No.

NATIONAL ROAD ADMINISTRATION
REPUBLIC OF MOZAMBIQUE

THE STUDY
ON
UPGRADING OF NAMPULA-CUAMBA ROAD
IN
THE REPUBLIC OF MOZAMBIQUE

FINAL REPORT
1 of 3
EXECUTIVE SUMMARY

November 2007

JAPAN INTERNATIONAL COOPERTATION AGENCY

Oriental Consultants Company Limited

Japan Engineering Consultants Company Limited

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JR
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The following foreign exchange rate is applied in the study:

1 US dollar = 25.75Mtn = 122.62 JP Yen, or 1 MTn = 0.21 JP Yen (June 2007),

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PREFACE

In response to the request from the Government of the Republic of Mozambique, the Government of Japan decided to conduct the Study on Upgrading of Nampula – Cuamba Road and entrusted to study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Keigo KONNO of Oriental Consultants Co., Ltd. and consist of Oriental Consultants Co., Ltd. in association with Japan Engineering Consultants Co., Ltd. to Mozambique, between September 2006 and October 2007.

The team held discussions with the officials concerned of the Government of Mozambique and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

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

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

November 2007

Eiji HASHIMOTO
Vice President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

November 2007

Mr. Eiji HASHIMOTO,
Vice President
Japan International Cooperation Agency (JICA)
Tokyo, JAPAN

We are pleased to submit to you the Final Report of the Study on Upgrading of Nampula – Cuamba Road in the Republic of Mozambique.

This study was conducted by Oriental Consultants Co., Ltd. in association with Japan Engineering Consultants Co., Ltd. under a contract to JICA, during the period from September 2006 to November 2007.

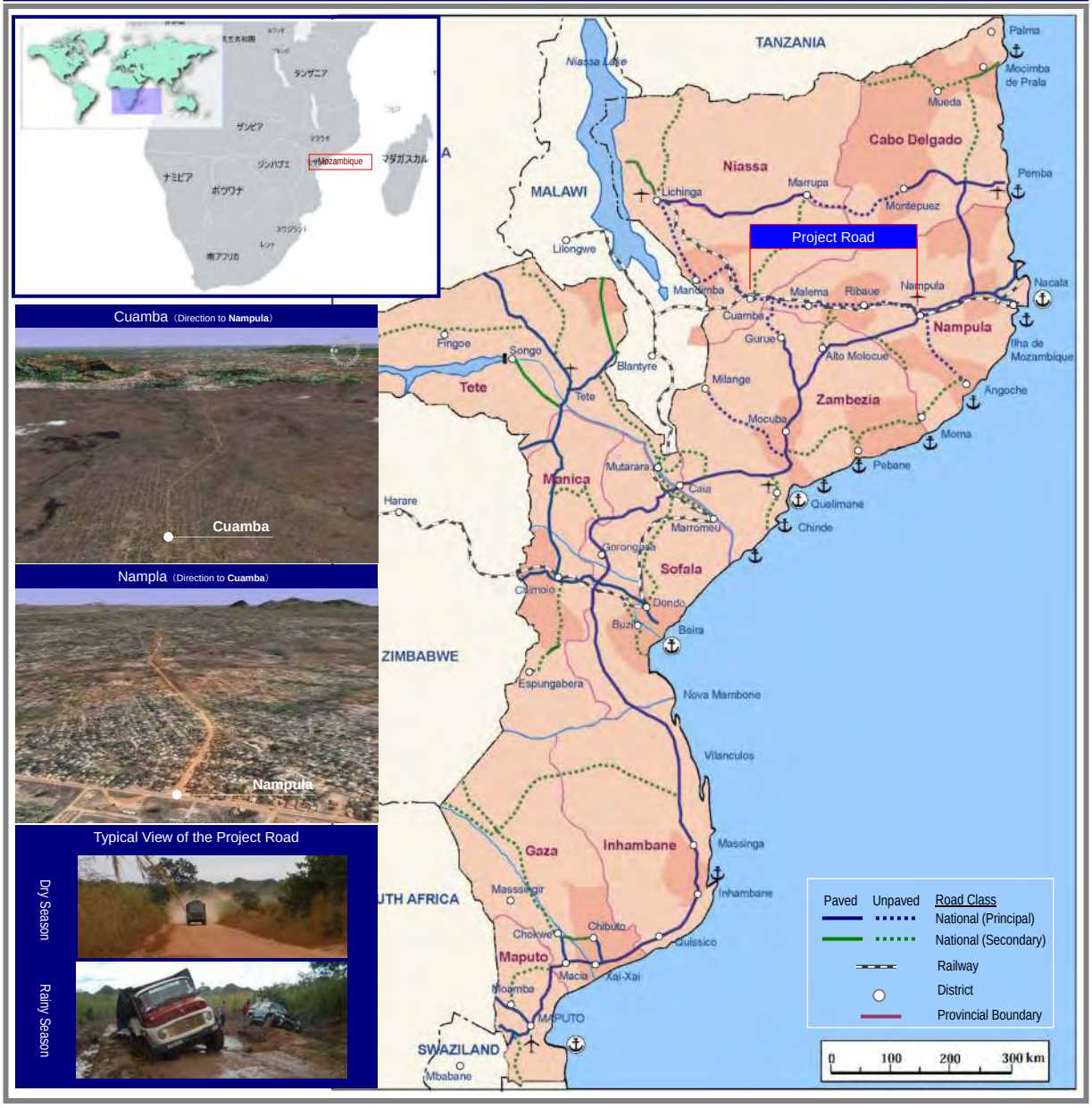
We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, Ministry of Foreign Affairs of Japan, Japan International Cooperation Bank, National Road Administration, JICA Mozambique Office and Embassy of Japan in Mozambique for their cooperation assistance throughout the Study.

Finally, we hope this report will contribute to further promotion of the project.

Very truly yours,

Keigo KONNO
Team Leader,
Study Team of the Study on Upgrading
Nampula – Cuamba Road

PROJECT LOCATION MAP



Cuamba (Direction to **Nampula**)

Nampla (Direction to **Cuamba**)

Typical View of the Project Road

Dry Season

Rainy Season

Satellite View of the Project Road

The Study Route Map

Illegal truck bus

Railway (Passenger & cargo): Many street venders approach to sell their products

Study bridge

L=94.2 RC-T

L=30.6 Bailey

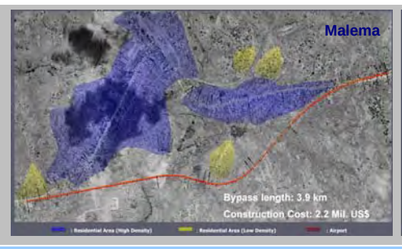
L=24.3 RC-Slab

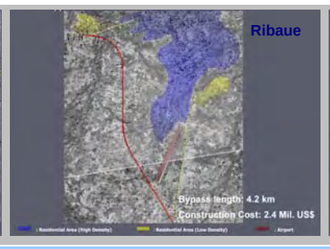
L=22.6 RC-Slab

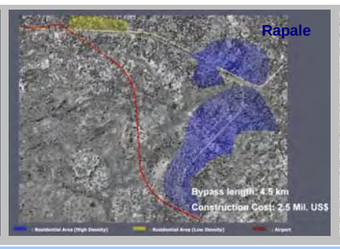
L=28.0 RC-Slab

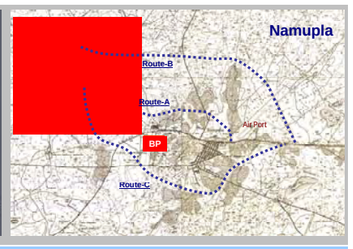
L=11.5 RC-Slab

Bypass plan in town section









Road condition (Malema-Cuamba)

Road condition (Ribaue-Malema)

Road condition (Nampula-Ribaue)

Road condition near Nampula

Project Outline

1. Country	Republic of Mozambique
2. Name of Study	The Study on Upgrading of Nampula – Cuamba Road in the Republic of Mozambique
3. Counterpart Agency	National Road Administration, Ministry of Public Works and Housing
4. Objectives of the Study	To carry out a feasibility study (the Study) on the upgrading of National Road No.13 between the cities of Nampula and Cuamba, which are a part of the Nacala Corridor, as an EPSA project with a loan from AfDB and JBIC.

1. The Study Area

- Four districts of Nampula, Mecuburi, Ribaue and Malema in Nampula province and the district of Cuamba in Niassa province
- The Study road of approximately 350km long

2. Scope of the Study

1) Feasibility Study

a) Execution of Supplementary Survey
b) Examination of Design Standards
c) Execution of Traffic Demand Forecast
d) Support for Environmental and Social Considerations
e) Execution of Preliminary Design
f) Execution of Construction Planning & Cost Estimate
g) Preparation of Project Implementation Plan
h) Examination of Economic and Financial Analysis
i) Examination of Road Maintenance and Traffic Management

2) Regional Development Plan

a) Examination of Overall Conditions and Current Regional Development Plans
b) Formulation of Regional Development Program
c) Selection of Pilot Projects
d) Execution of Pilot Projects
e) Execution of Emergency Works as Pilot Project

3. Narrative Description

Feasibility Study

Overall, the Study road width varies between 5m and over 10m and is generally lower than the surrounding ground. Furthermore the Study road has an earth/gravel surface with very poor drain. In order to design a suitable road as a part of the Nacala Corridor, traffic survey was carried out. As a result of the analysis using JICA STRADA model, the traffic demand in 2026 was forecasted that it was 1,262 vehicle/day in case of 80km/hr and 1,324 vehicle/day in case of 100km/hr. Based on the SATCC Standards, a design speed of 80km/hr was recommend in consideration of traffic safety, construction cost, social impacts, traffic management and operation. And furthermore, the selection of the suitable pavement composition was evaluated based on the initial cost and its financial viability using the EIRR indicator. As a result of the analysis, a DBST surface on a base layer of granular type was selected as the most economically viable pavement composition. Its composition was shown the lowest initial cost and the highest EIRR. Economic ratios of NPV, B/C and EIRR were US$ 50.443, 1.51 and 18.8% respectively. With regard to the concept of COI, ROW was arranged based on the environmental viewpoints, of which clearance width such as construction road and diversion was 7m from both shoulders respectively. With regard to the construction planning, the Study road was divided into 3 construction sections, which were Nampula – Ribaue, Ribaue – Malema, Malema – Cuamba. And the construction schedule was estimated at 36 months for each section.

Regional Development Plan

The northern region along the Study road area is high potential agricultural area. Various multi-sector projects and programs are on-going in the Study region. However there are some problems such as lack of transport, lack of knowledge on commercialization, lock of basic services in the remote areas, lack of traffic safety education and so on. Based on the result of a SWOT analysis, the priority strategic development programs under 3 development pillars, which were agricultural development, improvement of rural center and upgrading of basic service, was formulated. In order to examine the contents of 3 pillars, “Rural Center (Core) Project” which was one of the “Rural Development Program” as a “Pilot Project”, was planed. And for the increase of the synergic effect of the pilot project, the selected 3 pilot projects were packaged into one integrated pilot project, which was named “MICHINOEKI”. The MICHINOEKI provides the facilities such as market, parking area, public toilet, open space and bicycle center to provide functions of income generation, rest area place of information/events, and improvement of transport means for the farmer.

4. Conclusion and Recommendations

- Implementation of regional development programs together with the Study Road upgrading project. It is recommended that MICHINOEKI shall be implemented as a soft component of the project, and community roads along the study road shall be implemented together with this project.
- Support for Environmental and social consideration
  - Minimization of resettlement and stakeholder consultation
  - Support for Appropriate environmental and social consideration for other relevant activities
- Keeping the implementation schedule to start the construction work of the Study road from the beginning of 2009
- Starting the detailed design stage from the beginning of 2008
- Execution of severe site survey for quarries on the detailed design stage
- Expected shortage of cement supply for concrete structure due to the FIFA 2010 World Cup
- Execution of operation and maintenance of the upgrading road including Michinoeki Anchilo

SUMMARY OF PROJECT

[1] OVERALL APPROACH & IMPLEMENTATION PROGRAM OF THE STUDY

Mozambique's 16-year civil war, which lasted until 1992, ruined much of the nation and destroyed its key road infrastructure. After civil war, the Government of the Republic of Mozambique (hereafter referred to as the "GOM") has promoted various regional development plans in the country. As a first step, the rehabilitation of road infrastructure is not only indispensable but will stimulate economic growth and reduce poverty, which is considered important for the Action Plan for the Reduction of Absolute Poverty (hereafter referred to as "PARPA") for 2001 to 2005. Note that many donors, including the World Bank, the European Union, the African Development Bank, etc., support the road and bridge management program of PARPA and Roads III for rehabilitating Mozambique's key roads.

The Nacala Corridor, which extends to Malawi and Zambia through the Nampula and Niassa Provinces of Mozambique from Nacala Port, serves as a trucking route that connects northern agricultural areas with important provinces and/or districts and has the potential to produce benefits for these areas in the near future. However, during the rainy season from December to March, the amount of rainfall is comparatively large (ranging from 1200 to 2000 mm) and, as the Corridor is an unpaved road, it is frequently impassable during this period, adversely affecting the transportation of agricultural crops.

Given this background, the GOM wishes to draw up a road improvement plan for the Nacala Corridor that will upgrade inter-provincial connectively, and that will establish a network that will be compatible with that of the surrounding districts, provinces and counties to realize an effective international road system, with the aim of invigorating the socio-economy of northern Mozambique. In response of this request from the GOM, the Government of Japan (hereafter referred to as the "GOJ") has decided to carry out a Feasibility Study (hereafter referred to as the "F/S") for the road of northern provinces, i.e., "The Study on Upgrading of Nampula – Cuamba Road in the Republic of Mozambique" (hereafter referred to as "the Study").

Therefore, the objective of this Study is to carry out the F/S on the upgrading of National Road No.13 between Nampula and Cuamba, which is a part of the Nacala Corridor, approved by AfDB as the Enhanced Private Sector Assistance (EPSA) project, which is a co-financed scheme with the Japan Bank for International Cooperation (JBIC).

[2] GENERAL APPRECIATION

1 Road System

Mozambique's transport sector is governed by the following road sector policies and strategies:

- Road Sector Strategy 2007-2011 (RSS)
- Roads and Bridges Management and Maintenance Program (Roads III)
- PRISE 2007-2009

Mozambique has a road network of approximately 29,000 km, of which all national and regional roads classified are administrated by ANE; it has a coastline of approximately 2,700 km with the three (3) principal seaports being Maputo, Beira and Nacala. There are three (3) railway lines located around Maputo/Matola, Beira and Nacala and they constitute the Caminhos de Ferro de Mozambique (CFM) system.

2 Capacity of Road Sector Institutions

The road sector in Mozambique has been administrated by a number of government organizations, at national and provincial level. They are: the Ministry of Public Works and Housing (MOPH), the National Administration of Roads (ANE) and the Road Fund (FE) at national level, and the Provincial Delegations of ANE, the Municipal Councils and the District Administrations, at local level.

According to the ten-year Program, it requires financing of US$ 1,700 million, of which approximately 25% (US$ 432 million) is to be provided through IDA Adjustable Program Loan (APL) Credits. The Road Fund will need to contribute approximately US$ 600 million towards routine and periodic maintenance of the road network. The remainder of the program is to be financed by other donors and by the GOM's investment budget.

However, Phase 1 of the Program is behind schedule in terms of financing performance. Compared to the total US$ 703 million investment plan, only approximately US$540 million had been committed by both the GOM and donors, which accounts for only 77% of the total amount.

[3] FEASIBILITY STUDY

1 Approach & Methodology

The following approaches shall be applied to conduct the feasibility study on the Study Road.

- The Study Road should be upgraded as an all-weather road guaranteeing and all year round access.

- The most appropriate design speed for the Study Road shall be selected considering the cost-benefit aspect the capacity for transportation vs. construction costs.
- The most appropriate pavement type shall be selected considering locally available materials and its related costs.
- The necessity of bypass routes at major district centers on the Study Road shall be studied in line with forecasted traffic volumes the scale of resettlement and land acquisition.
- Future traffic demand on the Nacala Corridor shall be forecasted and shall take into account the transportation modes of road and railway.
- The improved Study road shall be operated and maintained by a suitable organization to ensure a long and useful life.

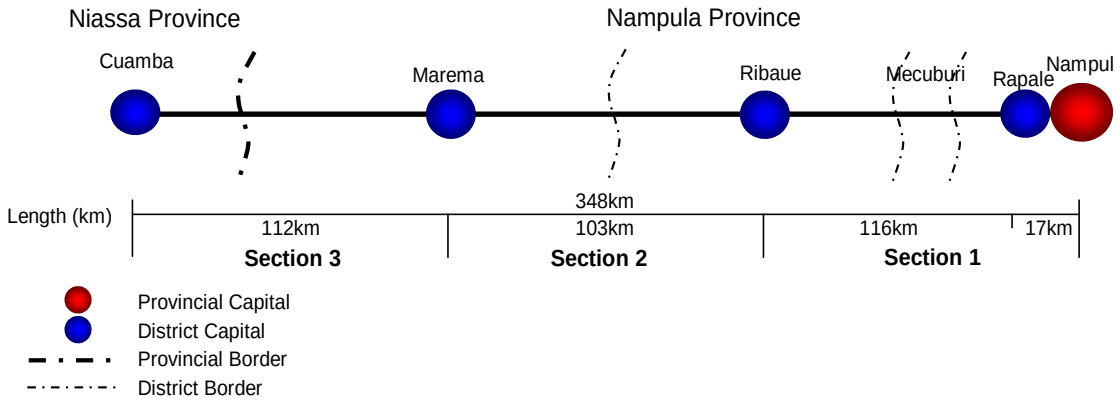
In order to implement the aforementioned approaches, the following methodology shall be applied for the feasibility study.

- JICA STRADA model is applied to forecast traffic demand and to properly assess the traffic volume on the Study Road and consider the effects on the road network.
- HDM-4/RED model is applied for the economic analysis in order to properly assess the effects on the blockage of the existing Study Road during the rainy season.

2 Existing Conditions of the Study Road & Bridges

The Study Road, with a total length of approximately 350km, passes through one city (Nampula), five districts (Nampula, Mecuburi, Ribaue and Malema in Nampula Province, and Cuamba in Niassa Province) and connects one provincial capital (Nampula) and four district capitals (Rapale, Ribaue, Malema, Cuamba), The Study Road is part of the NACALA CORRIDOR, connecting the Nacala Port with Malawi and Zambia.

The Study Road can be broadly divided into three sections as follows:



Outline of the Study Road

Overall, the Study Road width varies between 5 m and over 10m. The road is generally lower than the surrounding ground and has an earth/gravel surface with a poorly defined open drainage system. The side drains discharge surface water through irregularly positioned miter-drains. Crossing culverts on the road were observed at reasonably regular intervals. Some new culverts were recently constructed, and other culverts had headwalls repaired.

3 Natural Condition Survey for the Study Road

The natural condition Survey was carried out for the present conditions of the object road and those results of survey will be became the basic materials for the basic design. In addition, the aerial photo survey was carried out for topographical map to use for the basic design. Principal results of geological survey and hydrology survey are shown in table below.

Principal Results of the Survey

Survey Items	Survey Results
Geological Survey	• Sub-grade and sub-base of the existing study road are sufficiently strong for to use the sub-grade and the sub-base for the new road. • Laterite can not be used for material of sub-base, but when stabilized with cement or crushed stone, it can be used. • Only Cuamba Quarry can be used for surfacing and base materials. • Utilize of other quarry for above mentioned materials should be judged by other test results. • Laterite with 3% cement can be utilized for the sub-base but not for the base course. • Laterite with crushed stone can be utilized for the sub-base but depend on mix proportion.
Hydrological Survey	• Design high water level and design flood discharge were calculated by Rational Formula.

4 Traffic Demand Forecast for the Study Road

The following traffic surveys were executed: 1) traffic volume survey (24h and 12h), 2) a roadside origin-destination survey, 3) bus and train passenger survey, 4) situation survey of train operation, 5) interview survey of the major transport company. In addition to these surveys, the Study Team obtained some historical traffic data from ANE.

The overall demand for traffic movement has been formulated using a combination of data from the traffic surveys and economic growth data. The way in which traffic distributes on the road network is forecasted using the traffic assignment model JICASTRADA.

Based on the result of the analysis, average traffic demand in 2026 is 1,262 vehicle/day in case-1

(80kms/hr travel speed) and 1,324 in case-2 (100kms/hr travel speed).

Future Traffic Volume in 2026

［Case of 80kms/hr］ ［Unit：vehicles/day］

Section Name	AADT in 2006	Passenger Car	Mini-Bus	Bus	Cargo	Total
Nampula-Ribaue	335	111	324	177	767	1379
Ribaue-Malema	36	153	159	129	743	1184
Malema-Cuamba	141	138	125	127	833	1223
Sections Average	171	134	203	144	781	1262

［Case of 100kms/hr］ ［Unit：vehicles/day］

Section Name	AADT in 2006	Passenger Car	Mini-Bus	Bus	Cargo	Total
Nampula-Ribaue	335	111	367	173	795	1446
Ribaue-Malema	36	153	209	117	783	1262
Malema-Cuamba	141	138	125	127	873	1263
Sections Average	171	134	234	139	817	1324

5 Environmental & Social Considerations

The GOM has issued laws relevant to the environment, according to the EIA Law, all project's proponents must obtain have environmental certification from approval organization the Ministry of Environmental Coordination (hereinafter referred to as "MICOA"). This environmental law prescribes that rural road rehabilitation projects are is classified as "category A" projects, which is required an n EIA basically.

The IEE (pre-EIA) based on the JICA's guidelines indicated that it seems serious environmental impacts are not expected so far, however some key issues such as resettlement, elephant corridor and infection diseases items were picked up through the IEE. An EIA will be carried out based on the on procedures outlined by the of GOM's environmental law law basically. However other relevant environmental guidelines should be consulted as well referred from the view point of social considerations. Therefore JICA's has proposed a comprehensive ToR for the EIA based on the guidelines which includes all items from GOM, AfDB, JBIC and JICA. Thean environmental section in ANE, UASMA, in ANE has adopted this proposed ToR for the EIA. According to the timetable, the ESIA report will be submitted to MICOA in November 2007 and ANE will receive environmental permission by the end of 2007.

6 Applicable Design Standards

The application of a proper design standard will ensure that the following objectives are achieved:

- Ensure a safe, comfortable and high standard service level for the road users by the provision of adequate sight distance and sufficient roadway space
- Ensure that the roadway is designed economically
- Ensure uniformity in the design
- Ensure safety of the structures (bridges and culverts).

The applicable geometric design standard should adhere to the SATCC Standards. The design standards will be based on the proposed adopted design speed and take into consideration the construction cost and the environmental impacts.

7 Preliminary Design

This study aims to upgrade the Study Road, the Nampula – Cuamba Road which has a length of 350km. Through discussions with ANE and the results of field surveys by the Study Team, the concept of the Project was defined as follows:

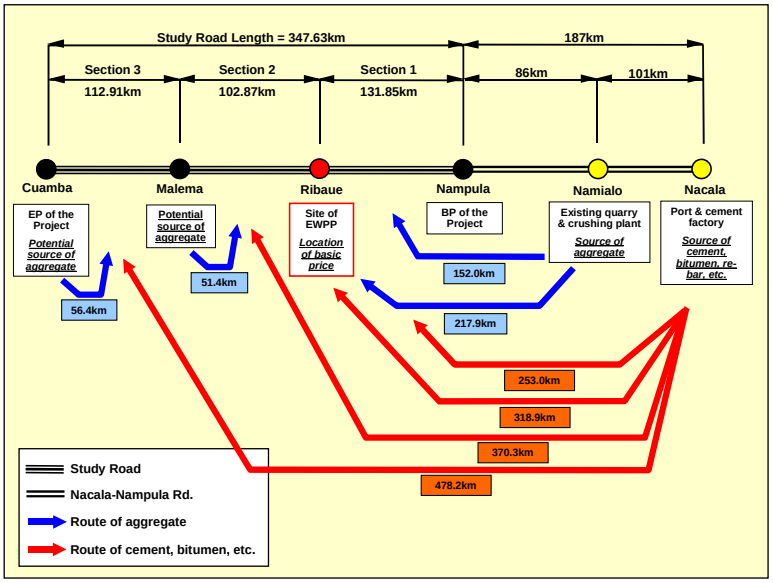
- To create an efficient primary road connection securing smooth traffic flow throughout the year corresponding to the future traffic demand
- To create a safe primary road connection by reducing the risk of accidents, especially the rate of injuries to pedestrians by motorized vehicles

The Upgrading of the Study Road will satisfy the geometric standards of SATCC for road safety. However, it is important that the impacts to the social and natural environmental are minimized. Accordingly, the following concepts of road alignment were discussed and agreed upon between ANE and the Study Team.

- The existing centerline shall be followed in the town and major villages.
- Other sections outside the towns and major villages shall satisfy the SATCC Standards taking into account the existing centerline wherever feasible.
- Bridges as evaluated in good condition by the bridge inventory survey shall be maintained in the project design to minimize initial capital costs.

8 Construction Planning & Cost Estimate

The study road will be divided into 3 construction sections as shown in following figure. Furthermore estimated project period is 36 months per each section



Locations & Functions of Important Places

Estimated project cost is summarized in following tables.

Total Project Cost (Design Speed = 80km/h; ALT-3)

(Currency: US $)

No.	Description	Section 1 Nampula to Ribaue 131.85 km	Section 2 Ribaue to Malema 102.87 km	Section 3 Malema to Cuamba 112.91 km	**Total** 347.63 km	% of (1-10)
0	Compensation	443,675	346,158	379,942	1,169,775	
1	Preliminary & general	11,882,980	9,776,507	11,598,963	33,258,450	28.7%
2	Earthworks	5,930,179	3,802,568	2,958,588	12,691,336	10.9%
3	Pavement	16,707,209	10,991,198	14,168,338	41,866,745	36.1%
4	Drainage	4,018,899	4,926,522	6,195,310	15,140,730	13.1%
5	Road furniture	175,198	176,688	292,253	644,139	0.6%
6	Miscellaneous	252,626	59,068	292,412	604,106	0.5%
7	Bridge	0	2,337,294	2,703,350	5,040,644	4.3%
8	Temporary construction road	1,262,692	1,028,483	1,059,032	3,350,207	2.9%
9	Dayworks	697,331	573,717	680,664	1,951,712	1.7%
10	Social issues	507,408	417,461	495,280	1,420,149	1.2%
	Total (1-10)	41,434,523	34,089,506	40,444,189	115,968,218	100%
11	Contingency 10%	4,143,452	3,408,951	4,044,419	11,596,822	
	Total construction cost (1-11)	45,577,975	37,498,457	44,488,608	127,565,039	
12	Engineering cost 8%	3,646,238	2,999,877	3,559,089	10,205,203	
	Total project cost (1-12)	49,224,213	40,498,333	48,047,697	137,770,243	
13	VAT 17%	8,368,116	6,884,717	8,168,108	23,420,941	
	Total project cost with VAT (1-13)	57,592,329	47,383,050	56,215,805	161,191,184	
14	Total(13) + (0)Compensation	58,036,004	47,729,207	56,595,747	162,360,959	

Unit Cost of the Project per kilometer (Currency: US $)

Type of unit cost	Section 1	Section 2	Section 3	Total
Unit construction cost (1-10)	$314,255 /km	$331,384 /km	$358,198 /km	$333,597 /km
Unit construction cost (1-11)	$345,681 /km	$364,523 /km	$394,018 /km	$366,956 /km
Unit project cost (1-12)	$373,335 /km	$393,685 /km	$425,540 /km	$396,313 /km
Unit project cost with VAT (1-13)	$436,802 /km	$460,611 /km	$497,882 /km	$463,686 /km
Unit project cost +VAT + Compensation. (1-14)	$440,167 /km	$463,976 /km	$501,247 /km	$467,051 /km
Unit construction cost (0-10)	$317,620 /km	$334,749 /km	$361,563 /km	$336,962 /km

9 Project Implementation

At present, AfDB and JBIC are considering to finance the Project. The Project implementation schedule should be consistent with the technical requirements and the availability of financial resources. The proposed Project implementation schedule is presented in the below.

- The detailed design stage will start from the beginning of 2008.
- The construction stage will start from the beginning of 2009 during 3 years.

10 Economic and Financial Analysis

The project scores an average level as an upgrade-to-paved intervention and its economic viability is acceptable, with an EIRR of over 12% for the optimum intervention among alternatives. Based on this result, N13 (Nampula - Cuamba) project is evaluated as one of the prioritized projects in the road sector. The particular importance of this primary road and of bringing it to all-weather transit-able condition is well established.

Result of Economic Analysis

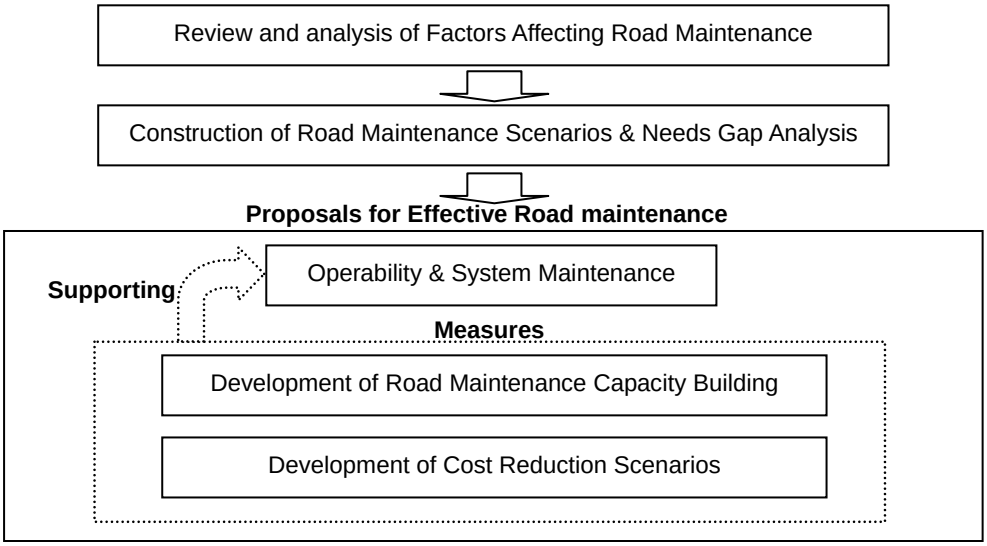
Section	Length (km)	Design Pavement Type	Construction Cost US$/km	Economic Ratio NPV	B/C	EIRR
Nampula-Ribaue	131.6	DBST on Granular	317,620	21,094	1.59	19.8%
Ribaue-Malema	102.9	DBST on Granular	334,749	15,389	1.53	19.0%
Malema-Cuamba	112.9	DBST on Granular	361,563	13,951	1.40	17.5%
Total	347.4	DBST on Granular	336,962	50,433	1.51	18.8%

Result of Sensitive Analysis

Case	Assumptions	Section N-R	R-M	M-C	Total
Base	Upgrade to paved road with DBST on Granular	19.8%	19.0%	17.5%	18.8%
1	Increase in traffic volume of +20%	23.0%	22.1%	20.5%	21.9%
2	Decrease in traffic volume of -20%	16.2%	15.5%	14.2%	15.3%
3	Decrease in investment costs of -20%	23.8%	22.8%	21.2%	22.6%
4	Increase in investment costs of +20%	16.8%	16.1%	14.8%	15.9%

11 Road Maintenance & Traffic Management

The proposals are comprehensive in order to develop the most effective road maintenance system. The workflow for this approach is shown in Figure below.



Developing an Effective Road Maintenance

Regarding to the traffic management such as overloading control and traffic safety, existing methods for overloading control rely on the use of axle-load weighing stations. Weighing stations will be an important measure to deal with the problem of overloaded vehicles. In addition to the overloading control, the following measures are recommended to reduce the level of road fatalities;

- Media campaigns on road safety
- Road safety awareness and education for rural children in communities and schools
- Strict enforcement of driver's license issuance and renewal
- Enforcement of traffic violations
- Strict vehicle inspection for registration and renewal

[4] REGIONAL DEVELOPMENT PLAN

1 Overall Conditions of the Study Area

The Study area is located in the provinces of Niassa and Nampula. The Nacala Corridor, which extends from Nacala Port to Malawi crossing the Provinces of Nampula and Niassa. The Study road is an unpaved road, it is frequently impassable during the rainy season, affecting the transportation of crops during this period. Socio-Economic Indicators of the provinces in the Study Area are shown below.

Socio-Economic Indicators in the Study Area

	Nampula	Niassa	National
Population – National Institute of Statistics (INE) projection for 2004	3,563,220	966,580	19 million
Children under age 18 (2004)	1,832,340	519,330	9,613,470
% of population that live below poverty line (2003)	52.60%	52.10%	54%
Infant mortality rate per 1000 (2003)	164	140	124
Chronic malnutrition among children 0-5 years (2003)	42%	47%	41%
Access to safe drinking water (2003)	32.20%	30.20%	35.70%
Access to sanitation (2003)	26.20%	70%	44.80%
HIV/AIDS Prevalence among 15- 49 year olds (2004)	9.20%	11.10%	13.60%
Primary School net enrolment rate (2003)	46.30%	47.30%	61%
Adult illiteracy rate (2003)	65.10%	64.40%	53.60%
Female illiteracy rate (2003)	81.40%	68%	68%
Fertility Rate (2003)	6.2	7.2	5.5
Total % of population with radios (2003)	48.30%	43%	45.50%

Source: UNICEF Moz.

2 Current Regional Development Plans and Activities

Various multi-sector projects and programs are on-going in the study region. It is noted that most of the development projects and programs are supported by donors and implemented with the assistance of NGOs.

The major NGOs and Agencies active in the region are; CARE International, CLUSA, SNV, World Vision, Save the children, Felocidade, Olipa-Odes, Ophavela, Oram, Monaso(HIV/AID) and CPI (Center for Promotion of Investment).

The major development issues of the study region are as follows;

- More than 90% of the population in the study region live in the rural areas
- Dispersed population distribution, only 25.6% of the population live within a distance of 10 km from the project road (both sides)
- The majority of the rural population engages in subsistence or family farming.
- Lack of transportation, especially in the rainy season due to impassable roads
- Lack of access to technology resulting in low agricultural productivity reliant on manpower only
- Lack of economic facilities in rural centers with respect to storage, markets, processing factories, means of transportation, etc.
- Lack of basic need services such as health, education, sanitary facilities
- Less than 10% of the farmers are members of producers association
- Many of the existing processing factories and storage facilities for agricultural products in Nampula City are deteriorated
- Vast availability of arable land and high potential to serve as a grain belt and contribute to food

security in Mozambique

- Interesting landscape and potential tourism attractions

3 Regional Development Program

Following table shows the summary of the regional development policies for each time horizon (period), and the priority strategic development program under the development pillars of 1) agricultural development, 2) Improvement of Rural Centers, and 3) Upgrading of Basic Services are proposed in the Study.

Establishment of Development Policies

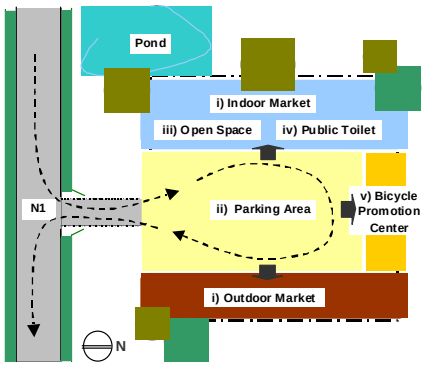
Period	Area involved	Agricultural Development	Improvement of Rural Center	Upgrading of Basic Services
Short	Half of 5 districts and 1 city (30 km radius zone)	Organization and transformation (increase of producer's associations: target=20%) and expansion of extension services, improvement of production facilities and management of natural resources	Improvement of rural center's functions, , improvement of mobility, and preventive measures for negative impacts	Improvement of medical, school and sanitary facilities
Mid	All of 5 districts and 1 city and expand area to other areas of Nacala Corridor	Organization and transformation (increase of producer's associations: target=30%), and & strengthening of producer's associations (target=30%) and continuation of above measures	Expand the above measures to the hinterland, improvement of markets, distribution and processing factories in Nampula and Nacala, and tourism development along the corridor	Improvement of medical, school, sanitary facilities, and electricity supply
Long	All of Nacala Corridor and expand to the northern 3 provinces	Increase & strengthening of producer's associations (target=50%) and continuation of above measures	Increase of jobs, improvement of public services, development of agro-processing center in the regional centers, and invitation of investments on large-scale livestock and plantation in the rural area, and integrated development of railway, airport and sea port	Improvement of medical, school, sanitary facilities, electricity supply, and settlement environment

4 Pilot Project

The objective of the Pilot Project is to grasp the development procedure, mechanism for project management and required necessary resources including human, material and financial. It will also serve to examine whether such projects are suitable to the local circumstances in Mozambique, and to identify an appropriate and achievable implementation and operation plan for the "Rural Center (Core) Project" which is the one of the main proposals of the "Regional Development Program".

To create a synergic effect between the pilot projects, the 3 selected projects are packaged into one integrated pilot project, which is called "MICHINOEKI". This pilot project will constitute of the following elements and conceptual lay-out plan for the facilities:

- For the income generation of the farmers / villagers, a market facility to sell agricultural products to the road users is provided
- For the information provision / promotion of events to villagers, an open space is provided
- For the rest area ,a refrigerator, parking area, public toilet and water supply is provided for the road users, and
- For the improvement of farmers' mobility a bicycle promotion center is provided to carry their products to the market.



The MICHINOEKI shall be implemented by PPP (Public and Private Partnership) method in cooperation with ANE, Local Government and the Project Operation Unit (POU).

The location of the proposed MICHINOEKI for pilot project is on the N1 km 19.1 from Nampula City (part of the central area of Anchilo Administrative Post). Through the experience of implementation, establishment of management and operation, monitoring and evaluation was conducted so that the recommendation and lessons leaned are following;

Recommendation

1. The contents/components of the MICHINOEKI which are i) parking lot, ii) Open Market, iii) Sales of Goods to rural people and drivers, iv) Pubic Toilet and v) Event Space are evaluated to be effective for full-scale project implementation, and should be part and parcel of future MICHINOEKI's.
2. The Administrative System (ANE: Owner of Facility, District: Owner of Operation) was confirmed to be efficient. The same system should be used for the full-scale project. The Financial recourses are expected to be provided by the soft component of the Nampula - Cuamba road improvement project.
3. The Bicycle promotion centre should be integrated into the MICHINOEKI project to promote the use of the bicycle for rural people and also to generate income for the operation of the road side station..

Lessons Learned

1. Technical assistance and capacity building is required for the operational staff of the MICHINOEKI. Most farmers are not business minded.
2. Promotion and publishment of the MICHINOEKI concept is important for the rural areas in order to have the farmers fully recognize and understand the MICHINOEKI's objectives and be involved in the outdoor market activities.
3. The staffs of MICHINOEKI have installed the community phone and started constructing another rest space under their decision. The community phone has been confirmed as a one of a useful public purpose by the results of operating records. It is recommended that the community phone should be provided into future MICHINOEKIs.

5 Roadside Station

The main objectives for the Roadside Station "MICHINOEKI" are as follows:

- **Rest:** Providing highway users with a clean, comfortable rest area
- **Market:** Providing a location for direct sale of products (and possibly for processing local products to generate added value)
- **Terminal:** Providing terminal functions for public transport.
- **Public Service:** Providing public services that are needed by local residents, as well as by highway users.

The study team identified the following proposed locations for future MICHINOEKI on the study road, and also visited each local administration and discussed the availability for each of these locations. All locations have been confirmed as being available for public facilities.

Layout arrangement considering the specific conditions in Mozambique and the site conditions are considered and the recommended layout plan for MICHINOEKI was proposed.

Through the pilot project in MICHINOEKI Anchilo, procedures for implementation, organization and operation have been tested which have provided important lessons learnt for its establishment in the Mozambican context. Especially, it is recommended that community phone should be installed through the scheme of Public Private Partnership (PPP) as a one of the MICHINOEKI's facilities. It helps much improvement for communication tools among rural people. And full scale implementation of the MICHINOEKI concept at the eight proposed locations on the study road is recommend as soft component of the main project for road improvement.

6 Emergency Works As Pilot Project

The Emergency works (hereafter described as "the Works") is a component of the pilot projects focusing on the rehabilitation of feeder roads and/or community infrastructures, which are strongly related with the regional development program. The works mainly aims that an effectiveness of small scale rehabilitation for community infrastructures are to be experimentally examined when it is undertaken within the framework of the regional development program. And secondary, specific data & information of construction as well as procurement are to be updated and compiled to feedback to the Feasibility study.

The Works were selected from the list of the prioritized projects, which are proposed in the Short-term Regional Development Policy.

Based on a technical examination as well as a needs assessment, the rehabilitation work for the existing community roads were carried out in the center of Ribaue district, which is a hub town in the region and provides public services both for education and for medical attentions.

The Works are to rehabilitate community roads of 0.98km in length and to improve access to the hospital and the school in Ribaue, Nampula Province. The Works comprise the following tasks:

- ✓ Road Pavement with a Single Chip Seal
- ✓ Installation of the Pedestrian Way and Rehabilitation of the Central Island (Strip)
- ✓ Installation of the Drainage and Cross Culvert

The rehabilitation work had progressed as scheduled. The Works commenced on May 29th and completed on July 30th, 2007. The total construction period was about 10 weeks. The facts and lessons indicate that it is optimum that the rehabilitation for the community infrastructures is comprehensively implemented in combination with the large scale road rehabilitation in terms of the project cost efficiency, the best management on the consturuction deliver time as well as its quality.

[5] CONCLUSIONS & RECOMMENDATIONS

The economic analysis of upgrading the Study Road concluded that project implementation (between 2009 and 2011) maybe appropriate based solely on benefits to road users and would produce substantial additional economic benefits. The economic validity for the Project is acceptable with an EIRR of 18% based on the most suitable pavement structure of DBST surfacing on granular base and sub-base assuming optimum maintenance interventions and based on the design speed of 80 km/h.

Recommendations based on the Study are summarized as follows.

(1) Implementation of regional development programs together with the Study Road upgrading

project. It is recommended that MICHINOEKI shall be implemented as a soft component of the project, and community roads along the study road shall be implemented together with this project.

(2) Support for environmental and social consideration
- ✓ Minimization of resettlement and stakeholder consultation
- ✓ Support for appropriate environmental and social consideration for other relevant activities

(3) Keeping the implementation schedule to start the construction work of the Study road from the beginning of 2009

(4) Starting the detailed design stage from the beginning of 2008

(5) Execution of severe site survey for quarries on the detailed design stage

(6) Expected shortage of cement supply for concrete structure due to the FIFA 2010 World Cup

(7) Execution of operation and management on the upgrading road including MICHINOEKI Anchilo

THE STUDY ON UPGRADING OF NAMPULA – CUAMBA ROAD IN THE REPUBLIC OF MOZAMBIQUE

FINAL REPORT

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ABBREVIATIONS

AADT	Annual Average Daily Traffic
AAQS	Ambient Air Quality Standards
ACE	Competent Authority of Road Sector
ADELNA	Local Economic Development Agency in Nampula
ADT	Average Daily Traffic
AfDB	African Development Bank
ANE	National Road Administration
APL	Adjustable Program Loan
ASNANI	Water and Sanitation Project in Nampula and Niassa Provinces
B/C	Benefit/Cost
CDN	Northern Development Corridor
CEPP	Training School for Teacher of Higher Education
CFM	Mozambique Railway Authority
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CLUSA	Cooperative League of the U.S.A.
COI	Corridor of Imact
CPI	Center for Promotion of Investment
DA	Directorate of Administration
DBST	Double Bituminous Surface Treatment
DEN	Directorate of National Roads
DEP	Department of Roads and Bridges
DER	Directorate of Regional Roads
DNEP	National Directorate of Roads and Bridges
DNPF	National Directorate for Planning and Finance
DNPO/MPF	National Directorate for Planning and Budgeting of the Ministry of Planning and Finance
DPOPH	Provincial Directorate of Public Works and Housing
ECMEP	State Enterprise for Construction and Maintenance of Roads and Bridges
EDM	Mozambique Electricity Company
EF	Equivalency Factors
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EITI	Extractive Industries Transparency Initiative
EME	Emergency Maintenance
EMP	Environmental Management Plan
EPSA	Enhanced Private Sector Assistance
ESA	Equivalent Standard Axles
ESAP	Environmental and Social Assessment Procedures
ESGI	Secondary School
ESIA	Environmental and Social Impact Assessment
EU	European Union
FDI	Direct Foreign Investment
FE	Fondo de Estrada
FIP	Preliminary Information File
FIRR	Financial Internal Rate of Return
Fls	Financial Intermediaries
FR	Forecast Reserve
GATV	Voluntary Testing and Assisting Office for HIV/AIDS
GDP	Gross Domestic Product
GHCN1	Global Historical Climatology Network ,version 1
GIS	Geographic Information System
GOJ	Government of Japan
GOM	Government of the Republic of Mozambique

GPS	Global Positioning System
H.W.L	High Water Level
HDM	Highway Design and Maintenance Standards Model
HDR	Human Development Rate
HIV/AIDS	Human Immunodeficiency Virus /Acquires Immune Deficiency Syndrome
HPR	Human Poverty Rate
I.M.F	International Monetary Fund
IDA	International Development Association
IEE	Initial Environmental Examination
IIAM	Mozambique Institute for Agricultural Research
IMAP	Training School for Primary School Teachers
INAV(I.N.A.V.)	National Institute of Road Traffic
INE	National Statistics Institute
IRI	International Roughness Index
IRMS	Integrated Road Management System
ITNs	Insecticide Treated Nets
IUCN	International Union for the Conservation of Nature and Natural Resources
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
LDF	Local Development Fund
LDI	Direct Local Investment
LED	Local Economic Development
MA	Ministry of Agriculture
MCA	Multi Criteria Analysis
MCC	Millennium Challenge Corporation
MICOA	Ministry for Coordination of Environmental Affairs
MDG	Millennium Development Goals
MOPH	Ministry of Public Works and Housing
MP	Periodic Maintenance
MPF	Ministry of Planning and Finance
MSA	Ministry of State Administration
MTC	Ministry of Transport and Communications
MTFF	Medium-Term Financial Framework
NEPAD	New Partnership for Africa's Development
NGO	Non-Governmental Organization
NPV	Net Present Value
OD	Origin and Destination
PAC	Environmental Action Plans
PAP	Project Affected Person(s)
PARPA	The Action Plan for the Reduction of Absolute Poverty
PGA	Environmental Management Plan
PIP	Project Implementation Plan
PPABS	Fishery Project
PRISE	Road Sector Integrate Program
RAP	Resettlement Action Plan
RF	Road Fund
RED	Roads Economic Decision Model
RISDP	Regional Indicative Strategic Development Plan
RoadⅢ	Roads and Bridge Management and Maintenance Program, phase 3
ROCS	Road and Coastal Shipping Project
ROW	Right of Way
RPF	Resettlement Policy Framework
RRIP	Rehabilitation of the Regional Roads Network
RSS	Roads Sector Strategy 2007-2011
SABS	South Africa Bureau of Standards

SADC	Southern African Development Community
SATCC	the Southern Africa Transport and Communications Commission
SBS	Sector Budget Support
SBST	Single Bituminous Surface Treatment
SEA	Strategic Environmental Assessment
ASDI	Swedish International Development Cooperation Agency
SMP	Strategic Maintenance Plan
STDs	Sexually Transmitted Diseases
SWOT	Strength, Opportunity, Weakness and Threat
TA	Technical Assistance
TOR	Terms of Reference
TOT	Training of Trainer
TRRL	Transport and Road Research Laboratory
TVE	Technical and Vocational Education
UASMA	Unit for Environmental and Social Issues
UNDP	United Nation Development Program
WB	World Bank
WHO	World Health Organization
WWF	World Wildlife Fund

The following foreign exchange rate is applied in the study:

1 US dollar = 25.75Mtn = 122.62 JP Yen, or 1 MTn = 0.21 JP Yen (June 2007),

PART 1: OVERALL APPROACH & IMPLEMENTATION PROGRAM OF THE STUDY

1.1 Background

Mozambique's 16-year civil war, which lasted until 1992, ruined much of the nation and destroyed its key road infrastructure. After the civil war, the Government of the Republic of Mozambique (GOM) has promoted various regional development plans in the country. As a first step, the rehabilitation of road infrastructure was indispensable in stimulating economic growth and reducing poverty. This objective remains important for the Action Plan for the Reduction of Absolute Poverty (PARPA 2001 - 2005). Note that many donors, including the World Bank (WB), the European Union (EU) and the African Development Bank (AfDB) support the road network and bridge management program of PARPA and Roads III for rehabilitating Mozambique's key roads.

The Nacala Corridor, which extends from Nacala Port to Malawi and Zambia through the Provinces of Nampula and Niassa of Mozambique, serves as a trucking route that connects northern agricultural production areas with important hinterland provinces and/or districts and has the potential to produce benefits for these areas in the near future. However, during the rainy season from December to March, the amount of rainfall is comparatively large (ranging from 1200 to 2000 mm) and, as the Corridor is partly an unpaved road, it is frequently impassable during this period, adversely affecting the transportation of agricultural crops.

Given the above-mentioned situation, the GOM requested the Government of Japan (GOJ) to conduct a feasibility study (F/S) for upgrading the Nampula – Cuamba Road. In response to this request from the GOM, the GOJ dispatched a Project Formulation Study Team and, based on its findings, recommended the execution of "The Study on Upgrading of Cuamba – Nampula Road in the Republic of Mozambique" (hereafter referred to as 'the Study'), designating the Japan International Cooperation Agency (JICA) to conduct the Study in accordance with the Agreement on Technical Cooperation signed by the GOM and GOJ on May 31, 2005 (hereafter referred to as 'the Agreement'). Furthermore, Minutes of the Meeting (M/M) were signed and exchanged on 31 March 2006, and the Scope of Works (S/W) signed on 29 August 2006.

1.2 Objective

The objective of the Study is to carry out a F/S on the upgrading of National Road No.13 between the cities of Nampula and Cuamba, which is a part of the Nacala Corridor. The results of the Study are expected to be approved by AfDB as the Enhanced Private Sector Assistance (EPSA) project, which is a co-financed scheme with the Japan Bank for International Cooperation (JBIC).

1.3 Study Area

The Study area comprises the four districts of Nampula, Mecuburi. Ribaue and Malema in Nampula province and the district of Cuamba in Niassa province, with the total length of the Study road being approximately 350 km.

1.4 Scope of the Study

The Study covers the work items below as agreed upon in the S/W and the M/M by the National Road Administration (ANE) under the Ministry of Public Works and Housing of the Republic of Mozambique (MOPH) and the Project Formulation Study Team.

(1) Related information/data collection, review & analysis

1) National and regional development plans
2) Investment plans
3) Donor activities
4) Socio-economic data
5) Land-use and disaster data
6) Natural environment data
7) Road administration system information and budget data
8) Related laws, regulations and standards
   a) Road and bridge design standards; information on construction machines, materials, aggregates, local consultants and companies; and right of way and road inventory data
   b) Land acquisition and compensation data, environmental impact assessment plans and environmental standards
9) Maps (topography, geology, hydrology, aerial photo, satellite images, etc.)
10) Site survey data

(2) Analysis of socio-economic framework

1) Execution of socio-economic framework analysis
2) Preparation of regional development framework
3) Execution of traffic demand analysis

(3) Preliminary design

1) Execution of supplementary survey
   a) Execution of traffic volume survey
   b) Execution of hydrological survey
   c) Execution of geological survey
   d) Execution of topographical survey
2) Examination of design standards and construction methodologies
   a) Examination of required level of upgrading
   b) Examination of road and bridge design standards
   c) Examination of road safety facilities
   d) Examination of construction methodologies
3) Examination of roadside stations
   a) Description and design of components and functions
   b) Preparation of operation and management system
   c) Promotion of coordination between local government and stakeholders
   d) Preparation of preliminary design and cost estimation
4) Examination of alternatives
   a) Road alignments
   b) Bridges
   c) Road safety facilities
5) Preliminary road design
   a) Route alignment design (Horizontal and vertical alignment)
   b) Road and pavement design
   c) Bridge design
   d) Road safety facilities
   e) Environmental measures
6) Road operation and maintenance
   a) Examination of operation and maintenance methodologies
   b) Examination and recommendations on operation and maintenance entities
   c) Preparation of operation and maintenance schedule
   d) Recommendations for load control and enforcement
7) Project implementation program
   a) Preparation of construction plan (by section)
   b) Preparation of construction schedule (by section)
   c) Preparation of procurement plan
   d) Examination of funding sources
8) Preliminary project cost estimate
   a) Calculation of project cost
   b) Calculation of land acquisition and compensation costs

c) Calculation of operation and maintenance costs

(4) Preparation of regional development programs & execution of pilot projects

1) Arrangement for a place suitable for pilot project
2) Study and prepare regional development programs
3) Selection of pilot projects
4) Execution of pilot projects

(5) Economic and financial evaluations and risk analysis

1) Examination of evaluation method
2) Cost Benefit analysis
3) Risk analysis

(6) Environmental evaluation

1) Social environment
2) Natural environment
3) EIA preparation

(7) Conclusion & recommendations

1.5 Study Approach

The study approach has been formulated based on the existing conditions that are affecting the Study Area and the Study Road. The following describes each of the main issues.

(1) Appreciation of Issues and Development Efforts

1) Although the Study Area has high socio-economic potential due to the existence of agriculture, the area has been struggling with poverty due to mainly lack of access to basic needs.

2) The Study Road and the regional roads in the Study Area are unpaved, and these roads regularly become impassable during the rainy season in spite of periodic road maintenance. This results in either increased costs for the freight and passenger transport or impossibility of transporting goods to and from markets.

3) Under serviced operation of the railway line, which is offering one scheduled passenger return trip every two days and nonscheduled freight trips, can not enhance economic growth through carrying both freight and passenger in the Study area. In addition, there is no future investment plan for this route at present.

4) Thus, the poor conditions of the transport network including roads and railways in the Study Area undermine poverty reduction efforts and stifle economic growth.

5) Based on PARPA II, Roads III and the Road Sector Strategy 2007 – 2011 (RSS), major donors such as AfDB, EU, WB and the GOJ, have recently improved some major roads and bridges in the two provinces of the Study Area. The road network for the Study Area shall be improved taking these improvements and current improvement plans into account in order to realize maximum synergy.

6) According to the pre-feasibility study conducted by ANE, the Study Road scores very high as an upgrading project (unpaved to paved roads), and its economic viability is quite high, with and EIRR of over 70%. Based on this result, one can conclude that the Study Road is evaluated as one of the highest ranked projects.

(2) Approach of Study

Based on this analysis, the Study team established the following approach to fulfill the objective of the Study.

- The minimum requirement of the Study road should be an all-weather road capable of allowing transport throughout the year.
- A regional development program for the Study area will be formulated together with the upgrading scenario of the Study road.
- Appropriate function and structure of the Study road will be considered at each stage of the regional development program,.
- Appropriate share of the transport mode between road and railway will be considered in the future traffic demand analysis.

Based on the aforementioned approach, the Study will be conducted according to the following steps:

1) To analyze the background and present situation of the natural and socio-economic environments;
2) To analyze the present and future relevant development plans within the area of influence of the Study Road;
3) To examine and formulate suitable pilot project plans and to execute them;
4) To conduct the preliminary design of the road;
5) To examine the feasibility of high-priority road improvement projects and to prepare an implementation plan for the projects with the highest priority.

The Study flow chart is as shown in Figure 1.5.1 below.

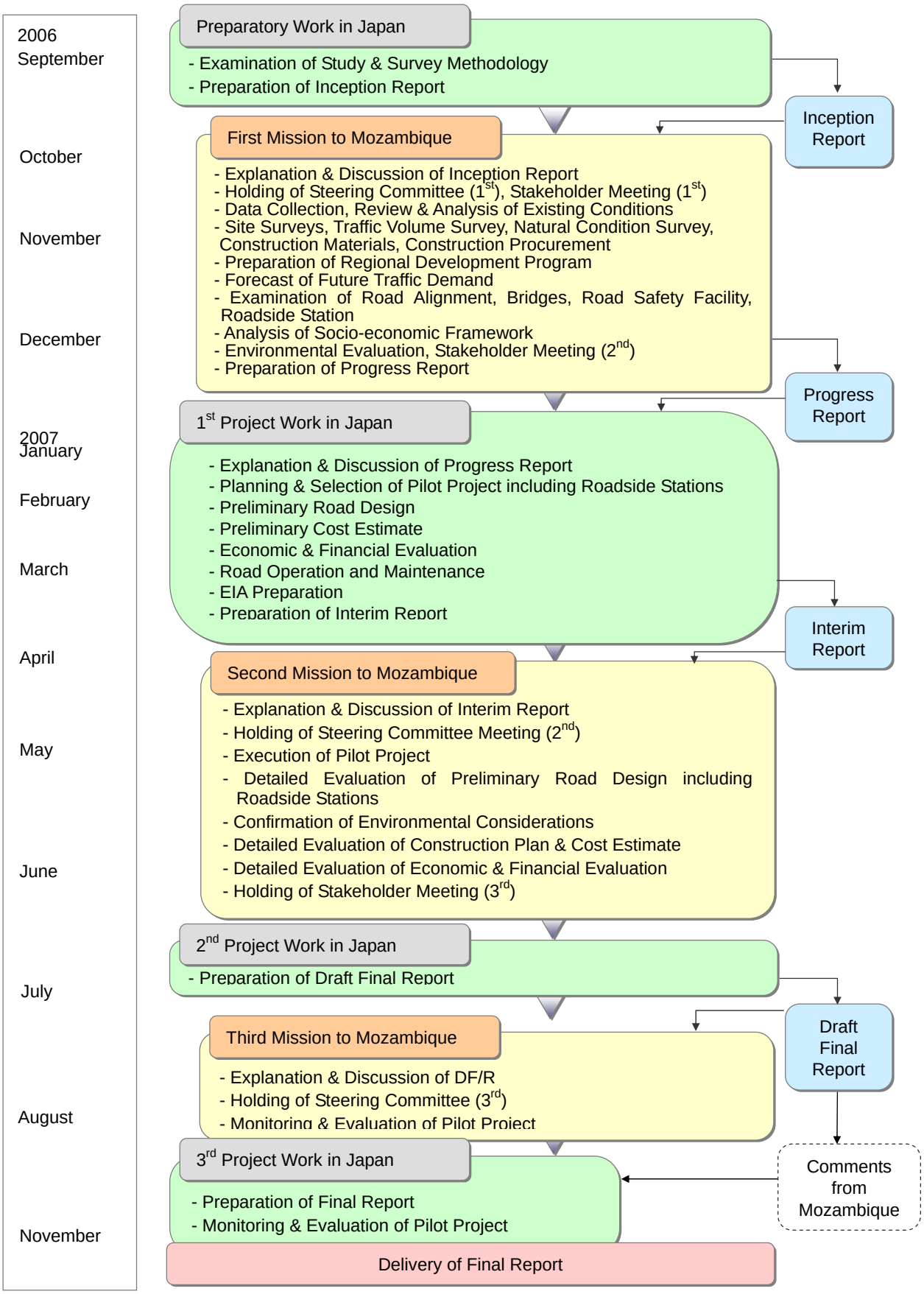


Figure 1.5.1 Study Flow

PART 2: GENERAL APPRECIATION

Chapter 1 Road System

1.1 Overview of National Development Plan and Road Sector Development Plan

The main objective of PARPA (2001-2005) and PARPA II (2006-2009) is to reduce the incident of absolute poverty. Based on this main strategy, PARPA and PARPA II focused on six areas: (i) education, (ii) health, (iii) agriculture and rural development, (iv) basic infrastructure, (v) good governance, and (vi) macro-economic and financial management.

Mozambique's transport sector is governed by the following road sector policies and strategies:

- Road Sector Strategy 2007-2011 (RSS)
- Roads and Bridges Management and Maintenance Program (Roads III)
- PRISE 2007-2009

1.2 Road System

All national and regional roads classified are administrated by ANE. However, this classification system does not include urban roads under the jurisdiction of municipal councils.

The Study Road (N13) is classified as a primary road. The Right of Way (ROW) for a primary road is required to be to a width of 30m outside the road shoulder on each side

Categorization	Designation	Functional Definition	Numbering
National Roads	Primary Roads	Form the national trunk road network and link: • Provincial capitals • Provincial capitals and other cities • Provincial capitals and main ports • Provincial capitals and important border posts	(a): N1 to N100 (b): N101 to N199
	Secondary Roads	Form the secondary network complementing the trunk road network and link: • Primary roads • Provincial capitals and sea or river ports • Primary roads and economic poles of high importance • Primary roads and (other) border posts	N200 to N399

Regional Roads	Tertiary Roads	Tertiary roads link: • Secondary roads with primary roads or with other secondary roads • District centres • District centres and administrative posts • District centres and economic poles of high importance	R400 to R799
	Vicinal Roads	Vicinal roads link: • Tertiary roads • Administrative posts • Administrative posts and other population centres	R800 onwards

(a): Roads that constitute major routes (itinerários principais)
(b): Other primary roads

Source: Final Report on The Reclassification of the Mozambique Road Network, 2003

1.3 Other Transport System

Mozambique has a road network of approximately 29,000 km; it has a coastline of approximately 2,700 km with the three (3) principal seaports being Maputo, Beira and Nacala. There are three (3) railway lines located around Maputo/Matola, Beira and Nacala and they constitute the Caminhos de Ferro de Mozambique (CFM) system. The table below shows the traffic modal split for both goods and passenger transportation in Mozambique.

Transportation		Road	Railway	Sea	Air	Pipeline
Goods (million TKM)	2004	950.7 (42.3%)	760.6 (33.8%)	279.1 (12.4%)	9.3 (0.4%)	248.3 (11.0%)
	2005	1,048.8 (46.8%)	762.8 (34.1%)	295.6 (13.2%)	7.4 (0.3%)	125.4 (5.6%)
Passenger (million PKM)	2004	20,906.2 (97.2%)	106.0 (0.5%)	29.8 (0.1%)	467.5 (2.2%)	-
	2005	23,909.7 (97.2%)	172.2 (0.7%)	18.5 (0.1%)	504.5 (2.1%)	-

Source: Statistical Yearbook

1.4 Transportation Movement at Malawi Border

In the early 1980s, as much as 95% of Malawi's trade was routed through the ports of Beira and Nacala. Unfortunately, war broke out in Mozambique, firstly a colonial war then a civil war and the Beira and Nacala routes were closed in 1983 and 1984 respectively. Both Zambia and Malawi made a modal shift away from rail to road transport.

Statistical data indicate that the international trade of Malawi has mainly been carried out through the South African ports, particularly Durban, for export. The contribution (30-40%) of the Mozambican ports, comprising Beira and Nacala, is not significant at

present. This would derive from the fact that South African ports, especially Durban, having sufficient function and facility to berth ships for international trade.

Chapter 2 Capacity of Road Sector Institutions

2.1 Public Institutions Responsible for Roads and Transport

The road sector in Mozambique has been administrated by a number of government organizations, at national and provincial level. They are: the Ministry of Public Works and Housing (MOPH), the National Administration of Roads (ANE) and the Road Fund (FE) at national level, and the Provincial Delegations of ANE, the Municipal Councils and the District Administrations, at local level.

2.2 Private Sector Institutions

The previous studies describe activities of both local and international contractors in the domestic markets. According to such reports, there is only wholly Mozambican contractor capable to execute road projects at the ICB basis but limiting value of 15 million per project, and other companies have capacity to undertake the project with approximately US$ 250,000 per year. Therefore, such small contractors can only participate in only minor works such as maintenance works.

The activities of domestic consulting firms are also in the similar situation of domestic contractors. Only several local consultants have been actively working for the road projects mainly with international consultants.

2.3 Current Road Maintenance System

Routine maintenance has been implemented by the provinces, through the DPOPH (Provincial Directorate of Public Works and Housing) and provincial DEPs (Mozambique Government incorporated DEPs into ANE's Provincial delegations in April 2006). Planning for routine maintenance on the national roads will continue to be the responsibility of the Operation Department of ANE, with liaison undertaken by the ANE delegates.

Regarding periodic maintenance and rehabilitation works, whereas ANE/DEN is responsible organization for both primary and secondary roads, provincial DEPs has responsibility of these works for both tertiary and vicinal roads.

2.4 Current Road Sector Investment Plan

The ten-year Program requires financing of US$ 1,700 million, of which approximately

25% (US$ 432 million) is to be provided through IDA Adjustable Program Loan (APL) Credits. The Road Fund will need to contribute approximately US$ 600 million towards routine and periodic maintenance of the road network. The remainder of the program is to be financed by other donors and by the GOM's investment budget.

However, Phase 1 of the Program is behind schedule in terms of financing performance. Compared to the total US$ 703 million investment plan, only approximately US$540 million had been committed by both the GOM and donors, which accounts for only 77% of the total amount.

2.5 Roads III Phase 2 Program

A detailed set of plans for the period 2007 – 2009 is being prepared for inclusion in the Roads-III Phase 2 Project Implementation Plan (PIP 2007 - 2009) based on the review results of Phase 1 implementation. PIP 2007 - 2009 includes detailed programs of works (paved and unpaved, investment and maintenance, national and provincial) and sector support activities (road sector planning and management, capacity building, road safety, and axle load control). Procurement, implementation and disbursement schedules are also included in PIP 2007 - 2009, as are the performance indicators that will be used to measure accomplishments and performance.

PIP 2007 - 2009 is to be reviewed and adjusted annually to take into account changes in needs and resource availability. Toward the end of Roads III Phase 2, the program for Phase 3 (PIP 3) will be prepared based upon a revised Strategy and rolling 5-year plan.

PART 3: FEASIBILITY STUDY

Chapter 1 Approach and Methodology

1.1 Introduction

Part 3 describes the approach, methodology and procedure of the feasibility study on the Study Road as well as its results, which comprises 10 chapters. Firstly the Study Team grasped the existing conditions of the Study Road including topography, geology, hydrology, natural and social environment and traffic, and established the upgrading concepts based on the understanding of characteristics of the Study Road. Secondly the preliminary design of road and bridges was conducted in order to formulate the upgrading concepts on the basis of design standards and specifications applied. This was followed by construction planning, cost estimate and implementation planning, and an economic analysis was executed in order to confirm the economic feasibility of the Study Road. In parallel to this process, an initial environmental examination (IEE) was also conducted to identify further check points in the EIA, which is now being undertaken by the GOM.

According to the contents of Part 3, Chapter 1 presents the approach and methodology for the feasibility study, considering the major issues of the Study Road.

1.2 Appreciation of Issues on Study Road

The following issues should be considered in order to conduct the feasibility study on the Study Road.

- **Function as an International Corridor (Nacala Corridor):** The neighboring countries of Malawi and Zambia as landlocked countries are paying a very large premium (estimated at 5-10 per cent for Malawi) on all imports and exports as a result of tremendously high transportation costs, as well as the unreliable and inefficient transport system (this applies to a somewhat lesser extent in the case of Zambia). There are two key problems that have been identified as critical in causing these inefficiencies. Firstly, the very poor quality of the physical infrastructure (particularly transport related), and secondly, the very unsatisfactory operation (including management, institutional, policy and procedural matters) of the existing infrastructure networks. The upgrading of the Study Road to all-weather road is expected to provide Malawi and Zambia with an alternative route to access an international port as well as secure a reliable international transportation route to Nacala.

- **Function as a Corridor for Regional Development in Mozambique:** Although the Northern area of Mozambique (the Study Area) has high economic potential due to the existence of agricultural resources, the area has been struggling with poverty due to mainly lack of access to basic needs. Particularly, the Study road and its access roads are unpaved and in poor condition. These roads regularly become impassable by heavy rain during the rainy season. This results in increased costs for the freight and passenger transport, frequent impossibility of transporting of goods to and from markets, and limiting access to market, school, hospital and other public facilities. The upgrading of the Study Road is expected to improve the access to district and province centers from the Study Area, which would promote socio-economic activities and social development of the rural poor.

1.3 Approaches and Methodology for the Feasibility Study

Within this context, the following approaches shall be applied to conduct the feasibility study on the Study Road.

- The Study Road should be upgraded as an all-weather road guaranteeing and all year round access.
- The most appropriate design speed for the Study Road shall be selected considering the cost-benefit aspect the capacity for transportation vs. construction costs.
- The most appropriate pavement type shall be selected considering locally available materials and its related costs.
- The necessity of bypass routes at major district centers on the Study Road shall be studied in line with forecasted traffic volumes the scale of resettlement and land acquisition.
- Future traffic demand on the Nacala Corridor shall be forecasted and shall take into account the transportation modes of road and railway.
- The improved Study road shall be operated and maintained by a suitable organization to ensure a long and useful life.

In order to implement the aforementioned approaches, the following methodology shall be applied for the feasibility study.

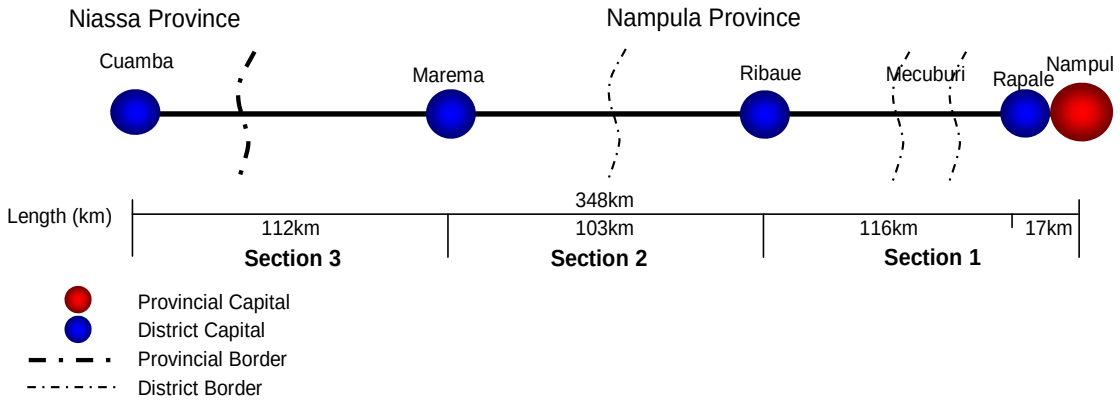
- JICA STRADA model is applied to forecast traffic demand and to properly assess the traffic volume on the Study Road and consider the effects on the road network.
- HDM-4/RED model is applied for the economic analysis in order to properly assess the effects on the blockage of the existing Study Road during the rainy season.

Chapter 2 Existing Conditions of the Study Road & Bridges

2.1 General Observation

The Study Road, with a total length of approximately 350km, passes through one city (Nampula), five districts (Nampula, Mecuburi, Ribaue and Malema in Nampula Province, and Cuamba in Niassa Province) and connects one provincial capital (Nampula) and four district capitals (Rapale, Ribaue, Malema, Cuamba), The Study Road is part of the NACALA CORRIDOR, connecting the Nacala Port with Malawi and Zambia.

The Study Road can be broadly divided into three sections as follows:



2.2 Existing Road and Bridge Conditions

Table below summarizes the results of the inventory survey for the Study Road.

Table Summary of Existing Road Conditions

Route	N13 (former N8)	**Length**	348km
Origin	Nampula (Nampula Province)	**Destination**	Cuamba (Niassa Province)
Terrain Conditions: From Nampula to Cuamba, the Study Road passes through flat and rolling terrain. The road steadily climbs, the altitude starts from 400MASL and reaches up to nearly 600MASL at Namina. Thereafter the road follows ups and downs around 500 – 600 MASL, across rolling terrain.			
Road Conditions: Overall, the Study Road width varies between 5 m and over 10m. The road is generally lower than the surrounding ground and has an earth/gravel surface with a poorly defined open drainage system. The side drains discharge surface water through irregularly positioned miter-drains. Crossing culverts on the road were observed at reasonably regular intervals. Some new culverts were recently constructed, and other culverts had headwalls repaired.			

Crossing Conditions: A total of 37 rivers or streams on the Study Road were identified. All waterways identified had crossing structures, including multi-cell pipe culverts, box culverts and bridges. Most of the rivers and streams have almost no discharge in the dry season and only one-third of the rivers have perennial but very slow water flow. The river gradients are gentle.
Roadside Conditions: The Study Road passes through numerous villages. Although lots of pedestrians and cyclists were observed within or near the towns and villages, their numbers are reduced to very few outside the towns and villages. Along the Study Road, cultivated lands are observed mostly near the villages with the remainder part being bush land
Traffic Conditions: Traffic on the Study Road is mainly observed in the morning. Although traffic volumes near towns like Nampula and Cuamba is relatively high, little traffic is observed on the sections 2 between Ribaue and Malema. Traffic counts are as follows; Section-1: 648 ADT, Section-2: 38 ADT, Section-3: 117 ADT Whereas mini-busses are most common on Section-1,heavy trucks account for the highest percentage on Section-3.
Socio-economic Conditions: The population figures (2005) for Nampula and Niassa Province are 3,643,739 and 992,764 respectively. These numbers account for respectively.19% and 5% of the national population. The GDPs (2004) of Nampula and Niassa Province are 8,212 and 1,908 billion Meticais, these account for 13% and 3% of Mozambique's GDP, respectively. On average, Mozambique's GDP grew by 9.2 percent annually between 2000 and 2004. Whereas Nampula and Niassa has growth rates of respectively 6.9 percent and 9.7 percent. The major economic activity of both provinces is agriculture.

Existing road conditions were analyzed in accordance with the following aspects.

【Analysis points】	【Target for Improvement】
A) Speed for National Trunk Road	Road Alignment and Road Width Road Surface
B) Securing of all-year passage for transport route	Drainage Facilities Road Surface
C) Traffic safety for resident population	Road Safety Facilities Bypass Route
D) Reduction of negative impacts such as pollution	Bypass Route

The following are the results of the analysis of the road and bridge inventory survey

- Necessity of Improvement of Road Alignment
- Necessity of Improvement of Road Surface
- Necessity to Improve Drainage and Culverts
- Necessity to Consider Bypass in Town Section

- Necessity of Improvement of Existing Narrow and Old Crossing Structure
- Necessity to Improve Existing Bridges that have Insufficient Discharge Capacity against Flood
- Necessity to Consider Retaining the Existing Bridges that have Sufficient Bridge Width for 2-lane Traffic as well as Sufficient Discharge Capacity against Flood

Chapter 3 Natural Condition Surveys for the Study Road

3. 1 Topographic Survey

3. 1. 1 Scope of Work

A topographic survey was conducted to assess existing topographic conditions for the Study road. The work items were as follows:

(1) Plan Survey for 5 River Crossing Points (refer to Figure 3.1.1)
(2) Road Alignment Survey
- Centerline survey
- Longitudinal survey
- Cross section survey

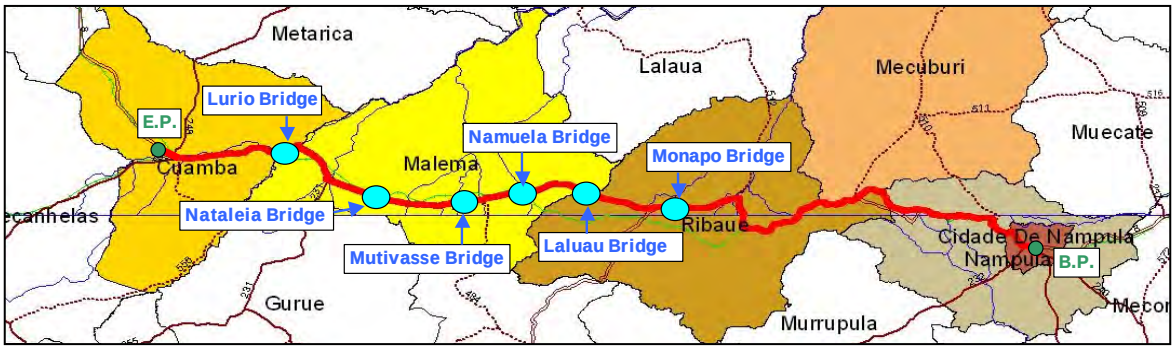


Figure 3.1.1 Location Map of Plan Survey for River Crossing Points

3. 1. 2 Survey Results

Topographic survey results are utilized in the preliminary design drawings for bridges.

3. 2 Aerial Photo Survey

3. 2. 1 Scope of Work

The Scope of Work is composed of the following items:
- Aerial Photography (length: 350km, Width: 5km)
- Development of the Photos (S=1/10,000)
- Preparing the Base Map for Design (S=1/10,000)

3. 2. 2 Survey Results

The base topographical map with contour lines was produced by using the three dimensional coordinates (XYZ) collected by the ground control survey (See Volume III Drawings). Its coordinates were matched to the road centerline survey of the first phase of

the Study.

3. 3 Geological Survey

3. 3. 1 Scope of Work

The Scope of Work for the Geological Survey was composed of the following items:

(1) Mechanical Boring Survey

- Mechanical Boring
- Standard Penetration Test (SPT)
- Laboratory Test (Unconfined Compression Test)

(2) Sub-grade Survey

- Dynamic Cone Penetration (DCP) Test

(3) Laboratory Test

- California Bearing Ratio (CBR) Test for Sub-grade with sampling
- Laterite Test with sampling
- Quarry Test with sampling
- Material Mixture Test

(4) Laboratory Testing for Laterite

- Liquid and Plasticity Limit
- Moisture Contents
- Granulometry (Grain Size) Test

5) Laboratory Testing for Quarries

- Aggregate Fracture Test (Aggregate Crushing Value /ACV)

6) Laboratory Testing for Material Mixture

- Three samples of laterite mixed with Cement at OPC 3 %, 4%, 5% (3 cases)
- One sample of laterite mixed with Crushed stone (60 %) (1 case)
- One sample of laterite mixed with Crushed stone (40 %) (1 case)

3. 3. 2 Survey Results

(1) Mechanical Boring Survey

A summary of the result for the mechanical boring survey is shown in Table 3.3.1.

Table 3.3.1 Summary of Mechanical Boring Survey

Bridge Name	Boring Number	Depth to Rock Layer	Bearing Stratum	Applicable Foundation Type
Monapo Bridge	BH01	11.25m	Slightly weathered granite rock	Pile foundation
	BH02	7.25m	Slightly weathered granite rock	Pile foundation
Lalaua Bridge	BH03	2.50m	Un-weathered granite rock	Spread foundation
	BH04	6.00m	Weathered granite rock	Spread foundation
Namuela Bridge	BH05	3.50 m	Un-weathered granite rock	Spread foundation
	BH06	0.75 m	Sound granite rock	Spread foundation
Mutivasse Bridge	BH07	6.50 m	Sound granite rock	Spread foundation
Nataleia Bridge	BH08	11.25 m	Sound granite rock	Pile foundation
Lurio Bridge	BH09	9.00 m	Sound granite rock	Pile foundation
	BH10	2.50 m	Sound granite rock	Spread foundation
	BH11	4.25 m	Sound granite rock	Spread foundation

(2) Dynamic Cone Penetration (DCP) Test

From the test results, it is concluded that the sub-grade of the existing Study road is sufficiently strong for the construction of a new road.

(3) California Bearing Ratio (CBR) Test

From the test results, it is concluded that the existing sub-base materials have sufficient strength and stiffness to act as a supporting sub-grade for the future pavement structure for upgrading, without the necessity to replace the material.

(4) Laboratory Testing for Laterite

From the test results, it is concluded that these materials by itself can not be used as sub-base materials mainly due to the high plasticity index (recommended to be lower than 12 for subtropical areas). Accordingly, it is necessary to consider improving the properties of these laterites using cement stabilization or mixing with crushed stones.

(5) Laboratory Testing for Quarries

A summary of the test results is shown in Table 3.3.2. According to ANE standards, the maximum ACV required for surfacing and base-course are 25% and 28%, respectively. However, Table 3.3.2 demonstrates that only the Cuamba Quarry satisfies the ANE standard for surfacing material. On the other hand, if the results of the Crushing strength, the Atterberg limits, the Flakiness index, the Abrasion loss test, the Absorption test, etc are all within the permissible limits, then it is permissible to

accept an ACV of up to 32% for the wearing course and base course. It is therefore recommended that these tests be carried out.

Table 3.3.2 Summary of Quarry Test Results

Sampling Location	Namialo	Km60+300	Ribaue	Malema	Cuamba
Abrasion Loss (%)	28.1	39.0	38.0	28.2	22.7
Wearing Course <32%(25%)	Pass	Fail	Fail	Pass	Pass
Base Course <32%(28%)	Pass	Fail	Fail	Pass	Pass
Aggregate for concrete <45%	Pass	Pass	Pass	Pass	Pass

Note: ( ); Exceptional Values

(6) Laboratory Testing for Material Mixture

1) Soil - Cement Mixtures

According to the Japanese Asphalt Pavement Manual (Japan Road Association), the standard for minimum strength of cement stabilized material for sub-base is 10 kgf/cm2 (0.98MPa) and for the base course 30 kgf/cm2 (2.9MPa). Therefore, the 3 soil samples tested with 3% cement can be utilized for the sub-base layer but not for the base course.

Table 3.3.3 Summary of Soil – Cement Mixture Test

Composition		Compressive Strength			
Laterite	Cement	Unit	Km 204+300	Km 256+500	Km 322+100
95%	5%	kPa	1,923	2,451	1,947
		MPa	1.9	2.5	1.9
		Kgf/cm^2	19.6	25.0	19.8
96%	4%	kPa	1,440	2,443	799
		MPa	1.4	2.4	0.8
		Kgf/cm^2	14.7	24.9	8.1
97%	3%	kPa	995	2,039	1,211
		MPa	1.0	2.0	1.2
		Kgf/cm^2	10.1	20.8	12.3

2) Material Mixture Test

From the test results it was found that the 70% (laterite) and 30% (crushed stone) mixture from the borrow pit at 79+000 is unacceptable neither as a sub-base material nor as a base-course, and the 60% (laterite) and 40% (crushed stone) mixture from the borrow pit at 124+200 is acceptable as a sub-base material but not as a base course layer.

3.4 Hydrology Survey

3.4.1 High Water Level

The high water level of rivers crossing as determined through interviews with local habitants is as shown in Table 3.4.1.

Table 3.4.1 High Water Level

River Name	Monapo	Laluau	Nataleia	Mutivasse	Namuela	Lurio
High Water Level (m)	561.7	545.7	592.9	596.6	623.9	505.3

3.4.2 Discharge

The discharge figures of the Rivers as obtained from DNA Maputo is shown in Table 3.4.2.

Table 3.4.2 Discharge

River Name	Maximum Discharge (m^3/s)	Month Year	Average of Maximum Discharge (m^3/s)	Period of Data Collection	Remarks
Meluli	273.86	Mar. 1998	27.78	May/1959 - Sep/2001	Not subjected river Close of Monapo River
Lalaua	17.04	Dec. 1971	3.45	Dec/1970 - Aug/1977	
Natalei1a	39.51	Aug. 1976	8.00	Oct/1960 - Mar/1985	
Mutivaze	8.57	Jan. 1965	3.07	Oct/1960 - Sep/1984	
Lurio	65.61	Jan. 1981	47.12	Apr/1959 - Apr/1961 Oct/1980 - Sep/1981	1)

1): Data available is insufficient, it seems that the actual discharge is more than $500m^3/s$.

3.5 Hydrological Analysis

3.5.1 Characteristics of Waterways on the Study Road

A total of 37 waterways, assumed to have a width of more than 5m, are identified on the Study Road during the bridge and road inventory survey. All waterways generally run from south to north. Most have a relative short length with small catchment areas. Only the Nataleia & Lurio Rivers are longer rivers with larger catchment areas.

3.5.2 Average Daily Rainfall of Each River Basin at Each Return Period

The average daily rainfall of each river basin for each return period is indicated in Table 3.5.1. Discharges of each river at the design return period are calculated. The calculation results of the discharges are shown in Table 3.5.2. Discharges of each waterway at the designated return period are calculated based on the procedures mentioned above. The calculation results of discharges for each waterway are shown in Table 3.5.3.

Table 3.5.1 Average Daily Rainfall at Each Return Period

Observatory	Return Period	Daily Rainfall (mm)	Observatory	Return Period	Daily Rainfall (mm)
Nampla	1/10	127	Malema	1/10	88
	1/20	138		1/20	94
	1/50	150		1/50	102
	1/100	160		1/100	108
Ribaue	1/10	109	Cuamba	1/10	103
	1/20	116		1/20	114
	1/50	125		1/50	132
	1/100	132		1/100	146

Table 3.5.2 Discharge at Each Return Period for Each Waterway (EAFM method)

River Name	A (m^2)	L (km)	S (m/m)	R24 (mm)	Design Peak Flow at Each Return Period			
					10yr (m^3/s)	20yr (m^3/s)	50yr (m^3/s)	100yr (m^3/s)
1 Intephe	23.0	7.7	0.012	127	59	64	69	74
2 Namuca	22.2	7.3	0.014	127	58	63	69	74
5 Namiali	18.0	8.4	0.012	109	40	43	46	49
10 Mutoloua	2.1	1.2	0.267	109	7	8	8	9
12 Monapo	31.9	10.5	0.015	109	61	65	70	74
14 Naiua	17.1	7.0	0.013	109	40	43	46	48
15 Nampaua	15.2	6.1	0.012	109	37	39	42	45
16 Iuhapua	19.1	7.7	0.014	109	44	46	50	53
17 Lagua	62.5	15.7	0.010	109	74	79	85	90
18 -	2.0	0.8	0.043	109	7	7	8	8
19 Lalaua	58.8	26.7	0.004	109	36	38	41	43
20 -	0.6	0.8	0.023	88	2	2	2	2
22 Tiwa	2.5	2.2	0.040	88	7	7	8	8
23 Naenca	4.6	2.0	0.048	88	12	13	14	15
24 Nataleia	332.6	47.7	0.018	88	-	-	-	-
25 Maposo	2.4	2.7	0.014	88	6	7	7	7
26 Mupari	21.7	9.4	0.017	88	38	40	44	46
27 Mutivasse	89.9	26.0	0.030	88	76	82	89	94
29 -	156.6	30.9	0.009	88	41	44	47	50
30 Namuela	20.9	8.2	0.063	88	31	33	36	38
33 Mulacatihe	68.8	18.9	0.046	103	89	98	113	126
34 Lurio	453.1	41.9	0.001	103	-	-	-	-

Note: A: Catchment Area, L: River Length, S: Average Waterway Slope, R24: Max. Daily Rainfall

Table 3.5.3 Discharge at Each Return Period for Each Waterway (Rational Formula)

Br.No	Bridge Name	Return Perido	Flood Concentration Time (T)	Average Rainfall Intensity (R_{24})	Rainfall Intensity within T	Rainfall Intensity (I)	Run-off Coefficient (f)	Catchment Area (A)	Design Discharge (Df)	Name of Obsevatory
			(h)	(mm)	(mm／t)	(mm／h)		(km^2)	(m^3／s)	
1	Intephe	1/20	1.753	138	58.2	33.2	0.37	23.0	79	Nampla
		1/50	1.753	150	63.3	36.11	0.37	23.0	85	
		1/100	1.753	160	67.5	38.51	0.37	23.0	91	
2	Namuca	1/20	1.586	138	56.3	35.5	0.37	22.2	81	Nampla
		1/50	1.586	150	61.2	38.59	0.37	22.2	88	
		1/100	1.586	160	65.3	41.17	0.37	22.2	94	
5	Namiali	1/20	1.875	116	50	26.67	0.37	18.0	49	Ribaue
		1/50	1.875	125	53.9	28.75	0.37	18.0	53	
		1/100	1.875	132	56.9	30.35	0.37	18.0	56	
10	Mutoloua	1/20	0.127	116	20.6	162.2	0.37	2.1	35	Ribaue
		1/50	0.127	125	22.2	174.8	0.37	2.1	38	
		1/100	0.127	132	23.4	184.25	0.37	2.1	40	
12	Monapo	1/20	2.043	116	51.4	25.16	0.37	31.9	83	Ribaue
		1/50	2.043	125	55.4	27.12	0.37	31.9	89	
		1/100	2.043	132	58.5	28.63	0.37	31.9	94	
14	Naiua	1/20	1.58	116	47.3	29.94	0.37	17.1	53	Ribaue
		1/50	1.58	125	50.9	32.22	0.37	17.1	57	
		1/100	1.58	132	53.8	34.05	0.37	17.1	60	
15	Nampaua	1/20	1.465	116	46.1	31.47	0.37	15.2	49	Ribaue
		1/50	1.465	125	49.7	33.92	0.37	15.2	53	
		1/100	1.465	132	52.5	35.84	0.37	15.2	56	
16	Iuhapua	1/20	1.652	116	48	29.06	0.37	19.1	57	Ribaue
		1/50	1.652	125	51.7	31.3	0.37	19.1	62	
		1/100	1.652	132	54.6	33.05	0.37	19.1	65	
17	Lagua	1/20	3.255	116	60	18.43	0.37	62.5	119	Ribaue
		1/50	3.255	125	64.7	19.88	0.37	62.5	128	
		1/100	3.255	132	68.3	20.98	0.37	62.5	135	
18		1/20	0.188	116	23.4	124.47	0.37	2.0	26	Ribaue
		1/50	0.188	125	25.2	134.04	0.37	2.0	28	
		1/100	0.188	132	26.6	141.49	0.37	2.0	29	
19	Lalaua	1/20	6.972	116	77.1	11.06	0.37	58.8	67	Ribaue
		1/50	6.972	125	83.1	11.92	0.37	58.8	72	
		1/100	6.972	132	87.8	12.59	0.37	58.8	76	
20		1/20	0.239	94	20.5	85.77	0.37	0.6	5	Malema
		1/50	0.239	102	22.3	93.31	0.37	0.6	6	
		1/100	0.239	108	23.6	98.74	0.37	0.6	6	
22	Tiwa	1/20	0.42	94	24.7	58.81	0.37	2.5	15	Malema
		1/50	0.42	102	26.8	63.81	0.37	2.5	16	
		1/100	0.42	108	28.4	67.62	0.37	2.5	17	
23	Naenca	1/20	0.364	94	23.6	64.84	0.37	4.6	31	Malema
		1/50	0.364	102	25.6	70.33	0.37	4.6	33	
		1/100	0.364	108	27.1	74.45	0.37	4.6	35	
24	Nataleia	1/20	6.728	94	61.8	9.19	0.28	332.6	238	Malema
		1/50	6.728	102	67	9.96	0.28	332.6	258	
		1/100	6.728	108	71	10.55	0.28	332.6	273	
25	Maposo	1/20	0.737	94	29.8	40.43	0.37	2.4	10	Malema
		1/50	0.737	102	32.3	43.83	0.37	2.4	11	
		1/100	0.737	108	34.2	46.4	0.37	2.4	12	
26	Mupari	1/20	1.788	94	39.9	22.32	0.37	21.7	50	Malema
		1/50	1.788	102	43.3	24.22	0.37	21.7	54	
		1/100	1.788	108	45.8	25.62	0.37	21.7	57	
27	Mutivasse	1/20	3.145	94	48.1	15.29	0.37	89.9	141	Malema
		1/50	3.145	102	52.2	16.6	0.37	89.9	154	
		1/100	3.145	108	55.2	17.55	0.37	89.9	162	
29		1/20	5.71	94	58.5	10.25	0.37	156.6	165	Malema
		1/50	5.71	102	63.5	11.12	0.37	156.6	179	
		1/100	5.71	108	67.2	11.77	0.37	156.6	190	
30	Namuela	1/20	0.972	94	32.6	33.54	0.30	20.9	59	Malema
		1/50	0.972	102	35.4	36.42	0.30	20.9	64	
		1/100	0.972	108	37.5	38.58	0.30	20.9	67	
33	Mulacatihe	1/20	2.087	114	50.9	24.39	0.37	68.8	173	Cuamba
		1/50	2.087	132	59	28.27	0.37	68.8	200	
		1/100	2.087	146	65.2	31.24	0.37	68.8	221	
34	Lurio	1/20	16.82	114	101.4	6.03	0.37	453.1	281	Cuamba
		1/50	16.82	132	117.4	6.98	0.37	453.1	325	
		1/100	16.82	146	129.8	7.72	0.37	453.1	360	

Table 3.5.4 shows the calculation results of water level based on flood discharge estimated with both the EAFM and the Rational Formula. Those water levels are compared to HWL indicated by interviews with several local residents, and the design water levels at designated return period are determined.

Table 3.5.4 Design Water Levels for Bridges to be Improved

Br. No.	Bridge Name	River Length	River Slope	Catch-ment Area	Return Period	Rationa Formula			EAFM Method			HWL Interviewed	Design HWL	Remarks
						Design Discharge	Water Depth	Design HWL	Design Discharge	Water Depth	Design HWL			
		(km)	(m/m)	(km^2)		(m^3/s)	(m)	(m)	(m^3/s)	(m)	(m)	(m)	(m)	
12	Monapo	10.5	0.015	31.9	1/20	83	-	-	65	-	-	561.7*		
					1/50	89	3.5	561.5	70	3.1	561.1		561.5	
					1/100	94	-	-	74	-	-			
19	Lalaua	26.7	0.004	58.8	1/20	67	-	-	38	-	-	545.7		
					1/50	72	2.7	545.7	41	2.1	545.1		545.7	
					1/100	76	-	-	43	-	-			
24	Nataleia	47.7	0.014	332.6	1/20	195	-	-	-	-	-	592.9*		*1:HWL after opening widened
					1/50	212	3.1	592.1*[1]	-	-	-		592.1	
					1/100	224			-	-	-			
27	Mutivasse	26.0	0.030	89.9	1/20	141	-	-	82	-	-	596.0		*2:In case the Br. extends to 30m
					1/50	154	3.5	595.5*[2]	89	2.6	594.6		595.5	
					1/100	162	-	-	94	-	-			
30	Namuela	8.2	0.063	20.9	1/20	59	-	-	33	-	-	623.9		
					1/50	64	3.8	625.8	36	3.0	625.0		625.8	
					1/100	67	-	-	38	-	-			
34	Lurio	41.9	0.001	453.1	1/20	281	-	-	-	-	-	505.3		
					1/50	325	4.8	505.9	-	-	-		505.9	
					1/100	360	5.0	506.0	-	-	-		506.0	
	*: Due to the narrow opeing, flood sometimes overflow at the bridge point.													

1) Conclusion of Estimation Results for Flood Discharge

As a result of the water level estimation, the flood discharge calculated with the Rational Method appears to better represent the actual hydraulic situations of the rivers studied. The flood water levels obtained from the local residents or flood traces at the crossing points better match the water levels calculated with the flood discharge of the Rational Formula. The results of the EAFM gave lower values than the HWL indicated by interviews. It may imply that some coefficients in the EAFM do not sufficiently represent the actual situation of the Study Area. Consequently, the water levels calculated with the Rational Formula will be applied as the design HWL for the new bridge design.

2) Design Discharge for New Culverts

As mentioned above, the flood discharges calculated with Rational Formula will be applied for the new culvert design.

Chapter 4 Traffic Demand Forecast for the Study Road

4.1 Data Gathering and Traffic Survey

The following traffic surveys were executed: 1) traffic volume survey (24h and 12h), 2) a roadside origin-destination survey, 3) bus and train passenger survey, 4) situation survey of train operation, 5) interview survey of the major transport company. In addition to these surveys, the Study Team obtained some historical traffic data from ANE.

A result of the above traffic volume survey, the Annual Average Daily Traffic (AADT) was as shown below.

Survey Point	ADT		Seasonal Variation		Converted Traffic		AADT
	1st (Oct)	2nd (Nov)	Oct	Nov	1st	2nd	
12h-1	2,844	3,592	1.034	1.162	2750	3091	2921
24h-1	-	453	1.034	1.162	-	390	390
12h-2	116	648	1.034	1.162	112	558	335
24h-2	106	121	1.034	1.162	103	104	103
12h-3	40	38	1.034	1.162	39	33	36
24h-3	138	255	1.034	1.162	133	219	176
12h-4	187	117	1.034	1.162	181	101	141
24h-4	390	419	1.034	1.162	377	361	369
12h-5	262	431	1.034	1.162	253	371	312

4.2 Traffic Growth Rate

ANE has prepared a traffic growth paper, namely “AN ASSESMENT OF ROAD TRAFFIC GROWTH”. According to the paper, traffic growth rates for each province were as shown below.

	Light Vehicles (gasoline powered)			
	2005-2010	2010-2015	2015-2020	2020-2025
Niassa	9.49	7.76	7.33	7.33
Cabo Delgado	7.14	5.84	5.51	5.51
Nampula	6.86	5.61	5.30	5.30
Zambezia	7.74	6.33	5.98	5.98
	Heavy Vehicles (diesel powered)			
	2005-2010	2010-2015	2015-2020	2020-2025
Niassa	6.14	5.61	5.93	6.25
Cabo Delgado	4.62	4.22	4.46	4.70
Nampula	4.44	4.05	4.28	4.52
Zambezia	5.01	4.57	4.83	5.10
	All Vehicles			
	2005-2010	2010-2015	2015-2020	2020-2025
Niassa	6.79	6.14	6.36	6.47
Cabo Delgado	5.11	4.62	4.78	4.87
Nampula	4.91	4.44	4.60	4.67
Zambezia	5.54	5.01	5.19	5.27

4.3 Traffic Demand Forecast

The overall demand for traffic movement has been formulated using a combination of data from the traffic surveys and economic growth data. The way in which traffic distributes on the road network is forecasted using the traffic assignment model JICASTRADA.

The tangible methodology and the scenarios for traffic demand forecast are shown below.

a) Future traffic demand has been derived based on future Origin Destination (OD) matrices with trend growth rates.
b) In case that the study road is improved and upgraded, it will attract some traffic from other roads and other transportation modes. The traffic survey indicates the following two possibilities of diverted traffic.
   - Passenger and cargo traffic with transportation mode change
   - Cargo traffic with route change
c) Future traffic demand has been estimated by accumulation above a) and b)

Based on the result of the above analysis, average traffic demand in 2026 is 1,262

vehicle/day in case-1 (80kms/hr travel speed) and 1,324 in case-2 (100kms/hr travel speed).

［Case of 80kms/hr］ ［Unit：vehicles/day］

Section Name	AADT in 2006	Passenger Car	Mini-Bus	Bus	Cargo	Total
Nampula-Ribaue	335	111	324	177	767	1379
Ribaue-Malema	36	153	159	129	743	1184
Malema-Cuamba	141	138	125	127	833	1223
Sections Average	171	134	203	144	781	1262

［Case of 100kms/hr］ ［Unit：vehicles/day］

Section Name	AADT in 2006	Passenger Car	Mini-Bus	Bus	Cargo	Total
Nampula-Ribaue	335	111	367	173	795	1446
Ribaue-Malema	36	153	209	117	783	1262
Malema-Cuamba	141	138	125	127	873	1263
Sections Average	171	134	234	139	817	1324

Chapter 5 Environmental and Social Considerations

5.1 Environmental Legislation

The GOM has issued laws relevant to the environment. According to the EIA Law, project proponents must obtain environmental certification from the Ministry of Environmental Coordination (hereinafter referred to as "MICOA"). This environmental law prescribes that rural road rehabilitation projects are classified as "category A" projects, which require an EIA. Furthermore the land law prescribes compensation for resettlement, and ANE will prepare a project-based resettlement action plan (hereinafter referred to as "RAP") for appropriate compensation based on the land law and the resettlement policy framework (hereinafter refereed to as "RPF") which was established by ANE in September 2006 in cooperation with the World Bank.

5.2 Pre-EIA thorough IEE based on JICA's Guidelines

The IEE (pre-EIA) indicated that serious environmental impacts are not expected, however some key issues were picked up. The most important being the "Resettlement" and the "Elephant corridor". With regard to resettlement, approximately 5,000 structures are located in the right of way (30ms on each side from the existing road shoulder). According to a rough estimation, approximately 600 structures are affected by the 80km/hr road alignment. The exact magnitude of the impact will be defined in a detailed ESIA and preliminary RAP which will be conducted by GOM in 2007. With respect to the elephant corridor, according to specialists from the Ministry of Agriculture, IUCN and WWF, the migration groups are minor and do not cross the Nampula- Cuamba road. Hence, the project is not likely to give serious direct impacts, but indirect impacts such as expansion of human activities, deforestation and poaching will increase and affect the elephant corridor. Therefore appropriate mitigation measures will be required in the future. Furthermore the spread of the sexual transmitted diseases such as HIV/AIDS is a serious social issue with development projects in African countries. ANE in cooperation with relevant organizations should conduct appropriate education campaigns and other mitigation measures for the project affected persons and road construction workers.

5.3 Recommendation regarding EIA and Current Progress

An EIA will be carried out based on the procedures outlined by the GOM's environmental law. However other relevant environmental guidelines should be consulted as well from the view point of social considerations. Therefore JICA's has proposed a comprehensive ToR for the EIA based on the guidelines from GOM, AfDB, JBIC and JICA. The environmental section in ANE, UASMA, has adopted this proposed ToR for the EIA.

According to the timetable, the ESIA report will be submitted to MICOA in November 2007 and ANE will receive environmental permission by the end of 2007. With regard to the RAP, it will be carried out in two phases due to lack of detailed information. A preliminary RAP will be prepared based on the feasibility study and a detailed RAP will be done based on the detailed design report.

Chapter 6 Applicable Design Standards

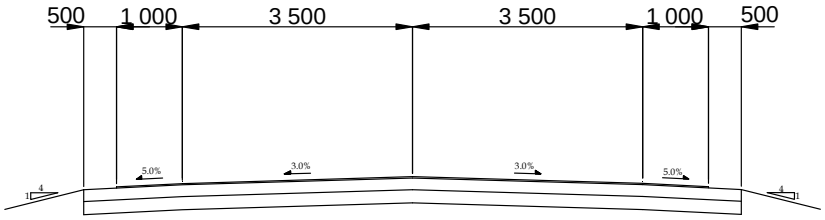
6.1 Introduction

The application of a proper design standard will ensure that the following objectives are achieved:

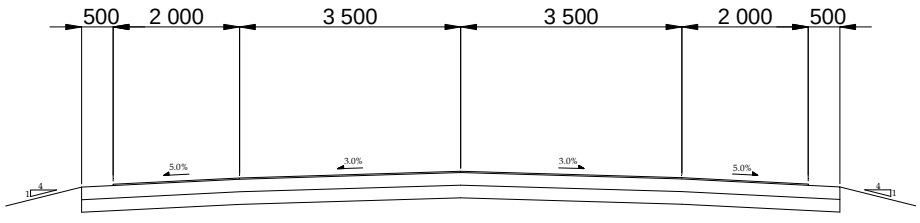
- Ensure a safe, comfortable and high standard service level for the road users by the provision of adequate sight distance and sufficient roadway space
- Ensure that the roadway is designed economically
- Ensure uniformity in the design
- Ensure safety of the structures (bridges and culverts).

6.2 Road Design Standards

The applicable geometric design standard should adhere to the SATCC Standards. The design standards will be based on the proposed adopted design speed and take into consideration the construction cost and the environmental impacts and so forth
Regarding the typical cross section, it is recommended to adopt the Nampula – Nacala Road cross section to maintain uniformity.



Typical Cross Section of Nampula – Nacala Road (Nominal Section)



Typical Cross Section of Nampula – Nacala Road (Town Section)

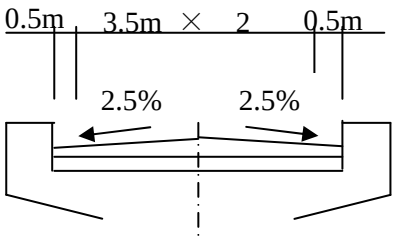
The design of pavement structures will be based on the methods given by the "SATCC Practice for the Design of Road Pavements" and "Practice for Pavement Rehabilitation".

6.3 Bridges and Culverts

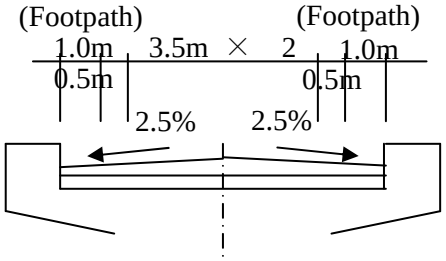
The SATCC codes are formulated on the basis of the British Design Codes. The ANE staff, although using the SATCC codes, still use the Portuguese codes for checking the SATCC based design.

After consideration of the above it has been decided that the SATCC specification should be adopted as the standard for bridge and culvert design for the Study.

The Study Team recommends the use of different bridge width formations depending on the surrounding areas, being unpopulated areas or populated areas.



Unpopulated Area



Populated Area or Long Span Bridge

The ANE guidelines in the National Roads Strategy propose a return period appropriate to the design discharge. The return periods for bridge design are proposed to be selected in the following way:

Flood Discharge	Recurrence Interval (yrs)
$20m^3/s > Q$	20
$20m^3/s < Q < 250m^3/s$	50
$Q > 250m^3/s$	100

Chapter 7 Preliminary Design

7.1 Introduction

This chapter discusses the upgrading concept, alternative routes and design for the Study Road, all as derived from the site survey results i.e., road inventory, natural condition and hydrological survey, and bridge inventory survey. The principal purpose of this chapter is to determine whether the respective upgrading scenarios are feasible.

7.2 Screening of Conceivable Alternative Routes and Design

1) Upgrading Concepts for Road Alignment

This study aims to upgrade the Study Road, the Nampula – Cuamba Road which has a length of 350km. Although the road is part of the Nacala Corridor and is one of the most important major roads in Mozambique, adequate maintenance and upgrading works have not been carried out due to lack of funds. As a result, this road has serious problems leading to interruption of traffic during the rainy season.
Through discussions with ANE and the results of field surveys by the Study Team, the concept of the Project was defined as follows:

- To create an efficient primary road connection securing smooth traffic flow throughout the year corresponding to the future traffic demand
- To create a safe primary road connection by reducing the risk of accidents, especially the rate of injuries to pedestrians by motorized vehicles

The Upgrading of the Study Road will satisfy the geometric standards of SATCC for road safety. However, it is important that the impacts to the social and natural environmental are minimized. Accordingly, the following concepts of road alignment were discussed and agreed upon between ANE and the Study Team.

- The existing centerline shall be followed in the town and major villages.
- Other sections outside the towns and major villages shall satisfy the SATCC Standards taking into account the existing centerline wherever feasible.
- Bridges as evaluated in good condition by the bridge inventory survey shall be maintained in the project design to minimize initial capital costs.

Upgrading concepts for the choice of alignment are based on following concepts:

Alternative-1: Minimum Upgrading Alternative (Design Speed of 80km/h)
Alternative-A is based on the existing alignment with minimal changes to accommodate a design speed of 80km/h, except for the town sections of Nampula, Rapale, Namina, Namigonha, Ribaue, Malema, Mutuali, Lurio and Cuamba. Pavement upgrading in the town sections is included.

Alternative-2: Maximum Upgrading Alternative (Design Speed of 100km/h)
Alternative-B is based on a re-alignment of the existing road to accommodate a design speed of 100km/h, except for the town sections and intersections of Nampula, Rapale, Namina, Namigonha, Ribaue, Malema, Mutuali, Lurio and Cuamba. Pavement upgrading in the town sections is included.

Based on considerations for traffic safety, construction cost, social impacts, traffic management and operation, a design speed of 80km/h is recommended as the most appropriate.

2) Upgrading Concepts for Pavement Design

Upgrading concepts for pavement design are based on the following concepts:

- To establish a structurally sound primary road securing a smooth traffic flow and corresponding to the future traffic demand
- To reduce the life cycle costs (optimizing the current investment with the future maintenance and operational cost) taking into consideration the maximum use of local materials and future maintenance by labor based methods

The Project area can be classified as a wet region. The following pavement alternatives will be considered:

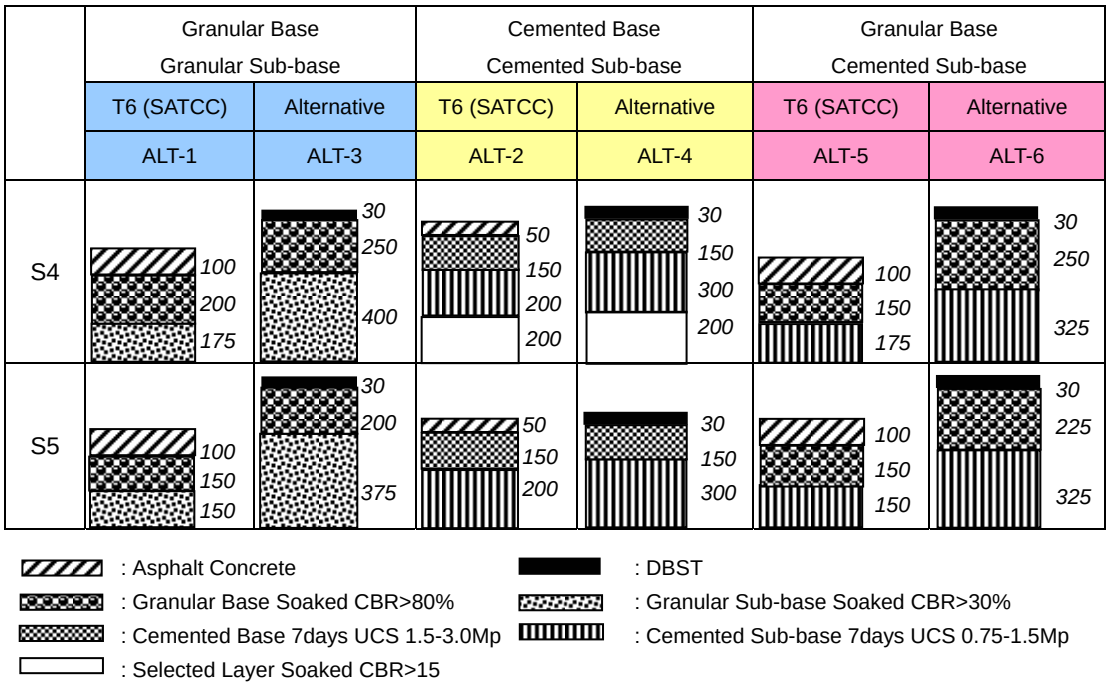
Pavement (Sub)Base Layer

Alternative-A: Granular Base and Sub-base Course
Alternative-B: Stabilized Base and Sub-base Course
Alternative-C: Granular Base and Stabilized Sub-base Course

Pavement Seal

Alternative-A: Asphalt Concrete as per SATCC Standard

Alternative-B: Bituminous surface treatment (similar as the Nampula – Nacala Road)



The selection of the suitable pavement composition is evaluated based on the initial cost and its financial viability using the EIRR indicator. The results of the cost estimates and the economic analysis, the ALT-3 which constitutes of a DBST surface on a Granular type (sub) base layer is selected as the most economically viable pavement composition. Its composition shows the lowest initial cost and the highest EIRR.

3) Upgrading Concepts for Bridge and River Crossing Structures

The upgrading concept for bridges and other river crossings will be discussed in this sub-chapter, based on the findings of the analysis of the bridge inventory survey, Since the bridge improvement cost forms a large portion of the total construction costs for any Project, considering various alternatives for the upgrading of bridges is important in the initial design stage of the Study Road.

Concept-1: Retaining the Existing Bridges that have Sufficient Width for 2-lane Traffic Operation as well as Sufficient Discharge Capacity for design Floods

Concept-2: Replacement of Existing Narrow, Short and Old Bridges by Box Culverts

Concept-3: Improvement of the Existing Bridges that have Insufficient Discharge Capacity for the design Flood

Concept-4: Improvement of Existing Medium Size Bridges with Narrow Bridge Width

7.3 Preliminary Design of the Study Road

1) Concept for the Re-Alignment Plan

The Study Team carried out an aerial photography survey to better understand the environmental and social impact of road realignment. Based on this survey, the Study Team has made efforts to reassess the realignment issue to further minimize impact to the natural and social environment. This was based on previous concepts described in chapter 7.2 and the following additional issues.

- To reserve big trees along the road wherever possible
- To reduce social negative impacts where the road alignment crosses major towns and (small) villages

The result of reassessing the alignment issue based on the aerial photos has resulted in the selection of an alignment which deviates less to the existing alignment as compared to the previous selected alignment. Negative social impact to the smaller villages was also minimized.

2) Drainage System

The existing vertical road alignment is lower than the surrounding ground level and this has resulted in eroded side drains in some of the sections. The existing erosion problem is a result of various causes such as the materials used for the drains (earth drains) and the accepted high flow velocities. In order to ensure good drainage of the road and side drains, the minimum longitudinal gradient is recommended to be 0.3%. Concrete lined drains are recommended for drains where the velocity of flow exceeds 0.6m/s.

In the town sections, a new U-type drain with concrete cover is proposed to ensure smooth traffic flows during heavy rain and to prevent damage to the road structure.

Regarding cross culverts, it is proposed that all existing culverts be replaced by new “Concrete Box Culverts” with sufficient discharge capacity and strength. Design policies for the provision of new box culverts are given below.

- Replace all existing box culverts with new concrete box culverts
- Install new concrete box culverts in all areas considered to have inadequate cross drainage

3) Road Traffic Safety

The risk of traffic accidents is likely to increase with the anticipated increase in traffic volume and higher driving speeds. The project will include proper road safety facilities such as pedestrian crossings, traffic signs and road markings.

7.4 Preliminary Design of Bridges

1) Introduction

This sub-chapter will discuss the appropriate alternatives for Concept 3 & 4 Bridges and determine the most suitable alternative for those bridges. Each of the bridges which fall into these categories will be discussed below.

2) Improvement Alternatives

Improvement alternatives for each bridge are described in Table 7.4.1 – 7.4.6 respectively.

Table 7.4.1 Determination of Improvement Alternative for Monapo Bridge

1.Bridge Name: No.12 Monapo Bridge (159+560)		
2.Existing Bridge Description: L=11.5m, Win= 7.3m, RC-Slab type		
3.Alternatives		
	Outline of Alternative	Results
Alt-A	Replacement with a new bridge with sufficient discharge capacity Br. L=25m (12.5m x 2) W=8m, RC-Hollow slab type	Applicable
Alt-B	Extension of the existing bridge to ensure sufficient discharge capacity Br.L=25m(7.25(new)+11.5(existing)+7.5(new))	Not applicable
Alt-C	Installation of a box culvert on the approach road in order to increase the discharge capacity	Not applicable

Table 7.4.2 Determination of Improvement Alternative for Lalaua Bridge

1.Bridge Name: No.19 Lalaua Bridge (186+740)		
2.Existing Bridge Description: L=28.0m (8.6+9.9+10.4), W=3.6m, RC-slab		
3.Alternatives		
	Outline of Alternative	Results
Alt-A	Replacement with a new bridge accommodating 2-lane traffic operation -Br. L=30m(15mx2), W=8.0m, RC-Hollow slab type	Applicable
Alt-B	Addition of a new bridge with one-lane width, beside the existing one	Not applicable
	-Br. L=30m(15mx2), W=4.5m, RC-Hollow slab type	

Table 7.4.3 Determination of Improvement Alternative for Nataleia Bridge

1.Bridge Name: No.24 Nataleia Bridge (225+600)		
2.Existing Bridge Description: L=22.6m(7.5m x 3), W=7.3m, RC-Slab type		
3.Alternatives		
	Outline of Alternative	Results
Alt-A	Replacement with a new bridge with sufficient discharge capacity -Br.L=48m(9+15x2+9), W=8m, RC-Hollow slab type	Applicable
Alt-B	Extension of the existing bridge to ensure sufficient discharge capacity - Br.L=48m (13.2(new)+7.5x3(existing)+13.2(new))	Not applicable
Alt-C	Protection of the approach roads by covering with concrete paving and revetment on the embankment slopes	Not applicable

Table 7.4.4 Determination of Improvement Alternative for Mutivasse Bridge

1.Bridge Name: No.27 Mutivasse Bridge (234+810)		
2.Existing Bridge Description: L=24.3m(6.3x4), W=3.4m, RC-slab type		
3.Althernatives		
	Outline of Alternative	Results
Alt-A	Replacement with a new bridge with sufficient discharge capacity - Br.L=30m(15mx2), W=10m including foot path	Applicable

Table 7.4.5 Determination of Improvement Alternative for Namuela Bridge

1.Bridge Name: No.30 Namuela Bridge (262+870)		
2.Existing Bridge Description: L=30.6m , W=4.2m, Bailey type		
3.Alternatives		
	Outline of Alternative	Result
Alt-A	Replacement with a new bridge accommodating 2-lane traffic operation - Br.L=30m(6.5+13.0+6.5), W=8.0m, RC-Hollow slab type	Applicable

Table 7.4.6 Determination of Improvement Alternative for Lurio Bridge

1.Bridge Name: No.34 Lurio Bridge (309+400)		
2.Existing Bridge Description: L=94.2m (15.7 x 6), W=1.1+3.6+0.7, RC T-shaped Girder		
3.Alternatives		
	Outline of Alternative	Result
Alt-A	Construction of a new bridge accommodating 2-lane traffic operation	Applicable
Alt-B	Construction of a new bridge accommodating one-lane traffic operation	Not applicable
Alt-C	Construction of a new bridge with stage construction, First stage: construct a substructure for a future 2-lane superstructure, and construct a superstructure for only one-lane initially. Second stage: Erect another one-lane superstructure in the future	Considerable depending on the project feasibility

Chapter 8 Construction Planning & Cost Estimate

8.1 Construction Planning

The Project shall be divided into 2 major components namely road and bridge works. The Study Road has a length of approximately 350 km between Nampula and Cuamba. Further, the road will be divided into 3 construction sections as shown in Figure 8.1.1.

Sources of materials, equipment and plant and other important places (e.g. major cities, limits of the various construction sections) for the Project and their functions are also described in Figure 8.1.1. Identifying and preparing of additional quarries along the Study Road will help to minimize the Project cost.

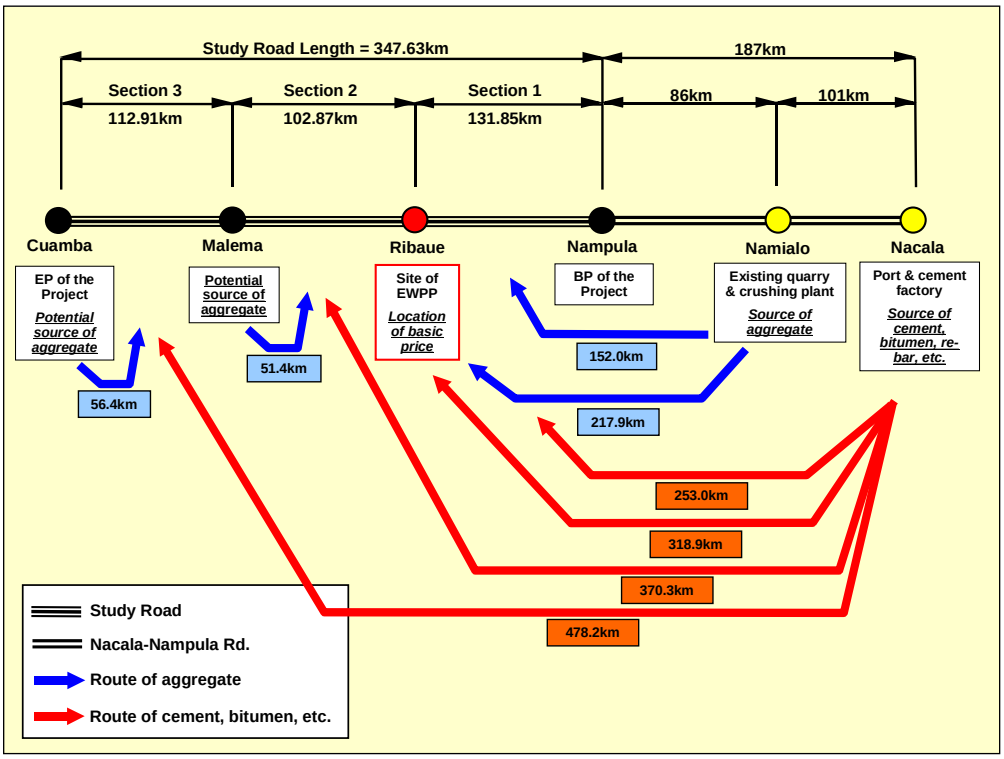


Figure 8.1.1 Locations & Functions of Important Places

A provisional construction schedule for the Project is estimated on the basis of quantities of construction works, expected daily performance of the working units, local conditions, etc. The construction schedule is estimated at 36 months for each section.

8.2 Cost Estimate

The Project cost estimate (hereafter referred to as "the Estimate") shall be made on the basis of result of the preliminary design, the quantity of each work item, and the construction planning of the Project. Unit cost of construction work for the Project shall be calculated on the basis of comparison and analysis of real market prices of similar projects previously implemented in Mozambique. Furthermore, the Bill of Quantities of Emergency Works under the Pilot Project (EWPP) in Ribaue will also be utilized.

The result of the Estimate are summarized in Table 8.2.1 – 8.2.3.

Table 8.2.1 Total Project Cost (Design Speed = 80km/h; ALT-3)

(Currency: US $)

No.	Description		Section 1 Nampula to Ribaue 131.85 km	Section 2 Ribaue to Malema 102.87 km	Section 3 Malema to Cuamba 112.91 km	Total 347.63 km	% of (1-10)
0	Compensation		443,675	346,158	379,942	1,169,775	
1	Preliminary & general		11,882,980	9,776,507	11,598,963	33,258,450	28.7%
2	Earthworks		5,930,179	3,802,568	2,958,588	12,691,336	10.9%
3	Pavement		16,707,209	10,991,198	14,168,338	41,866,745	36.1%
4	Drainage		4,018,899	4,926,522	6,195,310	15,140,730	13.1%
5	Road furniture		175,198	176,688	292,253	644,139	0.6%
6	Miscellaneous		252,626	59,068	292,412	604,106	0.5%
7	Bridge		0	2,337,294	2,703,350	5,040,644	4.3%
8	Temporary construction road		1,262,692	1,028,483	1,059,032	3,350,207	2.9%
9	Dayworks		697,331	573,717	680,664	1,951,712	1.7%
10	Social issues		507,408	417,461	495,280	1,420,149	1.2%
Total (1-10)			41,434,523	34,089,506	40,444,189	115,968,218	100%
11	Contingency	10%	4,143,452	3,408,951	4,044,419	11,596,822	
Total construction cost (1-11)			45,577,975	37,498,457	44,488,608	127,565,039	
12	Engineering cost	8%	3,646,238	2,999,877	3,559,089	10,205,203	
Total project cost (1-12)			49,224,213	40,498,333	48,047,697	137,770,243	
13	VAT	17%	8,368,116	6,884,717	8,168,108	23,420,941	
Total project cost with VAT (1-13)			57,592,329	47,383,050	56,215,805	161,191,184	
14	Total(13) + (0)Compensation		58,036,004	47,729,207	56,595,747	162,360,959	

Table 8.2.2 Bridge Construction Cost (Currency: US $)

Section	Bridge No.	Name	Span & Length	Type	Cost
2	12	Monapo	2@12.5=25.0m	RC hollow	452,123.97
	19	Lalaua	2@15.0=30.0m	RC hollow	522,422.84
	24	Nataleia	9.0+2@15.0+9.0=48.0m	RC hollow	710,680.92
	27	Mutivasse	2@15.0=30.0m	RC hollow	652,066.08
3	30	Namuleia	8.0+14.0+8.0=30.0m	RC hollow	602,003.26
	34	Lurio	31.3+31.4+31.3=94.0m	PC-I girder	2,101,346.61
				Total	**5,040,643.69**

Table 8.2.3 Unit Cost of the Project per kilometer (Currency: US $)

Type of unit cost	Section 1	Section 2	Section 3	Total
Unit construction cost (1-10)	$314,255 /km	$331,384 /km	$358,198 /km	$333,597 /km
Unit construction cost (1-11)	$345,681 /km	$364,523 /km	$394,018 /km	$366,956 /km
Unit project cost (1-12)	$373,335 /km	$393,685 /km	$425,540 /km	$396,313 /km
Unit project cost with VAT (1-13)	$436,802 /km	$460,611 /km	$497,882 /km	$463,686 /km
Unit project cost +VAT + Compensation. (1-14)	$440,167 /km	$463,976 /km	$501,247 /km	$467,051 /km
Unit construction cost (0-10)	$317,620 /km	$334,749 /km	$361,563 /km	$336,962 /km

Chapter 9 Project Implementation Plan

9.1 Introduction

This chapter describes the project implementation plan and disbursement schedule based on the capital investment and maintenance costs, which form the basis for the economic analysis.

9.2 Project Implementation Schedule

At present, AfDB and JBIC are considering to finance the Project. The Project implementation schedule should be consistent with the technical requirements and the availability of financial resources for the Project. The proposed Project implementation schedule is shown in the bar chart of Figure 9.2.1 below.

9.3 Disbursement Schedule

Based on the implementation schedule, the disbursement schedule (cash flow estimate) indicating both construction and maintenance requirements for a period of 20 years is presented in Table 9.3.1. Table 9.3.1 presents a summary of the initial project management costs, construction costs and the future maintenance costs.

Table 9.3.1 Summary of Disbursement Schedule

Year	Pre-Construction Stage		Construction Stage							Operation	Total		
			E/S (SV)		Civil Works		Others	Physical Contingency		Maintenance & Monitoring			
	A	B	A	B	A	B	B	A	B	B	A	B	Total (US$)
2007											0	0	0
2008	1,667,000										1,667,000	0	1,667,000
2009			1,706,200		41,914,000			4,191,400			47,811,600	0	47,811,600
2010			1,706,200		41,914,000			4,191,400			47,811,600	0	47,811,600
2011			1,706,200		20,957,000			2,095,700			24,758,900	0	24,758,900
2012										9,953,000	0	9,953,000	382,808
2013										9,953,000	0	9,953,000	382,808
2014										9,953,000	0	9,953,000	382,808
2015										9,953,000	0	9,953,000	382,808
2016										60,622,000	0	60,622,000	2,331,615
2017										9,953,000	0	9,953,000	382,808
2018										9,953,000	0	9,953,000	382,808
2019										9,953,000	0	9,953,000	382,808
2020										9,953,000	0	9,953,000	382,808
2021										60,622,000	0	60,622,000	2,331,615
2022										9,953,000	0	9,953,000	382,808
2023										9,953,000	0	9,953,000	382,808
2024										9,953,000	0	9,953,000	382,808
2025										9,953,000	0	9,953,000	382,808
2026										60,622,000	0	60,622,000	2,331,615
2027										9,953,000	0	9,953,000	382,808
2028										9,953,000	0	9,953,000	382,808
2029										9,953,000	0	9,953,000	382,808
2030										9,953,000	0	9,953,000	382,808
2031										60,622,000	0	60,622,000	2,331,615
Total	1,667,000		5,118,600		104,785,000			10,478,500		401,736,000	122,049,100	401,736,000	137,500,485

Note:

- All costs are 'financial costs', "Others" contains 'borrow pit restoration cost' & 'project management costs'.
- A: Component A defines imported items excluding items purchased on the local market.
- B: Component B defines domestic items including imported items purchased on the local market.
- E/S: Engineering Services, SV: Construction Supervision

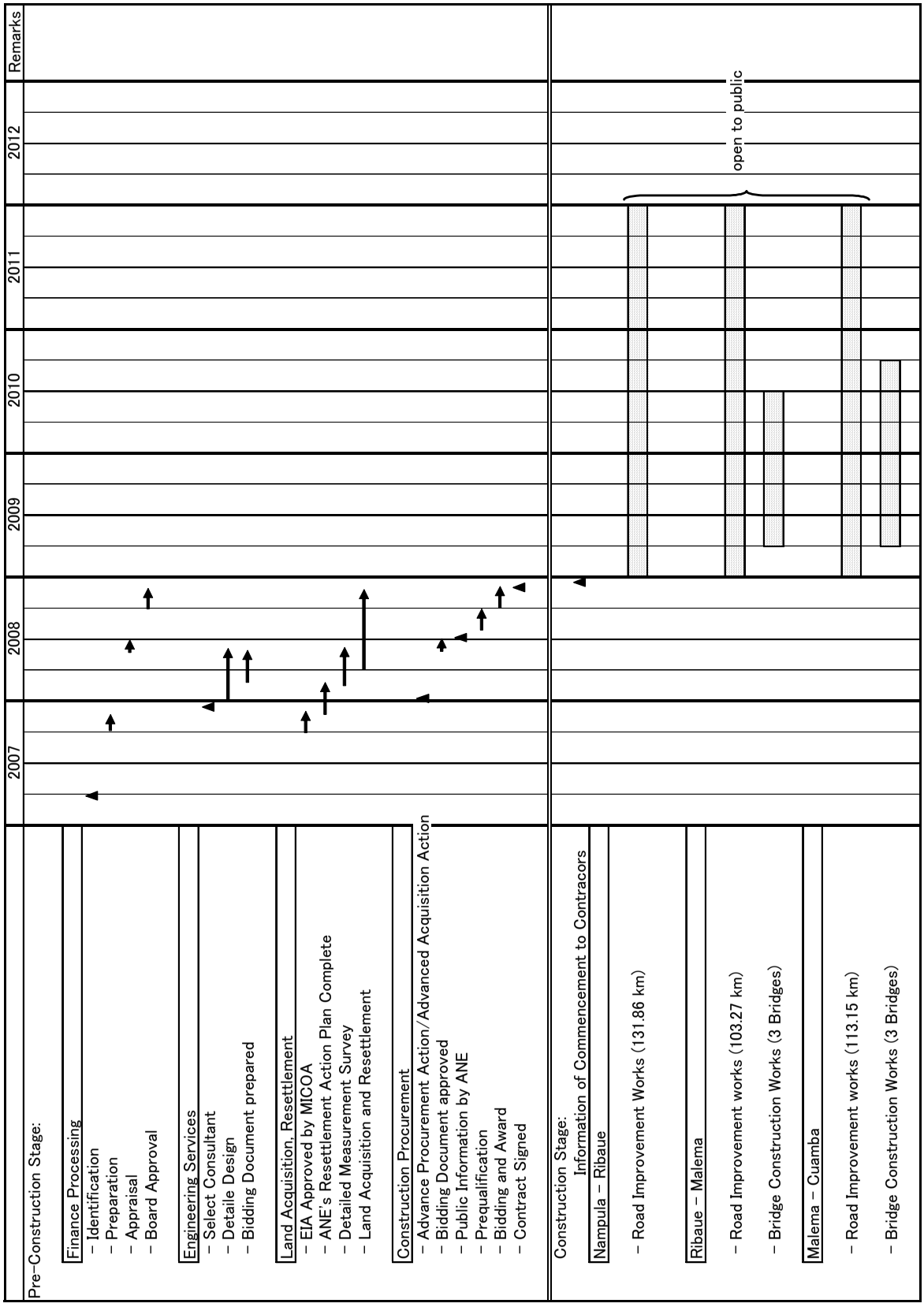


Figure 9.3.1 Project Implementation Schedule

Chapter 10 Economic and Financial Analysis

10.1 Economic Analysis for the Project

10.1.1 Introduction

Economic Analysis for the Project consists of comparing the case without the project to those with the different project alternatives. The case without the project is maintaining the existing road and applying periodic maintenance where necessary. The case with the project is the implementation of the road improvement interventions discussed in the previous chapters. The analysis determines their impact, and whether or not they are economically feasible, i.e. yielding a positive Net Present Value (NPV) at a 12% discount rate. Sensitivity tests are then applied on costs and traffic increases.

In this chapter, the quantitative measure used to determine the feasibility of the Study Road to evaluate the project from an economic perspective is the economic internal rate of return (EIRR). The EIRR is the discount rate at which the net present value of an investment is zero. The study team estimated the economic indicator using both the Highway Design and Maintenance Standards Model (HDM-4 model) and the Roads Economic Decision Model (RED model) for the road evaluated.

According to the surveys related to the road improvement between Nampula and Cuamba under the RBMMP by the World Bank and the other major road construction projects, EIRR and the multi-criteria analysis (MCA) are mainly applied by HDM-4 or RED. In this Study, both HDM-4 and RED models are used for a feasibility calculation, using traffic demand forecast data obtained from the survey conducted by the study team. Further, the MCA approach which incorporates assessments of each project's contribution in four areas of economic feasibility, connectivity, accessibility and social weight is applied for supplemental analysis.

10.1.2 Basic Assumptions for Analysis

An economic evaluation period for the project is assumed to be 20 years from the year 2009 at which the construction work is due to be commenced for 3 years.

Careful attention should be paid when selecting the discount rate for cost-benefit analysis and investment decision making. The estimated economic benefits that are expected to accrue from improving the roads should be assessed against the expected benefits from making alternative investments. From an economic perspective, the opportunity cost of capital is the most appropriate discount rate to rationalize road investment decisions and inform investment choices. For purposes of the economic analysis conducted in this feasibility study, the discount rate applied to the cash flows is 12 percent, as is suggested by ANE.

10.1.3 Result of Analysis

Output Data worked out as a result of RED/HDM-4 analysis for the Project is tabulated in Table 10.1.1.

Table 10.1.1 Result of Economic Analysis

Section	Length (km)	Design Pavement Type	Construction Cost US$/km	Economic Ratio NPV	B/C	EIRR
Nampula-Ribaue	131.6	DBST on Granular	317,620	21,094	1.59	19.8%
Ribaue-Malema	102.9	DBST on Granular	334,749	15,389	1.53	19.0%
Malema-Cuamba	112.9	DBST on Granular	361,563	13,951	1.40	17.5%
Total	347.4	DBST on Granular	336,962	50,433	1.51	18.8%

Source: Study Team

The EIRR hurdle rate used to determine if a road project is economically feasible is 12 percent in general, over the estimated twenty-year period. The decision rule applied in conducting the economic analysis was to recommend to ANE this road project alternative that equaled or exceeded the 12 percent hurdle rate. The study team considered other factors that influence their investment decision, based on local conditions and information developed during this study, as an alternative to strict adherence to the EIRR in the subsequent chapter.

The project scores an average level as an upgrade-to-paved intervention and its economic viability is acceptable, with an EIRR of over 12% in the selected alternative. Based on this result, the N13 (Nampula - Cuamba) project is evaluated as one of the prioritized projects. The particular importance of this primary road and of bringing it to all-weather transit-able condition is well established.

10.1.4 Sensitivity Analysis of Economic Analysis Result

In order to confirm to the above favorite result, sensitivity analysis is conducted for the best alternative case ALT-3 that scores the highest EIRR. This is firstly done by changing the value of benefit and cost by +20% and –20%. When the EIRR is less than the discount rate of 12%, the project is thought less feasible. The following cases for those projects were analyzed:

- Increase in normal traffic of +20%,
- Decrease in normal traffic of -20%,
- Decrease in investment costs of -20% and
- Increase in investment costs of +20%

The results of sensitivity analyses are presented in Table 10.1.2.

Table 10.1.2 Result of Sensitivity Analysis (EIRR)

Case	Assumptions	Section N-R	R-M	M-C	Total
Base	Upgrade to paved road with DBST on Granular	19.8%	19.0%	17.5%	18.8%
1	Increase in traffic volume of +20%	23.0%	22.1%	20.5%	21.9%
2	Decrease in traffic volume of -20%	16.2%	15.5%	14.2%	15.3%
3	Decrease in investment costs of -20%	23.8%	22.8%	21.2%	22.6%
4	Increase in investment costs of +20%	16.8%	16.1%	14.8%	15.9%

Source: Study Team

10.1.5 Multi Criteria Analysis (MCA)

Multi-criteria analysis (MCA) approach incorporates assessments of each project's contribution in four areas:

1. Economic Feasibility as measured by its internal rate of return;
2. Connectivity as defined by the major function of the road in the national grid;
3. Accessibility: external economic benefits accruing from increased accessibility, in particular, existing or potential for promoting small-holder agricultural, agro-industry, other industries, natural resource exploitation, tourism, inter-modal transportation, and additional Government priorities;
4. Social Weight: a factor measuring the incidence of poverty in the area of influence of the road

The results of the multi-criteria analysis exercise conducted in RSS are shown in the following Table 10.1.3. Among the 59 projects evaluated, the ranking and the project's MCA scores are calculated, after converted to a 100-point scale. Although any particular project's score has only meaning in relation to the scores of other projects, it is interesting to note that the process yielded a wide dispersion, indicating that according to the methodology and specific scoring used, there is much to differentiate among the projects. For each project, scores are shown for the four alternative weighting schemes.
Table shows the rank of the four alternative weighting schemes. For reference, and to indicate "gaps" in the ranking list, the Base Weight Score is also shown. This result is very consistent for the first twenty or so projects, with relatively little sensitivity to the weighting scheme used.
Since the computed EIRR in this F/S demonstrates a sound level similarly in RSS, it is assumed that such conclusion of the multi-criteria analysis exercise conducted in RSS remains unchanged, even after the F/S is carried out.

Table 10.1.3 Result of Multi Criteria Analysis for the Project

Evaluation Criteria	Rank/Score
MCA rank for Nampula – Cuamba project among National Roads Candidates	2nd
Base Weight	86
No EIRR	77
Low EIRR	76
High Weighting for Social Benefits	81

Source: ANE

10.2 Financial Analysis for the Project

10.2.1 PRISE 2007-2009

The PIP generally follows the structure presented in the Strategic Financial Plan contained in the RSS 2007 – 2011 in August 2006, with the addition of several projects and activities. For clarity, the program is divided into three parts, Overhead, Maintenance and Investment. Engineering services for design and supervision are presented within the civil works component, but estimated separately.

The plan comprises $1,043.3 million of activities over three years. A substantial portion of the planned civil works is still subject to finalization of feasibility studies, detailed designs and donor commitments. The projected program for 2007 – 2009 is fully funded, subject to the caveat noted above (see Table 10.2.1.) The Road Fund component is $195 million (19% of program expenditures) and the GOM contribution is projected to be $139.1 million (13%). Both of these constitute substantial increases over the planned and realized amounts for Phase 1 of Roads-3. Donors are expected to fund $709.1 million (68%) of program activities, also a substantial increase. Not only is the program fully funded in terms of total commitments, but mismatches in funding have been eliminated, largely due to the flexibility shown by donors.

The program includes a significant level of sector budget support, constituting 16% of total donor funding and 11% of the program as currently structured. From the SBS funds 82% are allocated to paved road periodic maintenance. Most donors have also shown considerable flexibility in their allocations, especially with respect to the areas of institutional support and capacity building. This has enabled the programming of all planned activities. Implementation has been planned by year with planned execution rising over the three years, especially with respect to major civil works components.

Table 10.2.1 Summary Sources and Uses of Fund, PRISE 2007 -2009 (USD million)

Component	Planned Uses	Funding				Total Funding
		Road Fund	GOM	SBS[1]	Donors	
Overhead	$69.6	$29.9		$15.3	$24.4	$69.6
Maintenance	$263.9	$165.1		$98.2	$0.5	$263.9
Rehabilitation and Upgrade	$709.8		$139.1		$570.5	$709.8
Total	$1043.3	$195.0	$139.1	$113.5	$595.6	$1043.3

Source: PRISE

10.2.2 New Financing Mechanisms

The ever-increasing demands for maintenance financing require that new and innovative sources of road user charges be explored. A comprehensive Road User Charges Study should be commissioned early in Phase 2 to explore alternative approaches for enhancing revenues. The consultancy should also include accompanying measures for implementing the proposed enhancements.

The planning for the Road Fund under the Strategy included increasing the revenue from

[1] Sector Budget Support

road user charges, mainly by increasing the fuel levy, to double the resources available in the Fund within 10 years (in USD terms). It was intended that donors should assist in "bridging" the funding gap, while revenues were increased according to a practical program.

On the expenditure side the Strategy set out proposals to use these additional funds to cover routine maintenance for all roads, and to cover an increasing percentage of the periodic maintenance, up to a point at the end of the ten-year program where periodic maintenance on all roads would be funded from this source. This is in addition to covering the administration costs of both the Road Fund organization and the ANE organization.

The existing sources of revenue to the Road Fund are the fuel levy, road and bridge tolls and transit (cross border) charges. In most countries motor vehicle license fees form part of the revenue to the Road Fund. These fees enable road user charges to recover the costs related to the use of each vehicle more accurately. Including motor vehicle license fees as a user charge to be paid into the Road Fund should be explored.

A promising source of additional user charges is the imposition of road tolls and the granting of long-term concessions. A pilot project to investigate the concept recently completed was concluded that a performance-based operations and maintenance contract through concession awarded to a private-sector entity on the basis of competitive bidding and incorporating routine maintenance only is financially viable. There is a potential for covering a wider scope of maintenance (i.e., including periodic) on other road sections where traffic volumes are higher than the pilot project.

Although not all roads are candidates for tolling, more roads could be the object of maintenance concessions that bundle rehabilitation or periodic maintenance to long-term routine maintenance of the infrastructure. A number of the more heavily trafficked roads in Mozambique, e.g., those that serve tourist destinations such as coastal resorts, are potential candidates for tolling. The possibility of imposing a road-use surcharge on tourist facilities also offers an avenue to be explored.

Other sources of revenue are also used in other countries to supplement the revenue to the Road Fund, including weighbridge fees on over-loaded vehicles, permit fees for buses and heavy vehicles, weight-distance charges on heavy vehicles, and congestion charges in cities. These should be systematically considered for inclusion in the revenue to the Road Fund.

Road sector legislation empowers local authorities to raise funds to maintain roads, but, this area requires substantial investigation. The authority to raise funds must be compared to the capacity to implement. Given potential revenues can be realized, these could substantially contribute to the local maintenance and rehabilitation initiatives by District, Municipal or Provincial level. These approaches should be further studied in the Road User Charges Study .

10.3 Conclusions and Recommendations

a. Economic Viability of the Project

The project scores an average level as an upgrade-to-paved intervention and its economic viability is acceptable, with an EIRR of over 12% for the optimum intervention among alternatives. Based on this result, N13 (Nampula - Cuamba) project is evaluated as one of the prioritized projects. The particular importance of this primary road and of bringing it to all-weather transit-able condition is well established.

b. Post-Construction Management and Maintenance

ANE, through provincial delegation, ensures the management and maintenance of all classified roads including the road sections proposed under this report. FE is responsible for financing these activities. The improvement of the maintenance performance is critical for post construction sustainability. Since maintenance will largely be implemented by the

provincial delegation of ANE, the establishment of functional offices will be crucial for the sustainability of the investments. Therefore, it is important to support ANE's re-organization and capacity strengthening especially at provincial level. The funding and implementation of technical assistance, on-the-job training, infrastructure and logistical support activities will be effective measures to ensure sustainability.

Chapter 11 Road Maintenance and Traffic Management

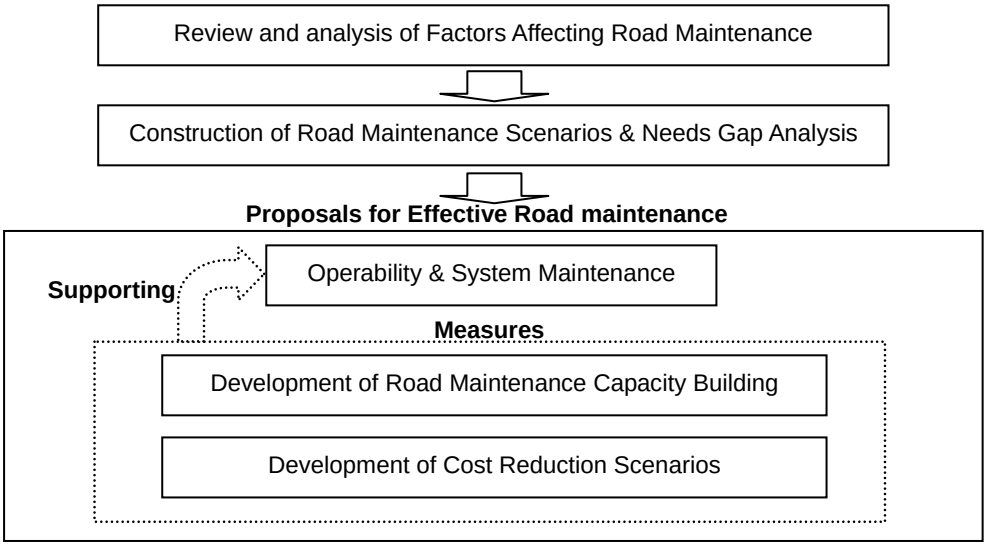
11.1 Introduction

This chapter describes the road maintenance and traffic management plan to be implemented after commencement of operation of the upgraded Study Road in order to ensure the ultimate goal of the Project.

11.2 Effective Road Maintenance System

1) Approach

The proposals are comprehensive in order to develop the most effective road maintenance system. The workflow for this approach is shown in Figure below.



2) Realizing an Effective Road Maintenance System

(1) Development of Core Road Network for Prioritizing Maintenance

It is recommended that the following data be obtained from ANE's provincial delegations to be sent to ANE headquarters for planning and analysis purposes (to be incorporate into the HDM-4 method) and be updated continuously as a basis for the justification for fund allocation.

- Road Inventory Data
- Road Condition Data
- Traffic Data

(2) Development of Operability and Systematic Maintenance

A standard system for the preparation of maintenance work-plans is required, including a review of unit rates for maintenance works in order to effectively and efficiently develop maintenance plans. Standard procedures for this have been defined in the RSS. ANE has a program for estimating unit costs for routine and periodic maintenance works.

(3) Development of Road Maintenance Capacity Building

The Road Training Center of MOPH , which is located in Chimoio, can play an important role in providing professional training for road technicians through the delivery of training courses to both private and public sector. However, new training topics (courses) on management, engineering, supervision, monitoring and maintenance activities are required for the various staff levels of contractors, consultants and clients.

(4) Development of Road Maintenance Manuals for Capacity Building

ANE has outsourced the supervision of road maintenance contracts to local consultancy firms. At present, manuals have been developed for maintenance planning of unpaved roads, procurement and contract management and spot improvement design. There may be a need for developing a manual for the maintenance of paved roads.

11.3 Traffic Management Operation

1) Axel Load Control Operation

Existing methods for controlling overloading rely on the use of axle-load weighing stations located at various strategic sections on the national road network. Weighing stations will be an important measure to deal with the problem of overloaded vehicles. The following is recommended:

- Strict enforcement of axle-load regulation.
- Set up weighing stations at strategic locations on the road.
- Educate transporters that work in particular sectors such as timber logging, heavy industry, etc….

2) Traffic Safety Operation

The key issues in the strategy relate to:

- Improved driving skills
- Use of helmets (motorcycles and bicycles) and seat belts (motorized vehicles)
- Combat drunk driving and excessive speeding
- Improved night-time visibility for pedestrians, bicyclist and motorcyclist
- Traffic management, signing and delineation of roads

Except for the latter, the above-mentioned issues lie outside the control of ANE, and are the responsibility of INAV, the police and other relevant organizations.

The following measures are recommended to reduce the level of road fatalities;

- Media campaigns on road safety
- Road safety awareness and education for rural children in communities and schools
- Strict enforcement of driver's license issuance and renewal
- Enforcement of traffic violations
- Strict vehicle inspection for registration and renewal

PART 4: REGIONAL DEVELOPMENT PLAN

Chapter 1 Overall Conditions of the Study Area

The Study area is located in the provinces of Niassa and Nampula. The Nacala Corridor, which extends from Nacala Port to Malawi crossing the Provinces of Nampula and Niassa in Mozambique, serves as a trucking route that connects northern agricultural zones with important cities and/or towns. In the rainy season, from November to April, the region has a high rainfall ranging from 1,200 to 2,000 mm. As the Study road is an unpaved road, it is frequently impassable during the rainy season, affecting the transportation of crops during this period.

Looking at the 3 regions in Mozambique, results of the economic performance study conducted by UNDP over the period under analysis continue to show heavy economic concentration in the southern region of the country, with an average of about 47% of real production as can be seen in Figure 1.1.1. Within the southern region, Maputo City stands out with a contribution in real terms of about 20.8%. The central region follows, with a contribution of 32%, and finally, the northern region with only 21% of national production. In the following tables and graphs, the relevant existing Socio-Economic Indicators of the provinces in the Study Area are shown.

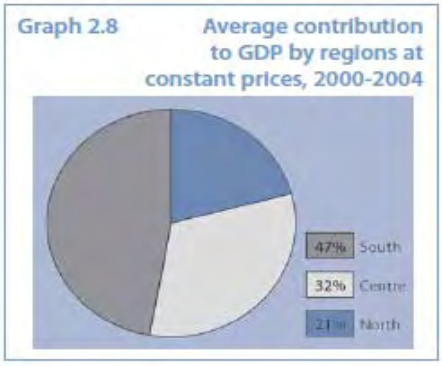


Figure 1.1.1 Average Contribution to GDP by Region

Source: Mozambique National Human Development Report 2005

Table 1.1.1 Existing Socio-Economic Indicators of the Provinces in the Study Area

	Nampula	Niassa	National
Population – National Institute of Statistics (INE) projection for 2004	3,563,220	966,580	19 million
Children under age 18 (2004)	1,832,340	519,330	9,613,470
% of population that live below poverty line (2003)	52.60%	52.10%	54%
Infant mortality rate per 1000 (2003)	164	140	124
Chronic malnutrition among children 0-5 years (2003)	42%	47%	41%
Access to safe drinking water (2003)	32.20%	30.20%	35.70%
Access to sanitation (2003)	26.20%	70%	44.80%
HIV/AIDS Prevalence among 15- 49 year olds (2004)	9.20%	11.10%	13.60%
Primary School net enrolment rate (2003)	46.30%	47.30%	61%
Adult illiteracy rate (2003)	65.10%	64.40%	53.60%
Female illiteracy rate (2003)	81.40%	68%	68%
Fertility Rate (2003)	6.2	7.2	5.5
Total % of population with radios (2003)	48.30%	43%	45.50%

Source: UNICEF Moz.

Chapter 2 Current Regional Development Plans and Activities

2.1 National and Regional Development Plans and Activities

2.1.1 Existing Development Plans

The following are existing international, national and regional development plans issued by different levels of organizations, that have a relation to the regional development of the study area,.

1) At National and International Level
   - PARPA II
   - MDG
   - NEPAD
   - SADC

2) At Regional Level
   - Development Plans of Nampula and Niassa Provinces
   - District Development Plans of Rapale, Mecuburi, Ribaue, Malema and Cuamba
   - Structure Plan of the City of Nampula

2.1.2 Major On-going Projects and Development Activities

Various multi-sector projects and programs are on-going in the study region. It is noted that most of the development projects and programs are supported by donors and implemented with the assistance of NGOs. The main donor organizations are as follows;

- AfDB (ASNANI Water Supply Project, Rural Electrification Project-III, Education IV Project)
- UNDP (Decentralized Planning and Financing Program, ADELNA)
- World Bank (Municipal Development Project)
- USAID (Rural Income Program, Trade and Investment Program, Health Program: Family planning)
- Netherlands (MAP OSUWELA II - Teacher training, MAP Nisome Fellowships Nampula: Higher education)
- Switzerland (Decentralization/Democratization: Government administration, Rural Development Northern Mozambique: Rural development)
- UK (Insecticide Treated Net Roll-Out: Infectious decease control)

- Norway (Soybean Pilot promotion: Industrial crops/export crops)

The major NGOs and Agencies active in the region are; CARE International, CLUSA, SNV, World Vision, Save the children, Felocidade, Olipa-Odes, Ophavela, Oram, Monaso(HIV/AID) and CPI (Center for Promotion of Investment).

2.2 Regional Development Issues

The major development issues of the study region stated in this chapter include;

- More than 90% of the population in the study region live in the rural areas
- Dispersed population distribution, only 25.6% of the population live within a distance of 10 km from the project road (both sides)
- The majority of the rural population engages in subsistence or family farming.
- Lack of transportation, especially in the rainy season due to impassable roads
- Lack of access to technology resulting in low agricultural productivity reliant on manpower only
- Lack of economic facilities in rural centers with respect to storage, markets, processing factories, means of transportation, etc.
- Lack of basic need services such as health, education, sanitary facilities
- Less than 10% of the farmers are members of producers association
- Many of the existing processing factories and storage facilities for agricultural products in Nampula City are deteriorated
- Vast availability of arable land and high potential to serve as a grain belt and contribute to food security in Mozambique
- Interesting landscape and potential tourism attractions

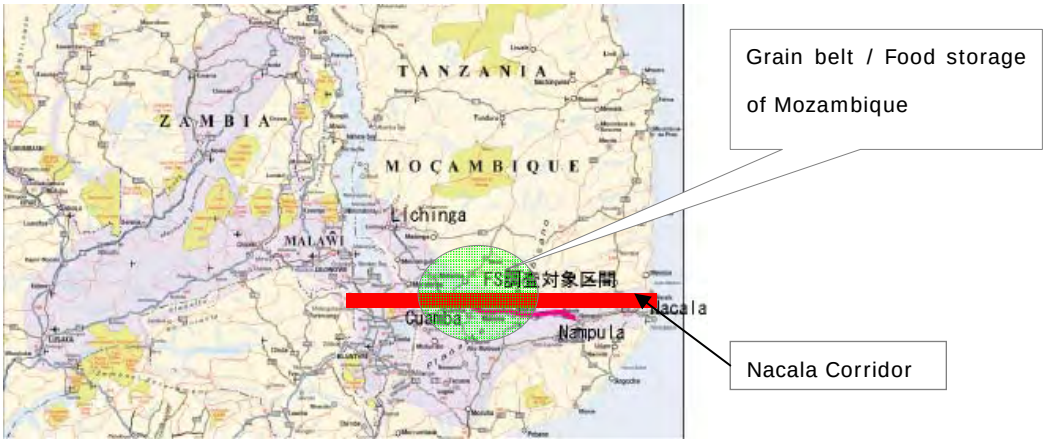


Figure 2.2.1 shows a SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis representing the 4 Factors of Predominance, Problems, Current Circumstances and Future Prospects. The development strategies of the region are examined based on the SWOT analysis as shown in the figure below.

	Current Circumstance	Future Prospect
Predominance	・ Vast arable land ・ Large labor force ・ Recognized as Nacala International Corridor ・ Existence of many NGOs	・ Improve accessibility to markets ・ Increase commercial demand（both Domestic and ／International） ・ Potential to be a food supply center ・ Increase of job and income
Problems	・ Difficult passable roads in rainy season ・ Lack of transport means and reliable access roads to the hinterland） ・ Lack of knowledge on commercialization ・ Large number of unorganized and isolated farmers ・ Lack of Basic Services in the remote areas	・ Worsened roadside environment and traffic safety due to increase of traffic volume ・ Increase of epidemic diseases (HIV/AIDS) due to increase of interchanges between people. Outflow of rural population (depopulation) and urbanization (over-population)

⇨ Development Strategy in Making Good Use of Predominances

⇨ Development Strategy to Cope with Problems

⇩ Short-term Strategy (Pilot Project)

⇩ Mid- to Long- term Strategy

Figure 2.2.1 SWOT Analysis

Chapter 3 Regional Development Program

3.1 Planning Flow Chart

Figure 3.1.1 shows the planning flow chart for the formulation of the regional development program and pilot project. The major steps are;

- Analysis of the Existing Situation of the Region
- Identification of the Development Issues (SWOT Analysis)
- Establishment of the Development Policies (Short-, Mid. Long-term)
- Formulation of the Development Program (Short-term Strategies)
- Formulation and Implementation of Pilot Project

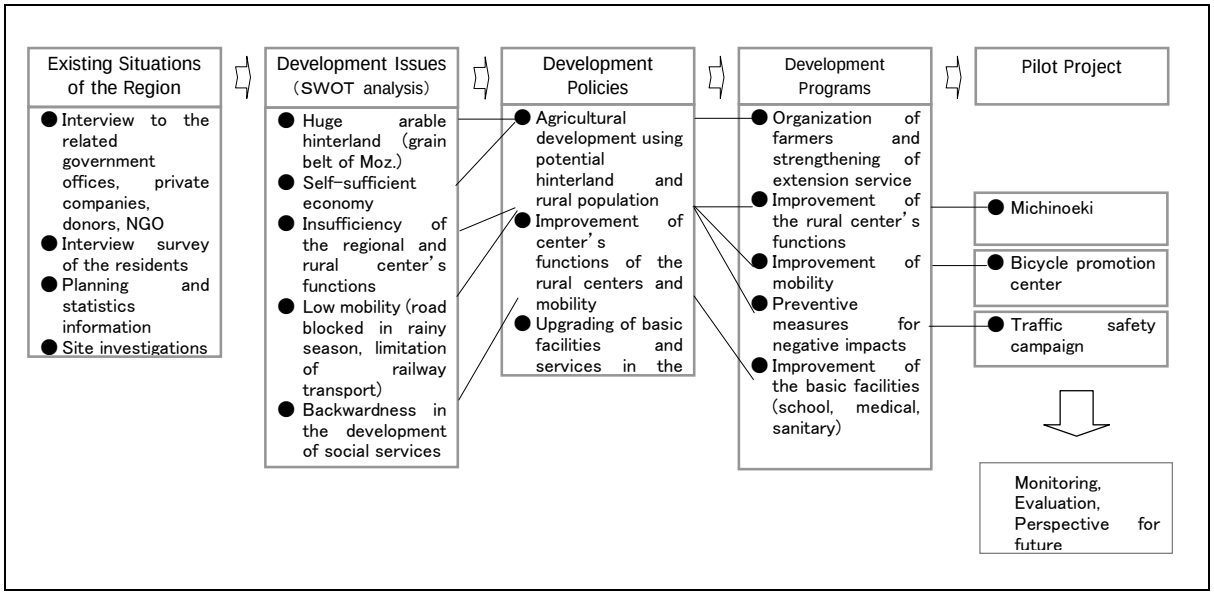


Figure 3.1.1 Planning Flow Chart of the Regional Development Study

3.2 Regional Development Program

Table 3.2.1 shows the summary of the regional development policies for each time horizon (period), and Figure 3.2.1 shows the short-term regional development program. The priority strategic development program under the development pillars of 1) agricultural development, 2) Improvement of Rural Centers, and 3) Upgrading of Basic Services are proposed. The candidate pilot projects are also formulated from the development programs.

Table 3.2.1 Establishment of Development Policies

Period	Area involved	Agricultural Development	Improvement of Rural Center	Upgrading of Basic Services
Short	Half of 5 districts and 1 city (30 km radius zone)	Organization and transformation (increase of producer's associations: target=20%) and expansion of extension services, improvement of production facilities and management of natural resources	Improvement of rural center's functions, , improvement of mobility, and preventive measures for negative impacts	Improvement of medical, school and sanitary facilities
Mid	All of 5 districts and 1 city and expand area to other areas of Nacala Corridor	Organization and transformation (increase of producer's associations: target=30%), and & strengthening of producer's associations (target=30%) and continuation of above measures	Expand the above measures to the hinterland, improvement of markets, distribution and processing factories in Nampula and Nacala, and tourism development along the corridor	Improvement of medical, school, sanitary facilities, and electricity supply
Long	All of Nacala Corridor and expand to the northern 3 provinces	Increase & strengthening of producer's associations (target=50%) and continuation of above measures	Increase of jobs, improvement of public services, development of agro-processing center in the regional centers, and invitation of investments on large-scale livestock and plantation in the rural area, and integrated development of railway, airport and sea port	Improvement of medical, school, sanitary facilities, electricity supply, and settlement environment

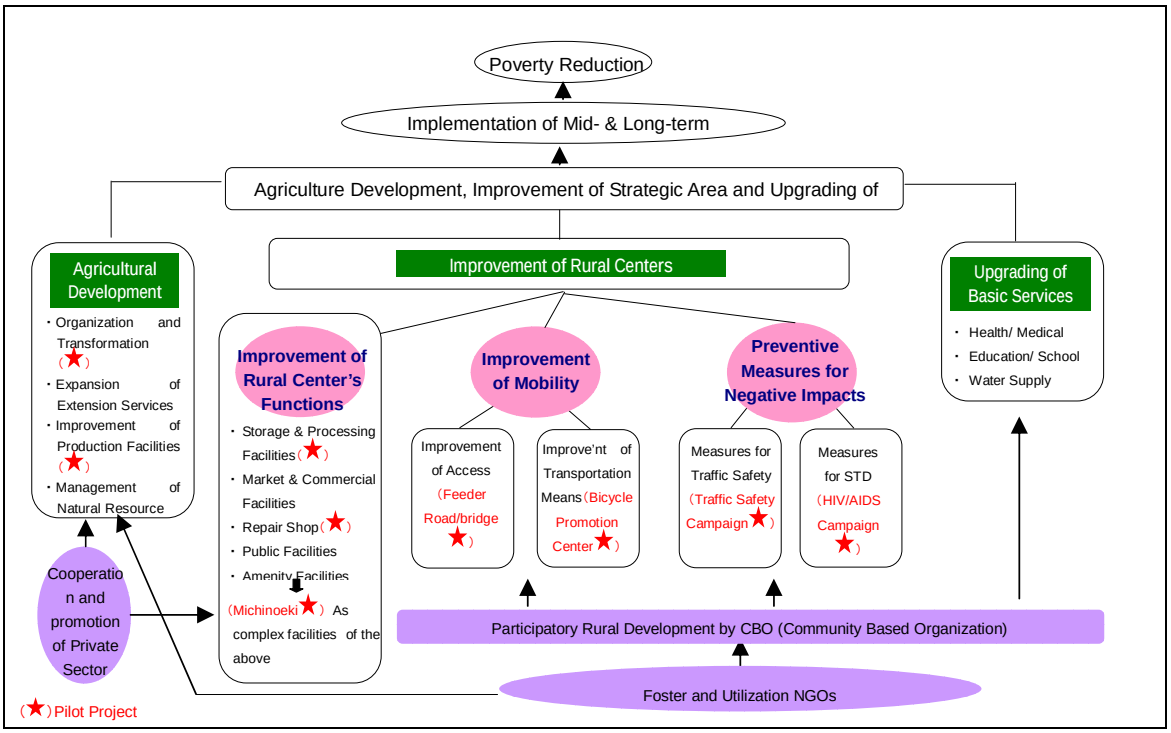


Figure 3.2.1 Formulation of Short Term Regional Development Program

The proposed short-term regional development program can be summarized as follows;

- Area Involved: A 50% of the area along the project road: Nampula city and Rapale, Mecuburi, Ribaue, Malama and Cuamba districts (30 km from the project road on each side)

- Development policy: After the completion of the improvement of the project road, the accessibility between each district to the city of Nampula will be largely improved. The agricultural products produced in each district can be transported quickly to the large market and processing factories in Nampula and Nacala. Until the completion of the road, the functions of collection, transient storing, initial processing and selling of the local products should be strengthened. The access from the hinterland to the project road and the rural centers should be improved through rehabilitation of feeder roads and bridges and extension of bicycles to the people in the hinterland for the convenient transport of their products, and expansion and improvement of public bus and pick-up transport services in the area of the project road (30 km on each side). This will involve about 62.8% of the rural population in the area

- Development program:

Agricultural Development

- Organization and transformation of family farming to commercial farming (for promotion of commercialization, marketing, transportation, management, investment, financing, enterprising, etc.).
- The target for the increase in membership of producers associations is set from less than 10% at present - 20% in 2013, involving as additional 25,000 farmer's households and about 830 groups
- Diversification of agriculture system through introducing conservative farming techniques, small-scale livestock, providing labor force, etc.
- Expansion of extensive services, including training of extension service personnel, research, development and application of appropriate technology, including promotion of demonstration and/or pilot farms.
- Improvement of production facilities, including improvement of irrigation system, adjustment of farm lands and farm road improvement, and development of seed and seedling supply centers.
- Management of natural resources for sustainable land use, including conservation of natural protection areas, introduction of community forest and reforestation projects,

transformation of slash-burn methods, etc.

Improvement of Rural Centers

- Improvement of rural center's functions
- Enhancing mobility and accessibility through improvement of feeder roads and bridges connection hinterland to the project road and by improving the availability of Transportation Means such as Bicycles with Carts and Load Carriers, etc.
- Preventive measures for the negative impacts of road project, including traffic safety and combating against HIV/AIDS

Upgrading of Basic Services

- Improvement of health/medical facilities including 2 health posts-type I, 7 health post-type II and 24 clinics.
- Improvement of educational/school facilities including 4 junior secondary schools, 21 primary schools stage II (EP-II) and 182 primary schools stage I (EP-I)
- Improvement of water supply facilities including 259 wells.

Chapter 4 Pilot Project

4.1 Objectives

The objective of the Pilot Project is to grasp the development procedure, mechanism for project management and required necessary resources including human, material and financial. It will also serve to examine whether such projects are suitable to the local circumstances in Mozambique, and to identify an appropriate and achievable implementation and operation plan for the "Rural Center (Core) Project" which is the one of the main proposals of the "Regional Development Program". These experiences will be gathered throughout the study period during the stages of formulation, implementation and monitoring of the pilot project. After the project management and evaluation phase, an operations manual and financial resources plan for a full-scale project implementation will be developed to ensure a smooth execution of the program.

4.2 Concept of Pilot Project

To create a synergic effect between the pilot projects, the 3 selected projects are packaged into one integrated pilot project, which is called "MICHINOEKI". This pilot project will constitute of the following elements:

- For the income generation of the farmers / villagers, a market facility to sell agricultural products to the road users is provided
- For the information provision / promotion of events to villagers, an open space is provided
- For the rest area ,a refrigerator, parking area, public toilet and water supply is provided for the road users, and
- For the improvement of farmers' mobility a bicycle promotion center is provided to carry their products to the market.

This packaged pilot project "MICHINOEKI" will be a strategic device for the strengthening of the functions of the Rural Center as shown in Figure 4.2.1.

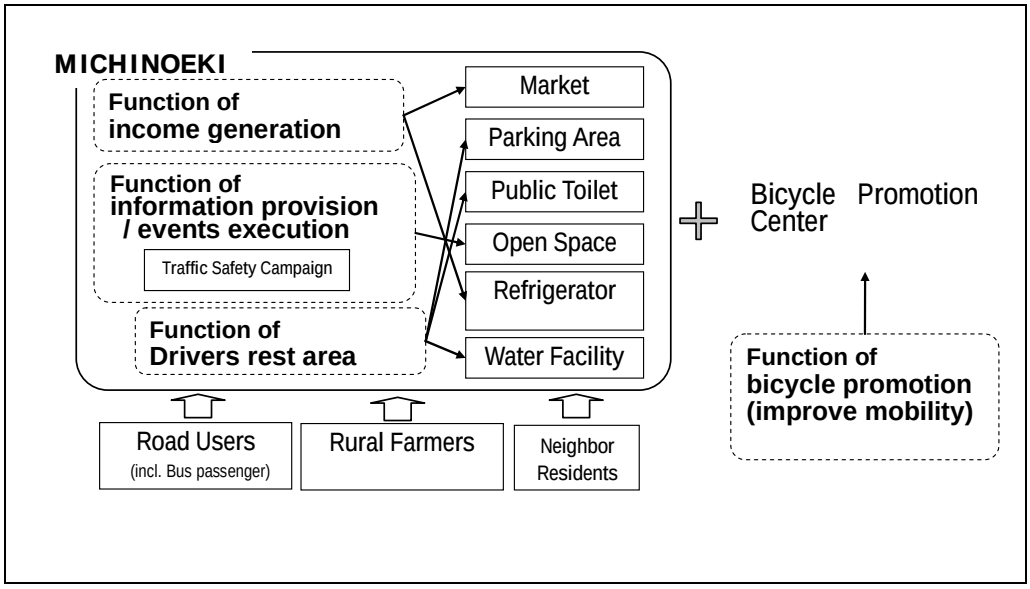


Figure 4.2.1 Concept of MICHINOEKI

4.3 Development Policy of the "MICHINOEKI"

Development Policy

The main facilities of the MICHINOEKI are market (indoor and outdoor), parking area, public toilet, opens pace and bicycle promotion center to provide functions of income generation, rest area place of information/events, and improvement of transport means for the farmers.

Table 4.3.1 Main Facilities of the MICHINOEKI

Facilities	Outline	Area (m^2)	Remarks
Access Road	Two-way	50 m(L) x 5 m(W)	Pavement: blocks +concrete
Indoor market and administration office building	Kiosk and office	42	Refrigerator, electric fan, information board
Outdoor market	20 tenants lots (10 more in the future)	105	Hard ground, light shelter with roof
Parking area	For 12 to 16 cars	424	Pavement: blocks + concrete
Open space (terrace and patio)	For resting, performing events, etc.	Terrace: 103 Patio: 22.5	Half of the terrace is roofed
Bicycle promotion center	Container storage for bicycles	14	

Source; JICA Study Team

Selection of the Pilot Project Site

The site of the pilot project is decided to select in Anchilo, 19 km east from the Nampula City. The main reasons of the selection are;

1) The expected future conditions for the study road already exists in Anchilo (the traffic volume has reached nearly 1,500 cars/day, good road condition, close to Nampula, easy to implement and monitor, etc.). In other areas along the study road such conditions of high traffic volume and paved roads do not yet exist.
2) The lessons leaned from this pilot project can be easily applied to other locations along the study road in the future, because the Anchillo is located along the Nacala Corridor, where is the same road with the project road.

Among 5 candidate sites in Anchilo, the following site was selected;

The location of the proposed MICHINOEKI is on the N1 km 19.1 from Nampula City (part of the central area of Anchilo Administrative Post). The site is located on the left side of the road from Nampula to Nacala, with a size of 30 m x 30 m (= 900 m2). An access road (50 m long and 5 meter width) is constructed from the road to the site.

Facility Planning and Design

In accordance with the operational requirements of the MICHINOEKI, which were identified earlier on the regional development program, facilities of a road side station are to be planned with 5 major functional components. These are: i) Market ii) Parking Area iii) Public Toilet iv) Open Space v) Bicycle Promotion Center. The site layout of the facility of the MICHINOEKI is show in Figure 4.3.1.

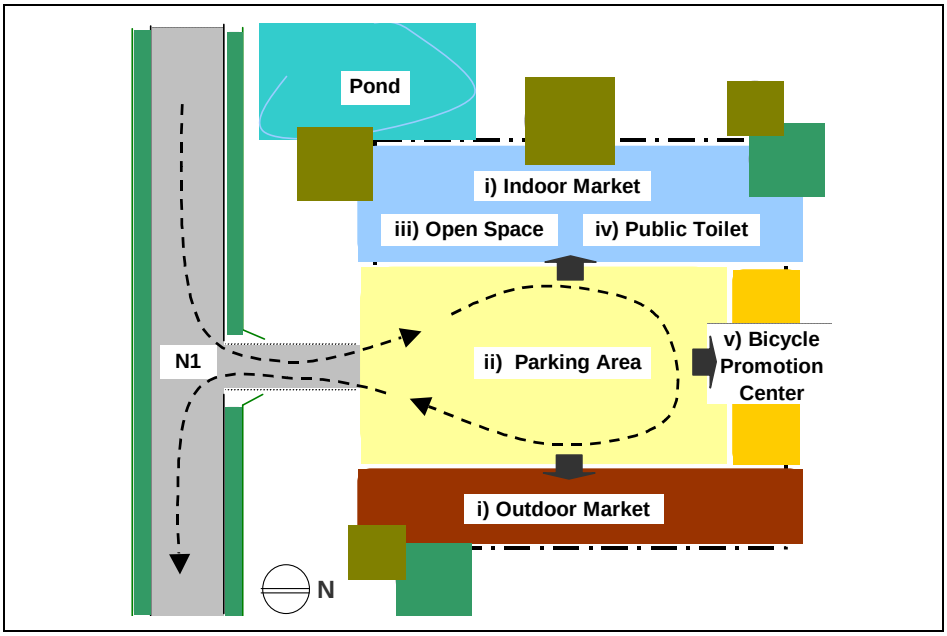


Figure 4.3.1 Site layout of the MICHINOEKI Facility

4.4 Management and Operation Plans

Figure 4.4.1 shows the management organization of the MICHINOEKI. The MICHINOEKI is implemented by PPP (Public and Private Partnership) method in cooperation with ANE, Local Government and the Project Operation Unit (POU). The major functions of the MICHINOEKI are providing public services and information for the road users and income generation devices for the local farmers and residents. Therefore the administration and management of the MICHINOEKI is done in partnership with ANE and the Local Government (Regional Development Organization). However, the actual operation is delegated to POU, which is established by the Local Government..

The procedures for the organization of the operation unit and appointment of staff are as follows;

- The provincial governor appoints the Station Master as the responsible person of the project and field supervisor on behalf of the Local Government
- The Station Master selects an eligible person or organization to establish the POU (The existing Forum of the Producer's Associations in the Anchilo Pilot Project)
- The selected person / organization (The Forum) establishes the POU and assigns the operation staffs

The facilities are owned by ANE, which subsequently lend the facilities to the POU (POU pays a monthly rental fee for the use of the facilities to ANE). The income from the rental fee shall be used for maintenance of the facilities, such as buildings, parking areas, water facilities, refrigerator, etc., and improvement and expansion of the facilities in the future. Other important aspects on project management and operations are;

- The POU should submit for approval and monitoring purposes monthly reports with financial and business statements to the ANE Nampula office and the Provincial Government of Nampula
- ANE Nampula should submit a copy of the monthly report to ANE Headquarter, which subsequently submits a copy of the half year report to the JICA Mozambique Office.
- The Local Government provides an auditor for the inspection of the financial statement once or twice a year.
- Coordination meetings between ANE and the Local Government will be held, when found necessary.
- The main sources of income are tenant receipts, sales income (food/drink) and profit of the bicycle sales, and the main expenditure items are salary of the staffs, rental fee, tax, cost for purchase of stock (prime cost) and other miscellaneous costs.

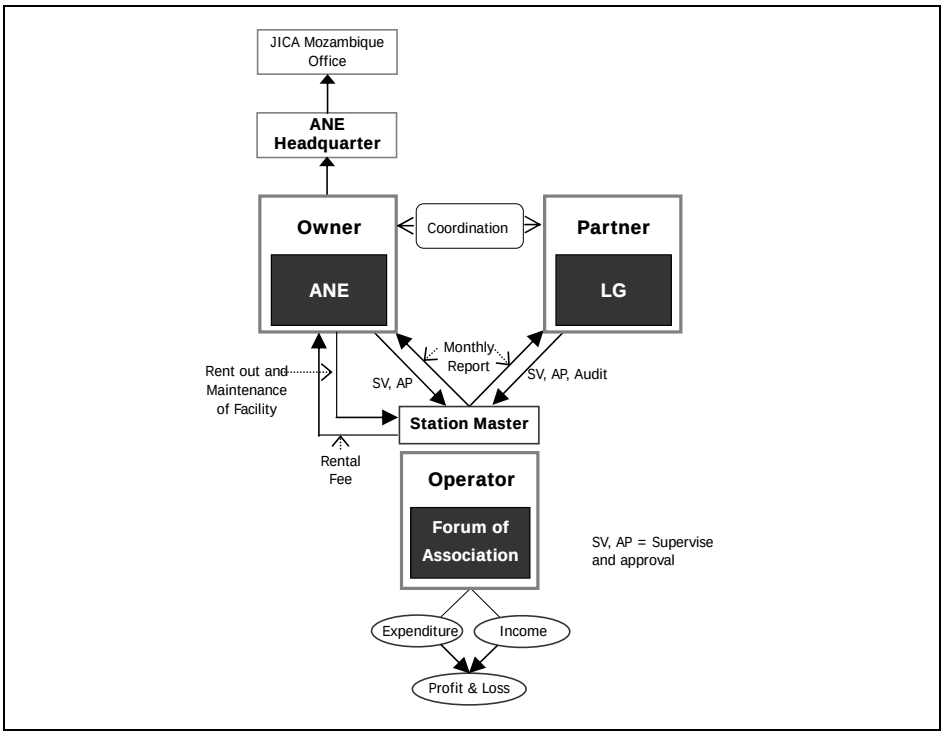


Figure 4.4.1 Management Organization of the MICHINOEKI Pilot Project

4.5 Monitoring and Evaluation for Pilot Project

Monitoring

The construction of the MICHINOEKI Anchilo was nearly finished by the end of July in line with the contract implementation plan and without any accidents. During this period, layout design and specifications of the facilities were discussed and adjusted with the contractor in order to adopt them to the Mozambican circumstances.

The approvals for Implementation included many different procedures. Although some of these procedures are still ongoing, this has not impeded the official start of the MICHINOEKI business.

The administrative system for the MICHINOEKI was discussed with ANE and the Nampula District Administration. The following agreement was reached:;

ANE:	Owner of the MICHINOEKI Anchilo Facility
Nampula District:	Manager of the MICHINOEKI Anchilo
Forum of Association for Farmers:	Operator of MICHINOEKI Anchilo

On 17th August, an "Opening Ceremony" was conducted attended by JICA, the Governor of Nampula Province and other related organizations. In this ceremony, the facility has been officially handed over from JICA to ANE, and subsequently from ANE to the Nampula District Administration and the Forum of Associations of Farmers.

This is the first experience where ANE collaborates with the local government structure. These organizations have already agreed to have a discussion on the future's management structure of the MICHINOEKI.

During the study, staff training has been conducted on several occasions to built capacity for operating the MICHINOEKI. This training included outlining the responsibility for each of the staff members, financial management (book keeping) and business planning. After the opening, the local staff of the study team has been assigned with the task to closely monitor the operation and suggest further improvements where deemed necessary.

In order to introduce the faction of events in MICHIOEKI, A traffic safety campaign was conducted on the 17th July 2007. It was organized by INAV (traffic safety education department the Transit Police, ANE and the Nampula district administration.

Evaluation of MICHIOEKI Pilot Project

Before presenting the results of the evaluation of the MICHINOEKI pilot project, a brief explanation will be presented in Table 4.5.1 about the purpose, outputs and activities of the pilot project.

Table 4.5.1. Narrative Summary for MICHINOEKI Project

Narrative Summary for MICHINOEKI Project	
Over Goal	The MICHINOEKI Project will contribute to the Regional Development Program as an additional component to the road upgrading project from Nampula to Cuamba
Project Purpose	The MICHINOEKIs a multi-functional facility aimed for drivers to rest and to provide rural income generating opportunities (markets) for the local population thereby improving their quality of life
Outputs	For Rural Farmers and Local Population 1. Provision of income generating opportunities 2. Provision of information/events for improving the quality of life 3. Promotion and sale of bicycles to rural people at affordable prices For Drivers 4. Provision of rest area/facilities for drivers For the future operation of the MICHINOEKI 5. Establishment of a system/methodology for the implementation of the MICHINOEKI 6. Establishment of organizational and operational procedures of the MICHINOEKI
Activities	1-1 Construction of outdoor market 1-2 Establishment of tenant operational organization for sales of rural goods by rural farmers 2-1 Execution of Traffic Safety Campaign 2-2 Installation and operation of public telephone 3-1 Transportation and collection of second hand Bicycles from Japan 3-2 Promotion and sale of Japanese Bicycles at affordable price 4-1 Construction of Parking Area 4-2 Construction of Toilet 4-3 Construction of Rest Facilities including sales of food and snacks 5-1 Clarification on the kind of approval necessary for the construction and operation of MICHINOEKI 5-2 Clarification on the required items and specifications for construction of the MICHINOEKI 6-1 Selection of Staff from the rural population ➢ Training of Staff for operation and management

For this purpose the aim was to evaluate the pilot project with a view to full-scale implementation. The following aspects were evaluated[1]:

"Effectiveness"	Did the project content and components acquire the desired effects
"Efficiency"	Where execution procedures and methods suitable to meet the local needs/environment?
"Viability" for full-scale project	Can the MICHINOEKI be viable and applied on a full-scale?

Each question was responded based on the following rating: A: Very Satisfied/Possible, B: Satisfied/Possible, C: Relatively Satisfied/Possible and D: Unsatisfied/Impossible. The reason and comments to each of the questions was also inquired.

The results of evaluation by each agency are described as below;

[1] According to the PCM and DAC project evaluation method, there are usually 5 (five) items to be evaluated, namely i) Relevance (Overall goal vs. Project Objective), ii) Effectiveness (Project Objective vs. Output), iii) Efficiency (Output vs. Input), iv) Impact and v) Sustainability.

1. Effectiveness

There are some aspects that where evaluated negatively but these do not represent the contents/components of the project itself, but rather contents/methods of each function. Therefore, the study team concludes that the contents/component of the project is effective for full-scale implementation.

Questionnaire	Responsible Agency			
	ANE	District	Post	
1-1 Is the Parking Area effective as a rest place for the drivers?	C			ANE's answer "C" means that the parking area must be increased at least twice the size of the pilot one. They recommended that the entrance and parking lot should be suitable for trailers.
1-2 Was the Traffic Safety Campaign recognized as an example of an event function in the MICHINOEKI? Did it motivate to carry out other events?	B	D	B	District's answer "D" means that this type of event is not enough for educating drivers. It must be targeted to driver's and conducted more frequently. The Administrative Post hopes that they will have opportunities to run a similar type of event by themselves.
1-3 Is the Open Market effective for income generation for rural people?	C	C	A	ANE and the District evaluated this question as "C In their opinion the idea is good but they are not satisfied with the present status. According to their observation, it has not matured yet. The Administrative Post rated this question as "A", pointing out the importance of restricting the market to 'only local products' to encourage the local rural economy.
1-4 Are the services for selling goods provided in the building effective for drivers and rural people?	B	B	A	Evaluated a high score because the shop improves especially the rural people's standard of life.
1-5 Is the Toilet a functional facility for drivers?	B	A	A	They evaluated a high score but they consider it important to include room facilities (motel) and more promotion is required.
1-6 Can the MICHINOEKI be implemented effectively by the road agency?	D	A	B	District and Administrative Post are satisfied. ANE is not satisfied. ANE suggested Food/Snack/Takeaway provisions, rooms and a Gas Station as future MICHINOEKI facilities according to its capacity.

Note: The areas marked in 'grey' have been left blank as the interviewee had difficulties responding to the question.

2. Efficiency

Most of the questions raised with respect to the introduction of the MICHINOEKI concept in Mozambique were evaluated positively. Especially, the bicycle promotion centre is seen as not only a way to promote the use of the bicycle in the rural area, but also an efficient method for income generation during the initial stages of operation. All participating organizations, pointed out that the capacity building of staff should be taken into consideration.

Questionnaire	Responsible Agency			
	ANE	District	Post	
2-1 Is the administrative set up of MICHINOEKI proper/reasonable? (Facility Owner = ANE, Operational Owner= District)	B	B	A	All evaluated high scores but the District raised the issue of having the opportunity to further discuss the ownership of the facilities.
2-2 Is the Forum (Agricultural Associations) suitable for the operation of the MICHINOEKI because of its public purpose?	B	A	A	All evaluated high scores. The Administrative Post pointed out that if the MICHINOEKIs located near their offices, the Administrative Post would be capable of operating the facility. If located outside it would be better operated by a forum. The District pointed out that the problem is the limitations of their capacity. They would need capacity building support to operate a MICHINOEKI.
2-3 Was it the proper that Staff of the MICHINOEKI was selected among the rural people?	B	B	B	All of them evaluated "B". The Administrative Post pointed out that staff selected must be persons who respect the forum.
2-4 Was the methodology appropriate to rent the outdoor market to rural farmers or associations		B	C	The Administrative Post pointed out that the Tax levies should be reduced in order to promote the involvement of local farmers. The District requested the capacity building for staff to operate the MICHINOEKI more efficiently.
2-5 Was the methodology for purchasing and storing goods appropriate?		C	C	They all evaluated "C". Problems identified are transport cost and limited staff capacity in the area of business management.
2-6 Was it appropriate to use the profit from the bicycle sales for the initial operation of the MICHINOEKI?	A	A	A	All of them marked "A". No one doubted this system.
2-7 Does the function of the MICHINOEKI such as outdoor market , bicycle sales, toilet, open space, and events meet the rural needs?	B	B	B	They all evaluated "B". The only problem raised is operational management by staff.
2-8 Is the MICHINOEKI project compatible with District and, Provincial Development Plans?		D		The District answered that the MICHINOEKI will be included into the next District Development Plan.

Note: The areas marked in 'grey' have been left blank as the interviewee had difficulties responding to the question.

3. Viability

All participating organizations evaluated that the full-scale implementation of the MICHINOEKI project as part of the Nampla - Cuamba Road upgrading is viable except the available financial recourses.

Questionnaire	Responsible Agency			
	ANE	District	Post	
3-1 Can the method for land acquisition for public use be applied to other locations?	A	A	A	All of them marked "A". The land acquisition for pubic facilities can be applied easily.
3-2 Can the electricity be supplied in the same way for other MICHINOEKI locations?	A	C		They all evaluated that it is possible, but some of the areas will have difficult access to electricity. One of the projects ("FUNAE") for solar power promotion is now starting. This could be helpful for the MICHINOEKI located in the rural areas.
3-3 Is the Financial support program already prepared for the full-scale project?	D	B		ANE stated that the MICHINOEKI project should be included as part of the Nampula-Cuamba road improvement project as soft component.
3-4 Is the Technical program and the Staff already prepared for full-scale project implementation?	D	A		ANE said it is difficult to do it by themselves. On the other hand, the District said it is possible that their pubic infrastructure department can handle the planning and design.
3-5 Will the Staff who were involved in the pilot project be assigned to the full-scale project?	B	A	A	All of them said it was possible.

Note: The areas marked in 'grey' have been left blank as the interviewee had difficulties responding to the question.

4.6 Recommendation & Lessons Learned

Recommendation

1. The contents/components of the MICHINOEKI which are i) parking lot, ii) Open Market, iii) Sales of Goods to rural people and drivers, iv) Pubic Toilet and v) Event Space are evaluated to be effective for full-scale project implementation, and should be part and parcel of future MICHINOEKI's.
2. The Administrative System (ANE: Owner of Facility, District: Owner of Operation) was confirmed to be efficient. The same system should be used for the full-scale project. The Financial recourses are expected to be provided by the soft component of the Nampula - Cuamba road improvement project.
3. The Bicycle promotion centre should be integrated into the MICHINOEKI project to promote the use of the bicycle for rural people and also to generate income for the operation of the road side station..

Lessons Learned

1. Technical assistance and capacity building is required for the operational staff of the MICHINOEKI. Most farmers are not business minded.
2. Promotion and publishment of the MICHINOEKI concept is important for the rural areas in order to have the farmers fully recognize and understand the MICHINOEKI's objectives and be involved in the outdoor market activities.
3. The staffs of MICHINOEKI have installed the community phone and started constructing another rest space under their decision. The community phone has been confirmed as a one of a useful public purpose by the results of operating records. It is recommended that the community phone should be provided into future MICHINOEKIs.

Chapter 5 Roadside Station

5.1 Concept of Roadside Stations

The World Bank expects a multiplier effect from the Roadside Stations creating benefits for marketing, production works, technical education, tourism, social participation and public services such as health and sanitation.

The World Bank produced a guideline on road side stations dated July 22, 2004. This guideline has brought together more than ten years of successful Japanese experience and selected practical work in other countries in East Asia and Africa. The guidelines discuss the MICHINOEKI concept adjusted to the specific context of developing countries and provide advice on the planning, design and operation of these facilities.

5.2 Application of the Concept of Roadside Stations

The main objectives for the Roadside Station "MICHINOEKI" are as follows:

First, drivers and travelers need a place to rest, buy gasoline, and maintain their vehicles. Secondly, market and restaurant facilities are used by drivers, travelers, and local residents. Thirdly, the Roadside Station "MICHINOEKI" provides public services such as water supply, public sanitation, and health care including HIV/AIDS care, education and training, and cultural activities. As many people gather at a transportation-related facility such as a Roadside Station "MICHINOEKI", it has a fourth function as well, that of a transportation terminal. Therefore, the main objectives of a Roadside Station "MICHINOEKI" can be classified into the following four categories:

- **Rest:** Providing highway users with a clean, comfortable rest area
- **Market:** Providing a location for direct sale of products (and possibly for processing local products to generate added value)
- **Terminal:** Providing terminal functions for public transport.
- **Public Service:** Providing public services that are needed by local residents, as well as by highway users.

Institutional Arrangements for Installation and Operation

There are two areas to consider; the Road Reserve adjacent to the road and the Local Area outside the Road Reserve Area. Parking and toilet facilities should be established in the Road Reserve. Community spaces such as restaurants and markets are located in the Local Area, because it is prohibited to build structures in the Road Reserve in Mozambique.

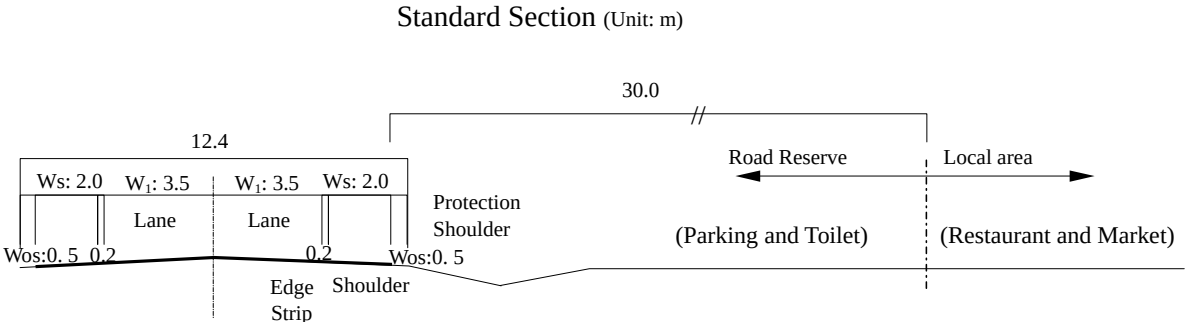


Figure 5.2.1. Arrangement for Installation

Implementation Plan for Future Roadside Station (MICHINOEKI)

1) Proposed Location for the Roadside Station (MICHINOEKI) on the Study Road

As the results of site survey conducted between 8 to 10 October 2007, the study team identified the following proposed locations for future MICHINOEKI on the study road. Table 5.2.1 and Figure 5.2.2 show their location. In this site survey, the following criteria for site selection have been taken into account;

- Availability for Land Acquisition
- Availability of Electricity and Water Resources
- Availability of Agricultural Products and Farmers Associations

As the MICHINOEKI is a driver's facility, their intervals shall be taken as approximately 50km or one hour's drive.

The Study team visited each local administration and discussed the availability for each of these locations. All locations have been confirmed as being available for public facilities.

Table 5.2.1. Proposed Location for future MICHINOEKI

No	Name	Location		KP	Longitude / Latitude	
1	Rapale	District	3.8km from Rapale Adimin.	13+700	15 02.942 S	39 08.361 E
2	Mutivaze	Post	1.0km from Post	37+700	15 00.160 S	38 57.774 E
3	Namina	Post	2.0km from Post	76+000	14 57.018 S	38 40.489 E
4	Ribaue	District	2.0km from Ribaue Admin.	130+200	14 57.651 S	38 19.297 E
5	Zimbabwe	Post (Iapala)	8.0km from Post	161+500	14 58.371 S	38 03.713 E
6	Malema	District	10.5km from Malema Admin.	225+500	14 56.804 S	37 30.160 E
7	Mutuali	Post	1.3km from Post	279+600	14 53.030 S	37 01.500 E
8	Cuamba	Municipal	3.5km from Cuamba Adimin.	341+500	14 48.214 S	36 34.567 E

Figure 5.2.2. Proposed Location for future MICHINOEKI

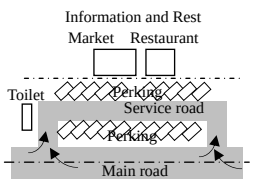
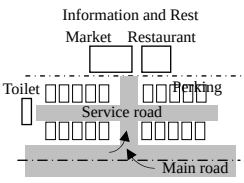
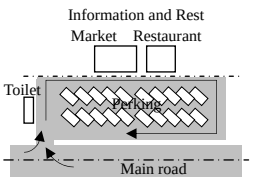
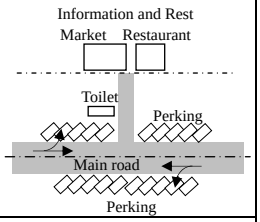
Note: The locations for the MICHINOEKI are numbered from the Nampula side

2) Layout of the Roadside Station

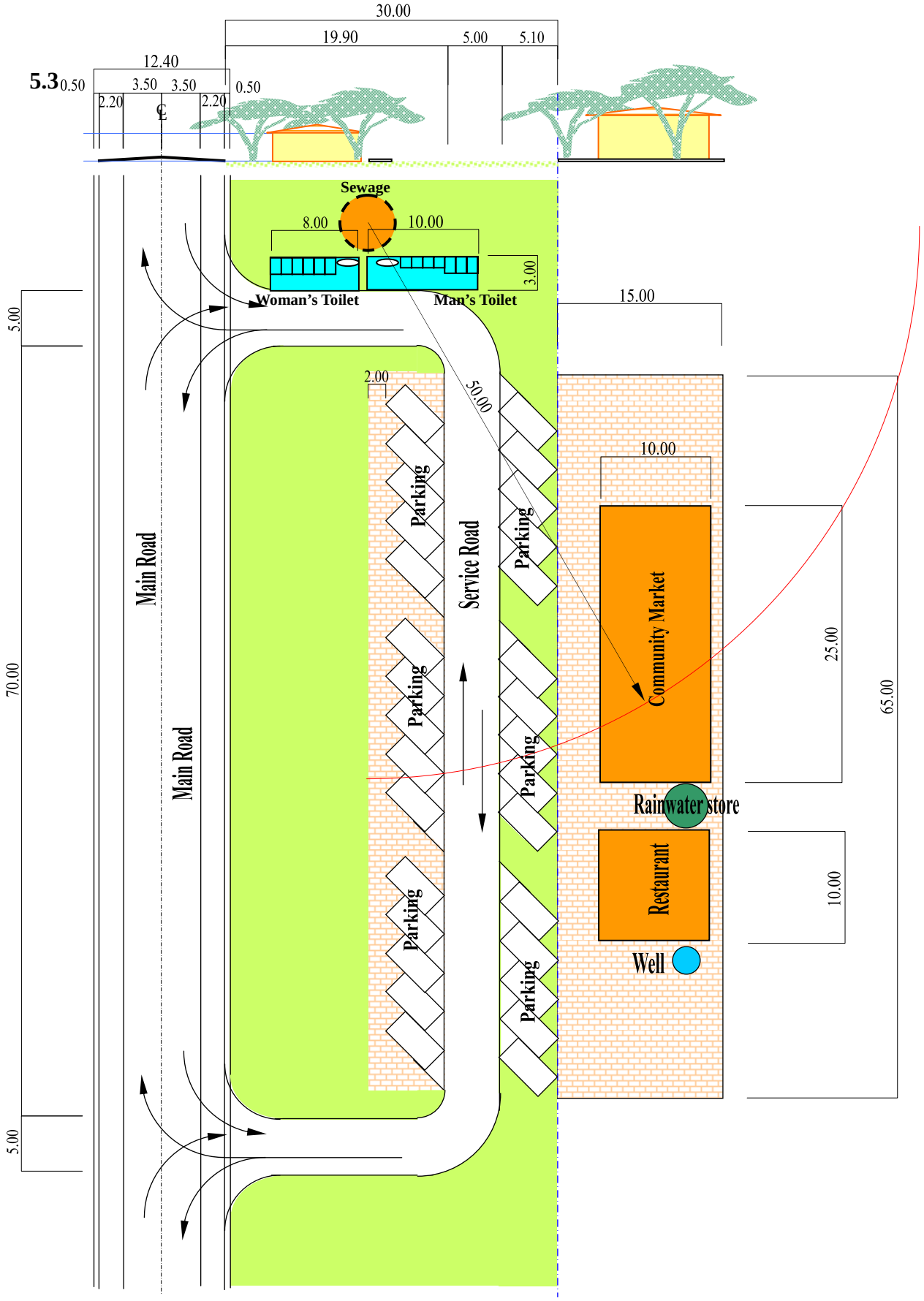
Layout arrangement considering the specific conditions in Mozambique and the site conditions are as follows:

- Right turn lanes are not needed on the main road because of the low traffic volume.
- Information and rest areas, restaurant and market facilities are planned outside the road reserve.
- Parking and toilet facilities are inside the road reserve.

Table 5.2.2. Comparison layout for Roadside Station

Item	Plan 1	Plan 2	Plan 3	Plan 4
Sketch				
Outline	*2 vehicle crossings *service road on one side.	*1 vehicle crossing. *parking on one side.	*1 vehicle crossing *service road around the parking area.	*No vehicle crossings * Parking on both sides of the main road.
Merits	Easy to park.	Reduced impact on main road traffic.	Reduced impact on main road traffic..	Easy to park for both lanes.
Demerits	Affects the main road traffic.	Not easy to park.	Concentration in the vehicle crossing	Causes pedestrians to cross the main road.

The next page shows the recommended layout plan for MICHINOEKI.


30.00
19.90
5.00
5.10
12.40
5.3
0.50
3.50
3.50
0.50
2.20
2.20
℄
Sewage
8.00
10.00
3.00
Woman's Toilet
Man's Toilet
15.00
5.00
2.00
50.00
10.00
Parking
Parking
Parking
Parking
Parking
Parking
Service Road
Main Road
Main Road
Community Market
Rainwater store
Restaurant
Well
25.00
10.00
65.00
70.00
5.00
5.00

5.3 Recommendations

With regard to the Study Road, we suggest the following concepts and elements to be applied for a Roadside Station.

Table 5.3.1 Four Concepts and Eight Elements

Four Concepts	Eight Elements
1. Clean 2. Sanitary 3. Safety 4. Comfort	1. Rest facility 2. Clean Water 3. Sanitary Toilets 4. Take away food sold under hygienic conditions (Restaurant, Market) 5. Road Safety 6. Information 7. Cooperation/Corroboration Activities between MICHINOEKIs & Local 8. Local Activities

Roadside Stations have contributed to the local development in Japan. We expect a similar impact along the Study Road in Mozambique.

Through the pilot project in MICHINOEKI Anchilo, procedures for implementation, organization and operation have been tested which have provided important lessons learnt for its establishment in the Mozambican context. Especially, it is recommended that community phone should be installed through the scheme of Public Private Partnership (PPP) as a one of the MICHINOEKI's facilities. It helps much improvement for communication tools among rural people.

Full scale implementation of the MICHINOEKI concept at the eight proposed locations on the study road is recommend as soft component of the main project for road improvement, based on the layout arrangements as shown in 5.4.4 of Main Text.

Chapter 6 Emergency Works As Pilot Project

6.1 Background

The Emergency works (hereafter described as "the Works") is a component of the pilot projects focusing on the rehabilitation of feeder roads and/or community infrastructures, which are strongly related with the regional development program. The works mainly aims that an effectiveness of small scale rehabilitation for community infrastructures are to be experimentally examined when it is undertaken within the framework of the regional development program. And secondary, specific data & information of construction as well as procurement are to be updated and compiled to feedback to the Feasibility study.

The works were selected from the list of the prioritized projects, which are proposed in the Short-term Regional Development Policy, in accordance with the following criteria:

- ✓ Urgency
- ✓ Local Needs
- ✓ Economic Development Effect
- ✓ Immediate Effect
- ✓ Conformity to the JICA Pilot Project Scheme

Subsequent to the selection of the Works, an appropriate site, scope and magnitude of the work were duly examined together with ANE as well as the local governments for an effective implementation under the JICA's local procurement scheme. Based on a technical examination as well as a needs assessment, the rehabilitation work for the existing community roads were carried out in the center of Ribaue district, which is a hub town in the region and provides public services both for education and for medical attentions.

6.2 Outline of the Works

The Works are to rehabilitate community roads and to improve access to the existing hospital and the school in Ribaue, Nampula Province. The Works comprise the following tasks:

- ✓ Road Pavement with a Single Chip Seal
- ✓ Installation of the Pedestrian Way and Rehabilitation of the Central Island (Strip)
- ✓ Installation of the Drainage and Cross Culvert

The project road is 0.98 km in length and composed of the following 3 sections:

- ✓ Hospital Road: Section Length = 330 m
- ✓ School Road 1: Section Length = 325 m

✓ School Road 2: Section Length = 325 m

The figure below indicates the location of the project road and each section.

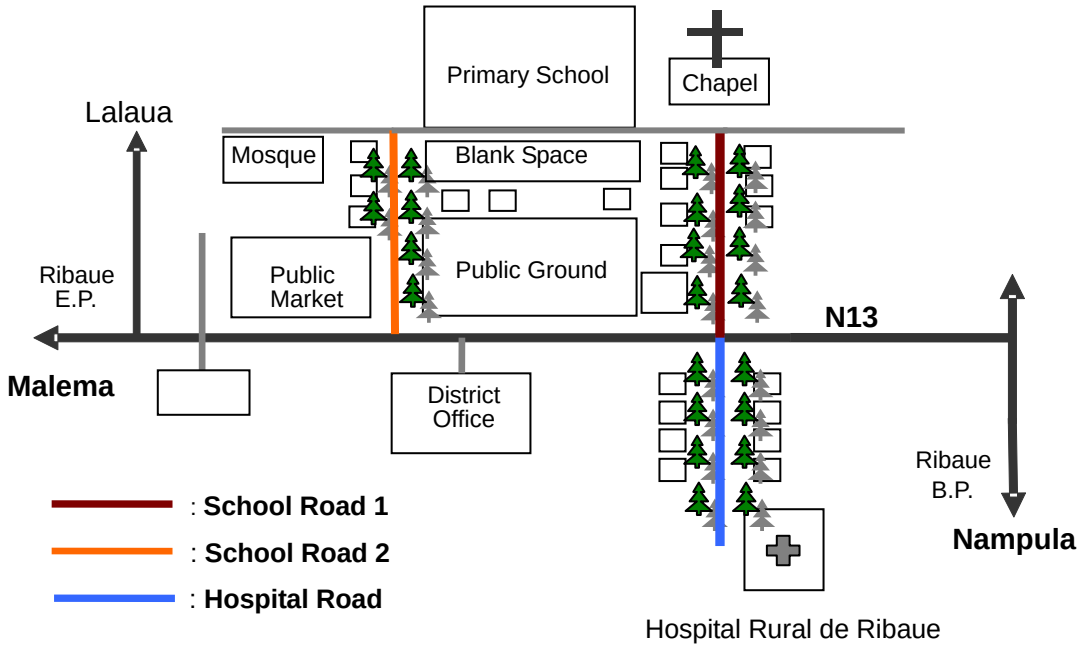


Figure 6.2.1 Location of the Project Road and Sections

6.3 Implementation of the Works

Selection of the Contractor

The JICA Study Team selected a contractor for the construction of the facilities in accordance with the JICA's Local Contract/Subcontract Guidelines. Selection was on a price-quotation basis amongst 3 local contractors. The awarded contractor is a Maputo-based reputable company called "CETA Construções e Serviços S.A.R.L.", who offered the lowest bid and presented an ample capability supported by plenty of relevant work experience. The contract was duly signed by both parties and entered into effect on the 16th April 2007.

Work Schedule & Progress

After the mobilization and preparatory works, the rehabilitation works commenced on 29th May, 2007, 6 weeks after signing of the contact. The rehabilitation work thoroughly progressed as scheduled and the Works were completed on July 30, 2007. It is observed that a one-week delay at the initial stage of the works, was recovered by increasing the working hours. Milestones in the work schedule are summarized as below.

- ✓ Commencement date: 29th May, 2007
- ✓ Finish date: 30th July, 2007
- ✓ Total construction period: 10 weeks

6.4 Outcomes from the Works

The following facts and lessons were pointed out for feeding back to the small scale construction in regional development.

- Capability of the local contractor（Time management, Quality management, Procurement）and required level for the site supervision.
- Quality achievable and required level for the site supervision.
- Updated construction cost and Unit price.
- Procurement conditions and local circumstances for primary material（aggregate, cement, bitumen, etc.）
- Results of the soil mechanical study

The facts and lessons indicate that it is optimum that the rehabilitation for the community infrastructures is comprehensively implemented in combination with the large scale road rehabilitation in terms of the project cost efficiency, the best management on the consturuction deliver time as well as its quality.

PART 5: CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the conclusions of the Study, project evaluation and project implementation requirements, and recommendations to achieve the overall objective of furthering the development of the Northern provinces.

1.1 Project Benefits

The economic analysis of upgrading the Study Road concluded that project implementation (between 2009 and 2011) maybe appropriate based solely on benefits to road users and would produce substantial additional economic benefits. The economic validity for the Project is acceptable with an EIRR of 18% based on the most suitable pavement structure of DBST surfacing on granular base and sub-base assuming optimum maintenance interventions and based on the design speed of 80 km/h.

In addition to the direct economic benefits, the Project is likely to produce significant social and other benefits in the Study Area and beyond.

The roles and functions of the Study Road are described below:

- The road will be upgraded to all weather paved standard as part of the Nacala Corridor. This corridor is an international trunk road connecting land-locked countries of Zambia and Malawi with the Nacala Port in Mozambique. This will not only promote the international trade but also the regional development in the northern region of Mozambique by creating reliable transportation of passengers and freight at reduced cost.
- Despite the road being located in one of the richest agricultural and natural resource area of northern Mozambique, the local population has been struggling with poverty including low illiteracy rates, poor access to basic needs and markets. The road upgrading will enable the rural people to easily access schools, hospitals, government offices and markets and expand their income generation opportunities.

Given the qualitative benefits for international trade and regional development together with the quantifiable economic benefits for the road users, one can conclude that the upgrading of the Study Road is socio-economically viable and necessary. The IEE shows that the negative impacts can be avoided or reduced to an acceptable level in compliance with the Mozambique laws and regulations and effective implementation of mitigation measures and a rigorous monitoring program.

On a conclusive remark, the Project is seen as viable.

1.2 Project Implementation Requirements

The Study Team identified a number of issues that need to be followed up by ANE to ensure a smooth implementation of the project. The following specific activities should be

undertaken.

(1) Project Management

ANE has sufficient capacity and experience to act as the executing agency for the Project. However, ANE should take not only both responsibilities for implementation and overall coordination but also operation and maintenance of the Study Road after completion. As a result of each activity, the Study Road will be maintained as an international trunk road.

(2) Pre-Construction Activities

(a) EIA approved by MICOA

An EIA approval from MICOA should be obtained by the end of 2007. This EIA will include a preliminary resettlement action plan and environmental & social impact assessment for construction stage.

(b) Land Acquisition and Resettlement

With regard to land acquisition and resettlement, ANE shall prepare a resettlement action plan to ensure a fair and smooth process of relocation and compensation of affected people.

1.3 Recommendations

The upgrading of the Study Road, including the reconstruction of six bridges, is planned to be completed by December 2011 with a loan from AfDB and JBIC as an EPSA project. The following recommendations are presented to guarantee a smooth implementation of the Project.

(1) Implementation of Regional Development Programs together with Road Upgrading

Although at present some international donors (AfDB and JBIC) have shown interest in financing the upgrading of the Study Road, there exist no specific regional development programs for the Study area. This existence of such a development program together with the proposed upgrading the Study Road would provide synergy on poverty reduction, which is the ultimate goal of the MOG..

JICA in particular has a wide experience in supporting regional development in African countries and subsequent aid schemes for technical cooperation (e.g. Technical Cooperation Project, deployment of volunteers). Further involvement of JICA in the area of regional development along the Study Road would be recommendable to support the identified regional development programs and to build the Michinoeki at the appropriate places. In the stage of implementation of Michinoeki and others, it is recommended that Michinoeki shall be implemented as a soft component of the project, and community roads along the study road shall be implemented together with this project.

(2) Environmental and Social Consideration

(a) Minimization of Resettlement and Stakeholder Consultation

Application of the COI concept is strongly recommended for smooth implementation of land acquisition and resettlement for the Project. It will minimize the period of resettlement activities as well as reduce the initial financial burden on the GOM.

ANE shall prepare a resettlement action plan based on Mozambique's EIA law and other relevant resettlement policies during the detailed design stage. In the implementation stage of resettlement activities, frequent consultation with the Affected People (AP) is important to achieve consensus.

(b) Appropriate Environmental and Social Consideration for other relevant activities

This project requires two EIA approvals; one for the road upgrading works and another for opening up new quarry and borrow pits. Previous experiences indicate that it is possible to obtain environmental permission simultaneously on both issues with an ESIA.
During the detailed design stage, ANE need to present a detailed plan for opening quarries and borrow pits to the provincial directorate of MICOA in Nampula, and submit a standard application form with approved ESIA and Environmental License to the Ministry of Mineral Resources in Nampula, in order to receive relevant permissions.

(3) Implementation Scheduling

The Project is regarded by both ANE and the GOM as one of the most important activities in the RSS program. In line with this, construction work is expected to begin in January 2009 with an estimated 36 months for completion. Considering this proposed schedule, the detailed design should be finalized by June 2008 together with the preparation of draft bidding documents. After completion of the detailed design, an appraisal will be carried out by AfDB and submitted to the board of AfDB for approval. During the appraisal and approval by AfDB, ANE should complete the other requirements such as land acquisition, resettlement and preparation for the procurement stage.

(4) Items to be carried out in the Detailed Design Stage

As mentioned above, the detailed design should start from January 2008 and finish within 6 months, by the end of June 2008. It will include additional field surveys, selection of the final design standards and specifications, preparation of the design report including drawings, bill of quantities, engineer's estimate, and the preparation of bidding documents.

The following specific activities should be undertaken in order to ensure a smooth construction of the works.

(a) Additional Geological Survey

- Boring survey including Standard Penetration Test (SPT) and laboratory test for each pier or abutment at the six bridge sites except for locations that were already included in the FS stage

- California Bearing Ratio (CBR) at every 10 km interval and Dynamic Cone Penetration (DCP) at every 2 km interval
- Laboratory test for soil materials for base and sub-base layers

(b) Topographical Survey

- Preparation of line mapping for houses, trees and others
- Centerline and cross sectional surveys of changing points topographies
- Plan survey for piers and abutments on the bridge sites

(5) Site Survey for Quarries

In the FS, aggregate and crushed stone for the Study Road were assumed to be supplied from respectively the existing quarry at Namialo for Section 1, a new quarry for Section 2 and the existing quarry near Cuamba for Section 3. Since the costs of quarry materials largely affect the total construction cost for road works due to long hauling distances, it is essential to map the quarry sites for each of the Road Sections. For this reason, it is recommended to undertake a detailed survey including possible new quarry sites and available volume and quality of the stones. If the availability of aggregate is not sufficient, the pavement design should be reviewed based on these surveys.

(6) Cement Supply for Concrete Structure

Construction work of the Study Road is expected to commence in January 2009 and cement supply for the concrete structure will follow a similar timing. Major concern on the supply of cement is the FIFA 2010 World Cup. Currently, Mozambique imports half of its cement from especially from South Africa. Therefore, the detailed design should take into account the shortage of supply in cement when drafting the construction methods. Furthermore, ANE should consider to make arrangements with the local cement factories to ensure an uninterrupted supply of cement for the Study Road projects for the next few years.

(7) Operation and Maintenance

The following recommendations are presented for the operation and maintenance stage of the Study Road and Michinoeki Anchilo.

- Weighing stations (axle load control), one place in each district, will be needed on the Study road to control overloading. Axle-load controls are crucial to protect the road pavement structure and prevent road surface damage that would reduce its economic life.
- A road safety program will be needed to develop and improve road safety awareness and education among rural people in nearby communities and drivers.
- Maintenance records should be computerized in the future to enable engineers to monitor maintenance activities and costs for each road surface type.
- Routine maintenance work, such as cleaning of the drainage facilities and cutting of grasses should be carried out using labor-based methods by local people for expanding employment opportunities along the Study Road.
- In order for Michinoeki Anchilo to be operated smoothly ANE should manage the staffs of Michinoeki Anchilo every month.