

MINISTRY OF WORKS
THE UNITED REPUBLIC
OF TANZANIA

**BASIC DESIGN STUDY REPORT
ON
THE PROJECT
FOR
PAVEMENT MAINTENANCE EQUIPMENT
FOR TRUNK ROADS
IN
THE UNITED REPUBLIC OF TANZANIA**

FEBRUARY 1993

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OF TANZANIA

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P R E F A C E

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

JICA sent to Tanzania a study team headed by Mr. Koichi MIYOSHI, Director, Second Basic Design Study Division, Grant Aid Study & Design Department, Japan International Cooperation Agency (JICA), and constituted by members of Katahira & Engineers International, from October 27 to November 17, 1992.

The team held discussions with the officials of the Government of Tanzania, 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 of the Government of the United Republic of Tanzania for their close cooperation which they extended to the team.

February 1993



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 Pavement Maintenance Equipment for Trunk Roads in The United Republic of Tanzania.

This study was been done 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 the present situation in Tanzania, and have planned the most appropriate project in the scheme of Japan's Grant Aid.

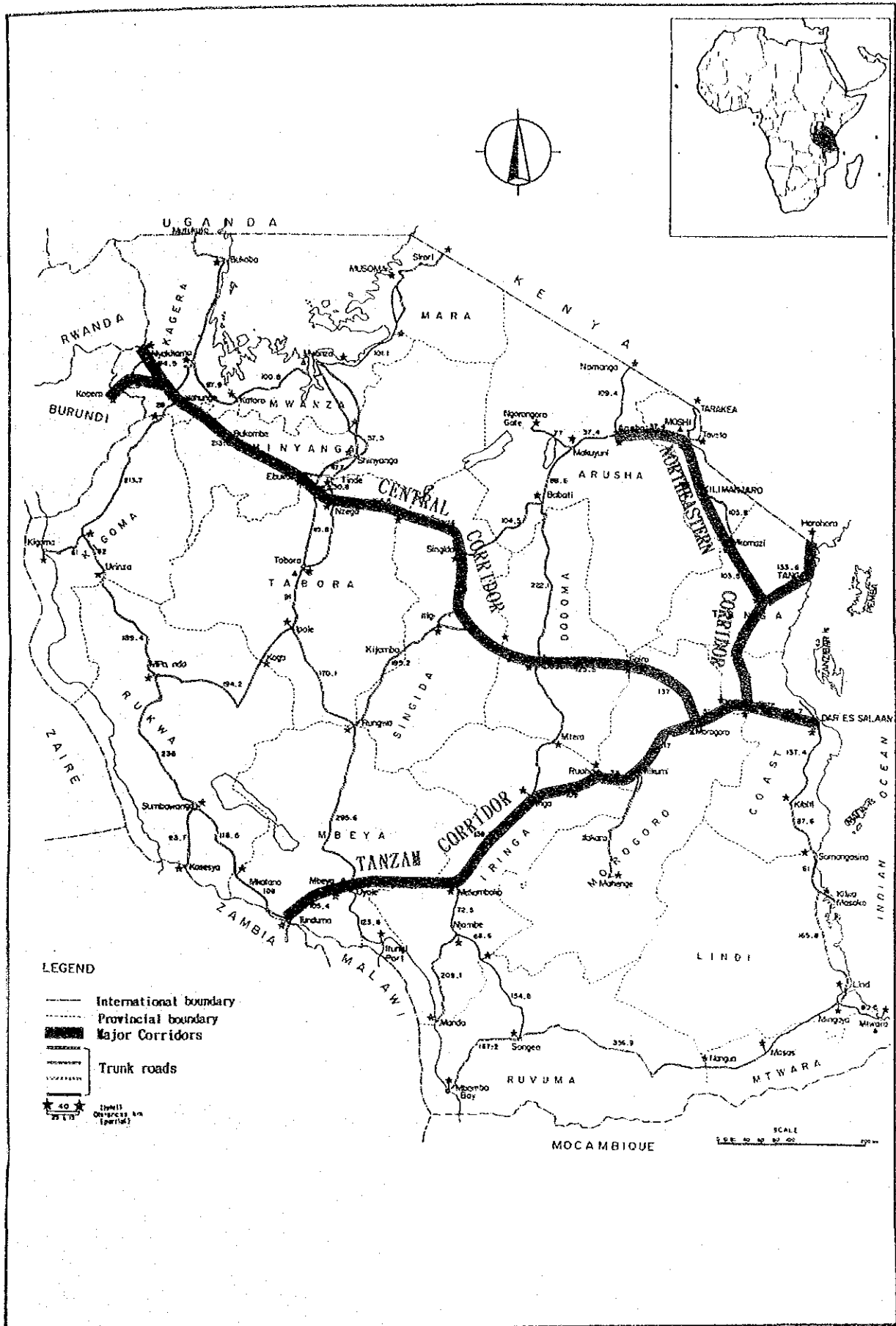
We wish to take this opportunity to express our sincere gratitude to the officials of JICA, the Ministry of Foreign Affairs and the Ministry of Construction. We also wish to express our deep gratitude to the officials of Ministry of Works, JICA office and the Embassy of Japan in Tanzania for their close 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,



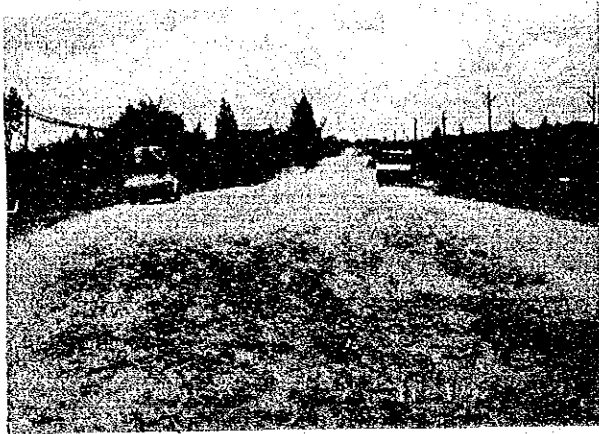
Minoru MIURA
Project Manager,
Basic Design Study Team on
Pavement Maintenance
Equipment for Trunk Roads
Katahira & Engineers International



LOCATION MAP

CONDITIONS ON TRUNK ROADS

Roads in need of maintenance



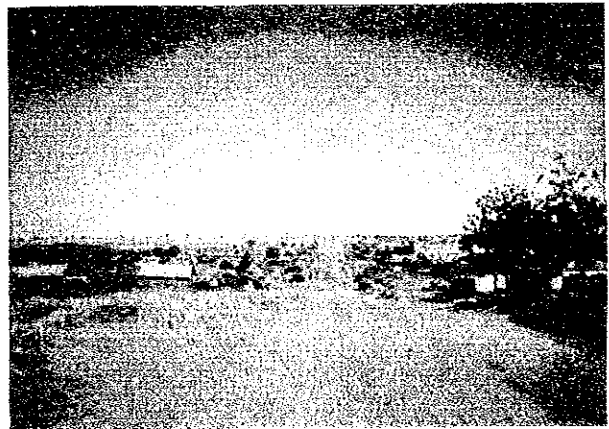
Coast Region



Dar es Salaam Region



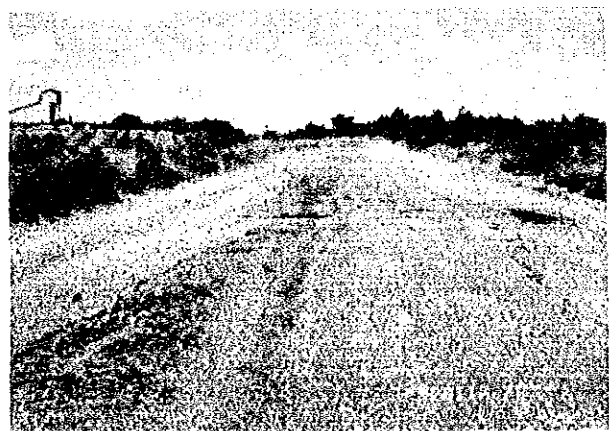
Morogoro Region



Iringa Region

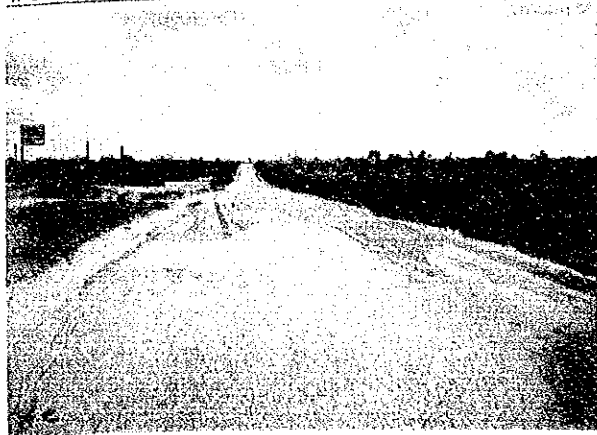


Tanga Region



Kilimanjaro Region

Well-Maintained roads



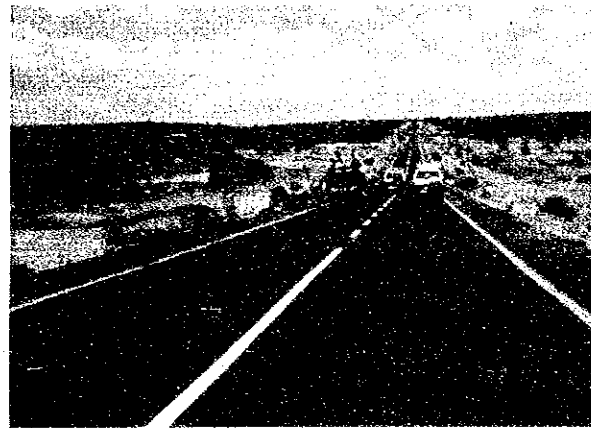
Resealing



Patching



Well maintained bitumen roads



Well maintained bitumen roads



Well maintained drainage



Shoulder and drainage maintenance



Bitumen road base construction



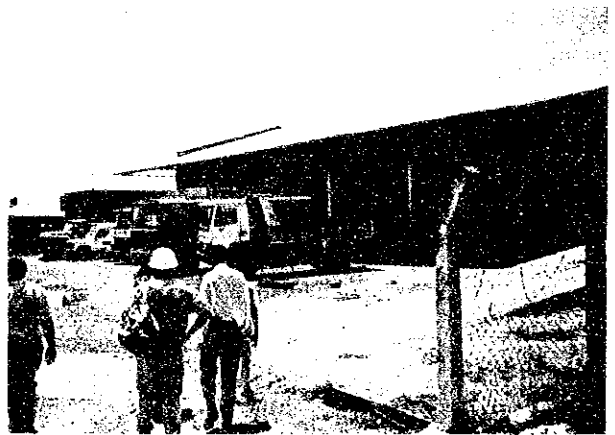
Overlay

REGIONAL ENGINEERS OFFICE[REO]

Dar es Salaam REO



Office



Storage

Kibaha REO



Overview

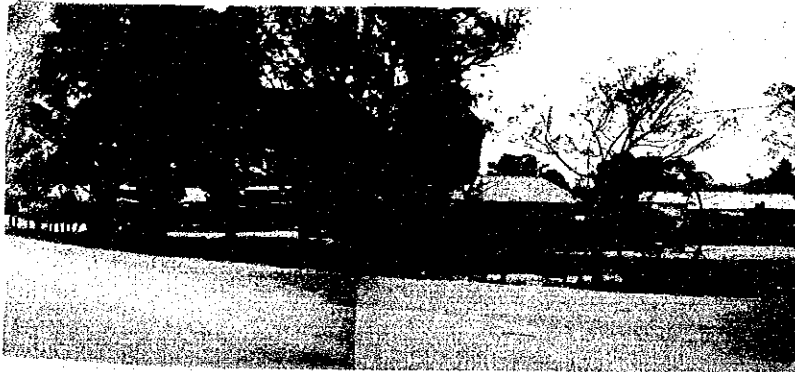


Vehicle repair

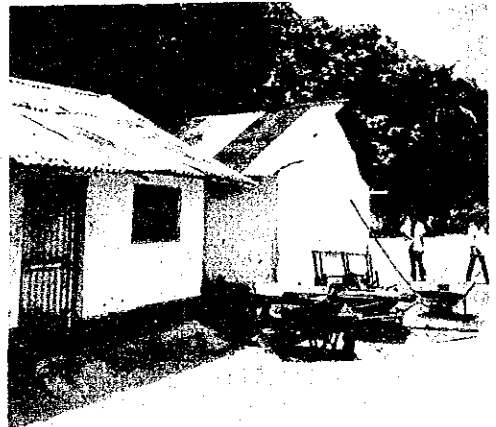


Spare Parts Rack

Kibiti Depot



Overview



Storage and bitumen tools

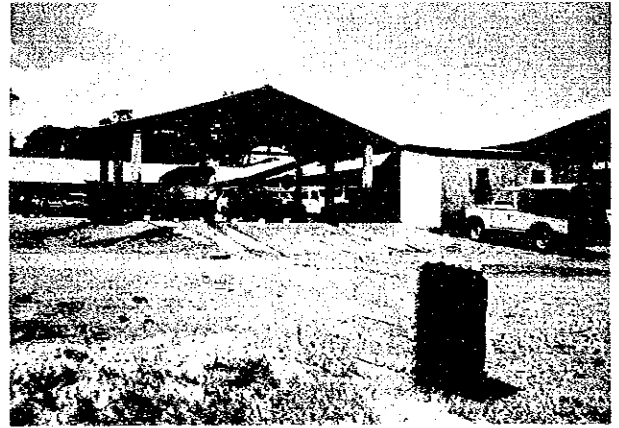
Morogoro REO



Overview



Workshop



Vehicle Workshop

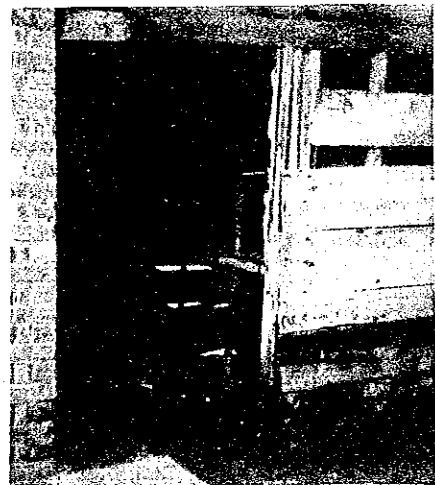
Iringa REO



Overview



Tipper trucks supplied under
Japan's Grant Aid



Spare Parts Rack

Dodoma REO



Overview

Vanga REO



Garage



Workshop

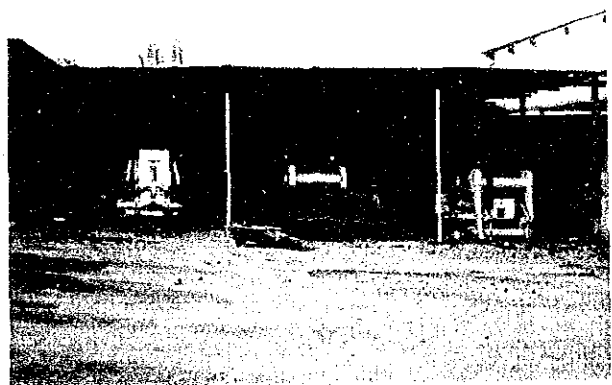
Kilimanjaro REO



Overview



Name board



Garage



Workshop



Vibration roller

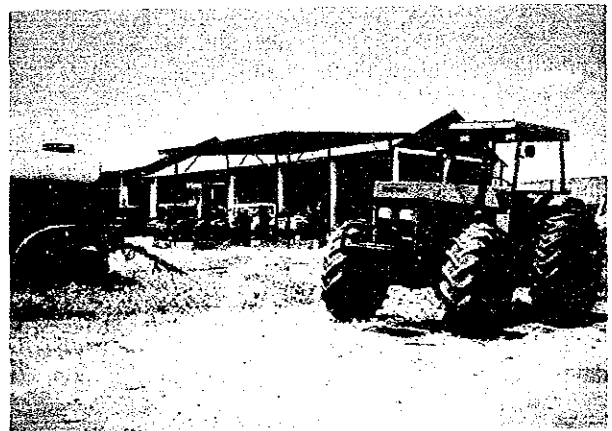


Plate Compactor

PEHCOL Office



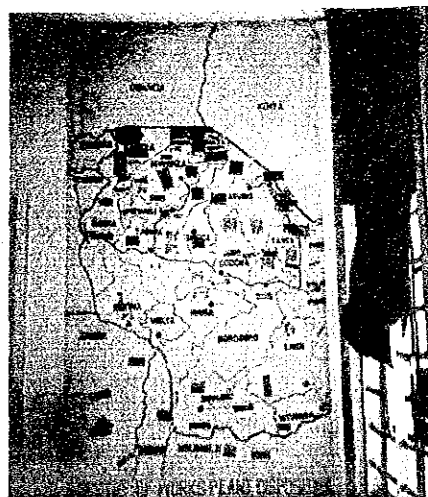
Office(Morogoro)



Workshop(Morogoro)

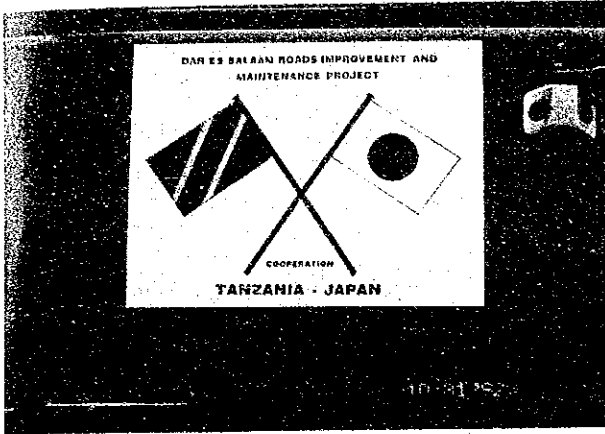


Ndundu Depot

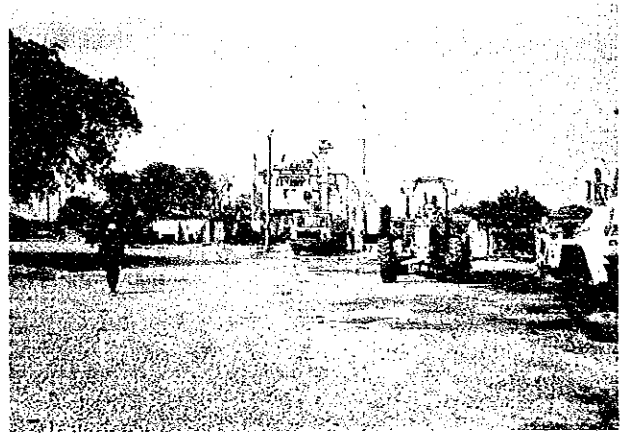


Control board (Morogoro)

DAR ES SALAAM ROADS IMPROVEMENT AND MAINTENANCE PROJECT



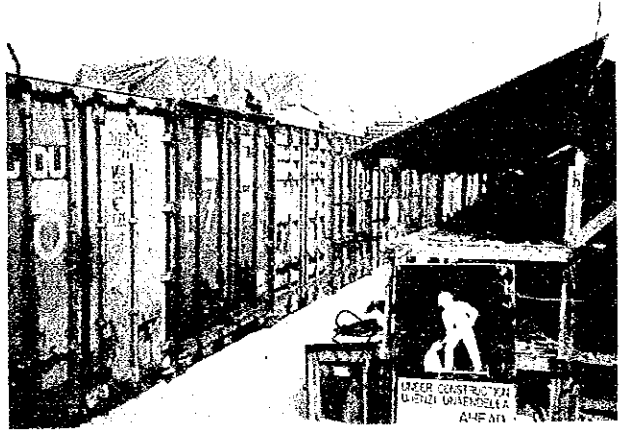
Project name board



Asphalt plant



Workshop



Spare parts storage



Parts rack



Construction in Dar es Salaam

SUMMARY

The Government of the United Republic of Tanzania is implementing the Second Five Year Development Plan (1988/89 - 1992/1993). The target of this plan in terms of GDP (5%) has been a bit unsatisfying when referring to the economic activities which occurred from 1985 to 1989. In order to effectively support and strengthen this plan, the Economic Recovery Programme II (ERP II) was set forth in July 1989.

ERP II included a National Transport Policy with the main objectives:

- To steadily develop the transport systems in keeping with the country's overall development objectives;
- To ensure complementarity in the development of the various modes of transport for optimum utilization of the resources;
- To make the best use of the means of transport which are the cheapest and most efficient in order to enhance national economic development;
- To make use of the most appropriate equipment which should be economical to operate and at the same time make best use of locally available resources;
- To ensure that standards of safety are compatible with quality of life, and protection of the environment are implemented and maintained for each mode of transport.

Since the First Economic Recovery Plan (1987-1989, ERP-I) was set forth on July 1986 under the assistance of the World Bank and IMF, road development in Tanzania has been implemented by the Integrated Roads Project (IRP) which aims to rehabilitate the existing trunk roads and to establish main rural road network.

Another primary objective of the IRP is to develop the Ministry of Works' (MOW) institutional capacity so that it can properly maintain the networks. Another objective is to transform it from a centrally controlled, direct labour-oriented organization to a

decentralized organization which is oriented to contract management.

The action programme of IRP includes (a) governmental institution strengthening programme, (b) road construction and rehabilitation programme and (c) road maintenance management programme. Among them, the main action items of the road maintenance management programme are as follows:

Road Maintenance Management Programme

- to procure equipment, vehicles, spare parts and factory machines for PEHCOL (Plant and Equipment Hire Co., Ltd.)
- to procure the same above for MOW
- to rent equipment for the road maintenance activities of REO
- to contract maintenance and emergency works on the 400 kms of trunk roads and the 3,600 kms of rural roads

The institutional establishment of PEHCOL and centralization of authority to REOs realizes private sectors participation in road and equipment maintenance activities. On the other hand, it is generally recognized that the force account system by REO will be introduced for routine maintenance works on paved trunk roads which will need relatively light equipment and vehicles and include daily activities.

The objective of this Project, therefore, is to support the REOs' force account activities for routine maintenance on paved trunk roads by providing adequate equipment.

In response to the request of the Government of the United Republic of Tanzania, The Government of Japan decided to conduct the Basic Design Study on the Project for Pavement Maintenance Equipment for Trunk Roads in Tanzania. JICA dispatched the Basic Design Study Team headed by Mr. Koichi MIYOSHI, Director, Second Basic Design Study Division, Grant Aid Study & Design Department, JICA, from October 27 to November 17, 1992, for the field investigation.

The Basic Design Study Team, during its stay in Tanzania, collected the relevant data and investigated the conditions of roads and 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 Study Team prepared the basic design considering the magnitude of maintenance and rehabilitation works, construction conditions and environmental conditions. Based thereon, the type and number of equipment were selected as shown in the following table.

LIST OF EQUIPMENT

| Type of Equipment | Quantity |
|-------------------------------|----------|
| 1. Truck with crane | 8 |
| 2. Cargo truck | 16 |
| 3. Dump truck (4 ton) | 8 |
| 4. Dump truck (2 ton) | 8 |
| 5. Hydraulic excavator | 8 |
| 6. Air compressor | 8 |
| 7. Pneumatic hand breaker | 16 |
| 8. Pick hammer | 16 |
| 9. Pavement tools | 16 |
| 10. Asphalt burner | 8 |
| 11. Asphalt sprayer | 8 |
| 12. Vibratory roller | 8 |
| 13. Vibratory plate compactor | 8 |
| 14. Concrete mixer | 8 |
| 15. Concrete vibrator | 16 |
| 16. Pump | 16 |
| 17. Step bridge | 8 |
| 18. Hand tools | 8 |
| 19. Generator | 8 |
| 20. Electric welder | 8 |
| 21. Safety tools | 8 |
| 22. Storage Container | 8 |

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 seven and a half months from procurement to handing over.

The Ministry of Works (MOW) is the responsible agent for comprehensively implementing the Project while the Roads and Aerodromes Division (RAD) and Regional Engineers Offices (REOs) takes charge of management for equipment provided. Both MOW and

RAD 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 paved trunk roads. Also the Project in collaboration with IRP's technical assistance can produce more effective results, since both are firmly inter-connected. Consequently this will contribute to the enhancement of MOW's managerial ability for equipment as well as to the betterment of "quality" in road transport services.

The implementation of this project will greatly benefit a population of 19 million (85% of the total) within 650,000 km² (74% of the entire land area). This area spans 16 regions in Tanzania and will also stimulate national economic growth for the middle and long term recovery programme.

Sufficient maintenance activities on trunk roads will help to increase rural area development (including the high potential agricultural areas). It will also promote employment opportunities as well as establishing economical and cost-stable transportation. The providing of equipment will also greatly help to implement the Integrated Roads Project.

The distribution of equipment fleets to Other Regions will be reviewed based on an engineering and economic appraisal of the progress of the IRP and the Project. This review will be conducted during or after the distribution of the first fleets into the 8 "A-Rank" Regions.

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CHAPTER I

INTRODUCTION

CHAPTER 1

INTRODUCTION

In response to the request of the Government of the United Republic of Tanzania, The Government of Japan decided to conduct the Basic Design Study on the Project for Pavement Maintenance Equipment for Trunk Roads in Tanzania. Japan International Cooperation Agency (JICA) dispatched the Basic Design Study Team headed by Mr. Koichi MIYOSHI, Director, Second Basic Design Study Division, Grant Aid Study & Design Department, Japan International Cooperation Agency (JICA), from October 27 to November 17, 1992, for the field investigation.

The Basic Design Study Team, during its stay in Tanzania, collected the relevant data and investigated the conditions of roads and 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 member list of the Study Team, survey schedule, list of persons met in Tanzania, Minutes of Discussions and other information are filed in the Appendices of this report.

CHAPTER 2

BACKGROUND

AND

CONTENTS

CHAPTER 2

BACKGROUND AND CONTENTS

2.1 Background

2.1.1 National Development Plan

The Government of the United Republic of Tanzania is implementing the Second Five Year Development Plan (1988/89 - 1992/1993). The target of this plan in terms of GDP (5%) has been a bit unsatisfying (when referring to the economic activities which occurred from 1985 to 1989 as shown in Table 6-1 of Appendix 6). In order to effectively support and strengthen this plan, the Economic Recovery Programme II (ERP II) was set forth in July 1989 with the main strategies as follows:

- to promote agricultural activities
- to effectively distribute the national resources
- to rehabilitate transport and communication activities
- to rehabilitate and secure the balance of domestic and international finance
- to reduce the inflation rate
- to activate manufacturing activities
- to rehabilitate and maintain social services

In 1989 the government of Tanzania adopted a National Transport Policy with these main objectives:

- To steadily develop transport systems in keeping with the country's overall development objectives;
- To ensure complementarity in the development of the various modes of transport for optimum utilization of the resources;
- To make the best use of the means of transport which are the cheapest and most efficient in order to enhance national economic development;

- To make use of the most appropriate equipment which should be economical to operate while at the same time making the best use of locally available resources;
- To ensure that standards of safety are compatible with quality of life, and protection of the environment are implemented and maintained for each mode of transport.

2.1.2 Conditions of Road Sector

There are five transport modes in Tanzania, i.e. road, rail, sea, river and lake and air. Road and rail transport modes take a big share in freight transportation of imported goods from Dar es Salaam Port to landlocked neighbouring countries as well as within inland areas. Road transportation, especially, has been utilized more highly than by rail as shown in Table-1.

Table-1 FREIGHT TONNAGE OF IMPORTED GOODS FROM DAR ES SALAAM PORT TO NEIGHBOURING COUNTRIES AND INLAND AREAS BY ROAD AND RAIL

| Destination | Unit: 1,000 tons | |
|-------------|------------------|---------|
| | by Road | by Rail |
| Inland | 438 | 23 |
| Zambia | 65 | 244 |
| Zaire | 28 | 9 |
| Burundi | 46 | 8 |
| Rwanda | 45 | 4 |
| Malawi | 44 | 0.05 |
| Uganda | 3 | 6 |
| Zimbabwe | 0.08 | - |
| Total | 669 | 294 |

Source: Appendix 5, 5-21

The total length of road network in Tanzania is approximately 90,000 km as categorized in Table-2.

Table-2 ROAD NETWORK LENGTH

| Categories | Length (km) |
|------------------|-------------|
| Trunk Road | 10,200 |
| Rural Trunk Road | 17,800 |
| Rural Road | 32,000 |
| Others | app. 30,000 |
| Total | 90,000 |

Source: Appendix 5, 5-4, 5-21

The 28,000 km network of trunk roads and rural trunk roads is under the jurisdiction of the Ministry of Works. Table-3 shows the list of nine corridors traversing to neighbouring countries.

Table-3 CORRIDOR LENGTH

| Corridor (Origin-Destination) | Length (Km) |
|--|----------------|
| THE TANZANIA ZAMBIA (Tanzam) CORRIDOR (Dar es Salaam-Morogoro-Iringa-Tunduma) | 935 |
| NORTHEASTERN CORRIDOR (Arusha-Chalinze/Segeera-Tanga-Horohoro) | 672 |
| CENTRAL CORRIDOR (Morogoro-Dodoma-Singida-Nzega-Mwanza/Rusumo) | 1,076 |
| THE LAKE CIRCUIT CORRIDOR (Mutukula ; Uganda Brd-Mwanza-Shirati ; Kenya Brd) | 809 |
| SOUTHERN COASTAL LINK ROAD CORRIDOR (Dar es Salaam-Kibiti-Lindi) | 454 |
| SOUTHERN CORRIDOR (Mtwara-Songea-Mbambabay) | 850 |
| WESTERN CORRIDOR (Biharamolu-Kigoma-S/Wanga-Tunduma) | 1,042 |
| GREAT NORTH ROAD CORRIDOR (Namanga-Arusha-Iringa, linking with Tanzam) | 773 |
| MID WEST CORRIDOR (Tambora-Rungwa-Mbeya) | 746 |
| Total | 7,357 |

Source: Appendix 5, 5-13

Figure-1 and Table 6-2 in Appendix 6 show Trunk Roads Network and records of trunk road conditions by Region respectively.

In Table 6-2 in Appendix 6, it is estimated that 54% of the paved trunk roads are presently in GOOD condition while 25% are in FAIR and 21% are in POOR condition. The categories GOOD, FAIR and POOR are based on the following definitions:

GOOD : Substantially free of defects, requires only routine maintenance

FAIR : Significant defects, requires resurfacing or strengthening

POOR : Extensive defects, requires immediate rehabilitation or reconstruction

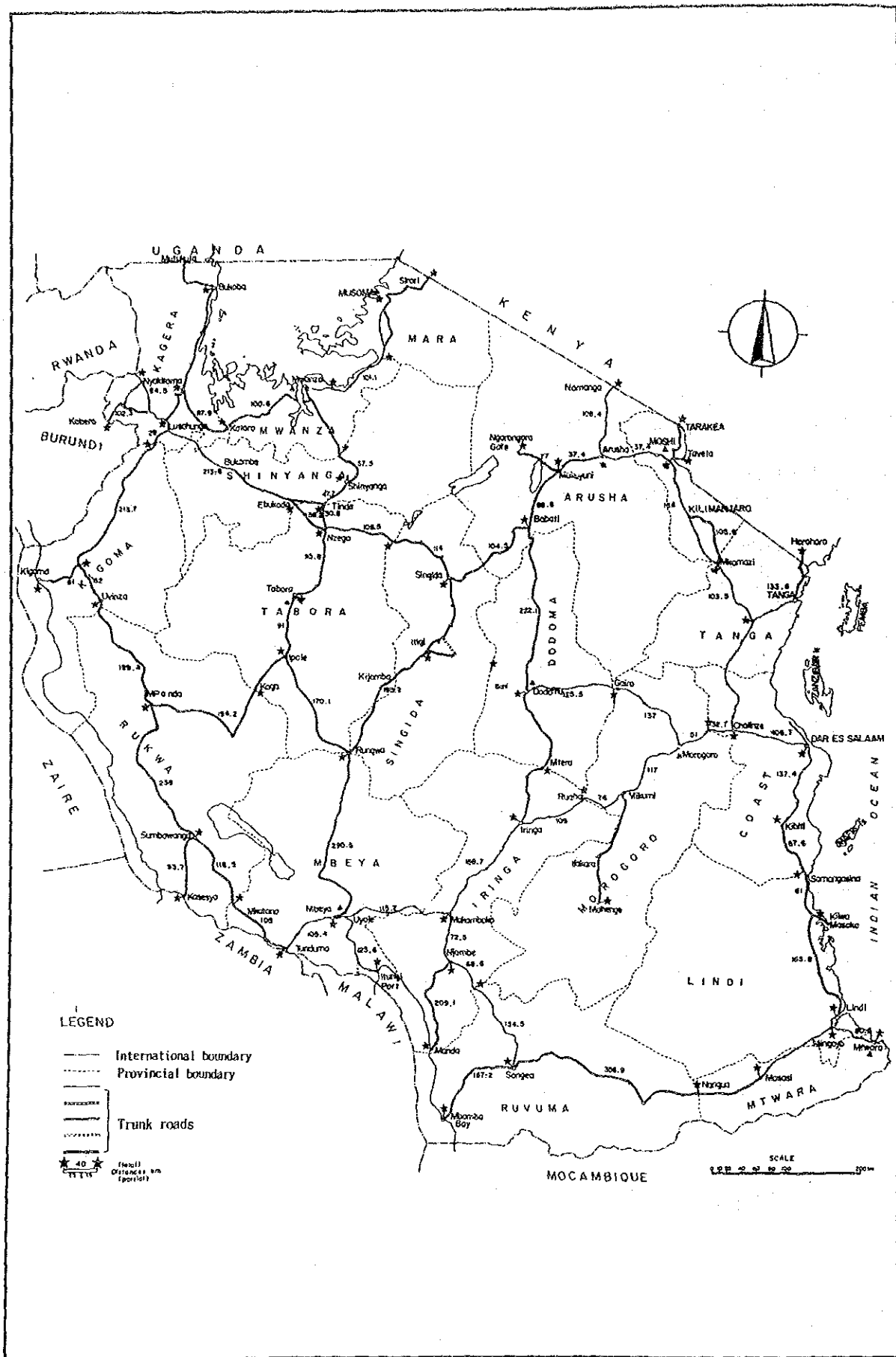
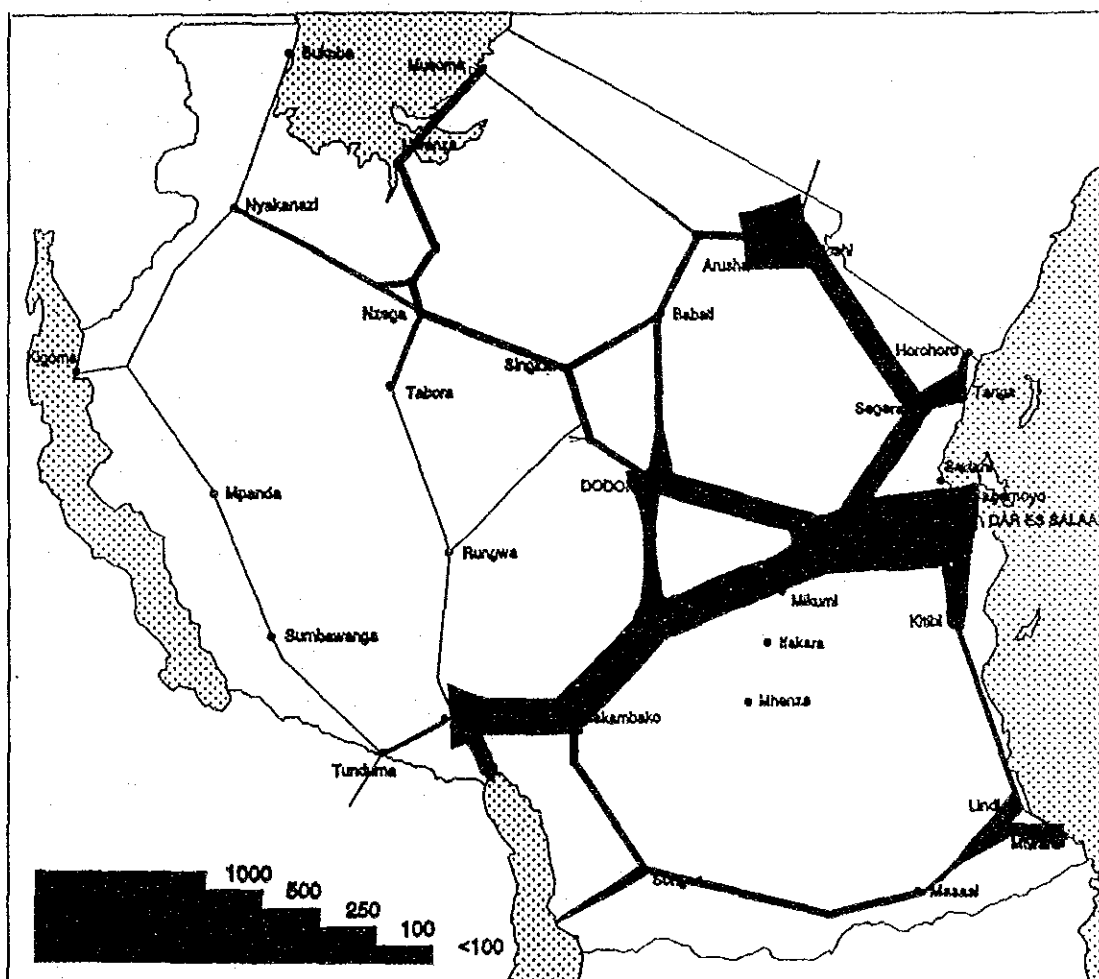


Figure-1 TRUNK ROADS NETWORK

The number of registered vehicles in Tanzania, which was 77,514 in 1983, 64,819 in 1984 and 72,072 in 1987, has been unstable for the past ten years due to economic stagnancy and poor road conditions. As a consequence, this situation produces a severe lack of transportation capacity on roads. Especially those roads which connect agricultural production areas (which are widely scattered) and consumption areas or international ports.

Average daily traffic (ADT) on the roads, as shown in Figure-2, is relatively light. On the paved trunk roads ADT generally ranges from 200 - 500 vehicles per day, except for the Himo Jct - Moshi - Arusha and Dar es Salaam (DSM) - Chalinze sections which carry ADTs of about 1000, - 1500 and 1000 vpd, respectively.



Source: Appendix 5, 5-13

Figure-2 AVERAGE DAILY TRAFFIC ON PAVED TRUNK ROADS

2.1.3 Roads Development Plan

Since the First Economic Recovery Plan (1987-1989, ERP-I) was set forth on July 1986 under the assistance of the World Bank and IMF, road development in Tanzania has been implemented by the Integrated Roads Project (IRP) which aims to rehabilitate the existing trunk roads and to establish a main rural road network.

Another primary objective of the IRP is to develop the Ministry of Works' (MOW) institutional capacity so that it can properly maintain the networks. Another objective is to transform it from a centrally controlled, direct labour-oriented organization to a decentralized organization which is oriented to contract management.

The followings are the IRP's targets:

- To create better road infrastructure and road transport services, thereby removing those bottlenecks which hinder the expansion of exports, the expansion of farm production and the increasement of business mobility.

Targets

By mid-1996

- * 70% of the trunk roads in good condition, (up from 15% in 1990),
- * 50% of the regional roads in good condition (up from 10% in 1990) in, at least, the 11 core regions serving important agricultural production districts, and
- * all those roads in good and fair condition (about 20,000 km) to be under regular maintenance;

By the year 2000

- * over 80% of trunk roads in good condition,
- * 50% of regional roads in good condition in all 20 regions, and

* the entire trunk and regional network of over 35,000 km (including all essential district and feeder roads) under regular maintenance.

- reducing road transportation costs for both freight and passengers;
- increasing the involvement of the private sector in road rehabilitation and maintenance tasks and road equipment management;
- improving transport planning, budgeting and revenue collection procedures; and
- strengthening Government institutions and private enterprises involved in the transport sector, by providing well focused training, at all levels, to operate, maintain and manage road infrastructure and transport services.

The action programme of IRP includes (a) governmental institution strengthening programme, (b) road rehabilitation programme and (c) road maintenance management programme, as follows:

Governmental Institution Strengthening Programme

- to strengthen MOW's departments and divisions
- to institute procedures in the Regional Engineer's Office (REOs) of the eleven core regions
- to renovate facilities at University of DSM Engineering Faculty
- to renovate facilities at Arusha and DSM Technical Colleges
- to re-equip MOW's Central Materials Laboratory (CML) and to provide training and technical assistance
- to train highway management
- to formulate and implement a road safety programme
- to coordinate project implementation and to establish a management information system
- to renovate MOW's and MCT's (Ministry of Communications and Transport) headquarters, CML and REOs, and to upgrade office technology and communications
- to revise the Government's procurement regulations
- to assist domestic contractors
- to make NIT's (National Institute of Transport) vocation training programmes shorter and more practical

Road Rehabilitation Programme

- for paved trunk roads : rehabilitation of 1,460 km overlay or resealing of 610 km
- for unpaved trunk roads : rehabilitation or improving of 2,550 km, and upgrading of 360 km
- for bridges on trunk roads: rehabilitation or replacement of 30 bridges
- for vehicular ferry : improvement of 10 vehicular ferry crossings
- for regional roads : rehabilitation of 3,000 km

Table-4 and Figure-3 show the implementation schedule for paved trunk roads rehabilitation programme in IRP (I).

Road Maintenance Management Programme

- to procure equipment, vehicles, spare parts and factory machines for PEHCOL (Plant and Equipment Hire Co., Ltd.)
- to procure the same above for MOW
- to rent equipment for the road maintenance activities of REO
- to contract maintenance and emergency works on the 400 kms of trunk roads and the 3,600 kms of rural roads

The total project cost of IRP(I) shown in Table-5 was appraised by the World Bank Group on March 1990 and Table-6 provides the estimated cost for road maintenance activities.

Table-5 PROJECT COST OF IRP(I)

Unit: US\$ million

| | Local | Foreign | Total |
|---|-----------|-----------|------------|
| Institutional Support | 10 | 38 | 48 |
| Rehabilitation Programme | 142 | 436 | 578 |
| Maintenance Programme | 23 | 46 | 69 |
| Freight, Passenger and Air Transportation | 1 | 4 | 5 |
| Sub-total | 176 | 524 | 700 |
| Contingency | 43 | 128 | 171 |
| Total | 219 (25%) | 652 (75%) | 871 (100%) |

Source: Appendix 5, 5-4

Table-4 IMPLEMENTATION SCHEDULE OF IRP (I) (PAVED TRUNK ROADS)

| Year | Description of Works | Donors | Completion | Progress Nov. 92 |
|---------------|---|------------|------------|---------------------|
| | | | year | |
| <u>Year 1</u> | <u>Start FY1989/90</u> | | | |
| (a) | Tanzam 1(A):Hwy 6 (53 km) | AfDF | 93/94 | 15 |
| (b) | Tanzam 2:Hwy 6/IRP (73 km) | IDA/NORAD | 91/92 | 100 |
| (c) | Tanzam 4:Hwy 6/IRP (91 km) | IDA/NORAD | 92/93 | 66 |
| (d) | Chalinze-Segera (174 km) | DANIDA | 91/92 | 100 |
| (e) | Segera-Same (177 km) | KfW-FRG | 94/95 | 52 |
| <u>Year 2</u> | <u>Start FY1990/91</u> | | | |
| (a) | Same-Himo Jct. (82 km) | NORAD | 92/93 | 54 |
| (b) | Kibiti-Ikwiriri (29 km upgrade) | SAUDI | 92/93 | 50 |
| (c) | Bukombe-Isaka (114 km upgrade) | EEC | 93/94 | 55 |
| (d) | Tanzam 5:Hwy 6/IRP (58 km) | IDA/NORAD | 92/93 | 40 |
| <u>Year 3</u> | <u>Start FY1991/92</u> | | | |
| (a) | Ibanda-Uyole (98 km) | NETH/EEC | 94/95 | 2 |
| (b) | Tanzam 3(A-1):Hwy 6 (33 km) | AfDF | 94/95 | 2 |
| (c) | Segera-Tanga (71 km) | DANIDA | 93/94 | 1 |
| <u>Year 4</u> | <u>Start FY1992/93</u> | | | |
| (a) | Kobero-Nyakasanza (59 km upgrade) | EEC | 93/94 | 0 |
| (b) | Himo Jct-Arusha (104 km) | AfDF/NORAD | 94/95 | - |
| (c) | DSM: Upanga & Bagamoyo Rds (10 km) | JAPAN | 93/94 | - |
| (d) | Musoma-Sirari (92 km upgrade) | EEC | 95/96 | - |
| (e) | Mwanza-Nyanguge (34 km) | EEC | 94/95 | - |
| (f) | DSM-Bagamoyo (34 km upgrade + 34 km) | ITALY | 95/96 | - |
| <u>Year 5</u> | <u>Start FY1993/94</u> | | | |
| (a) | Mwanza-Nzega #1 (20 km upgrade + 20 km) | IDA | 94/95 | - |
| (b) | Morogoro Road (5.7 km 4-lane) | JAPAN | 94/95 | - |
| (c) | Minjingu-Babati (upgrade 60 km) | ITALY | 95/96 | - |

Source: Appendix 5, 5-11

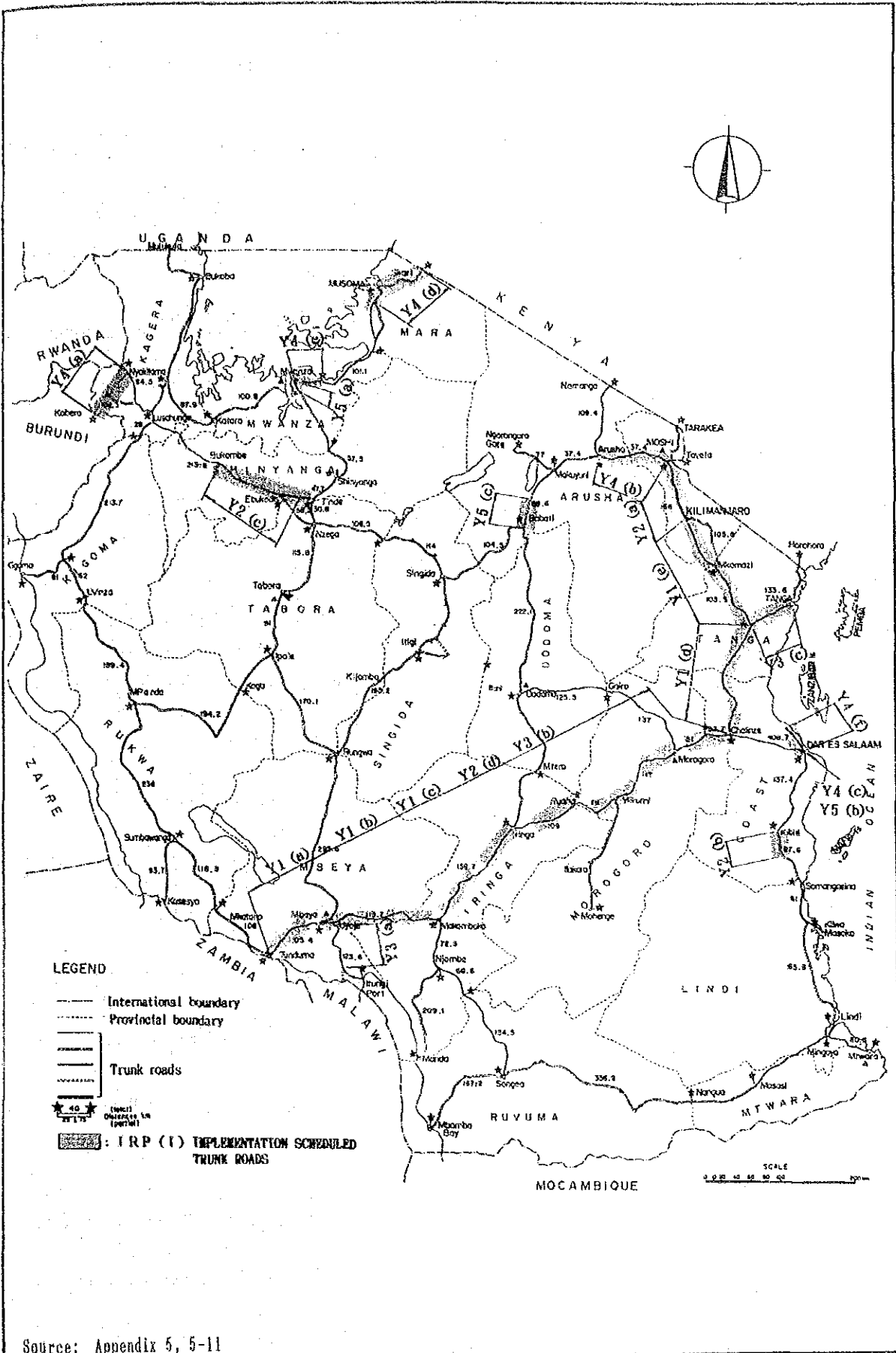


Figure-3 IMPLEMENTATION SCHEDULE OF IRP (I)
(PAVED TRUNK ROADS)

Table-6 ROAD MAINTENANCE COST OF IRP(I)

Unit: US\$ million

| | 90/91 | 91/92 | 92/93 | 93/94 | 94/95 | 95/96 |
|----------------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Routine Maintenance | 6.6 | 5.7 | 5.5 | 6.2 | 8.3 | 10.7 |
| Periodic Maintenance | 12.1 | 10.4 | 10.5 | 12.1 | 16.8 | 22.0 |
| Total (1) | 18.7 | 16.1 | 16.0 | 18.3 | 25.1 | 32.7 |
| Local (2) | 7.5 | 18.1 | 9.6 | 13.8 | 21.3 | 32.7 |
| Foreign | 11.2 | 8.0 | 6.4 | 4.5 | 3.8 | 0.0 |
| (2) / (1) % | 40 | 50 | 60 | 75 | 85 | 100 |

Source: Appendix 5, 5-4

The Government of Tanzania has already taken some key policy and institutional actions that are needed to enable attainment of their targets. According to the Status Report of June 1992 monitored by the World Bank Group, in particular:

- investment priorities have been reoriented to road rehabilitation and maintenance, and budgetary allocations for road maintenance are being increased annually;
- revenues for road maintenance are being collected from road users mainly through the imposition of a levy on fuel consumption, which is deposited into a dedicated Roads Fund;
- the institutional framework in MOW for planning, managing and maintaining the road networks has been restructured, through (i) the creation of the Division for Roads and Aerodromes (DRA), and (ii) the decentralization of authority for implementing road maintenance and works to the 20 Regional Engineer's Offices (REOs);
- execution capacity for maintaining the road network is being improved through the REOs' gradually increasing the contracting of road maintenance works; and
- MOW's road equipment has been transferred to a new Plant and Equipment Hire Co., Ltd. (PEHCOL) which, from July 1992, will hire to the REOs and contractors at commercial rates set by its Board of Directors.

These progressive implementations led the Government and the World Bank Group to prepare IRP(II) programme.

The institutional establishment of PEHCOL and centralization of authority to REOs realizes private sectors participation in road and equipment maintenance activities. On the other hand, it is generally recognized that the force account system by REOs will be introduced for routine maintenance works on paved trunk roads which will need relatively light equipment and vehicles and include daily activities. In fact, equipment less than 5 tons is managed directly under REO while that more than 5 tons is under PEHCOL in principle.

The objective of this Project, therefore, is to support the REOs' force account activities for routine maintenance on paved trunk roads by providing adequate equipment.

2.1.4 International Assistance

As of June 1992, IDA, DANIDA, FRG, ITALY, FINNIDA, NORAD, EEC, AfDB, JAPAN, etc. are funding road rehabilitation and resealing works in participation with IRP (refer to Table-4). Among them, DAL ES SALAAM ROADS IMPROVEMENT AND MAINTENANCE PROJECT is now implementing under Japan's Grant Aid system.

The following international agencies also are providing or preparing technical assistance to eleven REOs under IRP(I) (refer to Figure-12):

| <u>On going</u> | | <u>Under negotiation</u> |
|-----------------|-------------------|--------------------------|
| Iringa REO | : ODA-UK | Mwanza REO : IDA |
| Kilimanjaro REO | : Germany-GTZ | Shinyanga REO : IDA |
| Lindi REO | : FINNIDA | Kagera REO : UNDP |
| Mbeya REO | : NORAD | |
| Morocoro REO | : Switzerland-SDC | |
| Mtwara REO | : FINNIDA | |
| Ruvuma REO | : ODA-UK | |
| Tanga REO | : NORAD | |

(as of Nov. 1992)

2.2 Outline of Request

To ensure IRP implementation mentioned in previous sections, the Government of Tanzania requested the equipment listed in Table-7 to Japan:

Table-7 EQUIPMENT REQUEST LIST

| Equipment | Number per one set |
|-------------------------------|--------------------|
| 1. Pick-up truck | 1 |
| 2. Truck with crane | 1 |
| 3. Truck | 1 |
| 4. Tipper truck (4 ton) | 1 |
| 5. Tipper truck (2 ton) | 1 |
| 6. Mini-excavator | 1 |
| 7. Air Compressor | 1 |
| 8. Small breaker | 2 |
| 9. Pick hammer | 2 |
| 10. Asphalt cutter | 1 |
| 11. Tools for pavement | 1 |
| 12. Asphalt burner | 1 |
| 13. Hand roller | 1 |
| 14. Plate compactor | 1 |
| 15. Asphalt sprayer | 1 |
| 16. Concrete mixer | 1 |
| 17. Concrete vibrator | 2 |
| 18. Water pump | 2 |
| 19. Up and down bridge | 1 |
| 20. Tools for maintenance | 1 |
| 21. Generator | 1 |
| 22. Electric welder | 1 |
| 23. Tools for traffic control | 1 |
| 24. Storage container | 1 |

Note: 1. MOW requested 16 sets

2. MOW requested spare parts equivalent 20% of machine prices.

2.3 Study of the Project

2.3.1 Technical Data

2.3.1.1 Study Areas and Roads

This Project covers 16 Regions which have more than 50 km of paved trunk road network. All of the necessary data for this Study, i.e. population, land area, road length, etc. by Region, are filed in Table 6-2 of Appendix 6 and in the administrative region map is illustrated in Figure-4.

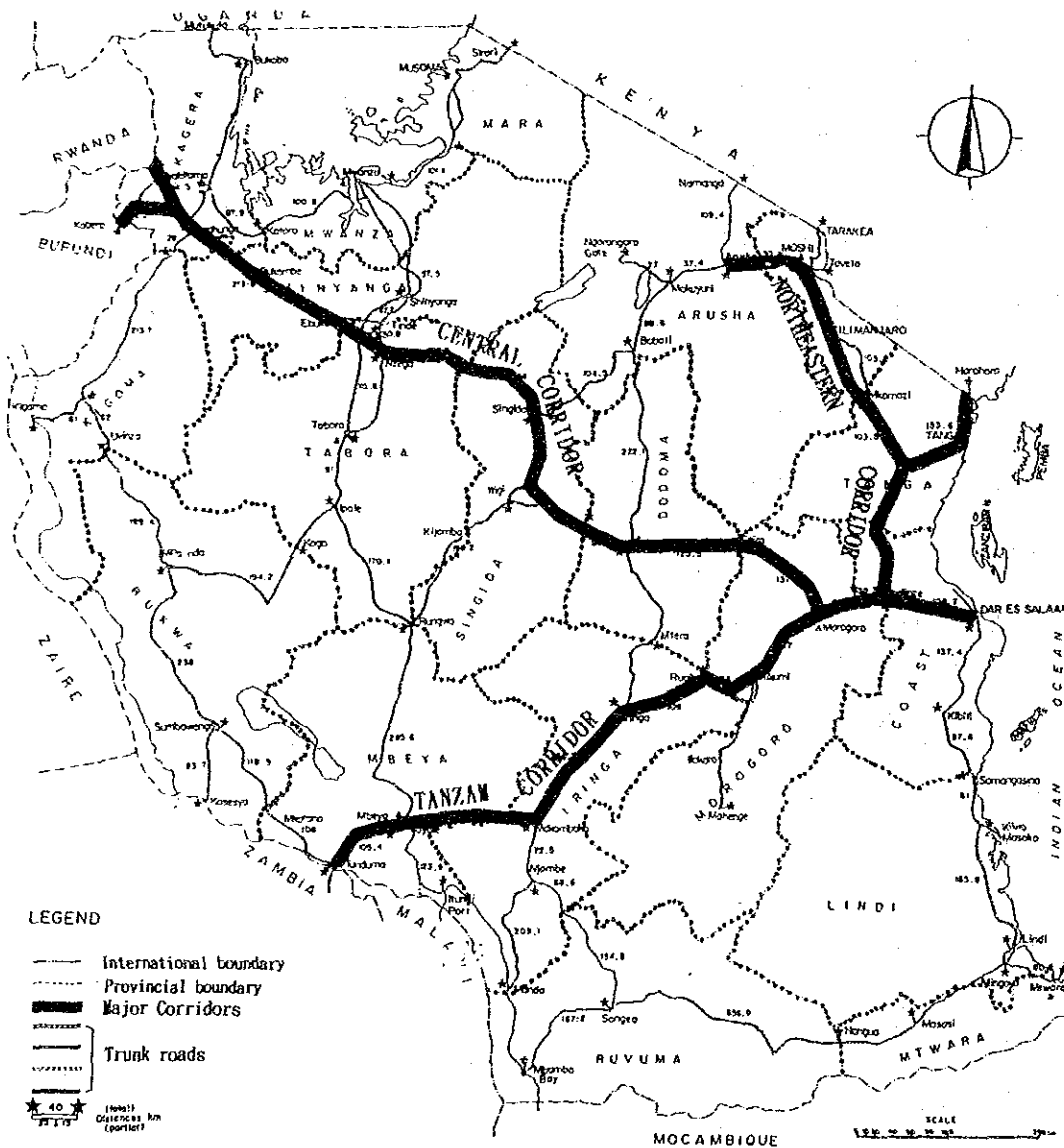


Figure-4 ADMINISTRATIVE REGION MAP

2.3.1.2 Methods for Road Maintenance

Road maintenance is seen to embrace Routine Maintenance, Periodic Maintenance, Emergency Maintenance and Rehabilitation.

Routine maintenance is the day to day upkeep of the road. It includes pot-hole repairs, edge breaks on sealed roads, drainage and water table repairs, and grading of unsealed roads.

Periodic maintenance is the carrying out of the gravelling programme, the resurfacing of sealed roads, major drainage, and bridge repairs.

Emergency maintenance refers to those tasks which stem from an immediate necessity to keep a road open (generally arising from storm damage).

Rehabilitation refers to those major works required to reshape and strengthen a road in order to return it to its proper operating standard.

There is a tendency in MOW to consider that routine and some emergency maintenance works will be implemented by the force account base, whose targeted work items (including equipment necessary for such activities) is shown in Table-8 or Figure-5.

Table-8. WORK ITEM AND EQUIPMENT FOR ROUTINE PAVED ROAD MAINTENANCE

| Work Item | Equipment |
|--|---|
| 1. Patrol on roads | Pick-up truck |
| 2. Transportation for equipment and gang | Truck, Truck with crane, Tipper truck, Up and down bridge |
| 3. Protection on worksites | Sings and Safety Equipment |
| 4. Replacement of destroyed portions | Mini-excavator, Compressor, Small breaker, Pick-up hammer, Asphalt cutter |
| 5. Placing and compaction of asphalt layer | Tools for pavement, Asphalt burner, Hand roller, Plate compactor, Asphalt sprayer |
| 6. Repair on concrete structures | Concrete mixer, Concrete vibrator |
| 7. Cleaning, water supply | Water pump |
| 8. Supporting equipment | Tools for maintenance, Generator, Electric welder, Storage container |

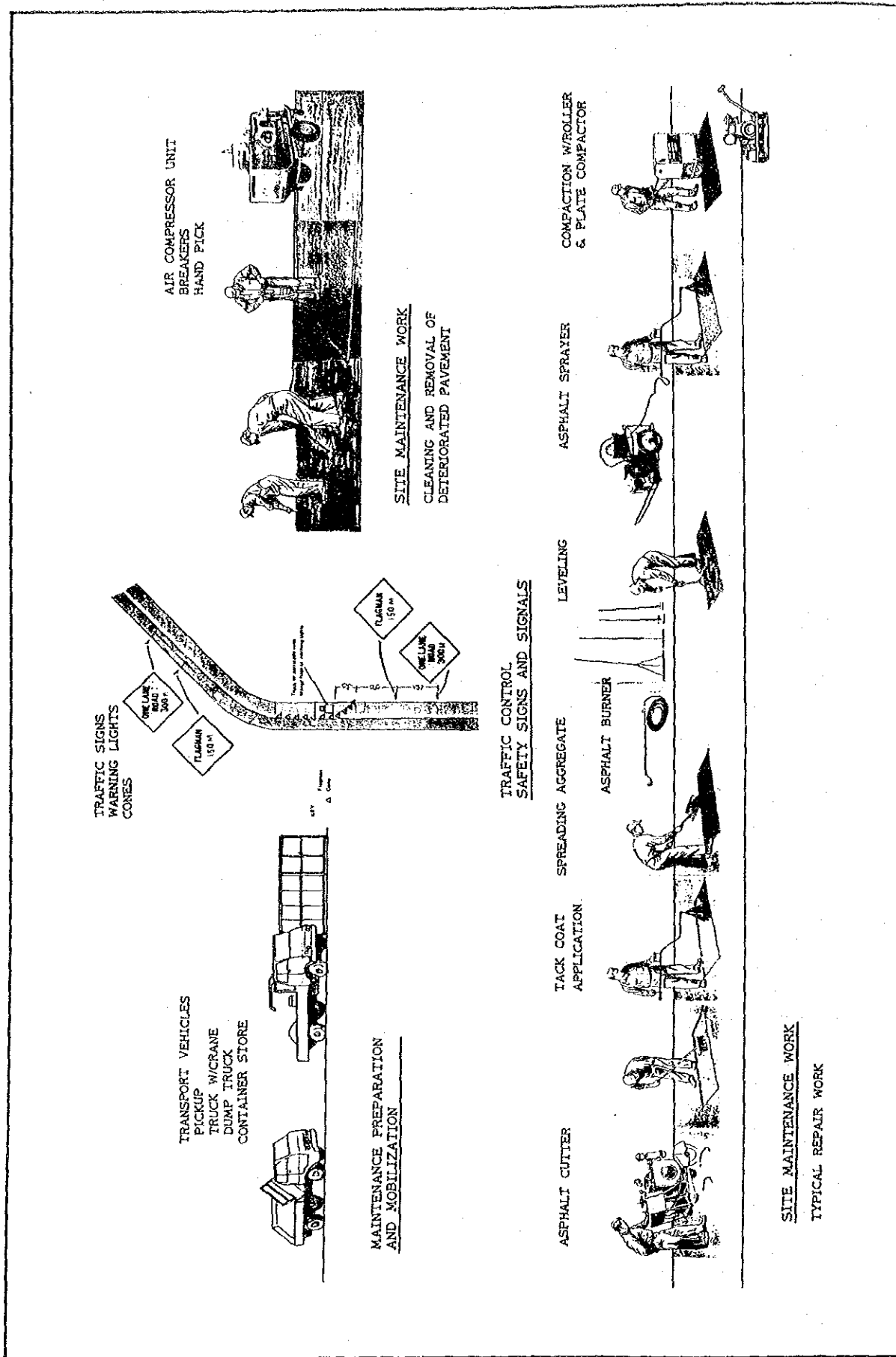


Figure-5 SITE MAINTENANCE WORK (TYPICAL REPAIR WORK)

2.3.1.3 Equipment Registered in MOW

Since all equipment more than 5 tons had their registrations transferred to PEHCOL in July 1992, there are only limited number of light equipment and vehicles in MOWs' workshops. For example, Dar es Salaam REO or Arusha REO has one pick-up truck, Tanza REO has one pick-up truck, three tipper trucks and one set of electric welding equipment. The Coast REO had no equipment during the Study.

2.3.2 Project Description

2.3.2.1 Executing Agency and Operational Structure

1. Overall Organization of the Ministry of Works

The Ministry of Works (MOW) became independent from the Ministry of Transportation after the organizational changes on November 1991 has the responsibility for planning, programming, construction and maintenance of roads and aerodromes in Tanzania. Its structure, as shown in Figure-6, includes two main sub-structures i.e. Headquarter (HQ) and Regional Engineer's Office (REO).

HQ responsibilities are:

- defining levels of service
- establish performance standards
- preparing national work programmes
- allocating resources to regions
- evaluating performance
- coordinating staff deployment
- coordinating training.

In 1992, permanent employees in the MOW now totaled up to 10,000. Of these, the number of technical personnel is estimated as 2400 out of which about 200 engineers are directly involved in roads, as shown in Table-9.

Table-9 NUMBER OF TECHNICAL PERSONNEL

| | | | |
|--------------------------------|---|-----|-------------|
| Managers | : | HQ | 13 |
| | | REO | 20 |
| | | | <u>33</u> |
| Engineers, Technicians : | | | |
| Engineers - roads | | | 201 |
| Technicians - roads | | | 665 |
| Technical Auxiliaries - roads | | | 1267 |
| Plant Operators | | | 268 |
| Ferries - Drivers & Attendants | | | 68 |
| | | | <u>2469</u> |

Source: Appendix 5, 5-16

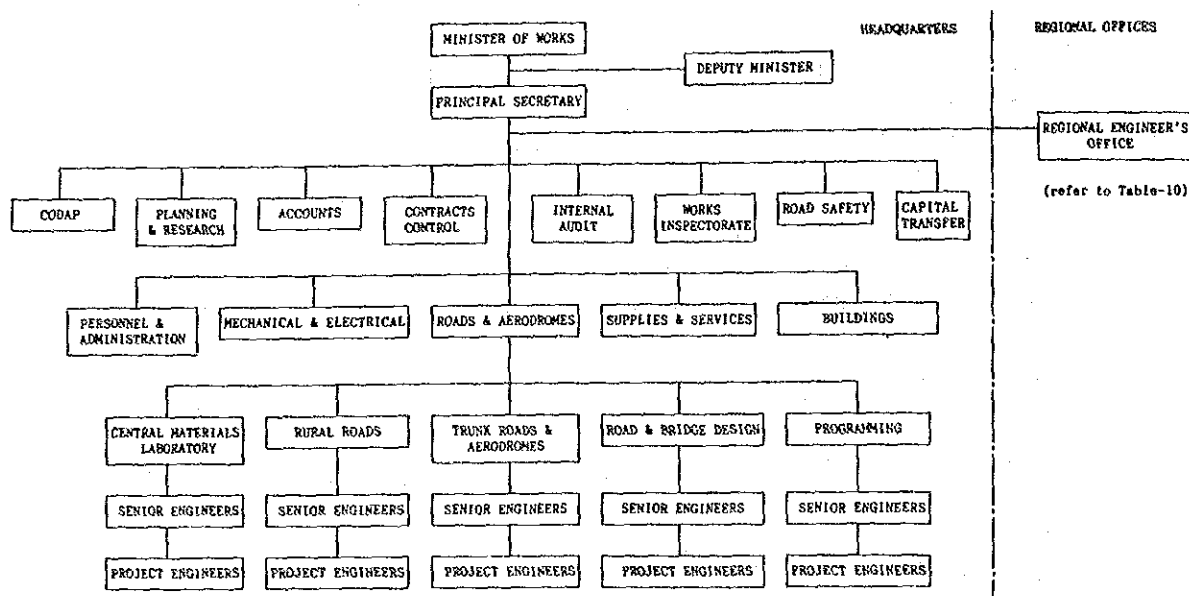


Figure-6 ORGANIZATION CHART OF THE MINISTRY OF WORKS

2. REO Organization

There are 20 REOs according to administrative regions, as listed in Table-10.

Table-10 REOS' HEADQUARTERS

| <u>Name</u> | <u>Headquarters</u> | <u>Name</u> | <u>Headquarters</u> |
|---------------|---------------------|-------------|---------------------|
| ARUSHA | Arusha | MBEYA | Mbeya |
| COAST | Kibaha | MOROGORO | Morogoro |
| DAR ES SALAAM | Dar es Salaam | MTWARA | Mtwara |
| DODOMA | Dodoma | MWANZA | Mwanza |
| IRINGA | Iringa | RUKWA | Rukwa |
| KAGERA | Bupoba | RUVUMA | Songea |
| KIGOMA | Kigoma | SHINYANGA | Shinyanga |
| KILIMANJARO | Moshi | SINGIDA | Singida |
| LINDI | Lindi | TABORA | Tabora |
| MARA | Musoma | TANGA | Tanga |

The Regional Engineer, as a head of REO, is responsible to the Principal Secretary MOW on all matters relating to the Works sector in his region. These include roads, aerodromes, buildings, stores, electrical and mechanical works, etc. He is responsible for monitoring the quality and effectiveness of the various work activities, for ensuring that scheduled works are completed to specified quality and on time, and for controlling the finances. He is also responsible for the welfare, training and discipline of his staff.

The Regional Engineer is administratively answerable to the Regional Development Director, and is duty bound to advise him on all technical matters. He also advises the District Councils, and in particular the District Engineers, in the scheduling of district works.

The structural organizations of REO, Trunk Road Engineers in REO and Electrical & Mechanical Engineers in REO are shown in Figure-7, 8 and 9, respectively.

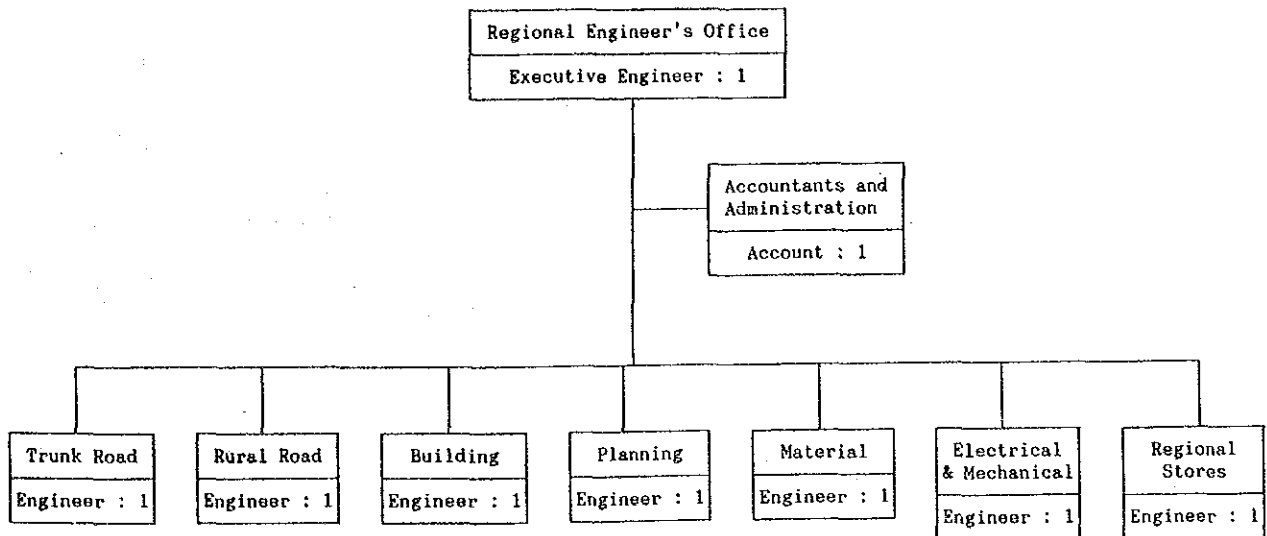


Figure-7 ORGANIZATION OF REO

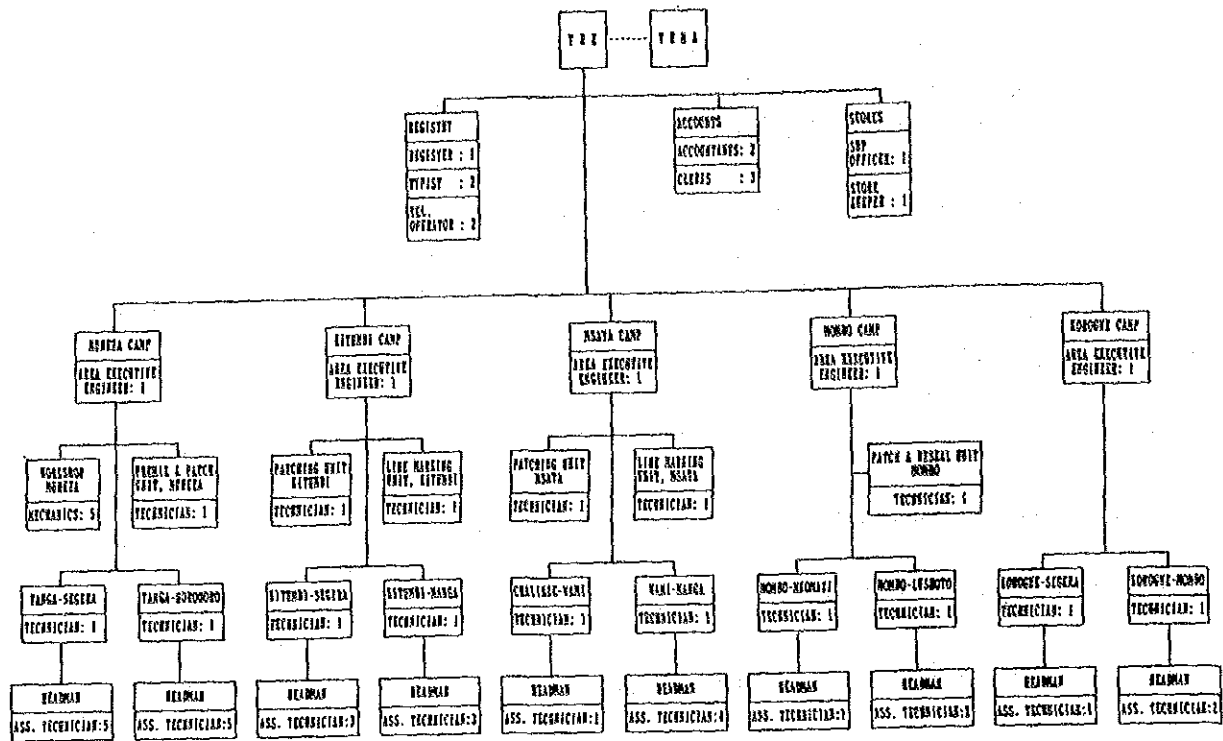


Figure-8 ORGANIZATION OF TRUNK ROAD ENGINEER

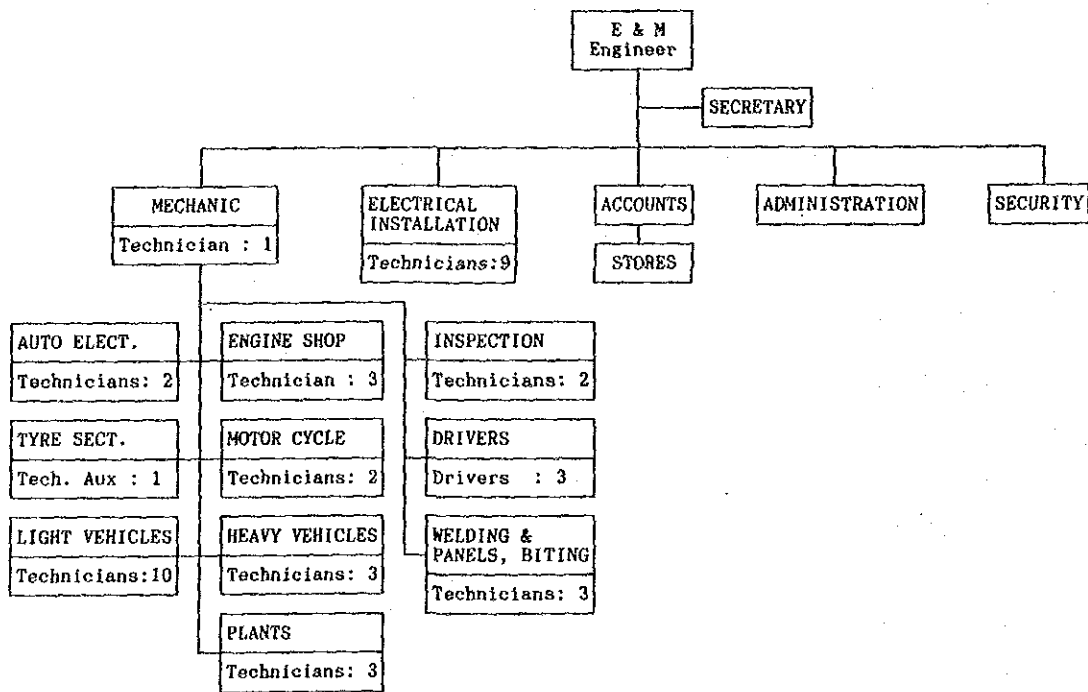


Figure-9 ORGANIZATION OF ELECTRICAL & MECHANICAL ENGINEER

2.3.2.2 Availability of Funds for Road Maintenance

Table-11 provides the expenditures for trunk road routine maintenance in FY 1991/92 and the approved budget for FY 1992/93.

Table-11 FY 1992/93 BUDGET FOR ROUTINE MAINTENANCE ON ROADS

| | Million TSh. | |
|-------------------|---------------------------|----------------------|
| | FY 1991/92 Expenditure | FY 1992/93 Budget |
| Trunk & DSM Roads | 1,578 | 1,660 |
| Rural Roads | 1,626 | 1,646 |
| Admin. Costs | (included in above) | 70 |
| Total | 3,204 | 3,376 |

Source: Appendix 5, 5-14

Reference: Appendix 6, Table 6-4

The total budget for road maintenance will be about 7 billion TSh. including 3.6 billion TSh. for periodic maintenance and 3.4 billion TSh. for routine maintenance from Table-10. On the other hand, IRP estimates 9 billion TSh. will be necessary for road maintenance in FY 1993/94, which is almost 1.3 times of FY 1992/93 budget. In order to meet the expenditure requirement for 1993/94 the following has been prepared for meeting the necessary revenue:

Table-12 ROAD INVESTMENT AND REVENUE FOR FY 1993/94

Unit: Billion Tsh.

| <u>Road Investment</u> | | <u>Revenue</u> | |
|------------------------|-------------|---------------------------|-------------|
| Trunk and Rural Roads | | Petrol and Diesel Charges | 9.7 |
| Routine & Periodic | 9.0 | Licensing (cars & trucks) | 3.0 |
| Resurfacing | 2.0 | Foreign traffic charges | 0.8 |
| Rehabilitation | 15.0 | Tyre tax | <u>0.7</u> |
| | (estimated) | Total Roads Fund | 14.2 |
| Emergency | 1.0 | Donors & Dev't | 15.0 |
| Ferries | 0.2 | | (estimated) |
| MOW overheads | <u>2.1</u> | Government Overheads | <u>2.1</u> |
| | 29.3 | Total | 31.3 |
| District Roads | <u>2.0</u> | | |
| Total | 31.3 | | |

Source: Appendix 5, 5-15

2.3.2.3 Road Maintenance Management System

A Road Maintenance Management System (RMMS) was introduced in July 1991 as a planning, monitoring and management tool for road maintenance because of the large number of management task involved, which are too complicated to allow for individual and uncoordinated responses to management demands.

The Road Maintenance Management System is the integrated collection of the various policies, procedures, activities and operations needed to accomplish the maintenance objectives of the MOW. To be successful this requires that:

- work activities are clearly defined and that standards are established for each activity
- management policies and procedures are established
- management responsibility at all levels is defined
- management information is provided at all levels
- all elements of the system are inter-related, but inter-dependent, so that each element can be studied and improved individually.

2.3.3 Technical Assistance

The eleven REOs (core regions) are receiving technical assistance in the form of maintenance and/or upgrading of trunk roads and strengthening of road management system in their regions, as mentioned in Section 2.1.4.

The Project in collaboration with this technical assistance can produce more effective results, since both are firmly inter-connected (refer to Section 3.1).

CHAPTER 3

**BASIC
DESIGN**

CHAPTER 3

BASIC DESIGN

3.1 Design Principles

The following considerations will be taken in principle to estimate appropriate equipment types and the reasonable number of equipment:

- to form the most suitable equipment fleet for routine maintenance works on bitumen roads
- to distribute the equipment fleet to prior REOs along the Tanzam Corridor (Dar es Salaam ~ Zambia), and the Central Corridor (Dar es Salaam ~ Rwanda, Brundi) and the Northeastern Corridor (Arusha ~ Chalinge/Segera ~ Tanga ~ Horohoro).
- to distribute the equipment fleet after considering the REOs' particulars, i.e. agricultural areas, traffic volume, etc.
- to distribute the equipment fleet after considering the length of trunk roads paved or to be paved in near future.
- to distribute the equipment fleet after considering the extend of IRP's technical assistance.

3.2 Basic Design

3.2.1 Equipment Types and Numbers

Types of equipment forming a fleet are proposed in Table-12 by the following considerations based on the Study results:

- (1) A cargo truck (1 ton capacity) is preferable to the pick-up truck which was requested. The cargo truck has a wide range of uses and can be used for transporting tools, equipment, staff and labourers. Therefore, two cargo trucks per fleet are proposed (instead of one pick-up truck).
- (2) The asphalt cutter (requested by the Tanzanian Government) has been excluded from the fleet. The reason being that it will be un-economical to replace worn-off cutter blades. Also, manual labour appears to be more practical at the

moment. Therefore, additional shank moil points (for digging) are proposed.

- (3) It is proposed that spare parts equivalent to 20% of FOB prices of machines will be supplied together of this Project.
- (4) Other requested equipment which is necessary for paved trunk road maintenance works is proposed.

Table-12 PROPOSED EQUIPMENT PER FLEET

| Equipment | Specification | Number |
|---------------------------|-------------------------|--------|
| Truck with crane | 4 ton | 1 |
| Cargo truck | 1 ton | 2 |
| Tipper truck | 4 ton | 1 |
| Tipper truck | 2 ton | 1 |
| Hydraulic excavator | 0.1 m ³ | 1 |
| Air compressor | 2.5 m ³ /min | 1 |
| Pneumatic hand breaker | Air 30kg | 2 |
| Pick hammer | Air 8kg | 2 |
| Pavement tools | | 2 |
| Asphalt burner | Kerosene | 1 |
| Vibratory roller | 0.7 ton | 1 |
| Vibratory plate compactor | 70kg | 1 |
| Asphalt sprayer | Kerosene | 1 |
| Concrete mixer | 0.1 m ³ | 1 |
| Concrete vibrator | 30mm x 250mm | 2 |
| Pump | 50mm | 2 |
| Step bridge | 0.5 m x 4 m | |
| Hand tools | With tool box | 1 |
| Generator | 10KVA | 1 |
| Electric welder | 5 KVA | 1 |
| Safety tools | | 1 |
| Storage container | Movable | 1 |
| Spare parts | | 20% |

Such factors of each Region as population density, land area, road density, whether or not it is a high potential agricultural area, etc. are considered in the study on the disposition of the equipment fleet. The following figures and tables refer to these factors:

Tanzam, Central and Northeastern Corridors; Figure-10
 High Potential Agricultural Areas ; Figure-10
 IRP Technical Assistance Regions ; Section 2.1.4
 Figure-11

Population Density, Land Area,
 Road Length ; Appendix 6 Table 6-3

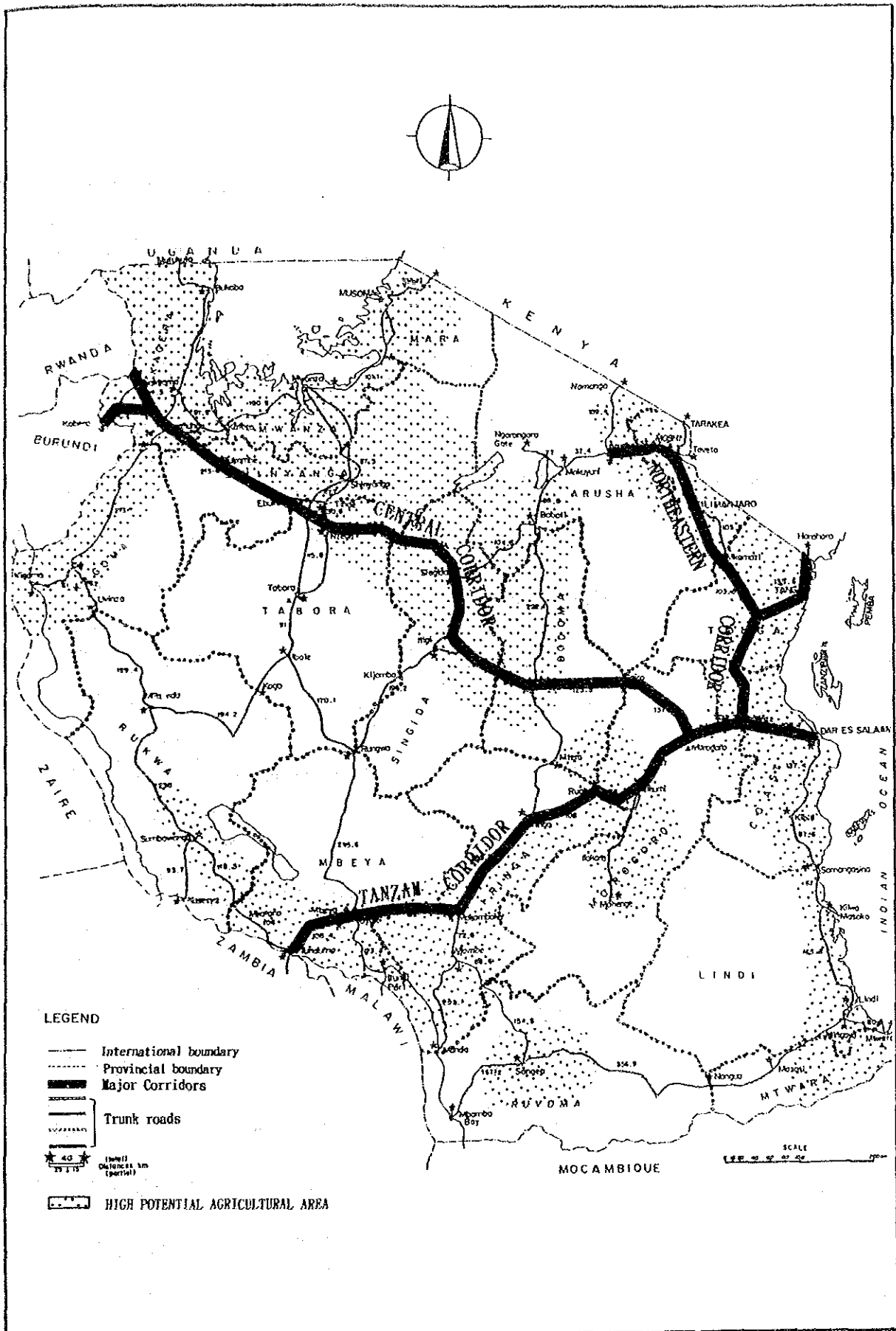


Figure-10 TANZAM, CENTRAL AND NORTHEASTERN CORRIDORS/
HIGH POTENTIAL AGRICULTURAL AREA

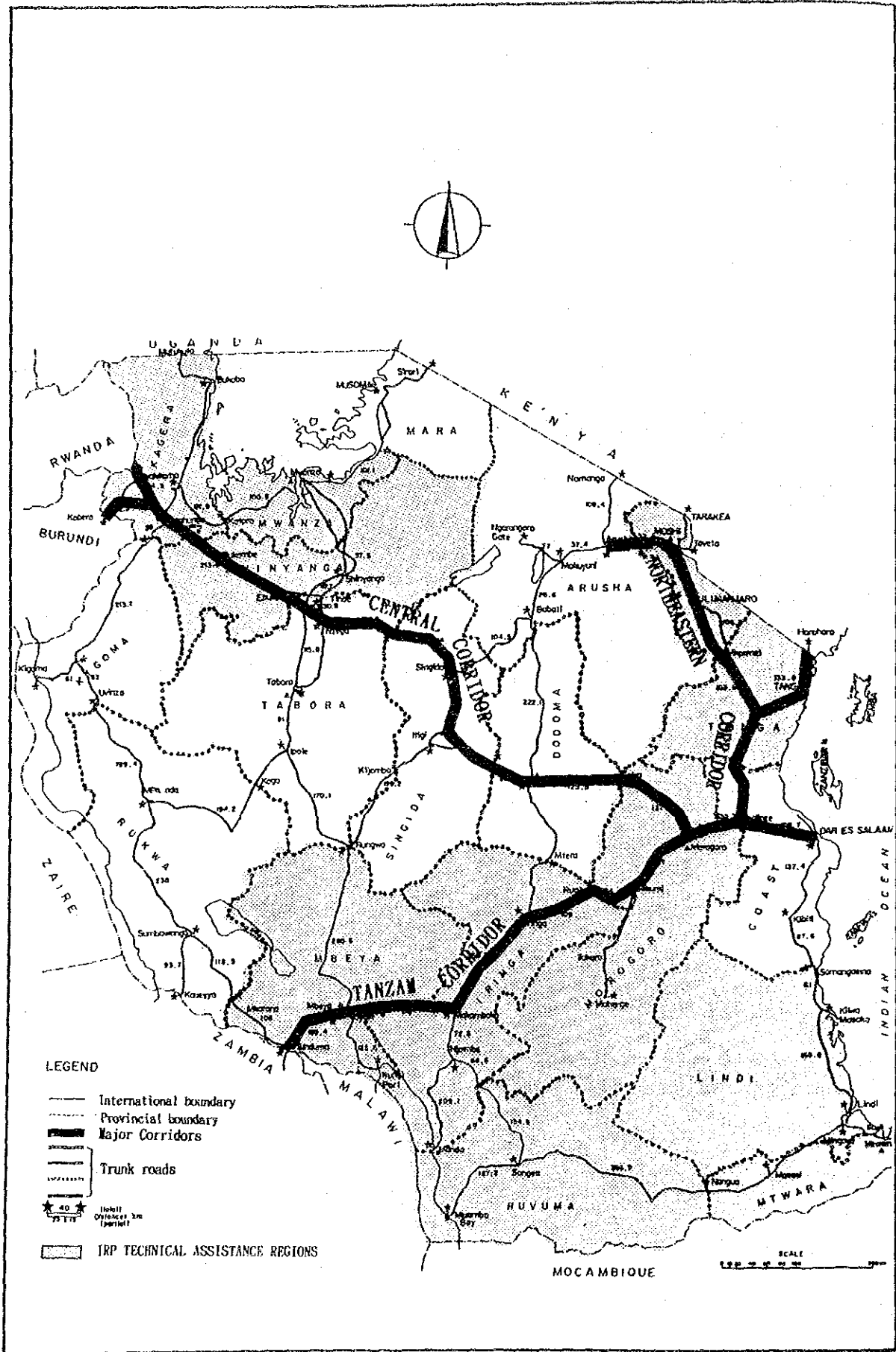


Figure-11 IRP TECHNICAL ASSISTANCE REGIONS

The proposed regions are categorized into A-rank Regions which seem to urgently need an equipment fleet and B-rank Regions in which the Project will be realized in accordance with the results after reviewing the implementation in A-rank Regions.

- (1) Kigoma, Rukwa, Singida and Tabora REOs having less than 50 km bitumen roads are excluded from this Project at the moment.
- (2) Mtwara, Lindi and Ruvuma have been ranked into the B-rank region because they are not situated along the 3 major corridors. However, the project will be implemented in these regions in accordance with the progress of the paved trunk road implementation program.
- (3) Dar es Salaam is ranked into the B-rank region because of its short total road length.
- (4) The Coast, Iringa, Mbeya and Morogoro Regions are ranked into A rank region because they, with their long total paved road length, are situated along the Tanzam Corridor which is, socio-economically, the most important for Tanzania.

The Coast Region is adjacent to Dar es Salaam, and it is expected that this region will be able to achieve a high level of technical expertise on its own (without the technical assistance of IRP).

- (5) Because the Kilimanjaro and Tanga REOs are situated along the Northeast Corridor, and because they service high potential agricultural areas, they are ranked into the A-rank region.
- (6) Dodoma REO is ranked into A-rank Region for the following reasons;
 - Because a part of the Central Corridor for Rwanda and Brundi passes through this region and also because Dodoma city is an important point for traffic from Iringa to Arusha.
 - Furthermore, Dodoma City is stated to become the capital of Tanzania forwards the end of the century and it is therefore expected that Dodoma City will be able to achieve a high level of technical ability on its own (without the help of IRP Technical Assistance).

(7) The implementation of the Project in the remaining regions (Kagera, Mwanza, Shinyanga, Mara and Arusha) will be done in accordance with the progress of the paved trunk road implementation program. However, The Shinyanga REO has been ranked as an A-rank Region because the road improvement programme plans to double the total paved road length which is the subject of this Project by the end of 1993, and also because the Shinyanga REO will serve as a pilot region for the Project.

As a result, 8 REOs, Coast, Dodoma, Iringa, Kilimanjaro, Mbeya, Morogoro, Shinyanga and Tanga, are ranked into A-rank Region as illustrated in Figure-12.

The distribution of equipment fleets to B-rank Regions (Arusha, Dar es Salaam, Kagera, Lindindi, Mara, Mtwara, Mwanza and Ruvuma) will be made after reviewing an engineering and economic appraisal of the progress by the IRP.

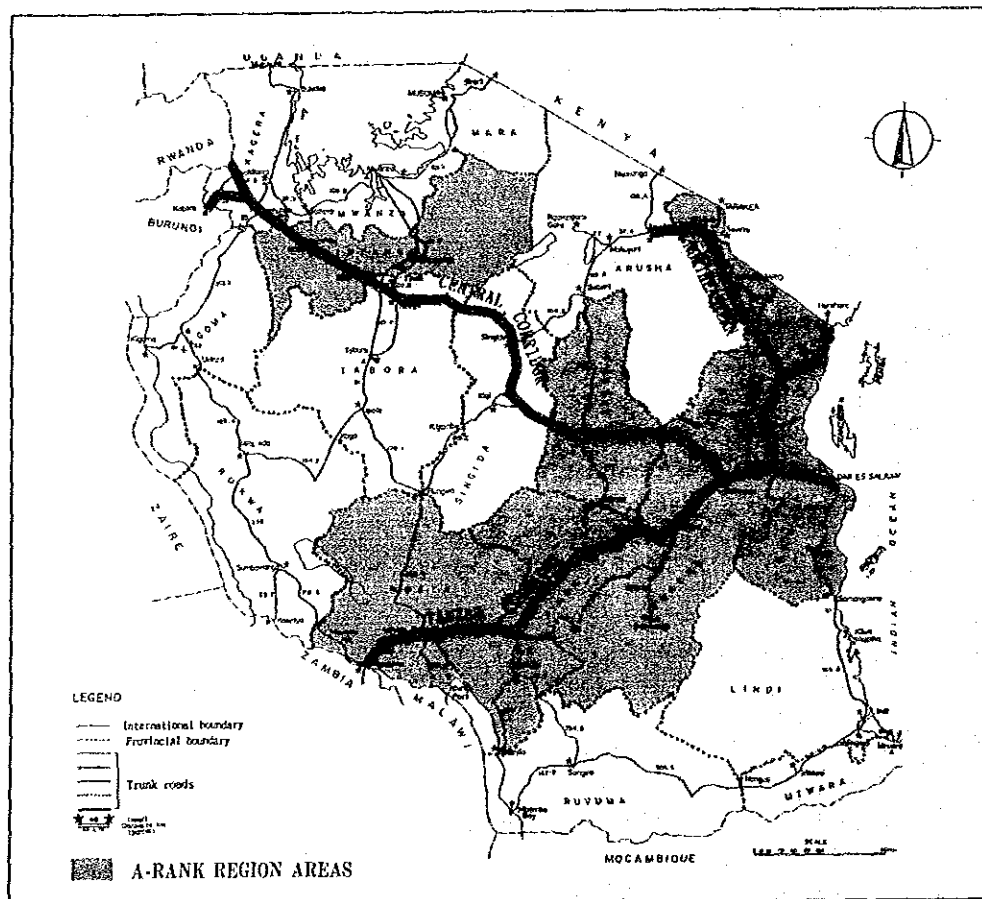


Figure-12 A-RANK REGIONS