1.2 Present Condition of Roads

(1) Types and Present Condition of Roads

The roads of Kenya are of many types, from forest trails – which are passable virtually only during the dry season – to technically constructed, paved multilane roads. The road system is divided into Classified Roads and Unclassified Roads, and Classified Roads together with Special Purpose Roads – which amount to 2,300 km – account for 52,940 km of the total road length of 150,600 km.

Classified Roads are administered by the MOTC and are composed of five types officially known as (A) International Trunk Roads, (B) National Trunk Roads, (C) Primary Roads, (D) Secondary Roads and (E) Minor Roads, plus Special Purpose Roads. The functions of the Classified Roads are as follows:

(A) International Trunk Roads link centrds of international importance and cross international boundaries or terminate at international ports

(B) National Trunk Roads connect centres and/or areas of national importance

(C) Primary Roads connect important provincial centres to each other or to higher class roads

(D) Secondary Roads link locally important centres to each other or to more important centres or higher class roads

(E) Minor Roads provide connections to minor centres in rural areas.

Special Purpose Roads are relatively small-scale roads built for the purpose of promoting agriculture, tourism or the economic development schemes of reclaimed areas.

Table 1-2-1 shows the length of Classified Roads and Special Purpose Roads by different surface types and traffic-volume classes. Paved Special Purpose Roads and paved Classified Roads total 5,920 km and constitute 11% of the total road length. The total length of road sections with a daily traffic volume exceeding 200 vehicles per day is 6,926 km, and 86% of this is paved. Sections of International Trunk Roads with a daily traffic volume exceeding 200 vehicles per day are all paved. Forty percent of the total length of National Trunk Roads and 83% of those sections of National Trunk Roads with a daily traffic volume exceeding 200 vehicles per day are paved. Only 22% of the total length of Primary Roads are paved, but 80% of the sections of Primary Roads with a daily traffic volume exceeding 200 vehicles per day is paved. Thus, the major roads of Kenya are at a highly improved level, if we do not consider the quality of the actual road surface.

Table 1-2-2 shows the condition of automobile traffic on Classified Roads, excluding Special Purpose Roads. Trunk Roads and Primary Roads which account for only 27% of the total network in length have a 90% rate of use. In contrast, Minor Roads which account for 45% of the total network have virtually no traffic. It can therefore be said without exaggeration that Kenya's social and economic activities are almost all supported by major

roads – that is, Trunk Roads or Primary Roads – and that the emphasis hitherto put on the development of arterial roads has been correct. A major issue in the future will be the effective promotion and development of minor roads (Secondary Roads and Minor Roads) in low-density development areas.

Table 1-2-1 Total Length of Classified Roads

Class / Volume / Type	Bitumen					Gravel/Earth			Total
	Over 2,000	2,000 ~ 1,001	1,000 ~ 501	500 ~ 0	Sub Total	Over 300	300 ~ 201	200 ~ 0	
International Trunk A	362.5	800.4	361.1	662.1	2,186.1	-	-	1,256.4	3,442.6
National Trunk B	28.8	265.6	337.5	486.5	1,118.4	56.7	176.0	1,403.8	2,754.9
Primary Trunk C	37.6	185.4	625.7	833.5	1,682.2	142.5	272.5	5,572.3	7,669.8
Secondary Trunk D	-	36.3	103.5	517.0	656.8	51.2	286.5	10 026.9	11,021.4
Minor Trunk E	-	-	7.2	236.0	243.3	5.5	14.2	25,480.1	25,743.1
Subtotal	428.9	1,287.7	1,435.0	2,735.2	5,886.9	255.9	749.2	43,739.5	50,631.6
Special Purpose Road	-	-	-	34.4	34.4	-	-	2,274.5	2,408.9
Total	428.9	1,287.7	1,435.0	2,769.6	5,921.2	255.9	749.2	46,014.0	52,940.7

Source: MOTC Maintenance of Road allocation funds, 1982--83.

Table 1-2-2 Amount of Travel by Class of Road and Vehicle Type, 1978

(In 000's Km)

Class of Roads	% of Total Network[1]	Average Yearly Vehicle Traffic per Kilometre of Road Class (Veh/Km)						
		Cars	Light Commercial Vehicles	Medium Commercial Vehicles	Heavy Commercial Vehicles	Buses	Total (Veh/Km)	(%)
Trunk	13	1,185	886	501	178	220	2,970	(62)
Primary	18	339	553	300	12	71	1,275	(27)
Secondary	23	71	258	95	1	53	478	(10)
Minor	46	1	8	2	-	-	11	(1)
All Roads	100	1,596	1,705	898	191	344	4,734	(100)
Per cent Veh/Km	-	(34)	(36)	(19)	(4)	(7)	(100)	-

[1] Excludes Special Purpose Roads.

(2) Classified Road System

Figure 1-2-1 is a map of the Classified Road system, in which the three classes, A, B and C, are differentiated. The dotted portions indicate relatively well populated districts with population densities exceeding 25 persons/km^2. There are 41 of these districts in all, and with the exception of 15 – Katiado, Laikipia, Narok, Baringo, Sanburu, Turkana, West Pokot, Lamu, Taita Taveta, Isiolo, Kitui, Marsabit, Garissa, Wajir and Mandera – all are well populated.

As can be seen, the areas of population concentration – with the exception of Mombasa and its surrounding area – are all in the central and western parts of Kenya. These account for 25% of the total area of the country and 85% of the total population.

The conditions of Trunk Roads A, Trunk Roads B and Primary Roads in the Classified Road system are as follows.

1) International Trunk Roads (A)

There are seven International Trunk Roads whose lengths are shown in Table 1-2-3. A109 and A104 follow a route from Mombasa to Uganda via Nairobi and Bungoma and form Kenya's arterial axis. The other five roads begin on this arterial axis and head north or south, passing through the main areas of the country – the provincial and district headquarters – and arriving in neighbouring countries.

The roads in the Trans-African Highway project with which Kenya is directly concerned are (a) the Mombasa-Lagos Trans-African Highway and (b) the Cairo-Gaborona Trans-East African Highway. A109 and A104 follow the route of the former, and A2 and A104, which cut across central Kenya from north to south, passing through Nairobi, follow the latter's route.

Thus, the International Trunk Roads link the main cities of the country with neighbouring countries and also compose a road system that is well-balanced for the country as a whole.

KENYA

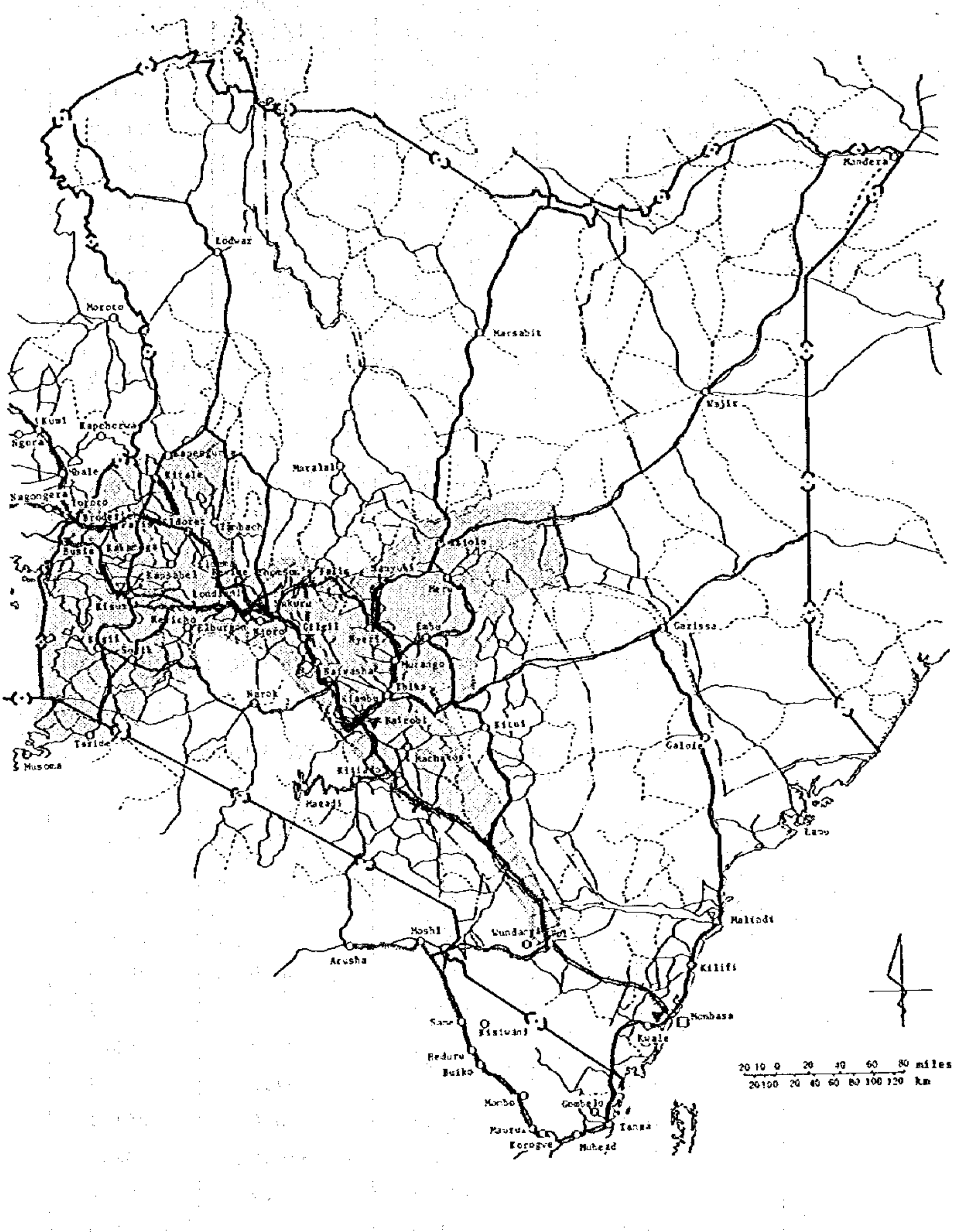


Fig. 1-2-1 Classified Road System in High Population Areas

Table 1-2-3 Total Length of International Trunk Roads

Type \ Class		Bitumen	Gravel/Earth	Total
Trunk	A 1	655.3	244.0	899.3
	A 2	311.3	495.9	807.2
	A 3	99.3	423.3	522.6
	A 104	544.4	12.0	545.6
	A 109	447.3	14.0	448.7
	A 14	103.3	2.0	103.5
	A 23	25.2	92.5	115.7
Total		2,186.1	1,255.4	3,441.5

Source: Road Maintenance Schedule.

As Table 1-2-5 shows, International Trunk Roads in areas of concentrated population account for 50% of the total length of roads in this category and approximately 70% of their paved sections and are well balanced in terms of rate of development.

2) National Trunk Roads (B)

National Trunk Roads cover ten routes, and their lengths are shown in Table 1-2-4.

Table 1-2-4 Total Length of National Trunk Roads

Type \ Class		Bitumen	Gravel/Earth	Total
Trunk	B 1	225.6		225.6
	B 2	53.9		53.9
	B 3	159.1	130.6	289.9
	B 4	125.7	130.2	255.9
	B 5	124.1	32.0	156.1
	B 6	115.0	87.9	202.9
	B 7	10.5	270.6	281.1
	B 8	118.0	330.5	448.9
	B 9	145.5	642.9	788.4
	B10	1.8		1.8
Total		1,079.2	1,624.7	2,704.5

Source: MOTC Road Maintenance Schedule.

Of these, the two routes in eastern Kenya are B8 which goes north along the coast from Mombasa and joins A3 at Garissa, and B9 which begins at Isiolo on A2 and goes via Wajir to Mandera, a city on the Ethiopian border. These routes have a function second in importance only to the International Trunk Roads and may be considered for an elevation in status in the future.

The eight other routes are all in central and western Kenya in areas of dense population and encircle their borders as if they were wrapped around these areas.

As Table 1-2-5 shows, National Trunk Roads in areas of population concentration comprise 55% of the total length and 70% of the paved sections of this category and, from the standpoint of their function, form an appropriate system.

3) Primary Roads (C)

Primary Roads complement the network formed by the Trunk Roads (A, B), provide access to the major facilities in each area and are basic to the support of the social and economic activities of the areas. In concentrated areas of population their length makes up 60% of the total length of Primary Roads and 75% of the paved sections. From the standpoint of the functions Primary Roads serve, they compose an appropriate system structure. It will be necessary to raise the rate of development of these roads in important agricultural development areas such as Narok, Kericho, Kishi, South Nyanza and Baringo. Tables 1-2-5 and 1-2-6 show road lengths in high density areas and the total length of Classified Roads in each district.

Table 1-2-5 Road Length in High Density Areas

Area / Class / Types	High Density Areas			All Areas		
	Bitumen	Gravel/ Earth	Total	Bitumen	Gravel/ Earth	Total
Trunk (A)	1,559.2	102.8	1,662.0	2,186.1	1,255.4	3,441.5
Trunk (B)	769.9	730.7	1,500.6	1,079.2	1,625.3	2,704.5
Primary (C)	1,282.0	3,259.5	4,541.5	1,682.2	5,987.6	7,669.8

Source: MOTC Road Maintenance Schedule.

Table 1-2-6-(1) Total Length of Classified Roads by District in 1982/3

		A			B			C			Total		
		Total	Bitumen	Gravel/ Earth	Total	Bitumen	Gravel/ Earth	Total	Bitumen	Gravel/ Earth	Total	Bitumen	Gravel/ Earth
Nairobi	Nairobi	85.7	85.7	-	-	-	-	-	-	-	85.7	85.7	-
	Total	85.7	85.7	-	-	-	-	-	-	-	85.7	85.7	-
Central	Kiambu	137.1	137.1	-	20.3	20.3	-	186.5	129.0	57.5	343.9	286.4	57.5
	Kirinyaga	40.0	40.0	-	42.1	42.1	-	47.8	47.8	-	129.9	129.9	-
	Muranga	40.5	40.5	-	-	-	-	182.8	137.4	45.4	223.3	177.9	45.4
	Nyandarua	4.3	4.3	-	27.8	27.8	-	233.3	43.4	189.9	265.4	75.5	189.9
	Nyeri	72.0	72.0	-	66.3	66.3	-	34.3	34.3	-	172.6	172.6	-
	Total	293.9	293.9	-	156.5	156.5	-	684.7	391.9	292.8	1,135.1	842.3	292.8
Coast	Kilifi	34.4	34.4	-	168.6	105.0	63.6	219.3	24.0	195.3	422.3	163.4	258.9
	Kwale	147.1	147.1	-	-	-	-	192.1	16.0	176.1	339.2	163.1	176.1
	Lamu	-	-	-	-	-	-	93.4	-	93.4	93.4	-	93.4
	Monbasa	31.6	31.6	-	13.0	13.0	-	22.6	18.8	3.8	67.2	63.4	3.8
	Taita/Taveta	220.3	129.3	91.0	-	-	-	22.5	21.5	1.0	242.8	150.8	92.0
	Tana River	114.5	25.5	89.0	267.3	-	267.3	21.5	-	21.5	403.3	25.5	377.8
	Total	547.9	367.9	180.0	448.9	118.0	330.9	571.4	80.3	491.1	1,568.2	566.2	1,002.0
Eastern	Embu	-	-	-	82.1	37.6	44.5	50.8	-	50.8	132.9	37.6	95.3
	Isiolo	45.0	9.0	36.0	136.4	-	136.4	-	-	-	181.4	9.0	172.4
	Kitui	141.2	16.0	125.2	167.7	2.5	165.2	200.0	-	200.0	508.9	18.5	490.4
	Machakos	311.4	297.6	13.8	65.5	3.0	62.5	385.6	116.9	268.7	762.5	417.5	345.0
	Marsabit	379.1	10.0	369.1	-	-	-	492.1	1.5	490.6	871.2	11.5	859.7
	Meru	71.0	71.0	-	191.6	40.3	151.3	122.7	50.2	72.5	385.3	161.5	223.8
	Total	947.7	403.6	544.1	643.3	83.4	559.9	1,251.2	168.6	1,082.6	2,842.2	655.6	2,186.6
North Eastern	Garissa	200.5	3.1	197.4	51.0	-	51.0	177.0	-	177.0	428.5	3.1	425.4
	Mandera	280.5	145.5	135.0	-	-	-	-	-	-	280.5	145.5	135.0
	Wajir	-	-	-	255.0	-	255.0	338.0	-	338.0	593.0	-	593.0
	Total	481.0	148.6	332.4	306.0	-	306.0	515.0	-	515.0	1,302.0	148.6	1,153.4
Nyanza	Kisii	27.7	27.7	-	51.1	51.1	-	182.8	50.5	132.3	261.6	129.3	132.3
	Kisumu	60.9	60.9	-	45.3	45.3	-	171.0	138.8	32.2	277.2	245.0	32.2
	Siaya	-	-	-	49.6	49.6	-	220.1	63.7	156.4	269.7	113.3	156.4
	South Nyanza	113.2	113.2	-	-	-	-	302.9	30.9	272.0	416.1	144.1	272.0
	Total	201.8	201.8	-	146.0	146.0	-	876.8	283.9	592.9	1,224.6	631.7	592.9

Table 2-2-6-(2) Total Length of Classified Roads by District in 1982/3 (Continued)

		A			B			C			Total		
		Total	Bitumen	Gravel/Earth	Total	Bitumen	Gravel/Earth	Total	Bitumen	Gravel/Earth	Total	Bitumen	Gravel/Earth
Rift Valley	Kajiado	132.0	132.0	-	-	-	-	375.1	101.7	273.4	507.1	233.7	273.4
	Kericho	-	-	-	159.8	97.6	62.2	282.6	55.1	227.5	442.4	152.7	289.7
	Laikipia	3.8	3.8	-	36.9	24.6	12.3	268.4	82.3	186.1	309.1	110.7	198.4
	Nakuru	146.8	146.8	-	109.6	89.9	19.7	196.0	185.0	11.0	452.4	421.7	30.7
	Narok	-	-	-	140.7	78.0	62.7	426.7	11.9	414.8	567.4	89.9	477.5
	Trans-Nzoia	50.3	50.3	-	19.6	19.6	-	125.8	17.6	108.2	195.7	87.5	108.2
	Vasin-Gishu	109.7	109.7	-	34.3	34.3	-	196.7	86.9	109.8	340.7	230.9	109.8
	Baringo	-	-	-	185.4	99.0	86.4	177.8	24.0	153.8	363.2	123.0	240.2
	Elegyo Marakwet	-	-	-	16.6	-	16.6	262.1	8.9	253.2	278.7	8.9	269.8
	Nandi	-	-	-	-	-	-	174.3	110.5	63.8	174.3	110.5	63.8
	Samburu	92.9	-	92.9	-	-	-	301.1	3.0	298.1	394.0	3.0	391.0
	Turkana	417.0	175.0	242.0	-	-	-	419.7	-	419.7	836.7	175.0	661.7
	West Pokot	119.3	119.3	-	43.8	-	43.8	41.1	-	41.1	204.2	119.3	84.9
	Total	1,071.8	736.9	334.9	746.7	443.0	303.7	3,247.4	686.9	2,560.5	5,065.9	1,866.8	3,199.1
Western	Bungoma	82.1	82.1	-	-	-	-	145.4	28.0	117.4	227.5	110.1	117.4
	Busia	13.2	13.2	-	26.4	26.4	-	132.9	-	132.9	172.5	39.6	132.9
	Kakamega	115.3	115.3	-	12.6	12.6	-	218.9	61.4	157.5	346.8	189.3	157.5
	Total	210.6	210.6	-	39.0	39.0	-	497.2	89.4	407.8	746.8	339.0	407.8

(3) Surface Conditions of Paved Trunk Roads

The total length of paved Trunk Roads is approximately 3,300 km. Many sections of A104, A109 and roads around Nairobi, Mombasa and Kisumu have damaged paving or have otherwise deteriorated because of the 10 to 15 years that have elapsed since the completion of paving, and because of heavy vehicle traffic and inadequate maintenance during this period. The following roads currently present obstacles to traffic, and their roadbeds may suffer damage if left unattended any longer. These are in urgent need of strengthening:

1)	Trunk A1	Kisumu – Kisii
2)	Trunk A2	Nairobi – Thika
3)	Trunk A104	Burn Forest – Uganda border
4)	Trunk A104	Kabete – Limuru T' off
5)	Trunk A109	Buchuma Gate – Machakos T' off

Table 1-2-7 Road Development Plan (1979–1983)
(Summary Sheet of Proposed Investment Programme)

Road No.	Project Name	Length (km)	Estimated Expenditure in K£1,000					Total 79/83	Source of Finance	Remarks
			78/79	79/80	80/81	81/82	82/83			
I.	Road Works									
1.	Int. Trunk Roads (A)	2,501	6,935	8,700	13,860	13,595	15,105	58,195	28	
2.	National Trunk Roads (B)	858	6,000	7,865	7,740	5,860	4,250	31,715	16	
3.	Primary Roads (C)	1,046	4,700	10,002	7,550	6,965	8,650	37,867	19	
4.	Others-Pri., Sec., & Minor Roads (C.D&E roads plus 4 bridges and a jetty)	1,275	5,830	4,950	3,250	2,445	2,335	18,810	9	
5.	Gravelling Programme	-	5,355	6,515	4,235	3,925	3,825	23,855	12	
6.	Rural Access Road Programme	-	3,500	3,500	3,500	4,200	4,300	19,000	9	
7.	Subtotal of Road works	-	32,320	41,532	40,135	36,990	38,465	189,442		
II.	Supporting Activities	-	1,394	3,155	3,010	3,040	2,540	13,140	6	
	Total of I + II		33,714	44,687	43,145	41,030	41,005	202,582	10	

Note: For a detailed project breakdown, see the various tables attached to this report.
Source: MOW Road Department Road Investment Programme 1979–1983.

1.3 Present Condition of Road Development

(1) Outline

Road development projects are undertaken by the Road & Aerodromes Department of the MOTC.

The Headquarters of this department is organized into eight bureaus, of which one is that of the Chief Engineer; to this bureau belong seven provincial offices which are extra-ministerial bureaus. The road development budget of the Road & Aerodromes Department consists of a development budget and current expenditures. The development budget is utilised for the building and rebuilding of Classified Roads and the study and design involved in executing such projects. Consultants and contractors carry out development projects under the direct control of Headquarters.

Current expenditures cover outlays for road maintenance and management, and most projects are directly managed by the seven extra-ministerial provincial offices which are:

1) Central provincial office;
2) Northeastern provincial office;
3) Eastern provincial office;
4) Coast provincial office;
5) Rift Valley provincial office;
6) Nyanza provincial office; and
7) Western provincial office.

(2) Road Project Costs

1) Level of Achievement of Road Development Investment Plan

The planned total budget for the fourth Five Year Plan, as shown in Table 1-2-7, is K£202,582,000. The planned budget for major road projects (Trunk Roads A and B and Primary Roads C) is K£127,777,000. A budget of K£37,626,000 is planned for ongoing major road projects from the third Five Year Plan, and the "Republic of Kenya Development Estimates for the Year 1981/82" indicates that these ongoing projects are continuing. Table 1-3-1 also shows figures from this 1981/82 report as well as for 1982/83. The approved estimates for 1980/81 and 1981/82 and those for 1982/83 total K£158,477,000, which is 78% of the total planned budget for the fourth Five Year Plan. From this it can be inferred that the fourth Five Year Plan is being carried out as planned.

2) Foreign Capital

As shown in Table 1-3-1, a high dependency of road development expenditures is on foreign capital: 32% in 1980/81, 39% in 1981/82 and it is expected to be 54% in 1982/83. Of the projects in which foreign capital was invested, Trunk Roads (A, B) had the greatest percent – 50% in 1980/81, 56% in 1981/82 and 59% in 1982/83 – followed by "miscellaneous" (mainly Rural Access Roads and the gravelling programme) – 31% in 1980/81, 30% in 1981/82 and 21% in 1982/83. The development of Trunk Roads offers high yields and naturally attracts large capital investment from abroad, and this can be expected to increase in the future. However, raising development capital for minor roads which offer low yield is expected to become more difficult, and economic methods of developing such roads must be studied.

Table 1-3-1 Gross Development Estimates

Kb '000

Year / Type	1980/81		1981/82		1982/83	
	Approved Estimates	External Receipts	Approved Estimates	External Receipts	Approved Estimates	External Receipts
Planning and Design	2,480	1,490	2,590	1,500	2,355	1,250
Trunk Roads (A, B)	14,600	5,750	22,134	12,270	34,565	20,818
Primary Roads (C)	6,020	640	18,750	1,515	11,737	5,090
Other Roads	5,775	200	3,545	-	5,256	381
Miscellaneous	7,870	3,600	9,850	6,700	10,950	7,472
Total	36,745	11,680	56,869	21,985	64,863	35,011

Source: Republic of Kenya Development Estimates for the years 1981/82, 1982/83.

3) Road Maintenance Expenditures

Table 1-3-2 shows the fourth Five Year Plan and actual expenditures for road maintenance. Actual expenditures exceed the initially planned budget, indicating that the Government of Kenya is putting its energy into road maintenance.

Table 1-3-2 The Fourth 5 Year Plan and Actual Expenditures

Kb '000

	1978/79	1979/80	1980/81	1981/82
The Fifth Plan	9,590	11,197	13,310	14,340
Actual Expenditure	10,290	12,815	15,610	17,130

The Maintenance Department of the MOTC calculates that road maintenance projects will continue to be beset by extremely severe economic conditions. A maintenance investment greater than 150% of present costs will be needed to keep public road assets from decreasing and to maintain desirable road conditions.

4) Acquisition of Funds for Road Development

Although the demand for road development in Kenya is quite high, the acquisition of funds may not be easy. It is therefore desirable that the Kenyan Government introduce an automobile tax and a toll system with the proceeds to be used for road development funds. These systems have already been successfully applied in developed countries based on the economical principle of beneficiary compensation.

a) Automobile Tax

The principal automobile taxes adopted in Japan are as follows:

(a) Consumption tax of volatile oil and light oil
(b) Automobile weight tax
(c) Automobile sales tax

The tax revenues from the above are used only for road development projects. In 1982, these sources accounted for about 50% of the total road development expenditures.

Automobile related taxation has also been introduced in Kenya, as shown in Table 1-4-2, and revenue from this source contributes greatly to the national budget. In order to provide sufficient funds for road development, and at the same time provide a fundamental infrastructure for socio-economic activities, the study team recommends the following:

(a) An increase in the ratio of return to the road sector of automobile related taxation.

Revenue from consumption tax was K£57,741 thousand and K£66,359 thousand in 1980 and 1981 respectively. Comparing these figures with those in Tables 2-2-14 and 2-2-15, the ratios of return to the road sector of the automobile related tax are seen to be respectively 70% and 80%. Thus the return of this to the road sector is not sufficient.

(b) Provision for New Sources of Funds

An automobile weight tax and automobile sales tax should be introduced. In Japan, these constitute about 10% of the total automobile related taxes.

b) Introduction of a Toll System

Toll systems introduced in developed countries are used to recover the expenses incurred by road development through a users toll. Japan considers thirty years as the period of redemption. Usually a revenue of about 3 times the cost of development can be obtained during a thirty year period.

Suppose a two lane road is constructed in Kenya which costs 400,000 K£/km, and also suppose a 3% yearly average growth rate p.a. for traffic demand. If the toll is set at 0.25 Ksh/km, then 6000 veh/day is required for the first year after its introduction.

Judging from Kenya's current traffic conditions, however, it may be quite difficult to find a road section where the above toll redemption conditions can be satisfactorily applied. Therefore, introduction of a partial redemption toll system in the following form is advised.

1 Partial construction costs (e.g., domestic portion) redeemed by toll revenue
2 Only maintenance costs for the tolled section redeemed by toll revenue.

The former type can be adopted for the Nairobi Bypass (which is explained later in section 2). The latter can be applied to tourist roads such as C-12 and C-91 to offset their maintenance expenses. It may be necessary to consider what kinds of vehicles utilise the road in introducing a toll system, and to specify which categories of vehicles are subject to toll. For example, the toll may be imposed on all vehicles excepting perhaps matatu and buses which pass through the toll section, or only on tourist vehicles.

(3) Present Condition of Road Construction

1) General Conditions of Road Construction

Road construction costs are covered by the development budget, and can be generally divided into major road projects, minor road projects and supporting activities. Major road projects are strengthening, reconstructing and improving roads to bitumen or gravel. Minor road projects include the gravelling programme and a rural access programme. There are also supporting activities such as studies and designs necessary to carry out these projects. Here, our particular concern will be the present state of major and minor road projects.

Practically all road construction jobs are contractual and capital intensive. Contractors for such jobs are almost entirely foreign capital enterprises. A necessary task for Kenya is the nurturing of domestic contractors and the creation of employment opportunities. The use of domestic contractors will minimise the flow of capital out of the country and activate the internal economy. Creating employment opportunities will raise the percentage of labour intensive jobs in construction work, thereby providing citizens with a means of acquiring a cash income and contributing to the creation of richer farming communities.

The construction of Rural Access Roads, carried out mainly as directly administered projects of the MOTC, is relatively easily adapted to labour intensive work. Such tasks as the rolling of road surfaces and the transportation of construction material naturally require mechanical power, but other tasks such as earthwork are labour intensive.

2) Construction Methodology

Construction methodologies are classified on the basis of the following criteria.

(a) In the area of technology, a major criterion is the method of construction.

(b) In construction execution, there is a choice between direct administration and contractual work.

(c) In the actual construction there is a choice between the use of mechanical power and manpower.

Since criterion (a) is related to selection of the method of temporary work during construction and is a matter requiring judgement based on advanced technical knowledge, it will be disregarded in this study.

Criterion (b) is related to the nurturing of domestic contractors. The qualifications of contractors include not only advanced technical skills but sound finances as well and, considering the present conditions in Kenya, nurturing of such contractors will require much time and great effort. One method that might be considered is the establishment of a public construction corporation by the third sector. Its first aim would be to supplement the financial resources of contractors. To develop needed technical skills, contractors would begin with the study, design and contracted construction work of small-scale projects for provincial minor roads, gradually increasing their experience and advancing toward eventual independence as private entrepreneurs. During the initial stages it will probably be necessary to employ experienced foreign consultants. For jobs contracted to public construction corporations, responsibility will gradually be transferred from headquarters to chief engineers of provincial offices who are knowledgeable about local conditions. This will give the staff of provincial offices opportunities to acquire technical skills.

Criterion (c) is concerned with the creation of employment opportunities. A construction methodology is chosen, first, on the basis of how suitable it is for the conditions of the country and the particular locality, and second, on the basis of how appropriate it is for the nature of the construction work. In countries where the cost of labour is very high, capital intensive projects are more advantageous than labour intensive projects. In Kenya, however, the cost of labour is presently very low and labour intensive projects can be introduced in many areas; such projects are also highly effective from the point of view of energy conservation. In localities where there is only a small population or in cases where construction must be rushed to completion before the start of the rainy season, such labour intensive projects are clearly unsuitable and supplementary mechanical power must be introduced. This manner of working has been relatively successful on Rural Access Road projects and its introduction for provincial minor road projects which are expected to increase has great potential; individual cases should be studied at the construction planning stage.

3) Road Design and Standard

(a) Outline

Road Design and Standards is a written guideline consisting of "Geometric Design of Rural Roads" (Part I), "Bridges" (Part II) and "Materials and Pavement Design for New Roads" (Part III). Parts I and II were established in 1979 and Part III in 1981.

(b) Geometric Design of Rural Roads

There are seven chapters to the "Geometric Design of Rural Roads" and all relevant items are included.

The following points should be added to "The Coordination of Horizontal and Vertical Alignments" (p. 5.28):

* a reverse point of an S-curve is not to be established on the top or bottom of vertical curves;
* a vertical curve with a bottom is not to be established on long straights.

(c) Bridges

"Design of Bridges" consists of two sections (General and Bridge Standard) and cannot be evaluated on the basis of this material alone. The British Standard is used as the main standard of design.

(d) Materials and Pavement Design for New Roads

This consists of 15 chapters and includes all items necessary for pavement design. Standard pavements are classified into 15 types on the basis of their base and subbase. Each type is further differentiated on the basis of the subgrade's C.B.R. and the traffic class, and many standard pavement structures (204 varieties) are illustrated.

Geometric designs for Rural Roads are thus available. It should be noted, however, that the British Standard is employed for bridge design. As this emphasizes the load, especially for short span bridges, the design is uneconomical, and therefore, the standard should be re-examined so that it more accurately reflects actual conditions in Kenya.

(4) Present Condition of Road Maintenance

1) Level of Road Maintenance and Management

With advances in road development, the number of facilities requiring maintenance is increasing as are roads that require large sums of money for maintenance and repairs, due to Kenya's natural and topographical conditions. The volume of road traffic is also increasing and there is a rapid trend toward larger vehicles. Consequently, the load on road facilities is becoming greater and wear is advancing. As road traffic in the provinces comes to play a more important role, passage in the rainy season will become a vital issue.

Like other social capital, road facilities require proper maintenance and repairs at regular intervals to prevent wear and deterioration; if maintenance and repair are delayed, costs rapidly escalate. It is therefore necessary to devise plans and methods of maintenance, repairs and improvements in maintenance technology as well as to secure the required funds. Durable road construction which can withstand increasing traffic loads is essential, and methods of construction must be updated.

2) General Condition of Road Maintenance

The maintenance of Kenya's Classified Roads is done by units (grading unit, regravelling unit and resealing unit) belonging to the 290 camps under the eight provincial offices which are extra-ministerial bureaus of the MOTC. Most of these projects are administered directly, although some (resealing and regravelling) are contracted out.

Looking at road maintenance historically through the last decade, total road length increased by 8,595 km (about 20%) in the ten years between 1971/72 and 1981/82. The cost of maintenance, on the other hand, has increased K£12,878,000, approximately 30%.

Table 1-3-1 Road Maintenance Expenditures

(K£000)

Year	Actual Expenditures	Year	Actual Expenditures
1972	5,382	1977	9,113
1973	6,392	1978	10,289
1974	6,848	1979	12,814
1975	8,013	1980	15,608
1976	7,901	1981	17,127

Source: MOTC Maintenance Department, Road Maintenance Schedule.

This is probably the effect of inflation and not a real increase. The maintenance budget for 1982/83 was K£15,862,000, which is K£295 per kilometre of road. Arterial road surfaces are marked by many potholes and cracks, and road management seems far from satisfactory. This is no doubt due in part to a low budget but as annual provincial office reports state, it also is related to shortages in bitumen, gasoline and machine parts.

3) Standard for Estimates of Road Maintenance Costs

Road maintenance work can be divided into routine maintenance, grading, regravelling, resealing and road marking.

(a) Routine Maintenance

Routine maintenance includes staff wages, housing allowance and other operations such as grass cutting, culvert clearing, culvert replacement, spot gravel replacement and patching. The current estimate standard establishes a unit cost per kilometre for the A.D.T. of each road and uses this as a basis for calculation.

These estimates have been studied and found reasonable and will be used.

(b) Grading

Grading numbers have been determined from road surface type (bitumen, gravel/earth) and the A.D.T. They are shown in Table 1-3-4.

Table 1-3-4 Grading Cycle per Year

Class of Road	1	2	3	4	5	6	7	8	9
A D T	Over 2000	1,001- 2,000	501- 1,000	0- 500	Over 300	201- 300	101- 200	31- 100	0- 30
Grading Cycle	1	2	2	2	5	4	3	2	1

(c) Regravelling

This is an operation to replace gravel worn and lost through the passage of vehicles and is closely related to the A.D.T. Regravelling is done to both gravel roads and pavement shoulders.

A great difference in level is created between the shoulder and the pavement, and the pavement is destroyed from the edges, narrowing the carriage width. Damage is particularly severe in places where many vehicles stop on the shoulder, and installation of side stones or extension of the bitumen over the shoulder may be necessary.

Kenya's standard now shows the cycle year for class 1 and 2 roads as eight years and for class 3 and 4 roads ten years; but judging from the present road conditions it may be necessary to shorten these cycles.

Table 1-3-5 Regravelling Cycles per Year

Class of Road	A D T	Cycle (Years)
5	Over 300	3
6	201 - 300	4
7	101 - 200	5
8	31 - 100	8
9	0 - 30	12

(d) Resealing

Resealing and bitumen patching are necessary to extend the life of a bituminous road. Water repeatedly penetrating the surface cracks and potholes during the rainy season results in the destruction of the entire pavement and makes expensive repairs necessary.

Resealing restores a bituminous road to its former condition, and the plugging of small cracks on the surface prevents the penetration of rainwater and forestalls pavement destruction. This has a high priority in road maintenance.

Table 1-3-6 Resealing Cycles

Road Class	A D T	Cycle (Years)
1	Over 2,000	4
2	1,001 - 2,000	5
3	501 - 1,000	6
4	0 - 500	8

(e) Road Marking

The cycle years for road marking are determined by traffic volume; standard cycles are shown in Table 1-3-7.

Table 1-3-7 Marking Cycles

Road Class	1	2	3	4
Cycle (Years)	1*	2**	5**	8**

* Centre and Edge Lines (by machine)
** Centre Line only (by hand)

4) Labour Intensive Methodology

Routine maintenance is primarily carried out as labour intensive work but other road maintenance work is mainly capital intensive. For roads with an A.D.T. of less than 100 vehicles (approximately 40,000 km), conduct of the work will probably not greatly affect the traffic; the possibility of grading and regravelling work now done by machine being changed to labour intensive work will therefore be studied. For roads with an A.D.T. of less than 100, 800 kshs of grading annually per kilometre is necessary. If the labour wage is 20 kshs per man-day, 40 persons can be employed. A work load of 25 meters per day per person will be sufficient.

In the central provincial office, road marking jobs have been labour intensive since last year. Reportedly begun because of a shortage of machinery, the change of method has resulted in a 50% reduction in expenses.

1.4 Current Road Transport Organisation and Management

(1) Laws Related to Road Transport

Two principal laws related to transport are the Traffic Act, chapter 403, 1978, and the Transport Licensing Act, chapter 404, 1979.

The Traffic Act is the law related to the registration and licensing of vehicles, driver licensing, regulation of traffic and public service vehicles. It also establishes procedures, fees, penelties and so forth. Public Service Vehicles (PSV) mentioned above refer to vehicles used for public passenger transport such as buses, taxicabs, and those used by tourism firms, etc. The Act establishes rules related to registration, driver licensing, and conductors of these PSV vehicles.

The Transport Licensing Act established the Transport Licence Board (TLB) as an executive organisation. The Act establishes the procedures, fees and penalties related to the licensing of transport of goods and passengers. The following classes of licence are issued under this act for goods carrying vehicles;

1) 'A' Licence: public carrier

2) 'B' Licence: limited carrier

3) 'C' Licence: private carrier

Short term licences are also issued.

No 'A' licences have been issued and public hauling is mainly done by 'B' operators. A 'B' licence enables the licensee to use the authorized vehicle for carriage of goods for or in connection with any trade or business carried on by him and for carriage of goods for hire and remuneration. 'C' licences are for the hauling of one's own goods.

The Road Service Licence (RSL) is for public passenger transport and is issued only for PSV vehicles. In applying for the RSL, the proposed

timetable, fare table, and a map approved by the District Commissioner must be submitted.

This Act states that the fare weight of any vehicle, other than those owned and operated by tour operations, must not exceed 3,048 kg. (Legal Notice 89, 1973). The Act also approves matatu operation.

(2) Authority Related to Road Administration

1) Ministry of Transport and Communications – MOTC

Transport administration in Kenya is under the Administrative Division of MOTC. The Transport Division of the Administrative Division is responsible for coordinating all matters pertaining to modes of transport (road transport, railway transport, ports and cargo hauling, marine services and shipping). The Road Transport Branch takes care of the administrative action specified by chapter 403 of the Traffic Act. Its activities include:

(a) Registration and licensing of motor vehicles and trailers

(b) Licence for Public Service Vehicles

(c) Licence to drive a Public Service Vehicle

(d) Licence to act as a conductor of a Public Service Vehicle

For (a), the application is sent directly to the Registrar of Motor Vehicles (director of the Road Transport Branch). All information on the application form is recorded on magnetic tape and kept at CBS (Central Bureau of Statistics). An inspection report is required for every licence registration for:

Public Service Vehicles
Commercial Vehicles
Heavy Commercial Vehicles

For (b), (c) and (d), the application form must be sanctioned by the Police Department before approval for the licence is granted.

2) Transport Licensing Board – TLB

The Transport Licensing Board (TLB) established by chapter 404 of the Transport Licensing Act is also under the control of the Road Transport Branch in the Administrative Division of MOTC, and therefore all the matters regarding finances and personnel are handled by the MOTC. The type of licences issued by the Transport Licensing Board are:

- 'B' Licence
- 'C' Licence
- Road Service Licence (R.S.L.)
- 'B' or R.S.L. Short Term Licence
- 'C' Short Term Licence
- Variation of 'B', R.S.L. and 'C'
- Replacement of 'B', 'C' or R.S.L.

'B', 'C' Licence and R.S.L. are effective until December 31st of the year in which issued, and an application for renewal is needed for continuation. A short term licence for a seasonal business or a need of limited duration may be granted for a period not exceeding three months.

(3) Authority Related to the Road Transport

1) Kenatco is the parastatal financed by the I.C.D.C. (Industrial and Commercial Development Corporation) and operated by a board of directors appointed by the Ministry of Commerce. Kenatco's main activity is the hauling of cargo within Kenya and to and from neighbouring states (the latter accounted for about 90% of the 1982 freight business), and passenger transport, especially taxicabs, within the city. Net operating profit was highest in 1973/74 but declined thereafter affected by the development of private transport services and the closure of the border between Tanzania in 1976/77, the year the worst operating loss was realised. At present, Kenatco has about 800 employees and operates 84 freight trucks (including trailers); however, the firm can subcontract as many as 300 vehicles when there is sufficient business. These subcontracts are important, and it is reported that the benefit gained by the sub-contracts is much higher than that from Kenatco's own freight business.

In 1981, a study undertaken by I.C.D.C. came up with the following suggestions for the improvement of Kenatco's operations:

(a) Purchase of new trucks, limiting the fleet size to 80, and disposing of some of the vehicles used more than 5 years or with maintenance troubles.

(b) Purchase of new taxicabs and increasing the fleet size to 120 from the present 76.

(c) Contracting for warehousing.

(d) Detailed study related to long distance passenger transport, especially luxury buses between Nairobi and Mombasa.

This study also pointed out the need for acquisition of a competent staff and expansion of markets in the future.

2) Current Private Freight Transport

At present, there are about 15 major hauliers based mainly in Nairobi and Mombasa and numerous small hauliers spread throughout the major business centers in the country. The yearly trends in the number of trucks and lorries in use (estimated), new registrations, and licences issued are shown in Table 1-4-1. The number of newly registered vehicles has been decreasing since a peak in 1978 and the number of vehicles in use began to decrease in 1982. Licence-issued vehicles decreased in 1979, but between 1980 and 1982 there was a small increase of 2%. Since one vehicle whose weight does not exceed 3,048 kg (the matatu) can operate without being licensed, the actual number of vehicles transporting freight is higher than that indicated by the table.

Table 1-4-1 Trucks and Lorries: Number of Vehicles in Use, New Registrations and Licences Issued

	1976	1977	1978	1979	1980	1981	1982
Vehicles in Use	20,732	21,007	22,185	23,115	23,594	23,956	23,539
New Registrations	1,417	1,857	2,848	2,669	2,255	2,091	1,355
Licences Issued	4,388	4,150	4,996	3,897	5,931	5,733	6,199

Source: Central Bureau of Statistics

At present, the government does not regulate the transport tariff. These seem to be determined based on transport cost and some of the large hauliers provide fare tables. In actual practice the tariff is apparently determined through negotiation with the customers and the regulated fare is not always applied. In Kenya, transport service can usually be supplied by the shipper-trader himself. In this sense, and considering the problem of competition with the matatu, it is not necessarily convenient for the hauliers to establish a regulated fare. A careful solution is needed for the imposition of tariff control.

3) Current Bus Transport

Bus transport in Kenya is operated by private enterprises with the exception of KBS (Kenya Bus Service, Ltd.), an undertaking partially owned by the Nairobi City Council. Long distance inter-city transport is mostly operated by small firms, the so-called "country-bus", with the exception of the "Luxury Coach" which is operated by a few large firms.

Yearly trends in the number of buses in use and those newly registered are shown in Table 1-4-2. Although there was a temporary increase in vehicles in use in 1982, on the whole since 1976 the number has decreased. New registrations totalled 330 in 1982 but is usually around 200 per year.

The maximum bus fare has been established by the government as 23 cts/km with accompanied baggage weighing less than 9 kg. This restriction on bus fare does not presently affect bus operation which is actually operating at a cheaper fare level.

Table 1-4-2 Buses and Coaches: Number of Vehicles in Use, New Registrations

	1976	1977	1978	1979	1980	1981	1982
Vehicles in Use	3,049	2,995	2,976	3,023	3,005	3,033	3,128
New Registration	215	171	205	275	208	247	330

The 1981 I.C.D.C. Report mentioned above examined the feasibility of luxury bus operation by Kenatco and disclosed that the business could be favourably undertaken by adopting a bus fare of shs. 70/= for 500 km (cts 14/km) between Mombasa and Nairobi.

The KBS bus terminal in Nairobi is frequently used by long distance buses. It is well located and no deficiency was observed in the condition of its facilities or capacity. Another bus terminal handles the country bus, and it is adequately surfaced and the layout well organised. An interchange between country buses and city service by the KBS was pointed out as an issue to be improved by the Nairobi City Council (Nairobi Urban Transport Project Draft Report, Sept. 1979).

4) Current Matatu Transport

The use of matatu is conspicuous in the city, in suburbs and for transport between adjacent districts. The competition between bus and matatu has long been a point of controversy and some adequate sharing of these modes must be determined in the near future. Organisations which represent the matatu's interests are the Matatu Vehicle Owner's Association and the Kenya Matatu Organisation. The former is for matatus which operate in the city and the latter for those of inter-urban operation.

Although many studies have been made on the matatu, the current state of its operation throughout the country has not yet been investigated. This conveyance has the advantage of freely entering the transport market. It contributes to the national economy by increasing employment opportunities, and its merits lie in the small initial investment required to initiate a business and quick response to demand. However, it poses serious operational problems because of poorly maintained vehicles and overloading which compromises safety. Another issue may be its carrying capacity per vehicle, which is small, so that the matatu mode cannot be efficiently used within and near a city, especially during peak periods. Matatus in city traffic cause great confusion.

There is no government regulation of matatu fares and these are set at almost the same as the bus fares. On some routes or periods of the day, the matatu's fare exceeds that of the bus, but even on such routes the matatu is likely to be preferred.

There are no established stops for matatus. In Nairobi, some matatus operate along the KBS bus route and stop at the KBS bus-stops. Many other stops are made throughout the city.

1.5 Issues on Roads/Road Transport

Some issues related to the development of the road system are:

(1) The road network system in Kenya has been well planned through previous studies. The future issues, therefore, should be to establish a long term development plan followed by a future road network plan which specifies

engineering details, such as road width, structure and pavement for each section.

(2) In highly populated areas paved trunk roads have been developed to a high level compared with other African countries. However, the following has been observed:

1) Road sections which were paved in early 1970 have deteriorated because of an increase in traffic volume and poor maintenance. On A2, A104 and A109, one can observe many sections where the surface is seriously damaged and requires overlay.

2) Nairobi lacks a ring road for through traffic. The inflow of heavy vehicles into the city center has an unfavorable impact on traffic. A ring road must be provided in the near future.

3) There are some sections of the trunk road near Nairobi where the traffic flow exceeds the design capacity of a single carriageway. These sections must be made into a dual carriageway in the near future.

(3) The development of minor roads has been delayed even in highly populated areas. Some sections are impassable during rainy seasons. Such roads must be developed to promote the socio-economic activities which are part of the regional planning.

(4) Construction methods for rural access roads are quite unique and have been successfully applied in Kenya. These methods can also be applied to classified roads. They have advantages in terms of cost, increase in employment opportunities, acquisition of engineering techniques, etc. It may be worthwhile to study the applicability of these methods to the construction of secondary and minor roads.

(5) Hitherto, trunk roads, which have a high impact on economic growth, have been developed with foreign capital investment. However, the prospects for this type of investment in future are dim, and securing capital for the development of provincial roads will be very difficult. It is therefore necessary to study the construction of low-cost roads. In order to raise funds, the introduction of automobile taxes and a system of toll roads based on the benefit principle should be considered.

(6) Many foreign capital enterprises have entered Kenya's construction contracting business. This is due to the financial weakness and lack of technical skills of domestic contractors. Since the nurturing of domestic contractors will diminish the flow of foreign capital from the country and create employment opportunities, government participation would be meaningful. Therefore, establishment of a public construction corporation by the third sector to nurture domestic contractors is worthwhile.

(7) The Provincial Engineer's Offices may extend their activity to the contracting and management of construction work in conjunction with the establishment of a public construction corporation. By limiting the function

of these offices to matters related to this corporation as their activities expand, the system, organisation, and technical issues of contracting and management can be arranged gradually in accordance with the growth of the corporation.

The issues related to road transport are as follows:

(8) Use of aged vehicles and shortage of fleet: It is said that a vehicle is used for an average of 15 years in Kenya. Aged vehicles are accident prone and therefore have disadvantages from the viewpoint of safety. The high cost of maintenance and fuel consumption creates inefficiency in transport activity and leads to loss in the national economy. A policy is necessary to modernise Kenya's fleet. Even though the growth in demand for transport – which can be seen from vehicle km – has been quite moderate in recent years, future demands associated with agricultural development policies and export promotion will be high, exceeding the capacity of the present-day fleet.

A policy based on anticipated future need should be established for the acquisition of an appropriate number of vehicles.

(9) Issues associated with matatu transport: Matatus greatly influence the national economy and it may be necessary to introduce a policy to foster them. Some control must be established to maintain safe and economical operation and government control is needed for the sound operation of a matatu system. Basic regulations are necessary for registration and vehicle inspection. The former may provide a data source from which to analyse the current status of the matatu and the latter would assure safety. In addition, it is recommended that a loan system be established so that a matatu operator can purchase an adequate vehicle.

(10) Data collection and analysis system: The CBS is now handling national statistical data in Kenya, collecting, analysing and retaining data from various sectors of the country. It also manages information related to vehicle registration and licensing. The CBS also distributes a survey questionnaire on transport data activity, however, this questionnaire is not designed to analyse goods movement.

Data concerning road transport is collected and analysed by the Transport Planning and Coordination Division of the MOTC. Traffic data is periodically collected at 3000 points throughout the country. An OD survey, however, is performed locally whenever required by a specific project. Nationwide surveys performed to date have been done by CIDA (1976) and by this study team (1983).

In establishing a transport plan, it is important to completely understand all conditions (freight movement, passenger movement and traffic movement). Periodic surveys will be necessary in the future. A system which analyses the collected data is also important and should be established at the earliest opportunity.

(11) Overload in truck transport: It has been pointed out that the average tonnes carried per vehicle on Road A109 is extremely high and that overload is one of the issues on this route. For maintenance of this road it is important to control overloads although such control should not depress economic activity. Besides imposing restrictions, there must be support to maintain a sufficient fleet to meet the desire of shippers and hauliers. In this sense, a policy should be stablished for future freight transport, taking into account the trends of Kenya's economy, transport and fleet.

2. Road Development Plan

2.1 Future Road Network

Kenya already has a classification and link allocation plan related to its road network. Prospects for the year 2000 indicate that there will be only minor problems in the network structure in maintaining the function of roads. Future issues, therefore, are appropriate road development and maintenance.

2.2 Future Traffic Demand

Table 2-2-1 shows the number of vehicle trips and vehicle km. During the period until 1988, the average growth p.a. of the total trip number of all vehicle types is projected at 4.5% and that of the total vehicle km at 4.9%. Up to the year 2000, the projection is estimated for two scenarios: the case without rail capacity restrictions (scenario A) and with such restrictions (scenario B). The difference in these scenarios appears in the number of trips as well as vehicle km: scenario B gives higher growth rates of 3.3% and 5.6% for the number of trips and vehicle km respectively.

Road traffic, especially along the principal corridors, is largely dependent upon whether or not sufficient rail transport capacity can be provided to meet future demand. The discussions developed in the previous sections have revealed that reaching this capacity will be fairly difficult. Therefore, scenario B will be used to determine road planning alternatives.

Table 2-2-2 shows the growth of traffic volume (AADT) on principal roads. High growth rates are observed at points linked to the areas where agricultural development is anticipated.

2.3 Roads/Road Transport Development Plan

2.3.1 Road Development Plan

Road development projects will be selected considering the current issues of road development and future demand.

(1) Road Development Criteria

The following criteria are considered.

1) Roads with an ADT more than 200 will be graded up to bitumen.

2) All trunk roads (A, B) will be paved.

3) All District Headquarters will be linked by paved roads.

4) Regardless of traffic demand, at least one bitumen surface primary road will be provided in areas where there is agricultural activity, and also in areas where agricultural development will be undertaken in the future.

(2) Design Standard

The design standard is based on the Geometric Design of Rural Roads (Part I) and Materials and Pavement Design for New Roads.

Table 2-2-1 Estimates of Future Vehicle Trips and Vehicle km Related to Road Transport

Vehicle Type \ Year		1983	1988		2000			
					Without capacity restriction for rail transport		With capacity restriction for rail transport	
			Number	Average growth rate p.a.	Number	Average growth rate p.a.	Number	Average growth rate p.a.
Number of trips per day	Passenger vehicle	11,985	14,413	3.8	22,238	3.7	22,238	3.7
	Freight vehicle	13,136	16,908	5.2	31,177	5.3	34,135	6.0
	Vehicle Total	25,121	31,321	4.5	53,415	4.5	56,373	5.0
Veh. km per day	Passenger vehicle	1,325,302	1,623,096	4.1	2,684,698	4.3	2,684,698	4.3
	Freight vehicle	1,746,087	2,292,625	5.6	4,351,808	5.5	4,868,973	6.5
	Vehicle Total	3,071,389	3,915,721	4.9	7,036,506	5.0	7,553,684	5.6

Table 2-2-2 Traffic Growth of Principal Roads

Roads	Points	1983 Traffic Volume (Veh/day)	1988 Traffic Volume (Veh/day)	1988 PCU Conversion	1988 Average Growth Rate p.a.	2000 Scenario B Traffic Volume (Veh/day)	2000 Scenario B PCU Conversion	2000 Scenario B Average Growth Rate p.a.
A1	South of KISII	336	488	576	7.7	1,195	1,410	7.7
	East of KISUMU	3,209	4,739	7,345	8.1	8,076	12,518	4.5
	South of KAKAMEGA	1,476	1,629	2,020	2.0	2,719	3,372	4.4
	South of LODWAR	35	85	129	19.5	728	1,099	19.5
A2	South of THIKA	3,179	3,533	5,088	2.1	6,460	9,302	5.2
	North of THIKA	3,162	3,510	5,019	2.1	6,381	9,125	5.1
	East of NYERI	984	1,085	1,476	2.0	1,971	2,681	5.1
	North of NYERI	210	237	327	2.4	481	664	6.1
A3	East of C94	39	54	105	6.7	140	273	8.3
A104	North of ATHI RIVER	3,877	4,515	7,314	3.1	8,811	14,274	5.7
	North of NAIROBI	3,479	4,535	7,483	5.4	8,742	14,424	5.6
	North of B3	3,160	3,622	6,049	2.8	7,191	12,009	5.9
	West of NAKURU	2,376	2,880	4,810	3.9	5,593	9,340	5.7
	South of ELDORET	702	832	1,506	3.5	1,588	2,874	5.5
	West of ELDORET	353	372	513	1.1	619	854	4.3
	West of WEBUYE	589	695	1,404	3.4	1,315	2,656	5.5
A109	East of VOI	1,189	1,387	2,705	3.1	2,954	5,760	6.5
	West of VOI	915	1,052	2,220	2.8	2,282	4,815	6.7
	North of MACHAKOS	3,490	4,077	6,686	3.2	7,768	12,740	5.5
A14	South of MOMBASA	1,732	1,971	2,641	2.6	3,467	4,646	4.8

Table 2-2-2 Traffic Growth of Principal Roads (cont'd.)

Roads	Points / Year / Traffic Volume	1983	1988			2000 Scenario B		
		Traffic Volume (Veh/day)	Traffic Volume (Veh/day)	PCU Conversion	Average Growth Rate p.a.	Traffic Volume (Veh/day)	PCU Conversion	Average Growth Rate p.a.
A23	West of VOI	308	370	522	3.7	683	963	5.2
B1	East of KERICHO	1,583	1,814	2,951	2.8	3,321	5,347	5.2
	West of KERICHO	1,366	1,513	2,436	2.1	2,742	4,415	5.1
	South of MASENO	1,135	1,604	2,101	7.1	3,676	4,816	7.1
	East of BUSIA	496	662	967	6.0	1,326	1,936	6.0
B2	South of KITALE	601	754	1,078	4.6	1,398	1,999	5.3
B3	East of NAROK	335	529	815	9.5	1,585	2,441	9.5
	West of NAROK	111	225	324	15.1	1,226	1,765	15.1
B4	North of NAKURU	97	174	256	12.3	702	1,032	12.3
	North of BARINGO	26	63	71	19.3	524	587	19.3
B6	South of MERU	335	387	596	2.9	687	1,058	4.9
B8	North of MOMBASA	1,272	1,460	1,883	2.8	2,771	3,575	5.5
	North of KILIFI	95	157	268	10.5	521	891	10.5
	North of MALINDI	95	157	268	10.5	521	891	10.5
C19	East of HOMA BAY	1,142	1,697	2,613	8.2	4,392	6,764	8.2
C20	South of HOMA BAY	336	488	576	7.7	1,195	1,410	7.7
C39	West of KAPSABET	480	500	655	0.8	812	1,064	4.1
C41	North of KAKAMEGA	2,774	3,193	5,364	2.9	6,402	10,755	6.0
C77	South of NYAHURURU	386	429	661	2.1	789	1,215	5.2

(3) Investigation of Current Road Facilities

Current road facilities were investigated by obtaining information from the Road Maintenance Schedule, July 1982, which was prepared by the Maintenance Branch of the MOTC. Here, roads are partitioned into several sections according to traffic volume class, and for each section the length, traffic volume and surface type are stated. The number of lanes of each road section is obtained from a 1/250,000 scale road map prepared by the MOTC Road Department. Alignment of each road (especially its vertical alignment) is read from this 1/250,000 geographical map. Information concerning the condition of road surfaces and their infrastructure, especially on the principal sections, is obtained by reviewing studies and reports prepared by consultants with aid from international organisations and/or foreign governments.

The study team also performed local surveys to collect this data. Based on the investigations stated above, a road inventory was prepared.

(4) Engineering Unit Cost

Engineering unit costs are estimated by reviewing existing surveys and design reports. The unit cost is evaluated for each category of engineering assuming an inflation rate of 10% p.a. when applicable.

(5) Project list

A project list is shown in Table 2-3-1, and corresponding sites for each project are indicated in Fig. 2-3-1.

One of the principal projects is the provision for a dual carriageway for A104 and A109 which form a part of the Trans-African Highway from Mombasa to Malaba through Nairobi. As seen in Fig. 2-3-2 (PCU on Trunk Road), a traffic flow exceeding the present capacity provided by the dual carriageway entering Nairobi City has already been observed. By the year 2000, sections from Machakos T'off (A109) to Kisumu (A1) through Mau Summit, from Mombasa to Mariakani and also from Nairobi to Santamor must have four lanes. One of the projects of great importance, therefore, is the construction of a dual carriageway on these road sections. These projects will be undertaken after the current projects pertaining to these sections planned by the MOTC are completed.

Construction of a Nairobi bypass seems another important project. Trips originating from the industrial area of Southeast Nairobi and fanning throughout the country along and A2 and A104 must pass through CBD of Nairobi once because of the network structure. This through traffic poses various problems for Nairobi urban traffic. A Nairobi bypass, an outer road ringing the city, may offer significant improvement in the urban traffic conditions by keeping through traffic off city roads. It would also provide a future frame for the Nairobi Metropolitan Area.

The configuration of the Nairobi bypass would be as follows: A road ringing the city with a total length of 50km as shown in Fig. 2-3-3. The bypass can be completed by extending the outer ring road which is now connected to

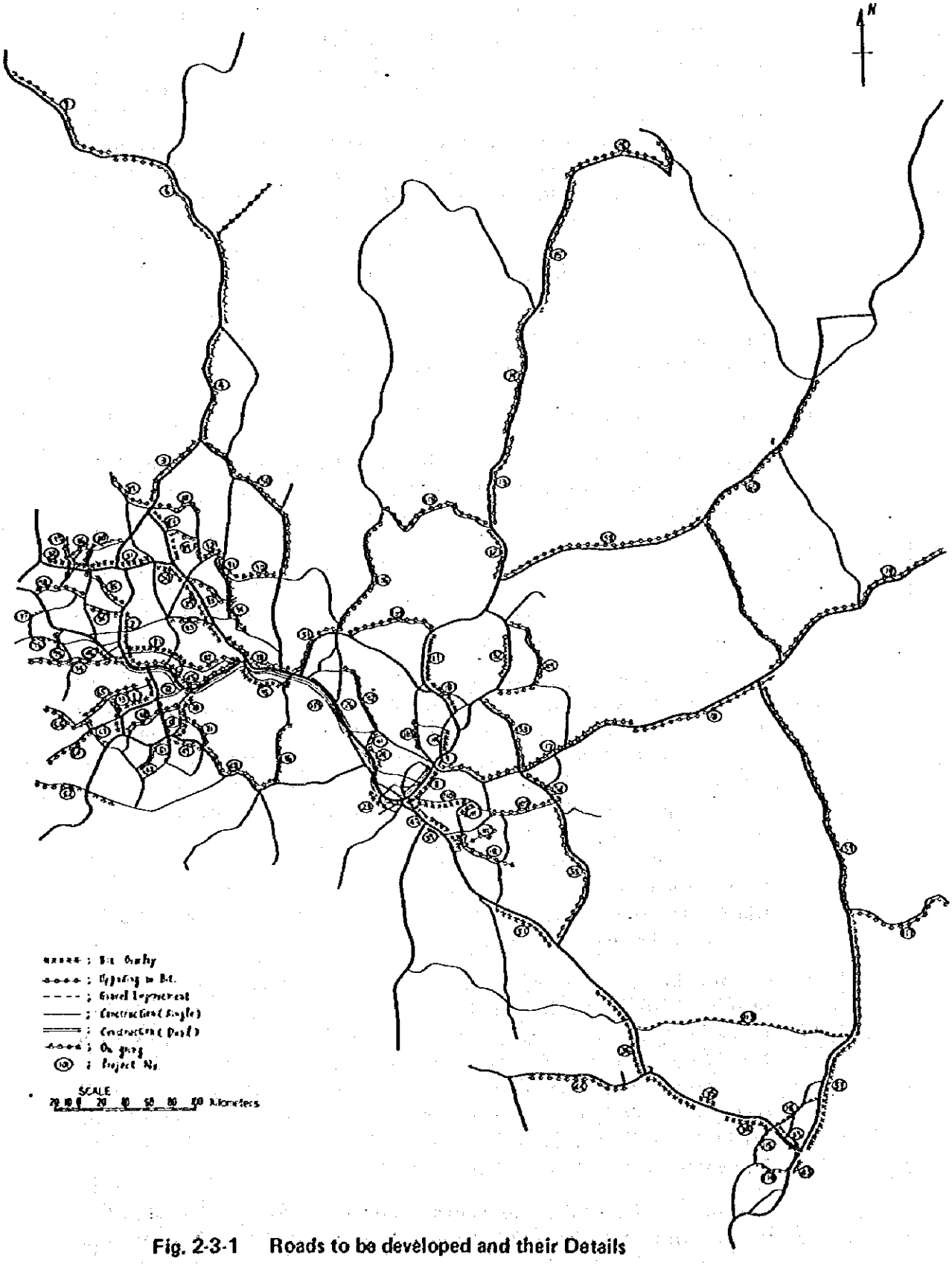


Fig. 2-3-1 Roads to be developed and their Details

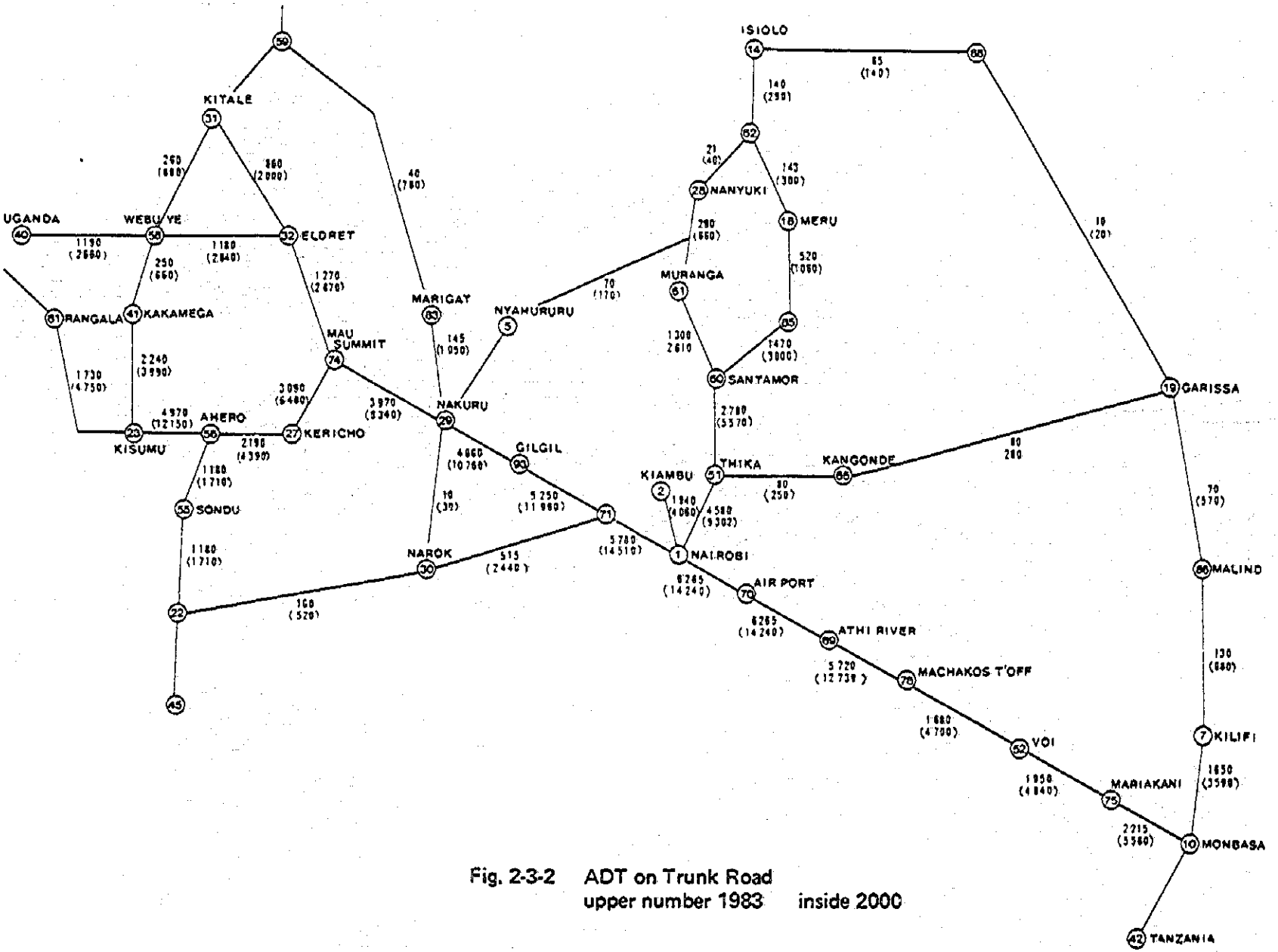


Fig. 2-3-2 ADT on Trunk Road
upper number 1983 inside 2000

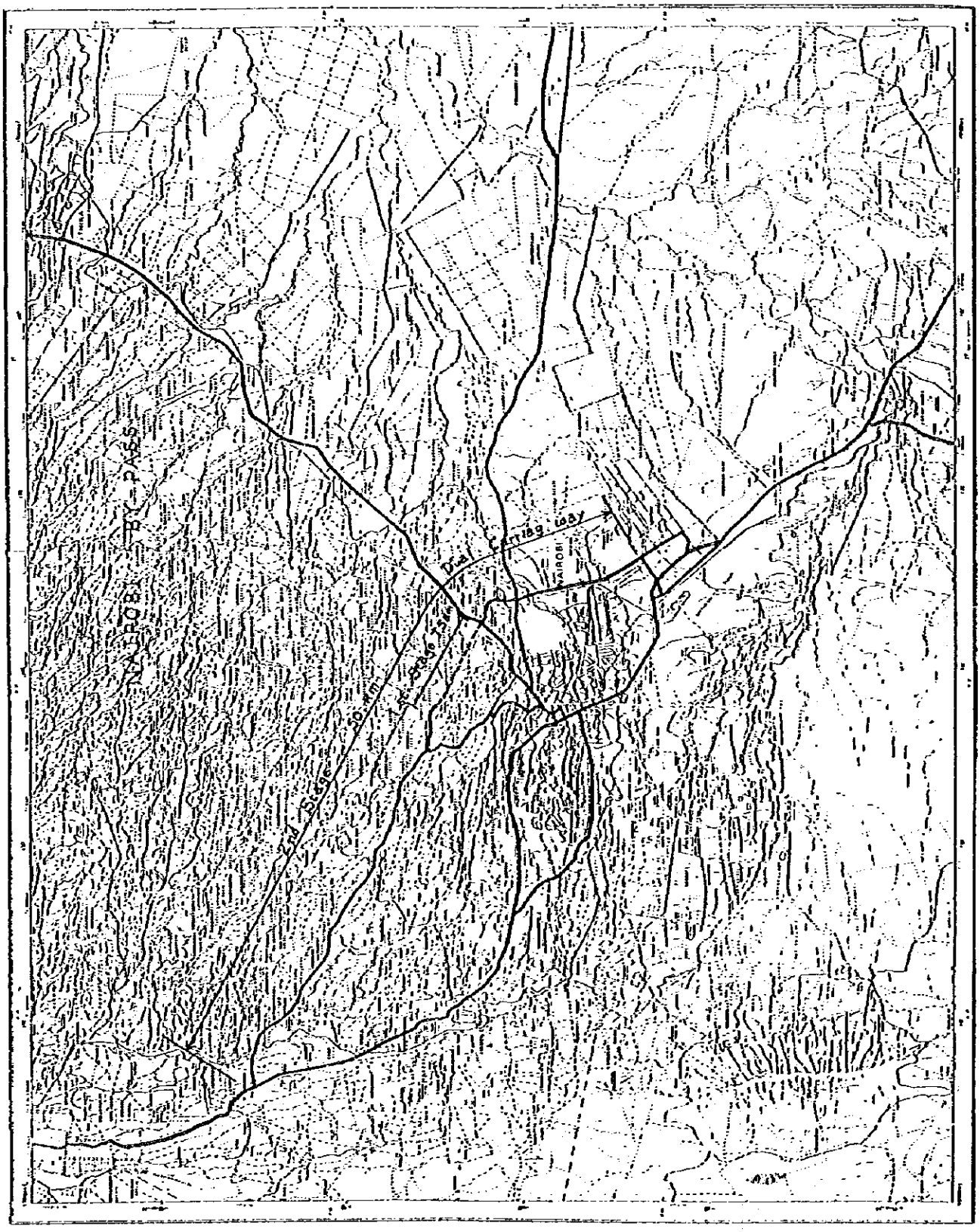


Fig. 2-3-3 Nairobi Bypass Configuraton

Thika Road (A2) and which stops at Ruaraka further westward to Muthaiga Road near the Kenya Technical Teachers College. For the first stage, a dual carriageway of 7.5km should be constructed between the present outer ring road and Muthaiga Road. In the second stage the 50km length is to be made into a dual carriageway. By providing Nairobi with a bypass, about 9,000 veh/day of through traffic can be excluded from the city (Fig. 2-3-4).

Construction of the Mombasa bypass is one of the projects with high priority. Mombasa bypass links International Trunk A109 and A14 by-passing Mombasa Island with the total length of 18km. It leaves A109 at Militini about 8km west of Mombasa Airport turn-off and passes through the west side of Kinango, a planned industrial area of Mombasa port and residential area in South Mainland, and links with A14 at Likoni.

The bypass also functions as an access road to the planned industrial area from International Trunk Roads A109 as well as a bypass road. In this sense the road is indispensable for the development of Mombasa port. Its construction must be promoted preceding the development of the South Mainland.

As the bypass has the aspect of an access road to the port development area, it may be reasonable to classify it as a national trunk road B. For this reason the Mombasa bypass appears in the project list as B11.

The project costs are summarised in Table 2-3-2. Total cost is K£815.2 million (at 1981 prices).

Table 2-3-2 Project Cost

K£ '000 at 1981 prices

Term \ Road Class	Trunk Rd (A)	Trunk Rd (B)	Primary (C)	Total
Total project cost	391,261	213,269	221,183	825,713

(6) Project Evaluation

Degrees of importance and urgency are evaluated for each project listed in Table 2-3-1.

1) Degree of Importance

The degree of importance of roads can be evaluated from the viewpoints of a) traffic demands and b) indispensability to the region. The latter can be well recognised for roads which constitute the only link to other outer regions. In such cases, we consider the degree of importance of the road to be high.

The following points are assigned in evaluating the degree of importance.

a) Traffic demand (maximum 4 points)

Point 4 $2{,}000 \leqq$ ADT

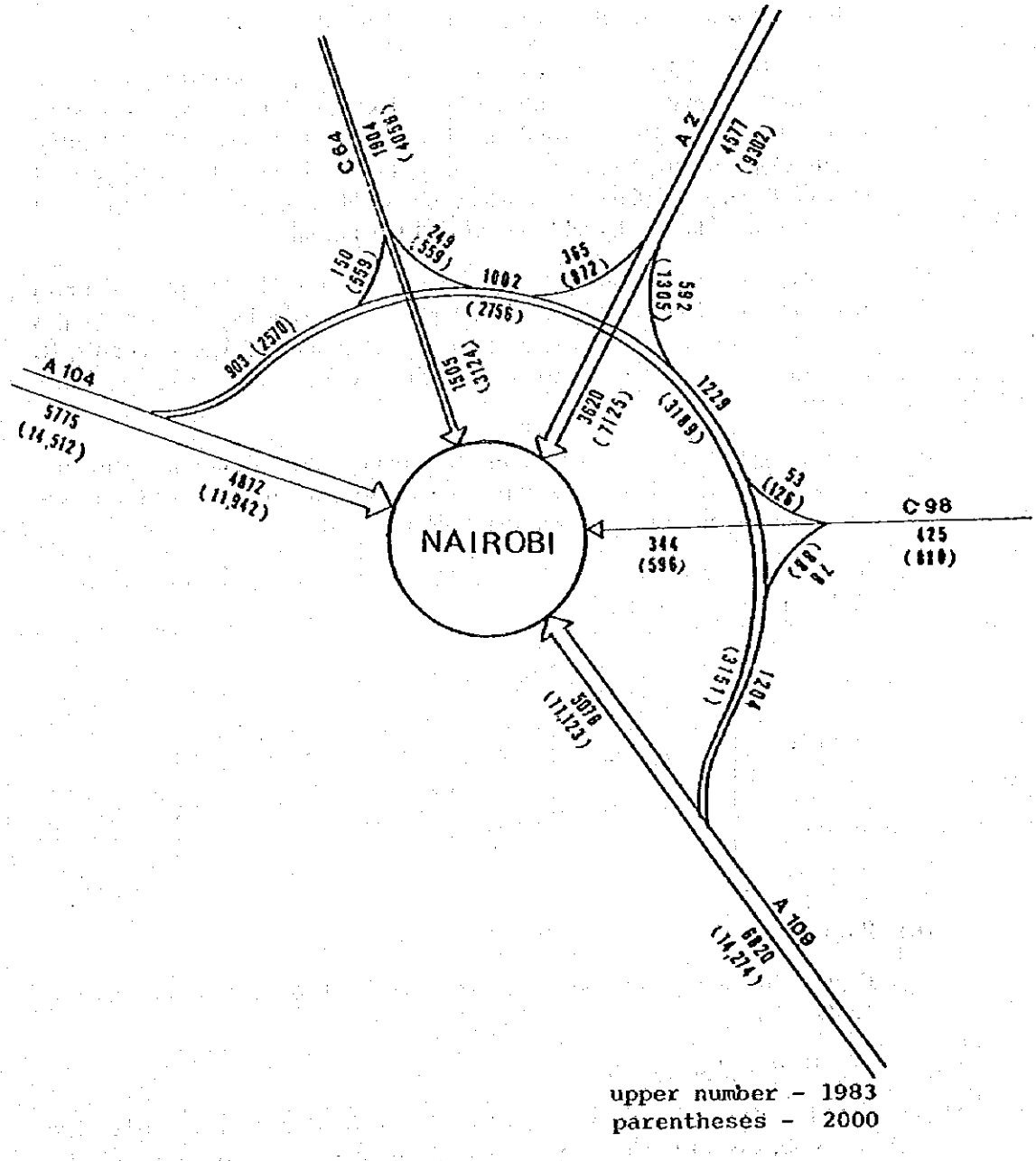


Fig. 2-3-4 Inflow, Outflow and Through Traffic Related to Nairobi

Point 3	1,000 ≦ ADT < 2,000
Point 2	500 ≦ ADT < 1,000
Point 1	ADT < 500

b) Indispensability to the region (maximum 1 point)

Point 1	If the road is indispensable to the region in establishing an adequate network
Point 0	otherwise

Then the importance rank is set in the following way:

Rank A:	Points equal to or more than 4
Rank B:	Points equal to 3
Rank C:	Points equal to or less than 2

2) Degree of Urgency

The degree of urgency is evaluated by c) balance between demand and capacity of the facility, d) the degree of damage of paved roads and e) the effect on running cost reduction. The last factor is introduced from the viewpoint that improvement in the vertical alignment easing the vertical slope may contribute to the reduction in fuel consumption and to economical driving. Such factors are especially applied to sections of the A109 and A104 roads which have a steep gradient and where the use of heavy vehicles is extensive.

Degree of urgency is evaluated from the following points of view.

c) Balance to demand (maximum 2 points)

Point 2:	degree of congestion is more than 1.5
Point 1:	degree of congestion is more than 1.0 but less than 1.5

d) Degree of pavement damage (maximum 2 points)

Point 2:	pavement is seriously damaged
Point 1:	pavement is slightly damaged

e) Effect on running cost reduction

Point 1:	if the vertical alignment is greater than 6 percent
Point 0:	otherwise

Then the urgency rank is set is the following way.

Rank A:	Points equal to or more than 4
Rank B:	Points euqla to 3
Rank C:	Points equal to or less than 2

3) Evaluation of Order of Priority

The order of priority is determined by adding the points for the degree of importance and urgency and assigning a weight to them. Employed weights are one and two for importance and urgency respectively. Weighting in this way, minor roads which do not merit relatively high

Rank

A: highest importance
B: critical
C: medium

Table 2-3-1 Road Project List

No.	Name of Project	Contents	Importance Rank	Urgency Rank	Cost (K£ '000 at 1981 price)			Development Plan		
					Domestic	Foreign	Total	1984-1988	1989-1993	1999-2000
1	A-1 (Ahero-Kisii)	L = 81 km Bit. Overlay+Widening	B	C	10,000	-	10,000		4,000	6,000
2	A-1 (Kisumu-Kakamega)	L = 48 km Bit. Overlay	A	C			4,825	1,400	3,425	
3	A-1 (Kapenguria-Marich Pass)	L = 65 km Upgrading to Bit	on going				3,500	3,500		
4	A-1 (Marich Pass-Lodwar Fergusons Gulf)	L = 260 km Upgrading to Bit	on going				1,500	1,500		
5	A-1 (Lodwar-Sudan Border)	Bridges + Culverts only	B	C			4,173	1,000	3,173	
6	A-1 (Lodwar-Kakuma)	L = 134 km Upgrading to Bit	B	C			16,235			16,235
7	A-1 (Kakuma-Sudan Border)	L = 216 km Upgrading to Bit	C	C			16,500			16,500
8	A-2 (Nairobi-Thika)	L = 2 x 39 km Overlay/Reconstruction with Dual Carriageway	A	B			8,250	5,000	3,250	
9	A-2 (Thika-Makutano)	L = 12 km 1st stage: Reconstruction on new alignment 2nd stage: Construction with Dual Carriageway	A	B			8,785 (4,145)	2,000	2,145	4,640

Rank

A: importance
B: critical
C: medium

No.	Name of Project	Contents	Importance Rank	Urgency Rank	Cost (K£ '000 at 1981 price)			Development Plan		
					Domestic	Foreign	Total	1984-1988	1988-1993	1999-2000
10	A-2 (Sagana-Marua)	L = 37 km Bit Overlay	A	C			2,565	1,000	1,565	
11	A-2 (Kiganjo-Nanyuki)	L = 58 km Bit Overlay	A	C			5,865	1,000	4,865	
12	A-2 (Isiolo-Wambajn)	L = 53 km Upgrading to Bit	C	C			5,426			5,426
13	A-2 (Wambajn-Meriller)	L = 89 km Upgrading to Bit	C	C			6,282			6,282
14	A-2 (Meriller-Marsabit)	L = 128 km Upgrading to Bit	C	C			10,885			10,885
15	A-2 (Marsabit-Turbi)	L = 121 km Upgrading to Bit	C	C			10,690			10,690
16	A-2 (Turbi-Moyale)	L = 125 km Upgrading to Bit	C	C			12,258			12,258
17	A-3 (Thika-Kangondi-Lagatula)	L = 180 km Upgrading to Bit	on going				3,900	3,900		
18	A-3 (Lagatula-Garissa)	L = 139 km Upgrading to Bit	B	C			12,750		2,000	10,750
19	A-3 (Garissa-Liboi)	L = 204 km Upgrading to Bit	C	C			18,750			18,750

Rank

A: importance
B: critical
C: medium

No.	Name of Project	Contents	Import-ance Rank	Urgen-cy Rank	Cost (K£ '000 at 1981 price)			Development Plan		
					Domestic	Foreign	Total	1984-1988	1989-1993	1999-2000
20	A-104 (Nairobi-By Pass)	1st stage: L = 7.5 km Construction 2nd stage: L = 50 km Construction with Dual Carriageway	A	A			19,650 (3,000)	3,000	16,650	
21	A-104 (Westland-St. Austins)	L = 3 km Construction to Dual carriageway	A	A			1,000	1,000		
22	A-104 (St. Austins-Kabete)	L = 2 x 5 km Bit Overlay	A	A			350	350		
23	A-104 (Kabete-Limuru)	L = 12 km Bit Overlay	A	A			3,312	3,312		
24	A-104 (Uplands-Longonot T'off)	L = 26 km 1st stage: Bit Overlay 2nd stage: Construction with Dual Carriageway	on going				7,220 (1,500)	1,500	1,720	4,000
25	A-104 (Naibasha-Township Road)	L = 6 km 1st stage: Upgrading to Bit 2nd stage: Construction with Dual Carriageway	B	C			1,890 (570)		570	1,320

Rank

A: importance
B: critical
C: medium

No.	Name of Project	Contents	Import-ance Rank	Urgen-cy Rank	Cost (K£ '000 at 1981 price)			Development Plan		
					Domestic	Foreign	Total	1984-1988	1989-1993	1999-2000
26	A-104 (Naibasha-Gilgil-Lanet)	L = 57 km 1st stage: Construction on new alignment 2nd stage: Construction with Dual Carriageway	A	C			22,290 (9,750)		9,750	12,540
27	A-104 (Nakuru-By Pass)	L = 20 km 1st stage: Construction on new alignment 2nd stage: Construction with Dual Carriageway	A	B			7,821 (3,421)	1,700	1,721	4,400
28	A-104 (Nakuru-Timboroa)	L = 81 km 1st stage: Bit Overlay 2nd stage: Construction with Dual Carriageway (Nakuru-Mau Sumarit 54 km)	on going				17,130 (5,250)	5,250		11,880
29	A-104 (Timboroa-Eldoret)	L = 60 km Bit Overlay	B	B			7,500	3,000	4,500	
30	A-104 (Eldoret-Turbo)	L = 35 km Bit Overlay	B	B			6,000	2,000	4,000	
31	A-104 (Turbo-Webuye)	L = 39 km Bit Overlay	B	B			6,680	2,400	4,280	
32	A-104 (Webuye-Malaba)	L = 61 km Bit Overlay	B	B			6,090	2,000	4,090	

Rank

A: importance
B: critical
C: medium

No.	Name of Project	Contents	Importance Rank	Urgency Rank	Cost (K£ . :000 at 1981 price)			Development Plan		
					Domestic	Foreign	Total	1984-1988	1989-1993	1999-2000
33	A-109 (Mombasa-Mariakani)	L = 42 km 1st stage: Construction on new alignment 2nd stage: Construction with Dual Carriageway	A	B			23,220 (13,980)	6,980	7,000	9,240
34	A-109 (Mariakani-Taru)	L = 45 km Bit Overlay	B	A			4,495	2,000	2,495	
35	A-109 (Mackinnon Road-Buchumaq)	L = 16 km Bit Overlay	B	A			1,744	1,744		
36	A-109 (Buchumaq-Mtito Andei)	L = 142 km Bit Overlay	B	B			15,500	5,000	10,500	
37	A-109 (Emali-Kibwezi)	L = 71 km Bit Overlay	A	B			10,510	3,500	7,010	
38	A-109 (Uw-Machakos T'off)	L = 28 km Bit Overlay	B	A			3,055	3,055		
39	A-109 (Machakos T'off-Athi River)	L = 17 km 1st stage: Bit Overlay 2nd stage: Construction with Dual Carriageway	B	A			10,795 (5,661)	5,661	5,134	
40	A-109 (Athi River-Air Port T'off)	L = 15 km Construction with Dual Carriageway	B	A			5,000	5,000		

Rank

A: importance
B: critical
C: medium

No.	Name of Project	Contents	Import-ance Rank	Urgen-cy Rank	Cost (K£ . '000 at 1981 price)			Development Plan		
					Domestic	Foreign	Total	1984-1988	1989-1993	1999-2000
41	A-14 (Likoni Ferry Terminal)	Widening ferry ramp approaches	B	A			735	735		
42	A-14 (Mombasa-Likoni)		under investigation				40,000			40,000
43	A-14 (Likoni-Waa)	L = 15 km Bit Overlay	A	B			1,635	1,635		
44	A-23 (Mwate-Taveta)	L = 90 km Upgrading to Bit	C	C			4,500			4,500
	Sub-Total	A					391,261	81,122	103,843	206,296

Rank

A: importance
B: critical
C: medium

No.	Name of Project	Contents	Import-ance Rank	Urgen-cy Rank	Cost (K£ '000 at 1981 price)			Development Plan		
					Domestic	Foreign	Total	1984-1988	1989-1993	1999-2000
45	B-1/A-1 (Mau Summit-Kericho-Kisumu)	L = 136 km 1st stage: Bit Overlay 2nd stage: Construction with Dual Carriageway	on going				33,920 (4,000)	4,000	5,820	24,100
46	B-1 (Kisumu-Yala)	L = 42 km Bit Overlay	B	B			5,570	5,570		
47	B-2 (Lesemu Sin-Kitale)	L = 56 km Bit Overlay	B	C			7,431	3,700	3,731	
48	B-3 (Narok-Amala-Bonet)	L = 100 km Upgrading to Bit	B	B			5,000	2,500	2,500	
49	B-3 (Bonet-Sotik)	L = 40 km Upgrading to Bit	B	B			6,200	3,100	3,100	
50	B-4 (Akeriamet-Baringo)	L = 160 km Upgrading to Bit	C	C			23,760		5,000	18,760
51	B-5 (Nakuru-Nyahururu)	L = 44 km Upgrading to Bit	B	C			6,298	1,000	5,298	
52	B-6 (Thuchi-Nkubu)	L = 55 km Upgrading to Bit)	on going				1,600	1,600		
53	B-7 (Embu-Kangondi)	L = 80 km Upgrading to Bit	B	B			4,000	2,000	2,000	
54	B-7 (Kangondi-Kitui)	L = 45 km Upgrading to Bit	B	B			2,250	1,000	1,250	

Rank

A: highest
B: high
C: higher

No.	Name of Project	Contents	Import-ance Rank	Urgen-cy Rank	Cost (K£ '000 at 1981 price)			Development Plan		
					Domestic	Foreign	Total	1984-1988	1989-1993	1999-2000
55	B-7 (Kitui-Kibwezi)	L = 150 km Upgrading to Bit	C	B			19,500		2,500	17,000
56	B-8 (Kelifi-Bridge)		under investigation				25,000	2,250	22,750	
57	B-8 (Mombasa-Malindi)	L = 50 km Bit Overlay of Some Section	A	C			4,000	2,000	2,000	
58	B-9 (Mado Gashi-Isiolo)	L = 190 km Opgrading to Bit	B	C			17,420	1,000	1,000	15,420
59	B-8/C-112 (Malindi-Garsen-Garissa-Lamu)	L = 434 km Upgrading to Bit	B	B			28,800	2,000	5,000	21,800
60	B-8/D569/C81 (Garissa-Modogashi-Wajir)	L = 247 km Gravel Improvement	C	B			12,000	2,000	2,000	8,000
61	B-11 (Mombasa-By Pass)	L=18 km Dual Carriage Construction with	A	A			10,520	10,520		
	Sub-Total	B					213,269	44,240	63,949	105,080

Rank

A: importance
B: critical
C: medium

No.	Name of Project	Contents	Import-ance Rank	Urgen-cy Rank	Cost (K£ '000 : at 1981 price)			Development Plan		
					Domestic	Foreign	Total	1984-1988	1989-1993	1999-2000
62	C-15 (Sotik-Gorgor)	L = 27 km Gravel Improvement	C	B			1,250			1,250
63	C-13 (Kihancha-Muhoro Bay)	L = 44 km Upgrading to Bit	C	C			2,200			2,200
64	C-16 (Keroka-Nyangusu)	L = 28 km Upgrading to Bit	C	C			1,400			1,400
65	C-18 (Rody Kopany-Karungu)	L = 48 km Upgrading to Bit	C	B			2,400		2,400	
66	C-19 (Agoro-Kendu Bay-Homa Bay)	L = 71 km Upgrading to Bit	B	B			9,515		9,515	
67	C-19 (Homa Bay-Mbita)	L = 33 km Upgrading to Bit	C	C			3,810			3,810
68	C-20 (Homa Bay-Rongo)	L = 33 km Upgrading to Bit	B	C			3,570			3,570
69	C-21 (Kisii-Chemosit)	L = 70 km Upgrading to Bit	C	C			7,210			7,210
70	C-22 (Jebilat-Atela)	L = 38 km Upgrading to Bit	C	C			1,890			1,890
71	C-23 (Sotik-Kericho)	L = 50 km Bit Overlay	B	C			5,900		5,900	
72	C-24 (Nr Bonet-Litein)	L = 42 km Upgrading to Bit	C	C			3,180			3,180

Rank

A: importance
B: critical
C: medium

No.	Name of Project	Contents	Import-ance Rank	Urgen-cy Rank	Cost (K£ '000 at 1981 price)			Development Plan		
					Domestic	Foreign	Total	1984-1988	1989-1993	1999-2000
73	C-25 (Sondu-Kapsoit)	L = 35 km Gravel Improvement	C	C			2,000			2,000
74	C-26 (Oyugis-Kendu Bay)	L = 22 km Upgrading to Bit	C	C			1,100			1,100
75	C-26 (Kisian-Bondo-Usenge)	L = 75 km Upgrading to Bit	C	C			3,200			3,200
76	C-28 (Rangala-Miruka)	L = 15 km Upgrading to Bit	C	C			750			750
77	C-29 (Siaya-Luambwa)	L = 25 km Gravel Improvement	C	C			1,200			1,200
78	C-30 (Luambwa-Bumala)	L = 35 km Gravel Improvement	C	C			1,585			1,585
79	C-31 (Mumias-Busia)	L = 39 km Upgrading to Bit	C	C			4,245			4,245
80	C-32 (Myanga-Lwakhakha)	L = 35 km Upgrading to Bit	C	C			1,730			1,730
81	C-33/C-42 (Bungoma-Chwele-Kamakoiwa)	L = 50 km Upgrading to Bit	C	C			2,500			2,500
82	C-34 (Kisumu-Muhoponi)	L = 56 km Bit Overlay	B	B			7,000	7,000		
83	C-35 (Londiani-Ft. Ternan)	L = 53 km Upgrading to Bit	C	C			5,500			5,500

Rank

A: importance
B: critical
C: medium

No.	Name of Project	Contents	Import-ance Rank	Urgen-cy Rank	Cost (K£ '000 at 1981 price)			Development Plan		
					Domestic	Foreign	Total	1984-1988	1989-1993	1999-2000
84	C-36 (Kapsabet-Nabkoi)	L = 44 km Upgrading to Bit	B	C			6,850			6,850
85	C-40 (Kakamega-Mumias)	L = 37 km Upgrading to Bit	C	B			4,248			4,248
86	C-41 (Kakamega-Musikoma)	L = 44 km Upgrading to Bit	C	C			2,200			2,200
87	C-42 (Kamakoiwa-Malikisi)	L = 42 km Upgrading to Bit	C	C			2,120			2,120
88	C-45 (Kitale-Suam)	L = 26 km Upgrading to Bit	C	C			1,970			1,970
89	C-48 (Kitale-E350)	L = 27 km Upgrading to Bit	C	C			1,370			1,370
90	C-50 (Moi's Bridge-Sergoit)	L = 52 km Upgrading to Bit	C	C			2,500			2,500
91	C-51 (Marigato-Kabarnet)	L = 39 km Upgrading to Bit	on going				3,190	3,190		
92	C-51 (Kabarnet-Tambach)	L = 40 km Upgrading to Bit	C	B			5,700			5,700
93	C-51 (Tambach-Sergoit)	L = 32 km Upgrading to Bit	on going				2,312	2,312		
94	C-54 (Hepkorio-Kimwarer)	L = 20 km Upgrading to Bit	C	C			1,000			1,000

Rank

A: importance
B: critical
C: medium

No.	Name of Project	Contents	Import-ance Rank	Urgen-cy Rank	Cost (K£ . '000 at 1981 price)			Development Plan		
					Domestic	Foreign	Total	1984-1988	1989-1993	1999-2000
95	C-53/C-55 (Eldama Ravine-Nyeru-Iten)	L = 118 km Upgrading to Bit	on going				5,000	5,000		
96	C-56 (Nakuru-Njoro-Mausummit)	L = 55 km Bit Overlay	B	C			7,000			7,000
97	C-57 (Narok-Mau Narok)	L = 61 km Upgrading to Bit	B	B			3,000	3,000		
98	C-62 (Mutaiga R/A-Unephq)	L = 5 km Bit Overlay + Widening	on going				26	26		
99	C-64 (Kiambu-Ngewa-Uplands)	L = 14 km Upgrading to Bit	on going				1,000	1,000		
100	C-65 (Ruiru-Nyanduma-Kagwa)	L = 46 km Upgrading to Bit	on going				3,525	3,525		
101	C-67 (Makomboki-Karati Ri)	L = 29 km Upgrading to Bit	C	C			1,450			1,450
102	C-68 (Magumu-Kithioro)	L = 17 km Upgrading to Bit	C	C			850			850
103	C-69 (Longonot T'off-Olkalau)	L = 105 km Upgrading to Bit	B	B			5,250		5,250	
104	C-70 (Gacharage-Kangema)	L = 28 km Upgrading to Bit	C	B			6,600			6,600

Rank

A: importance
B: critical
C: medium

No.	Name of Project	Contents	Import-ance Rank	Urgen-cy Rank	Cost (K£ '000 at 1981 price)			Development Plan		
					Domestic	Foreign	Total	1984-1988	1989-1993	1999-2000
105	C-71 (Makutano-Muranga)	L = 29 km Bit Overlay Reconstruction	C	B			2,670			2,670
106	C-76 (Nanyuki-Karagoini)	L = 72 km Upgrading to Bit	C	C			3,600			3,600
107	C-77 (Nyahururu-Maxmar)	L = 102 km Upgrading to Bit	C	C			7,670			7,670
108	C-97 (Makutano-Kitui)	L = 66 km Upgrading to Bit	C	B			5,250			5,250
109	C-97 (Junet. A109-Machakos)	L = 19 km Bit Overlay	B	B			1,750	1,750		
110	C-92 (Meru-Ena)	L = 78 km Upgrading to Bit	C	C			3,900			3,900
111	C-98 (Kangundo-Dundra)	L = 57 km Bit Overlay	C	C			5,250			5,250
112	C-99/E-480, D516/D517 (Kangundo-Mitaboni-Machakos-Tawa)	L = 64 km Part Upgrading to Bit/Part Bit Overlay	C	B			7,420			7,420
113	C-99/D514 (Machakos-Makueni)	L = 64 km Upgrading to Bit	C	B			9,811			9,811
114	C-103 (Malindi-R. Post (Tsavo))	L = 78 km Gravel Improvement	C	B			3,745			3,745

Rank

A: importance
B: critical
C: medium

No.	Name of Project	Contents	Import-ance Rank	Urgen-cy Rank	Cost (K£ '000 at 1981 price)			Development Plan		
					Domestic	Foreign	Total	1984-1988	1989-1993	1999-2000
115	C-106 (Waa-Kwale-Kinango)	L = 40 km Gravel Improvement	C	B			1,650			1,650
116	C-107 (Kinango-Mariakani)	L = 42 km Gravel Improvement	C	B			2,016			2,016
117	C-107 (Mariakani-Kaloleni-Kilifi)	L = 50 km Upgrading to Bit	B	B			5,115		5,115	
118	C-112 (Garsen Causeway)	L = 17 km Causeway	C	B			7,600	7,600		
119	C-78/C-79 (Maralal Mailakikoon)	L = 131.4 km Up to Bitumen					13,440			13,440
	Sub-Total	C					221,183	34,403	28,180	158,600
	Grand-Total						825,713	159,765	193,972	469,976

points in terms of importance can be adequately evaluated.

4) Development Plan

All the projects listed are assumed to be completed during the 17 years to the year 2000. It is assumed that the development budget will grow at an average growth rate of 5% p.a. and also that the cost assigned each year is proportional to the annual budget. The portion of cost in each planning period (i.e., short, medium and long term plan period) is then computed by totalling the costs for each year over the plan period. Considering the amount of cost in each period as a restriction, projects in each period are assigned according to the order of priority evaluated in 3). The valuated results are summarized in Table 2-3-1. Figures in ( ) show the cost incurred in the first construction stage if the project is undertaken in two stages.

2.3.2 Road Transport Project

(1) Fleet of Freight Transport Vehicles

In part II, the problem of a fleet shortage was pointed out as an important issue in road transport. The lack of a proper truck fleet may result in an especially unfavorable aspect in terms of overload, and lack of transport capacity to meet demand. The growth of demand for truck transport can be seen through an index: the growth of freight vehicle km, the majority of which comes from performance of medium and heavy goods. The average growth rate of freight vehicle km during the five years from 1983 to 1988 has been estimated as 5.6%, and that from 1988 to 2000 as 5.5%, when there is no capacity restriction on rail transport (scenario A) and 6.5% when such restriction is taken into account (scenario B). On the other hand, the average growth rate of the number of trucks and lorries during the past 5 years is 2% (actually there has been a decline in number during the last few years). If this situation continues, it is obvious that Kenya will experience a serious shortage in its truck fleet. The number of trucks/lorries in 1983 is estimated at 24,000, and the daily transport distance per vehicle at 72.75km. Table 2-3-3 shows a breakdown in the computation of future fleet size employing the above unit transport distance. Based on the present growth rate of 2%, the future fleet will be 26,500 vehicles and 33,600 vehicles in the years 1988 and 2000, respectively, while by 1988 the demand will call for 31,500 vehicles and by 2,000, 59,800 vehicles and 66,900 vehicles for scenarios A and B, respectively. The shortage projected for 1988 is, therefore, 5,000 vehicles (1,060 vehicles per year from 1983 to 1988) and for 2,000, 26,200 and 33,300 vehicles (2,180 and 2,780 vehicles per year from 1987 to 2000) for scenarios A and B, respectively.

Maintaining an appropriate freight transport fleet is an important issue for the Kenyan economy, especially for the promotion of export and improvement of the foreign trade balance. Some policy must be set up immediately.

Necessary conditions would include a relaxation of restrictions in the import of medium and heavy goods vehicles and parts, and also financial aid for the purchase of vehicles by private haulers. Concerning the latter, it may be

possible to establish a loan system through such government organizations as I.C.D.C. Funding for this could be provided through foreign aid. It may be also possible that the government could supply the vehicles through some kind of lease system. The government might establish a lease company as a parastatal, or perhaps Kenatco could undertake this business. The company might purchase the vehicles from a foreign country or request a grant from an appropriate foreign organisation.

(2) OD Traffic Survey and Goods Movement Survey

To provide an important data source for establishment of a national development plan by the government, a transport survey is important. OD traffic surveys and surveys on goods movement are particularly essential in such planning. Since an economic development plan in Kenya is prepared every f five years, it may be appropriate to take such surveys every five years to assist in the preparation of this plan.

(3) Project List

Provision for an appropriate fleet of freight vehicles and the necessity for an OD traffic survey and goods movement survey have been pointed out. Concerning the former it is supposed that 10% of the required fleet during the next five year plan (1984–1988) will be supplied through a government organisation such as I.C.D.C., Kenatco or others. This 10% is a reasonable amount to request as foreign aid. The remainder and post-1988 fleet requirements must be provided through a relaxation of import restrictions and promotion by the introduction of private investment. In the first year, a survey to investigate demand, feasibility of the business, an appropriate organisation, etc. will be required; cost for this must be included in the project cost. A project list is shown in Table 2-3-4.

Table 2-3-3 Computation of Future Freight Fleet Required

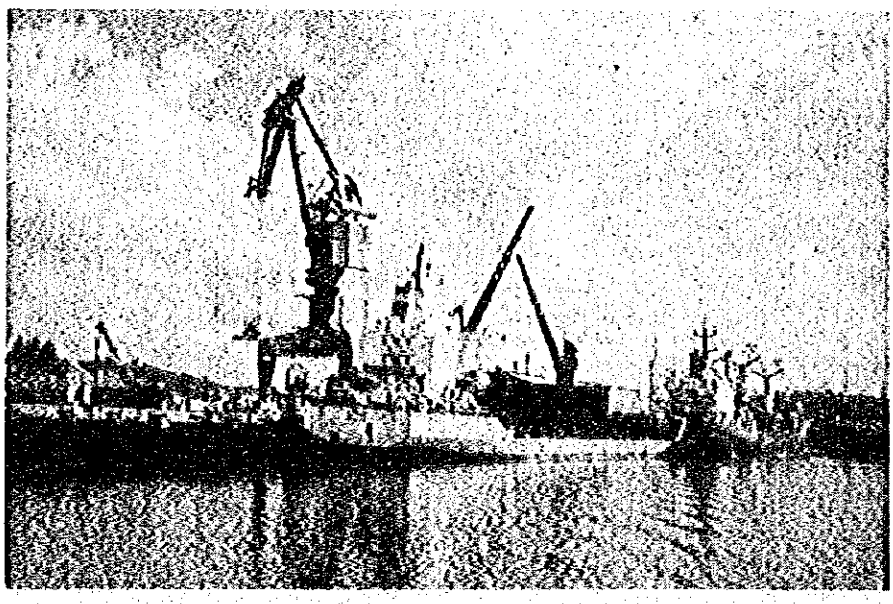
Items \ Year	1983	1988		2000			
				Without capacity constraint for Rail Transport		With capacity constraint for Rail Transport	
		Number	Average Growth Rate p.a.	Number	Average Growth Rate p.a.	Number	Average Growth Rate p.a.
1 Total Vehicle km per day	1,746,087	2,292,625	5.6	4,351,808	5.5	4,868,973	6.5
2 Future Fleet Based on Current Growth Rate	24,000	26,500	2.0	33,600	2.0	33,600	2.0
3 Fleet Required (computed from 7275km/veh)	24,000	31,500	-	59,800	-	66,900	-
4 Estimated Shortage (3 - 2)	-	5,000	-	26,200	-	33,300	-
5 Estimated Average Fleet Shortage p.a.	-	1,000	-	2,180	-	2,780	-

Table 2-3-4 Road Transport Project List

K₩000 at 1983 price

Project Name	Content	Cost			Importance Rank	Urgency Rank
		Domestic	Foreign	Total		
Acquisition of fleet for freight transport	Providing the required trucks and lorries during the 5th 5 year plan	30	26,970	27,000	A	A
OD Traffic Survey and Goods Movement Survey	Survey to assist establishment of a new 5 year Plan every 5 years	125	125	250	A	N.A.

PART IV. PORTS



1. Present Condition

1.1 Port Situations

1.1.1 Natural Conditions

The length of the coastline in Kenya is about 400 km. There are reefs along the coast and near the seaports, except for Malindi port, which is located at a calm inlet.

The tidal range is 12 feet, and the maximum tidal current velocity at Mombasa port is 1.5 kt in front of Mbaraki wharf near the port entrance and 1.0 kt at other locations.

The subsoil in Mombasa port is mainly sand and mud-stone.

1.1.2 Port Facilities

1) Mombasa Port

Main facilities are:

General cargo wharf	(−10m):	2,339m
Container wharf	(−11m):	580m
Cement wharf	(−11m):	315m

The entrance channel at Mombasa port has been dredged to a width of 350 m and a depth of 13.72m. The S-shaped alignment of this channel restricts the maximum size of entering vessels to 250 m in overall length, that is, to a 50,000–60,000 KWT tanker. Only one-way sailing is allowed in the entrance channel.

2) Kilifi, Malindi and Lamu Ports

Kilifi port is located about 50 km north of Mombasa port. Its facilities are two jetties for small craft which are located on the southern side of the entrance to a creek. The basin around the jetties is very calm.

Malindi port is located about 55 km north of Kilifi port. It has only one jetty on a sand beach which is very rare along the Kenyan coast. The jetty is being extended into deep water since the depth at the jetty has become shallow due to littoral drift.

Lamu port is located on the east coast of Lamu Island about 140 km north of Malindi port in a calm basin separated from the Indian Ocean. It has a single jetty with reinforced concrete slabs on steel piles which is used as a public cargo wharf. The maximum water depth of the jetty is about 2.5 m at L.W.L. Ships must be moved to the offing at low tide or they might run aground.

1.1.3 Present Development Plan for Mombasa Port

A container terminal development project is underway at Mombasa port to cope with the increased container cargo. Construction of an inland container depot is in progress at Nairobi city to correspond with this Mombasa project. The container terminal is composed of a 550 m long and 11 m deep wharf

and a 2,460 slot container yard equipped with 9 transfer cranes. It is connected with the inland container depot by railway. A19 ha inland container depot having 792 slots has already been constructed as the first phase of the plan. This depot is equipped with 2 transfer cranes on a 620 m long crane rail. Each crane has a capacity of 35 to 40 tonnes.

1.2 Port Activities

1.2.1 Cargo Handling Volume

(1) Mombasa Port

The volumes of crude oil, dry bulk, and general cargo for both imports and exports handled from 1969 to 1981 are illustrated in Figures 1-2-1 and 1-2-2. Export volume decreased whereas import volume increased.

The total cargo handling volume was about 8.2 million tonnes in 1981. General cargo was about 1.9 million tonnes, dry bulk about 1.5 million tonnes, and crude oil was about 4.8 million tonnes.

Figure 1-2-3 shows the number of containers handled. Table 1-2-1 and Figure 1-2-4 show the ratio of containerised cargo to containerisable cargo. The volume of containerisable cargo is assumed to be 75% of the general cargo.

Containerisation of export cargo is increasing rapidly and the ratio for exports is more than double the corresponding import figure; the 1983 ratio was estimated as 50%.

Modal split of inland cargo transportation can be calculated as shown in Table 1-2-2 using the Monthly Review of Port Work, KPA. Road transport accounted for 75%.

The modal split for containers is calculated from the monthly report of the Kenya Railways. The share of railway transport in house to house containers (about 75% of all containers) was 5% in 1981 and 7.5% in 1982.

The ratio of cargo to/from landlocked countries to the total general cargo handled at Mombasa is calculated in Table 1-2-3. About 20% of the general cargo was to/from landlocked countries.

(2) Lamu, Malindi and Kilifi Ports

The cargo handling volume at each port from 1978 to 1981 is shown in Figure 1-2-5. Volume at Lamu, the second largest port in Kenya, was only 5,000–10,000 tonnes per annum.

The major cargoes at Lamu port are subsistence commodities, such as food, drinks, fuel, and cement for roughly 25,000 citizens who reside around Lamu. Export cargo was about 800 tonnes of mangrove poles, shipped to the Gulf countries.

1.2.2 Cargo Handling

An annual average of 960 dry cargo ships called between 1979 and 1981. One fourth of these waited an average of 3 days for a berth. Net waiting days

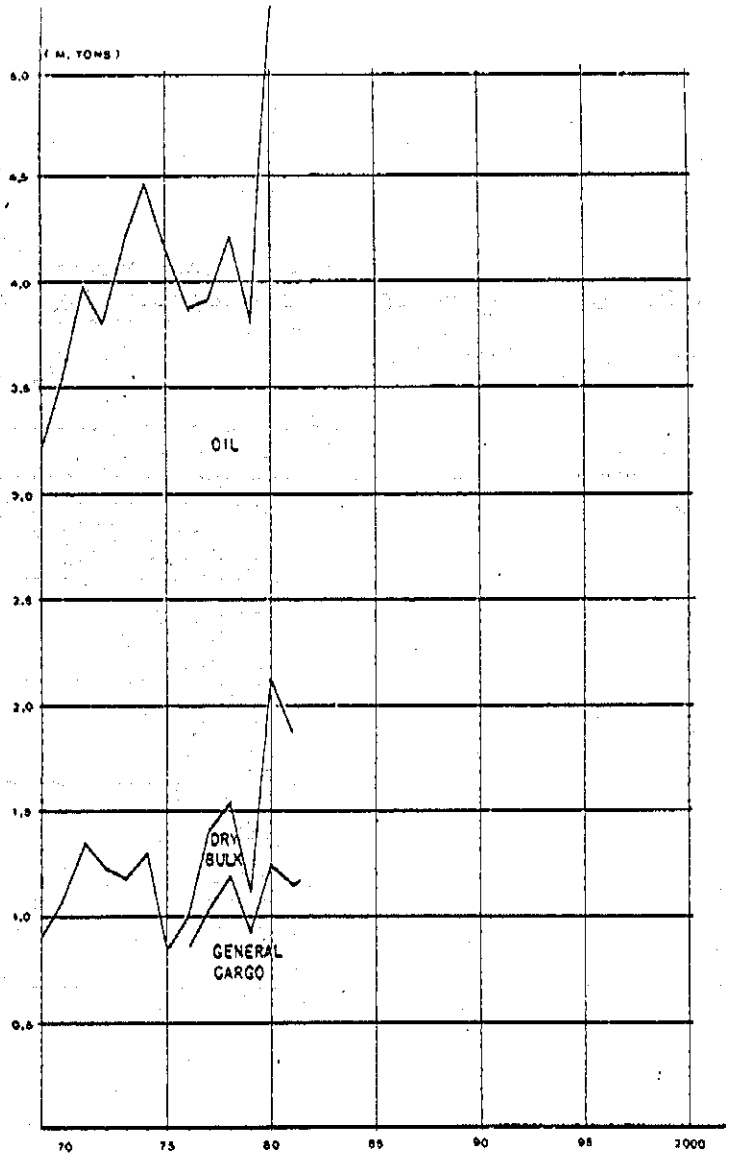


Fig. 1-2-1 Import Cargo Volume at Mombasa Port

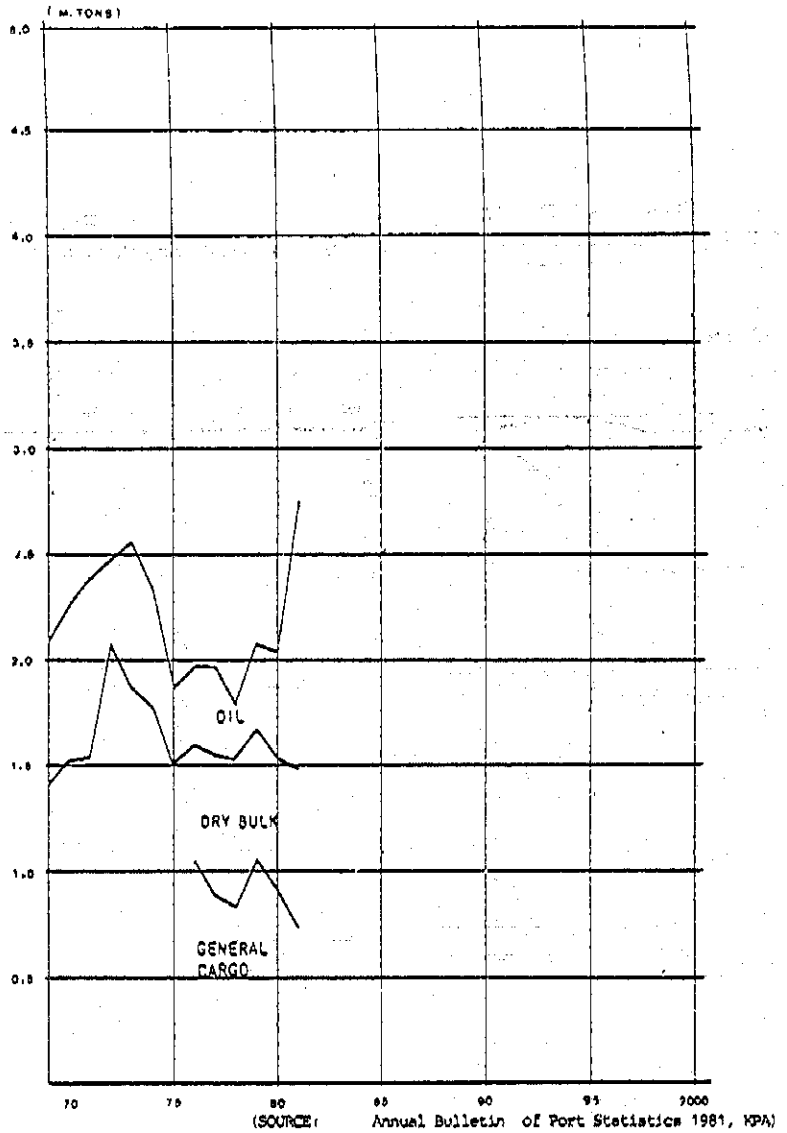
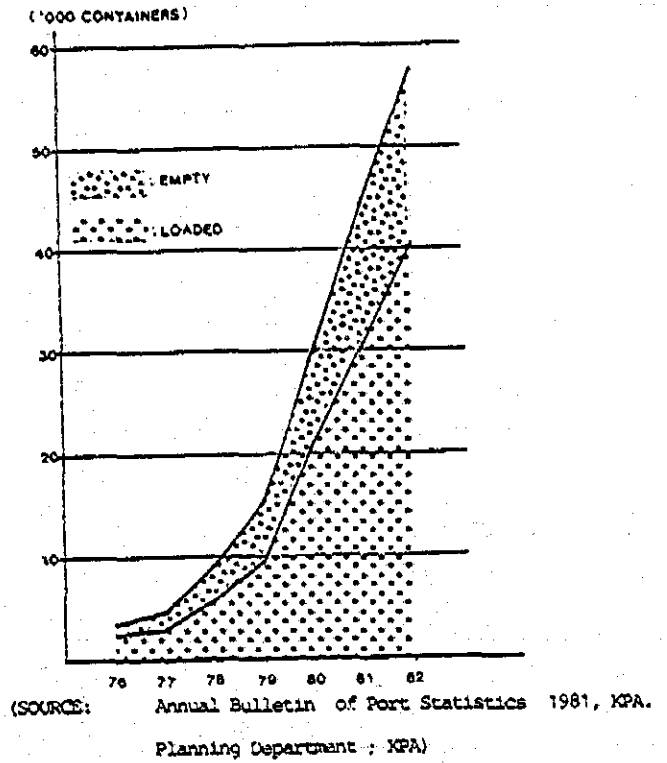


Fig. 1-2-2 Export Cargo Volume at Mombasa Port



(SOURCE: Annual Bulletin of Port Statistics 1981, KPA.
Planning Department : KPA)

Fig. 1-2-3 Number of Containers Handled at Mombasa Port

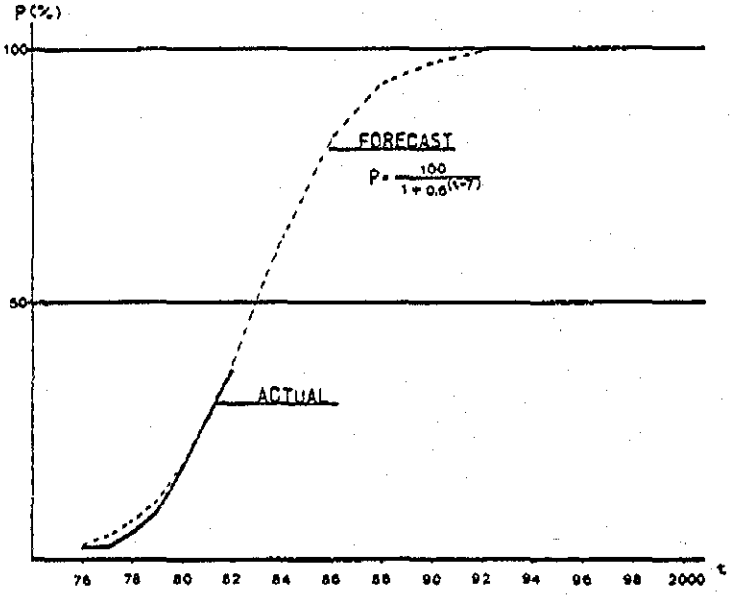
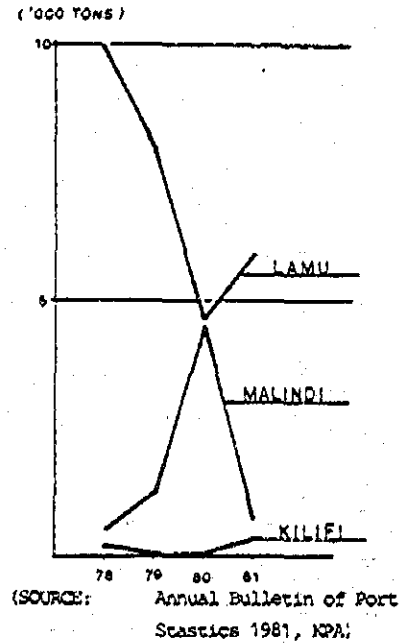


Fig. 1-2-4 Ratio of Containerised Cargo to Containerisable Cargo



(SOURCE: Annual Bulletin of Port Statics 1981, KPA)

Fig. 1-2-5 Cargo Handling Volume at Kilifi, Malindi and Lamu

Table 1-2-1 Ratio of Containerised Cargo to Containerisable Cargo

(%)

	1976	1977	1978	1979	1980	1981	1982
Import	1.7	2.1	3.5	6.1	12.1	16.3	21.7
Export	2.7	2.9	6.3	9.3	23.2	43.2	58.0
Average	2.3	2.5	4.8	8.3	17.1	27.6	36.4

(SOURCE: KPA)

Table 1-2-2 Share of Cargo Volume by Transportation Mode

(%)

	Import	Export	Total
Road	72	83	75
Railway	28	17	25

(SOURCE: Monthly Review of Port Working KPA)

Table 1-2-3 Share of Transit Traffic for Landlocked Countries in Mombasa General Cargo

(%)

	1977	1978	1979	1980	1981
Share of Transit Traffic	24	18	20	17	19

(SOURCE: Annual Bulletin of Port Statistics 1981, KPA)

Table 1-2-4 Berth Occupancy Rate

Berth	General Cargo	Dry Bulk	Container	Shimanzi Oil Jetty	Kipevu Oil Jetty
Berth Occupancy Rate	75	35	45	45	40

(SOURCE: KCHS)

Table 1-2-5 Handling Productivity, Ship Working Day and Number of Gang per Shift

Berth	General Cargo	Dry Bulk	Container
Tonnes/Gang Shift	68	304	316
Tonnes/Ship Working Day	498	1539	1170
Ship Working Day	5.1	9.4	3.0
Number of Gangs/shift	2.5	1.7	1.3

(SOURCE: KCHS)

averaged 0.7 days.

From cargo handling records kept by the KCHS in 1981 and 1982 the berth occupancy rate by ship type was analysed, as shown in Table 1-2-4. General cargo berths were heavily used.

Table 1-2-5 shows the results calculated from the KCHS records for such items as handling productivity by gang-shift/ship-working-day and the number of gangs for one shift by commodity.

The handling productivity for general cargo shows a very low value of 10 tonnes/hour. This is attributed to the piecework system applied at this port. Port workers consider their work finished when the cargo volume handled reaches a certain level even though this may be before their working hours have ended.

The number of containers handled shows a very low value of 5 to 6 per hour; this is due to the lack of forklifts in the container yard. Container handling productivity is likely to increase when the transfer cranes which have now been placed in the yard become operable.

1.3 Port Management

1.3.1 KPA (Kenya Port Authority)

All Kenyan ports facing the Indian Ocean are administered by the KPA under the control of the Ministry of Transport and Communication. In addition to port construction and facility maintenance, the KPA itself provides some types of port services. As of the end of 1981, the number of employees was 3,986.

1.3.2 KCHS (Kenya Cargo Handling Service, Ltd.)

The KCHS is a subsidiary company of the KPA engaged in cargo handling services. Its functions overlap those of KPA and it has a tendency to increase the number of supervisors in its work force, which totalled 8,616 as of the end of 1981.

1.3.3 Revenues and Expenditures

Stevedoring had a conspicuously large deficit in both 1980 and 1981 (Table 1-3-1). Although KCHS had an 8% surplus in 1980, inflation-driven price and wage increases produced a deficit in 1981 amounting to 6.2% of its revenues (Table 1-3-2).

Table 1-3-1 Income and Expenditure Account (KPA)

K.Shs. M	1980	1981
Operating Revenue		
1. Shipping	71.6	71.0
2. Stevedoring	168.5	188.5
3. Wharfage	372.5	379.2
4. Handling Cargo	134.2	124.2
5. Penalty Storage	87.2	90.1
6. Other Operating Revenue	43.0	40.5
Net Revenue Account Receipts	54.2	86.7
Total Operating Revenue	931.1	980.3
Operating Expenditure		
Abstract 'A' Shipping	40.2	▲ 75.7
'B' Stevedoring	213.5	▲ 276.8
'C' Wharfage	75.5	97.9
'D' Handling Cargo	105.7	116.2
'E' Storage	1.5	1.8
'F' General Charges	86.9	▲ 152.2
'G' Miscellaneous Expense	43.1	55.6
Net Revenue Account Charges	1.5	1.7
Total Operating Expenditure	568.0	777.9
SURPLUS FOR THE YEAR	363.1	202.4

Source: Annual Bulletin of Port Statistics 1981

Table 1-3-2 Revenue and Expenditure Account (KCHS)

K.Shs. M.		1980	1981
Revenue:			
Shorehandling	Imports	75.0	74.5
	Exports	20.2	17.5
Stevedoring	Normal Rate	93.8	103.5
	Overtime Rate	46.3	60.7
Lighterage		2.0	1.3
Overtime Orders		28.3	25.6
M.P.S.		27.9	33.8
Contingent Revenue		-	-
	TOTAL	293.5	316.8
Expenditure:			
1. Administration			
A: Non-Operational		31.4	35.7
B: Office Services and other Miscellaneous charges		7.0	11.2
2. Operations			
A: Operational Overheads		17.1	20.5
B: Handling Services			
1. (a) Handling Overside		137.7	172.5
(b) Lighterage		2.2	2.8
2. Handling Overquay		74.1	93.8
	TOTAL	269.6	336.6
Net Surplus/(Deficit)		23.9	(19.7)

Source: Summary of Actuals 1980, 1981 and Budget 1982

1.3.4 Labour Management

A qualification system with more than 50 grades is used for effective labour management. This system is linked with the wage system. Labourers' working hours are recorded by a time card system as with common employees. A two shift system is adopted during regular working hours, and a third shift is treated as overtime.

Cargo handling management is done by the superintendent and his assistants for each section in the port. A stevedore gang for general cargo operations is usually composed of 21 labourers, 9 in the hold, 6 on the quay, and 6 in the shed. The average number of gangs employed a day is 90, based on the annual number of 26,700 employed in 1981. The number of labourers retained by KCHS was 5,292 at the end of 1981, which seems larger than necessary. However, absenteeism of labourers is high, especially after payday. Large fluctuations in labourer attendance rate are assumed to be a managerial problem.

There are two labour unions involved in ports in Kenya, the Mombasa Dockworkers Union and The Railways and Harbours Union. They are very powerful, but have not gone on strike since 1970.

1.4 Present Issues

1.4.1 Port Facilities and Cargo Handling

(1) Mombasa Port

a) The berth occupany rate at the general cargo wharves is very high at 75%, while 25% of all calling vessels wait an average 3 days for berthing This port congestion will be alleviated soon by increased handling productivity made possible by the containerisation of general cargo.

b) The container terminal construction project underway at Mombasa is to cope with the increase of container cargo. No container freight station has been included in this project on the assumption that all containers handled at Mombasa port will be transported by rail to/from the inland container depot. However, the container terminal should be equipped with a container freight station and ancillary facilities, since a certain number of containers will be collected/delivered by truck.

c) Development of railway capacity is needed to ensure the smooth transport of the containers.

d) Deterioration of pavement in the sheds and on the apron hinders the smooth movement of equipment being handled.

(2) Lamu Port

Although lamu city is very dependent on sea transport, the port is not well developed.

For example,

- There is only a single berth, and this cannot accommodate even 100 tonne

ships for berthing at low tide.
- There is no shed in the port.

1.4.2 Issues on Port Management and Operations

(1) Cargo Handling Efficiency

According to Table 1-2-5, average handling productivity of general cargo in Mombasa was:

Productivity:	68 tonnes/gang/shift	(8.5 tonnes/gang/hour)
	498 tonnes/ship/day	(7.5 gangs/ship/day)
Average ship working days:	5.1 days/ship	

Liner ship operators generally expect a port to handle 1,000 tonnes of cargo per ship per day, but the above data shows that the rate in Mombasa is only half this figure. For dry bulk cargo, daily productivity was 1,539 tonnes/ship/day which seems very low.

As shown in Table 1-2-5, 3,510 tonnes (400 TEU) of containers per ship were handled in a 3 day period. The productivity of container handling was 316 tonnes (36 TEU) per gang shift. International standard productivity by a container crane is said to be 20 to 25 TEU per hour or 200 TEU per gang shift, thus Mombasa port was able to provide container handling service at only 18% of the standard rate.

Low productivity in general cargo handling is due to the piecework system being used as mentioned earlier.

The volume of piecework is settled between the ship's officer and the stevedore in consideration of the kind of cargo or the stowage conditions in each hatch. It is usually agreed upon at around 80 tonnes per gang shift in the traditional way. Nowadays, this target is performed in a 2 to 4 hour operation using efficient machinery, and the ships are then obliged to wait a long time for the next shift's gangs. Port users, therefore, cannot obtain more efficient service even when they promote cargo palletisation or a pre-sling system for quick despatch. Consequently, there are complaints about the piecework system.

(2) Organisation and Management

Management of cargo handling on board ship is performed by the sectional superintendent and his assistants. Good cooperation with labourers and the crane driver who is always the key man of the operation is a most important factor in improving handling productivity. There is some concern about lack of communication in the line of command because the crane drivers belong to the KPA and the labourers to the KCHS. Low handling productivity and the over-employment of labourers would seem the cause of the continuous deficit in the stevedoring business.

(3) Port Charges

Port charges should be discussed in comparison with the quality of service

provided, such as productivity in cargo handling. For example, when a 10,000 G.R. tonne liner ship chartered at $3,000 per day is operated as in Table 1-2-5, the ship's costs are $15,000 for the 5 working days needed for general cargo. But if handling productivity is doubled, 2.5 working days may be saved and the ship's operator could use the surplus of $7,500 on port fees which corresponds to 52% of the total stevedoring charges for the ship ($14,400).

Handling productivity and port charges should be competitive with other ports since the cargo flow in the port is mostly international trade.

In Table 1-4-1 Mombasa port is compared with other ports for port charges under the hypothetical conditions of a 10,000 GRT ship staying 24 hours.

Table 1-4-1 Port Charges in Several Ports

	Mombasa	Dar Es Salaam	Durban	Singapore	Shimizu	Bombay	Lagos	Maputo	Colombo
	$=KShs.12	$=TShs.11	$=R.1.111	$=Sp$2.18	$=¥240	$=Rs.10	$=N.0.693	$=Mts.42.4	$=Rs.23.4
Port Dues	$ 623	$ 500	$ 1,236	$ 688	$ 900	$ 1,128	$ 8,312	$ 1,156 *	$ 5,625
Pilotage	767	727	540	514	529	330	1,443	189	5,625
Towage	767	682	*	367	782	660	577	283	876
Navigational	432	364	607	-	83	900	2,944	*	950
Dockage	3,450	3,272	1,372 *	2,202	1,125	1,650	3,550	*	15,000
Mooring	192	136	130	55	144	-	87	*	-
Total	6,231	5,681	3,885	3,826	3,563	4,668	16,913	1,628	28,076
Stevedoring Charge	26,450	18,818	21,944	11,606	22,751	12,397	21,108	28,208	10,810
G. Total	32,681	24,499	25,829	15,432	26,314	17,065	38,021	29,836	38,886
< Ship > G.R.T. 10,000 tons N.R.T. 6,000 tons LOA 150 m General Cargo 2,500W/tons, 4,000 H/tons, overtime operation 30%, overtime charge 50% Additional Berthing/Unberthing in daytime 1 hour each									
Cargo operation	5 days	5 days	3 days	2 days	3 days	5 days	5 days	5 days	5 days

2. Port Development Plan

2.1 Cargo Volume Forecast

2.1.1 Mombasa Port

The cargo handled at Mombasa Port includes not only that for Kenya but also for the landlocked countries. The cargo volume forecast, taking into consideration the production and consumption of agricultural or industrial goods within Mombasa's hinterland, is shown in Volume II, Part IV.

Table 2-1-1 shows the cargo forecast by commodity (general cargo, container cargo and dry bulk cargo) each year, based on the cargo volume forecast in Volume II, Part IV.

In forecasting the container cargo volume, 75% of the general cargo is assumed to be containerisable and the containerisation ratio, (container cargo to containerisable cargo) is estimated using Fig. 1-2-4.

Table 2-1-1 Cargo Volume Forecast in Mombasa Port

UNit: thousand tonnes

	1988	1993	2000
General cargo	701	668	936
Container cargo	1,616	2,000	2,809
Dry bulk cargo	1,578	2,590	4,089
Liquid cargo	4,433	5,044	6,224
Total	8,328	10,302	14,058

2.1.2 Lamu Port

The cargo volume at Lamu port is forecasted as shown in Table 2-1-2. Cargoes in the hinterland of Lamu are assumed to be as follows:

- Goods necessary for daily life
- Cargo at present transported overland between Lamu and Mombasa, but which is expected to be diverted to the sea route
- Export cargo expected from the Tana River Development Project

Table 2-1-2 Cargo Volume Forecast in Lamu Port

Unit: thousand tonnes

	1988	1993	2000
General cargo	97	168	378

2.2 Development Plan in Mombasa Port

2.2.1 Basic Concept of Port Development

The ports in Kenya deal in cargo not only for Kenya but also for the land-locked countries where no port exists, namely Uganda, Zaire, Rwanda, Burudi, etc. This situation should be taken into consideration in formulating the port development plan, because Mombasa port will maintain this present role in the future.

The main origins and destinations of internationally traded cargo passing through Mombasa port are located around and beyond Nairobi, 400 km away from the Kenyan coast. Therefore land transport of cargo is most important. The land transport system, railways and roads, linking Mombasa port, which is the only international trading port in Kenya, with these origins and destinations is established for the time being, but is expected to be developed in the future. From the point of view of land transport capacity, Mombasa port should be developed as a major international trading port as at present, because the major origins and destinations of cargo through the port will probably not change in the future.

The volume of container cargo passing through Mombasa port is increasing rapidly, following the pattern of worldwide containerisation, and the port should be developed in order to cope with this containerisation. It should be developed not only as a place for cargo movement but also for industry and trading using its locational advantage facing the sea. An industrial or living base can also be established by such development.

2.2.2 Port Development Plan

(1) Port Facility Plan

1) Estimation of Cargo Handling Productivity

Number of berths needed for handling cargo is dependent on the cargo handling productivity, which now varies with the type of cargo as mentioned in Section 1.2.

The annual cargo handling volume of one berth is estimated in Table 2-2-2 by assuming a berth occupancy rate, a handling productivity rate, and the number of gang-shifts per berth (from Table 2-2-1).

Table 2-2-1 Assumption of Berth Occupancy Rate, Handling Productivity and Number of Gang-Shifts

		General Cargo Ship	Dry Bulk Ship	Container Ship
Berth Occupancy Rate		65%	60%	60%
Handling Productivity	1984	100 t/gang/shift	2,000 t/day/ship	15 TEU/hour
	2000	130 t/gang/shift	3,000 t/day/ship	20 TEU/hour
Number of Gang-Shifts per Berth		2.5	2.0	1.5

Table 2-2-2 Annual Cargo Handling Volume per Berth

Unit: t/berth/year

	1984	1988	1993	2000
General Cargo	140,000	150,000	163,000	180,000
Dry Bulk	340,000	390,000	440,000	500,000
Container (TEU)	660,000 (76,000)	720,000 (83,000)	780,000 (90,000)	870,000 (100,000)

2) Required Port Facilities

(a) Wharves

The required number of berths can be obtained as shown in Table 2-2-3 from the cargo volume forecast (Table 2-1-1) and the annual cargo handling volume per berth (Table 2-2-2).

Table 2-2-3 Required Number of Berths

	1988	1993	2000
General Cargo Berths	5	5	6
Container Berths	3	3	4
Dry Bulk Berths	6	9	10

The number of conventional berths will decrease as containerisation of cargo increases. Instead of conventional berths, container berths will be required. Besides the two container berths being developed, a third will be needed by 1988 and an additional fourth by the year 2000. It is preferable to locate all container berths in the same area for effective container handling. Therefore, the conventional berths which are adjacent to the container berths being constructed should be converted. Each container berth should be equipped with 2 gantry cranes.

(b) Container Yard

Areas for the following purposes are needed in the container berths:

i) Container freight stations for LCL cargo which is transported by truck.

ii) A yard for handling containers to and from the landlocked countries, estimated at 20% of all containers.

iii) A maintenance shop for containers and handling equipment.

There is, however, not enough area for the above purposes in the container berths now being constructed and in the planning. Therefore, the area adjacent to the container berths (referred to above) should be secured.

The area assigned to the Ken-Ren fertilizer plant is suitable for a container yard. Railway sidings should be constructed in the yard for land transport of containers by railway.

(c) Inland Container Depot

The majority of containers handled in Mombasa should be transported upcountry by land. Nairobi Inland Container Depot, 19 ha, is being built to handle the containers which will be transported by rail.

The main origins and destinations of the containers are farther inland than Nairobi. To cope with the increase of containers handled in the upcountry, expansion of the Nairobi Inland Depot and the construction of new inland depots in such places as Eldoret, Kisumu, and Nakuru will be needed in the future.

Development of railway transport capacity is required in parallel with the construction of the inland depots.

(d) South Mainland Development

The following factories are planned to develop industry and agriculture in Kenya. These factories should be located at suitable points along the coast so that they can be supplied with necessary materials.

- Steel Mill
  Production capacity: in 1990; 300,000 tonnes/year
  in 1995; 550,000 tonnes/year
  in 2000; 850,000 tonnes/year
- Coal Firing Power Plant: 120,000 KWh
- Fertiliser Plant: 200,000 tonnes/year

The premises of Mombasa port are not large enough to accommodate the factories and the area behind the port, which is occupied by houses, is also too small.

There is, however, a large area of virgin land at the south of Mombasa Island which may be suitable for this use. Therefore, it is recommended that the south mainland be developed not only for these factories but also for another purpose mentioned later. To develop the south mainland a new railway and road should be constructed connecting it with the existing railways and roads. This connection should be implemented by the responsible organisations.

The following factories and facilities are expected on the south mainland.

- Export processing zone
- Steel mill
- Coal firing power plant
- Fertiliser plant
- Shipbuilding and related factories
- Coal terminal
- Light industry

Development of the south mainland will create labour opportunity and will absorb surplus labourers of KPA and KCHS.

(e) Grain Terminal

Stabilisation of the grain supply is very important for the life of the people. Kenya, however, has sometimes suffered from a grain production shortage. The Ministry of Agriculture is therefore planning to increase grain imports in order to stabilise the grain supply.

A grain terminal including silos is needed for these grain imports and the south mainland seems a suitable location for it. There is enough area for its construction and land transport to Nairobi will be assured by the new connection.

(f) Export Processing and Free Trade Zone

Mombasa port is very advantageously located in terms of trade along the East African Coast. Development of an export processing and free trade zone making use of this locational advantage will increase economical activities and create labour opportunities in Kenya. Since a large area of land is required, the

south mainland is a suitable location for developing this export processing and free trade zone.

(g) Bulk Terminal

The cargo volume forecast anticipates an increase of cement, soda ash and flourspar exports. Therefore, the handling capacity of exports must be increased. Since Mbaraki Terminal is used for these exports at present and there is room for adjacent expansion, such expansion is reasonable so that the terminal can handle bulk exports in the future.

The locations of the above-mentioned facilities are shown in Figures 2-2-1 and 2-2-2.

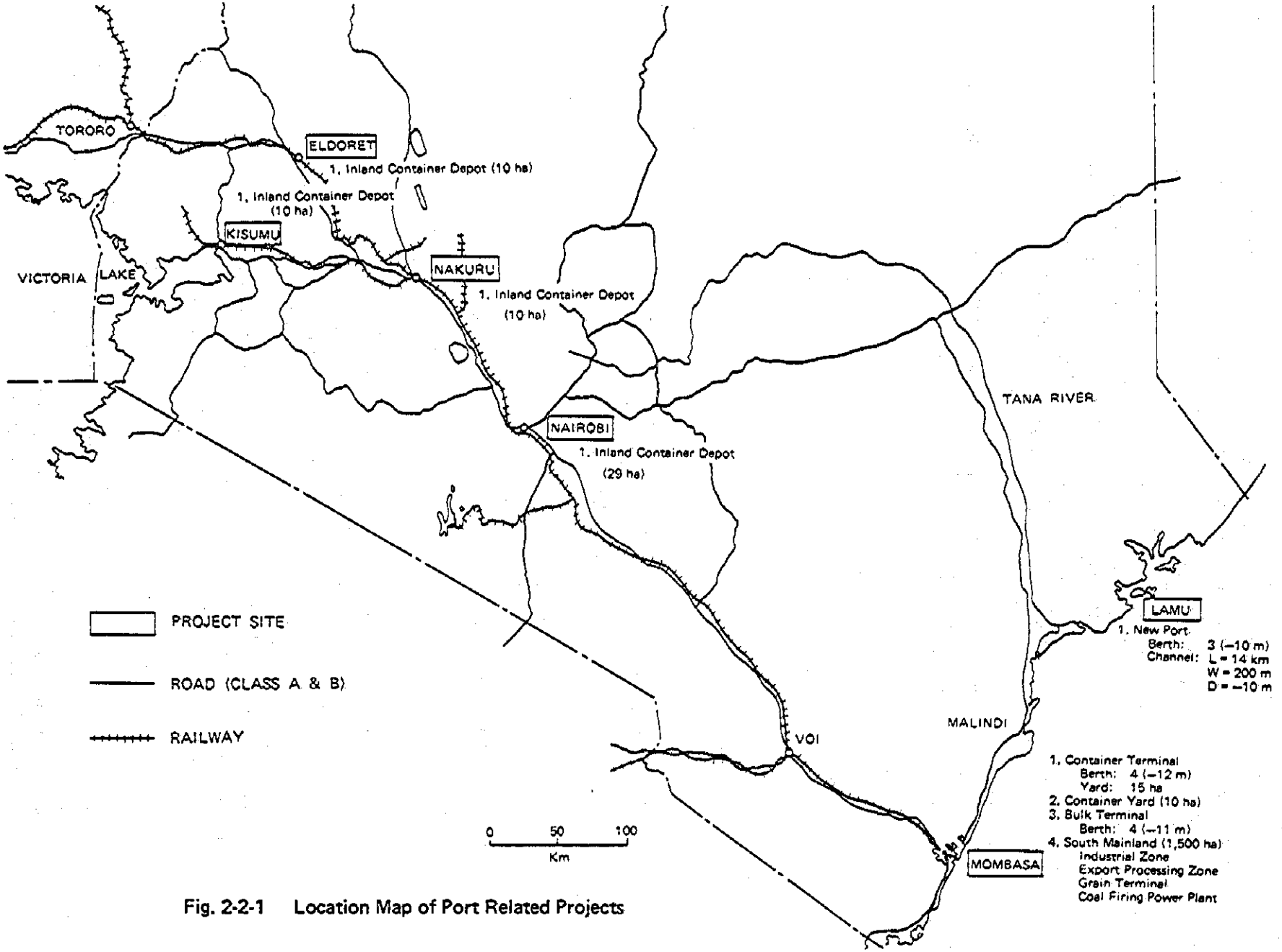


Fig. 2-2-1 Location Map of Port Related Projects

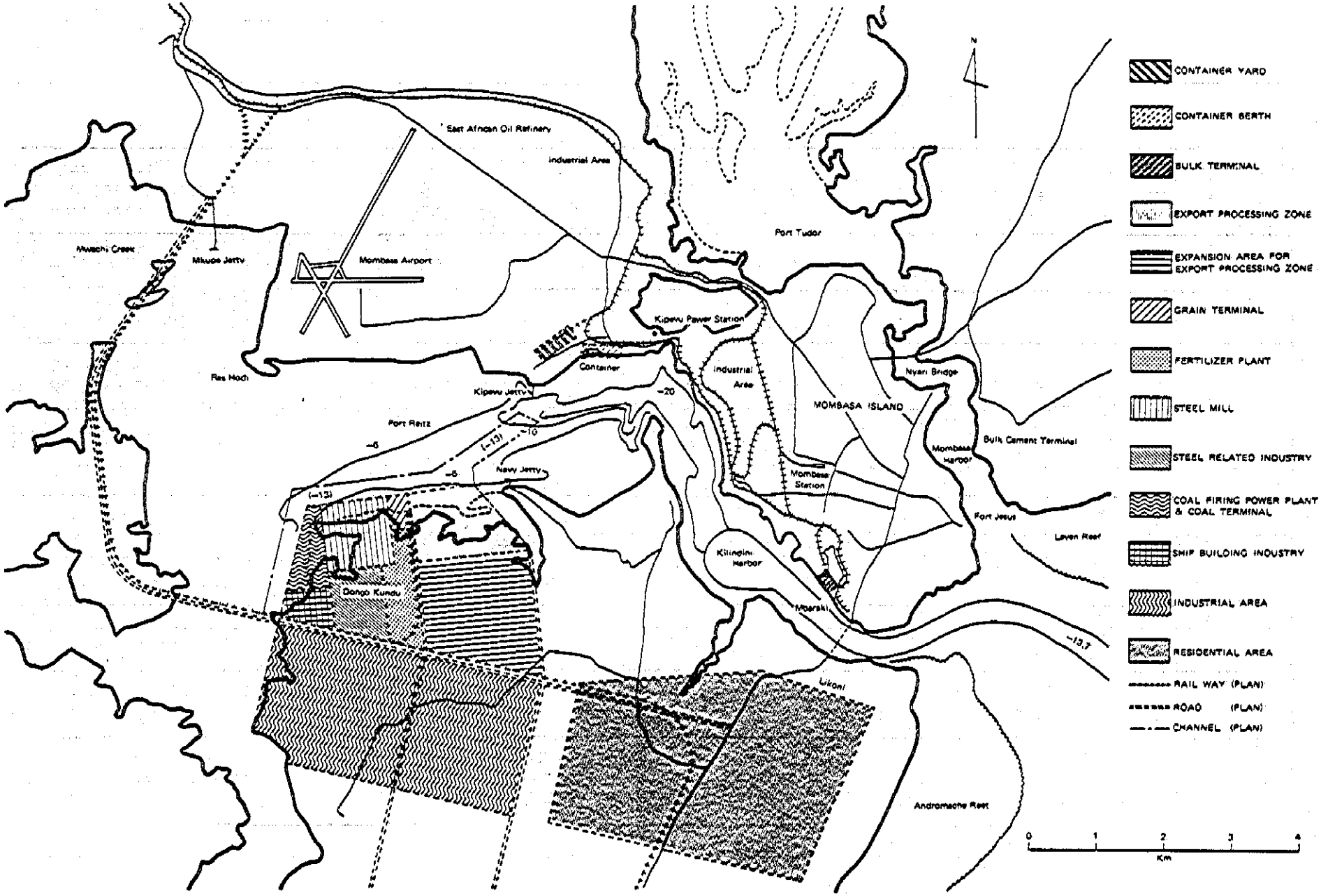


Fig. 2-2-2 Location Map of Proposed Projects in Mombasa

Table 2-2-4 Proposed Projects in 5th 5-Year Plan (1984–1988)

1 KSh= ¥ 19
1 $ = ¥ 240
1 $ = 12.632 KShs

NO	Project Name	Project	Total Cost(Unit:Million KShs) Local Currency	Foreign Currency	Total	Construction Period	Degree of Importance	Degree of Urgency	Note
1	Mombasa Port Container Berth(1st Phase)	-12m Berth; 300m Yard; 9 ha	101	304	405	3 years	A	A	
2	Mombasa Port Container Yard(1st Phase)	Yard; 5 ha Railway Siding	35	106	141	3 years	A	A	
3	Mombasa Port South Mainland Development (1st Phase)	-13m Berth; 2,300m Industrial Area; 325 ha	513	1,540	2,053	4 years	A	A	
4	Mombasa Port Bulk Terminal(1st Phase)	-11m Berth; 200m	25	76	101	2 years	A	B	
5	Inland Container Depot Nairobi(1st Stage)	10 ha	10	29	39	1 year	A	B	
6	Inland Container Depot Eldoret(1st Stage)	10 ha	12	37	49	1 year	B	B	
7	Lamu Port New Port Development (1st Phase)	-10m Berth; 200m	36	111	147	3 years	B	B	
	Total		732	2,203	2,935				

Table 2-2-5 Proposed Project in 6th 5-Year Plan (1989–1993)

1 KSH = ¥ 19
1 $ = ¥ 240
1 $ = 12.632 KSHs

NO	Project Name	Project	Total Cost (Unit: Million KSHs)			Construction Period	Degree of Importance	Degree of Urgency	Note
			Local Currency	Foreign Currency	Total				
1	Mombasa Port Container Berth (2nd Phase-1st Stage)	-12m Berth; 300m Yard; 9 ha	34	101	135	1 year	A	A	
2	Mombasa Port Container Yard (2nd Phase)	Yard; 5 ha Railway Siding	35	106	141	3 years	A	A	
3	Inland Container Deport Nairobi (2nd Stage)	10 ha	20	59	79	2 years	A	B	
4	Inland Container Depot Eldoret (2nd Stage) Kisumu (1st Stage)	Eldoret; 10 ha Kisumu; 10 ha	37	111	148	3 years	B	B	
5	Mombasa Port South Mainland Development (2nd Phase)	-13m Berth; 1800m Industrial Area; 160 ha	309	929	1,238	3 years	A	A	
6	Mombasa Port Bulk Terminal (2nd Phase)	-11m Berth; 325m	41	123	164	3 years	A	B	
7	Lamu Port New Port Development (2nd Phase)		171	513	684	3 years	X B	B	
	Total		647	1,942	2,589				

Table 2-2-6 Proposed Projects in 7th 5-Year Plan (1994—1998)—2000

1 KSH = ¥ 19
1 $ = ¥ 240
1 $ = 12.632 KSHs

NO	Project Name	Project	Total Cost(Unit: Million KSHs)			Construction Period	Degree of Importance	Degree of Urgency	Note
			Local Currency	Foreign Currency	Total				
1	Mombasa Port Container Berth (2nd Phase-2nd Stage)	-12m Berth; 300m Yard; 9 ha	67	203	270	2 years	A	A	
2	Inland Container Depot Kisumu(2nd Stage), Nakuru	Kisumu; 10 ha Nakuru; 10 ha	62	185	247	5 years	B	B	
3	Mombasa Port South Mainland Development(3rd Phase)	Revetment; 1500m Industrial Area; 1015 ha	231	694	925	5 years	B	D	
4	Lamu Port New Port Development (3rd Phase)	-10m Berth; 200m	36	111	147	2 years	B	B	
	Total		396	1,193	1,589				

Table 2-2-7 Proposed Projects in Mombasa Port

Project			5th 5-Year-Plan '84	'85	'86	'87	'88	6th 5-Year-Plan '89	'90	'91	'92	'93	7th 5-Year-Plan '94	'95	'96	'97	'98	'99	2000	Project Cost (100 million Kshs) Local Currency	Foreign Currency	Total
Mombasa Port Container Berth	1st Phase	1 Berth 300m		—	—	—														1.01	3.04	4.05
	2nd Phase	1 Berth 300m										—	—	—						1.01	3.04	4.05
Mombasa Port Container Yard	1st Phase	5 ha		—	—	—														0.35	1.06	1.41
	2nd Phase	5 ha							—	—	—									0.35	1.06	1.41
Inland Container Depot	Nairobi	10 ha					—	—	—											0.30	0.88	1.18
	Eldoret	10 ha					—	—	—											0.37	1.11	1.48
	Kisumu	10 ha										—	—	—						0.37	1.11	1.48
	Nakuru	10 ha															—	—	—	0.37	1.11	1.48
South Mainland Development	1st Phase	2,300m 325 ha		—	—	—	—	—												5.13	15.40	20.53
	2nd Phase	1,800m 160 ha						—	—	—										3.09	9.29	12.38
	3rd Phase	1,015ha											—	—	—	—	—			2.31	6.94	9.25
Railway and Road Connection to South Mainland	1st Phase	15 km		—	—	—														(0.86)	(2.63)	(3.49)
	2nd Phase	3 km				—	—													(0.15)	(0.44)	(0.59)
Bulk Terminal Development	1st Phase	200 m		—	—															0.25	0.76	1.01
	2nd Phase	325 m							—	—	—									0.41	1.23	1.64
Total																				15.32 (16.33)	46.03 (49.10)	60.35 (65.43)

Note: Figures in parentheses are project costs including railway and road connections to South Mainland

(2) Improvement of the Port Management System

The most important point to be improved in Mombasa port is the efficiency of its functions. High productivity of cargo handling in port minimizes the users' costs. It will reinforce the international competitive power of their exports and contribute greatly to reductions in the price of imports, and thus to the payment of foreign exchange. Consequently, high productivity in the port brings an enormous profit to the nation as well as to the shipping companies, which will reflect it in ocean freight prices.

A container terminal is being constructed at Mombasa port to cope with the present world transport revolution. Consequently, the KPA should turn its main attention to the management of this terminal. Shipping companies and freight conferences may soon designate the Mombasa terminal and the Nairobi depot as their designated C.Y. or C.F.S.. Should this happen, terminal operations and inland transport which are now consignee's expenses will be charged to the shipping companies. It is desirable for these facilities to provide reliable and efficient services in order to obtain this designation at the earliest time, thus increasing foreign currency revenues.

1) Efficiency of Port Functions and Proper Strength

Efficiency of port functions means the simplification of management organisation, customs procedure, and access to inland transport as well as the improvement of cargo handling. Substantial labour and machinery management ability is required to improve cargo handling productivity even while awaiting enough forklift trucks or machinery. Inadequate maintenance of machinery for lack of spare parts should be immediately improved.

The piecework system is considered a major cause of low productivity in cargo handling at Mombasa port. This system should be abolished and workers should be motivated through such management techniques as Quality Control Activity.

It is essential for efficient operations to cultivate teamwork in the gangs. When they are engaged in cooperative work with regular members, their awareness of teamwork should produce communication, a sense of responsibility, and flexibility on the job. It is also recommended that if the climate in Mombasa precludes long working hours, the number of shifts per day should be increased.

Improvement in operation methods and handling of equipment have contributed to the improvement of productivity in a pilot program by the Port of Singapore Authority. Cargo volume tripled between 1971 and 1981, while staff strength remained constant throughout those years. This was accomplished by putting emphasis on developing the skills of the labourers, introducing various incentive schemes, a program of computerisation, and by the mechanisation of cargo handling operations.

The annual cargo handling volume per employee in various ports was calculated as follows:

Mombasa:	700 W/T or 800 F/T
Bombay:	600 W/T
Colombo:	200 F/T
Shimizu (Japan):	8,300 F/T
South Africa:	5,100 W/T
Lagos:	1,000 W/T
Singapore:	9,200 F/T

There seems, at present, to be a great difference in productivity between developed ports and developing ports, but by the year 2000 Mombasa port may be developed to the level shown in Table 2-2-7. The proper number of employees in the year 2000 was calculated based on future cargo volume and handling productivity in both Mombasa and the inland depots:

Manual Workers:	1,400 persons
Drivers:	770
Checkers:	420
Clerks:	430
Supervisors:	400
Engineers:	380
Total:	3,800

It is recommended that the number of employees gradually be reduced from the present 12,600. In order to absorb surplus labourers, employment opportunities should be increased by developing such projects as the export processing zone in the south mainland.

2) Management System for Container Transport

Good coordination with the inland depots and the railways will be an important subject for future container terminal management since the origin/destination points of Mombasa cargo are concentrated around and beyond Nairobi. A consistent series of transport services is desirable.

In order to secure reliable container transport, one alternative is to establish a committee composed of personnel from KPA, KCHS, KR and Customs which would facilitate good communications between the organisations concerned.

2.2.3 Preliminary Evaluation of Alternative Plans

(1) Container Terminal

As mentioned previously, containerisation of Mombasa port cargo is progressing rapidly. Hence, it is urgent that the container terminal be developed in order to enhance the competitive power of Mombasa port in the international container transport business. The inland depot project, together with the container terminal project, should therefore be implemented in the 5th five-year-Plan.

(2) South Mainland Development

In order to secure economic growth in Kenya, industrial and agricultural development are absolutely necessary. Proper location of industry is dependent on the type of industry. Those which require a large quantity of raw materials and which produce goods for export are best located in coastal areas.

By developing these industries and export processing in Mombasa, an increase in labour opportunities is expected and surplus labourers of KPA, KCHS and also citizens in Mombasa will be able to find jobs.

2.3 Development Plan for Other Ports

2.3.1 Basic Concept of Port Development

(1) Kilifi and Malindi Ports

Cargo handling volume in both ports is very low and no remarkable increase in volume is anticipated in the future.

The distance between Mombasa and these two ports is nost great, 50 km to Kilifi and 100 km to Malindi, and it is preferable to move cargo between Mombasa and these ports by land transport rather than by sea.

Therefore, full scale port developments will not be needed in the near future, but improvement of jetties to cope with the gradual increase of cargo will be required.

(2) Lamu Port

Lamu port is located 240 km north of Mombasa port. During the rainy season, all roads into Lamu are impassable and the city is completely isolated. Therefore, the port plays a very important role in supporting the daily life of its citizens.

Nevertheless, there is only one public jetty in Lamu port at present. Many dhows are moored at a nearby shallow revetment during cargo handling, and no cargo handling equipment can be used on the jetty. There is no shed or warehouse. Improvement and addition of port facilities are urgently required to resolve these problems.

Since the objective area for the Tana River Basin Development Project is included in the hinterland of Lamu port, the port must be developed to handle the Project's agricultural products.

The layout of Lamu city was heavily influenced by Arabic culture. Houses were built very close together on both sides of 1 – 1.5 m wide paths. This layout hampers modernisation of the city. Therefore, the relocation of Lamu District offices from the island to the mainland (Mokowe) is now in progress.

Considering the layout and that no truck transport of cargo is possible in the city, the new Lamu port development should be undertaken in a place other than the existing port. Manda Bay seems the best place for the new port, because a wide land area is available and the water depth would allow entrance of large ships.

2.3.2 Port Development Plan

(1) Lamu Port

The existing port facilities should be improved to transport cargo necessary for the daily life of the citizens by:

1) Construction of sheds and warehouses

2) Increasing the water depth at the jetty front and expansion of the jetty width to allow use of equipment

3) Development of a road (including a bridge) between Mokowe and Lamu Island

(2) New Lamu Port

The new port should be developed as an international trading port independent from Mombasa.

Based on the cargo forecast shown in Table 2-1-2, the new port needs the facilities shown in Table 2-3-1.

Table 2-3-1 Facilities needed for the New Lamu Port

	1988	1993	2000
Berth (-10 m)	1	2	3
Channel (-10 m)		L = 14 km, W = 200 m, d = -10 m	
Road	L = 16.5 km		

Roads connecting the new port and the existing road/town should be constructed by the responsible organisations concerned.

Table 2-3-2 shows a time schedule and project cost for the new port.

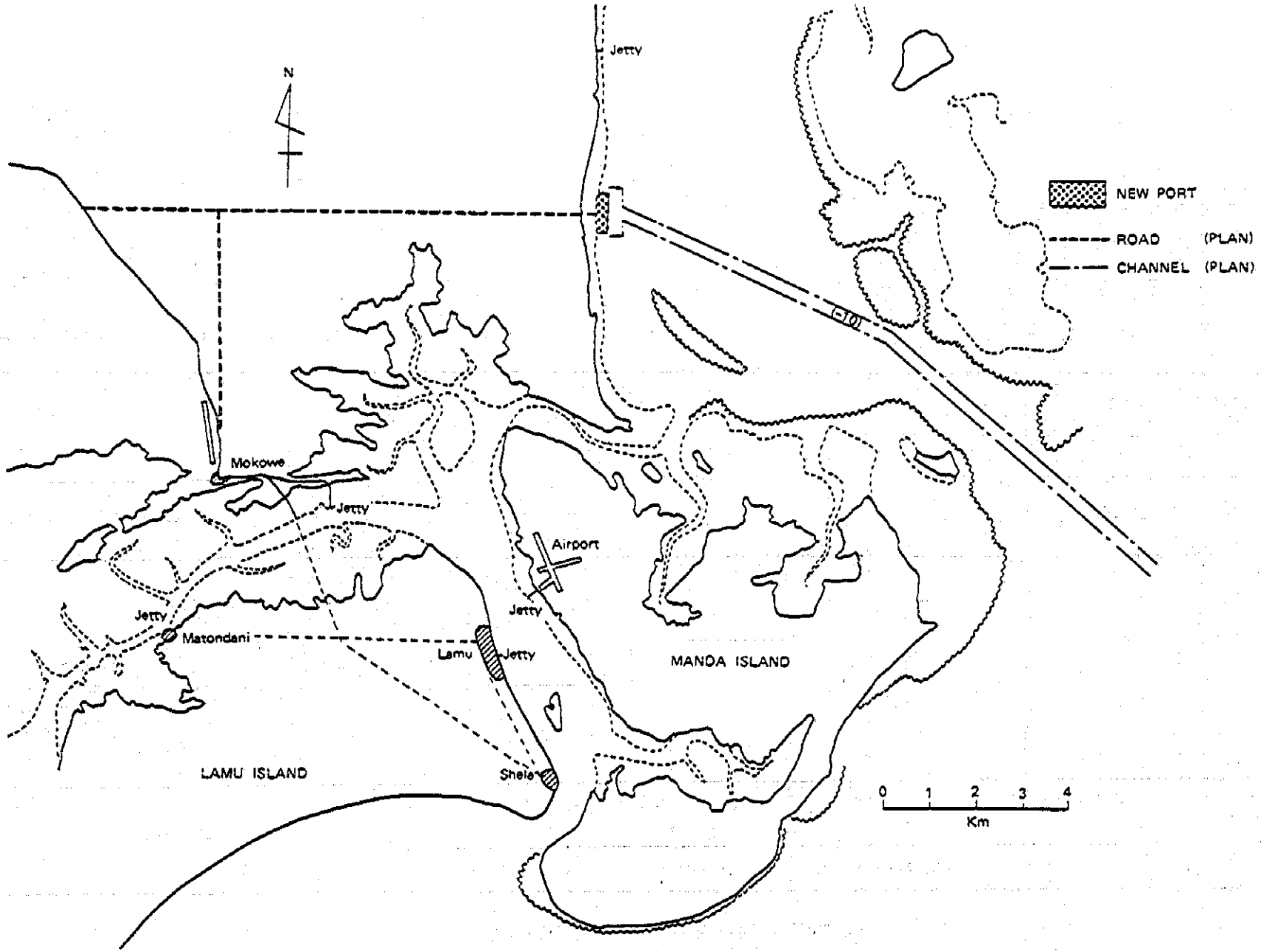


Fig. 2-3-1 Map of Proposed Project in Lamu

Table 2-3-2 Proposed Project in Lamu Port

Project			5th 5-Year-Plan					6th 5-Year-Plan					7th 5-Year-Plan							Project Cost (100 million Kshs)		
			'84	'85	'86	'87	'88	'89	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99	2000	Local Currency	Foreign Currency	Total
Lamu Port New Port Development	1st Phase	-10mBerth 200 m			———	———	———													0.36	1.11	1.47
	2nd Phase	-10mBerth 200 m								———	———	———								1.71	5.13	6.84
	3rd Phase	-10mBerth 200 m													———	———				0.36	1.11	1.47
(Road in the Port)		(16.5 km)			———	———	———													(0.17)	(0.50)	(0.67)
Total																				2.43	7.35	9.78
																				(2.60)	(7.85)	(10.45)

Note: Figures in parentheses are project costs including road.

2.3.3 Preliminary Evaluation of Alternative Plans

Regional development around Lamu is significantly behind the development in the corridor including Nairobi and Mombasa. The Tana River Basin Development has just started. The regional development around Lamu will be important in maintaining a balance in the country. The port project is necessary for the development of the region to transport a large quantity of goods produced in the area.

Mombasa is presently the only port which can accommodate large ships in Kenya, and development of a second facility which could handle such vessels would secure the safety of sea transport for the country.