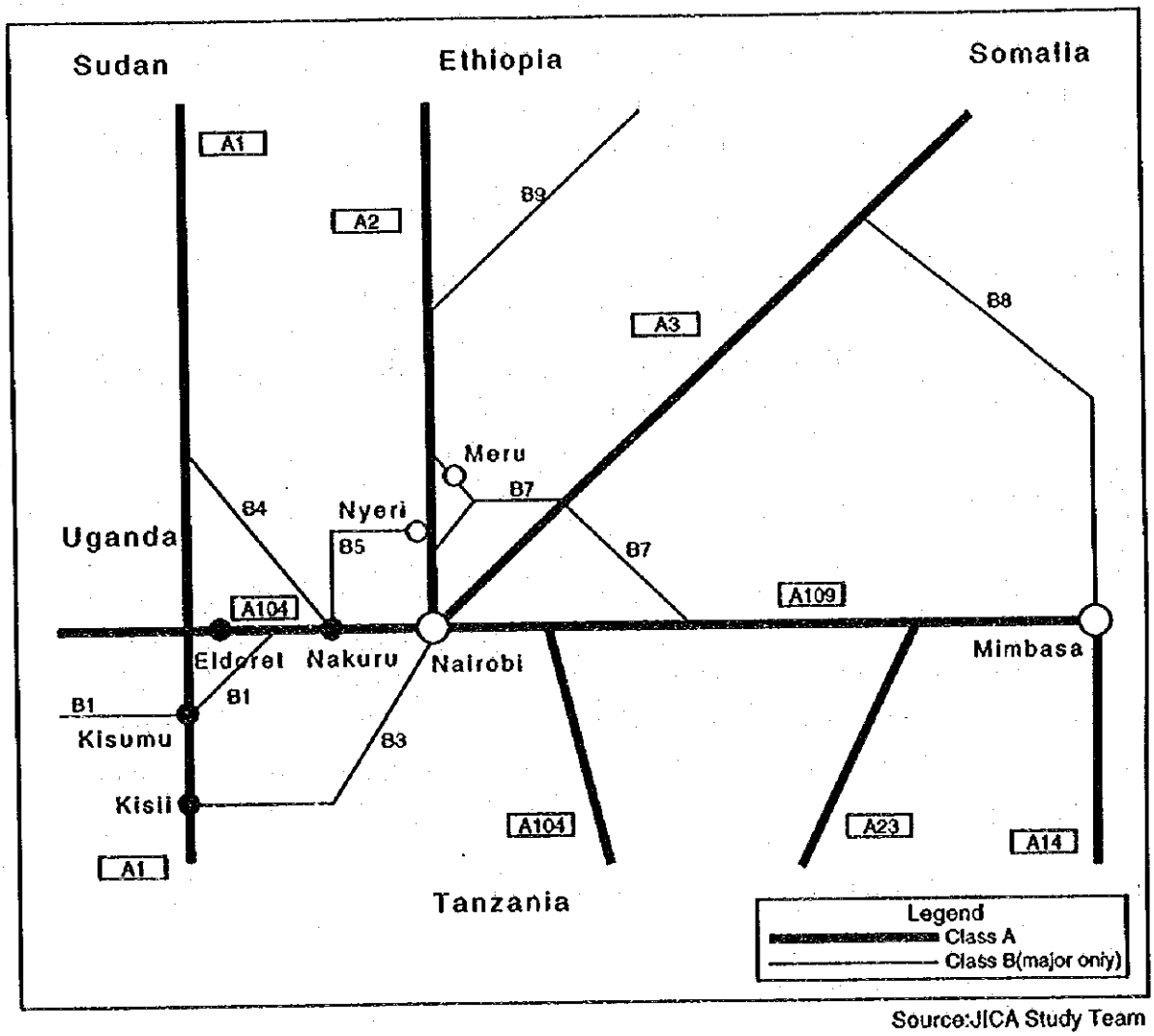
(8) Problems and Issues

1) Excessive Load on Mombasa-Nairobi-Eldoret Corridor

As mentioned above, considerable traffic volume is concentrated to Mombasa, since Mombasa is one of the most important gateways not only for Kenya, but also for East African Countries.

A sole "major arterial" road is provided between Mombasa and Nairobi in the existing arterial network. This is the reason why all the traffic movements gather towards Mombasa through this major arterial road. Some pavement sections of this road have deteriorated.

It is imperative to maintain the Mombasa-Nairobi road as an arterial road. This urges to review the existing conditions of the road and undertake necessary countermeasures. The Mombasa-Nairobi road improvement programme is to start supported by the World Bank financing.



Source:JICA Study Team

Figure 4.3.8 Present Major Road Network Pattern

Another issue is the necessity to provide some alternative route to the major arterial function between Mombasa and Nairobi. This is necessary for the case that a disaster causes the closing down of the traffic on the road. It would also imply the need to complete missing links in order to connect Mombasa with other regions.

2) To Maintain Accessibility to International Trunk Roads

Since the international trunk roads configure a simple network pattern, accessibility to them becomes important.

3) Traffic Congestion

As has been observed in section 4.3.2(1) Traffic Volume, a high congestion ratio is not found at present, the exception being only a section of A 104, which is located to the northwest of Nairobi. Overloading by trucks is observed on trunk roads. The improvement of traffic safety, law enforcement and other regulations are countermeasures, necessary at the present time to overcome the overloading problem.

4) Urban Pattern and Existing Road Network

a Urban Functioning

There exist two main issues to be considered from an urban development point of view. One is issue is that concentration of regional development becomes necessary, due to the limited resources available. The second issue is that it is also necessary to avoid excessive concentration of population in a few large cities of the country, in order to keep an economic balance between urban and rural areas. As mentioned already earlier in this report, the Government's service center policy and the growth center policy have been introduced to address these issues. These policies define the following city and town functions :

-Growth Centers

The six cities Mombasa, Kisumu, Eldoret, Nakuru, Nyeri, and Kakamega are designated as such a growth center in the National Development Plan for intensified development of infrastructure and services.

-Service Centers

Around 1,700 cities and towns are designated with the aim at improving the quality of rural life.

-Rural Trade and Production Centers

Towns with a population of below 5,000 people are designated as either urban centers or trading centers under the jurisdiction of county council, to facilitate the growth of small towns on agricultural and other productive activities.

b Road Function

The classified roads consist of class A, B, C, D and E plus SPR. The roles and function of classified road A, B, and C are defined in the Road Design Manual as follows :

-Class A

Roads linking centers of international importance and crossing international boundaries or terminating at international airports.

-Class B

Roads linking nationally important centers (principal towns/urban centers).

-Class C

Roads linking provincially important centers to each other, or to higher class roads (urban/rural centers).

c Relationship between Urban Pattern and Road function

It is important to introduce the idea of a hierarchy of cities and towns. There is some discrepancy in the relationship between the hierarchy of cities and towns and road functions, because any explicit designation depending on urban hierarchy can not be done by analyzing all the cities and towns in the whole country. It becomes therefore crucial to establish a hierarchy of all cities and towns. The current road classification system was decided some time ago and the classification seems to have had a rather administrative justification. The introduction of some new road classification seems to be necessary, and if it is