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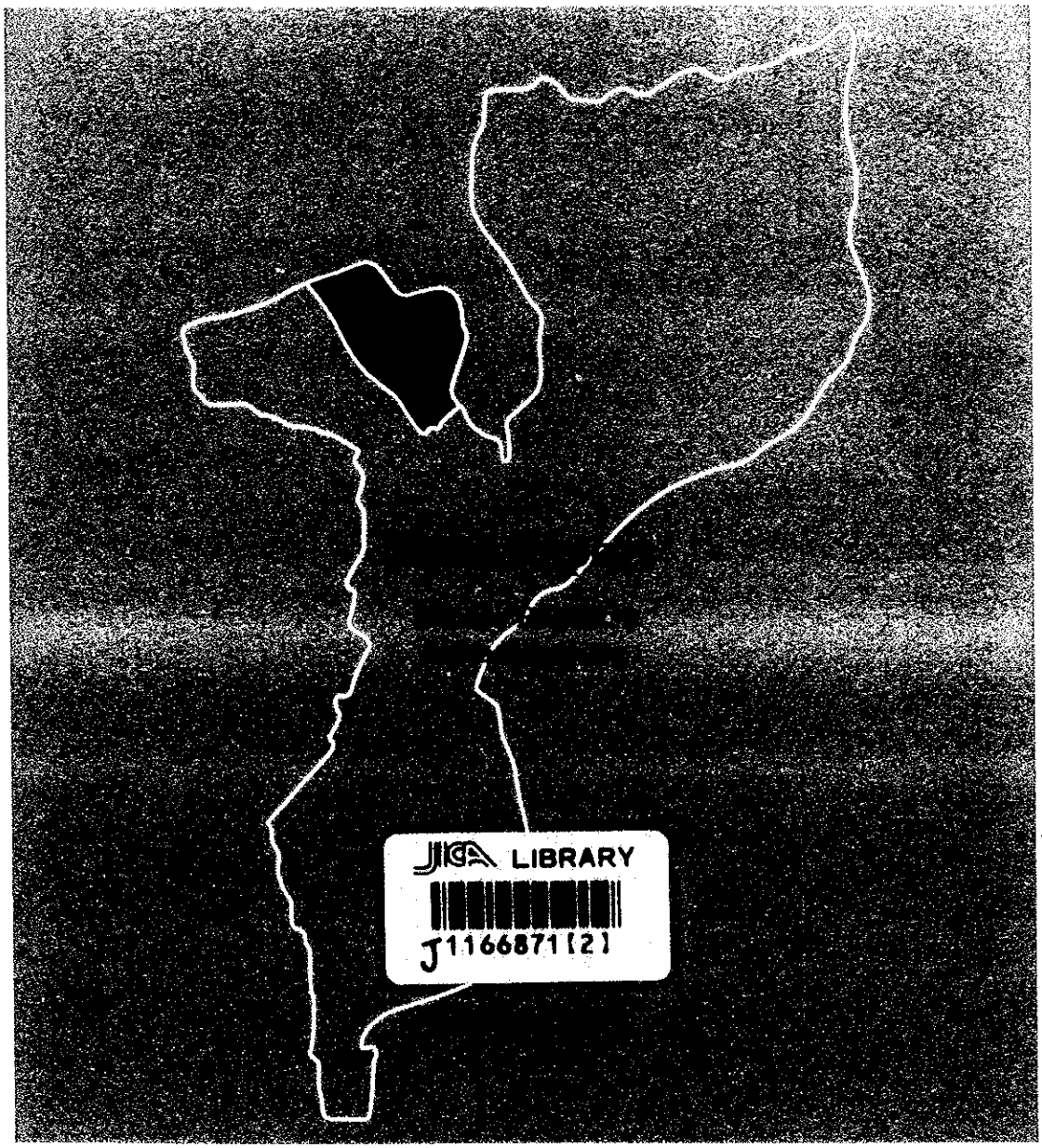
Zambezi Valley Development Authority

The Republic of Mozambique

The Study on the Integrated Development Master Plan of the Angonia Region in the Republic of Mozambique



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The Study on the Integrated Development Master Plan of the Angonia Region in the Republic of Mozambique

Sector Report 4 Infrastructure

October, 2001

Japan International Cooperation Agency

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Japan International Cooperation Agency (JICA)

Zambezi Valley Development Authority
The Republic of Mozambique

The Study on the Integrated Development Master Plan of the Angonia Region in the Republic of Mozambique

Final Report
Sector Report 4
Infrastructure

October, 2001

RECS International Inc.
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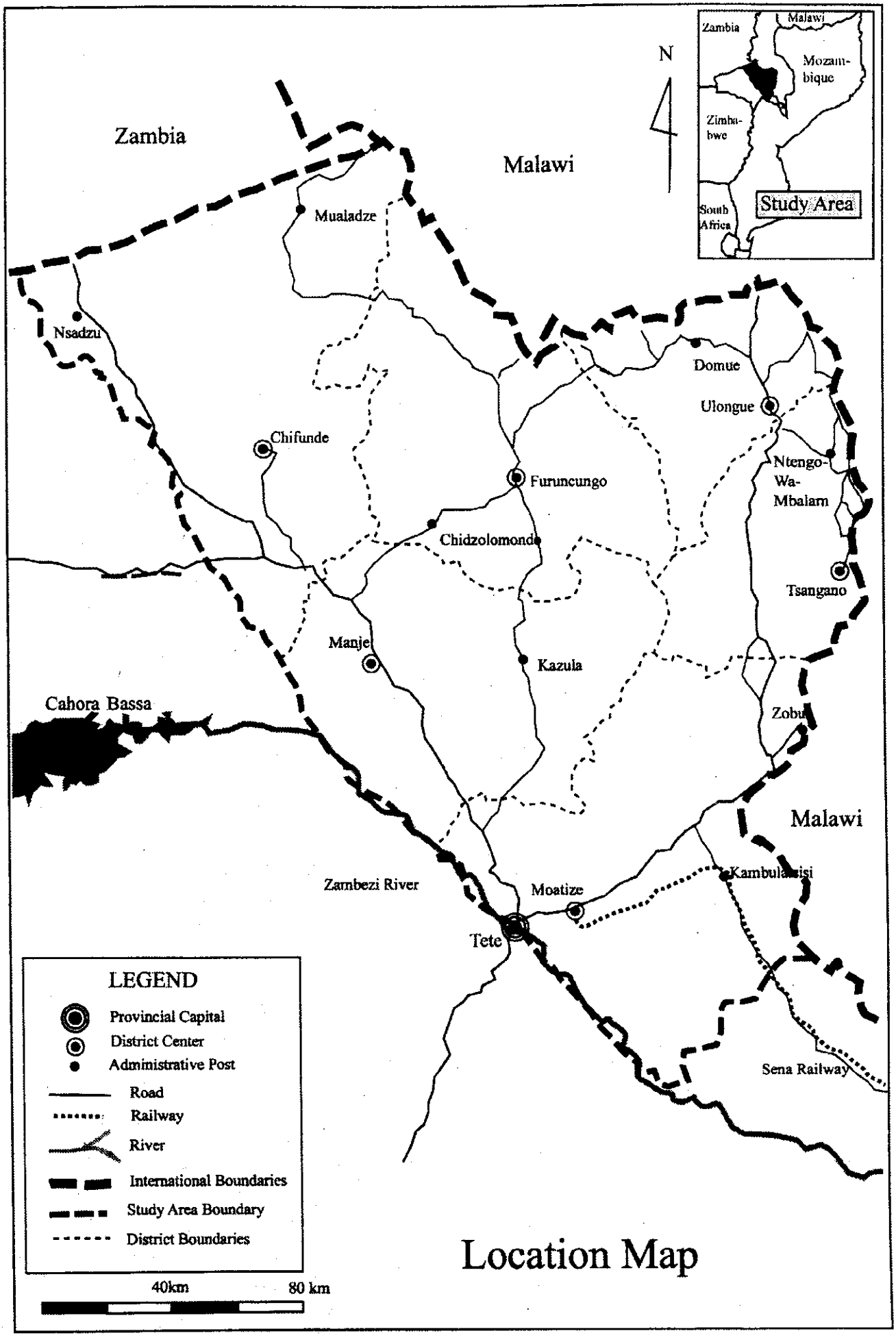
Zambia
Malawi
N
Zambia
Malawi
Mozam-
bique
Zimba-
bwe
South
Africa
Study Area
Mualadze
Nsadzu
Domue
Ulongue
Chifunde
Furuncungo
Ntengo-
Wa-
Mbalam
Chidzolomondo
Tsangano
Manje
Kazula
Cahora Bassa
Zobue
Malawi
Zambezi River
Moatize
Kambulamisi
Tete
Sena Railway
LEGEND
Provincial Capital
District Center
Administrative Post
Road
Railway
River
International Boundaries
Study Area Boundary
District Boundaries
40km
80 km
Location Map

Abbreviations

ADM	Airport Authority of Mozambique
ADP	Accelerated Demining Program
ADPP/DAPP	Development Aid from People to People
AIDS	Acquired immune deficiency syndrome
ANE	Road Authority
ARA	Regional Administration of Water
ARC	Action for the Rights of Children
ASPS	Agricultural sector program support
BAD	African Development Bank
BADEA	Arab Bank for African Development
CAIA	Agro-Industrial Complex of Angonia
CCAP	Church of Central African Presbyterian
CCF	Cease-fire Commission
CFM	Port and Railway Authority
CIDA	Canadian International Development Agency
CIDAC	Centro de Informação e Documentação Amílcar Cabral (Amílcar Cabral Center of Information and Documentation)
CIDC	Canadian International Demining Center
CPI	Investment Promotion Center
DANIDA	Danish International Development Assistance
DAs	District Administrators
DNA	National Directorate of Water
EDM	Electricity of Mozambique
EIA	Environmental impact assessment
FRELIMO	Mozambique Liberation Front
GDP	Gross domestic product
GNP	Gross national product
GPZ	Gabinete do Plano de Desenvolvimento da Região do Zambezi (Zambezi Valley Development Authority)
GRDP	Gross regional domestic product
HALO Trust	Hazardous Area Life-Support Organisation Trust
HCB	Cahora Bassa Hydropower Corporation
HI	Handicap International
HIV	Human immuno-deficiency virus
IDB	Inter-American Development Bank
IDPs	Internally displaced persons
IMF	International Monetary Fund
INE	Institute of National Statistics
IRC	International Rescue Committee

ISCOS	Istituto Sindacale per la Cooperazione allo Sviluppo
IVA	Value added tax
JCI	Japan Consulting Institute
JICA	Japan International Cooperation Agency
LAM	Mozambique Air Lines
LWF	Lutheran World Federation
MARD	Ministry of Agriculture and Rural Development
mCel	Mozambique Cellular
MEDDS	Mechem Explosives and Drug Detection System
MIAF	Mozambique National Household Survey on Living Conditions
MICOA	Ministry of Environmental Action Coordination
MINED	Ministry of Education
MIPF	Ministry of Planning and Finance
MLTC	Mozambique Leaf Tobacco Company
MMRE	Ministry of Mineral Resources and Energy
MOH	Ministry of Health
MOTC	Ministry of Transport and Communications
MPF	Ministry of Planning and Finance
MPWH	Ministry of Public Works and Housing
MTLC	Mozambique Tobacco Leaf Company
NACP	National AIDS Control Program
NDI	National Demining Institute
NGO	Non-government organization
NHS	National Health System
NMCC	National Mine Clearance Commission
NORAD	Norwegian Agency for International Development
NPA	Norwegian People's Aid
NRC	Norwegian Refugee Council
OD	Origin-destination
ODA	British Overseas Development Administration
ONG	National Directorate of Geology
ONUMOZ	United Nations Operation in Mozambique
OPEC	Organization of Petroleum Exporting Countries
PAR	Participatory action research
PARPA	Action Plan for Reduction of Absolute Poverty
PHC	Primary health care
PLA	Participatory learning and action
PRA	Participatory rural appraisal
PROAGRI	National Program of Agrarian Development
RA	Rural appraisal

RENAMO	Mozambique National Resistance
RRA	Rapid rural appraisal
S/W	Scope of work
SAC	Survey Action Center
SCS	Special Clearance Services
SIDA	Swedish International Development Agency
SLP	Sena line program
TDM	Telecommunications of Mozambique
UNDAF	United Nations Common Development Assistance Framework
UNDP	United Nations Development Program
UNHCR	United Nations High Commission for Refugees
UNICEF	United Nations Children's Fund
UNIDO	United Nations Industrial Development Organization
UNOHAC	United Nations Office for Humanitarian Assistance Coordination
WVI	World Vision International
ZMM-GT	Zambezi-Malawi-Mozambique Growth Triangle

The Study on the Integrated Development Master Plan of the Angonia Region

Sector Report 4: Infrastructure

Part 1: Transportation

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Sector Report 4: Infrastructure

Part 1: Transportation

Chapter 1. Existing Conditions

1.1. Existing Transport Policies and Related Organizations

1.1.1. Transport policies

The Mozambique's transport facilities and services have deteriorated significantly over the past two decades. This is mainly due to destruction during the long-term civil war, lack of human resources, lack of improvement funds and an appropriate maintenance. The transport activity has declined for all transport modes except air transport. After the civil war, investments on the transport infrastructures have been concentrated mainly in the railway and port system that connects ports on the coastal area and the surrounding land locked countries. Other transport infrastructures that would contribute to national economic and trade growth were not given high priority. As a result, road infrastructure faced various problems such as deterioration of road system, lower rate of road pavement, destruction of bridges, lower rate of road density, etc. Despite the higher priority given, the rail-port infrastructure also suffered from aging and deterioration, especially rail infrastructure.

Transport system plays an important role in developing production areas, strengthening linkages between production and consumption areas, improving services delivery and transporting people. In order to improve such a poor condition of transport infrastructures, the Government of Mozambique (GOM), with assistance of international financial organizations and donor countries, has been implementing a number of projects for rehabilitation and maintenance of the transport infrastructures. Non-physical measures have been taken also such as institutional improvements, strengthening of organizations, human resource development, strengthening and participation of private sector, and software development of the transport sector.

As part of these efforts, the GOM has established the transport policy in April 1996, which includes the following major policies.

- to contribute to institutional development of the transport operator,
- to encourage private participation in the creation of new infrastructures,
- to promote development of an adequate and competitive tax policy,
- to reduce urban and peripheral passenger traffic jam,
- to rehabilitate infrastructures effective for the development of the country and complementary to the existing transport system.

In the road sub-sector, the national road policy and strategy were established in July 1998. This policy seeks;

- to complete the restoration of traffic on the classified roads network,
- to continue to expand rehabilitation of high traffic volume roads,
- to ensure their effective maintenance,
- to prioritize the use of local resources, and
- to employ modern and efficient planning and control systems.

Based on the road policy mentioned above, the strategy and an action program for the road sub-sector were prepared. They consist of rehabilitation framework, framework of bridges rehabilitation and reconstruction, routine maintenance, and periodical maintenance. The main objectives of the road sub-sector strategy are:

- to increase, in the medium term, the percentage of roads in good or reasonable condition from 39% to 70% or from 10,600 km to 19,030 km,
- to provide them with routine and periodic maintenance with the quality adapted to growing traffic volume, and
- to maximize the use of local resources and train national institutions.

An emphasis of the strategy above is placed on rehabilitation and reconstruction of roads and bridges and their routine and periodic maintenance rather than on construction of new roads.

1.1.2. Transport administration

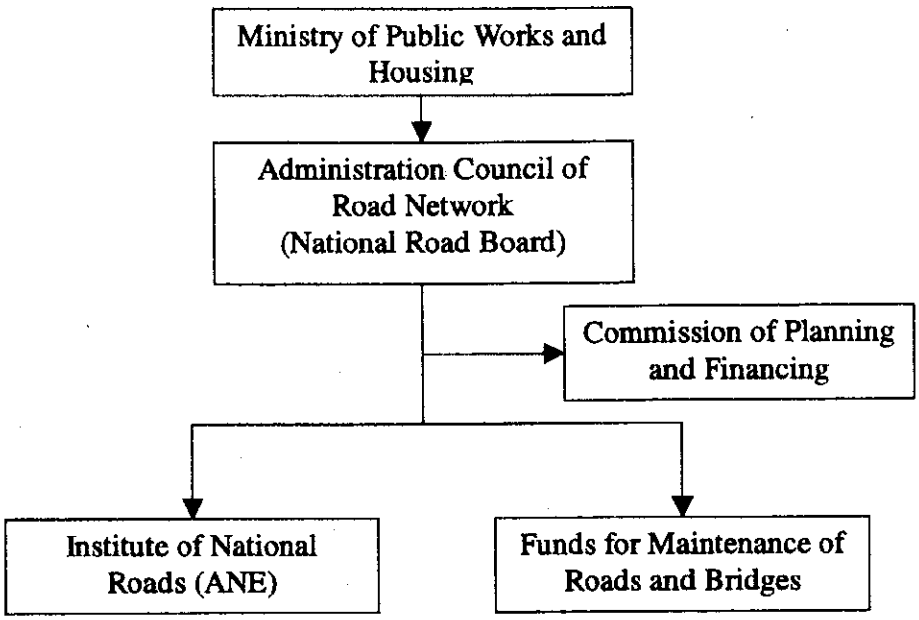
(1) Road

Road and road transport administration consists of three levels of government bodies: central government, provincial government, and district office. Within the central government, the Ministry of Transport and Communication (MOTC) is responsible for road transport, railway, port, airport and civil administration, while Road Authority (ANE) is in charge of road management.

The ANE was established in April 1999 by restructuring and separating the Department of Roads and Bridges (DNEP) to become fully responsible for financing, management, and control of the road network.

The ANE is an independent organization, which reports directly to National Road Board, instead of to the Ministry of Public Works and Housing (MPWH). This structure was approved by the Minister of Public Works and Housing in May 1996 and implemented in January 2000.

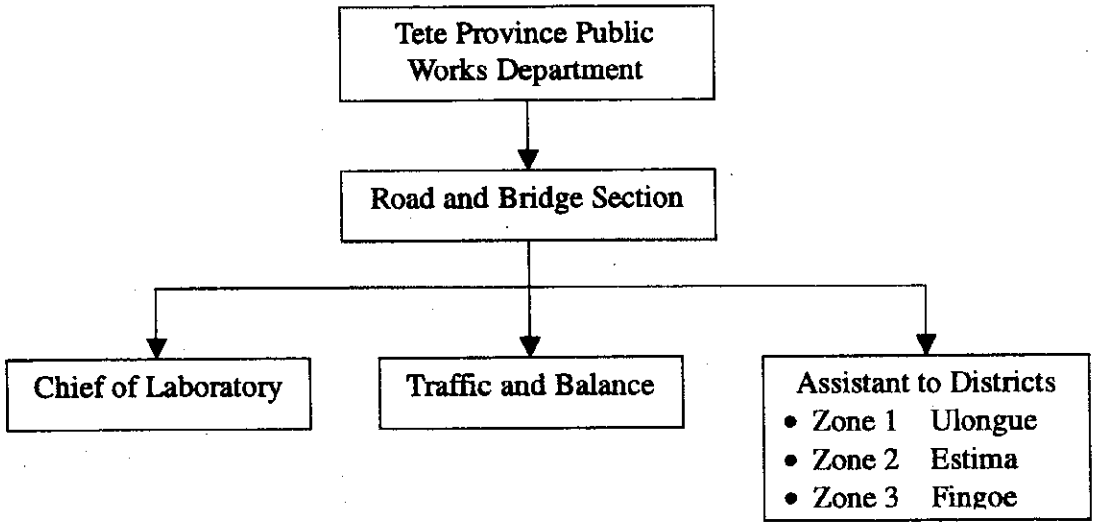
Institutional Organization of Road Authority



The administration council of road network established in the ANE is composed of nine members, each representing the Ministry of Public Works and Housings (MPWH), Ministry of Planning and Finance (MPF), Ministry of Transport and Communication (MOTC), Ministry of Interior (MOI) and four private businessmen and one academician.

At the provincial level, the Road and Bridge Section of the provincial office of MPWH acts as ANE provincial office in charge of operating and managing the road infrastructure. The figure below shows an organization chart of ANE of Tete Provincial Office.

Organizational Structure of Tete Road section



The major roles of the ANE Tete Office are:

- to prepare road planning,
- to grasp condition of road in Tete Province,
- to coordinate and supervise road improvement and rehabilitation projects,
- to prepare budget program for the central office,
- to supervise road maintenance and management projects, and
- to manage classified roads.

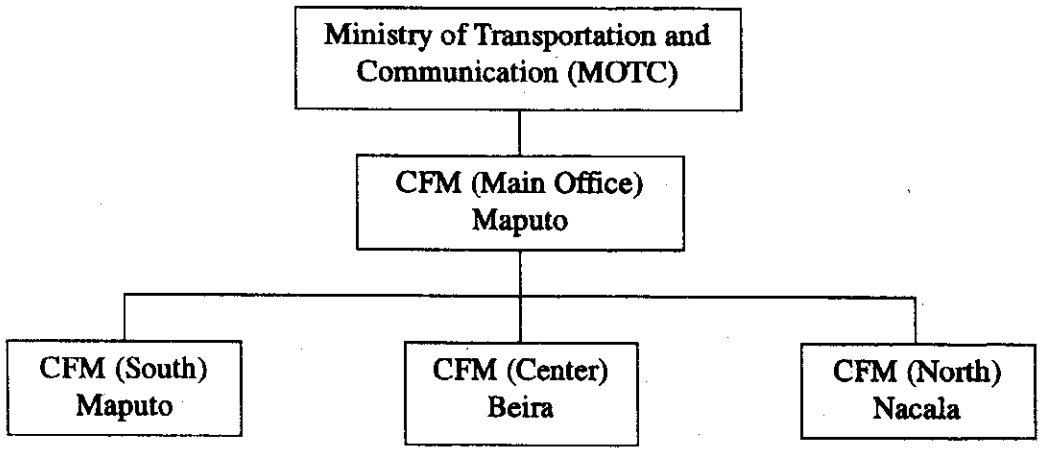
In case of coordination of the national road project implementation, it is necessary for the provincial ANE office to report to the ANE Maputo Office. At the district level, non-classified roads are managed by district offices. Due to limited capability of district offices, however, the ANE Tete office is practically responsible for managing non-classified roads.

Provincial budget is used only for road routine maintenance works, whereas the Central Office takes charge of rehabilitation and periodic maintenance works, planning, budget preparation, contracting with contractors etc.

(2) Railways and Ports

The railways and ports in Mozambique are managed and operated by the Port and Railway Authority (Portes e Caminhos de Ferro de Mozambique (CFM)). The CFM has a main office in Maputo and three regional offices, namely CFM (South), CFM (Center), and CFM (North). The railways and ports in the Beira Corridor belong to the CFM (Center) as shown in the figure below.

Institutional Organization of Railway and Port Authority (CFM)



The main issues in the railway and port sub-sector are pointed out in the Railway and Ports Restructuring Project as follows.

- The railways and ports not financially self- sustaining

- High transport costs for exports/imports of commodities with the neighboring countries
- Parasitic framework inappropriate in the current competitive environment
- Inappropriate organizational structure of CFM
- Surplus staff
- Inappropriate regulatory framework
- Poor condition of some tertiary ports
- Inadequacy of the transport sector policy

The Government strategy addresses the sub-sector's issues as follows;

- Need for large scale involvement of the private sector in operation and management
- Rationalization of CFM staff
- Comprehensive restructuring of CFM
- Strengthening the MOTC and refining the transport policy
- Establishment of an appropriate regulatory framework
- Rehabilitation of a number of tertiary ports

The CFM – Center has already made concession to private companies for the operation of the Port of Beira. At this moment, railway restructuring is still going on.

(3) Airport and air transport

The airports in Mozambique are managed and operated by the Airport Authority of Mozambique (Aeroportos de Moçambique / ADM), whereas air transport is operated by Mozambique Air Lines (LAM) under supervision of MOTC. The major airports in Mozambique are located in Maputo, Beira, Nampula, Quelimane, Tete and Pemba.

1.1.3. Development cooperation from donors

(1) Mozambique

The GOM has given priority to the rehabilitation of transport infrastructures in order to restore the country's economy. In the transport sector, the following projects have been implemented:

a) Roads and Coastal Shipping Project (ROCS)
b) Second Roads and Coastal Shipping Project (ROCS II),
c) Rail and Port Restructuring Project

After completion of the aforementioned ROCS I & II projects, "Roads and Bridge Management and Maintenance Program (RBMMP)" is scheduled to start in December 2001. Its aims are reduction of poverty through road investments, improvement in policies, and better road sector management.

The progress of ROCS project is summarized is the table below.

Physical and Financial Progress of ROCS I and II Project, 1998

Project	Physical progress (km)		Financial progress (US$ mil.)		% physical progress
	Planned	Completed	Planned	Completed	
Rehabilitation of national roads	1,510	454	105	85	30
Reopening of emergency roads	9,000	5,644	107	98	62
Rehabilitation of feeder roads	3,250	2,815	15	11	87
Periodical maintenance	3,000	2,101	60	51	70
Routine maintenance	1,900	15,500	15	8	82
Assembly of metallic roads	5,000	2,600	24	21	52
Reconstruction of bridges	1,093	360	20	11	33
Civil constructions	Several	Several	12	7	60
Supervision	-	-	17	14	82
Total			375	306	82

Source: ANE, *ROCS Annual Review Report-1998.*

The RBMMP project is a nationwide program, comprising the following components.

- Component A: Civil works
- Component B: Institutional strengthening and policy reforms
- Component C: Strategy formulation for phase two and three

This program consists of Phase 1, 2 and 3. They are implemented over periods of four, three and three years respectively. The physical and financial targets of RBMMP are set as follows.

Physical and Financial Targets of RBMMP

Project	Physical target (km)	Financial target (US$ mil.)
Rehabilitation of major trunk roads & bridges	1,510	105
Rural road rehabilitation & maintenance support program	3,250	15
Periodic maintenance	3,000	60
Routine maintenance	1,900	15
Assembly of metallic roads	5,000	24
Reconstruction of bridges	1,093	20
Rehabilitation of bridges	-	

Source: ANE.

(2) Study Area

In the Study Area, two international roads and national and regional roads were

rehabilitated and maintained under ROCS I & II project, while the other roads, either national or district, have not been rehabilitated nor maintained except some district roads as shown in the tables below.

Road Rehabilitation and Maintenance under ROC I and II Project

	Road Section	Surface Type
EN 103	Zobue – Changara	Asphalt
EN 221, ER 548	Tete – Cassacatiza	Asphalt
EN 222	Matema – Francungo	Gravel
ER 463	Dobue – EN 223	Gravel
ER 456	Daca – Furancungo	Gravel

Source: ANE.

Road Rehabilitation made under Proarea Project

District	Road Name	Length (km)
Angonia	Binga – ER 463	12.0
	Jali – ER 463	14.5
	Dziwanga – EN 223	5.3
Chiuta	EN 221 – Kapalautsi	16.1
Macanga	Casupe – Francungo	18.6
	Old Gandali – ER 463	9.4
Tsangano	Banga – EN 223	5.3

Source: UNDP Proarea.

The Danish Development Authority (DANIDA) plans to rehabilitate ER 223 in Tsangano district.

Road Rehabilitation to be planned by DANIDA

District	Road Name	Length (km)
Tsangano	ER 223 – Tsangano	12.0

Source: DANIDA.

1.2. Traffic Surveys

(1) Objectives of the traffic surveys

The Study Area forms part of the Beira Corridor, which serves as a direct transit link from/to Beira Port by road to/from such landlocked countries as Malawi, Zimbabwe, and Zambia. The Beira-Malawi transit link passes through the Study Area. The Study Area is geographically surrounded by the neighboring countries: Zimbabwe, Zambia, Malawi. The major transport corridors of South Africa, Zimbabwe, Mozambique, and Malawi exists in the Study Area with international traffic passing through the Study Area.

Considering such circumstance, a cargo traffic survey was carried out to obtain information on both international and domestic freight traffic passing through the Study Area.

(2) Contents of the traffic surveys

The contents of the traffic survey are:

- truck interview survey, and
- traffic count survey on the Zambezi River Bridge.

Their outlines are described as follows.

Outline of Traffic Surveys Conducted

	Survey	Survey Objective	Survey Stations/Lines	Survey Date
1	Truck Interview Survey	To obtain information of freight traffic for both international and domestic traffic	• Five survey stations - Calomue Entry Point - Biri-Biri Entry Point - Zobue Entry Point - Changara Gate Point - Cuchamano Entry Point	(in 2000) Sep. 26 & 27 Sep. 26 & 27 Sep. 27 & 28 Sep. 28 & 29 Sep. 29 & 30
2	Traffic Count Survey	To get information of traffic volume on Zambezi Bridge	• Zambezi River Bridge	Oct.3 &5

Source: JICA Study Team

(3) Locations of truck interview survey

The truck interview survey stations are selected at the national and provincial boarder points as follows (Figure 1.1):

a) Zobue Entry Point (to/from Malawi),
b) Calomue Entry Point (to/from Malawi),
c) Biri Biri Entry Point (to/from Malawi),
d) Changara Gate Point, and
e) Cuchamano Entry Point (to/from Zimbabwe).

(4) Truck interview survey

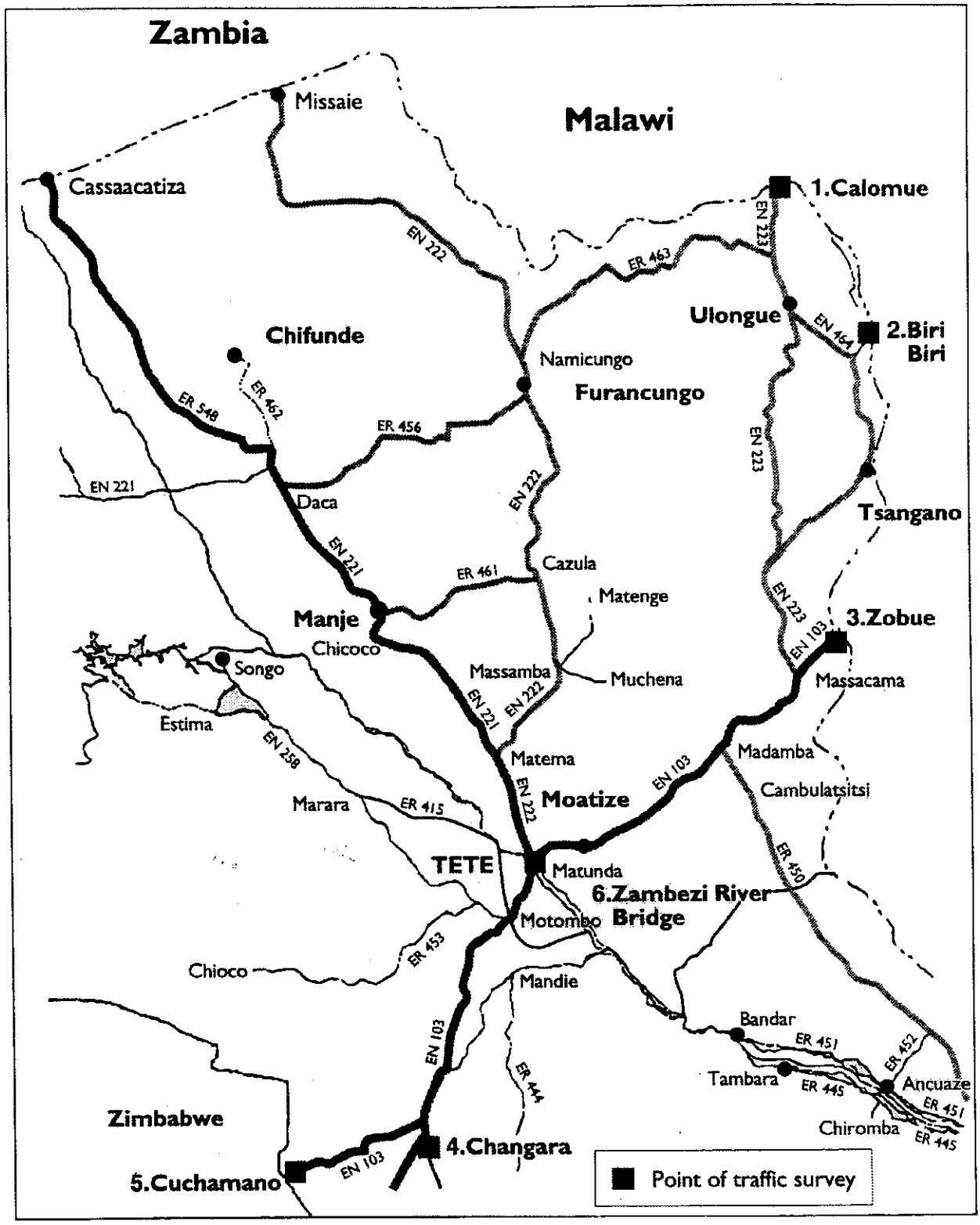
The tuck interview survey consists of survey station, survey date, vehicle type, vehicle registration, origin, destination, cargo type, capacity of truck, and Actual loading. The truck interview survey form is shown in Appendix.

(5) Traffic count survey

The Road Authority (ANE) carries out traffic surveys every year. The traffic count survey in this study was conducted only at the Zambezi River Bridge as a screen line of the area. The objective of the survey was to check the accuracy of the ANE's truck interview survey. The vehicle classification used in this study principally follows that of ANE's

traffic count survey. The traffic survey form is shown in Appendix.

Figure 1.1. Location Map of Traffic Survey



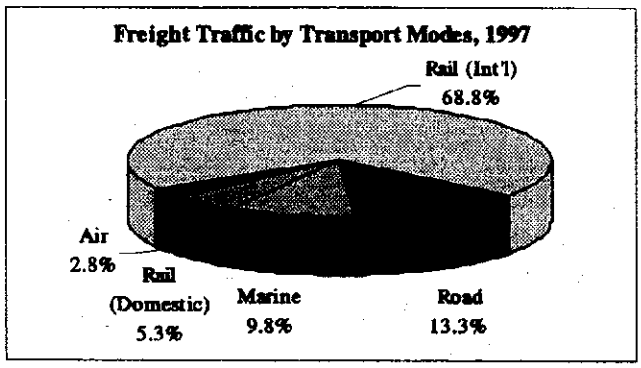
1.3. Traffic Demand Situation

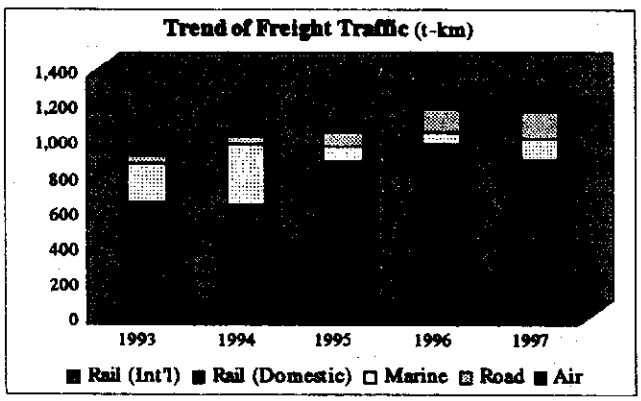
1.3.1. Overall transport demand in Mozambique

First, overall transport demand situation in Mozambique is overviewed in this sub-section.

Freight traffic

As for the freight traffic, railway had the largest share at 74% in 1997. This is due to international freight traffic by rail from the ports in Mozambique to the neighboring countries such as South Africa, Zimbabwe, Malawi, and Zambia, accounting for about 70% of all the freight traffic. The domestic freight traffic volume was very small with its share at only 5%. This means that present railway and port system mainly serves to transport international freight to the neighboring countries.



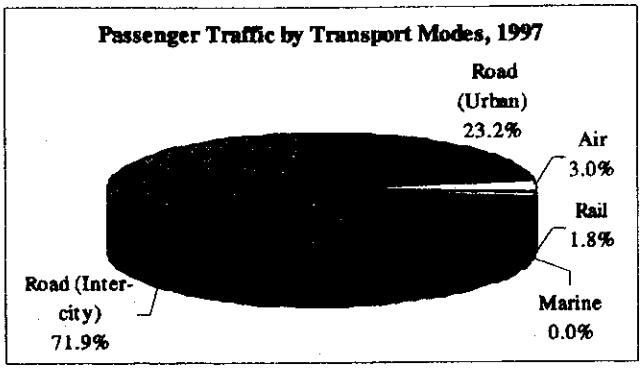


Although road accounted for only 13% of all freight traffic in 1997, road based freight traffic is increasing at a very high growth rate as a result of the progress in road rehabilitation and maintenance works in the country in recent years.

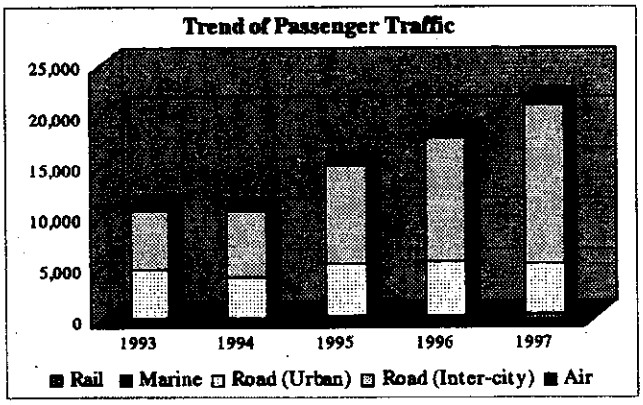
Freight traffic increased at an average growth rate of 6.7% per annum from 1993 to 1997. This was largely due to an increase in road based cargo traffic. This tendency is expected to continue as long as improvement in road condition continues. Railway traffic was steadily increasing in the same period due to an increase in international cargo traffic by railways. An increase in domestic cargo traffic by railways was sluggish in the same period.

Passenger traffic

Road is the largest mode for passenger traffic accounting for 95% of the total in 1997 as shown below. Especially, the road-based inter-city passenger traffic was the largest among all transport modes.



Road-based inter-city passenger traffic was increasing at a high growth rate as presented below due to motorization caused by economic growth and urbanization.



1.3.2. Traffic characteristics in the region

This sub-section describes and analyzes the freight traffic characteristics on the basis of the information collected by the truck traffic survey carried out as part of this study.

International freight movement

The Study Area forms part of the Beira Corridor, which serves as a direct transit link to Beira Port. At the same time, this area belongs to an international transport corridor for Zambia, Malawi, Mozambique, Zimbabwe and South Africa. Many international cargoes pass through this region.

Table 1.1 shows freight traffic volume incoming and outgoing from/to this region. According to this table, entry freight traffic (incoming traffic) volume from the other areas in the year 2000 was about 1.38 million tons, while exit traffic (outgoing traffic) volume in the same year was 1.09 million tons. Freight movements from/to the neighboring regions/countries are characterized as follows.

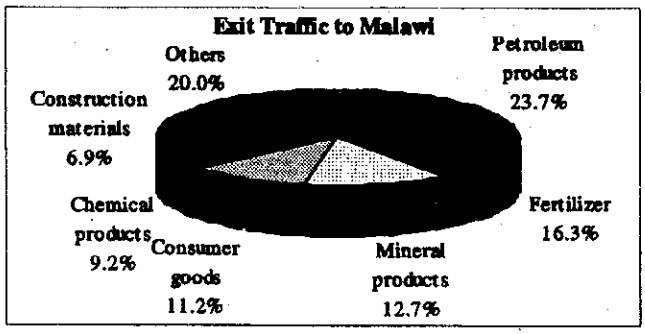
Freight traffic to/from Malawi

First, freight traffic from/to Malawi is analyzed based on Table 1.1. The following are the salient features of freight traffic.

a) Total cargoes to/from Malawi in the year 2000 amounted to 1.05 million tons, of which 0.46 million tons were the entry cargoes from Malawi and 0.59 million tons the exit cargoes to Malawi.

b) The largest entry cargo from Malawi is predominately tobacco, accounting for about 50% of the total traffic. The other major entry cargoes from Malawi are sugar (19%) and coffee and tea (12%).

c) The major exit cargoes to Malawi are petroleum products, with a share of about 24%. These products are transported from the Beira Port. The second major exit cargo to Malawi is fertilizer (17%). There were many trucks in this season (September), transporting fertilizer from South Africa to Malawi for plantations of coffee, tea and tobacco. The third major cargo was coal (13%). Coal is produced in Moatize and mostly exported to Malawi. Other exit cargoes to Malawi are consumer goods, construction materials and manufactured goods. These cargoes mainly come from Zimbabwe and South Africa.



Freight traffic to/from Zimbabwe

Secondly, the freight traffic from/to Zimbabwe (including South Africa) is analyzed. From Table 1.1, the following features of the freight traffic can be observed:

a) Total cargoes to/from Zimbabwe in the year 2000 amounted to 0.92 million tons, of which 0.57 million tons were entry cargoes from Zimbabwe and 0.35 million tons exit cargoes to Zimbabwe.

b) The major exit cargoes from Mozambique to Zimbabwe are predominately tobacco, accounting for about 70% of all the cargoes. All of these cargoes are transit from Malawi. Other major exit cargoes to Zimbabwe, coffee and tea, are also transit from Malawi.

Table 1.1. Freight Traffic Volume by Freight Type at the Surveyed Station, 2000

1. Entry (Unit: 000tons/Year)

	BiriBiri	Calomue	Zobue	Changara	Cuchamano	Total
Tobacco	35.4	8.1	188.1	0.0	5.9	237.5
Coffee/Tea	0.0	0.0	55.5	0.0	0.0	55.5
Sugar/Salt	0.0	0.0	88.3	4.3	43.9	136.5
Rice/Sago/Maize/Cotton/Wheat/Beans/Fish/Banana	0.0	0.0	31.0	23.5	80.6	135.1
Petroleum product	0.0	0.0	0.0	213.2	0.0	213.2
Drinking Products	0.0	0.0	6.1	1.0	0.0	7.1
Fertilizer	0.0	0.0	0.0	0.0	143.2	143.2
Other Chemical products	0.0	0.0	0.0	0.6	11.3	11.9
Mineral Products	0.0	0.0	0.0	0.0	0.0	0.0
Wood/Wood products	0.0	0.0	0.0	0.0	3.4	3.4
Textile products	0.0	0.0	15.6	44.6	0.0	60.2
Leather/Shoes	0.0	0.0	2.8	0.0	2.4	5.2
Consumer goods	0.0	0.0	2.8	7.7	92.7	103.2
Construction materials	0.0	0.0	0.0	5.7	106.3	112.0
Construction equipment	0.0	0.0	14.8	9.5	0.0	24.3
Transportation good,parts, tier	0.0	0.0	0.2	14.0	5.7	19.9
Other manufactured goods	0.0	0.0	10.5	21.1	35.2	66.8
Livestock	0.0	0.0	0.0	0.0	4.5	4.5
Scrap	0.0	0.0	4.3	0.0	0.6	4.9
General goods	0.0	0.0	0.0	0.0	32.8	32.8
Total	35.4	8.1	420.0	345.2	568.5	1,377.2

2. Exit (Unit: 000tons/Year)

	BiriBiri	Calomue	Zobue	Changara	Cuchamano	Total
Tobacco	0.0	0.0	0.0	13.4	241.2	254.6
Coffee/Tea	0.0	0.0	0.0	0.0	47.8	47.8
Sugar/Salt	1.2	0.0	34.0	92.3	0.0	0.0
Rice/Sago/Maize/Cotton/Wheat/Beans/Fish/Banana	0.0	0.0	29.4	11.7	18.4	59.5
Petroleum product	0.0	0.0	141.8	0.0	0.0	141.8
Drinking Products	0.0	0.0	0.2	0.0	7.3	7.5
Fertilizer	39.7	0.0	57.5	0.0	0.0	97.2
Other Chemical products	0.0	0.0	9.7	0.0	0.0	9.7
Mineral Products	0.0	0.0	75.7	0.0	0.0	75.7
Wood/Wood products	0.0	0.0	0.0	7.1	2.8	9.9
Textile products	0.0	0.2	8.7	0.0	17.8	26.7
Leather/Shoes	0.0	0.0	2.0	0.0	0.0	2.0
Consumer goods	0.0	5.3	59.1	0.0	5.7	70.1
Construction materials	0.0	0.0	41.1	0.0	0.0	41.1
Construction equipment	0.0	0.0	5.1	0.0	3.0	8.1
Transportation good,parts, tier	0.0	0.0	9.1	0.0	0.0	9.1
Other manufactured goods	0.0	0.0	53.9	26.7	6.1	86.7
Livestock	0.0	0.0	0.0	0.0	0.0	0.0
Scrap	0.0	0.0	0.0	0.0	0.0	0.0
General goods	0.0	0.0	14.8	0.0	4.5	19.3
Total	40.9	5.5	542.1	151.2	354.6	1,094.3

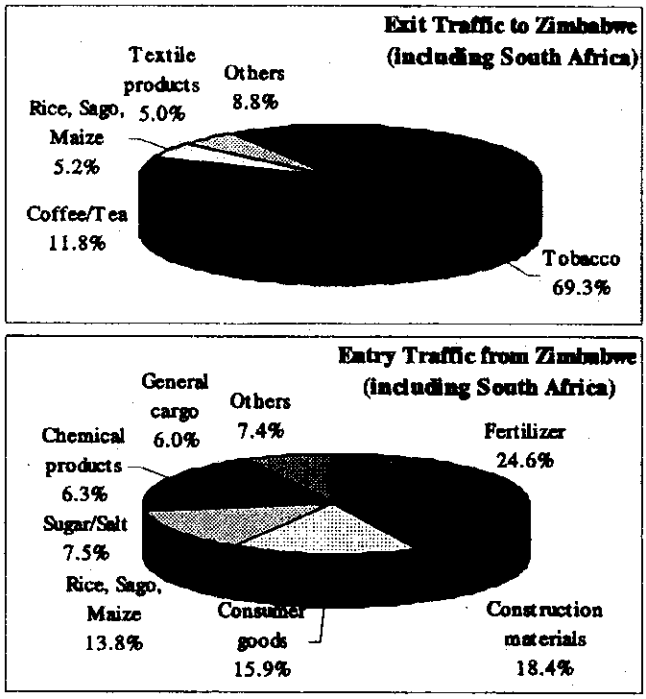
1,094.3

3. Total (Unit: 000tons/Year)

	BiriBiri	Calomue	Zobue	Changara	Cuchamano	Total
Tobacco	35.4	8.1	188.1	13.4	247.1	492.1
Coffee/Tea	0.0	0.0	55.5	0.0	47.8	103.3
Sugar/Salt	1.2	0.0	122.3	96.6	43.9	136.5
Rice/Sago/Maize/Cotton/Wheat/Beans/Fish/Banana	0.0	0.0	60.3	35.2	99.0	194.6
Petroleum product	0.0	0.0	141.8	213.2	0.0	355.0
Drinking Products	0.0	0.0	6.3	1.0	7.3	14.6
Fertilizer	39.7	0.0	57.5	0.0	143.2	240.4
Other Chemical products	0.0	0.0	9.7	0.6	11.3	21.6
Mineral Products	0.0	0.0	75.7	0.0	0.0	75.7
Wood/Wood products	0.0	0.0	0.0	7.1	6.3	13.3
Textile products	0.0	0.2	24.3	44.6	17.8	86.9
Leather/Shoes	0.0	0.0	4.9	0.0	2.4	7.2
Consumer goods	0.0	5.3	62.0	7.7	98.4	173.3
Construction materials	0.0	0.0	41.1	5.7	106.3	153.1
Construction equipment	0.0	0.0	19.8	9.5	3.0	32.4
Transportation good,parts, tier	0.0	0.0	9.3	14.0	5.7	29.0
Other manufactured goods	0.0	0.0	64.4	47.8	41.3	153.5
Livestock	0.0	0.0	0.0	0.0	4.5	4.5
Scrap	0.0	0.0	4.3	0.0	0.6	4.9
General goods	0.0	0.0	14.8	0.0	37.3	52.1
Total	76.3	13.6	962.1	496.4	923.1	2,471.5

c) A few cargoes exported directly from Mozambique to Zimbabwe include only maize, other agriculture products and dry fish.

d) There are various kinds of entry cargoes from Zimbabwe to Mozambique. These include fertilizer, consumer goods, construction materials, and etc. These cargoes are mostly transit to Malawi.

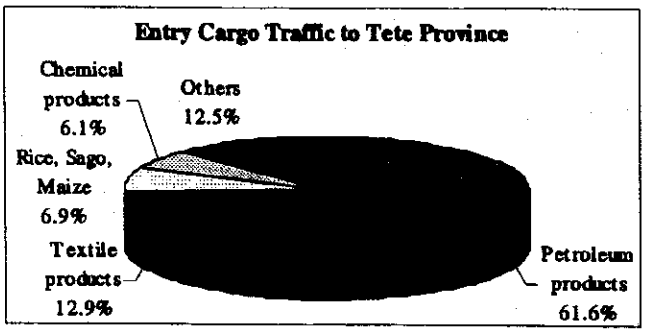


Freight traffic to/from Changara

Lastly, freight traffic from/to Changara gate point on EN 102, the transit route to the Beira port, is analyzed. The following features of the freight traffic are observed.

a) The total cargo volume at Changara in the year 2000 was 0.50 million tons, of which 0.35 million tons were entry cargoes from Beira and Sofala and 0.15 million tons exit cargoes.

b) The largest entry traffic to Tete was petroleum products, such as gasoline and diesel, accounting for about 70% of the total cargo volume.



c) The major exit traffic from Tete Province is sugar/salt product, with a share of about 60% of the total cargo volume.

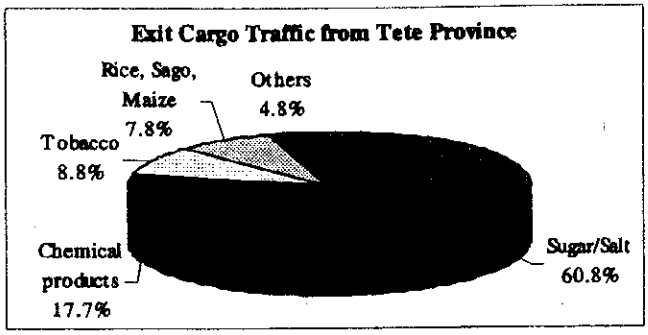


Table 1.2 shows the origins and destinations (OD) of freight traffic based on the traffic survey conducted in this study.

Table 1.2. Estimated Freight Traffic Volume, 2000

(Unit: 10^3t/year)

	Study Area	Tete Province	Beira & Sofala	Other Mozambique	Sub Total
Study Area	0	0	16,808	28,755	45,563
Tete Province	0	0	0	0	0
Beira & Sofala	51,840	0	0	3,645	55,485
Other Mozambique	15,998	0	0	0	15,998
Sub Total	67,838	0	16,808	32,400	117,045
Malawi	0	0	103,275	2,633	105,908
Zimbabwe	27,135	0	0	0	27,135
South Africa	47,385	0	0	1,418	48,803
Zambia	0	0	0	0	0
Total	142,358	0	120,083	36,450	298,890

	Malawi	Zimbabwe	South Africa	Zambia	Total
Study Area	66,623	7,493	0	0	119,678
Tete Province	0	0	0	0	0
Beira & Sofala	227,813	0	3,645	7,493	294,435
Other Mozambique	0	0	0	0	15,998
Sub Total	294,435	7,493	3,645	7,493	430,110
Malawi	0	26,933	317,723	2,835	453,398
Zimbabwe	203,108	0	0	0	230,243
South Africa	202,703	0	0	0	251,505
Zambia	0	0	405	0	405
Total	700,245	34,425	321,773	10,328	1,365,660

Source: Estimates by JICA Study Team based on the traffic survey data collected.

The following are observed.

a) The total cargo traffic volume in the Study Area in the year 2000 including transit cargoes was about 1.37 million tons per year (about 4,550 tons/day),

b) Transit traffic accounted for 81% of the total cargo traffic volume in the Study Area. Freight traffic originating or terminating in the Study Area was only 19%,

c) As for OD of the freight traffic volume, that of Malawi-South Africa was the largest among all OD pairs with a total volume of 0.52 million tons (about 38% to total cargoes). The second largest OD pair was Beira-Malawi followed by Malawi- Zimbabwe. Cargo movements to/from Zambia from/to other areas were low.

1.3.3. Regional freight movements

Transport demand in Mozambique has been declining significantly over the last two decades, mainly due to destruction of socio-economic infrastructures. Roads as well as railways and ports are in a poor condition everywhere. The government has been making great efforts to rehabilitate and maintain these infrastructures since 1994, resulting in the recovery of these infrastructures to a tolerable level.

For the last two decades, agricultural production in the region has been characterized by self–sustained production. Many farmers produce agricultural products mostly for their living with little cash crop production. Many farmers were constrained to get involved with commercialized production due to poor transportation infrastructures and limited availability of transportation means to transport agricultural products to other areas and to purchase consumer's goods.

As the political situation has stabilized and socio-economic infrastructures improved, the agricultural system in the region has been expanded and many farmers began to produce crops in surplus. As a result, many farmers now wish to sell their products to markets. They, however, have a limited transport means to markets. They transport their cash crops to markets either by bicycle, animal drawn cart or on foot. Sometimes small-scale traders come to the region and buy their products by trader's own transport means.

According to the interviews with the administrators in the Study Area, each district, except Tete and Moatize cities, has only a few vehicles. They are mostly donated by international organizations. They are used only for medical purposes or social purposes, and not for transporting agricultural products. The study team sometimes observed that representatives of villagers have travelled to markets in major town such as Tete to sell their products using public transport system. It also observed that some traders of Malawi buy agriculture products in Angonia and Tsangano and transport villager's products to Malawi's markets.

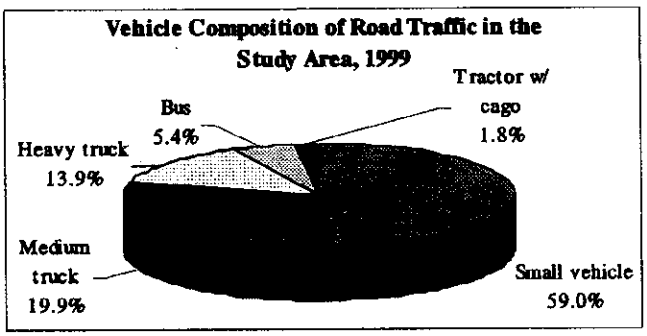
Main roads have been rehabilitated and maintained but used mainly by non-motorized transportation for agricultural products due to the lack of means of motorized transport. Farmers need access to larger and more markets to sell their products.

Traffic volume on the major roads in the Study Area is shown in Figure 1.2. According to this figure, the traffic volume on the roads except EN 103 is generally very small. This is largely due to small-scale agricultural farmers, lower rate of cash crops, lower level of family income, and low level of vehicle ownership.

In addition, the following features are observed from this figure.

a) Traffic volume on EN103 is extremely high compared with the other roads. The traffic volumes on this road are 3,100 vehicles/day between Tete and Matundo, 2,110 vehicles/day between Matundo and Mortize, 1,555 vehicle/day between Mussacama and Zobue and 550-570 vehicles/day on the other sections. This road can be defined as international road linking South Africa, Zimbabwe, Mozambique and Malawi on one part and the Beira Port and Malawi on the other part. Heavy-truck composition is very high because many international heavy trucks pass through this road. At the same time, many traffic concentrates in this road due to major secondary roads such as EN 221/222 and EN223 connecting with this road.

b) The share of small vehicle is 54%, while heavy trucks such as trailers, heavy lorry, container trucks and tank lorry with the maximum loading capacity of 30-40 tons account for 14%.



c) The traffic volume on other roads is comparatively small. Road sections over 100 vehicles/day are EN 222 (between Matundo and Matema), EN 221 (between Matema and Moatize boundary), EN 223 (between Massacama and Ulongue).

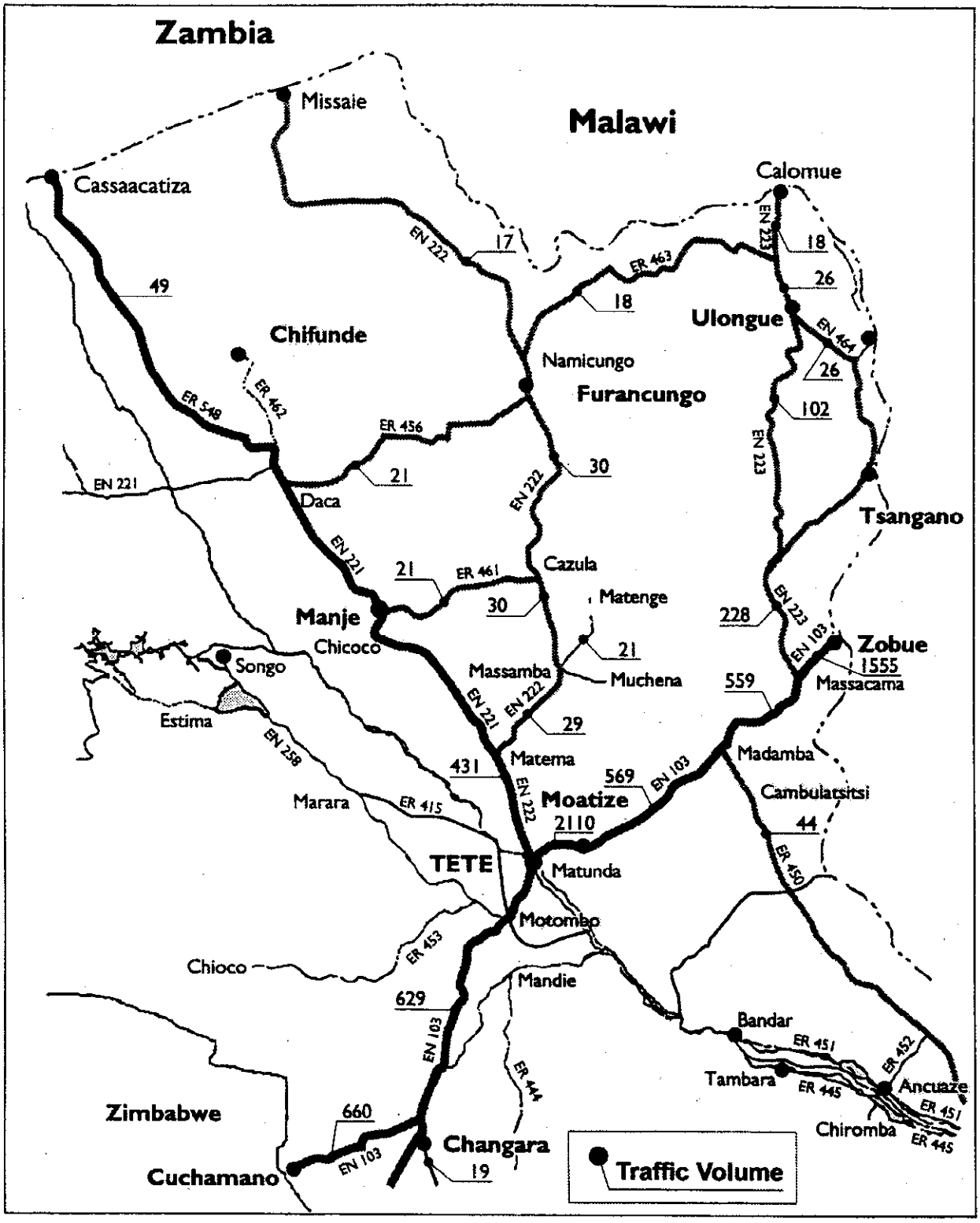
The average vehicle composition rate in the study area is as follows;

Vehicle Composition of Average Road Traffic in the Study Area, 1998

Vehicle Type	Percentage (%)
Small vehicles	60
Medium and heavy trucks	33
Buses	5
Tractors	2

Source: ANE traffic count survey in 1998.

Figure 1.2. Traffic Volume on the major Roads in the Study Area



1.4. Existing Transport Facilities and Services

1.4.1. Overall transport situation

Figure 1.3 shows the existing transport networks in Mozambique. This figure shows the strategic location of Mozambique in relation to the neighboring countries, advantageous as providing import and export routes. Those neighboring countries, namely Malawi, Zimbabwe, Zambia are land-locked with no marine ports. The transport system in this region, therefore, has evolved in relation to marine ports. Three transport corridors have developed in Mozambique, namely Maputo, Beira and Nacala Corridors.

1.4.2. Roads

(1) Overall road network

The table below shows a comparison of road densities among the SADC countries. The table shows the road densities in Mozambique are one of the lowest among the nine countries.

International Comparison of Road Densities in SADC Countries

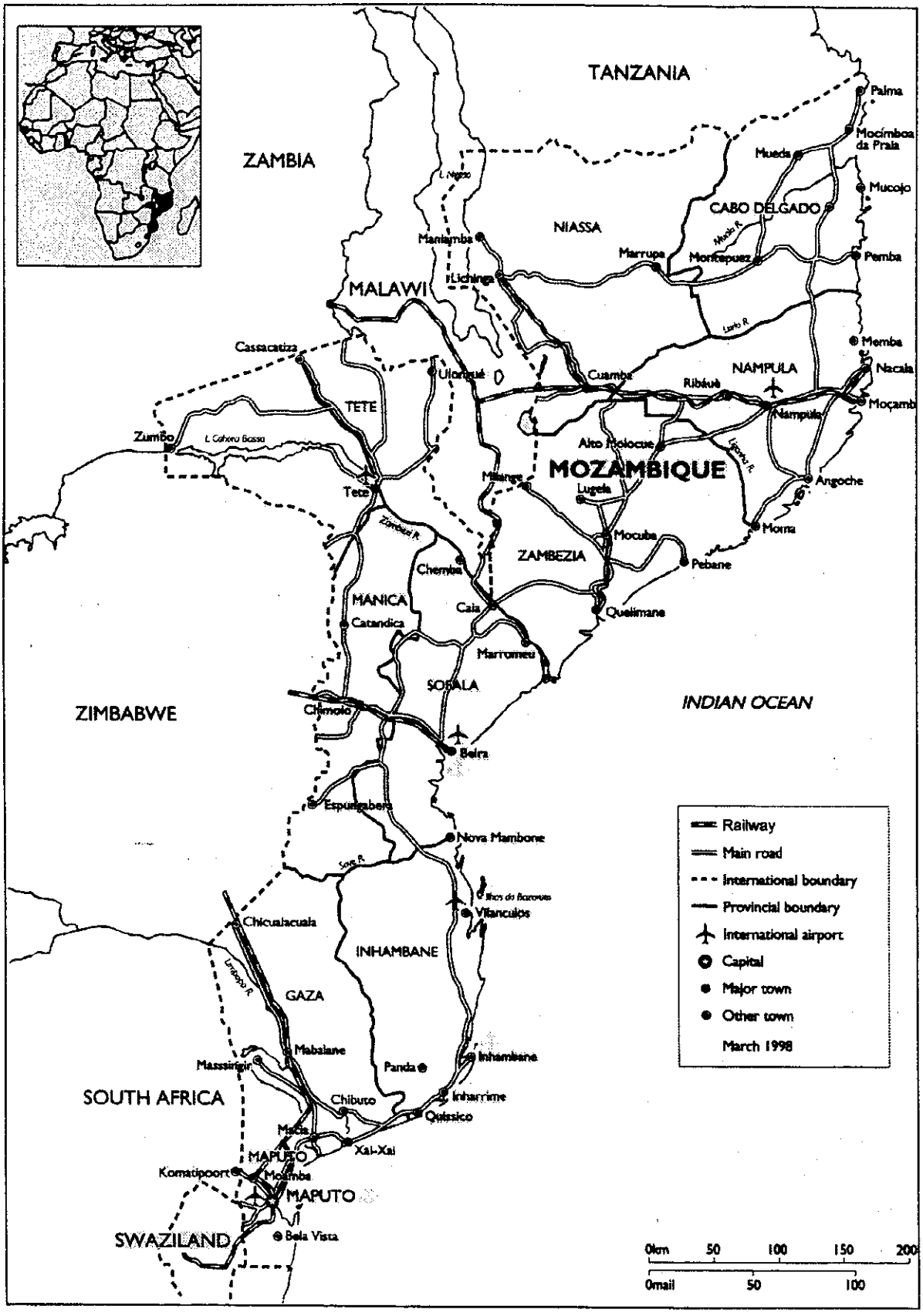
Country	Road length [1] (km)	Area [2] (km^2)	Population [2] (10^3-person)	Road density (km/km^2)	Road density ($km/10^3$-person)	Road density (km/sq rt km^2 persons)
Mozambique	26,192	799,380	16,500	0.033	1.587	7.21
Angola	70,570	1,246,700	11,000	0.057	6.415	19.06
Botswana	18,327	581,700	1,000	0.032	18.327	24.03
Malawi	14,594	118,500	10,000	0.123	1.459	13.41
Namibia	39,156	824,300	2,000	0.047	19.578	30.49
South Africa	511,352	1,221,000	38,000	0.418	13.456	75.07
Tanzania	88,000	945,100	30,500,	0.093	2.885	16.39
Zimbabwe	85,488	390,800	11,300	0.098	7.565	40.68
Zambia	66,000	752,600	9,500	0.088	6.947	24.68

Sources: 1) Transport and Communication, *Study for South Africa, Volume 1 Summary and Main Report*, 1998; 2) INE, *Statistical Yearbook*.

The roads in Mozambique can be classified as follows.

- Primary roads are public roads. They constitute part of the Main Road Network, connecting cities, provincial capital cities and main centers, main ports and border ports of the neighboring countries.
- Secondary roads are public roads complementary to primary roads connecting provincial centers, sea and river ports, trade, industrial and agricultural centers, railways stations and these with primary roads.
- Tertiary roads form part of the road network, which connects district centers or local interest areas and Secondary Roads.

Figure 1.3. Existing Transport Networks in Mozambique



- Unclassified roads are those to which no class has been assigned.
- Urban roads are public roads located in the urban area.

The classified roads, either primary, secondary or tertiary roads, are controlled and managed by ANE, while non-classified roads, consisting of district roads and urban roads, are managed by district offices and municipalities, respectively.

Mozambique has a total road length of 29,200 km, of which primary roads are 4,310km or 15% of total length, the secondary roads 8,124km or 28%, the tertiary roads 13,777kms or 47%, and the remaining non-classified roads as shown in the table below.

Road Length in Mozambique, 1998

Type	Length (km)	Percent (%)
Classified Roads	26,211	90
Primary road	4,310	15
Secondary Road	8,124	28
Tertiary Roads	13,777	47
Unclassified Road	2,996	10
Total	29,207	100

Source: INE, *Statistical Yearbook, 1998.*

The following table shows pavement type of the roads in Mozambique. Although great efforts have been made during the last decade, the length of the paved roads is only 5,339 km or 20% of the total length. Dirt or earth roads still extend for 13,918 km or 53%.

Road Length by Surface Type, 1998

Type	Length (km)	Percent (%)
Paved	5,339	20
Gravel	6,935	26
Dirt	13,918	53
Total	26,192	100

Source: INE, *Statistical Yearbook, 1998.*

The following table shows the conditions of roads. Good and fair condition roads in Mozambique are about 7,300km or 28% of the total length. Weak and bad conditions are predominant among the road network with a total length of about 14,000km or 53%, whereas impassable road length is 4,500km or 17%.

Road Length by Surface Condition, 1998

Surface Condition	Length (km)	%
Good	3,528	13
Fair	3,822	15
Weak	6,019	23
Bad	8,276	32
Impassable	4,548	17
Total	26,193	100

Source: INE, *Statistical Yearbook, 1998.*

(2) Road network and conditions in the region

The road network in Tete Province is shown in Figure1.4. The roads with bold line are mostly paved sections in higher rank, while other sections remain mostly gravel or earth roads. The main road network in Tete Province has the following features.

EN103, defined as an international road connecting Zimbabwe and Malawi, runs in the northeast to southwest direction. This road together with EN102 (from Changara in Tete Province to Chimoio in Manica Province) and EN6 (from Beira to Chimoio) provides important link in the Beira Transport Corridor.

The other international road, consisting of EN221, EN222 and EN548, leads to Zambia. This road runs from northwest to southeast direction in the region. These roads with EN 103 reach the neighboring countries and the Port of Beira.

The road length by road classification in Tete Province and the Study Area is shown below. The share of the secondary roads in the Study Area is higher than that in Tete Province.

Road Length in the Region

Type	Tete Province[1)]		Study Area[2)]	
	Length (km)	Percent (%)	Length (km)	Percent (%)
Classified Roads	2,838	92	1,529	97
Primary road	270	9	123	8
Secondary Road	1,084	35	948	60
Tertiary Roads	1,484	48	458	29
Ulassified Road	243	8	47	3
Total	3,081	100	1,576	100

Sources: 1) ibid.; 2) Estimates by the Study Team

The road density in Tete Province and the Study Area is shown in the following table. It is observed that the road density in the Study Area is slightly higher than that of Tete province.

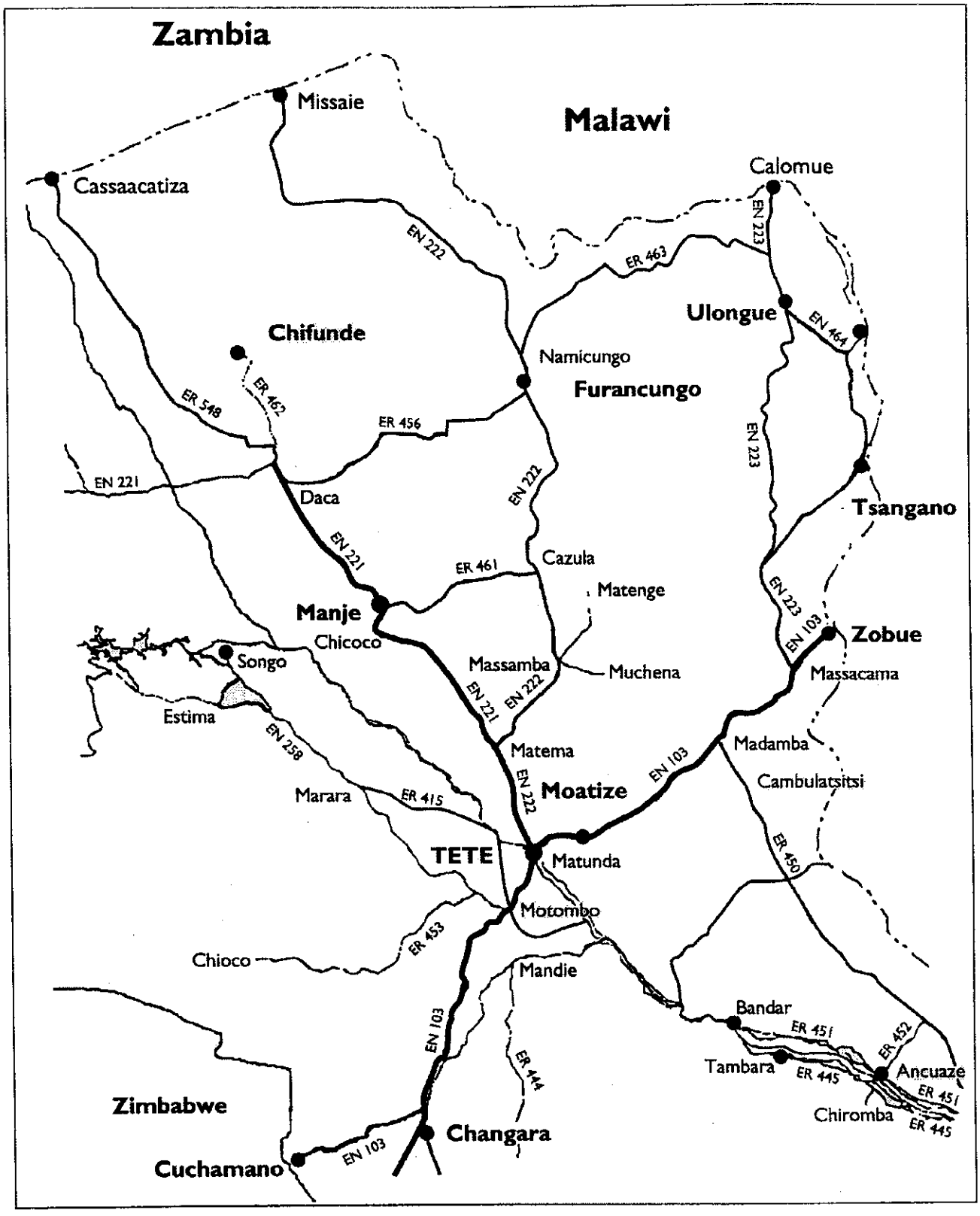
Comparison of Road Density in the Region

	Road Density		
	km/km²	km/10³ persons	km/√km² x pop
Mozambique	0.033	1.59	7.21
Tete Province	0.031	2.69	8.83
Study Area	0.039	2.22	9.26

Source: Estimates by the Study Team.

The pavement type of the roads in Tete Province and Study Area is shown below. The paved road length of Tete Province and the Study Area is almost same. The gravel road length of the Study Area is higher than that of Tete Province. This indicates that the maintenance level of the roads in the Study area is better than that of Tete Province.

Figure 1.4. Road Network in Tete Province



Road Length by Surface type in the Region

Type	Tete Province [1]		Study Area [2]	
	Length (km)	%	Length (km)	%
Paved	881	31	545	35
Gravel	215	8	660	42
Dirt	1,742	61	371	23
Total	2,838	100	1,576	100

Sources: 1) INE, *Statistical Yearbook, 1998*; 2) Estimates by the Study Team.

The road condition in the Study Area is better than in Tete as shown below.

Road Condition in the Region

Condition	Tete Province [1]		Study Area [2]	
	Length (km)	%	Length (km)	%
Good	270	10	545	35
Fair	795	28	552	35
Weak	1,007	35	365	23
Bad	496	17	40	3
Impassable	270	10	47	3
Total	2,838	100	1,576	100

Sources: ibid.

The characteristics of the major roads in the Study Area are described below.

EN 103

This road ensures quick connection between Zimbabwe and Malawi. It acommodates the trafic between Tete and Chimoio cities from the EN 102. This road is all tarred with generally good condition with some pothols in the section between Changara and CuchamaNo. Periodical maintenance works have been made recently.

EN 221

The EN 221 after the intersecting point with the EN 222 connects Tete city with Zambia through border posts of Malowera and Cassacatiza. All the four sections of this road are tarred in a reasonably good condition. All sections have been under a periodical maintenance or a routine maintenance until now.

ER 222

The starting of this road is also after the intersecting point in Matundo (with EN 103) and it goes to Missaie, through Matema, Massamba, Cazula, Furacungo and Namicunga. The first section of this road between Matundo and Matema is tarred,and the remaining section of the roads is gravel. Its conditions are reasonable.

EN 223

EN 223 starts at the intersecting point in Mussacama on EN 103 and reaches at Calomue on the border with Malawi passing through Ulongue. The road is basically tarred except

some sections as gravel road. This road is generally in a fair condition with some portions in a weak condition. A periodical and a routine maintenance programs are needed. Two bridges along this road requires rehabilitation..

ER 456

The road connects Daca on EN221 and Furancungo on EN 222. This road is made by gravel. It is in a fair condition. Improvement of this road was made in the recent year under routine maintenance programme.

ER 461

ER 461 extends from Chicoco (Manje) to Cazula connecting EN 221 to EN 222, which goes up to ER 456 in the North. The road is gravel type. It is in a fair condition. Maintenance works were made under the routine maintenance programme.

ER 462

This road extends from Bene to Chifunde. The road is of gravel type and is in a reasonably fair condition. There is a temporary wood bridge over a river, which requires immediate reconstruction.

ER 463

This road connects between Calomwe on EN 223 and Furancungo on EN 222. This road is gravel type in a reasonably fair condition. Its improvement was made under routine maintenance programme in the recent year.

ER 548

ER 548 is a tarred road in a good condition. It connects Bene on the cross with ER 462 to Cassacatiza on border with Zambia. It continues from EN 221 and 222 and functions as an international road to Zambia. This road has been under periodical maintenance programme.

(3) Road maintenance and rehabilitation

1) Routine maintenance

Routine maintenance is the activity to be carried out once or twice per year. Routine maintenance is made by employing labor, either skilled or unskilled. These operations are planned and carried out regularily. During routine maintenance works of the gravel and earth roads, the following activities are undertaken.

a) Regularization, light or deep, according to the real situation. Manual closure of small pockets, designation of the routine closure, smoothing of the specific materials,
b) Designated public area: Obstacle removal on road side. Refilling at inferior level. Vegetation control.

c) Drainage works: Removal of obstacles and cleaning of the channels and hydraulic passages. Reconstitution, refilling and opening of small channels.

d) Repair of damages and the hydraulic passages. Repairs of the head walls.

These activities can be compulsory or occasional. They are compulsory when routine maintenance has to be carried out on defined periods, 5 to7 years generally, on the planned works, independently of the quality level and the road services. Occassional works has to be made according to the necessities and demand to gurantee the minimum quality and service level. It is recommended that the compulsory activities be made annually with a systematic control of the roads.

2) Periodic Maintenance

Periodic maintenance is an activity required in a road section after some years. These interventions are normally of great magnitude. They need equipment and skilled labour. These operations are costly and a careful planning needed. From time to time urgent works with emergency nature take place

The following activities are carried out in periodic maintenance.

a) On carriage way
   - Manual refilling of large areas
   - Recharge (manual and with tractors) general or localized according to the level of damages seen on the road surface

b) On designated public areas
   - Recharge of the sides
   - Erosion control
   - Repairs

c) In drainage works

It is recommended that periodic maintenance be carried out in every five-year term before the carriage way disappears completely.

3) Road maintenance and rehabilitation of non-classified roads

In accordance with the road policies of the government, management of the roads not classified is of the responsibility of district administrations. They prioritize those roads with more impact on agricultural commercialization. At the district level, administrations have shown lack of capacity in organizational, technical and financial aspects in achieving the objectives. District administrations often do not have sufficient fund due to insufficient revenue source such as tax revenue. A great part of the rehabilitation and maintenance of these roads have been carried out by the NGOs and some private companies for their benefit.

(4) Road construction industry

Registration and classification method of contractors was established in 1988. In 1989, 19 contractors were registered, followed by 62 in 1990 and 23 in 1991. In 1993, 123 contractors were registered with the Ministry of Public Works and Housing. Of these, nine were with foreign capital and four were state enterprises. Those qualified to the road works were eleven enterprises and ten state contractors for road and bridge construction (ECMEP). Only a small part of the local contractors and foreign contractors were ready for participating in major projects with a budget of one million dollars or more.

The drawbacks and disadvantages of the local contractors are:

- lack of transparent financial and fiscal operation, an important factor for promoting investments and assistance for local contractors,
- lack of specific support for developmening the contractors in the rural area,
- competition with international contractors,
- lack of financial capacity and delay in reaching contract agreement,
- lack of capable managers, technicians, and administrative staff, and
- complex administration in prospect tenders announced by the government and lack of transparency on the evaluation of tenders.

Maintenance of the roads made in 1998 was allocated in the following proportions:

- ECMEP's (10 enterprises): 70%
- Local contractors (47 enterprises): 11%
- Consortium of enterprise: 18%

The total number of labours involved in the road maintenance was 6,000 employees. The ECMEPs are in the phase of privatization.

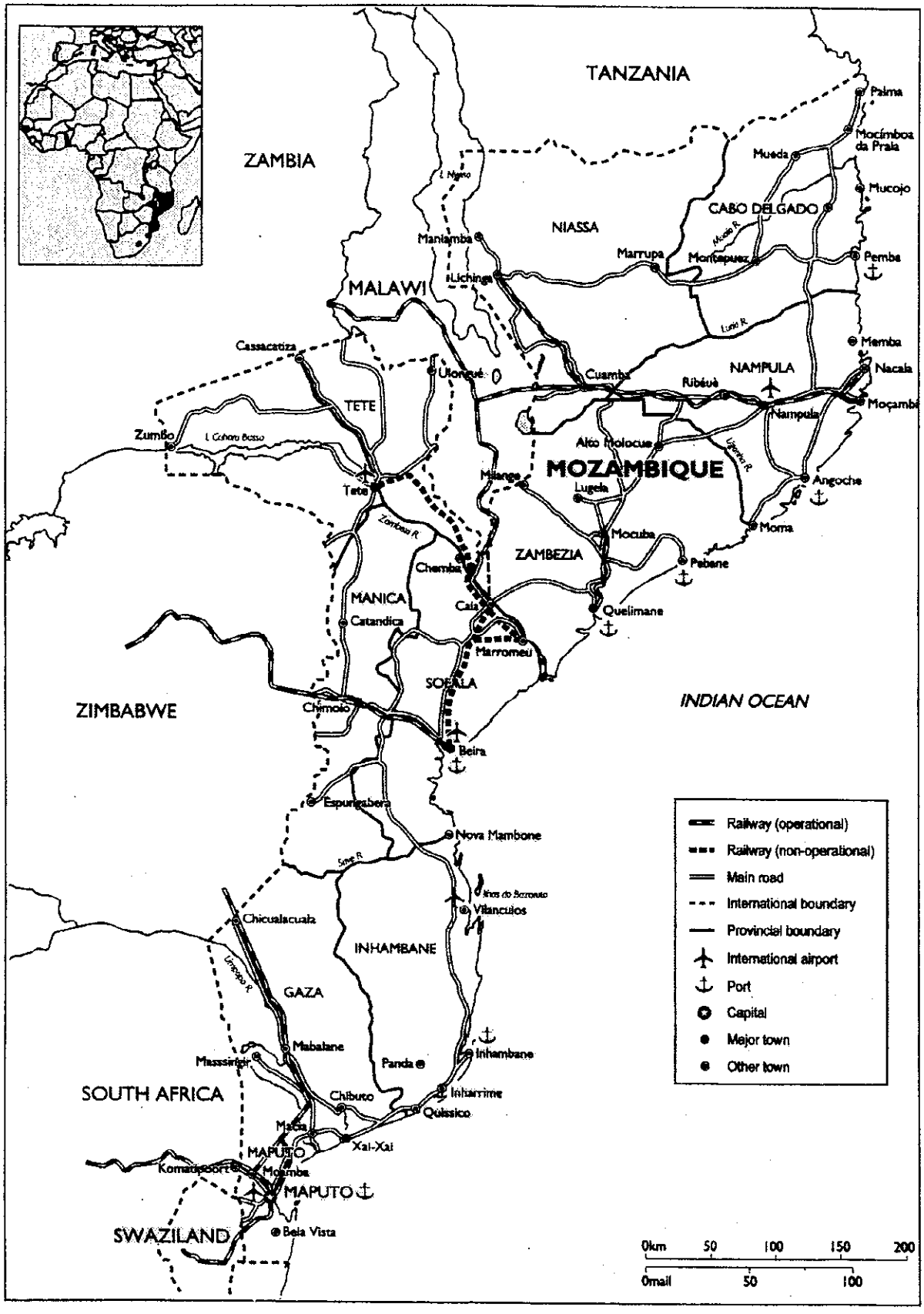
1.4.3. Railways and ports

(1) Overall situation of railways and ports

Geographically Mozambique is located in import and export routes for the neighboring countries, namely Malawi, Zimbabwe, Zambia. These land-locked countries have no marine ports. The transport system in Mozambique, especially railways, therefore, has developed in relation to marine ports. In Mozambique, there are three major transport corridors, namely Maputo, Beira and Nacala Corridors. Figure 1.5 shows the railways and ports system in Mozambique.

The railway and port facilities in Mozambique have historically been developed together, under the operation of the Mozambique Railways and Ports Authority (CFM). The CFM divides Mozambique into three regions, each administered by CFM-South, CFM-Center, and CFM-North. The Beira corridor, which is directly related with the Study Area,

Figure 1.5. Rail and Port System in Mozambique



includes the Machipnda line, Sena Line and Beira Port. These facilities are operated and managed under CFM-Center.

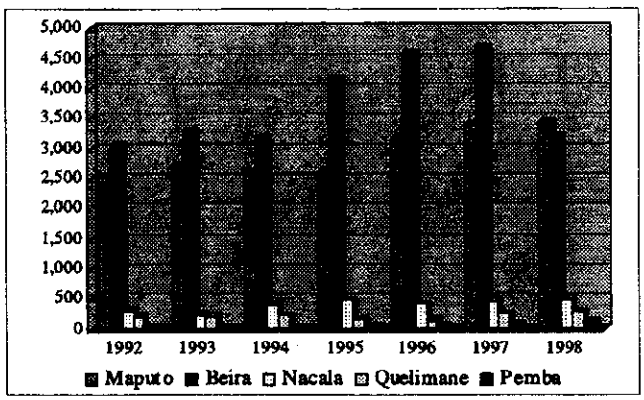
An outline of the ports and railways in Mozambique are described below.

(2) Port

1) Major ports in Mozambique

In Mozambique, there are five major seaports, Maputo, Beira, Nacara, Quelimane, and Pemba, of which three function as the regional ports of SADC countries. The cargo handling volume of these five ports are shown below.

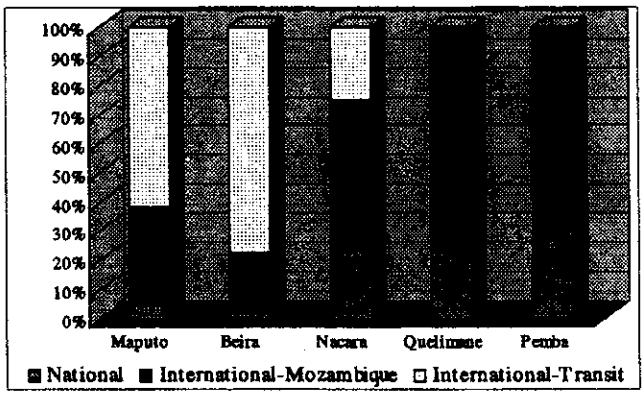
Trend of Cargo Handling Volume by Major Ports, 1992-1998



The total cargo handling volume in Mozambique increased at about 8% per annum during the 1992-1997 period, though not reaching the peak year of 1975.

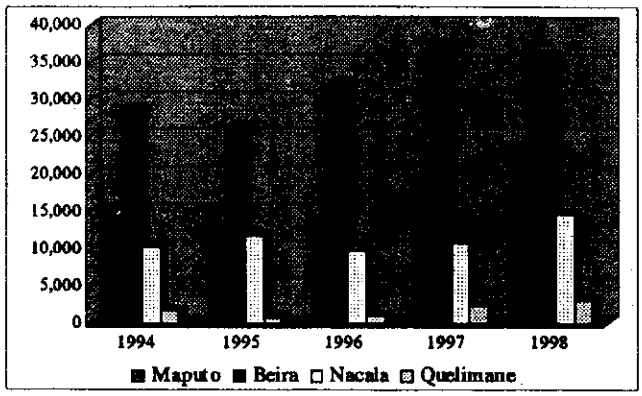
The Mozambique's railway and port system serve as the import and export routes for the neighboring counties. As a result, transit traffic accounts for a substantial portion of the total traffic. The table below shows percent shares of transit traffic in the total cargo throughput. The share of transit traffic in Maputo, Beira, and Nacara ports is 60%, 80% and 25%, respectively.

Share of Transit Traffic



Container traffic in the major ports is shown below. Container traffic had been increasing rapidly in recent years. The container handling volume in Beira Port is the largest among all the ports.

Container Handling Volume by Port, 1994-1998



2) Beira Port

Export and import cargoes from the Study Area are handled through the Beira Port. Figure 1.6 illustrates the layout plan of the existing Beira Port facilities. Table 1.3 shows an outline of the facilities. The cargo handling capacity of the Beira Port is around 5 million tons per annum. The actual handling volume in 1999 was about 2.1 million tons including oil. The utilization rate of this port was about 40%.

The Beira Port suffers from a serious sedimentation problem caused by the Pungue River. To tackle this problem, the Port of Beira acquired a dedicated dredger with Japanese grant aid program. Additional investment, however, needs to be made to ensure calling by larger ocean-going vessels. The port of Beira has a coal terminal for Moatize coal. At this moment, however, this terminal is not functioning.

Operation of the Beira Port except the coal terminal has already been privatized. At this moment, performance of its operation is generally very good.

(3) Railways

1) Overview of railways

Railway cargo traffic volume by region is shown below. In Mozambique, there are three major railway regions, namely south, center, and north. These three regions correspond to Maputo, Beira, and Nacara Corridors. With yearly fluctuations, railway cargo traffic volume has been generally increasing.

Figure 1.6. Layout Plan of Beira Port Facilities

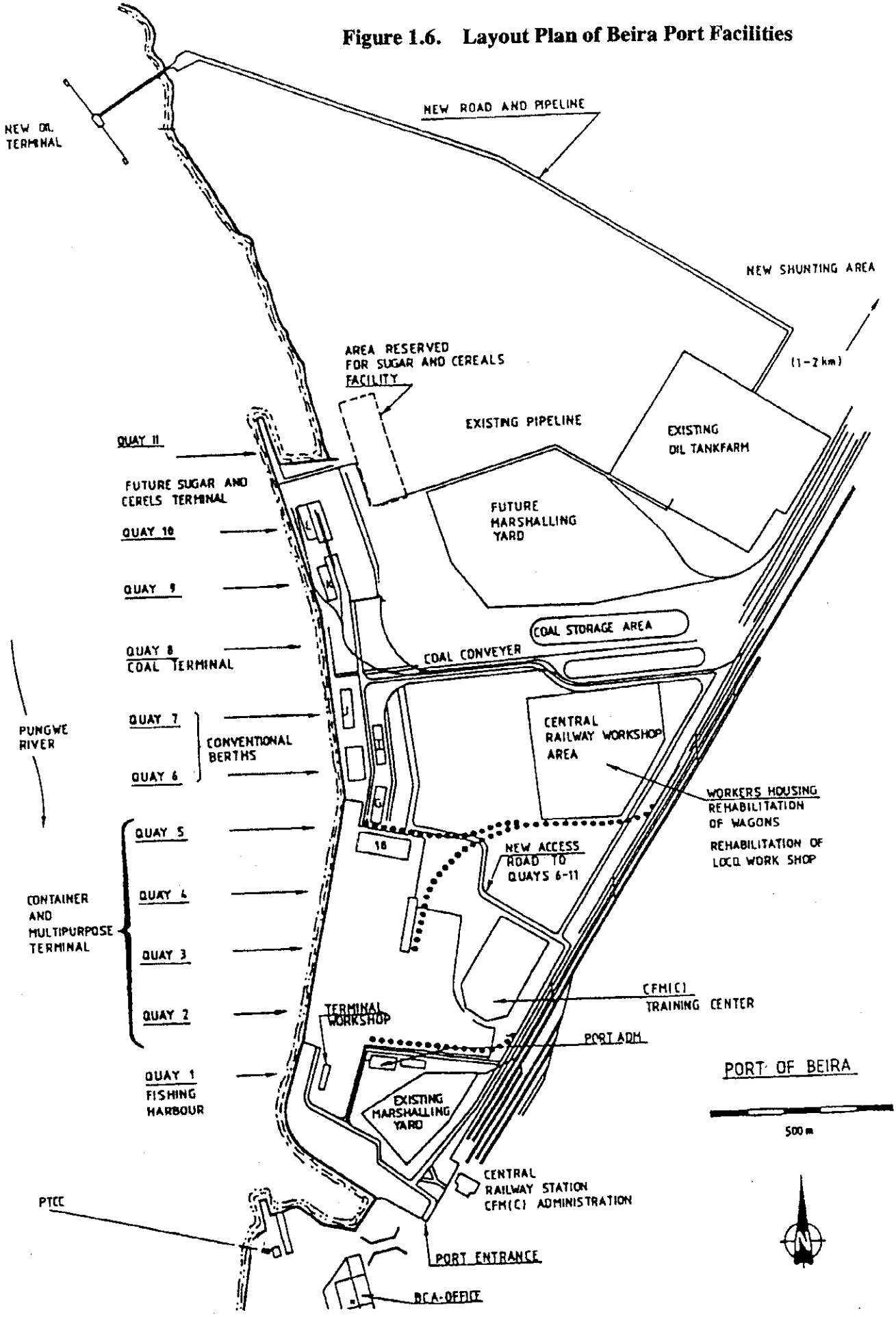
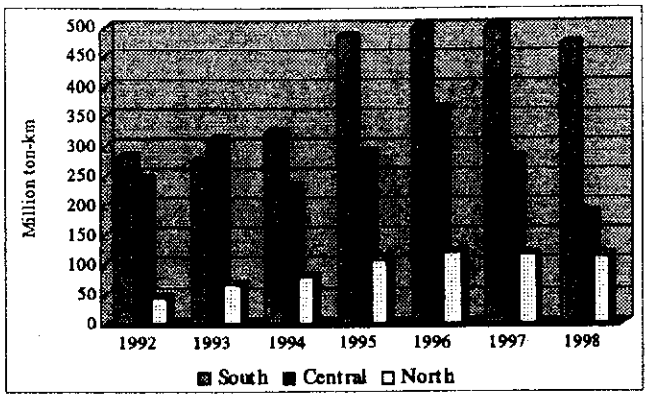


Table 1.3. Facilities and Service at Beira Port

Terminal & Quays	MCT Quay 2-5	GCT Quay 7, 9 & 10	Cold Storage Quay 6	Coal/Ore Terminal Quay 8	Oil Terminal Quay 11	New oil Terminal Quay 12
Quay Length	645m	857m (Quay 6-10)	Included in 857 m	Included in 857 m	228m	264m
Depth	Quay 2-4=11m, Quay 5=9m	Quay 7=7.8m, Quay 9, 10=9.2m	6.8m	7.2 m	9m	12m
Capacity	100,000TEU/year	2,300,000		1,200,000	4,500 dwt to 20,000dtz	4,500 dtz to 60,000dtz
Commodity	Containers, granite & copper	Dry general cargo	Citrus fruit, vegetables & fresh produce	Coal, tallow & molasses	Fuel & oil (jet, diesel, petrol, avgas, etc.)	Fuel & oil (jet, diesel, petrol, avgas, etc.)
Handling Equipment	2 gantry cranes (50t), Kalmar forklifts (16-45t), Kalmar reach-stacker (45t), 1 rail transfer crane, forklifts, tugmasters, tractors, trailers, etc.	Cat. forklifts (35t), 12 Linde forklifts (3, 5 & 7 tons), Bobcats for bulk cargo	3 electric cranes of 3 tons & 2 of 2 tons	1 unit of 200 t/hour capacity & 2 of 90 t/hour; 8 bagging units		3 loading arms with pipes of 10" & a manifold for loading hoses
Warehouse	one 10,000m^2	15,000m^2	340,648m^2			
Stacking Area	200,000m^2					
Electrical Refer Points	74					

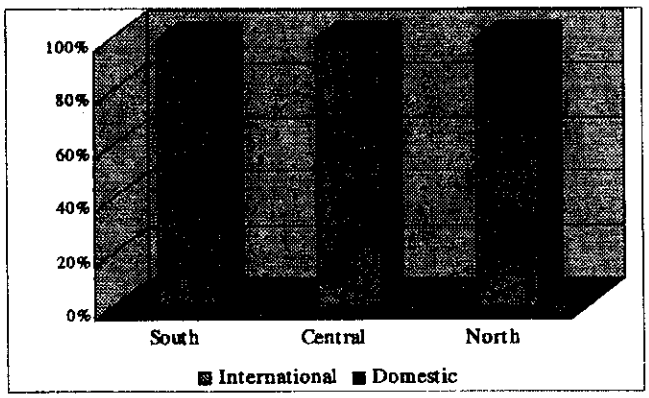
Source: CFM-Central, *Beira port Handbook 1999*.

Trend of Railway Cargo Traffic Volume by Regions, 1992-1998



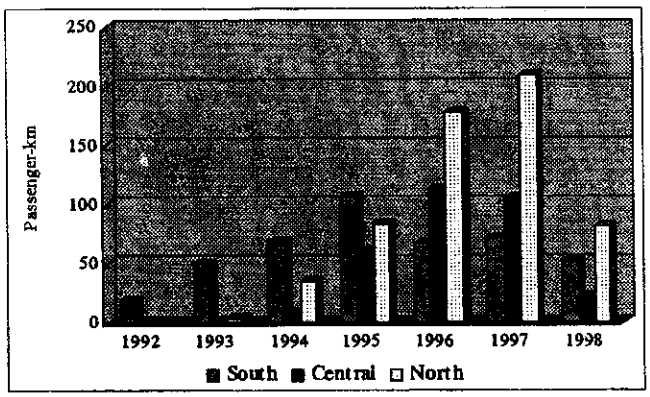
International transit cargo and national cargo volumes are shown below. The share of international transit cargo to the total cargo is very high. In Beira corridor, 96% of the railway cargo traffic is transit in terms of ton-km basis, serving mainly the neighboring countries.

Share of Transit Traffic by Regions, 1998



Railway passenger traffic volume by region is presented below. The passenger traffic had been increasing annually during the 1992-1997 period, but drastically dropped in 1998.

Railway Passenger Traffic Volume by Regions, 1992-1998



2) CFM-Center

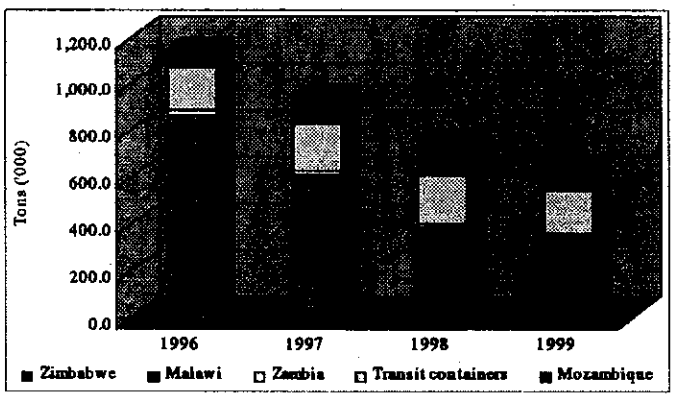
Table 1.4 shows cargo traffic volume of the Machipanda Line in 1999. The following features are observed.

a) The total freight traffic in 1999 transported by the Machipanda line from/to Zimbabwe, Zambia, and influential areas of this line in Mozambique was 0.65 million tons, of which the up-traffic to Zimbabwe was 0.34 million or 52% and the down-traffic to the Beira port was 0.31 million or 48%.

b) As for the up-traffic to Zimbabwe, fertilizer, vehicles and containers were predominant. The down-traffic to the Beira port included granite, copper, stone and cotton.

c) Freight traffic volume has been decreasing year by year. The freight traffic volume in 1999 was 0.65 million tons down from 1.2 million tons in 1996.

Machipanda Railway Traffic Volume, 1996-1999



(3) Review of Sena railway program

The World Bank funded a feasibility study on the rehabilitation of the Sena railway completed in 1997 by Giersing Rose Ltd. This study analyzed the possibility of developing Moatize coal with the rehabilitation of the Sena railway. After this study, CFM held a conference on the rehabilitation and reconstruction of the Sena line in 1998 in order to call on investors and donors. Recently, GPZ has undertaken a study called "the Sena Line Program (SLP)" and prepared a strategy assessment report in May 2000. A review of these studies follows.

The Sena railway line was completed in 1922 up to the Zambezi river and extended to Moatize and Blantyre in 1934 with the construction of the Dona Ana Bridge. The Portuguese and British colonial governments collaborated closely in funding and construction works.

Table 1.4. Cargo Traffic Volume of Machipanda Line, 1998-1999

(Unit: 10^3t)

					Growth rate (%)		
	1996	1997	1998	1999	96-97	97-98	98-99
Down traffic (to Beira)	697.0	598.2	336.6	337.5	-14.2	-43.7	+0.3
Zimbabwe	492.5	383.9	122.9	126.1	-22.1	-68.0	+2.6
Malawi	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Zambia	26.6	23.3	12.0	14.5	-12.4	-48.5	+20.8
Transit containers	129.2	146.0	142.3	151.6	+13.0	-2.5	+6.5
Mozambique	48.5	45.0	59.4	45.3	-7.2	32.0	-23.7
Up traffic (to Zimbabwe)	455.2	352.0	416.2	311.5	-22.7	+18.2	-25.2
Zimbabwe	380.3	232.2	273.2	230.1	-38.9	+17.7	-15.8
Malawi	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zambia	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transit containers	52.5	53.5	66.1	31.7	+1.9	+23.6	-52.0
Mozambique	22.4	66.3	76.9	49.7	+196.0	+16.0	-35.4
Total	1,152.2	950.2	752.8	649.0	-17.5	-20.8	-13.8
Zimbabwe	872.8	616.1	396.1	356.2	-29.4	-35.7	-10.1
Malawi	0.2	0.0	0.0	0.0	-100.0	0.0	0.0
Zambia	26.6	23.3	12.0	14.5	-12.4	-48.5	+20.8
Transit containers	181.7	199.5	208.4	183.3	+9.8	+4.5	-12.0
Mozambique	70.9	111.3	136.3	95.0	+57.0	+22.5	-30.3

Source: CEM Center.

As illustrated in Figure 1.7, the Sena Railway runs between Beira and Moatize via Dondo, Inhaminga and Caia. Branches exist towards Marromeu and Villa Nova. The total length of this line is about 580 km. In the central and northern regions of Mozambique, the Machipanda line and the Nacara line are both operational, serving different areas. These two railway lines share part of the potential market area of the Sena railway line.

As for the traffic demand, the SLP study forecast the Sena railways transport demand, at about 0.5 to 0.8 million tons per annum. This does not include the freight transported in containers between Beira and Malawi, or Beira and the northern portions of Zambia. This does not include potential coal production in Moatize, either.

CFM made a separate forecast on the basis of 1981's actual traffic demand and taking into consideration the potential along the line. The total traffic demand in 2001, after the opening of the Sena line, is forecast at about 1.8 million tons per annum and is expected to rise to about 4 million tons in 2006. This includes potential coal production in Moatize and Malawi's overseas trade (Table 1.5). If the traffic for coal and Malawi's overseas trade is subtracted form the total traffic estimated by CFM, the total demand for the Sena line would be around 0.8 million tons per annum, equivalent to the high estimation of the SLP study. The important factors of the traffic volume of the Sena railway are potential coal production and Malawi's overseas trade.

Figure 1.7. Location Map of Sena Line

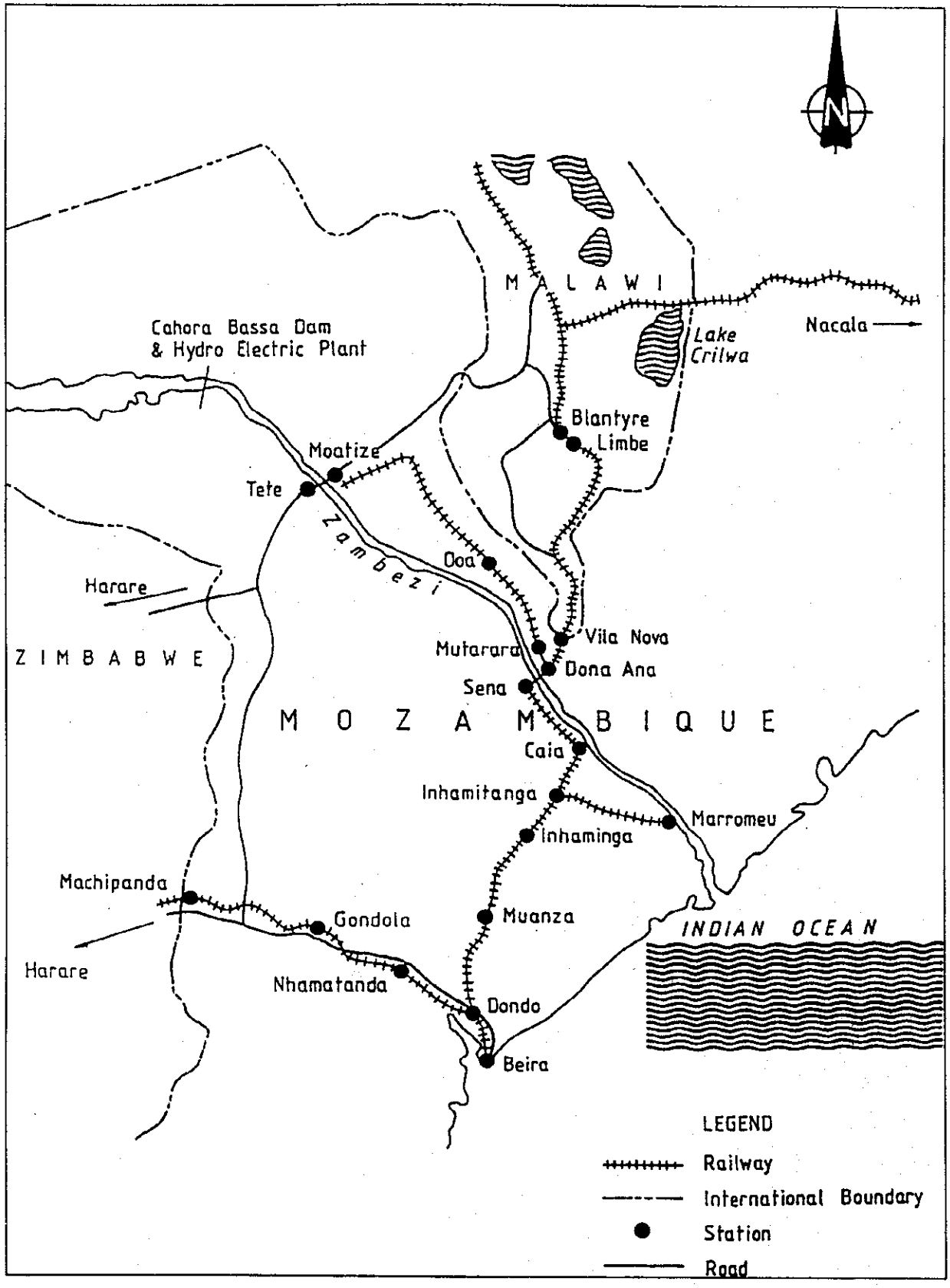


Table 1.5. Transport Demand of Sena Line

(Unit: 10^3t)

Item	1981	2001	2006 Low	2006 High
Coal	600	800	2,000	7,000
Sugar	120	60	115	115
Molasses	30	22	40	40
Timber	20	30	95	95
Cotton	40	40	80	80
Limestone	300	150	225	225
Fertilizer	75	53	140	140
Construction materials	55	80	125	125
POL	40	65	150	150
Cement	13	130	197	197
Container	50	54	90	90
General cargo	50	90	120	120
Malawi overseas trade	500	285	600	600
Total	1,893	1,859	3,977	8,977

Source: CFM, First Technical and Financial Conference: Rehabilitation and Reconstruction of Sena Line, April 20, 1998.

Since the Sena railway has been abandoned in around 1984, tracks, rolling stocks, and stations are heavily mined with explosive devices. The consensus on the track condition is as follows.

a) The worst conditions are encountered in the areas between Mwanzasa and Caia, especially around Inhaminga. In some sections tracks were overturned or have disappeared completely.

b) Between Sena and Moatize, the line is supposed to be in a better condition and structures seem to be robust.

c) Although the track has been de-mined between Dondo and Mwanza,the rural population avoid living in this area.

In the Sena line program, the following scenarios were proposed for different levels of development:

- Scenario 1: No railway scenario
- Scenario 2: A low - level railway rehabilitation scenario
- Scenario 3: A high - level railway rehabilitation scenario

The SLP study recommends the low-level rehabilitation (scenario 2) as most preferable. It includes re-establishment of the line from Dondo through Sena and via Vila Nova de Fronteira to Malawi, including Marromeu line but not to the Moatize branch. The advantage of this scenario is a significant reduction in capital requirements while coping with mid-term tangible cargo demand.

1.4.4. Road transport

(1) Vehicle registration

Registered motor vehicles in Mozambique had been gradually increasing since 1993 (Table 1.6). In Mozambique, there were 60,241 registered vehicles in 1997, of which 75% were light vehicles. Heavy vehicles accounted for 14.6% and the remaining were motorcycles. The motorization level in Mozambique is very low at 3.6 vehicles per 1,000 persons. Vehicles are not affordable for many people due to their low income, resulting in a low motorization rate. Mozambique is the lowest group among SADC countries.

Table 1.6. Vehicles Registered in Mozambique and by Province

	1992	1993	1994	1995	1996	1997	Growth Rate (%)
Mozambique	46,453	47,659	52,988	53,268	54,026	60,241	5.3
Light vehicles	30,467	30,408	33,076	29,506	36,134	45,134	8.2
Heavy vehicles	7,865	8,131	10,035	10,455	9,553	8,771	2.2
Motorcycles	8,121	9,120	9,877	13,307	8,338	6,336	-4.8
Province							
Niassa	n.a.	n.a.	627	699	848	841	10.3
Cabo Delgado	n.a.	n.a.	1,119	1,152	2,134	2,231	25.9
Nampula	n.a.	n.a.	3,879	4,249	6,906	7,546	24.8
Zambezia	n.a.	n.a.	786	735	899	860	3.0
Tete	n.a.	n.a.	2,639	2,345	2,892	2,412	-3.0
Manica	n.a.	n.a.	2,123	2,117	2,499	4,422	27.7
Sofala	n.a.	n.a.	7,638	9,801	6,173	7,812	2.3
Inhambane	n.a.	n.a.	1,293	838	2,909	3,011	32.5
Gaza	n.a.	n.a.	2,301	2,564	2,321	2,242	-0.9
Maputo	n.a.	n.a.	5,777	1,480	2,995	3,741	-13.5
Maputo City	26,015	25,544	24,806	27,288	23,449	25,123	-0.7

Source: INE, *Estatisticas dos Transportes e Comunicacoes, 1997.*

(2) Road transport industry

In Tete province, there are only ten bus routes as shown below. Though the bus routes seem to be extensively servicing the rural areas, many frequent-service bus routes however, are found only between Tete and Moatize.

In Tete province, there are 60 bus companies with 88 buses in total. The number of buses per company is only 1.7. The scale of the bus companies is small. Most companies are operating with one bus only.

Bus Routes in Tete Province

1	Tete-Moatize
2	Tete-Zobue
3	Tete-Angonia
4	Tete-Chiuta
5	Tete-Cassacatiza
6	Tete-Chiuta
7	Tete-Massamba-Furancungun
8	Tete-Songo-Cahora bassa
9	Tete-Estima
10	Tete-Changara-Cuchamano

Source: Ministry of Transportation & Communication.

Number of Bus Companies and Buses

Number of bus companies	60
Number of buses	88
No. of buses/companies	1.7

Source: ibid.

The table below shows a bus tariff system. Bus fare is determined by the distance proportional fare system. Unit cost per km of the national standard is Mt.220/km. In Tete province, however, that of tarred road section is Mt.250/km and non-tarred roads section Mt.270/km, higher than the national standard due to higher petroleum cost.

Bus Tariff System

National standard	Mt.220/km
Tete province	
- Tarred road	Mt.250/km
- Non-tarred road	Mt.270/km

Source: ibid.

The number of trucking companies in Tete province is only five, of which international trucking companies are three. The remaining two are inter-regional companies. The total number of trucks is 18. The number of trucks per company is 3.6. Price of trucking service is determined on a negotiation basis.

Number of Trucking Companies and Trucks

Number of trucking companies	5
- Inter-regional trucking	2
- International trucking	3
No. of trucks	18
No. of trucks per company	3.6

Source: ibid.

(3) Problems and constraints

The following problems are identified in the road transport sub-sector.

- The level of development in public transport system in Tete province is significantly lower than Maputo and Sofala provinces in terms of network and frequent services. This is because of limited traffic demand due to small population size, low family income and lower trip generation in Tete province.
- There is no bus terminal in Tete City. Traffic demand for public transport is low at present, therefore the need to facilitate a bus terminal is not high. In the future, however, it will become necessary to prepare such facilities in Tete City to meet an increasing demand for public transportation.

1.4.5. River transport

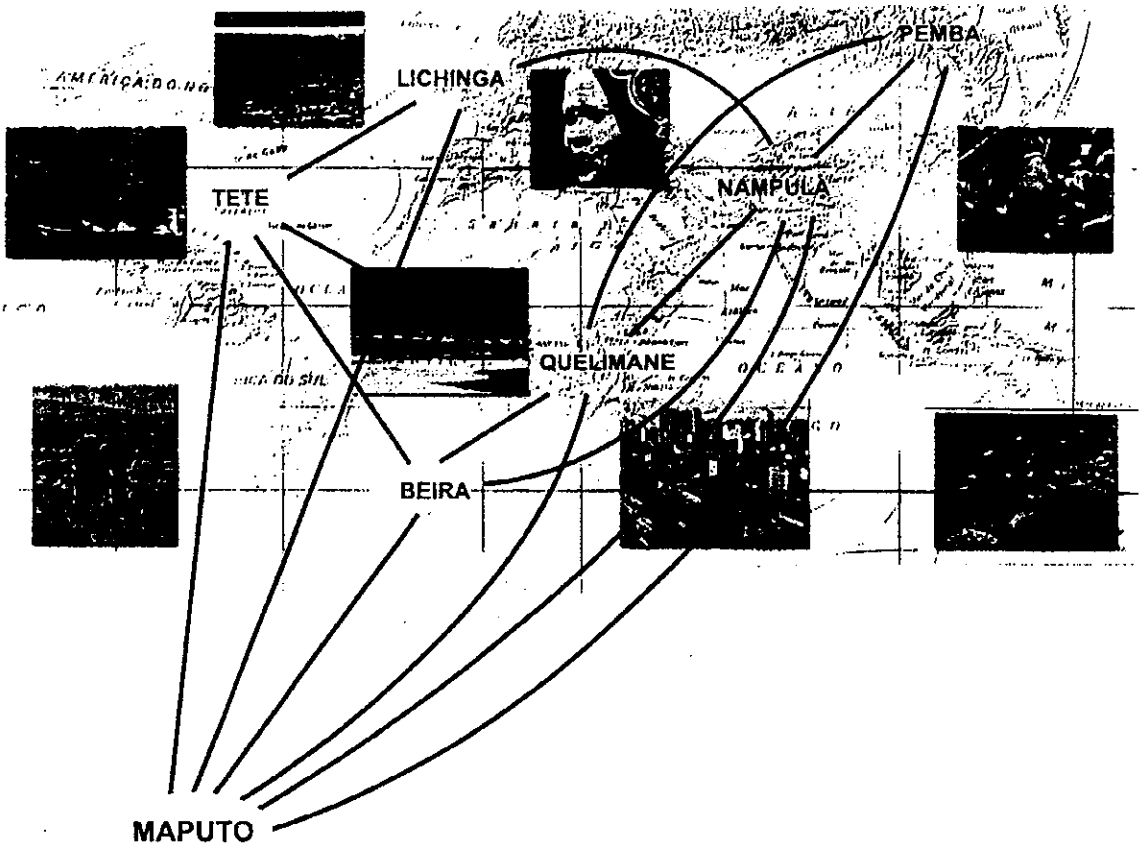
In the early part of 20th century, the Zambezi river was used as the main transport route from the Indian Ocean to Tete province. After the construction of the Sene Railway between Beira and Malawi and Moatize, however, the waterway between Malawi or Tete and Beira was not used any more as transport route. Since the Cahora Bassa dam upstream on the Zambezi River was built, fluvial transport for commercial purposes was limited because of the effect of the dam on the water flows in the river system. River transport along the Zambezi river at present is limited to small vessels with 1 to 2 feet draft. Navigation is cumbersome due to shifting shallows.

It has been reported that Austral Coal, one of the potential investors in the Moatize Coal Mine, investigated the use of 3,000 tons per annum with a 2.7m draft as a means of exporting coal. The study found that the river would require extensive dredging to facilitate this. If the coal transport is restricted to barges with one-meter draft and loading and unloading facilities needed, river transport is not a competitive option for coal transport. In practical terms, navigation seems to be limited to vessels of a few hundred tons up to Caia or Sena and maximum a hundred tons up to Tete.

1.4.6. Airports and air transport

The airports in Mozambique are operated and managed by the Mozambique Airport Authority (Aeroportos de Moçambique / ADM) under supervision of MOTC. The main airports in Mozambique are Maputo, Beira, Nanpula, Quelimane, Tete and Pemba. The other airports are generally small. Figure 1.8 shows a domestic air network in Mozambique.

Figure 1.8. Air Transport Network in Mozambique



The air transport system in Mozambique is still at a low stage of development. The number of aircrafts landed and departed was 33,727 only in 1997 (See Table 1.7). The number of passengers, both international and domestic, was 532 thousand only in 1997, while freight traffic was 6.1 thousand tons. Mail traffic was 0.3 tons in the same year (Tables 1.8 and 1.9). Although air transport demands are generally not high, air transport demand has been growing in recent years.

The Tete airport, with a runway of 2,480 m length, is given an international airport status. There are, however, no regular international flights. At present, regular air services are provided only for domestic flights as shown in the table below. There are small-scale airstrips in Ulogue in Angonia, Mualazi in Chifunde, Furancungo in Macanga, and Manje in Chiuta. It would be possible to extend air services to other part of Tete province utilizing these district airstrips.

Table 1.7. Number of Aircraft Landed and Departed at Major Airports, 1995-1997

Airport	Number of Aircraft Landed and Departed			Growth Rate(%)	
	1995	1996	1997	1996/95	1997/96
Maputo	27,880	12,668	13,228	-55	4
Beira	8,933	6,451	6,544	-28	1
Nampula	3,862	2,276	2,819	-41	24
Quelimane	1,872	3,068	3,507	64	14
Tete	1,153	1,274	1,019	11	-20
Pemba	796	1,148	1,367	44	19
Others	1,976	3,385	5,243	71	55
Total	46,475	30,270	33,727	-35	11

Notes: 1) Numberof aircraft landed/departed = Total of passenger and cargo aircrafts.
2) "Others" include Lichinga, Inhambane, Inhaca, Chimoio, and Vilanculos airports.
Source: INE, *Estatisticas dos Transportes e Comunicacoes*, 1997.

Table 1.8. Number of Passengers at Major Airports, 1995-1997

Airport	Number of Passengers(Thousand Persons)			Growth Rate(%)	
	1995	1996	1997	1996/95	1997/96
Maputo	274	273	336	0	23
Beira	55	56	69	3	22
Nampula	37	40	44	6	11
Quelimane	21	30	36	43	17
Tete	13	10	9	-23	-10
Pemba	16	16	16	0	2
Others	10	11	22	13	96
Total	426	437	532	2	22

Notes: 1) Numberof aircraft landed/departed = Total of passenger and cargo aircrafts.
2) "Others" include Lichinga, Inhambane, Inhaca, Chimoio, and Vilanculos airports.
Source: INE, *Estatisticas dos Transportes e Comunicacoes*, 1997.

Table 1.9. Cargo and Mail Traffic at Major Airports, 1995-1997

Airport	Goods	Air Freight (ton)			Growth Rate (%)	
	Mail	1995	1996	1997	1996/95	1997/96
Maputo	Goods	3,480	3,490	3,781	0	8.4
	Mail	221	236	234	7	-1
Beira	Goods	678	671	1,062	-1	58.4
	Mail	92	39	28	-57	-28.9
Nampula	Goods	476	538	489	13	-9.1
	Mail	16	21	31	32	44.9
Quelimane	Goods	84	291	392	246	34.7
	Mail	7	10	5	43	-50
Tete	Goods	193	173	137	-10	-20.8
	Mail	4	6	5	50	-16.7
Pemba	Goods	250	266	183	6	-31.1
	Mail	5	12	9	140	-26.7
Others	Goods	120	76	78	-37	3.5
	Mail	6	7	3	5	-49.3
Total	Goods	5,281	5,504	6,123	4	11.2
	Mail	351	332	315	-6	-5

Notes: 1) Numberof aircraft landed/departed = Total of passenger and cargo aircrafts.
2) "Others" include Lichinga, Inhambane, Inhaca, Chimoio, and Vilanculos airports.
Source: INE, *Estatisticas dos Transportes e Comunicacoes*, 1997.

Regular Flight from Tete Airport

(As of October 2000)

From	To	Via	No. of flt.	Aircraft*
Tete	Maputo	Direct	5	BE 1 (4 flights), B737 (1 flight)
		Quelimane	1	B737 (1 flight)
	Nampula	Lichinga	2	BE 1 (2 flights)
	Quelimane	Direct	1	B737 (1 flight)
	Lichinga	Direct	3	BE 2 (3 flights)

*B 737=Boeing 737, BE 1=Beachcraft 1900.
Source: LAM.

Chapter 2. Constraints and Potentials

2.1. Development Issues

2.1.1. Overall issues in Mozambican transport sector

(1) Policy issues

The transportation sector in Mozambique has entered a new era following the restoration from destruction and neglect during the civil war. Inter-territorial transport routes have been re-established, and the trunk road system rehabilitated. The policy emphasis in the transport sector has now shifted to supporting sustainable socio-economic development in the different regions of the country.

While further strengthening of infrastructure of the inter-territorial transport corridors is necessary for Mozambique to take advantage of its strategic position, its implication to socio-economic development of different regions in Mozambique needs to be examined. Development of the transport system in Mozambique should be complementary to the corridor development in order to promote national spatial and socio-economic integration.

An important sub-issue here is the modal composition. While the ports and railway system is comparatively more important for the transport corridors, its position in the national transport system needs to be clarified.

Another sub-issue is the coordination among different modes of transportation. Multi-modal transportation, linking ports, railways and roads, is becoming increasingly "the mode" in international transportation, especially for cargoes. This trend would definitely have implications to inter-agency coordination in the Mozambican government.

(2) Administrative/financial issues

The Mozambique government faces administrative and financial constraints in improving its transportation system. It is quite sensible for the government to emphasize rehabilitation and proper maintenance of existing infrastructures rather than construction of new facilities. Proper allocation of limited financial and administrative resources in the coming decades should reflect needs for regional development and national integration.

Improvement of non-classified roads would become more important for internal integration of any region, which should become a basic and viable socio-economic unit to contribute to the national integration in a world increasingly becoming competitive.

Encouraging private sector participation and community involvement are an essential direction to pursue in expanding resources for transport development. The private sector has already been involved not only in construction but also in operation and management of some transport facilities. A regulatory framework for privatization of public transport

operations may be made more effective. Community participation in improving the transport sector is only sporadic and in small scale. Capacities to manage non-classified roads at the district and local levels should be expanded by community participation in more institutionalized ways.

(3) Technical issues

Technical issues involved in the transport sector in Mozambique include design standards for roads, hierarchical systems for ports and airports to serve local, regional and national needs, and user charges for public transport operations. These are not immediate issues yet, but may be looked into in the subsequent stage of the Study as they may relate to the Angonia regional development and planning.

2.1.2. Development issues for international transport system

Tete is importantly located at an intersecting point of two international transport corridors. The first one may be defined as north-south African transport corridor, which runs through North-eastern Zambia, Malawi, Tete, Zimbabwe, and South Africa, in the South-eastern African countries. The second one is Beira Corridor, which passes through Beira, Tete, Malawi and north-eastern Zambia. This corridor is also very important for world trade through Port of Beira.

With regard to the international transport system, two major issues may be identified to improve the international transport system in the Study Area. The first issue is how to strengthen international transport system of the both corridors. According to international trade statistics of the neighboring countries, international trade of the neighboring countries including Mozambique has been increasing at high growth rates. Both corridors are likely to become increasingly important within South-eastern African countries in accommodating international traffic flows.

The second issue is to how to provide a multi-modal transport system. The cross-border freight traffic survey shows that a lot of freight traffic flow is in-coming and out-going to/from Beira, Zimbabwe, and South Africa using road transport system. In order to ensure economical and efficient freight traffic flow, a multi-modal transport system needs to be established.

2.1.3. Development issues for regional transport system

A fundamental issue in the regional transport system is how to establish a multi-modal transport system. The Study Area should follow the motorization trend emerging in Mozambique as well as to rely on other modes, especially railways playing an increasingly important role in various aspects. As a matter of principle, all the modes should be strengthened in a mutually complementary manner.

In addition, four broad issues may be identified to improve the regional transport system in the Study Area to support the Angonia regional development.

The first issue is how to remove bottlenecks on principal roads such as impassable condition of principal roads during rainy season, difficult access to district center, wooden bridges often washed away and damaged bridges on the principal roads.

The second issue is how to strengthen the trunk transport system centering to Tete City. At present, the road network and road transport in the Study Area center on Tete City. The degree of concentration would even increase in the future. This is not only inevitable but also desirable. In fact, Tete City with its vicinities should serve as the inland center for the entire central Mozambique. This prospect should be duly reflected in the future transport system development in the Study Area. The existing artery roads and the airport need to be upgraded, the Sena Railway restored in steps, and some new facilities established such as a bus terminal, container depots and a small river port.

The third issue is how to create nodal points on the road network to serve effectively the transport needs of vast rural territories. A few secondary towns should be strengthened with designated functions respectively. Transport links among secondary towns and Tete city should be upgraded. Candidates include Ulongue for agro-related trade and agro-processing, Manje for trade and distribution, Zobue and Nsadzu for border trade and related services, and Moatize for resource-based manufacturing.

The fourth issue is how to ensure access to markets and various services for majority of rural population. Selected rural settlements may be strengthened as rural service centers by improving a set of infrastructure facilities in a strategic way. At the same time, non-classified roads should be improved with participation of local communities to ensure access to the rural service centers.

2.2. Future Traffic Demand Forecast

In order to formulate a plan for future transport system in the Angonia Region, future traffic demand is forecast for international freight traffic, road traffic, rail traffic, and air traffic. The results are summarized below.

2.2.1. Freight traffic demand

Economic growth rates of the neighbor countries are estimated first. Macro-economic indicators are estimated in the "Transport and Communications Integration Study[1]". This study forecasts GDP as an assumption for traffic demand estimation as shown below.

[1] "Transport and communications integration study, The catalyst for economic development in Southern Africa " May 1998, Southern African Development Community (SADC)

Forecast of Macro-Economic Indicator of GDP

Unit: %/year

Country	1995-2002	2002-2007	2007-2017
Mozambique	4.4	4.3	4.8
Malawi	2.7	2.0	2.3
South Africa	3.6	3.2	3.7
Zambia	2.5	1.8	2.2
Zimbabwe	3.9	2.7	3.1

Source: SADC, Transport and communications integration study.

Based on the forecast GDP growth rates of the neighboring countries above and that in the Study Area estimated as part of the socio-economic framework, the following economic growth rates are assumed for the planning periods of the present study.

Growth Rate of Macro-Economic Indicator (GDP)

Unit: %/year

Country	2001-2005	2006-2015	2016-2025
Mozambique	8.0	8.0	8.0
-Study Area	5.5	10.0	8.5
Malawi	2.4	2.3	2.3
South Africa	3.4	3.7	3.7
Zambia	2.2	2.2	2.2
Zimbabwe	3.3	3.1	3.1

Sources: ibid.; Estimates by the Study team.

The existing freight traffic demand is estimated on the basis of the cross-border freight traffic survey conducted in this study. The average daily freight traffic demand obtained from the freight traffic survey is converted to yearly traffic volume taking into account monthly fluctuations of the freight traffic. The result of the estimation for the year 2000 is shown in Table 1.10. These data indicate that the total freight traffic volume in relation to the Study Area is estimated at 1.36 million tons in 2000.

According to the freight traffic demand analysis made in "Transport and Communications Integration Study", the elasticity of freight traffic demand to economic indicator (GDP) was estimated to be about 1.0. In this study, the elasticity of freight traffic demand to GDP is assumed at 1.0 as well. Using the existing freight traffic demand in 2000, assumed GDP/GRDP growth rates and the elasticity index, freight traffic demands is estimated for the years 2005, 2015 and 2025 as shown in Table 1.11, 1.12 and 1.13. The table below presents a summary.

Summary of Fright Traffic Forecast Related to the Study Area

Year	Fright Traffic Volume (10^3 tons)	Average Growth Rate (%/year)
2000	1,365.7	-
2005	1,660.3	4.0
2010	2,621.2	4.7
2025	4,206.9	4.8

Source: Estimates by JICA Study Team.

Table 1.10. Estimated Freight Traffic Volume, 2000 (Base Year)

Unit: '000 tons/Year

	Study Area	Tete Prov.	Beira & Sofala	Other Moz.	Sub Total	Malawi	Zimbabwe	South Africa	Zambia	Total
Study Area	0	0	16,808	28,755	45,563	66,623	7,493	0	0	119,678
Tete Province	0	0	0	0	0	0	0	0	0	0
Beira & Sofala	51,840	0	0	3,645	55,485	227,813	0	3,645	7,493	294,435
Other Mozam.	15,998	0	0	0	15,998	0	0	0	0	15,998
Sub Total	67,838	0	16,808	32,400	117,045	294,435	7,493	3,645	7,493	430,110
Malawi	0	0	103,275	2,633	105,908	0	26,933	317,723	2,835	453,398
Zimbabwe	27,135	0	0	0	27,135	203,108	0	0	0	230,243
South Africa	47,385	0	0	1,418	48,803	202,703	0	0	0	251,505
Zambia	0	0	0	0	0	0	0	405	0	405
Total	142,358	0	120,083	36,450	298,890	700,245	34,425	321,773	10,328	1,365,660

Source: Estimates by JICA Study Team.

Table 1.11. Projected Freight Traffic Volume, 2005

Unit: '000 tons/Year

	Study Area	Tete Prov.	Beira & Sofala	Other Moz.	Sub Total	Malawi	Zimbabwe	South Africa	Zambia	Total
Study Area	0	0	23,299	39,861	63,161	80,862	9,292	0	0	153,315
Tete Province	0	0	0	0	0	0	0	0	0	0
Beira & Sofala	71,863	0	0	5,356	77,219	293,533	0	4,809	9,608	385,168
Other Mozam.	22,176	0	0	0	22,176	0	0	0	0	22,176
Sub Total	94,039	0	23,299	45,217	162,556	374,394	9,292	4,809	9,608	560,660
Malawi	0	0	133,068	3,392	136,460	0	30,995	366,543	3,176	537,175
Zimbabwe	33,654	0	0	0	33,654	233,748	0	0	0	267,401
South Africa	58,909	0	0	1,870	60,779	233,849	0	0	0	294,629
Zambia	0	0	0	0	0	0	0	465	0	465
Total	186,602	0	156,367	50,479	393,449	841,991	40,288	371,817	12,785	1,660,330

Source: Estimates by JICA Study Team.

Table 1.12. Projected Freight Traffic Volume, 2015

Unit: '000 tons/Year

	Study Area	Tete Prov.	Beira & Sofala	Other Moz.	Sub Total	Malawi	Zimbabwe	South Africa	Zambia	Total
Study Area	0	0	55,158	94,366	149,524	146,873	17,525	0	0	463,447
Tete Province	0	0	0	0	0	0	0	0	0	0
Beira & Sofala	170,125	0	0	11,563	181,688	485,008	0	8,491	15,876	691,063
Other Mozam.	52,500	0	0	0	52,500	0	0	0	0	52,500
Sub Total	222,625	0	55,158	105,929	383,712	631,882	17,525	8,491	15,876	1,057,486
Malawi	0	0	219,870	5,605	225,475	0	40,458	492,603	4,007	762,543
Zimbabwe	63,470	0	0	0	63,470	305,107	0	0	0	368,577
South Africa	114,269	0	0	3,302	117,571	314,274	0	0	0	431,845
Zambia	0	0	0	0	0	0	0	625	0	625
Total	400,364	0	275,028	114,836	790,228	1,251,262	57,983	501,719	19,883	2,621,075

Source: Estimates by JICA Study Team.

Table 1.13. Projected Freight Traffic Volume, 2025

Unit: '000 tons/Year

	Study Area	Tete Prov.	Beira & Sofala	Other Moz.	Sub Total	Malawi	Zimbabwe	South Africa	Zambia	Total
Study Area	0	0	121,867	208,496	330,363	248,513	30,798	0	0	940,036
Tete Province	0	0	0	0	0	0	0	0	0	0
Beira & Sofala	375,879	0	0	24,963	400,842	801,386	0	14,993	26,232	1,243,453
Other Mozam.	115,994	0	0	0	115,994	0	0	0	0	115,994
Sub Total	491,873	0	121,867	233,458	847,199	1,049,899	30,798	14,993	26,232	1,969,121
Malawi	0	0	363,295	9,260	372,555	0	52,809	662,017	5,055	1,092,436
Zimbabwe	111,538	0	0	0	111,538	398,250	0	0	0	509,789
South Africa	206,577	0	0	5,831	212,408	422,358	0	0	0	634,765
Zambia	0	0	0	0	0	0	0	840	0	840
Total	809,989	0	485,162	248,549	1,543,700	1,870,508	83,607	677,850	31,286	4,206,951

Source: Estimates by JICA Study Team.

2.2.2. Road traffic demand

First, an analysis was made on the relationship between the growth rate of past road traffic volume and that of Mozambique's economic indicator in terms of GDP from 1996 to 1998. The analysis shows that an increase in economic activities by one point results in a rise of the road traffic volume by a range between 0.97 and 0.94 point. The elasticity of road traffic volume to GDP is close 1.0. It is assumed, therefore, that the elasticity of the road traffic demand to GDP is be 1.0.

The road traffic demand in the years 2005, 2015 and 2025 are forecast on the basis of the present road traffic demand, economic growth rate and its elasticity index. Table 1.14 shows the forecast road traffic volume on the principal roads in the relevant years.

2.2.3. Rail traffic demand

(1) Review of rail traffic demand made by the previous studies

The Sena Line Program (SLP)[2] Study worked out a transport demand forecast as summarized in Table 1.15. This forecast is based on a preliminary market analysis and interviews with various potential railway users. According to the forecast, the total traffic demand for the Sene Line in the mid-term period would range from 0.5 to 0.8 million tons per annum. This estimate does not include container traffic between Beira and Malawi or Beira and the northern parts of Zambia and potential coal production in Moatize.

Taking into account these additional freight tarffic from Beira to Malawi, and that from Moatize to Beira, potential transport demand of the Sene Railway Line is forecast to range from 1.1 million tons excluding mining products to 2.1 million tons including mining products as shown below.

Potential Mid-term Transport Demand of Sena Railway Line by GPZ

Unit: mill. tons/year

	Item	Scenario I	Scenario II	Scenario III
1	Minerals	5 to 7	1.0	-
2	Petrochemicals	0.5	-	-
3	Traffic from Malawi	0.6	0.6	0.6
4	Domestic Traffic	0.5	0.5	0.5
	Total Cargo	6.6 to 8.6	2.1	1.1

Source: GPZ: Sena Line Programme, summary of the Development Strategy.

In this traffic demand forecast, the following three scenarios are considered.

- Scenario I: High-level development including Moatize line
- Scenario II: Low-level development including Moatize line

[2]GPZ, Sena Line Programme, Strategy Assessment Report; May 2000.

Table 1.14. Forecast of Daily Traffic Volume on Classified Roads in the Study Area, 2000-2025

(Unit: vehicles/day)

Road No.	Section		Length	Surface	2000	2005	2010	2025
	From	To	(km)	Type	(Base year)			
EN103	Tete	Matundo	1.1	Asphalt	3,866	5,053	13,106	29,631
	Matundo	Moatize	15.8	Asphalt	2,578	3,370	8,740	19,760
	Moatize	Modamba	54.2	Asphalt	695	909	2,357	5,329
	Modamba	Mussacama	36.5	Asphalt	683	893	2,316	5,235
	Mussacama	Zobue	15.3	Asphalt	1,900	2,483	6,441	14,563
EN221	Matema	Chicoco	63.2	Asphalt	128	168	435	983
	Chicoco	Daca	38.2	Asphalt	120	157	406	918
	Daca	Bene	19.7	Asphalt	111	145	377	852
EN222	Matundo	Matema	33.7	Asphalt	99	129	336	759
	Matema	Massamba	34.6	Gravel	89	117	302	684
	Massamba	Cazula	28.7	Gravel	527	688	1,785	4,036
	Cazula	Furacungo	64.2	Gravel	35	46	120	272
	Furacungo	Namicunga	11.4	Gravel	35	46	120	272
	Namicunga	Missaie	144.9	Gravel	37	48	124	281
EN223	Mussacama	Ulongue	130.8	Asphalt	37	48	124	281
	Ulongue	Colomue	26.5	Asphalt	38	50	128	290
ER450	Necungas	Madamba	51.3	Gravel	21	27	70	159
ER456	Daca	Furacungo	92.8	Gravel	279	364	944	2,135
ER460	Massamba	Matengr	26.5	Dirt	125	163	423	955
ER461	Chiuta	Cazula	50	Dirt	32	42	108	243
ER462	Bene	Chifunde	36	Dirt	22	29	75	169
ER463	Furacungo	rnz c/En223	110.3	Gravel	54	70	182	412
ER548	Bene	Cassacatiza	129	Asphalt	26	34	87	197
Total					502	656	1,700	3,844

Source: GPZ, *Rehabilitacao Urgente de infra-Estrutur as Produtizvas no Vale do Zamveze: Relatorio Final*, 1999.

Table 1.15. Potential Midterm Transport Demand in the Sena Region

	Sector	Tons per year	
		low	high
1. Agro-Forestry			
1.01	Existing Forest Licensees	15,000	15,000
1.02	Madal Rice Plantation	17,000	17,000
1.03	Further Rice Cultivation	10,000	20,000
1.04	Malawi Rice Imports (re-route)	20,000	25,000
1.05	Sena Sugar Plantations	50,000	120,000
1.06	Further Sugar Plantation	100,000	200,000
1.07	Malawi Sugar (re-route)	12,200	15,200
1.08	Confection Production	30,000	50,000
1.09	Beverage aproduction	1,000	2,500
1.10	Mozambique Leaf Tobacco Plantation	4,000	4,000
1.11	Malawi Tabacco Exports (re-route)	24,400	25,500
1.12	Agrimo Cotton Gin Fiber	6,000	7,000
1.13	Agrimo Cotton Gin Seed	10,000	11,000
1.14	Agrimo/Cargill Cottonseed Oils Plant	2,000	6,000
1.15	Textafrica textile Plant Consumption	3,000	10,000
1.16	CAN/Entreposto Cotton for Textafrica	6,000	10,000
1.17	Other Cotton Consumption for Apparel	10,000	15,000
1.18	Malawi Cotton Export (re-route)	400	3,600
1.19	Zambezia Tea Production (re-route)	1,600	4,300
1.20	Malawi Tea Exports (re-route, expand)	6,700	8,700
1.21	Further Coffee Production	500	4,000
1.22	Malawi Coffee Exports (re-route, expand)	3,000	7,000
1.23	Madal Dess. Coconut Plant (re-route)	6,000	6,000
1.24	Madal Copra & Cake Plant (re-route)	3,000	3,000
1.25	Further Coconut Production	20,000	30,000
1.26	Sena Coconut Supply (re-route)	5,000	10,000
1.27	Further Sunflower Oils Production	2,000	6,000
1.28	Further Citrus Production/Processing	10,500	12,200
1.29	Agrimo lentil Production	4,000	5,000
1.30	Further Maize Production	15,000	20,000
1.31	Further Wheat Production	2,000	5,000
1.32	Malawi Misc. Agri. (re-route, expand)	15,000	20,000
1.33	Animal Feed Production	1,000	3,000
1.34	Livestock & Fishing	0	0
1.35	Enacomo Hunting Lodge Cattle Supply	100	1,000
1.36	Nestle Beef Byproducts	1,500	1,500
1.37	Fish Processing Plant	4,000	5,000
	Sub-Total	421,900	708,500
2. Manufacturing			
2.01	Portland Cement (Malawi) Export/Supply	10,000	20,000
2.02	Sawmill Lumber Production	10,000	12,000
2.03	Manufactured Wood Products	2,000	5,000
2.04	Botaicals production/Supply	1,000	2,000
2.05	Fertilizer Factory	0	10,000
2.06	Malawi Fertilizer Imports (re-route)	5,000	10,000
2.07	Textafrica Textile Distribution	0	0
2.08	Cotton Apparel Manufactureing Plants	20,000	30,000
2.09	Added Misc. Malawi/Manufacturing	15,000	20,000
	Sub-Total	63,000	109,000
	Total Tonnage	484,900	817,500
	Domestic Traffic	373,200	662,500
	Traffic from/to Malawi	111,700	155,000

Source: GPZ, Sena Line Programme, *Strategy Assessment Report*, May 2000.

- Scenario III: Minimum-level development excluding Moatize line

A study called "Development Study of Moatize Coal Fields and Transport Infrastructure[3]" w(hereafter "Rose Study"), completed with the assistance of the World Bank, prepared a transport demand forecast as shown in the table below.

Potential Transport Demand of Sena Railway Line by Rose Study

Unit: mill. tons/year

	Item	High-cost Scenario	Medium-cost Scenario	Low-cost Scenario
1	Minerals	3 to 10	1.00	0.69
2	Traffic from Malawi	0.30	0.30	0.30
3	Limestone	0.46	0.46	0.46
4	Coal/Duff to Dondo	0.07	0.07	0.07
5	Timber	0.05	0.05	0.05
6	Sugar	0.11	0.11	0.11
7	Cotton	0.04	0.04	0.04
8	Other agro-products	-	-	-
	Total Cargo	4.03 to 11.03	2.03	1.72

Source: Development Study of Moatize Coal Fields and Transport Infrastructure, Aug.1997, Giersing Rose A/S.

According to this forecast, the total freight traffic demand for the Sene Line would range from 1.73 million tons in the low cost scenario, 2.03 million tons in the medium cost scenario, to 4 to 11 million tons in the high cost scenario.

CFM[4], in charge of the rehabilitation and operation of the Sena Railway Line, has also forecasted the traffic demand for the Sena Railway Line as shown in the table below. The total freight traffic demand for the Sene Line ranges from 1.86 million tons in 2001 to 3.98 million tons in 2006, according to this forecast.

Based on these traffic demand forecasts, the following observations are made.

a) In case of the whole Sena Railway rehabilitated with low cost level, freight traffic demand would range from 1.72 million tons to 2.1 million tons per annum. There is not a big difference among different estimates.
b) In case of the medium cost improvement of the whole Sena Railway, forecast freight traffic demand would range from 2.03 million tons to 4.0 million tons per annum.
c) In case of the high cost improvement level, forecast freight traffic demand would range from 4.03 million tons to 11.03 million tons. This largely depends upon the amount of coal production.

[3]Development Study of Moatize coal Field and Transport Infrastructure, August 1997, Giersig Rose A/S.
[4]CFM First Technical Conference: Rehabilitation and Reconstruction of Sena Line.

Freight Traffic Demand of Sena Railway Line forecasted by CFM

10^3 tons/year

	Item	1981	2001	2006
1	Coal	600	800	2,000
2	Sugar	120	60	115
3	Molasses	30	22	40
4	Timber	20	30	95
5	Cotton	40	40	80
6	Limestone	300	150	225
7	Fertilizer	75	53	140
8	Construction materials	55	80	125
9	POL	40	65	150
10	Cement	13	130	197
11	Container	50	54	90
12	General cargo	50	90	120
13	Malawi overseas trade	500	285	600
	Total	1,893	1,859	3,977

Source: CFM First Techinical and Financial Conference: Rehabilitation and Reconstruction of Sena Line.

(2) Forecast by the Study Team

As already mentioned, the Study Team has carried out a freight traffic survey at the entry/exit points and the cross border points. This traffic survey provides useful information on the cross-border freight flow to/from Malawi, Zimbabwe and the Study Area. The freight traffic demand forecast of the Sene Railway Line in this study is based on the data obtained from this freight traffic survey. The freight traffic demand forecast for the areas of the Sena region outside the Study Area is carried out on the basis of the SLP Study.

1) Mineral products

Based on the examinations and investigations made for the possibility of mineral production in the Study Area, the following three cases of transporting mineral products from the Study Area to Beira are assumed.

- Low production case: Only Moatize coal is transported by SRL.
- Medium production case: In addition to the low production case, other minerals are transported by SRL.
- High production case: Moatize coal produced in a full amount and other mineral products are transported by SRL.

The result of the three cases in potential mineral production transported by the SRL is shown below.

Potential Mineral Products in the Study Area

Unit: tons/year

	Sector	Low prod.	Medium prod.	High prod.
1	Coal	1,000,000	3,000,000	6,000,000
2	Iron	0	0	300,000
3	Cupper	0	0	200,000
4	Fluorite	0	0	50,000
5	Apatite	0	0	100,000
6	Black and red granites	0	0	3,000
7	Aortozit	0	0	10,000
	Total	800,000	1,020,140	6,563,000

Source: Estimates by JICA Study Team.

Coal production could possibly range from 1 million tons to 6 million tons per annum depending upon the marketability of coal. The other mineral products might also be produced. All these cases are based on the assumption that the Sena Railway Line from Dondo to Moatize be re-opened.

2) Rail traffic to/from Malawi

According to the cross-border traffic survey, it is estimated that the freight traffic between the Study Area and Malawi in 2000 was 453,000 tons for export and 700,000 tons for import, totally 1,153,000 tons per annum. Some of the freight traffic would be diverted from road-based transport system to railway. This would largely depend upon the type and origin and destination of cargoes.

In order to forecast rail traffic to/from Malawi, the following assumptions are made in this study.

a) Most cargoes are to be diverted from road-based transport system to rail-based transport due to lower transport cost of railway.
b) If the origin and destination of freight traffic belong to areas affected by the Sena railway, bulky cargoes, including mineral products, wood products, construction materials and petroleum products, may be diverted to the railway almost 100%. Non-bulky cargoes such as coffee, tea, general cargoes and consumer goods are diverted about 50% (Malawi-Beira) or 33% (Malawi- South Africa).
c) Traffic generated by the reopening of the railway is expected to be about 20 % of the traffic diverted to railway in case of high estimation, while in low case, this portion is not considered.

The results of the forecast based on these assumptions are shown in Table 1.16. The cargo volume to be transported by the Sena Railway would be about 433,000 tons in case of low estimation and 520,000 tons in case of high estimation.

Table 1.16. Potential Transport Demand to/from Malawi, 2000

	Malawi (Low)			Malawi (High)		
Item	Import	Export	Total	Import	Export	Total
1 Tobacco	0	75,057	75,057	0	90,069	90,069
2 Coffee/Tea	0	16,489	16,489	0	19,787	19,787
3 Sugar/Salt	2,091	42,929	45,020	2,509	51,515	54,024
4 Rice/Meize	12,273	6,070	18,343	14,727	7,284	22,011
5 Drinking Product	0	2,225	2,225	0	2,671	2,671
6 Ptrolum Product	166,456	0	166,456	199,747	0	199,747
7 Fertilizer	14,835	0	14,835	17,802	0	17,802
8 Other Chemical Product	0	0	0	0	0	0
9 Mineral products	11,543	0	11,543	13,852	0	13,852
10 Wood Product	0	0	0	0	0	0
11 Textille Product	9,652	5,395	15,047	11,582	6,474	18,056
12 Leather	0	709	709	0	851	851
13 Consumer Goods	15,815	944	16,759	18,978	1,133	20,111
14 Construction Materials	15,289	709	15,998	18,347	851	19,198
15 Construction equipment	2,666	2,967	5,633	3,200	3,560	6,760
16 Transportation Goods, parts	2,463	0	2,463	2,956	0	2,956
17 Other Manufactured Goods	17,070	3,508	20,578	20,484	4,210	24,694
18 Livestock	742	0	742	890	0	890
19 Scrap	68	674	742	81	809	890
20 General Goods	4,317	0	4,317	5,180	0	5,180
Total	275,279	157,677	432,956	330,335	189,213	519,548

Source: Estimates by JICA Study Team.

Table 1.17. Potential Transport Demand to/from the Study Area, 2000

	Study Area (Low)			Study Area (High)		
Item	In-coming	Out-going	Total	In-coming	Out-going	Total
1 Tobacco	0	0	0	0	0	0
2 Coffee/Tea	0	0	0	0	0	0
3 Sugar/Salt	2,127	3,342	5,468	2,552	4,010	6,562
4 Rice/Meize	9,315	507	9,822	11,178	608	11,786
5 Drinking Product	507	0	507	608	0	608
6 Ptrolum Product	19,035	0	19,035	22,842	0	22,842
7 Fertilizer	14,363	0	14,363	17,236	0	17,236
8 Other Chemical Product	304	0	304	365	0	365
9 Mineral products	0	0	0	0	0	0
10 Wood Product	0	7,088	7,088	0	8,506	8,506
11 Textille Product	1,013	0	1,013	1,215	0	1,215
12 Leather	0	0	0	0	0	0
13 Consumer Goods	1,416	0	1,416	1,699	0	1,699
14 Construction Materials	5,670	0	5,670	6,804	0	6,804
15 Construction equipment	0	0	0	0	0	0
16 Transportation Goods, parts	0	0	0	0	0	0
17 Other Manufactured Goods	304	1,013	1,317	365	1,215	1,580
18 Livestock	0	0	0	0	0	0
19 Scrap	0	0	0	0	0	0
20 General Goods	0	0	0	0	0	0
Total	54,053	11,949	66,002	64,864	14,338	79,202

Source: Estimates by JICA Study Team.

3) Rail traffic to/from the Study Area

The railway freight traffic to/from the Study Area in 2000 is estimated to be 120,000 tons for outgoing and 142,000 tons for incoming traffic, with a total volume at 262,000 tons.

Based on the same assumptions for Malawi, the diverted traffic to the Sena Railway is forecast. The result of this forecast is shown in Table 1.17. About 66,000 tons in case of low estimation and 79,000 tons in case of high estimation would use the Sena Railway.

4) Rail traffic in Sena region

The rail traffic in the Sena region is forecast based on the GPZ study as shown in Table 1.18.

5) Summary of the traffic estimation

A summary of the forecast freight traffic demand is shown below.

Potential Freight Traffic Demand of Sena Railway Line in 2010

Unit: tons/year

	Item	High demand	Medium demand	Low demand
1	Minerals	6,563	3,000	1,000
2	Traffic from Malawi	655	546	546
3	Traffic from Tete Prov.	167	139	139
4	Domestic Traffic	654	380	380
	Total Cargo	8,039	4,065	2,065

Source: Estimates by JICA Study Team.

In this traffic demand forecast, the following three cases of traffic demand are considered;

Low traffic demand case

a) Low case is used for mineral production.
b) Diverted traffic to SRL includes those from Malawi and the Study Area.
c) Traffic from/to the Sena region is taken from the low case of the SLP study.

Medium traffic demand case

a) Medium case is used for mineral production.
b) Both traffic diverted to the SRL from Malawi and the Study Area and that newly generated are considered.
c) Traffic from/to the Sena region is set in between the low case and the high case of the SLP study

High traffic demand case

a) The high case is used for mineral production.
b) Both traffic diverted to the SRL from Malawi and the Study Area and that newly generated are considered.
c) High case of the SLP study is used for traffic to/from the Sena region.

Table 1.18. Potential Midterm Transport Demand in the Sena Region Excluding Malawi

	Sector	Tons per year	
		low	high
1. Agro-Forestry			
1.01	Existing Forest Licensees	15,000	15,000
1.02	Madal Rice Plantation	17,000	17,000
1.03	Further Rice Cultivation	10,000	20,000
1.04	Sena Sugar Plantations	50,000	120,000
1.05	Further Sugar Plantation	100,000	200,000
1.06	Confection Production	30,000	50,000
1.07	Beverage aproduction	1,000	2,500
1.08	Mozambique Leaf Tobacco Plantation	4,000	4,000
1.09	Agrimo Cotton Gin Fiber	6,000	7,000
1.10	Agrimo Cotton Gin Seed	10,000	11,000
1.11	Agrimo/Cargill Cottonseed Oils Plant	2,000	6,000
1.12	Textafrica textile Plant Consumption	3,000	10,000
1.13	CAN/Entreposto Cotton for Textafrica	6,000	10,000
1.14	Other Cotton Consumption for Apparel	10,000	15,000
1.15	Zambezia Tea Production (re-route)	1,600	4,300
1.16	Further Coffee Production	500	4,000
1.17	Madal Dess. Coconut Plant (re-route)	6,000	6,000
1.18	Madal Copra & Cake Plant (re-route)	3,000	3,000
1.19	Further Coconut Production	20,000	30,000
1.20	Sena Coconut Supply (re-route)	5,000	10,000
1.21	Further Sunflower Oils Production	2,000	6,000
1.22	Further Citrus Production/Processing	10,500	12,200
1.23	Agrimo lentil Production	4,000	5,000
1.24	Further Maize Production	15,000	20,000
1.25	Further Wheat Production	2,000	5,000
1.26	Animal Feed Production	1,000	3,000
1.27	Livestock & Fishing	0	0
1.28	Enacomo Hunting Lodge Cattle Supply	100	1,000
1.29	Nestle Beef Byproducts	1,500	1,500
1.30	Fish Processing Plant	4,000	5,000
	Sub-Total	340,200	603,500
2. Manufacturing			
2.01	Sawmill Lumber Production	10,000	12,000
2.02	Manufactured Wood Products	2,000	5,000
2.03	Botaicals production/Supply	1,000	2,000
2.04	Fertilizer Factory	0	10,000
2.05	Textafrica Textile Distribution	0	0
2.06	Cotton Apparel Manufactureing Plants	20,000	30,000
	Sub-Total	33,000	59,000
	Total	373,200	662,500

Source: GPZ, Sena Line Programme, *Strategy Assessment Report*, May 2000.

According to the forecast, the following observations can be made.

a) It would be rather easy to achieve the coal production level in Moatize at 1,000,000 tons per annum, judging from the past production experience and international marketability. It would also be possible to produce 6 million to 10 million tons assumed under the high production case.

b) It would be probable that the freight traffic to/from Malawi and the Study Area would be diverted to the Sena Railway in a range of about 500,000 tons to 600,000 tons per annum. This is almost one half of the freight traffic to/from Malawi and the Study Area to Beira and South Africa to be diverted to the railway.

c) As for the domestic traffic in the Sene Region, it may be an over-estimation, judging from the present low traffic volume on roads in the Sena region.

2.2.4. Air traffic demand

Air traffic demand in the years 2005, 2015 and 2025 is forecast on the basis of the present air traffic demand, economic growth rate and its elasticity index. The table below shows the forecast air traffic volume in the relevant years.

Air Traffic Forecast at Tete Airport

Year	Passenger (10^3 pass.)	Cargo (tons)	Postal cargo (tons)
2000 (base year)	11.9	180.8	6.6
2005	15.6	236.3	8.6
2015	30.9	468.9	17.1
2025	69.9	1,060.2	38.7

Source: Estimates by JICA Study Team.