JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)

No. 1

MINISTRY OF PUBLIC WORKS
REPUBLIC OF KENYA

BASIC DESIGN STUDY REPORT ON THE PROJECT FOR MAINTENANCE EQUIPMENT OF ROAD AND BRIDGE IN REPUBLIC OF KENYA

FEBRUARY 1993

KATAHIRA & ENGINEERS INTERNATIONAL

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P R E F A C E

In response to a request from the Government of The Republic of Kenya, the Government of Japan decided to conduct a basic design study on Maintenance Equipment for Roads and Bridges and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Kenya a study team headed by Mr. Toshimitsu MURAMATSU, Chief of Construction Equipment Division, Road Department, Chubu Regional Construction Bureau, Ministry of Construction and constituted by members of Katahira & Engineers International, from November 7th to December 5th, 1992.

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

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

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

February 1993

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

Mr. Kensuke Yanagiya
President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

We are pleased to submit to you the basic design study report on Maintenance Equipment of Road and Bridge in Republic of Kenya.

This study has been made by Katahira & Engineers International, based on a contract with JICA, from October 20, 1992 to February 26, 1993. Throughout the study, we have taken into full consideration of the present situation in Kenya, and have planned the most appropriate project feasible in the scheme of Japan's Grant Aid.

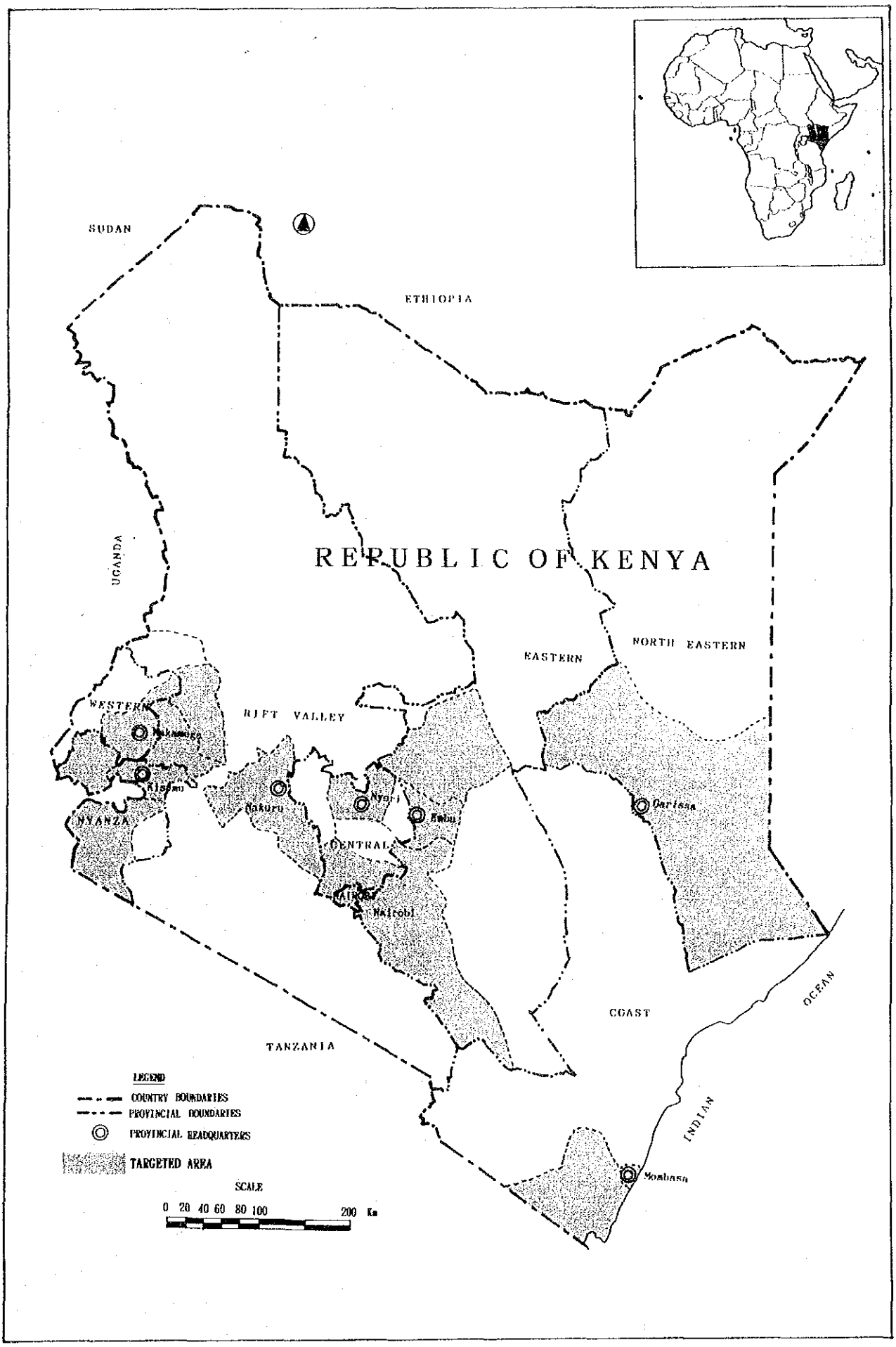
We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, the Ministry of Foreign Affairs and the Ministry of Construction. We also wish to express our deep gratitude to the officials concerned of Ministry of Public Works, JICA Office and the Embassy of Japan in Kenya for their close cooperation and assistance during our study.

Finally, we hope that this report will be effectively used for the promotion of the project.

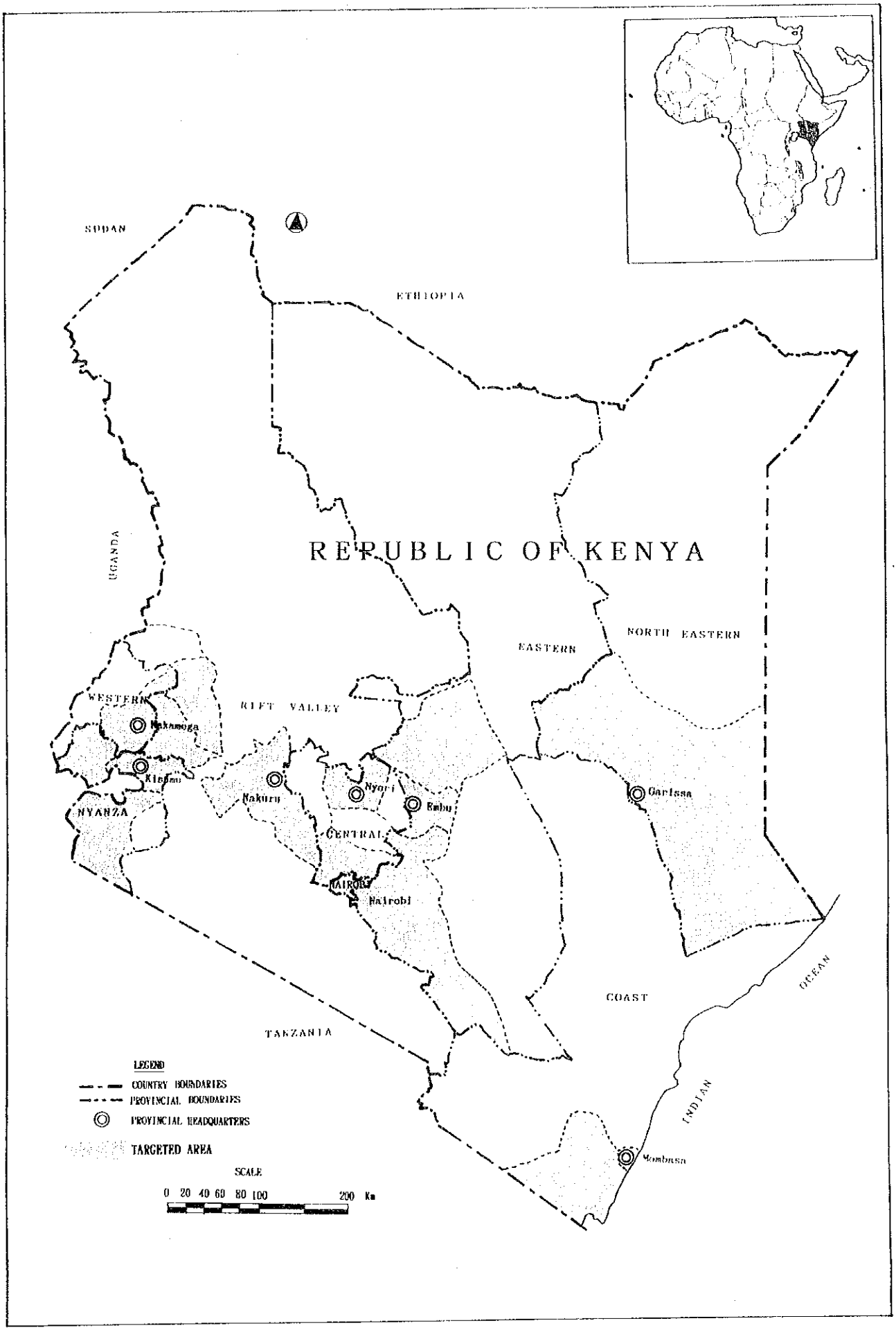
Very truly yours,

M. Miura

Minoru MIURA
Project Manager,
Basic Design Study Team on
Maintenance Equipment
of Road and Bridge
Katahira & Engineers International

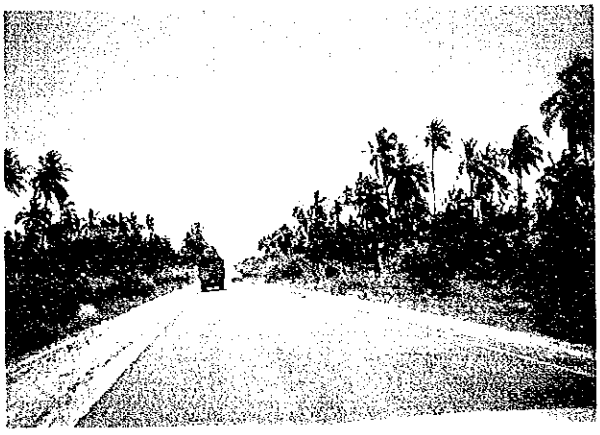


AREAS COVERED BY THE BASIC DESIGN STUDY

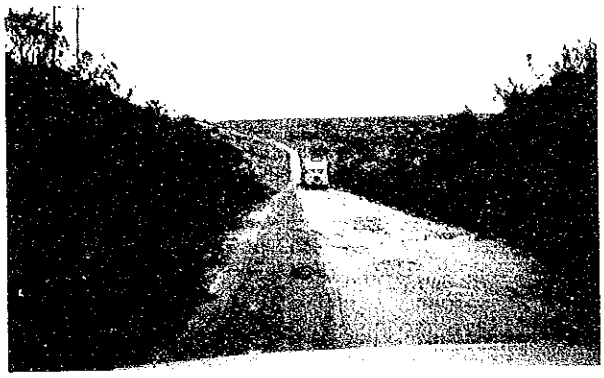


AREAS COVERED BY THE BASIC DESIGN STUDY

ROAD CONDITIONS



Bitumen Road (well maintained)



Bitumen Road (in need of maintenance)

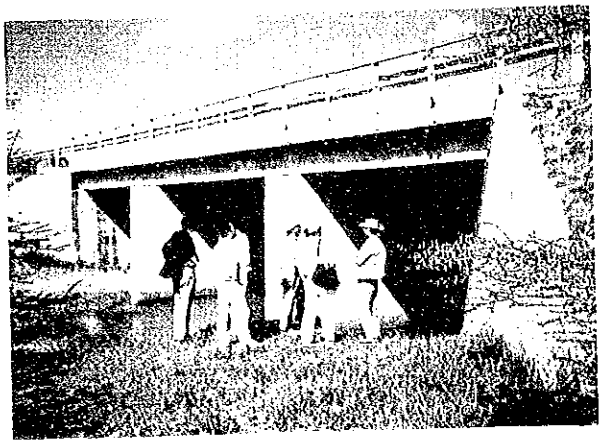
Gravel Road (well maintained)

Gravel Road (in need of maintenance)

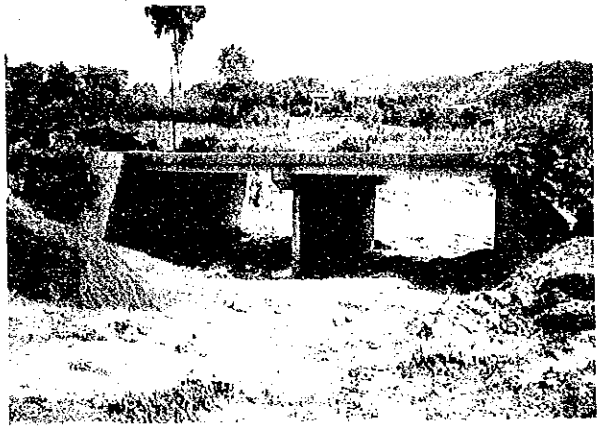
Earth Road (well maintained)

Earth Road (in need of maintenance)

BRIDGE CONDITIONS

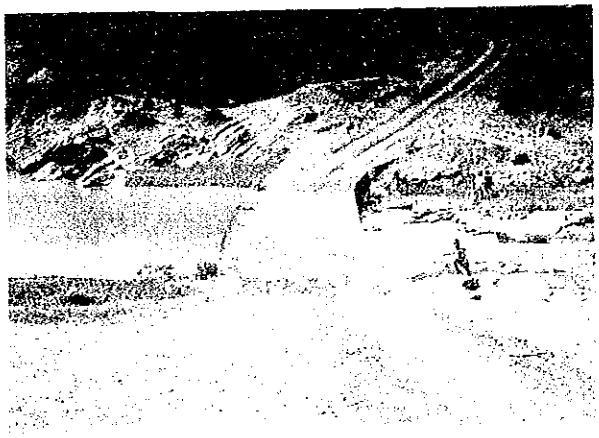


RC Girder Bridge

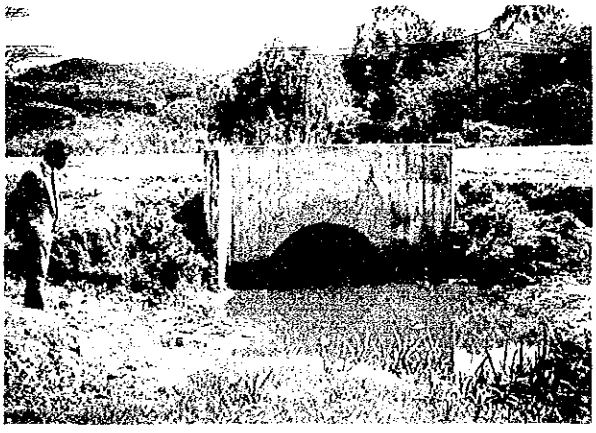


H-steel Girder Bridge

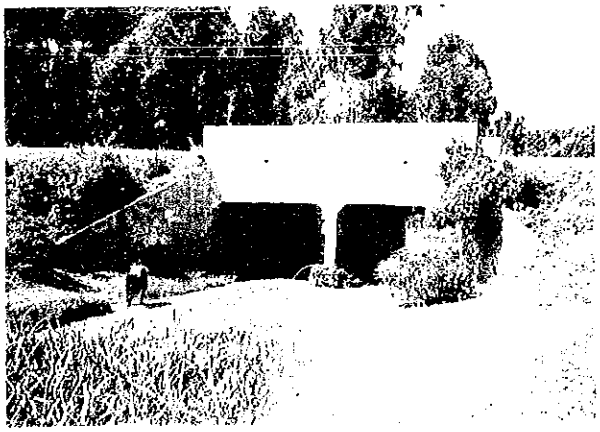
Bailey Bridge



Drift



Pipe Culvert



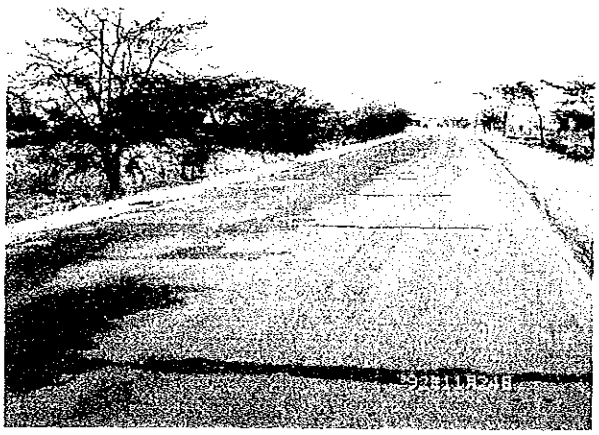
Box Culvert

PRACTICE ON MAINTENANCE ACTIVITIES

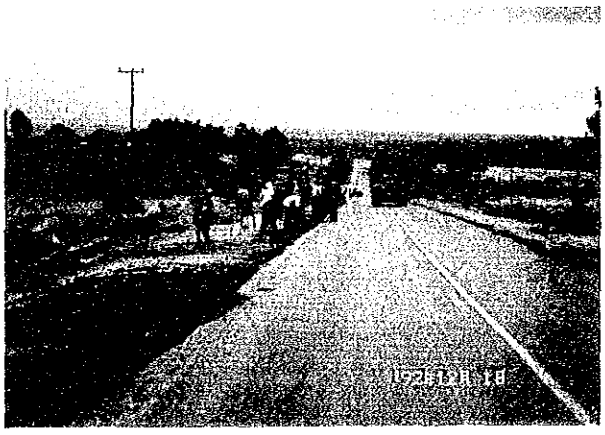
Marking on pot-hole

Sweeping on damaged area
(pot-hole)

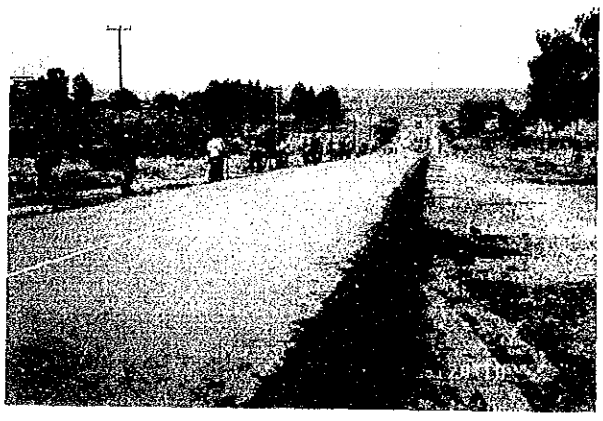
Patching on crack



Partial resealing and patching

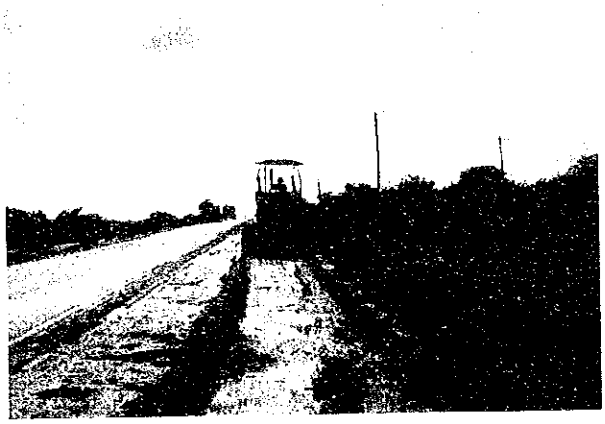


Sweeping on damaged area
(shoulder)

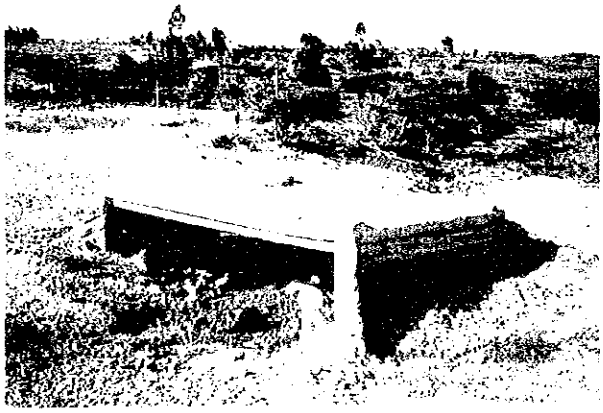


Resealing to shoulder

Filling pot hole with aggregate

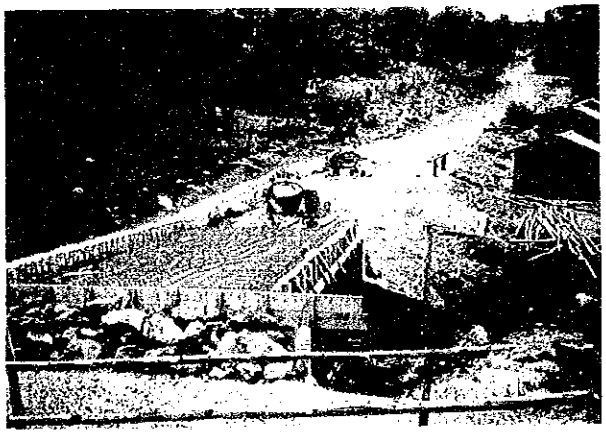


Grading road side



Strengthening on slab and wing
(RC bridge)

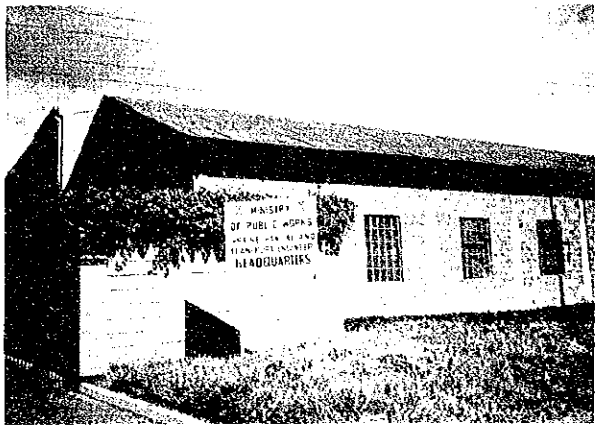
PC Girder yard



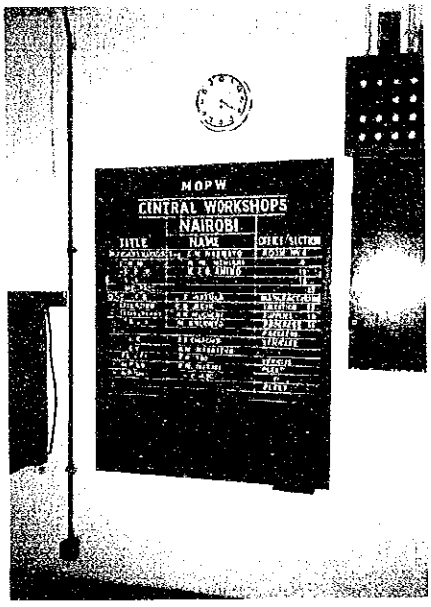
Reconstruction of RC bridge

New construction of RC bridge
from damaged drift

INTRODUCTION OF RD AND MTD*



MTD Headquarters



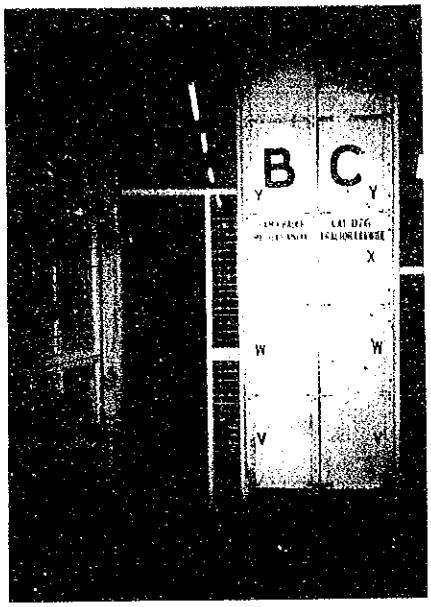
Central Workshops - Engineers -

Central Workshops - Overview -

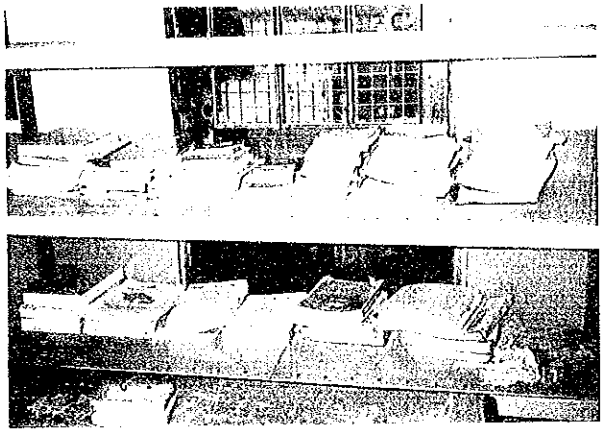
Central Workshops
- Repairing Motor Grader -

Central Workshops
- Vehicle Atelier -

* Note: RD; Road Department
MTD; Mechanical and Transport Department



Central Workshops- Parts Store room -

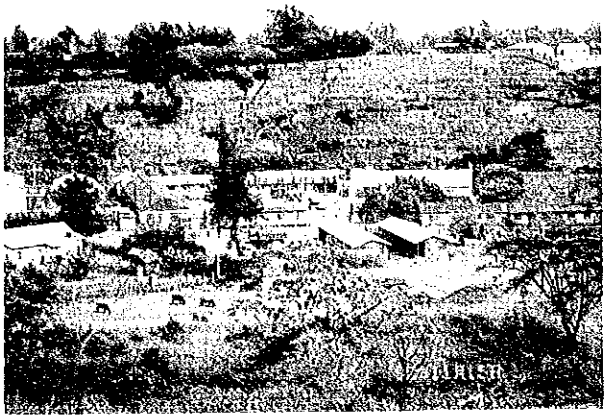


Central Workshops
- Maintenance and Parts Manual -

MACHAKOS PWO * - Overview-

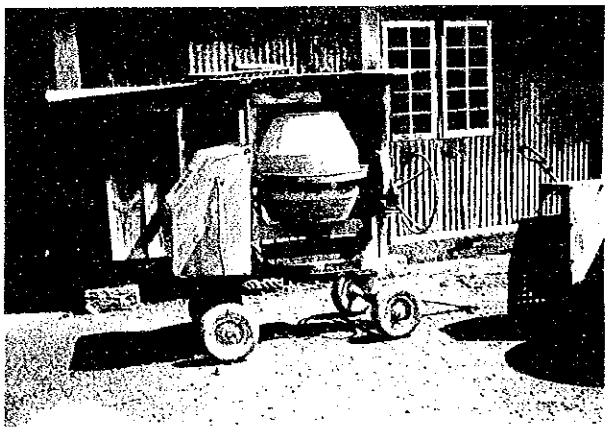
MACHAKOS Bridge Unit - Overview -

* Note: PWO ; Provincial Works Office



CENTRAL PWO - Overview -

CENTRAL PWO - Name plate of PWO -



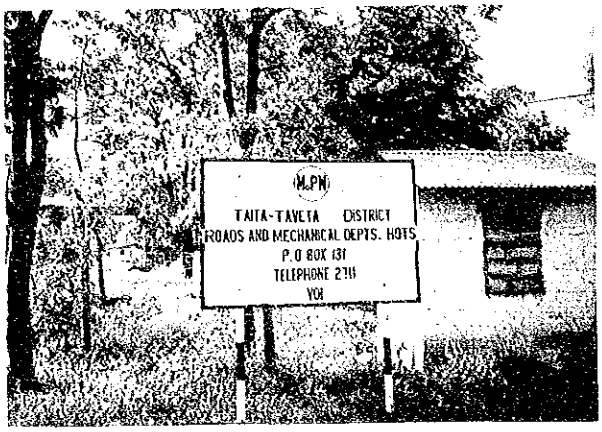
CENTRAL PWO - Concrete mixer -

CENTRAL PWO - Roller

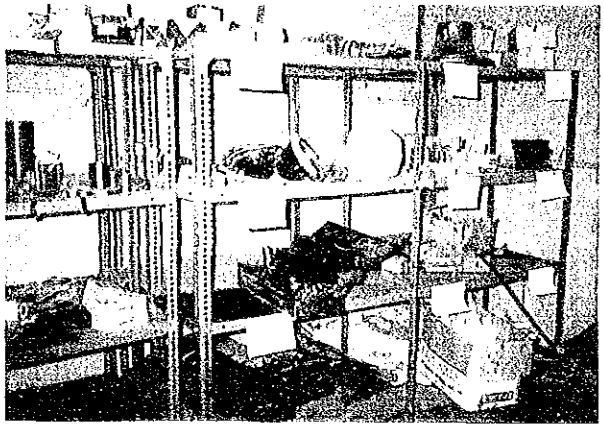
MOMBASA PWO - Overview -

MOMBASA PWO - Japan Overseas Cooperation Volunteer -

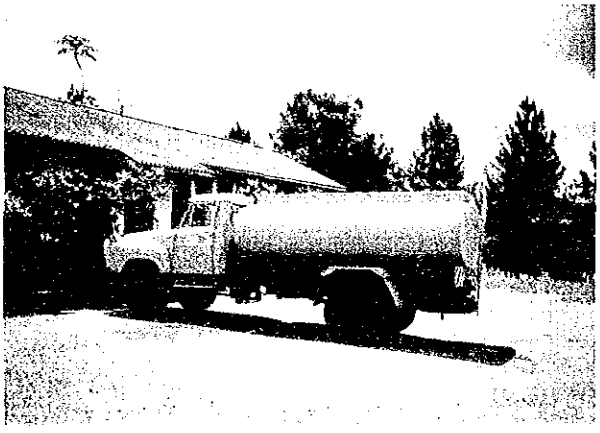
MOMBASA PWO - Repairing pick-up engine -



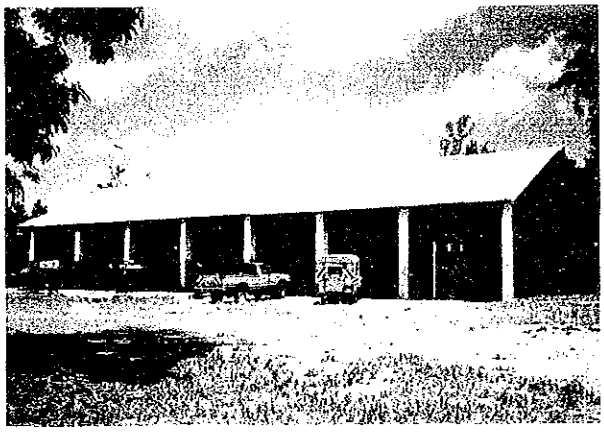
TAITA-TAVETA DWO *



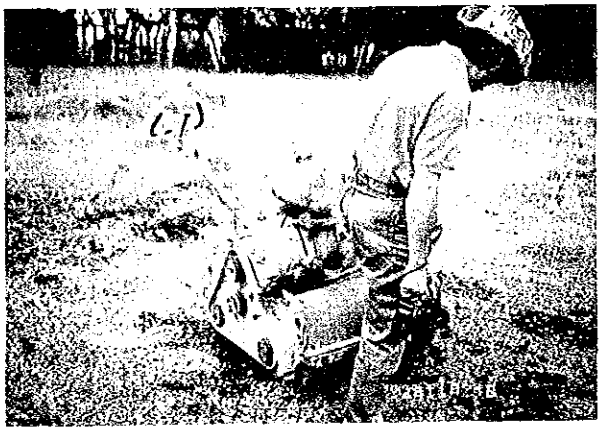
TAITA-TAVETA DWO - Parts store -



KWALE DWO - Tank lorry by Japan's Grant Aid -



KWALE DWO - Workshop -



VOI CAMP - Vibration roller -

MAKINDU CAMP - Concrete mixer -

SULTAN HAMUD CAMP - Vibration roller -

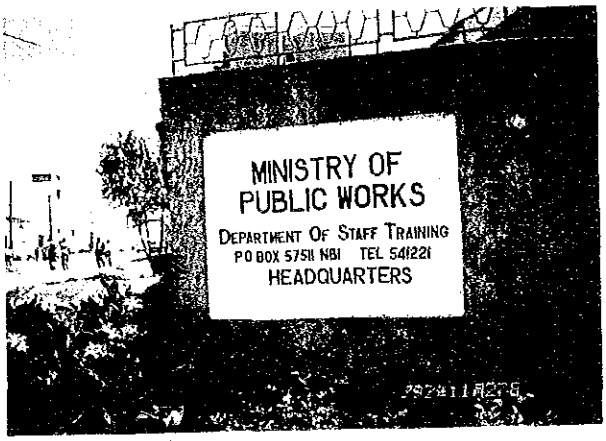
* Note: DWO ; District Works Office

RUIRU MINI-PROJECT FOR WORKSHOP MANAGEMENT

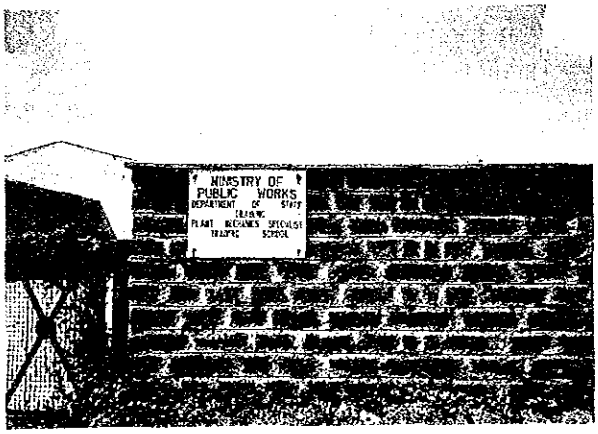
Project board

RUIRU Construction site

TRAINING CENTRE

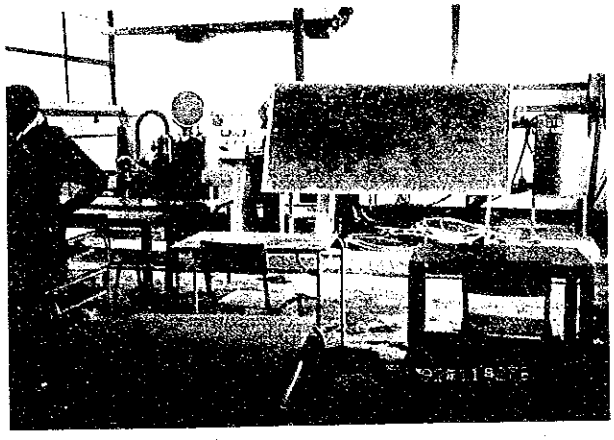


Headquarters

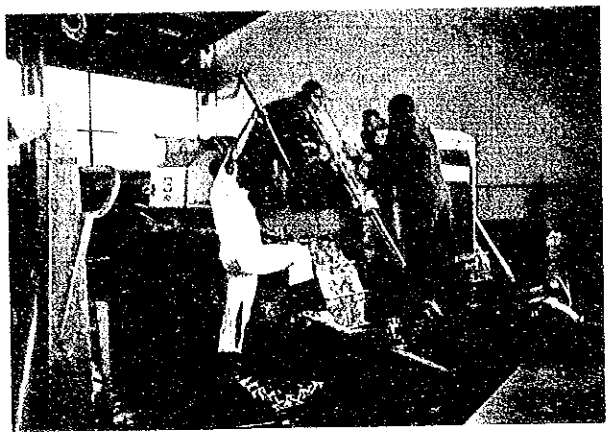


Headquarters - Plant mechanics specialist training school -

Headquarters - Lecture rooms -



Headquarters - Lecture room -



Headquarters - Repairing heavy equipment -

NGONG Site training centre - Overview -

NGONG Site training centre
- Under training (Grader, Shovel) -

SUMMARY

In the 1970s after independence, Republic of Kenya achieved its national goals at high levels thanks to its strategic location in East Africa, its highly developed infrastructure, and its superior educational system. However, in the 1980s, low market prices for coffee and tea (which were Kenya's main exports) produced heavy economic constraints in all sectors. Constraints such as an increase in Kenya's international debt, and slow implementation of the modernization of Kenya.

An efficient transport system, especially a road network in Kenya, is not only a critical infrastructural prerequisite for a country's economic development but it is also a direct contribution to social welfare.

The Ministry of Public Works (MOPW), which retains responsibility for all aspects of road infrastructure, set forth The Third Highway Sector Programme (1992 - 2000) in order to implement The 6th National Development Plan effectively.

The main objectives of The Third Highway Sector Plan are:-

(a) to maintain all of the existing classified road networks to an acceptable standard;

(b) to preserve investments in Kenya's existing roads by:

  i) rehabilitating of deteriorating bitumen roads; and
  ii) re-gravelling of bad gravel roads;

(c) to selectively upgrade the existing road network;

(d) to establish equitable levels of road access throughout the country with special emphasis on rural areas;

(e) to improve the government system, structure and bureaucracy; in particular the Development Planning and Coordination Division, the Mechanical and Transport Department, the Materials Branch and the Department of Staff Training; and

(f) to improve and keep up road safety conditions.

In order to invest in an effective manner the limited funds for roads development, MOPW has given priority to:-

(a) According the highest priority to the maintenance and rehabilitation of the existing roads.

(b) Undertaking the construction of new roads only in those areas where other development projects are planned and where lack of roads would hinder the implementation of those projects.

(c) Undertaking the construction of the classified Minor Roads in those highly-populated areas which have been newly organized for high agricultural output. The construction of these roads will introduce labour-intensive techniques in order to create meaningful employment in those rural areas and thereby improve the living conditions of the inhabitants.

The MOPW has faced such mechanical problems that there is a large amount of old equipment which is un-serviceable for effective site works. Furthermore, highly frequent usage of serviceable equipment will produce more un-serviceable equipment due to mechanical damages which can only be repaired at high cost. In order to overcome this vicious circle, the Government of Kenya, through MOPW, requested that the Government of Japan supply equipment to be assigned for road and bridge maintenance.

In response to the request of the Government of The Republic of Kenya, the Government of Japan decided to conduct the Basic Design Study on the Project for Maintenance Equipment of Road and Bridge in Republic of Kenya. Japan International Cooperation Agency (JICA) dispatched the Basic Design Study Team headed by Mr. Toshimitsu MURAMATSU, Chief of Construction Equipment Division, Road Department, Chubu Regional Construction Bureau, Ministry of Construction, from November 7th to December 5th, 1992, for the field investigation.

The Basic Design Study Team, during its stay in Kenya, collected the relevant data and investigated the conditions of roads, bridges and construction equipment as well as their management scheme.

After returning to Japan, the Team reviewed the collected data, the results of their investigations as well as the effective studies on the appropriate project substance including selection of equipment, distribution scheme of equipment fleet and implementation plan of the Project.

The table hereunder lists type and number of selected equipment.

LIST OF EQUIPMENT

Type of Equipment	Quantity
Light truck	27
Dump truck	38
Cargo truck	27
Vibratory roller	19
Concrete mixer	14
Concrete vibrator	14
Pump	14
Air compressor	2
Vibratory compactor	14
Pneumatic hand breaker	4
Small service truck	10
Spare parts	20%

Implementation of the Project is structured by three phases, i.e. detailed design, procurement (including marine transportation), and handing over. The periods required are five months for detailed design and eight months from procurement to handing over.

The Roads Department (RD) of the Ministry of Public Works (MOPW) is the responsible agent for comprehensively implementing the Project while the Mechanical and Transport Department (MTD) of MOPW takes charge of management for equipment provided. Both RD and MTD should implement and manage the Project in terms of budgetary scale, organization and maintenance system.

The project aims to provide equipment to facilitate sufficient maintenance activities for roads and bridges. Consequently this will contribute to the enhancement of MOPW's managerial ability for equipment as well as to the betterment of "quality" in road transport services.

The implementation of this plan will benefit the 25 million people who reside within the entire 564,000 km² area of Kenya. Especially, great benefits can be expected in those high potential agricultural areas which are situated along the international trunk road which runs from Mombasa Port to Uganda. This road has taken the most important role in the transport sector and extends to a population of 13 million people within a land area of 60,000 km². It will also promote employment opportunities as well as establishing economical and cost-stable transportation service.

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CHAPTER 1

INTRODUCTION

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INTRODUCTION

In response to the request of the Government of The Republic of Kenya, the Government of Japan decided to conduct the Basic Design Study on the Project for Maintenance Equipment of Road and Bridge in Republic of Kenya. Japan International Cooperation Agency (JICA) dispatched the Basic Design Study Team headed by Mr. Toshimitsu MURAMATSU, Chief of Construction Equipment Division, Road Department, Chubu Regional Construction Bureau, Ministry of Construction, from November 7th to December 5th, 1992, for the field investigation.

The Basic Design Study Team, in Kenya, collected the related data and inspected the conditions of roads, bridges and equipment as well as their management scheme. Based on these investigations, this Report has been prepared after conducting the effective studies on the appropriate project scale including reviewing the backgrounds and objectives, analyzing the socio-economic impact and selecting the kinds and amounts of equipment to be provided under the Japan Grant Aid. This report was completed in February, 1993.

The member list of the Study Team, survey schedule, list of persons met in Kenya, Minutes of Discussions and other information are filed in the appendices of this report.

CHAPTER 2

BACKGROUND AND CONTENTS

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2.1 Background

2.1.1 National Development Plan

In the 1970s after independence, Republic of Kenya achieved its national goals at high levels thanks to its strategic location in East Africa, its highly developed infrastructure, and its superior educational system. However, in the 1980s, low market prices for coffee and tea (which were Kenya's main exports) produced heavy economic constraints in all sectors. Constraints such as an increase in Kenya's international debt, and slow implementation of the modernization of Kenya.

The Government of Kenya set up The 6th National Development Plan (1989 - 1993) having the following aims:

(a) the economy will expand in such a way as to create productive employment for almost two million new entrants to the labour force,

(b) this growth must come from agriculture, revitalized industry and small-scale enterprises,

(c) greater foreign exchange generation will have to be achieved through the expanded capacity of the industrial sector to diversity into export orientation in support of traditional exports of agriculture and tourism,

(d) there will have to be moderation in the Government's provision of basic needs services, which calls for cost-sharing,

(e) the Government will play a more significant role in caring for the environment in addition to from providing policy and operational support to private initiative,

(f) the private sector will be given a greater role in the economy and the requisite technical and financial resources will be made available,

(g) in achieving the foregoing, due regard will be given to the judicious management of the public debt, the stability of the currency and the balance of payment and

(h) while growth and employment generation are of critical importance in the structural adjustment process, certain safeguards will be taken to ensure the equitable distribution of the benefits of growth in order to improve the welfare of as many Kenyans as possible.

The targets of this plan and its implementation during 1989 to 1991 are shown in Table 6-1 of Appendix 6.

The policy for transport and communications as indicated in the 6th National Development Plan is:

(a) To accord high priority to the maintenance of existing facilities and services. New investments will be limited only to those which will remove bottlenecks to development and those projects which will yield relatively high returns as a result of new productive sectors of the economy.

(b) To support the Government's efforts in the encompassing programme of District Focus for Rural Development by ensuring that an appropriate level of access is available on a year-round basis.

(c) To afford a reasonable level of transport and communications services to all users throughout the country, especially those services in remote areas and regions with low traffic demand level.

(d) To provide employment opportunities by using labour intensive techniques in the construction and maintenance of transport projects whenever such technology is deemed appropriate.

(e) To develop missing road links with Kenya's neighbours.

2.1.2 Road Development Plan

An efficient transport system, especially a road network in Kenya, are not only critical infrastructural prerequisites for a country's economic development but also make a direct contribution to social welfare.

The Ministry of Public Works (MOPW), which retains responsibility for all aspects of road infrastructure, set forth The Third Highway Sector Programme (1992 - 2000) in order to implement The 6th National Development Plan effectively.

The main objectives of The Third Highway Sector Plan are:-

(a) to maintain all of the existing classified road networks to an acceptable standard;

(b) to preserve investments in Kenya's existing roads by:

i) rehabilitating of deteriorating bitumen roads; and
ii) re-gravelling of bad gravel roads;

(c) to selectively upgrade the existing road network;

(d) to establish equitable levels of road access throughout the country with special emphasis on rural areas;

(e) to improve the government system, structure and bureaucracy in particular the Development Planning and Coordination Division, Mechanical and Transport Department, Materials Branch and Department of Staff Training; and

(f) to improve and keep up road safety condition.

In order to invest in an effective manner the limited funds for roads development, MOPW had given priority on:-

(a) According the highest priority to the maintenance and rehabilitation of the existing roads.

(b) Undertaking the construction of new roads only in those areas where other development projects are planned and where lack of roads would hinder the implementation of those projects.

(c) Undertaking the construction of the classified Minor Roads in those highly-populated areas which have been newly organized for high agricultural output. The construction of these roads will introduce labour-intensive techniques in order to create meaningful employment in those rural areas and thereby improve the living conditions of the inhabitants.

Financial schedule of this programme is shown in Table-1.

Table-1 THIRD HIGHWAY SECTOR PROGRAMME

K£ million

	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/2000	Total
Development	150	199	179	206	242	266	242	222	1,706
On-going Project	138	146	112	72	64	45	15	9	601
New Project	12	53	67	134	178	221	227	213	1,105
Recurrent	112	117	123	118	103	86	76	73	808
On-going Project	45	46	50	51	54	55	58	60	419
New Project	67	71	73	67	49	31	18	13	389
T o t a l	262	316	302	324	345	352	318	295	2,514

Source: Appendix 5, 5-1

2.1.3 Conditions on Road Sector

The value of output of the transport modes is provided in Table-2.

Table-2 VALUE OF OUTPUT, 1987 ~ 1991

K£ million

	1987	1988	1989	1990	1991
Road	311.7 (49.9)	355.2 (50.0)	420.1 (48.6)	476.9 (45.6)	510.5 (44.2)
Railway	60.7 (9.7)	67.9 (9.6)	80.0 (9.3)	94.5 (9.0)	112.6 (9.7)
Water	75.5 (12.1)	79.0 (11.1)	109.9 (12.7)	134.2 (12.8)	148.7 (12.9)
Air	131.3 (21.0)	155.7 (21.9)	192.6 (22.3)	268.2 (25.6)	316.2 (27.4)
Services	45.6 (7.3)	52.2 (7.4)	61.2 (7.1)	72.7 (7.0)	67.1 (5.8)
Incidental	624.8(100.0)	709.3(100.0)	863.8(100.0)	1046.5(100.0)	1155.5(100.0)

Source: Appendix 5, 5-2
Note: 1) ( ) is percentage of total
2) Value in 1991 is provisional

Road transport contributes 44% of the total output of the transport sector in 1991, while contributions of other transports are not more than 30%.

Table-3 shows the number of registered vehicle in Kenya, annually growing with a 6% growth rate for the past several years.

Table-3 NUMBER OF REGISTERED VEHICLES

Number

	1986	1987	1988	1989	1990
Motor Cars	127,351	133,335	141,791	149,696	157,696
Utilities, panels, vans, pick-ups, etc.	69,457	73,718	78,501	83,500	88,300
Lorries, trucks and heavy vans	25,190	27,916	29,706	31,183	32,583
Buses and Mini-buses	8,218	9,172	10,756	12,006	13,208
Motor and auto cycles	18,990	20,121	21,252	22,347	23,447
Other motor vehicles	19,415	20,345	21,582	22,347	23,843
Trailers	11,814	12,272	12,915	13,533	14,157
Total	280,435	296,879	316,403	334,808	353,408

Sources: Appendix 5, 5-3
Note: 1) Numbers in 1990 are provisional

The present road system with a combined total length of approximately 150,600 km of classified and unclassified roads, consists of a highly diversified network ranging from dry-weather earth roads to bitumen highways carrying high volumes of traffic.

The Ministry of Public Works (MOPW), through its Roads Department (RD), is the overall authority responsible for design, construction, and maintenance of the classified road network at present totaling 52,000 km. In addition RD has responsibility for some 11,000 km of classified roads covering special purposes like access to agricultural schemes, Government access, and improved rural access. Thus the MOPW is currently administering a road network of about 63,000 km out of a combined total national network of 150,600 km. The balance, 87,500 km, falls within the jurisdiction of the various authorities including the Municipal Councils, National Parks and Reserves, and the Ministry of Agriculture, and Local Governments.

Table-4 provides the roads' lengths under MOPWs' responsibility by road class and surface type, and Figure-1 shows a trunk and main road network.

Table-4 ROADS LENGTH BY CLASS AND SURFACE TYPE

AS OF JUNE 1992

CLASS OF ROAD	SURFACE TYPE			TOTAL (Km)
	BITUMEN (Km)	GRAVEL (Km)	EARTH (Km)	
International Trunk Roads	2,667	783	241	3,691
National Trunk Roads	1,403	821	524	2,748
Primary Roads	2,503	3,292	2,160	7,955
Secondary Roads	1,171	6,128	3,922	11,221
Minor Roads	664	6,711	19,138	26,513
Sub-total	8,408	17,736	25,984	52,128
Special Purpose Roads	214	8,357	2,422	10,993
T o t a l	8,622	26,093	28,406	63,121

Source: Appendix 5, 5-4.

A visual inspection of the condition of paved roads in 1990 classified 2,600 km (32%) as in Good condition, 3,100 km (39%) as in Fair condition, and 2,200 km (28%) as in the Critical condition. Good condition implied that nothing more than continued correct maintenance was required, Fair condition implied that some form of periodic maintenance was necessary, and Critical condition indicated that a substantial amount of pavement failure had taken place, and immediate rehabilitation was necessary to keep the road in operation. In the absence of correct remedial treatment, Good roads will deteriorate into Fair condition, and Fair roads will progressively fail and require rehabilitation.

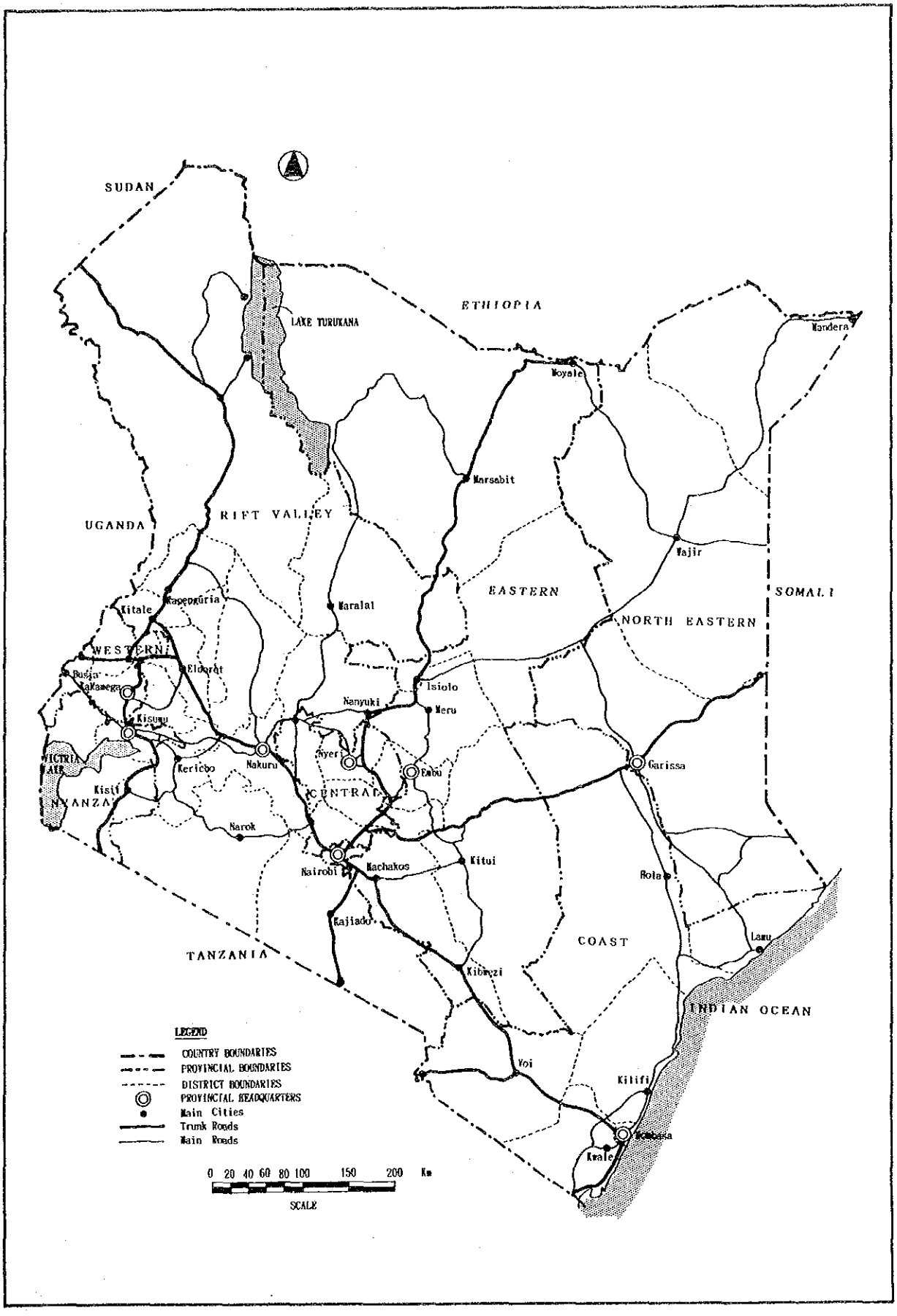


Figure-1 TRUNK AND MAIN ROAD NETWORK

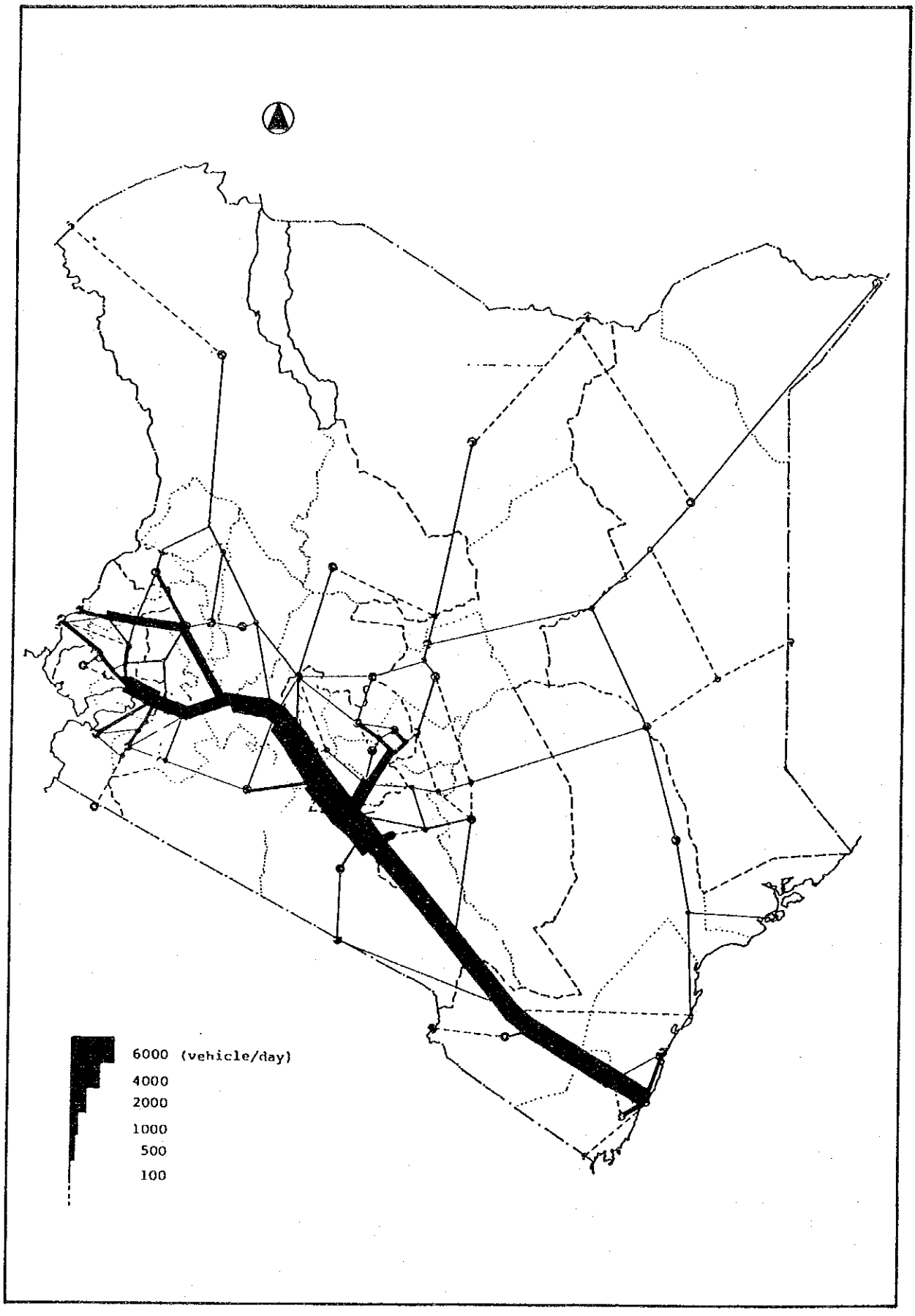


Figure-2 AVERAGE DAILY TRAFFIC VOLUME : 1983

2.1.4 Development and Technical Assistance of International Agencies

The Government of Kenya has sought and received considerable multi-lateral and bilateral donor support in the form of loans, credits and grant aid, for the implementation of various road development programmes since 1979. The assistance realized by the World Bank was as follows:

- 1979-1983, The First Road Sector Programme
  Road construction, Maintenance, Traffic law enforcement and Road safety
- 1984-1989, The Second Road Sector Programme
  Continuity of The First Road Sector Programme, Strengthening of institutions and assistance of the domestic construction industry

The total amounts released by bilateral donor support of France, Germany and Japan and loaned by the African Development Bank, Arab Bank for Economic Development in Africa, etc., including the World Bank during 1981 and 1984 were 240 billion K£.

The Government of Kenya is presently asking the World Bank Group to resume multi-lateral donor support stopped since November 1991 and preparing the documents for inviting donor countries to effectively implement The Third Road Sector Programme (1992-2000) introduced in Section 2.1.2.

The Government of Japan supplied the construction equipment for agricultural road maintenance to Kenya in 1984 and 1988, as follows:

- Year	; FY/1984		FY/1988
- Project name	; Supplying Equipment for Agricultural Road Maintenance		Same as left
- Amount	; 600,000,000 Yen		596,000,000 Yen
- Date of E/N	; December 1984		November 1988
- Contents	; Motor grader	30	Motor grader 40
	Truck	20	Tank lorry 21
	Tank lorry	10	Pick up truck 40
	Concrete mixer	25	
	Pedestrian vibration roller	40	
	Wagon car	10	
	Pick up truck	20	

2.2 Outline of Request

MOPW has faced such mechanical problems that there is a large number of old equipment which is un-serviceable for effective site works and highly frequent usage of serviceable equipment will produce more un-serviceable equipment due to mechanical damages which can only be repaired at high cost. In order to overcome this vicious circle, the Government of Kenya, through MOPW, requested to the Government of Japan to supply the equipment listed in Table-5, to be assigned for road and bridge maintenance.

Table-5 REQUESTED ROAD AND BRIDGE MAINTENANCE EQUIPMENT

Number

EQUIPMENT / PROVINCE/DISTRICT	TRUCK F.B.7T	TIPPER 7-8T	PICK-UP	PEDES-TRIAN VIBR. ROLLERS 700KG.	GRAWLER TRACTOR 90HP	FRONT WHEELED LOADER 1m³	CON-CRETE MIXER (hand fed 175 litrs)	CON-CRETE VIB-RATOR	WATER PUMP	COM-PRESSOR	CON-CRETE BREAKER	TRUCK CRANE 6 TON	BACKHOE EX-CAVATOR	PRIME MOVER WITH TRAILER	TOTAL
Nairobi	1B	2	1B											1	5
Central Prov. HQ.	1		1	1B			6B	6B	6B						21
Kiambu	1	2	1	1											5
Kirinyaga	1	2	1	1											5
Muranga	1	2	1	1											5
Nyandarua	1	2	1	1											5
Nyeri	1	2	1	1											5
Coast Prov. HQ.	1B		1B	1B			6B	6B	6B						21
Kilifi	1	2	1	1											5
Kwale	1	2	1	1											5
Lamu	1	2	1												4
Mombasa	1	2	1	1											5
Taita Taveta	1	2	1	1											5
Tana River	1	2	1	1											5
Eastern Prov. HQ.	1B		1B	1B			3B	3B	3B						12
Embu	1	2	1	1											5
Isiolo	1	2	1	1B			1B	1B	1B						8
Kitui	1	2	1	1											5
Machakos	1	2	1	1B			3B	3B	3B						14
Marsabit	1	2	1												5
Meru	1	2	1	1											5
Makueni	1	2	1	1	1	1									7
N/Eastern Prov. HQ.	1B		1B	1B			3B	3B	3B						12
Garissa	1	2	1												4
Mandera	1	2	1												4
Wajir	1	2	1												4
Nyanza Prov. HQ.	1B		1B	1B			6B	6B	6B						21
Kisii	1	2	1	1											5
Kisumu	1	2	1	1											5
Siaya	1	2	1	1											5
Homa Bay	1	2	1	1											5
Nyamira	1	2	1	1	1	1									7
Migori	1	2	1	1	1	1									7
Rift Valley Prov. HQ.	1B		1+1B	1+1B			6B	6B	6B						22
Kajiado	1	2	1	1B			1B	1B	1B						8
Kericho	1	2	1	1											5
Laikipia	1	2	1												4
Nakuru	1	2	1	1											5
Narok	1	2	1	1											5
Trans Nzoia	1	2	1	1											5
Uasin Gishu	1+1B	2	1+1B	1B			6B	6B	6B						25
Baringo	1	2	1	1											5
Elgeyo Marakwet	1	2	1	1											5
Nandi	1	2	1	1											5
Samburu	1	2	1												4
Turkana	1	2	1	1											5
West Pokot	1	2	1	1											5
Western Prov. HQ.	1B			1B			5B	5B	5B						17
Bungoma	1	2	1	1											5
Busia	1	2	1	1											5
Kakamega	1	2	1	1											5
Vihiga	1	2	1	1	1	1									7
BRIDGES															
Nairobi HQ.	2		2		1	1				2	1	1	2	1	16
TOTAL:	55	90	55	45	5	5	46	46	46	2	1	1	2	1	403

Note: "B" denotes Bridging Unit

2.3 Study of the Project

2.3.1 Technical Background

2.3.1.1 Study Area and Relevant Data

The study of the Project covers all of Kenya divided into seven administrative Provinces whose boundaries are shown in Figure-3 together with the locations of Provincial Works Offices and District Works Offices under MOPW.

Table-6 provides road length and the number of bridges falling under the jurisdiction of each Provincial Works Office (Appendix 6 Table 6-2 gives data on District Works Offices).

Table-6 ROAD LENGTH AND NUMBER OF BRIDGES IN PROVINCIAL WORKS OFFICES

As of June 1992

Provincial Works Office	Road Length (Km)				Road Density 1)	Number of Bridges 2)
	Bitumen	Gravel	Earth	Total		
Nairobi	352	31	2	385	56	-
Central	1,944	3,362	2,430	7,736	59	73
Coast	761	1,830	3,268	5,859	7	52
Eastern	1,097	4,829	7,065	12,991	8	86
Northeastern	147	659	4,046	4,852	4	15
Nyanga	747	3,716	2,737	7,200	57	67
Rift Valley	3,169	9,186	7,700	20,055	12	150
Western	405	2,480	1,164	4,049	49	70
Total	8,622	26,093	28,406	63,121	11	513

Source: Appendix 5, 5-4

Note: 1) Road Density = [Road Length (Km)/Land Area (Km^2)] x 10^{-2}

2) Number of bridges programmed in budget for 5 years 1988/89 - 1992/93.

The length of roads where routine maintenance work will be required is approximately 20,000 km, i.e. 32% of 63,000 km, which is classified as in Good surface condition (refer to Section 2.1.3), while the number of bridges to be maintained is one hundred in a year according to budget allocation tables for 5 years during 1988/89 to 1992/93.

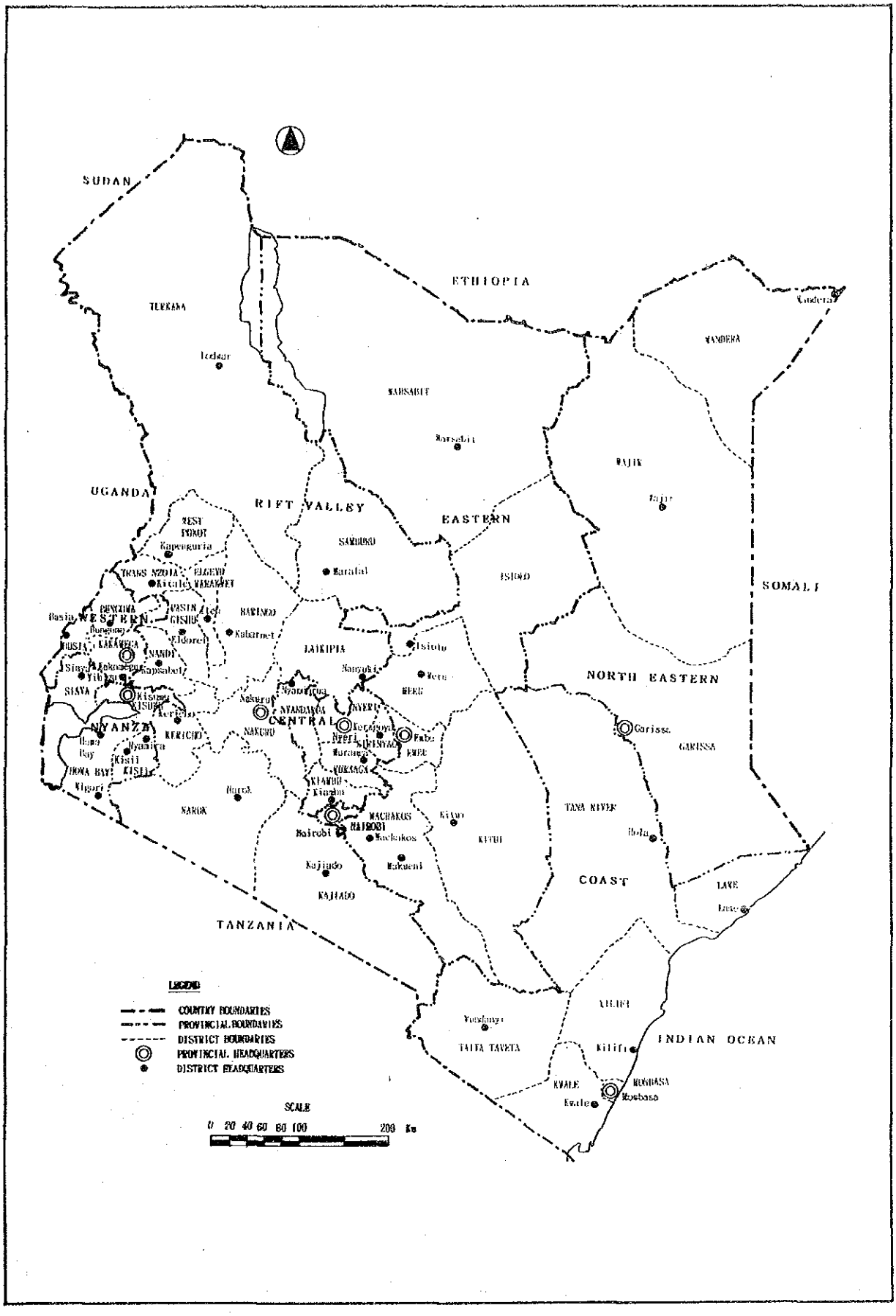


Figure-3 ADMINISTRATIVE BOUNDARIES IN KENYA

Bridge maintenance works include maintaining the following types of bridges and reconstructing or constructing small bridges with about 20 m span:

- RC Girder Bridge (single-lane, 2-lane)
- H-Steel Girder Bridge
- Bailey Bridge
- Drift (concrete, gabion)
- Culvert (box, pipe)

Photographs on page Ph-ii at the beginning of this report illustrate typical structure of above.

2.3.1.2 Methods for Road and Bridge Maintenance

All phases of road and bridge maintenance, from planning to implementation and monitoring, are managed by the Highway Maintenance Management System (HMMS) which was initiated in Oct. 1986 with support from the World Bank and has been fully functioning since Feb. 1990.

Maintenance works include periodic activities and routine activities. The periodic maintenance activity of resealing and re-gravelling is executed both by sub-contracted workers and government employees. Routine maintenance is all carried out by the force account units of the Roads Department, MOPW.

In this Section, the maintenance methods and necessary equipment fleet are briefed based on HMMS.

1. for Gravel Roads

Method

(1) Grading
(2) Patching
(3) Re-gravelling

Equipment Fleet (Table-7)

Table-7 TYPICAL EQUIPMENT FLEET FOR GRAVEL ROAD MAINTENANCE

(1) Grading	(2) Patching	(3) Re-gravelling
· Motor Grader : 1 · Tyred Roller : 1~2 · Water Tanker : 1 · Pump Water/Mud : 1~2 · Pick up : 1	· Truck : 1 · Hand Roller : 1	· Dozer : 1 · Wheeled Loader : 1 · Tipper Truck : 3~4 · Motor Grader : 1 · Tyred Roller : 1~2 · Water Tanker : 1 · Pump Water/Mud : 1~2 · Pick up : 1

2. for Bitumen Roads

Method

(1) Routine Activity : General Repairs
- Sanding
- Local Sealing
- Crack Sealing
- Filling in Depressions
- Patching

(2) Periodic Activity :
- Surface Dressing
- Overlays

Equipment Fleet (Table-8)

Table-8 TYPICAL EQUIPMENT FLEET FOR BITUMEN ROAD MAINTENANCE

(1) Routine Activities	(2) Periodic Activities	
General Repairs : Sanding, Local Sealing Crack Sealing, Filling in Depressions Patching	Surface Dressing	Overlays
· Mobile Bitumen Pre-Mixer : 1 · Tipper Truck : 1 · Hand Roller : 1 · Pick up : 1	· Garbage Truck : 1 · Mobile Bitumen Pre-Mixer : 1 · Material Truck (Tipper Truck) : 3~4 · Tyred Roller : 2 · Wheeled Loader : 1 · Truck : 1 · Tipper Truck : 1	· Garbage Truck : 1 · Bitumen Distributor : 1 · Finisher : 1 · Steel Wheeled Roller : 1 · Tyred Roller : 1 · Tipper Truck : 4~5 · Pick up : 1

3. for Bridges

Method

	Kinds of Work			
	Earth Work	Concrete Work	Remove Cleaning Work	Manpower Work
· Maintenance of approach road	*			
· Construction of short span bridge		*		
· Replacement of deck		*	*	*
· Expansion of span		*	*	
· Rehabilitation of bridge		*	*	
· Construction of river protection, etc.	*	*		*
· Removing of bridge			*	*
· Maintenance and construction of bridge facilities	*	*	*	
· Cleaning			*	*

Equipment Fleet (Table-9)

Table-9 TYPICAL EQUIPMENT FLEET FOR BRIDGE MAINTENANCE

(1) Earth Work		(2) Concrete Work		(3) Remove · Cleaning Work	
· Tipper Truck	: 1	· Concrete Mixer	: 2	· Breaker	: 4
· Small Dozer	: 1	· Concrete Vibrator	: 2	· Compressor	: 2
· Vibrating Compactor	: 2	· Pump Water/Mud	: 2	· Truck	: 1
· Pump Water/Mud	: 2	· Truck	: 1	· Pick up	: 1
· Truck	: 1	· Pick up	: 1		
· Pick up	: 1				

2.3.1.3 Condition of Equipment Registered in MOPW

The total number of construction equipment registered in MOPW is 6,147 of which a half is classified as "now usable" defined as below.

now usable equipment:
equipment in operation or standing by for operation, and classified as "serviceable (sv)" under Equipment Management System (EMS) of MOPW.

now unusable equipment:
equipment unable to be in operation now, and classified in followings under EMS;
"Under Repair (UR)", "Unserviceable & beyond Repair (US)", "Boarded (BD)", "Disposed of (DD)", "Waiting for Parts (WP)", "Moving to next section (MO)", "Recommended for boarding (BR)", "Accident Write of (AW)", "Unserviceable & Repairable (ER)" and "No Record (NR)".

Table-10 shows the conditions of equipment for maintenance purpose, totaled to 3,253 numbers. Among them, 1,363 pieces of equipment (42%) are "now usable" and 1,890 pieces (58%) are "now unusable".

Monthly Reports specified in "Equipment Maintenance System (EMS, refer to Section 2.3.2.3)" and reported by Provincial Works Offices through District Works Offices indicate that 38% of the total are under "now usable" while 62% are under "now unusable" as shown in Table-11.

The reason that more than 60% of the equipment is under "now unusable" is not for lack of a proper management system for equipment maintenance, but rather it is the practice that reparable equipment has been rebuilt by using spare parts which have been taken from old aged equipment in completely unusable condition.

Table-10 CONDITION OF MAINTENANCE EQUIPMENT IN MOPW

Number

Main Class	Now Usable	Now Unusable		Total
		Under Repair	Others	
Trucks	159 (37)	92 (21)	181 (42)	432
Tipper Trucks	201 (38)	70 (13)	258 (49)	529
Wheeled Tractors	388 (50)	63 (8)	324 (42)	775
Supervisory Vehicles	152 (41)	72 (20)	143 (39)	367
Tractors	48 (33)	41 (28)	57 (39)	146
Graders	150 (37)	102 (26)	150 (37)	402
Rollers (Pedestrian Vib.)	47 (52)	15 (16)	29 (32)	91
Rollers (Tandem/Wheeled)	25 (34)	7 (9)	42 (57)	74
Rollers (Tyred)	16 (32)	3 (6)	31 (62)	50
Bitumen Equipment	22 (478)	3 (7)	21 (45)	46
Mixers	27 (51)	2 (4)	24 (45)	53
Water Tanks	46 (43)	14 (16)	47 (44)	107
Loaders	40 (41)	20 (20)	38 (39)	98
Fuel Tankers	42 (51)	14 (17)	27 (32)	83
Total	1,363 (42)	518 (16)	1,372 (42)	3,253

Source : Appendix 5, 5-5
Note : 1) Figures in ( ) are percentage to total.

Table-11 CONDITION OF MAINTENANCE EQUIPMENT IN PROVINCIAL · DISTRICT WORKS OFFICES

Provincial Works Office		District Works Office		Condition		
				Now Usable	Now Unusable	Total
NAIROBI		Nairobi	Number	12	22	34
			(%)	(35)	(65)	
CENTRAL		Kiambu	Number	26	53	79
			(%)	(33)	(67)	
COAST		Klifi		16	37	53
		Kwale		16	23	39
		Lamu		19	22	41
		Mombasa		25	68	93
		Taita Taveta		32	40	72
		Tana River		16	24	40
		Sub-Total	Number	124	214	338
			(%)	(37)	(63)	
EASTERN		Embu		18	36	54
		Isiolo		23	16	39
		Kitui		31	75	106
		Machakos		32	87	119
		Meru Makueni		7	13	20
		Sub-Total	Number	111	227	338
			(%)	(33)	(67)	
NORTH EASTERN		Garissa		14	18	32
		Mandera		18	58	76
		Wajir		21	29	50
		Sub-Total	Number	53	105	158
			(%)	(34)	(66)	
NYANZA		Kisii		17	2	19
		Siaya		27	45	72
		Sub-Total	Number	44	47	91
			(%)	(48)	(52)	
RIFT VALLEY	A	Kajiado		25	29	54
		Kericho		31	33	64
		Narok		6	13	19
		Trans Nzoia		20	23	43
		Uasin Gishu		24	44	68
		Sub-Total	Number	25	29	54
			(%)	(43)	(57)	
	B	Baringo		32	39	71
		West Pokot		8	10	18
		Sub-Total	Number	40	49	89
			(%)	(45)	(55)	
WESTERN		Bungoma		26	25	51
		Kakamega Vihiga		42	67	109
		Sub-Total	Number	68	92	160
			(%)	(43)	(57)	
Total		27 Districts	Number	584	951	1,535
			(%)	(38)	(62)	

2.3.2 Project Description

2.3.2.1 Executing Agency and Operational Structure

1. Organization of the Ministry of Public Works

The ministry responsible for the Project is the Ministry of Public Works (MOPW) which is the overall authority responsible for design, construction and maintenance of the classified road network, as mentioned in Section 2.1.3.

The organizational structure of the MOPW is shown in Figure-4. The function of road planning is the responsibility of the Development Planning and Coordination Division while that of the Roads Department (RD) is design, construction, and maintenance of roads. The research and testing of all road making materials and quality control, especially during construction, is carried out by the Materials Department. The Mechanical and Transport Department (MTD) provides and maintains the plant and equipment used for road construction and maintenance.

The Roads Department (RD) is headed by the Chief Engineer (Roads) who reports to the Permanent Secretary of MOPW through the Engineer-In-Chief. The Department is divided into four main branches of Design, Construction, Special Projects, and Maintenance, each of which is headed by a Chief Superintending Engineer. Further subdivisions of the RD are shown in Figure-5.

The current staff of the RD is composed of 12,279 employees consisting of: 174 engineers, 1,059 road supervisors; 1,867 technicians and artisans, the majority of which are associated with the plant and equipment maintenance; 1,255 drivers and plant operators, and 7,924 support and other general staff.

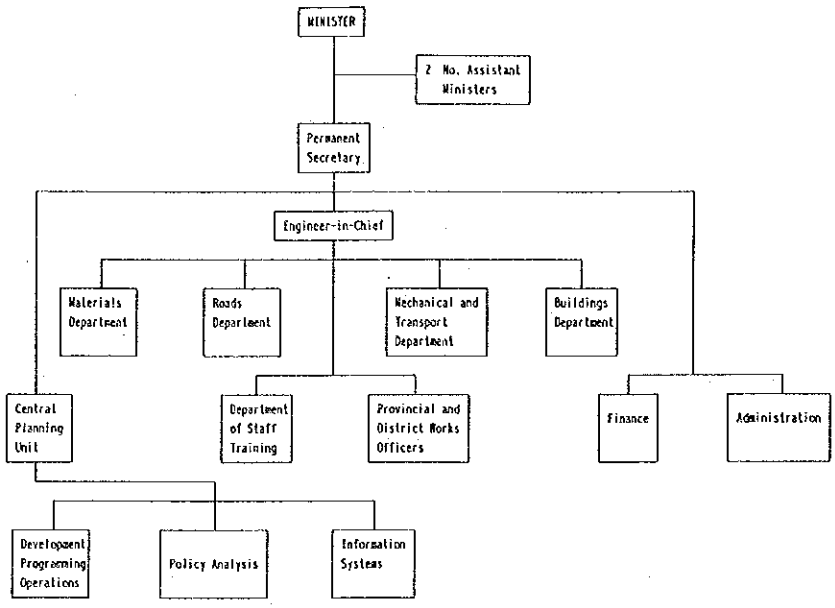
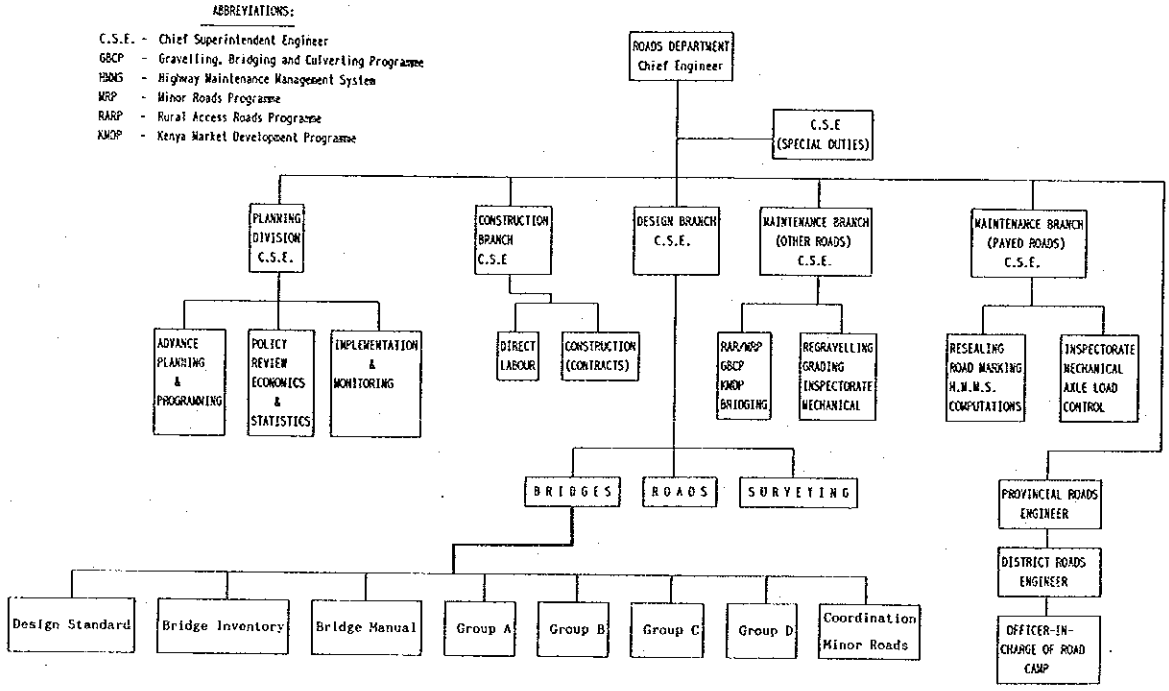


Figure-4 ORGANIZATION OF THE MINISTRY OF PUBLIC WORKS



GEOGRAPHICAL AREAS FOR EACH GROUP

Group A : Central Province,
Kajiado, Laikipia and Samburu (Kajiado B.U.)

Group B : Embu, Meru, Isiolo and Marsabit (Embu B.U.)
Coast and N. Eastern Province
Machakos and Kitui Districts (Machakos B.U.)

Group C : Nakuru, Kericho, Narok and Baringo Districts (Njoro B.U.)
Uasin Gishu, Transzoia, Nandi, Elgeyo Marakwe and West Pokot (Eldoret B.U.)

Group D : Nyanza & Western Province
Turkana District.

Figure-5 ORGANIZATION OF THE ROAD DEPARTMENT

2. Organization of the Mechanical and Transport Department

The implementing agency of the Project is the Mechanical and Transport Department (MTD) which is structured by 6 main Divisions, i.e. Workshop, Supplies, Technical, Design, Administration and Operation, shown in Figure-6. The operation division assigns staff including mechanical engineers, supervisors, etc. in 7 Provincial Works Offices and in 45 District Works Offices. Table-12 presents the number of staff under MTD in each Provincial Works Office.

Table-12 STAFF DISTRIBUTION OF MTD

	Number
Headquarters (Nairobi)	14
Northeastern	106
Central	191
Coast	100
Western	178
Rift Valley	99
Eastern	195
Nyanza	228
Nairobi + Central Workshop	481
Total	1,622

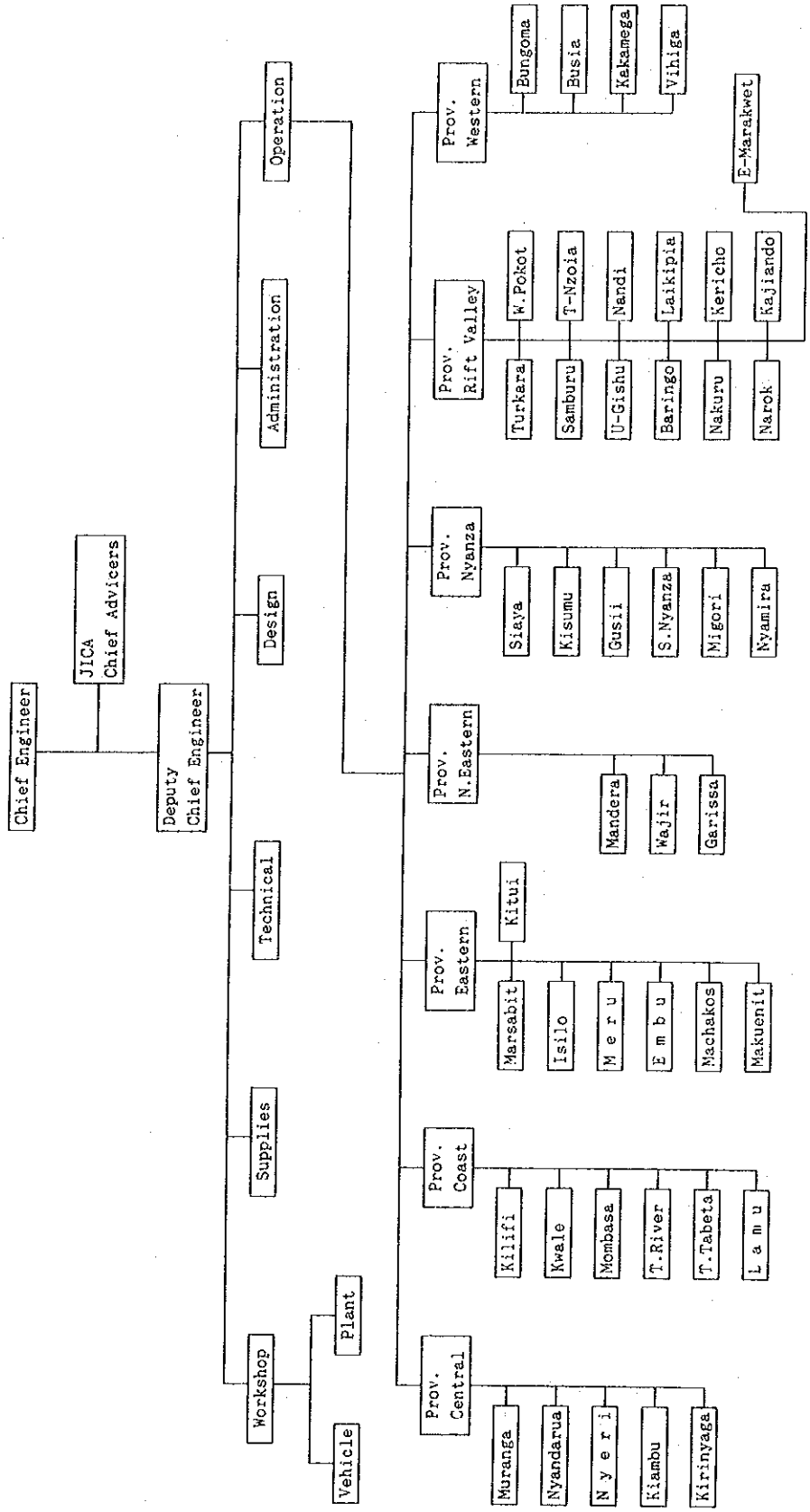


Figure-6 ORGANIZATION OF THE IMPLEMENTING AGENCY

3. Organization of Provincial and District Works Offices

List and organization of Provincial Works Offices are provided in Table-13 and Figure-7 respectively.

Table-13 PROVINCIAL WORKS OFFICES

Provincial Works Office	Location of Headquarters	Number of District Works Offices	Number of Road Camps
Nairobi	Nairobi	1	1
Central	Nyeri	5	40
Coast	Mombasa	6	31
Eastern	Embu	7	47
Northeastern	Garrisa	3	7
Nyanza	Kisumu	6	38
Rift Valley	Nakuru	4	23
Western	Kakamega	4	23
		45	275

The District Works Offices are sub-divided into 275 Road Camps which are distributed throughout the country according to the density of the road network. Each Road Camp covers an average of 230 km.

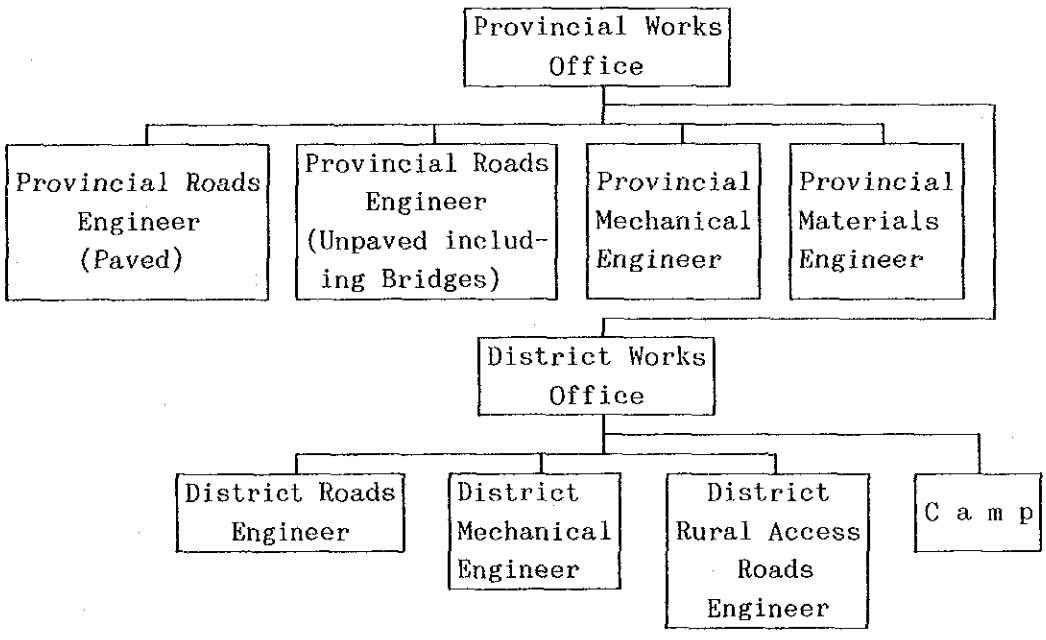


Figure-7 ORGANIZATION OF PROVINCIAL WORKS OFFICES

2.3.2.2 Availability of Funds for Road Maintenance

Table-14 shows the availability of funds for road activities from FY 1988/89 to the proposed FY 1992/93.

Table-14 AVAILABILITY OF FUNDS FOR ROAD ACTIVITIES (1988/89 ~ 1992/93)

K£ Million

	1988/89	1989/90	1990/91	1991/92	1992/93
1. Road Maintenance	31	34	39	43	46
· Treasury	24	23	25	26	29
Recurrent main budget	5	6	8	8	10
Miscellaneous	1	1	1	2	1
HQ Adm./Personnel	4	4	4	4	5
District Adm./Personnel	14	12	12	12	13
· Road Tolls	7	11	14	17	17
2. Capital Expenditure	47	88	94	111	109
Total (1 + 2)	78	122	133	154	155

Source: Appendix 5, 5-12

Total available funds (excepting road tolls which totaled K£ 126 million in FY 1992/93), correspond to approximately 4.5% of the national budget in each year, and the funds from Treasury for road maintenance have accounted for 1% of the national budget for this duration.

On the other hand, necessary costs for road maintenance activities in a year have been estimated by HMMS through some revisions, as provided in Table-15.

Table-15 NECESSARY COSTS FOR ROAD MAINTENANCE ACTIVITIES

K£ Million

Items	Costs
1. Bitumen Roads	55
Routine	3
Periodic	13
Off Pavement (Shoulders/drains/marking)	10
Overlay	29
2. Earth and Gravel Roads	61
Routine	36
Periodic (Re-gravelling)	25
Total (1 + 2)	116

Source: Appendix 5, 5-12

The necessary costs for road maintenance, K£ 116 million, is 2.5 times of the funds available for road maintenance, K£ 46 million (refer to Table-14). In this regard, the MOPW organized a "Road Maintenance Initiative Policy Seminar" on June 1992 and presented the following budgetary policy:

> "Statutory mechanisms should be established to ensure the provision of a minimum of 120 million Kenyan pounds per annum at 1992 prices for expenditure on highway maintenance activities. These provisions should be made from the revenues accruing from direct and indirect taxes on road users. This sum[1] currently represents approx. 36% of the revenues being collected. The mechanisms referred to should be established by Parliament either through an amendment to the Finance Act, or through legislation to put in place a new institution to manage the Republic's highway network."

Source: Appendix 5, 5-12
Note: 1) Refer to Table-16

Table-16 CENTRAL GOVERNMENT REVENUE FROM ROAD VEHICLES IN 1988

K£ Million

Items	Revenue
1. Petrol and Diesel Taxes	158
Import Duty	24
Consumption Taxes	134
2. Other Import Duties	45
Motor Vehicles	32
Chassis with Engine	1
Bodies and Parts	7
Tyres and Tubes	5
3. Licences	15
Total (1 + 2 + 3)	218
	(at 1992 price : 345)

Source: Appendix 5, 5-12

2.3.2.3 Equipment Maintenance Plan

Routine maintenance activities for roads and bridges are all carried out by the government employees units of the RD. These units are highly equipment intensive, and consequently have to rely on the services of the MTD. The MTD has not been properly funded and as a result is running an aged equipment fleet. Moreover, lack of spare parts in addition to this situation has forced RD and MDT to insufficiently manage, operate and maintain the equipment.

To offset the mechanical problems mentioned above, the following actions have been taken:

(a) the bulk of periodic maintenance of resealing and re-gravelling has been shifted from execution by direct labour equipment intensive units to execution by private contractors;

(b) finance has been secured from the World Bank to procure essential spare parts and replacement equipment for road maintenance purposes;

(c) the Road Department allocates annually part of its budget for procurement of essential spare parts and has within its organization a mechanical section to deal with minor equipment repairs, and in 1989/90 had allocated funds to MTD for the rehabilitation of 65 pieces of heavy earth moving equipment (graders and dozers);

(d) plans are being advanced to introduce labour intensive techniques for routine maintenance of the classified road network wherever applicable and most of the road maintenance personnel, including engineers, have already received the basic training.

In order to effectively implement the above and support HMMS, MTD established "Equipment Management System (EMS)" whose main functions are as follows:

(a) Asset control
(b) Services support
(c) Data support
(d) Financial support

(e) Equipment replacement
(f) Computerization

The Equipment Management System (EMS), by systematizing all equipment maintenance activities (from site checking by operators to reporting by engineers) can effectively support the MTD by scheduling equipment purchases and by budgeting for road maintenance as well as construction. EMS, therefore, will take an important and effective role in implementation of this Project. Appendix 6 Table 6-3 shows the examples of reporting forms specified in EMS.

2.3.3 Technical Assistance

The following project, RUIRU MINI-PROJECT FOR WORKSHOP MANAGEMENT, implementing under Japanese Technical Assistance will be expected to assist this Project:

- Name of Project
  Ruiru Mini-Project for Workshop Management

- Duration
  October 1, 1991 - September 30, 1995

- Place
  Ruiru Workshop, Kianbu District, Central Province

- Experts
  Long-term experts
  Construction equipment management ; 2 persons
  - Short-term experts
  Workshop construction ; 1 person
  Equipment ; 1 person

- Equipment supply
  Approximately 70 Million Yen

- Counterparts Training
  2 engineers for productivity promotion and construction equipment management

CHAPTER 3

BASIC DESIGN

CHAPTER 3

BASIC DESIGN

3.1 Design Principles

Decisions regarding the appropriate numbers and types of equipment should be made in accordance with the following principles:

1) The selection, numbers and combinations of maintenance equipment will be solely determined by the roads' (or bridges') construction type.

2) For the general maintenance of roads and bridges, at least one fleet will be dispatched to each Provincial Works Office.

3) The areas where the international trunk road between Mombasa and Uganda traverses will be a high priority for dispatching equipment fleets.

4) Road length and density (main trunk roads under MOPW's jurisdiction) also will be a high priority.

5) Newly-established workshops or District Engineers Offices will also be a high priority.

6) Each Provincial Works Office will determine the distribution of their equipment fleet(s) by considering the specific needs of each area (population density, economic activities, area size, etc.).

3.2 Basic Design

3.2.1 Selection of Types and Number of Equipment

3.2.1.1 Maintenance Equipment

1. Road Maintenance Equipment

Table-17 presents equipment classification in terms of its service, based on Table-7 and -8 which detail the equipment fleet for both gravel and bitumen roads maintenance.

Table-17 EQUIPMENT CLASSIFICATION BY SERVICE

Service Item	Equipment
Patrol	Pick-up
Material Transport	Truck, Tipper
Crew Transport	Pick-up
Construction	
Earth Work (Loading/Carrying)	Wheeled Loader
(Grading)	Grader, Dozer
(Compaction)	Tyred Roller, Hand Roller
Bitumen Work	Mobile Bitumen Pre-Mixer
Supplemental Work	Water Tanker, Pump

Equipment fleets for routine road maintenance were proposed as shown in Table-18, after considering the following by the Study:

(a) the equipment for loading, carrying and grading works may not need to be supplied by Japan's Grant Aid, since MOPW has prepared financial resources to repair some of the damaged ones.

(b) mobile bitumen pre-mixers may also need not be supplied, since bitumen mixing work can be carried out at the construction site or mixed bitumen can be delivered by tippers from the nearest mixing plant.

(c) hand rollers will be preferred for the compaction works in narrow areas and the transportation of them rather than tyred rollers will be preferred.

Table-18 PROPOSED EQUIPMENT FLEET FOR ROAD MAINTENANCE

Equipment	Number per a fleet
Truck	1
Tipper	2
Pick-up	1
Pedestrian Vibrating Roller	2

2. Bridge Maintenance Equipment (I)

Equipment necessary for earth and concrete works in bridge maintenance are: concrete mixer, concrete vibrator, water/mud pump, small dozer and vibrating compactor. Same considerations as in previous paragraph 1. may conclude that small dozer will be unnecessary to be provided under Japan's Grant Aid. Table-19 gives the proposed equipment fleet for earth and concrete works in bridge maintenance.

Table-19 PROPOSED EQUIPMENT FLEET FOR BRIDGE MAINTENANCE (EARTH AND CONCRETE WORKS)

Equipment	Number per fleet
Truck	1
Pick-up	1
Concrete Mixer	2
Concrete Vibrator	2
Water/Mud Pump	2
Vibrating Compactor	2

3. Bridge Maintenance Equipment (II)

Concrete breaking works are required in the activities of restoring, strengthening and removing bridges and their facilities, and should be executed prior to such activities during short periods.

Therefore, equipment fleet for concrete breaking work shown in Table-20 is proposed.

Table-20 PROPOSED EQUIPMENT FLEET FOR BRIDGE MAINTENANCE (CONCRETE BREAKING WORKS)

Equipment	Number per fleet
Truck	1
Pick-up	1
Compressor	2
Breaker	4

4. Small Service Truck for Equipment Maintenance

Each equipment fleet will be distributed to each Provincial or District Works Office from MTD Headquarters in Nairobi, and will be under operation for various maintenance works executed by each Camp.

Routine inspections and minor repair of equipment in Camp, as specified in EMS, should be performed as often as necessary in order to insure that all equipment is always in top mechanical condition. These considerations thus suggest the supply of small service trucks for equipment maintenance in the Project. The main equipment and tools to be mounted in small service trucks are as follows:

- Mechanic Tool Set
- Jib Crane
- Generator
- Tyre Service Tool Set
- Work Bench

3.2.1.2 Distribution of Equipment Fleets

For each Province or District, factors such as population density, land area, road density, whether or not it is a high potential agricultural area, the number of bridges maintained during 5 years, etc. have been considered in studies regarding the distribution of the equipment fleets. The following figures and tables detail these factors:

Road Density ; Figure-8, Appendix 6 Table 6-2
High Potential Agricultural Area ; Figure-9
Number of Bridges ; Table-6 (Section 2.3.1.1), Figure-10
Population Density, Land Area, Road Length ; Appendix 6 Table 6-2

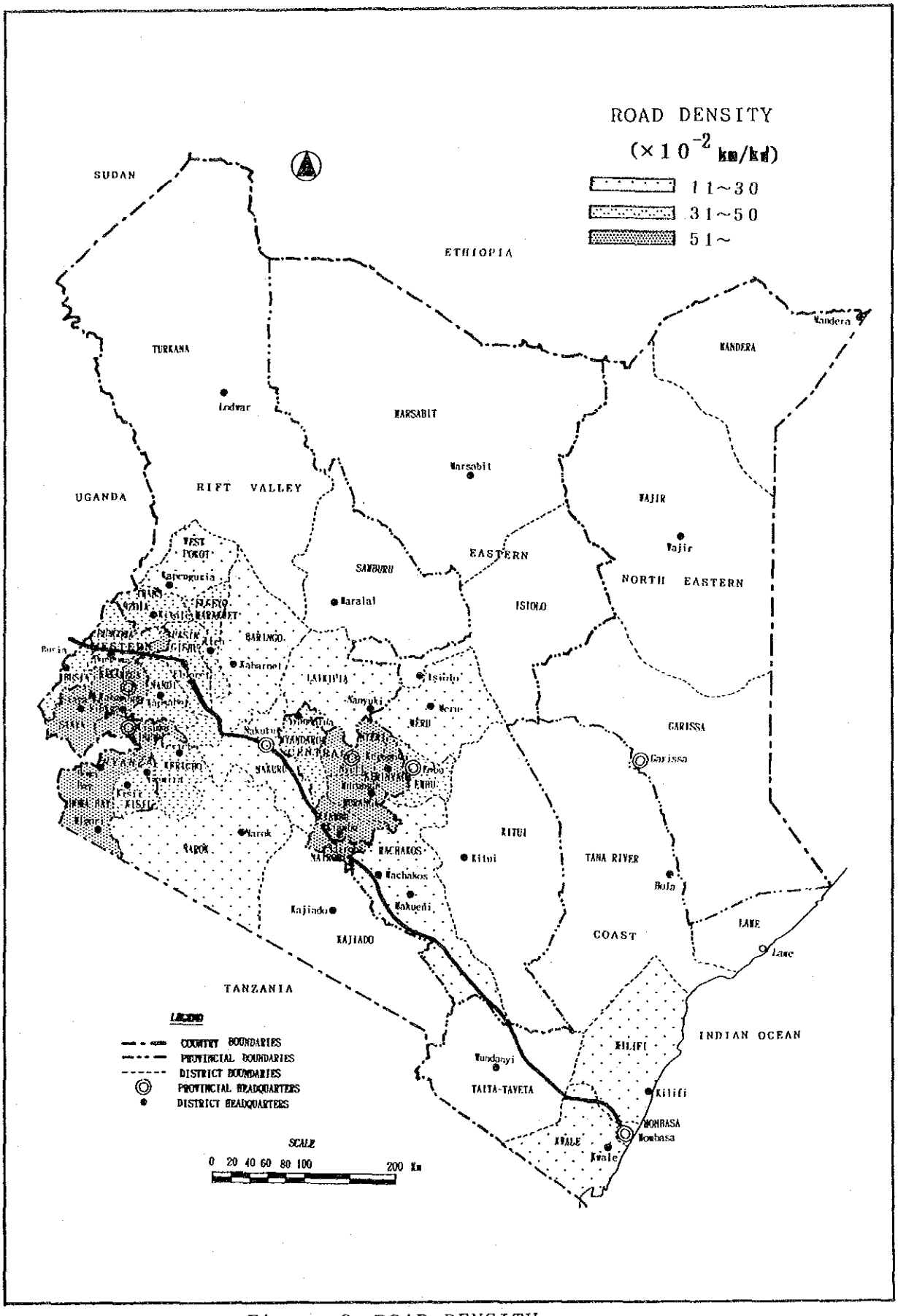


Figure-8 ROAD DENSITY

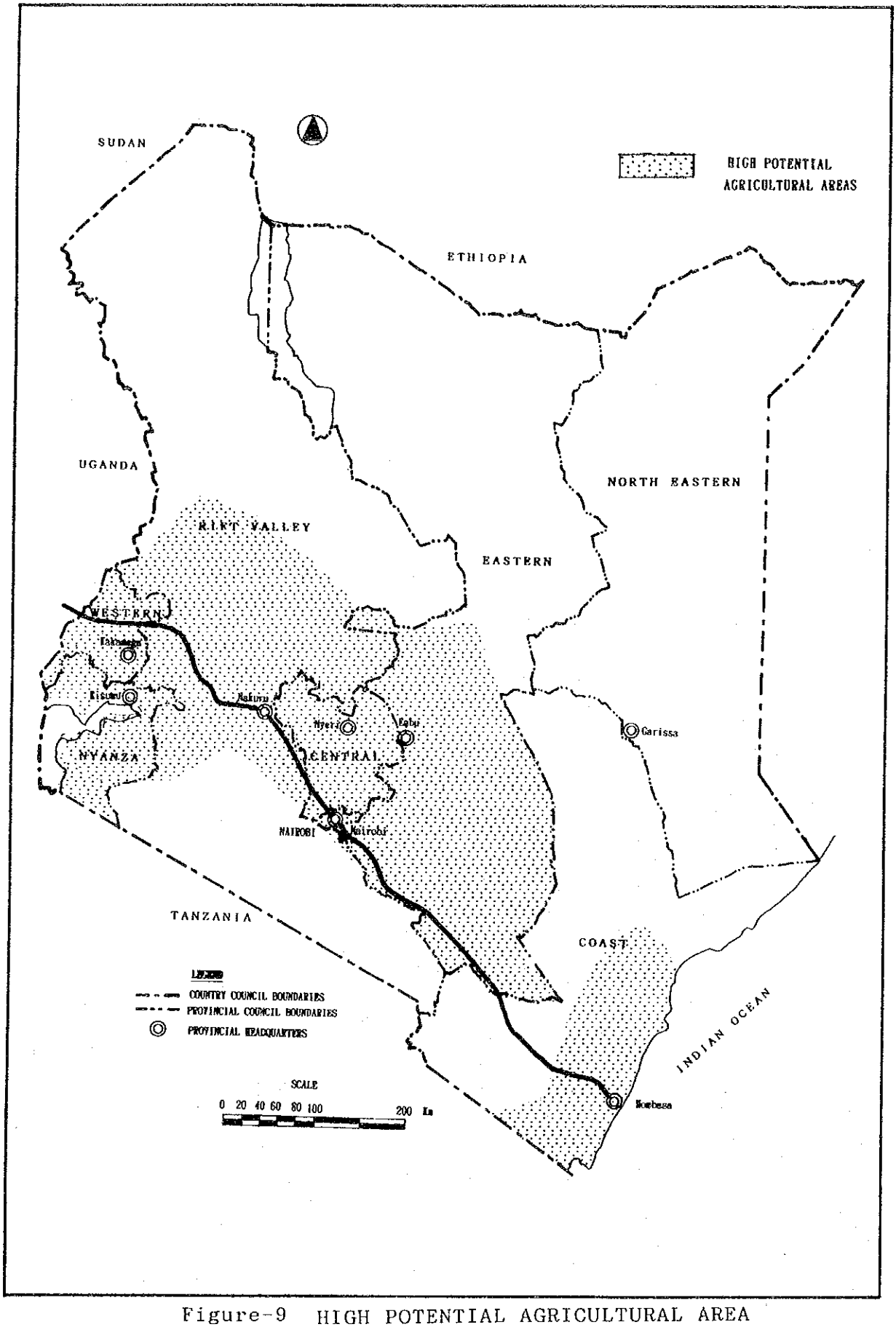


Figure-9 HIGH POTENTIAL AGRICULTURAL AREA

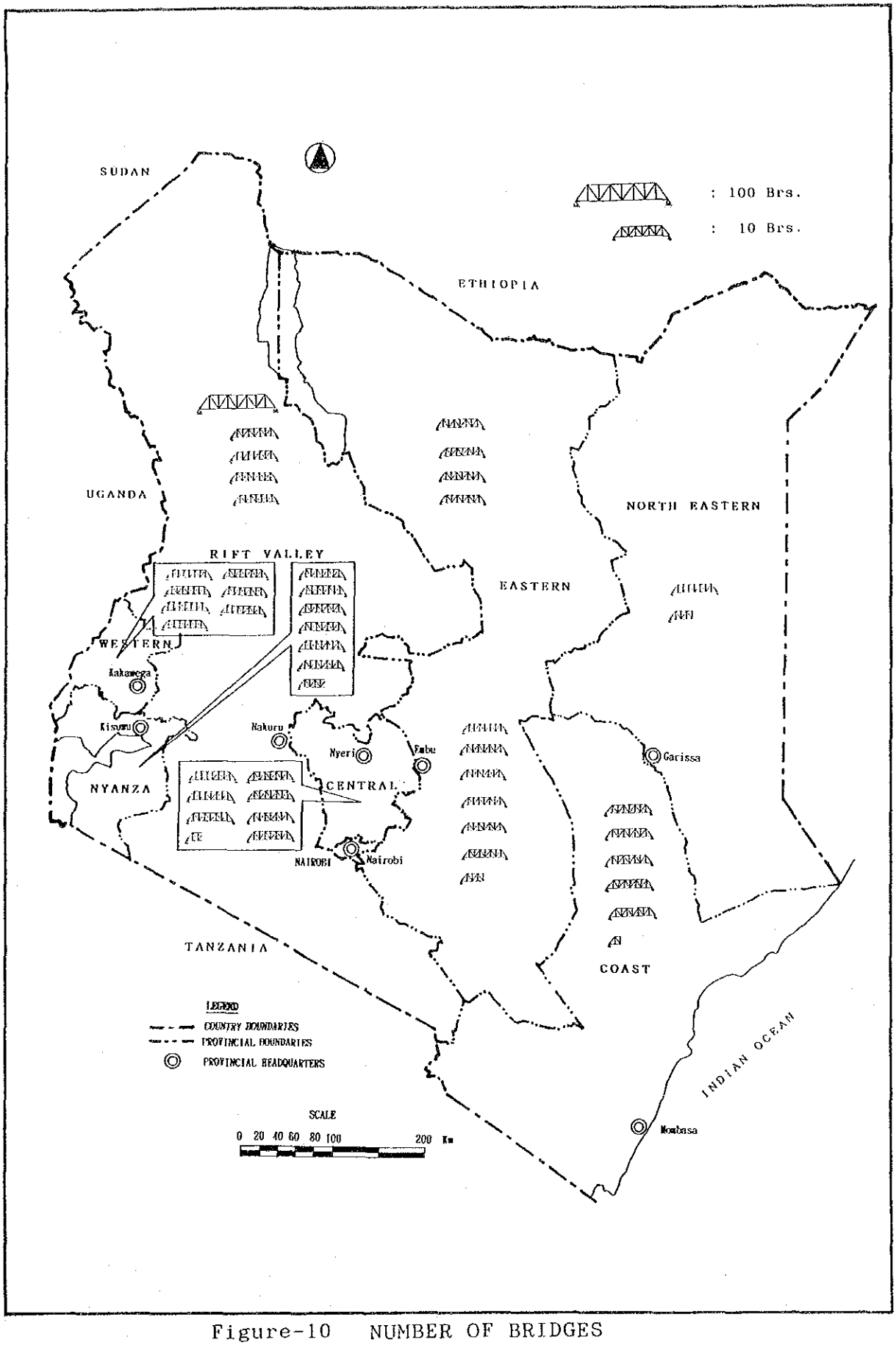


Figure-10 NUMBER OF BRIDGES

1. Equipment Fleet for Road Maintenance

Upon fulfillment of the guideline that one fleet should be dispatched to each Provincial Works Office headquarters, the distribution plan for other fleets is proposed as below.

(a) Nairobi Prov.

One fleet is enough because of the short total length of the roads.

(b) Central Prov.

One fleet will be dispatched to the Kiambu Dist., where the road density is quite high and the most important international trunk road between Mombasa and Uganda (Mombasa - Uganda Road) passes through.

(c) Coast Prov.

Another fleet will be dispatched to the Kwale Dist., where the international trunk road traverses to Tanzania.

(d) Eastern Prov.

One fleet each (for a total of 3) will be dispatched to the Makueni Dist. and the Taraka Nithi Dist. The Makueni Dist. contains a section of the Mombasa - Uganda Road. The Taraka Nithi Dist. is a high agricultural output area located at the foot of Mt. Kenya. Both District Works Offices are newly opened.

(e) Northeastern Prov.

Another fleet will be dispatched to the Headquarters at Garissa which exercises jurisdiction over a very wide area albeit of very low density of both population and roads.

(f) Nyanza Prov.

One fleet each (for a total of 3) will be dispatched to the Migori Dist. (where the road density is quite high

and the Office is newly opened), and in Siaya with high road density.

(g) Rift Valley Prov.

One fleet each will be dispatched to the Trans Nzoia Dist. and the Nandi Dist., both of which have high road density. A fourth fleet will also be dispatched to the Uasin Gishu Dist., where the Mombasa - Uganda Road traverses.

(h) Western Prov.

One fleet will be dispatched to the newly opened Vihiga Dist.

The above proposals on distribution of fleets are summarized in Table-21 and Figure-11.

Table-21 PROPOSED PLAN FOR DISTRIBUTION OF EQUIPMENT FLEET FOR ROAD

Province	Number of Fleets	Proposed Provincial on District Works Office
Nairobi	1	Nairobi (HQ)
Central	2	Nyeri (HQ), Kiambu
Coast	2	Mombasa (HQ), Kwale
Eastern	3	Embu (HQ), Makueni Tharaka Nithi
Northeastern	2	Garissa (HQ)
Nyanza	3	Kisumu (HQ), Migori Siaya
Rift Valley	4	Nakuru (HQ), Uasin Gishu Trans Nzoia, Nandi
Western	2	Kakamega (HQ), Vihiga
Total	19	

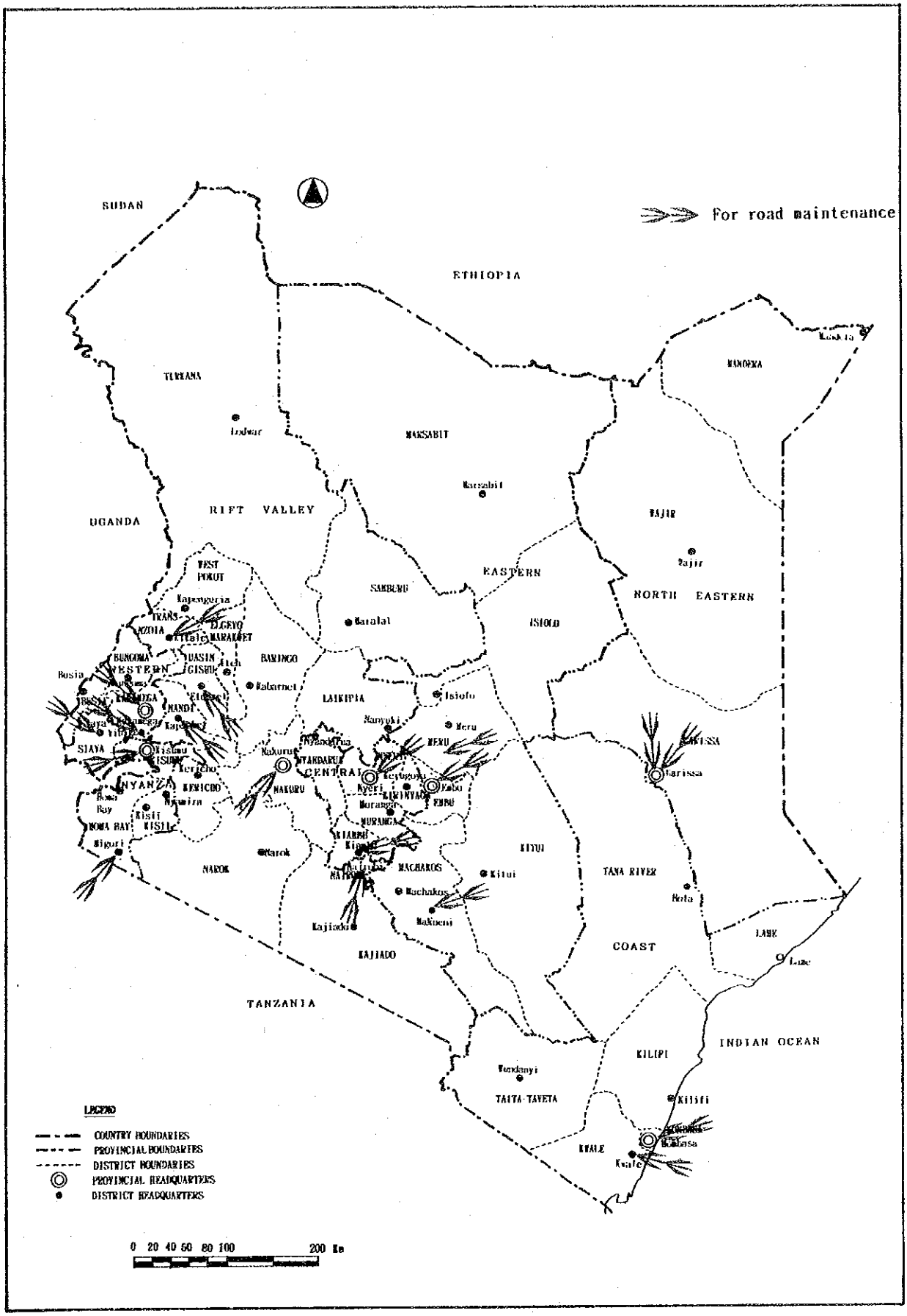


Figure-11 DISTRIBUTION OF FLEETS
(ROAD MAINTENANCE EQUIPMENT)

2. Equipment Fleet for Bridge Maintenance (I)

One fleet each will be dispatched to the seven Provincial Works Offices except Nairobi, as shown in Table-22 and Figure-12.

Table-22 PROPOSED PLAN FOR DISTRIBUTION OF EQUIPMENT FLEETS FOR BRIDGE MAINTENANCE (I)

Provincial Works Office	Number of Fleets
Central	1
Coast	1
Eastern	1
Northeastern	1
Nyanza	1
Rift Valley	1
Western	1
Total	7

3. Equipment Fleet for Bridge Maintenance (II)

One fleet is stationed at MTD Headquarters in Nairobi and will stand by to be dispatched for operations at site works as required by Provincial or District Works Offices. Dispatchment will be made after considering the urgency, frequency and scale of the requests. Table-23 and Figure-12 provide the proposed location of distribution.

Table-23 PROPOSED PLAN FOR DISTRIBUTION OF EQUIPMENT FLEET FOR BRIDGE MAINTENANCE (II)

Location	Number of Fleets
Nairobi MTD HQ	1
Total	1

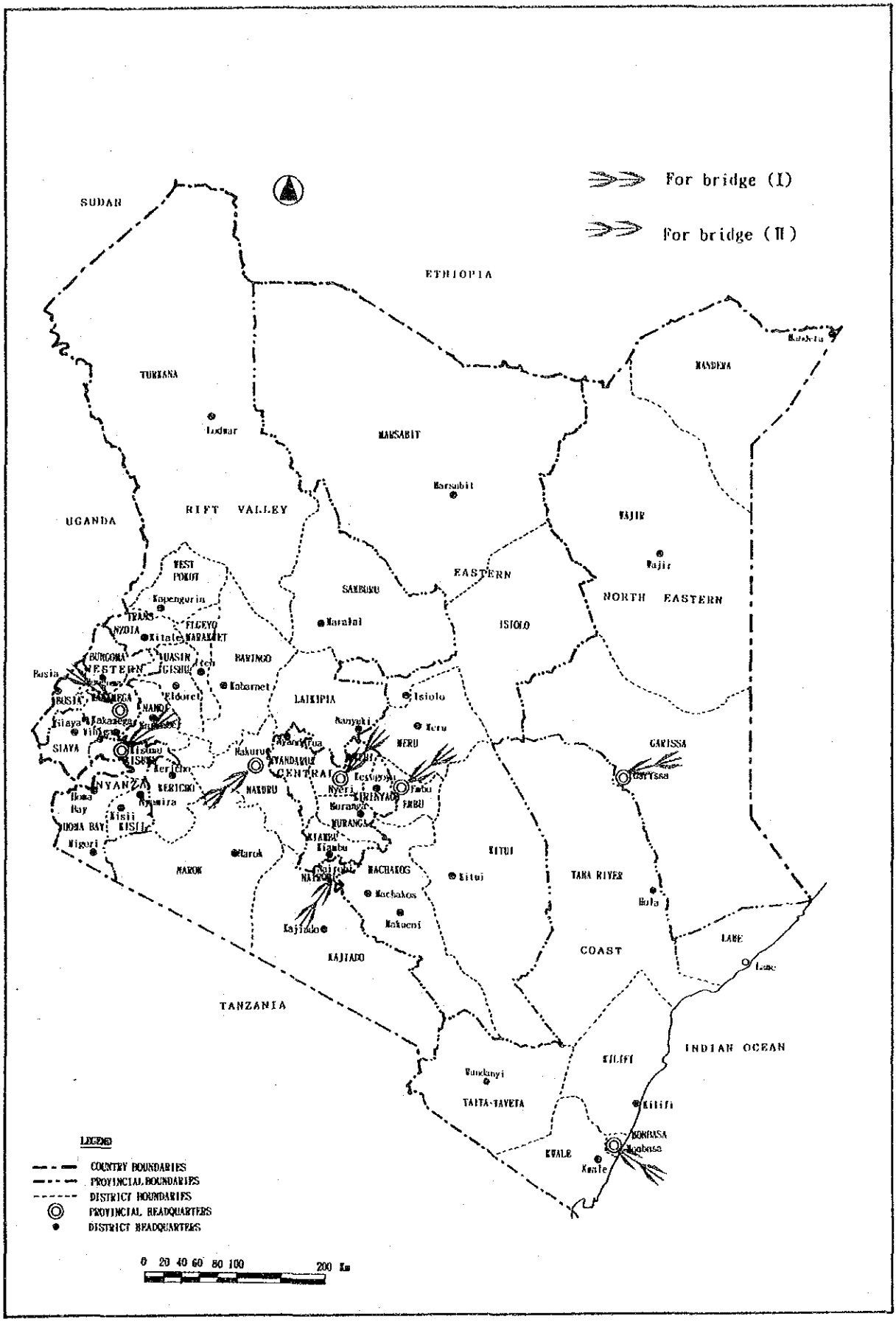


Figure-12 DISTRIBUTION OF FLEETS
(BRIDGE (I), BRIDGE (II))

4. Small Service Trucks for Equipment Maintenance

One service truck will be dispatched to each Provincial Works Office, after considering their purposes and specific need. One extra service truck each will be dispatched to Ruiru in the Kiambu Dist. (where a new workshop is under construction through the Japanese Technical Assistance Programme) and to Uasin Gishu of Rift Valley Province where the total road length is quite long and where the Mombasa - Uganda Road is traverses. The proposed distribution plan is presented in Table-24 and Figure-13.

Table-24 PROPOSED DISTRIBUTION PLAN FOR SMALL SERVICE TRUCKS

Province	Number	Location
Nairobi	1	Nairobi
Central	2	Nyeri, Ruiru
Coast	1	Mombasa
Eastern	1	Embu
Northeastern	1	Garissa
Nyanza	1	Kisumu
Rift Valley	2	Nakuru, Uasin Gishu
Western	1	Kakamega
Total	10	

The proposed distribution plan for Equipment Fleets is shown in Table-25.

Table-25 PROPOSED DISTRIBUTION PLAN FOR EQUIPMENT FLEETS

	Number of Equipment Fleets			
Province	for Bitumen Road	for Bridge Maintenance (I)	for Bridge Maintenance (II)	for Small Service Truck
Nairobi	1	0	1	1
Central	2	1	0	2
Coast	2	1	0	1
Eastern	3	1	0	1
Northeastern	2	1	0	1
Nyanza	3	1	0	1
Rift Valley	4	1	0	2
Western	2	1	0	1
Total	19	7	1	10

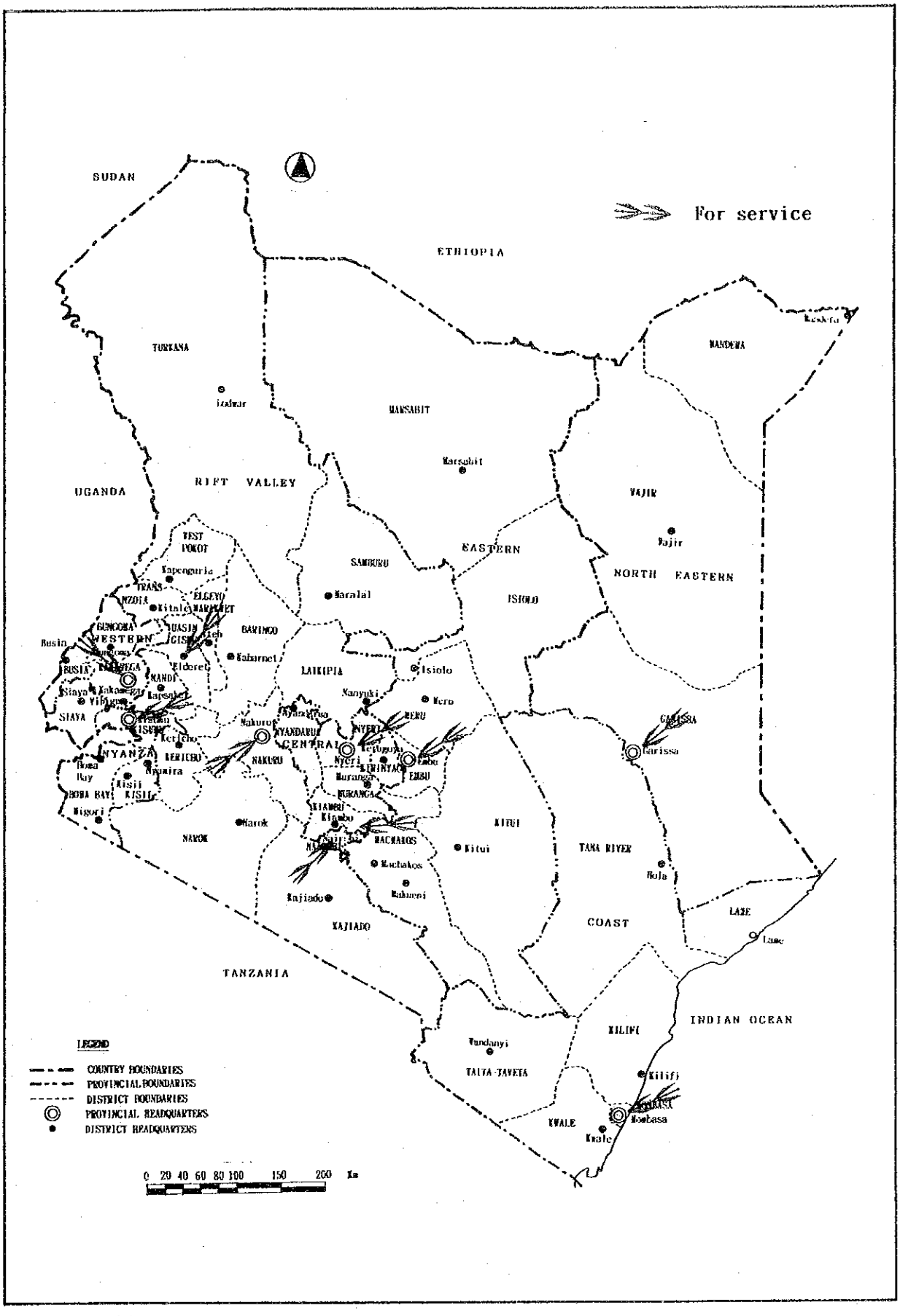


Figure-13 DISTRIBUTION OF SMALL SERVICE TRUCKS

3.2.2 Specifications of Proposed Equipment

The types and standard specifications for the equipment were proposed based on the study results, as listed in Table-26. The specifications were in accordance with JAPAN'S CONSTRUCTION EQUIPMENT SPECIFICATION MANUAL 1989, Japan Mechanized Construction Association.

It is proposed that spare parts equivalent to 20% of FOB prices of machines are supplied together with this Project. The effective specifications of spare parts for each machine should be carefully selected by reviewing the proposal from MTD and the results of the Basic Study. The comments to the MTD's proposal listed in Table-27 are as follows:

- cost proportion of engine parts and chassis parts is recommended to be as 4 : 6
- percentage of parts necessary for repair due to accidents is recommended to be less than 20% of total
- cost proportion of running and periodic spare parts to total is recommended to be higher than proposed.

Table-26 PROPOSED STANDARD SPECIFICATIONS FOR EQUIPMENT

HAULING EQUIPMENT									COMPACTING EQUIPMENT		
		CARGO TRUCK			DUMP TRUCK			LIGHT TRUCK			VIBRATORY ROLLER
ENGINE MAX. OUTPUT	HP	more than 165	ENGINE MAX. OUTPUT	HP	more than 165	ENGINE MAX. OUTPUT	HP	more than 80	ENGINE MAX. OUTPUT	HP	more than 4.9
WEIGHT			WEIGHT			WEIGHT			OPERATING WEIGHT	kg	more than 500
· Max. Loading Cap.	kg	more than 7500	· Max. Loading Cap.	kg	more than 7000	· Max. Loading Cap.	kg	more than 1000			
· Vehicle Weight	kg	more than 5200	· Vehicle Weight	kg	more than 5600	· Gross Vehicle Weight	kg	more than 2450	PERFORMANCE		
· Gross Vehicle Weight	kg	more than 12500	· Gross Vehicle Weight	kg	more than 12500				· Max. Speed	km/h	more than 3.5
						PERFORMANCE			· Frequency	vpm	more than 3300
PERFORMANCE			PERFORMANCE			· Max Torque	kg-m	more than 12	· Centrifugal Force	kg	more than 1000
· Max Travel Speed	km/h	more than 90	· Max Travel Speed	km/h	more than 90	· Min. Turning Radius	mm	less than 5900	· Rolling Width	mm	more than 570
· Min. Turning Radius	mm	less than 7200	· Min. Turning Radius	mm	less than 6400						
						DIMENSIONS			DIMENSIONS		
DIMENSIONS			DIMENSIONS			· Overall Length	mm	more than 4900	· Overall Length	mm	more than 2350
· Overall Length	mm	more than 7600	· Overall Length	mm	more than 6400	· Overall Width	mm	less than 1700	· Overall Width	mm	less than 660
· Overall Width	mm	less than 2500	· Overall Width	mm	less than 2500	· Overall Height	mm	less than 1650	· Overall Height	mm	less than 1200
· Overall Height	mm	less than 2600	· Overall Height	mm	less than 2750	· Wheel Base	mm	more than 3000	· Wheel Base	mm	more than 550
· Wheel Base	mm	more than 4200	· Wheel Base	mm	more than 3600	· Body					
· Body			· Body			Length	mm	more than 2250	ENGINE		
Length	mm	more than 5200	Length	mm	more than 3800	Width	mm	more than 1500	· Type		Water Cooled Diesel
Width	mm	more than 2300	Width	mm	more than 2200	Height	mm	more than 400			
Height	mm	more than 450	Height	mm	more than 550				WHEEL		
						CABIN			· Width	mm	more than 570
ENGINE			ENGINE			· Type		single	· Diameter	mm	more than 400
· Type		Water Cooled Diesel	· Type		Water Cooled Diesel	· Seating Cap.	person	3	· No. of Wheel	piece	2
· Displacement	cc	more than 7100	· Displacement	cc	more than 7100						
						ENGINE					
POWER LINE			POWER LINE			· Type		Water Cooled Gasoline			
· Transmission Type		Synchromesh	· Transmission Type		Synchromesh	· Displacement	cc	more than 1550			
· No. of Speeds		6F - 1R	· No. of Speeds		6F - 1R						
						POWER LINE					
BRAKE			BRAKE			· No. of Speeds		4F - 1R			
· Type		Hydraulic with Vacuum Booster	· Type		Hydraulic with Vacuum Booster	· Drive		4 x 2			
TIRE			TIRE			TIRE					
· Size		9 x 20 - 14	· Size		9 x 20 - 14	· Size					
· No. of Tire (without Spare)	piece	6	· No. of Tire (without Spare)	piece	6	front		6 x 14 - 6			
						rear		6.5 x 14 - 8			
						· No. of Tire (without Spare)	piece	4			

Table-26 PROPOSED STANDARD SPECIFICATIONS FOR EQUIPMENT

(2/3)

COMPACTING EQUIPMENT			CONCRETE EQUIPMENT											
		VIBRATORY PLATE COMPACTOR			CONCRETE MIXER			CONCRETE VIBRATOR				PNEUMATIC HAND BREAKER		
ENGINE MAX. OUTPUT	HP	more than 5	ENGINE MAX. OUTPUT	HP	more than 10	ENGINE MAX. OUTPUT	HP	more than 5	WEIGHT	kg	more than 30
WEIGHT	kg	more than 70	PERFORMANCE · Mixing Cap. · Drum Rev.	1 tr rpm	more than 200 more than 23	Vibrating Head Diameter	mm	more than 28	PERFORMANCE · No. of Blow · Air Consumption · Piston Stroke	bpm m^3/min mm	more than 1550 less than 1.5 more than 100
PERFORMANCE · Max. Speed · Frequency · Centrifugal Force	km/h vpm kg	more than 1.5 more than 5800 more than 1300	ENGINE · Type		Water Cooled Diesel	WEIGHT · Head (with 4m lead shaft) · Engine	kg kg	less than 12 less than 30	DIMENSIONS · Length · Cylinder Diameter · Shank Diameter Length	mm mm mm mm	more than 650 more than 55 more than 32 more than 150
DIMENSIONS · Overall Length · Overall Width · Overall Height · Plate Size Length Width	mm mm mm mm mm	more than 950 less than 500 less than 790 more than 550 less than 500	MIXER · Type		Handwheel Tilting Type	PERFORMANCE · Frequency · Amplitude · Length	vpm mm mm	more than 9000 less than 1.4 less than 480	HOSE · Size	mm	
ENGINE · Type		Air Cooled Gasoline	TIRE · Size · No. of Tire	piece	4 x 8 - 6 4	LEAD SHAFT · Flexible Shaft Diameter · Rubber Hose Diameter · Length	mm mm m	more than 10 more than 29 more than 4	ATTACHMENT (per one breaker) · Hose · Shank Moil Point Asphalt Cutter · Hose Band	Length x pce Length x pce Length x pce piece	20 m x 2 450mm x 5 350mm x 5 350mm x 10 4
						ENGINE · Type		Air Cooled Gasoline			
						ATTACHMENT (per one engine) · Vibrating Head · Lead Shaft	piece piece	3 3			

Table-26 PROPOSED STANDARD SPECIFICATIONS FOR EQUIPMENT

(3/3)

OTHER EQUIPMENT									
		PUMP			AIR COMPRESSOR			SERVICE TRUCK	
ENGINE MAX. OUTPUT	HP	more than 3.8	ENGINE MAX. OUTPUT	HP	more than 25	ENGINE MAX. OUTPUT	HP	more than 75	
WEIGHT	kg	more than 40	WEIGHT	kg	more than 650	WEIGHT · Max Loading Cap. · Vehicle Weight · Gross Vehicle Weight	 kg kg kg	 more than 2700 more than 2100 more than 5000	
PERFORMANCE · Discharge · Head · Bore	 m^3/min m mm	 more than 1.0 more than 23 more than 80	PERFORMANCE · Free Air Delivery · Discharge Pressure	 m^3/min kg/cm^2	 more than 2.5 more than 7	PERFORMANCE · Max. Torque · Min. Turning Radius	 kg-m mm	 more than 17 less than 6800	
DIMENSIONS · Overall Length · Overall Width · Overall Height	 mm mm mm	 more than 515 less than 430 less than 490	DIMENSIONS · Overall Length · Overall Width · Overall Height	 mm mm mm	 more than 2300 less than 1400 less than 1300	DIMENSIONS · Overall Length · Overall Width · Overall Height · Wheel Base · Ban Body Length Width Height	 mm mm mm mm mm mm mm	 more than 5800 less than 1950 less than 3600 more than 3350 more than 3850 more than 1900 more than 2000	
ENGINE · Type · Displacement	 cc	Air Cooled Diesel more than 190	ENGINE · Type · Displacement	 cc	Water Cooled Diesel more than 950	ENGINE · Type · Displacement	 cc	Water Cooled Diesel more than 2750	
ATTACHMENT (per one pump) · Suction Hose · Discharging Hose	Length x pce m	20m x 3 (with strainer, hose coupling set) 100 (with 5 sets of hose coupling)	RECEIVER TANK · Capacity	l tr	more than 24	POWER LINE · No. of Speed · Drive		5F - 1R 4 x 2	
			AIR COCK · Size · No. of Cock	mm piece	more than 20 more than 2	TIRE · Size · No. of Tire (without spare)	 piece	7 x 15 - 8 6	
			TIRE · Front (No. of Tire) · Rear (No. of Tire)		Caster (1) 5 x 10 - 6 (2)	MOUNTED EQUIPMENT AND TOOLS · Mechanic Tool Set · Steel Cabinet · Grease Pump · Drum Pump · Jib Crane (for drum lifting) · Generator · Air Compressor · Electric Cord Reel · Air Hose · Battery Charger · Tire Service Tool · Hydraulic Jack · Work Bench		One set(Annex List) Lockable Steel Cabinet High Pressure Hand Type Revolutionary Type Lifting Cap. 250kg with Chain Block 5 KVA, 220 V MOTOR Output 0.75KW more than 150L/min 22A,Cord Length 30m φ6mm, Hose Length 20m with hose band 6-12V : 70A, 18-24V : 35A (Quick Charge Type) One set(Annex List) 10 ton, 2 pieces	

Classification / Equipment	Division Item	%	Class Item	%	Subclass Item	%
Truck (7t) Tipper (7t)	Engine	10	Housing	1	Consumables	88
			Mechanism	3		
			Exhaust	1		
			Hydraulic System	2	Un-consumables	12
			Fuel System	2		
			Cooling System	1		
	Chassis	90	Electric System	21	Consumables	20
			Transmission System	10		
			Brake System	2		
			Suspension	30	Un-consumables	80
			Drive System	5		
			Cabin	22		
Pick up cabin (single 1t)	Engine	45	Housing	1	Consumables	35
			Mechanism	23		
			Hydraulic System	2		
			Fuel System	8	Un-consumables	65
			Cooling System	3		
			Electric System	8		
	Chassis	55	Electric System	18	Consumables	22
			Transmission System	10		
			Brake System	10		
			Suspension	15	Un-consumables	78
			Drive System	2		

Classification / Equipment	Division Item	%	Class Item	%	Subclass Item	%
Vibration Roller (0.5t)	Engine	20	Housing	3	Consumables	70
			Hydraulic System	10		
			Fuel System	7	Un-consumables	30
	Body	80	Transmission System	40	Consumables	12
			Handling System	15		
			Suspension	5	Un-consumables	88
			Drive System	20		
Concrete Mixer ($0.2m^3$)	Engine	30	Hydraulic System	28	Consumables	100
			Fuel System	2		
	Body	70	Suspension	4	Un-consumables	100
			Drive System	66		
Engine Pump (80mm, Diesel)	Engine	85	Mechanism	3	Consumables	97
			Hydraulic System	43		
			Fuel System	15	Un-consumables	3
			Cooling System	24		
	Body	15	Suspension	5	Consumables	100
			Drive System	10		
Compressor ($2.5m^3/min$)	Engine	75	Hydraulic System	40	Consumables	70
			Fuel System	12		
			Cooling System	23	Un-consumables	30
	Body	25	Electric System	6	Consumables	0
			Transmission System	13		
			Suspension	6	Un-consumables	100

Note: % is cost proportion.

3.3 Project Implementation Plan

3.3.1 Basic Concept

The Project shall be implemented within the scope of Japan's Grant Aid Programme and the authority of the Project shall be the Government of Kenya. Therefore, after the signing of the Exchange of Notes between the Governments of Japan and Kenya, the Project shall be implemented in accordance with the provisions of Japan's Grant Aid Programme.

The Roads Department (RD) of the Ministry of Public Works (MOPW) is the responsible agent for comprehensively implementing the Project while the Mechanical and Transport Department (MTD) of MOPW takes charge of management for equipment provided.

The Project cost shouldered by the Government of Japan covers the manufacturing of the proposed equipment, transportation of the equipment from Japan to the port of entry in Kenya (Mombasa Port) and the relevant consulting services for implementing the Project.

The scope of undertaking by the Government of Kenya covers the transportation of the proposed equipment from Mombasa Port to MTD Headquarters in Nairobi and the implementation of operation and maintenance of the equipment.

3.3.2 Implementation Supervisory Plan

In supervising the implementation for the Project, appropriate and effective supervision will be enforced in accordance with adequate consultations with the Kenyan side. Primary precautions in the supervisory process are as shown below:

(a) Prior to the delivery of equipment and materials, their suppliers will be asked to submit a detailed execution plan. Its contents will be sufficiently studied, and the propriety of the schedule, the procurement plan, and the equipment and material specifications will be judged on that basis. Especially the spare parts for all equipment shall be specified by full discussions between both Kenya and Japan sides.

(b) Before the shipment of the equipment, a study will be made in Japan as to whether or not their specifications, contents, volume, etc., meet the design requirements.

(c) Concerning the delivery and handing over of the equipment, confirmation will be made as to whether or not the suppliers appropriately conduct operational guidance and whether or not they provide proper guidance regarding the operation, maintenance, and management of the equipment.

(d) In order to smoothly enforce the implementation, close contacts will be maintained with the Kenyan side and the suppliers, and sufficient consultations will be carried out with them.

3.3.3 Procurement Plan

All of the proposed equipment shall be procured in Japan, because of the unavailability of such equipment in Kenya and in consideration with the reliability in equipment manufacture, the easiness in future repair and maintenance services, and the restricted time schedule for Japan's Grant Aid System.

3.3.4 Implementation Schedule

Implementation of the Project is structured by three phases, i.e. detailed design, procurement (including marine transportation), and handing over. The periods required are five months for detailed design and eight months from procurement to handing over, as shown in Table-28.

Table-28 PROJECT IMPLEMENTATION SCHEDULE

	1	2	3	4	5	6	7	8	9	10	11	12	13
Detailed Design	(5 months)												
Equipment Procurement and Supervisory	Manufacture of Equipment (8 months)							Marine Transportation					
									Inland Transportation				
									Inspection/ Handing Over				

Main targets of the Project Implementation Plan are described below.

Detailed Design

After signing of the Exchange of Notes between the Governments of Japan and Kenya, the detailed design related to providing construction equipment shall be executed by a Japanese consulting firm. The detailed design works shall comprise the following preparations;

- Specifications for the equipment
- Cost estimation of the Project
- Tender and contract documents for the equipment procurement

Tendering

The Consultant shall execute the following services relevant to the tendering for Kenya;

- Tender notice
- Tender pre-qualification
- Tendering
- Tender evaluation

Manufacture of equipment

After formalizing the contract, the contractor will receive the note of contract from the Government of Japan. Then, the contractor will manufacture the equipment.

Transportation of equipment

The Japanese contractor will execute the marine transportation from Japan to Mombasa Port of Kenya. The Government of Kenya has the responsibility of the land transportation from Mombasa to MTD Headquarters in Nairobi.

Handing over of equipment

The consultant and contractor will execute the following services at MTD Headquarter in Nairobi:

- Submission of Operation Manual for all equipment
- Submission of Maintenance Manual for all equipment
- Required assembly for equipment
- Guidance of operation for each equipment
- Inspection and handing over

The cost to be shouldered by Kenya is roughly estimated as follows:

In-land transportation	10,079	thousand Kenya Shillings
Custom clearance fee	1,089	thousand Kenya Shillings
Total	11,168	thousand Kenya Shillings

CHAPTER 4

PROJECT EVALUATION AND CONCLUSION

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The implementation of this plan will benefit the 25 million people who reside within the entire 564,000 km² area of Kenya. Especially, great benefits can be expected in those high potential agricultural areas which are situated along the international trunk road which runs from Mombasa Port to Uganda. This road has taken the most important role in the transport sector and extends to a population of 13 million people within a land area of 60,000 km².

The effect and extent of improving the present situation by implementing the Project are summarized in Table-29.

Table-29 EFFECT AND EXTENT OF IMPROVING THE PRESENT SITUATION BY IMPLEMENTING THE PROJECT

Present Condition and Problems	Proposed Measures	Effect and Improvement Level by the Project
Insufficient maintenance activities for road and bridges due to lack of enough investments in the infrastructure has hindered the smooth improvement of the Kenyan economy.	To provide equipment to facilitate sufficient maintenance activities for roads and bridges.	Sufficient maintenance activities for roads and bridges will greatly benefit rural area development, especially in high potential agricultural production areas. It will also promote to increase employment opportunities as well as establishing economical and cost-stable transportation service.
The MTD has not been properly funded and as a result is running an aged equipment fleet. Moreover, a lack of spare parts in addition to this situation has forced RD and MTD to insufficiently manage, operate and maintain the equipment.		Providing new equipment will help to break the vicious circle of aging and insufficient equipment. By breaking this circle the Project can greatly contribute to the effective implementation of the Third Road Sector Programme.

APPENDICES

APPENDIX 1. Member List of the Basic Design Study Team

MEMBERS OF THE BASIC DESIGN STUDY TEAM

Mr. Toshimitsu MURAMATSU	Leader Chief of Construction Equipment Division, Road Department, Chubu Regional Construction Bureau, Ministry of Construction
Mr. Kenji MAEKAWA	Project Coordinator Second Basic Design Study Division, Grant Aid Study & Design Department, Japan International Cooperation Agency (JICA)
Mr. Minoru MIURA	Road Maintenance Planner Katahira & Engineers International
Mr. Satoshi KOGAWA	Equipment Management Planner Katahira & Engineers International
Mr. Hidetomo AKUTSU	Equipment Control and Maintenance Planner/Estimator Katahira & Engineers International

APPENDIX 2. Survey Schedule

Survey Schedule during Nov. 7 ~ Dec. 5, 1992

No.	Date	Activities	
		Discussion etc.	Site Survey
1	1992 Nov. 7 (Sat)	· Equipment Management Planner (MR. KOGAWA) Lv. Tokyo, Ar. London	
2	Nov. 8 (Sun)	· MR. KOGAWA Lv. London	
3	Nov. 9 (Mon)	· MR. KOGAWA Ar. Nairobi · Discussion on survey schedule at JICA	
4	Nov. 10 (Tue)	· Courtesy to Embassy of Japan · Discussion on site survey, schedule, questionnaire, etc. at MOPW Main Workshop	· MOPW Main Workshop Nairobi HQ
5	Nov. 11 (Wed)	· Moving to Embu · Moving to Nyeri	· Roads in Central Prov. and Eastern Prov. · Eastern Prov. HQ
6	Nov. 12 (Thu)	· Moving to Nakuru · Team Leader (MR. MURAMATSU) Lv. Tokyo, Ar. Paris · Equipment Control and Maintenance Planner/ Estimator (MR. AKUTSU) Lv. Dar es Salaam, Ar. Nairobi	· Central Prov. HQ · Roads in Rift Valley Prov.
7	Nov. 13 (Fri)	· Moving to Njoro · Moving to Nairobi · MR. MURAMATSU Lv. Paris · Project Coordinator (MR. MAEKAWA) and Road Maintenance Planner (MR. MIURA) Lv. Dar es Salaam Ar. Nairobi · Explanation on Inception Report at JICA · Explanation on Inception Report at MOPW Bridge Section · Collecting data	· Rift Valley Prov. HQ and Workshop · Roads in Rift Valley Prov. · Njoro Camp

No.	Date	Activities	
		Discussion etc.	Site Survey
8	Nov. 14 (Sat)	· MR. MURAMATSU Ar. Nairobi · Internal meeting · Discussion with JICA experts on · Roads/Bridge condition · Maintenance · Ruiru Mini-Project · Survey schedule	
9	Nov. 15 (Sun)	· Moving to Nyeri · Moving to Muranga · Moving to Nairobi	· Roads in Central Prov. · Central Prov. HQ, Workshop · Facilities · Equipment Management · Bridges and construction site in Central Prov.
10	Nov. 16 (Mon)	· Explanation on Inception Report and discussion on Request, survey schedule, etc. at MOPW HQ. · Explanation on Inception Report and discussion on survey schedule at EOJ · Explanation and discussion on Inception Report at MOF · Collecting data at MOPW	
11	Nov. 17 (Tue)	· Discussion on equipment selection and deposition · Collecting data at MOPW · Moving to Ruiru · Moving to Nairobi	· Nairobi Workshop · Facilities · Equipment · Roads in Nairobi Prov. and Central Prov. · Kiamb Dist. Workshop Ruiru Mini-Prov.
12	Nov. 18 (Wed)	· M/S MURAMATSU, MAEKAWA and KOGAWA moving to Machakos · Moving to Nairobi thru Kajiado · M/S MIURA and AKUTSU · Study on equipment type and work volume · Selection and number of equipment · Cost estimation · Collecting data · Internal meeting	· Roads and construction site in Eastern Prov. · Machakos Dist.Workshop · Roads and bridges in Eastern and Rift Valley Prov. · Kajiado Dist. Workshop

No.	Date	Activities	
		Discussion etc.	Site Survey
13	Nov. 19 (Thu)	· Internal meeting · Discussion on maintenance work, work volume, selection and number of equipment, deposition plan, etc. at MOPW · Drafting Minutes of Discussions	
14	Nov. 20 (Fri)	· Discussion on selection and number of equipment, deposition plan, etc. at MOPW · Discussion on Minutes of Discussions draft · Collecting data	
15	Nov. 21 (Sat)	· Internal Meeting · Setting forth Minutes of Discussions	
16	Nov. 22 (Sun)	· Internal Meeting	
17	Nov. 23 (Mon)	· Signing on Minutes of Discussions · Report on the Study at EOJ and JICA · Discussion on equipment management, equipment under Japan's Grant Aid, spare parts, etc. at Nairobi Workshop HQ.	· Nairobi Workshop HQ.
18	Nov. 24 (Tue)	· M/S MURAMATSU and MAEKAWA Lv. Nairobi Ar. London · M/S MIURA, KOGAWA, AKUTSU moving to Sultan Hamud, Makindu, Kibwegi, Mtito Andei, Taita Taveta and Monbasa	· Roads in Nairobi Prov. and Eastern Prov. · Sultan Hamud Camp · Makindu Camp · Kibwegi Camp · Mtito Andei Camp · Taita Taveta Dist. · Roads in Coast Prov.
19	Nov. 25 (Wed)	· M/S MURAMATSU and MAEKAWA Lv. London · M/S MIURA, KOGAWA, AKUTSU discussion on facilities, equipment, spare parts and activities of JOCV at Monbasa PWO. · Moving to Monbasa thru Kwale	· Coast Prov. · Monbasa Dist. · Roads in Coast Prov. · Kwale Dist. Workshop

No.	Date	Activities	
		Discussion etc.	Site Survey
20	Nov. 26 (Thu)	· M/S MURAMATSU and MAEKAWA Ar. Tokyo · M/S MIURA, KOGAWA and AKUTSU moving to Nairobi	· Roads in Coast Prov. and Eastern Prov.
21	Nov. 27 (Fri)	· MR. KOGAWA Lv. Nairobi Ar. London · Discussion on training activities and facilities at DST HQ. · Discussion on usage conditions of equipment and spare parts	· Mechanics School · Plant Mechanics Specialist School · Field Practical Unit and Plant Operators Training School
22	Nov. 28 (Sat)	· MR. KOGAWA Lv. London · Moving to Muranga, Mweiga, Nanyuki, Nyahururu	· Roads in Nairobi Prov. and Central Prov. · Muranga Dist. Workshop · Bridge construction sites (Kaweru, Muranga, Mweiga, Nyeri) · Roads in Rift Valley Prov.
23	Nov. 29 (Sun)	· MR. KOGAWA Ar. Tokyo · Study on bridge construction work · Regulating data	
24	Nov. 30 (Mon)	· Discussion on Highway Maintenance Management System at MOPW HQ. · Regulating data	
25	Dec. 1 (Tue)	· Moving to Machakos, Kangundo, Siadhani · Moving to Nairobi	· Roads and maintenance works in Eastern Prov. · Roads and bridges in Machakos Dist. · Machakos Dist.Workshop and Bridge Unit · Bridge construction sites (Kangndo, Machakos, Siadhani)
26	Dec. 2 (Wed)	· Report on the Study at JICA · Greeting to MOPW · Preparation of homeward bound	
27	Dec. 3 (Thu)	· M/S MIURA and AKUTSU Lv. Nairobi, Ar. London	
28	Dec. 4 (Fri)	· Lv. London	
29	Dec. 5 (Sat)	· Ar. Japan	