STUDY REPORT ON THE PROJECT FOR REHABILITATION AND MAINTENANCE OF ZAMBEZIA PROVINCE ROADS IN THE REPUBLIC OF MOZAMBIQUE

February 1996

Japan International Cooperation Agency (JICA)

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ON
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PREFACE

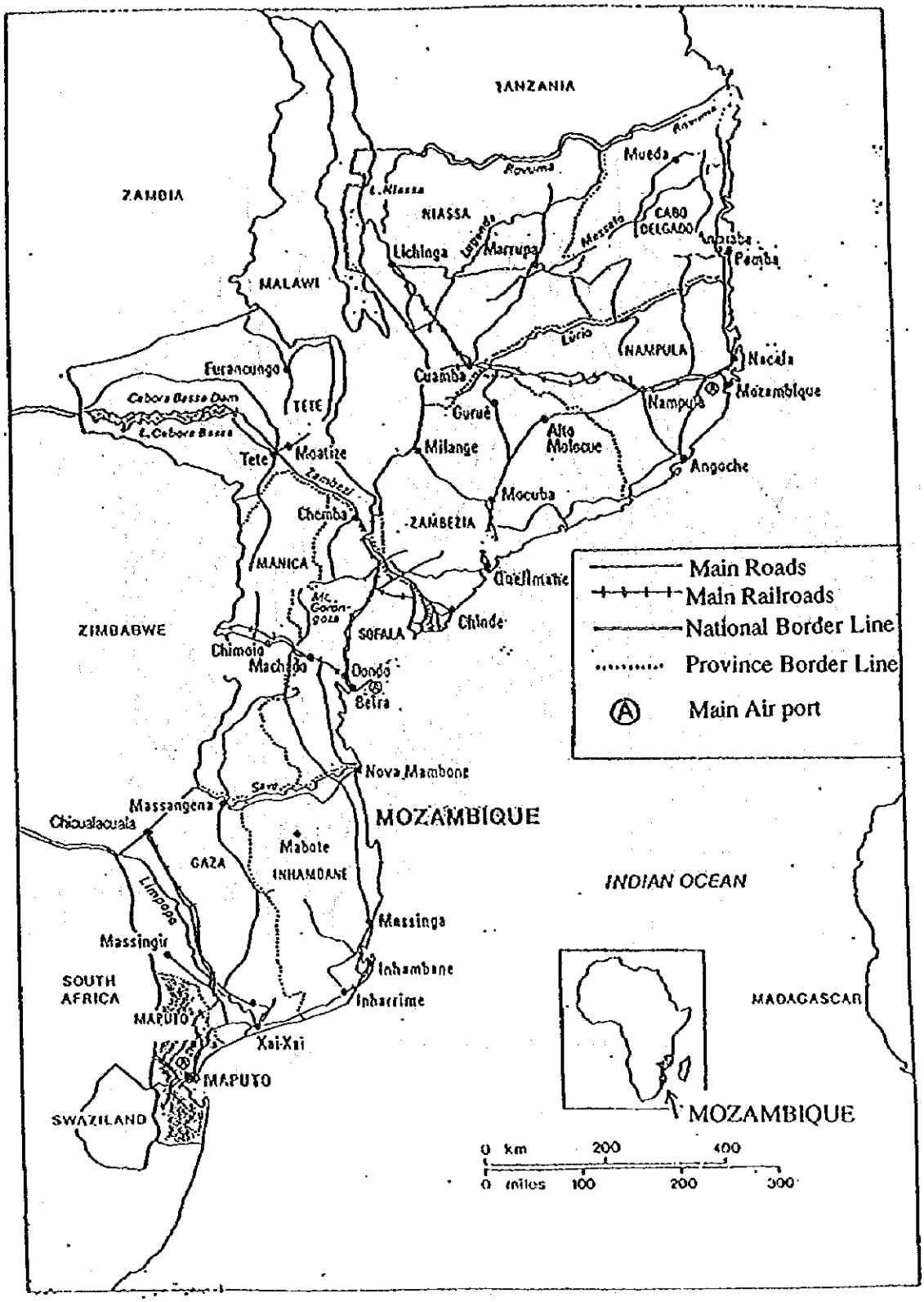
In response to a request from the Government of the Republic of Mozambique, the Government of Japan decided to conduct a basic design study on the Project for Rehabilitation and Maintenance of Zambezia Province Roads and entrusted the Japan International Cooperation Agency (JICA) to conduct the study with the assistance of the Japan International Cooperation System (JICS).

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

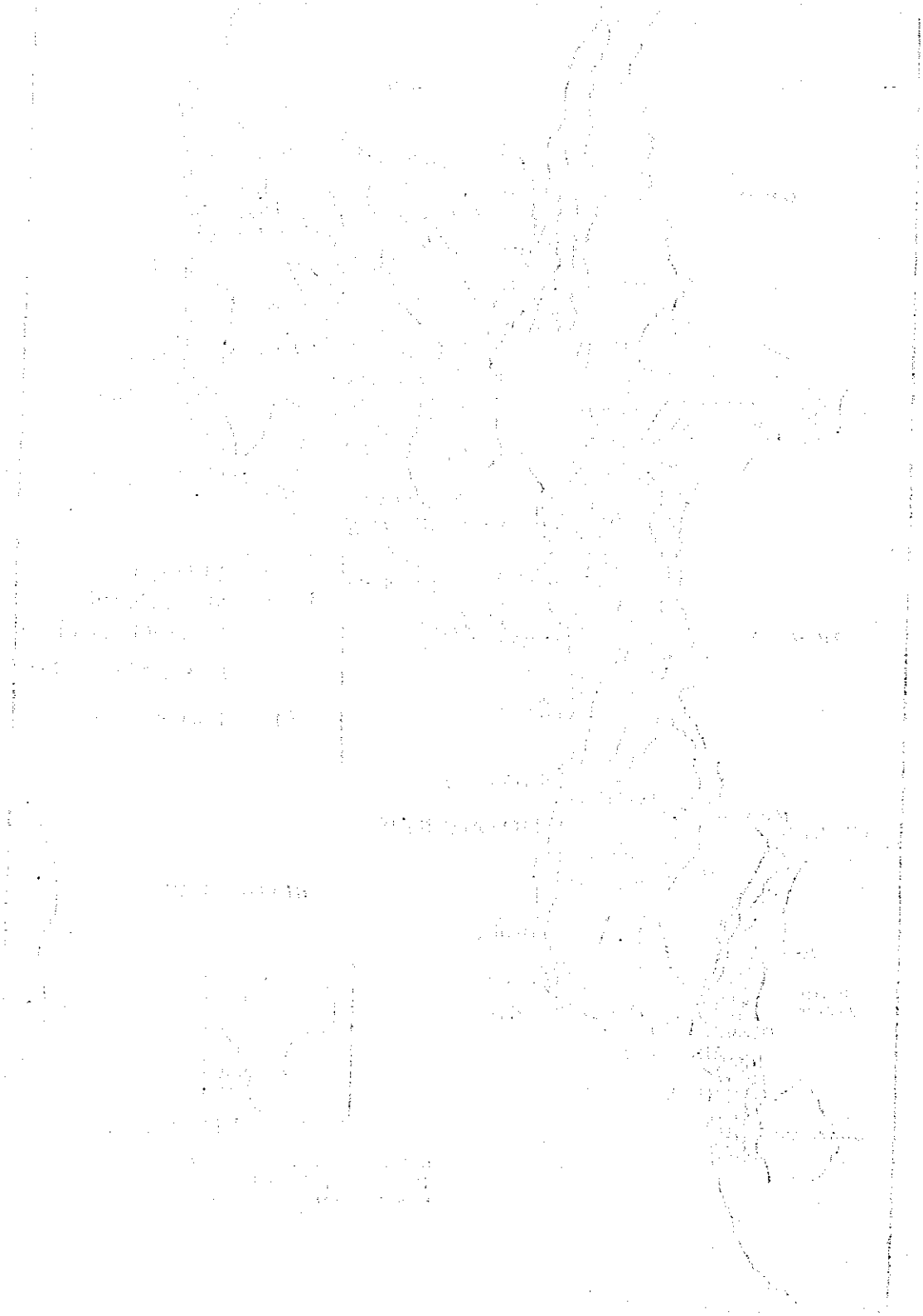
I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Mozambique for their close cooperation extended to the study.

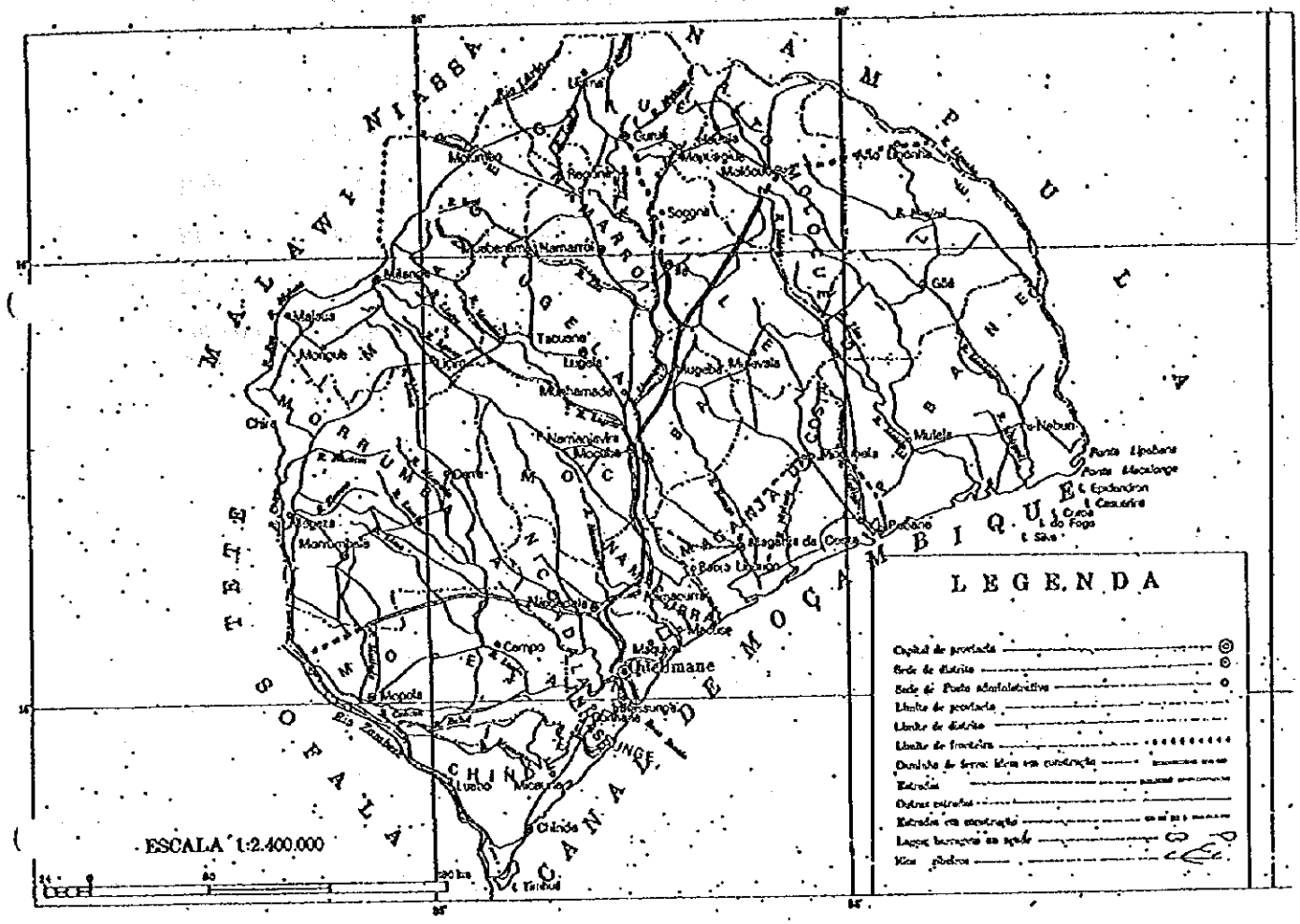
February 1996

Kimio Fujita
President
Japan International Cooperation Agency



Location Map of the Republic of MOZAMBIQUE





Location Map of ZAMBEZIA Province

Abbreviations

AfDB	: African Development Bank
DNEP	: Departement of National Directorate of Roads and Bridges
ECMEP	: Empresa de Construcao e Manutencao de Estradas e Pontes
EEC	: Europian Economic Community
IDA	: International Development Association
IMF	: International Monetary Fund
ROCS-I	: Road and Coastal Shipping Project
ROCS-II	: Road and Coastal Shipping Project
USAID	: United States Agency for International Development

Chapter 1 Background of the Project

Since the independence of the Republic of Mozambique in 1975, the country was plagued with civil wars, droughts, etc., and as a result, its economy was inactivated. However, with the cooperation of the World Bank and IMF, Economic Reconstruction Plan (1987 to 1990) was established to expand agricultural production and to activate the production foundation. In the subsequent NPR : National Reconstruction Plan (1994 to 1996), a major issue was to let people returning after the termination of civil wars settle in their own country, and the rehabilitation and maintenance of the domestic road network was pursued as a priority project. In this connection, Road and Coastal Shipping Project I (ROCS-I, 1992 to 1996) was established to rehabilitate and improve the transport foundation in priority districts and major corridors, and in succession, Road and Coastal Shipping Project II (ROCS-II, 1994 to 1998) was established with the rehabilitation and maintenance of roads as an important item. These were intended to rehabilitate and maintain trunk roads with high priority and to enhance the administration ability of the organization in the road sector for supporting Economic Reconstruction Plan.

The road network of the whole country extends to a total road length of about 29,200 km, and Zambezia Province has a road network of 4,460 km corresponding to 15.3% of it. However, the domestic road conditions are heavily damaged, and the poorly maintained roads account for about 90%. Particularly in Zambezia Province, the corresponding percentage is as large as 93%.

To improve the road conditions, the Department of National Directorate of Roads and Bridges (DNEP) which administers the road network of the whole country, rehabilitates the roads under an established priority order according to the ROCS-II and the 5 Year Plan Road Network, but since the construction machines they have are insufficient in absolute quantity and superannuated, the progress of rehabilitation is very slow.

Zambezia Province is blessed with rainfall, and agriculture is actively practiced in the plateau zones. The province is the second largest agricultural production province in the country, next to Inhabane Province, and has a population as large as about 3,300,000. The province also has many people who returned from neighboring countries, and settlement of the people is a serious issue. The agricultural production in the province is demanded to be further expanded, but it is considerably limited by the heavily damaged road conditions.

In order to activate the inter-regional transport of people and materials for economic promotion, and to solve the settlement problem of the returning people for support of regional economic promotion, the rehabilitation and maintenance of the roads in the province is urgently needed.

Chapter 2 Contents of the Project

2-1 Objective of the Project

The Road and Coastal Shipping Project II (ROCS-II) as the master plan specifies to rehabilitate about 3,450 km of trunk roads and about 3,250 km of local roads, and to maintain about 11,700 km of roads in a road network extending to a total length of about 29,200 km in the Republic of Mozambique. The objective of the present project is to improve 2,720 km of damaged roads out of the 4,460 km of roads in Zambezia Province covered by the above ROCS-II, by supplying the construction machines necessary for the maintenance and rehabilitate of the roads.

2-2 Basic concept of the Project

In Mozambique, for economic reconstruction and settlement of returning people, the rehabilitation and maintenance of the heavily damaged road network is the most important issue. The Zambezia Provincial ECMEP also rehabilitates and maintains the roads in the province under the ROCS-II. However, among about 120 construction machines owned by them, most are transport vehicles such as agricultural tractors and trailers, and this composition of machines is insufficient for rehabilitating and maintaining 2,720 km of roads.

So, to improve the work execution capacity of Zambezia Provincial ECMEP for contribution to the earlier accomplishment of road rehabilitation and maintenance in the province, it is intended to supply road construction machines such as bulldozers and motor graders, and other machines to support the construction machines.

Since most of the roads in the province are not paved, the construction machines to be supplied should be machines for rehabilitating and maintaining unpaved roads.

2-3 Basic Design

2-3-1 Design Concept

In view of the urgency, priority and relations with other assisting organizations, it has been decided to cover existing local roads among the roads in Zambezia Province under the present project, and since most of the roads in the province are not paved, the construction machines necessary for rehabilitating and maintaining unpaved roads have been selected according to the following policies.

1) Policy for natural conditions

Zambezia Province, into which road rehabilitating and maintaining machines are planned to be introduced, is located at the center of the Republic of Mozambique in the tropical climate zone. The air temperature throughout the year ranges between about 20 to 30°C, and the annual amount of rainfall exceeds 1,000 mm. In the rainy season, the monthly amount of rainfall reaches 250 mm. So, the machines should be designed to suit the tropical area. As a rainfall countermeasure and safety measure, a cabin or canopy, etc. should be installed for the driver's seat. The machines should be delivered to the site in any other season than the rainy season (November to February).

2) Policy for maintenance of machines by the competent offices

The maintenance of construction machines is carried out basically by respective provincial ECMEPs (regional bureaus for construction and maintenance of roads and bridges) under the guidance of Department of National Directorate of Roads and Bridges (DNEP). The Zambezia Provincial ECMEP which operates the present project owns and manages about 120 various construction machines. The maintenance ability of DNEP is relatively high under the guidance by consultants from the World Bank, and maintenance is positively grappled with, for example, by constructing a new service factory. However, most machines they have are agricultural tractors, trailers, dump trucks, etc., and the staff are poor in the experience of maintaining large construction machines. Maputo Provincial ECMEP plays a central role in Mozambique with an established support organization, and service shops of dealers of construction machine makers are also

sufficiently equipped for maintenance under established service organizations. So, for the time being, the latter service shops will be sufficiently utilized for maintenance of machines.

Japan granted similar construction machines 5 times in the past, and their average operating rate is as relatively high as 85%, and it can be considered that there is no special problem with the maintenance of construction machines.

The language of the manuals indispensable for service should be Portuguese which is the local official language.

3) Policy for selection of construction machines

The construction machines to be supplied under the present project are not for the purpose of implementing any specific construction project, but for the purpose of enhancing the capacity of DNEP to rehabilitate and maintain paved roads and unpaved roads. Therefore, it has been decided to select the specifications and numbers of construction machines in reference to the earthwork volume necessary for rehabilitating and maintaining the roads to be covered by the present project, based on the construction methods conventionally adopted by DNEP. In the selection, the utilization conditions of the existing machines owned by DNEP, the utilization conditions of the construction machines supplied from Japan under grant aids, and consistency should be sufficiently taken into account.

Motor vehicles such as dump trucks and cargo trucks other than pick-up D. should be of cab-over type in view of easier maintenance.

4) Policy for the term of works

DNEP demands earlier arrival of the construction machines, and plans to use all of them in combination for rehabilitating and maintaining unpaved roads. Therefore, all the machines should be delivered early and simultaneously.

5) Policy for delivery of machines

The unloading port of the machines to be supplied will be Maputo Port, since all the goods procured from foreign countries including Japan are unloaded at Maputo Port. Some goods will be

transported from South Africa on land, but they will also be delivered at Maputo. The inland transport from Maputo to Zambezia will be undertaken by Mozambican government.

The present design is worked out in reference to "The Project for Rehabilitation and Maintenance of Inhabane Province Roads in the Republic of Mozambique". A feature of the present project compared to the project in Inhabane Province is that the roads to be rehabilitated and maintained are as long as 2,720 km. The acceptance of new machines involves such problems as the personnel expense of operators and service men, the increase of operation expense, and the training of new personnel, and in view of about 200 persons of staff in each provincial ECMEP, a certain upper limit in the acceptable number of machines must be considered. In Inhabane Provincial ECMEP, about 190 persons are planned to be additionally introduced to meet the newly introduced machines. This means to double the present staff force, and a sharp increase more than it is feared to pose a difficult problem. So, also in Zambezia Province, it is judged to be appropriate to keep the quantity of newly introduced machines at almost the same level as that in Inhabane Province.

The quantity of machines to be introduced has been decided in reference to the above concept, for rehabilitating and maintaining 60% of 2,720 km by the newly introduced machines.

2-3-2 Basic Design

1) Flow to decide the necessary machines and quantities

The present project will cover 1,632 km corresponding to about 60% of the total road length of 2,720 km. The machines to be selected for the annual construction lengths of respective work categories, and their quantities have been decided in reference to the work categories of the construction methods generally adopted by DNEP.

The present project covers unpaved roads, and the planned work categories and necessary machines are as listed in Table 3.

Table 3 Work categories and necessary machines (for unpaved roads)

Work category	Description	Main necessary machines
Patching	Patching pot holes on the surface of unpaved road	Wheel loader Dump truck
Roadbed rolling	Supplying a roadbed material on the portions of the roadbed where the roadbed material is deprived of by scattering and scraping, and rolling the road surface for repair	Wheel loader Dump truck Motor grader Water tank truck Water pump Vibration roller
Leveling	Leveling an undulating road surface	Motor grader
Widening	Removing the bush, land-filling, leveling the roadbed material, and rolling, for securing shoulders.	Bulldozer Wheel loader Dump track Water tank truck Water pump Vibrating roller

The annual earthwork volumes of respective work categories, and the necessary quantities of main machines obtained from the capacities of respective machines are shown in Table 4.

Table 4 Calculated quantities of main machines

※Leveling : per 3,045㎡/h, Roadbed rolling : per 3,045㎡/h, Vibration roller (Large) : 43㎡/h

Work category	Annual work volume		Quantities of machines for respective work categories					
	Construction area (㎡)	Earthwork volume (㎥)	Wheel loader (100㎥/h)	Dump truck (9.9㎥/h)	Motor grader		Bulldozer (24㎥/h)	Vibration roller (Large)
					Leveling	Roadbed rolling		
Patching 1,632km	—	97,920	0.91	8.87	—	—	—	—
Leveling 1,632km	24,480,000	—	—	—	5.61	—	—	—
Roadbed rolling 820km	1,025,000	153,750	1.42	13.871	—	1.65	—	2.48
Widening 100km	500,000	150,000	1.39	13.57	—	—	4.34	2.42
Calculated necessary quantity of machine			3.72	36.27	5.61	1.65	4.34	4.90
Necessary quantity of machine for Zambezia Province (demanded)			4 (4)	36 (10)	7 (5)		4 (3)	Medium 4, Large 2 (M 4, L 2)
Quantity granted to Inhabane Province (FY 1994)			3	32	6		4	Medium 2, Large 5

Total quantities of necessary machines obtained by adding service and support machines for transport, liaison, supervision, etc., to the main machines obtained in Table 4 are listed in Table 5.

Table 5 List of necessary machines

No.	Machines	Specification	Q'ty	Application
1	Bulldozer	200 HP or more	4	Excavation and land filling
2	Motor grader	135-150 HP class	7	Leveling of road surface
3	Wheel loader	110-130 HP class	4	Loading of earth and aggregate
4	Dump truck	Carrying capacity 6 to 8 tons, volumetric capacity 4 m^3	36	Transport of earth and aggregate
5	Water tank truck	Tank capacity 6,000 liters	2	Water sprinkling during rolling compaction
6	Fuel tank truck	Tank capacity 8,000 liters	1	Fuel supply to construction machines
7	Cargo truck	Carrying capacity 6 tons	5	Transport of apparatuses and materials
8	Cargo truck with crane	Carrying capacity 5 tons, crane capacity 3 tons/2.6 m	1	Transport of apparatuses and materials
9	Workshop truck	Aluminum van body, mounted with repair tools	1	Repair of machines at site
10	Lubrication truck	Mounted with a lubricating tank and compressor	1	Lubrication of machines
11	Vibrating roller(1)	4-5ton class, with smooth roller as front wheel and tire as rear wheel	4	Rolling of road surface
12	Vibrating roller(2)	6-8ton class, with smooth roller as front wheel and tire as rear wheel	2	Rolling of road surface
13	Air compressor	Air flow rate 5 m^3, discharge pressure 7 kg/cm^2	3	For breaker of temporary rehabilitation
14	Generator	Output 20 kVA (50 Hz, prime)	2	Repair by welding machine, etc.
15	Truck crane	Maximum lifting load 25 tons (3 m)	1	Buried installation of culvert, etc
16	Pick-up T	4 x 4, carrying capacity about 500 kg	10	Transport of apparatuses and materials

Chapter 3 Implementation Plan

3-1 Implementation Plan

3-1-1 Implementation Schedule

This project will be implemented after the Exchange of Notes (E/N) is concluded between Japan and Mozambique based on a decision in a cabinet meeting of the Japanese government. Therefore, the project will be designed after conclusion of E/N.

3-1-2 Obligations of Recipient Country

Obligations of the recipient country in the implementation of the grant aid are as follows:

① Quick unloading and customs clearance of supplied machines

② Exemption of supplied goods and supply services from customs duties and domestic taxes

③ Providing conveniences to Japanese staff concerned with this project for their entry into and residence in the recipient country

④ Bearing the other necessary expenses than those granted under this project

⑤ Attendance of counterparts

⑥ Adequate maintenance and utilization of supplied machines

⑦ Conclusion of agreement with bank

⑧ Security of operating expense and staff

⑨ Expenses for customs clearance, bonded warehouse, and domestic transportation to respective local offices

3-2 Operation and Maintenance Plan

The supplied machines will increase the machines owned by Zambezia Provincial ECMEP. In reference to "The FY 1994 Project for Rehabilitation and Maintenance of Inhabane Province Roads in the Republic of Mozambique" implemented by Japan, the staff additionally required for the present project are 71 operators of heavy machines and motor vehicles, 13 workers, 19 maintenance and

service men, 7 office workers, and 17 engineers and foremen, i.e., about 127 persons in total. The expense annually required to maintain this work force will be about 494,000 dollars which can be broken down into about 40,000 dollars for personnel expense and about 454,000 dollars for operation expense. Since this amount corresponds to 9% of the road maintenance budget of Zambezia Province (FY 1996), there is no problem with the budget.

Chapter 4 Project Evaluation and Recommendations

4-1 Project Effects

1) Verification of warranty

The Mozambican government has been implementing the Road and Coastal Shipping Project II (ROCS-II) since 1994 in succession to the Road and Coastal Shipping Project I (ROCS-I) for road rehabilitation and maintenance, based on the NPR.

The present project conforms to the ROCS-II to be referred to as the master plan. The ROCS-II is positively promoted with very high priority by major assisting organizations such as the World Bank and AfDB, to show the urgency of road rehabilitation and maintenance in Mozambique. So, the implementation of the present project under a grant aid is warranted.

2) Beneficial effects

The implementation of the present project is expected to give the following effects:

[Benefited region and benefited population]

①About 3.3 million inhabitants of Zambezia will be directly benefited, and all the inhabitants of Mozambique will be indirectly benefited.

[Direct effects]

① Enriched road rehabilitating and maintaining machines will promote the rehabilitation and maintenance of the road network, to improve the heavily damaged local roads of Zambezia Province.

② Improved road surfaces will decrease the wear and loss of motor vehicles, with expected effects to reduce the transportation cost and to decrease accidents for higher safety.

③ The transport of people and materials will be activated, to give large economic secondary effects in Zambezia Province which has a large potential for economic growth with a many population and active agriculture and other industries.

[Indirect effects]

① The rehabilitation and maintenance efficiency for the trunk roads conducted under the ROCS-II will be greatly enhanced, to improve the road function as planned.

② The activation of long-term economic activities will be contributed to.

4-2 Recommendations

Since the project is expected to give enormous effects as described above and will contribute to the improvement of the basic human needs of inhabitants in general; it can be confirmed that the implementation of the present project under a grant aid is warranted. In view of operation and management, the preparedness of the recipient country is considered to be insufficient both in staff and fund. However, if the following recommendations are respected, the present project will be more smoothly and effectively implemented.

① Smooth implementation of the project is desired through quick customs clearance and transport of the supplied machines.

② The machines will be operated and maintained by Zambezia Provincial ECMEP. In this case, the staff and budget necessary for maintenance of the machines must be positively provided.

③ DNEP has constructed a computer-operated machine management system, and the machines supplied under the project are expected to be operated at higher rates by effectively utilizing the system.

④ In future, if an expert of repair techniques is dispatched, to further improve the repair techniques at site, the project will be more efficiently operated.