Ministry of Transport and Communications
Portos e Caminhos de Ferro de Moçambique

THE PREPARATORY SURVEY
ON
NACALA PORT DEVELOPMENT PROJECT
IN
THE REPUBLIC OF MOZAMBIQUE

FINAL REPORT
SUMMARY

June 2011

JAPAN INTERNATIONAL COOPERATION AGENCY

The Overseas Coastal Area Development Institute of Japan
Oriental Consultants Co., Ltd.
ECOH CORPORATION
Ides Inc.

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Cost Estimation Base: the average rate in 2010
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PREFACE

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey on Nacala Port Development Project in the Republic of Mozambique, and organized a survey team headed by Dr. Kobune of Ides and consists of OCDI, Oriental Consultants, ECOH CORPORATION, and Ides between June, 2010 and April, 2011.

The survey team held a series of discussions with the officials concerned of the Government of the Republic of Mozambique, and conducted field investigations. As a result of further studies in Japan, the present report was finalized.

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

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

June, 2011

Kiyofumi KONISHI
Director General,
Economic Infrastructure Department
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

June 2011

Mr. Kiyofumi KONISHI
Director General
Economic Infrastructure Department
Japan International Cooperation Agency

Dear Sir,

It is my great pleasure to submit herewith the Final Report of "The Preparatory Survey on Nacala Port Development Project in the Republic of Mozambique".

The Study Team comprised of The Overseas Coastal Area Development Institute of Japan (OCDI), Oriental Consultant Co. Ltd., ECOH Corporation and Ides Inc. conducted studies during the period of June 2010 and June 2011 according to the contract with the Japan International Cooperation Agency (JICA).

The Study Team compiled this report, which proposed the Medium and Long-term Development Plan of Nacala Port with the target year of 2030 and the Short-term Development Plan, and selected the Urgent Rehabilitation Project through close consultations with officials of the Mozambique Government, in particular, Ministry of Transport and Communications (MTC), Portos e Caminhos de Ferro de Mocambique E.P. (CFM), as well as the Management of Corredor de Desenvolvimento do Norte (CDN), and authorities concerned.

On behalf of the Study Team, I would like to express my sincere appreciation to the MTC, CFM, CDN and authorities concerned for their cooperation, assistance, and heartfelt hospitality extended to the Study Team.

We are also very grateful to the Japan International Cooperation Agency, the Ministry of Foreign Affairs and the Ministry of Land, Infrastructure, Transport and Tourism for valuable suggestions and assistance during the course of the Study.

Yours Faithfully,

小舟 浩治

Koji Kobune
Team Leader
The Preparatory Survey
on Nacala Port Development Project
in the Republic of Mozambique

ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
ABS	Absolute Figure
ADS-B	Automatic Dependent Surveillance Broadcast
AfDB	African Development Bank
ANE	National Roads Administration
BCI	Banco Comercial de Investimentos
ASTEM	American Standard for Testing Materials
BH	Bore Hole
BOF	Berth Occupancy Factor
BOR	Berth Occupancy Rate
BS	British Standards
BOT	Build Operate Transfer
CAPEX	Capital Expenditure
CBA	Cost Benefit Analysis
CBD	Central Business District
CBR	California Bearing Ratio
CCFB	Campanhia Dos Caminhos De Ferro Da Beira SARL (Beira Railroad Corporation)
CD	Chart Datum
CDIT	Coastal Development Institute of Technology (Japan)
CDL	Chart Datum Line
CdM	Cornelder de Moçambique S.A.
CDN	Corredor de Desenvolvimento do Norte
CEAR	Central East African Railway
CF	Conversion Factor
CFM	Portos e Caminhos de Ferro de Moçambique, E.P.
CFS	Container Freight Station
CFU	Colony Forming Units
CHF	Swiss Franc
CIF	Cost, Insurance and Freight
COFRAC	French Committee for Accreditation
CNG	Compressed Natural Gas
CNT	Container Terminal
CY	Container Yard
DAC	Development Assistance Committee
DANIDA	Danish International Development Assistance
dB	Decibel
DB	Dry Bulk
DBT	Dry Bulk Terminal
DBST	Double Bituminous Surface Treatment
D/D	Detailed Engineering
DDT	Dichloro-diphenylt-richloroethane
DEI	Direccao de Eeconomia e Invetimento, MTC
D.L.	Datum Level
DO	Dissolved Oxygen
DRC	Democratic Republic of the Congo
DSCR	Debt Service Coverage Ratio
DWT	Dead Weight Tonnage
EAS	Estude Ambiental Simplificado
EC	European Code
E. coli.	Escherichia Coli
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EIRR	Economic Internal Rate of Return
EMODORAGA	Empresa Moçambicana de Dragagens
EN	European Norm
ENRC	Eurasian Natural Resources Corporation

EPDA	Environmental Pre-Viability Report and Scope of Definition
EPZ	Export Processing Zone
EQI	Export Quantity Index
EU	European Union
EUR	Euro
EVSL	Enhanced Variable Spread Loan
FAO	Food and Agriculture Organization
FC	Full Container Ship
FD	Floating Dock
FDI	Foreign Direct Investment
FIRR	Financial Internal Rate of Return
FNU	Formazin Nephelometric Units
FOB	Free On Board
F/S	Feasibility Study
FSL	Fixed Spread Loan
FTU	Formazin Turbidity Unit
GAAP	Generally Accepted Accounting Principle
GAZEDA	Gabinete das Zonas Economicas de Dessemvolviment Acelerado
GC	General Cargo
GDP	Gross Domestic Product
GIS	Geographic Information Systems
Gj	Giga Joules
GNI	Gross National Income
GOM	Government of Mozambique
GPS	Global Positioning System
GRT	Gross Tonnage
GT	Gross Tonnage
HWL	Highest Water Level
IBRD	International Bank for Reconstruction and Development, World Bank
ICA	Infrastructure Consortium for Africa
ICB	Interlocking Concrete Block
IDZ	Industrial Development Zone
IEA	International Energy Agency
IEE	Initial Environmental Evaluation
IFZ	Industrial Free Zone
IMF	International Monetary Fund
IMO	International Maritime Organization
INE	National Statistics Institute
IOI	Indian Ocean Islands
ISPS	International Ship and Port Facility Security
ISO	International Organization for Standardization
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
JPY	Japanese Yen
JSPL	Jindal Steel & Power Limited
N	Newton
LDC	Least Developed Countries
IFZ	Industrial Free Zone
LLC	Land Locked Country
LNEC	Laboratório Nacional de Engenharia Civil
LOA	Length Overall
LSCI	Liner Shipping Connectivity Index
LWL	Lowest Water Level
MCLI	Maputo Corridor Logistics Initiative
MDS	MDS Transmodal (UK)
MICCS	Model for International Container Cargo Simulation
MICOA	Ministry of Coordination of Environmental Affairs
MMR	Ministry of Mineral Resources
MN	Mega Newton

MPDC	Maputo Port Development Company
MSL	Mean Sea Level
MT	Metric Ton, Mozambican Methical
MTC	Ministry of Transport and Communications
MUSD	Million United States Dollars
MZ	Mozambique
MZN	Mozambican Methical
NF	French Norm
NGO	Non-government Organization
NILIM	National Institute for Land and Infrastructure Management (Japan)
NPV	Net Present Value
NSO	National Statistical Office (Malawi)
NTU	Nephelometric Turbidity Units
OCDI	The Overseas Coastal area Development Institute of Japan
OD	Origin and Destination
ODA	Official Development Assistance
OPIC	Overseas Private Investment Corporation
O.R	Operating Ratio
ORET	Dutch International Development Agency
OSBP	One Stop Border Post
PAPA	Plan of Action for food Production
PARPA II	Action Plan for the Reduction of Absolute Poverty 2006-2009
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCC	Pure Car Carrier
PEP	Plano Estrategico Provincial
pH	Potential of Hydrogen
PR	Progress Report
PMU	Project Management Unit
PPG	Public and Publicly Guaranteed
PSU	Practical Salinity Unit
PV	Present Value
RC	Reinforced Concrete
RORO	Roll-on/Roll-off
RTG	Rubber Tired Gantry crane
SADC	Southern African Development Community
SATCC	South Africa Transport and Communications Commission
SC	Semi Container Ship
SDI	Spatial Development Initiative
SDCN	Sociedade de Desenvolvimento do Corredor do Norte SA
SER	Simplified Environmental Report
SEZ	Special Economic Zone
SF	Safety Factor
SIDA	Swedish International Development Cooperation Agency
SM	Steel Marine
SPSP	Steel Pipe Sheet Pile
SPT	Standard Penetration Test
SS	Suspended Solid
St.	Station
SWOT	Strength, Weakness, Opportunity and Threat
TAT	Total Turnaround Time
TBT	Tributyltin, Turbidity,
TEU	Twenty-foot Equivalent Unit
THC	Total Hydrocarbon
TICAD IV	The Fourth Tokyo International Conference for African Development
TICTS	Tanzania International Container Terminal Services
TKM	Ton-kilometer
T-N	Total nitrogen
TOC	Total Organic Carbon

TOR	Terms of Reference
T-P	Total Phosphorus
TPA	Tanzania Port Authority
T-S	Total Sulphur
TSS	Total Suspended Solid
UAC	Unit of Account
UCCD	Corridor Development Coordination Unit、MTC
UK	The United Kingdom of Great Britain and Northern Ireland
UNCTAD	The United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
USA	The United States of America
USD	US Dollar
USGS	United States Geological Survey
UVI	Unit Value Index
VAT	Value Added Tax
VLCC	Very Large Crude Carrier
VLR	Variable Rate Loan
WB	World Bank
WHO	World Health Organization
WO	Without
W.R	Working Ratio
ZAR	South African Rand
ZEEN	Zona Economicz Especiale de Nacala (Nacala Special Economic Zone)
ZH	Zero Hidrográfico

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EXECUTIVE SUMMARY

1. Introduction

Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched a mission to Mozambique from November 16 to December 4, 2009. The mission prepared the Scope of Works and the Implementing Arrangements for the Preparatory Survey on Nacala Port Development Project in the Republic of Mozambique based on the investigation of the Mission. The "Scope of Works" was agreed upon between the Ministry of Transportation and Communications (hereinafter referred to as "MTC") and JICA on February 16, 2010.

The objective of the Study is to enhance transaction capability by rehabilitating/expanding terminals and providing new handling facilities at Nacala Port (hereinafter referred to as 'the Port'), with a larger goal of facilitating trade and economic development of the Nacala Corridor area.

The scope of the Study covers the following items:

[1] Analysis of the Existing Conditions
[2] Formulation of Medium/Long term-Port Development Plan (Target Year: 2030)
[3] Formulation of Short-term Plan/Urgent Project for Rehabilitation of the Port

2. Status Quo of Nacala Port and Logistics in Southern Africa

2.1. Socioeconomic trends of Mozambique

The latest data from the Census of Population and Housing in 2007 indicate that the country currently has a population of 20.5 million. The population is growing at a rate of 2.4% per annum and the birth rates are estimated at around 5 children per woman.

Mozambique's recent history has been an example of a successful post-conflict recovery and economic takeoff. The proportion of the population living in absolute poverty is falling continuously. The recent annual GDP growth rate is around 7%. GDP per capita increased from 297 USD in 2004 to 478 USD in 2008.

Agriculture is the main activity of the Mozambican population. Approximately 84% of the economically active population in Mozambique works in agriculture. However, the share of the agricultural sector in GDP is only 14.6%. Most farmers in Nampula Province are smallholders. Agricultural methods are mainly manual and very little agricultural technology has been introduced. Nampula province has fertile loamy soil that is perfect for cultivation. International development partners including JICA have been assisting the agricultural development in the Province.

The country's industrial sector is dominated by basic metal, namely aluminum production, which accounts for 55% of the total production of the industrial sector. Northern Provinces are less developed than the rest of the country. Therefore industrial development of this region is one of the most important strategies of the nation. Nacala Special Economic Zone (SEZ) Development Project is a key project for the industrial development of the Northern Provinces.

Though Mozambique has a rich reserve of natural resources such as coal and natural gas, the amount of production is still rather small. In Tete Province, large scale coal mining projects are progressing. The projects include the development of the country's three largest coal deposits - Moatize-Minjova, Senangoe, and Mucanha-Vuzi. According to Vale Mozambique, they will produce 12,000,000 tons of coking and thermal coal annually in Phase-1 from year 2011. The coal will be transferred to Beira Port. In Phase-2, Vale will use Nacala Bay since Beira Port will reach full capacity.

2.2. Trends of inland goods distribution in/around Mozambique

Based on the survey data on cross border road traffic to/from Malawi, it is assessed that the annual freight volume at borders on Nacala Corridor is considerably small. To date, the cargoes through the Nacala Corridor have been largely conveyed by railway due to the poor road condition. Almost three hundred thousand tons were transferred by railway in 2009. According to the historical data from 1996, it is clear that the railway transport volume has not increased steadily. This would be because of the poor condition of infrastructure, lack of locomotives and inefficient management.

More than 50% of containers to/from Malawi are moving through Beira, while only 15% are through Nacala. Dar es Salaam handles 12%, whereas Durban handles 20%. Major gate port for Zambia is Dar es Salaam which handles 60% of its import/export container cargoes. Durban handles around 20%. 10% are via Walvis Bay through Trans Caprivi Corridor which is being developed rapidly. Beira also handles 10%, while Nacala is not functioning as a gate port of Zambia at this moment. The estimated result of gate ports for bulk cargoes has the same tendency as containers basically. As for Malawi, the share of Durban is smaller compared with the container share, because the maritime network has little significance in bulk transport, and Durban has less advantage. As for Zambian cargoes, a large amount of mineral products exported through Durban Port thrust up the port's share. Imported crude oil through the Tazara pipeline helps the share of Dar es Salaam remain high.

2.3. Trends of maritime transport in/around Mozambique

There are 18 services by 10 shipping lines to cover Maputo, Beira, Nacala, Pemba and Quelimane. Out of those, 11 are main line services and 7 are feeder services. All feeder services call at Durban where major shipping lines have their transshipment hubs for the Southern African region.

Analysis on the slot allocation revealed that Mozambican ports are more "dependent" on the other ports' cargo sources. No port in Mozambique can be served alone and needs to be combined with some other ports in the adjacent areas such as in South Africa, IOI and Tanzania/Kenya.

2.4. Present conditions of Nacala Port

(1) Port facilities

The Port has a container terminal (South Wharf) and a conventional cargo terminal (North Wharf). The northern part of the conventional terminal is dedicated to liquid bulk handling. The North Wharf has a length of 620 m, while the South Wharf has a length of 372 m. The water depth of the former varies from -7.5 m to -10 m. The latter has a water depth of -14 m over the full length. The South Wharf accommodates two container vessels at a time. Large draft dry bulkers are also moored at the South Wharf hampering container operation.

(2) Cargo throughput and vessel traffic

The average growth rate of the total handling volume in the last ten years is 7.6%, whereas the average growth rate of container cargoes in the same period is 8.8%. The container growth rate in the last five years recorded 12.3%. More than 95% of cargoes are international cargoes including transit and transshipment cargoes. The volume of inbound cargoes is larger than that of outbound cargoes both in Mozambican cargo and transit cargo. The percentage of the transit cargo is around 10%., which is rather small compared with Maputo or Beira due to the condition of roads and railways connecting with LLCs. It is remarkable that the Port handles transshipment cargoes, even though the quantity is very small. Nacala is the sole Mozambican port which handles transshipment containers.

The Port received 299 vessels including 108 container vessels in 2009. 50,000 DWT-class vessels call at the Port almost every month and occasionally even larger vessels enter the Port.

(3) Operation and management

In 2005 facilities of the Port were taken over by CDN based on the concession agreement. CDN has responsibilities, rights and duties to manage/operate/rehabilitate the Port for a 15-year concession from the day of take over and an option for a further 15 years. The power of port authority exercised

by CFM was ceased as of the date when CDN's operation began. In 2010 Vale Mozambique, which requires rehabilitation of the railway and construction of a port terminal for the coal mining project in Tete Province, acquired an approximate 25% share of CDN. The concessioned area includes both the container terminal and conventional terminal; however, the oil terminal is excluded from the concessioned area. The oil terminal is managed and operated directly by CFM.

Operation works in the container terminal and conventional terminal are contracted out to a stevedoring company. The role of CDN in terminal operation is planning and instruction. Maritime services such as pilotage and tug assistance are provided by CDN. Containers are unloaded and loaded by ship cranes. Yard operation is carried out using reachstackers and chassis. The container handling productivity widely varies from a few units/hour/ship to 20 units/hour/ship. On average the container handling productivity is about 8 units/hour/ship. The average dwell time of transit container cargoes is longer than 25days.

(4) Financial status

CDN has been preparing consolidated financial statements (the Port and the railway) since its operation began. CDN has continued to show negative net worth from 2005 and the heavy loss of equity continues to be MT 100 million per year. The U.S. Overseas Private Investment Corporation provided CDN with US$ 13.5 million of financing for a project that includes rehabilitation of the railway and the Port. CDN and BCI bank signed an additional loan agreement in 2009 so the total amount of bank loan at present is almost 17 million USD. CDN expended about 70% of the OPIC loan for operational cost of railway sector between 2005 and 2007, not for investment of the railway and/or the Port.

The Study Team estimated balance sheets and income statements of CDN-port. These data indicate CDN-port is profitable. Return on Net Fixed Assets is about 109%. Return on Equity (ROE) is about 55%. The Operating Ratio of 82% is unsatisfactory. These figures mean that an inefficient operation has been performed under creaky facilities. Thus, the financial sustainability of the Port is very precarious.

(5) Development plans

A master plan for the development of the Nacala Bay was prepared in 1974, just after the completion of the existing port facilities, by CFM. The master plan includes an integrated zoning plan of the Nacala Bay for various functions of the port including commercial port, petroleum terminal, and mineral terminal. CFM has reviewed the previous master plan; however, the updated plan is still a conceptual plan and no quantitative background data or development time schedule are presented. The concession contract requires CDN to prepare its development plan of the Port over the concession period. However, CDN has not formulated a plan.

2.5. Baseline information of natural and social environment

The coastal area of Nacala Bay is comprised of a wide variety of important marine habitats such as seagrass bed, coral reef, mangrove, intertidal flat and sandy beach. Whales and dolphins are also known to be present in Nacala Bay. The main marine habitats found near the Port are seagrass bed, intertidal flat and sandy beach. The seabed in front of the port terminals are contaminated by high levels of one or more harmful organic compound. Contamination is most significant in front of the North Wharf, in particular for DDT, PCBs and TBT.

2.6. Environmental laws and regulations

According to the Environment Law (Law No. 20/97), an environmental license must be acquired prior to conducting any activity with potential environmental impact. The environmental license is acquired through submission of an EIA report and approval from the environmental authority. The EIA process for port rehabilitation project is estimated to take in total approximately 10 months.

3. Medium/long-term Port Development Plan (Target Year: 2030)

3.1. Issues of the Port

To become a driving force of the socio-economic development of the northern Provinces of Mozambique or greater Nacala Corridor area, the Port must be competitive and sustainable. At present, however, the Port is neither competitive nor sustainable for numerous reasons as described below:

(1) Sustainability

- Damaged pier structure of the container terminal
- Shortage of functional capacity
- Shortage of spatial resources in the existing footprint of the Port for future development
- Increase of traffic impedance of urban road network
- Lack of a growth strategy and updated master plan
- Managerial and financial problems of CDN
- Inadequate concessional framework
- Imperfect institutional framework for port sector
- Shortage of human resources and knowledge

(2) Competitiveness

- Low productivity of container handling
- Shallowness of basin alongside quays for bulk cargo handling
- Long dwell time
- Burden of scanning inspection

3.2. Development strategy of the Port

The proposed development strategies corresponding to each development target are summarized as follows:

Target 1. Trade and transport facilitation for LLCs and landlocked region in Mozambique

(1) Regeneration of container logistics function
- Relocation and expansion of the container terminal to the North Wharf
- Demolishing of sheds and spur lines of the railway
- Relocation of the oil and general cargo terminal from the North Wharf
- Separation of container handling and bulk cargo handling
- Modernization and computerization of container operation
- Upgrading and increase of container handling equipment
- Construction of a transit cargo terminal in the vicinity of the Port
- Capacity building

(2) Creation of mega port function for bulk cargoes
- Expansion of port to the north, to the south and to Nacala-a-Velha
- Construction of a deep water terminal
- Introduction of efficient bulk cargo handling equipment

(3) State of the art sea and rail interface
- Construction of a multimodal terminal equipped with modernized operation systems
- Concentration of the function of multimodal terminal on sea and rail transfer
- Construction of a marshalling yard and a station for regional cargoes outside the Port
- Demolishing of all rail tracks along quays
- Construction of a branch rail line linking Nacala-a-Velha

(4) Strengthening maritime link through introduction of container transshipment function
- Improvement of overall efficiency of container handling
- Installation of a sufficient number of quay gantry cranes

Reform of customs regulation
Introduction of incentive policy of port tariff
Revival of domestic container network

Target 2. Industrial development of Northern Mozambique

(5) Seamless supply chain between the Port and the SEZ
Establishment of a basic policy of integration of the Port and the SEZ
Construction of the Port Expressway linking the Port, the SEZ and the Corridor
Simplification of procedure for cargo movement between the Port and IFZs
Integration of operation system of the Port and IFZs
(6) Port for agricultural development
Efficiency improvement of the Port aiming at improving market access of the sector
Quality improvement of cargo handling for sensitive agricultural products
Formation of a gateway processing function by integrating the Port and the SEZ
Establishment of a reliable cold chain
Provision of economical route of fertilizer import
Strengthening of incentive policy of port tariff for agricultural products
(7) Creation of grain-hub function
Construction of a grain terminal with deep water berth and modern equipment
Formation of a wheat processing complex in the SEZ

3.3. Forecast of Future Maritime and Land Transport Network

(1) Maritime Transport Network

For the network for East Asia, Nacala would be decoupled from Durban and even from Maputo, then incorporated into main lines of a cluster combined with IOI ports or Tanzanian/Kenyan ports. For South Asia and Middle East, Nacala would be coupled with Tanzanian/Kenyan ports. As Beira has a rich cargo source, it will have a chance to be incorporated into those clusters. However, in case of the trade lanes for Middle East, there will be some possibility for Beira to be feedered to and transshipped at Nacala, due to its remote position from the cluster of Mombasa/Dar es Salaam/Nacala. For the network for Europe, North America and South America, Nacala would still be covered by feeders due to the long distance from those trade lanes.

(2) Land transport network

As most arterial roads will be paved, it is expected to shorten the travel time through the road. In particular, the international transportation between Malawi and Nacala Port will become more efficient with the improvement of the Corridor. The cross border traffic will greatly benefit from the establishment of OSBP. The planned rehabilitation of the railway along the Corridor by Vale Mozambique will also benefit transit cargo transport between Malawi/Zambia and the Port.

3.4. Demand forecast

The cargo demands in Nacala Port in the target years of 2020 and 2030 were forecasted employing a mathematical model, and considering various factors including:

- Macro economic trend of Mozambique and LLCs
- Market perspective of major commodities
- Improvement on Nacala Corridor (road and railway)
- Development of ports and corridors in the eastern and the southern Africa
- Trend of maritime network
- Industrial development in the Northern Mozambique
- Development of SEZ adjacent to the Port
- Development of coal mines in Tete

・ Productivity improvement of port operation

The forecasted cargo volume for the base case is shown in the table below. The forecasted volume includes 20 million tons of mineral products in 2020 and 40 million tons of mineral products in 2030, which will be handled in a dedicated terminal in Nacala-a-Velha.

			2008	2020	2030
International	Total	(1,000MT)	955	24,391	48,723
	Container	(1,000MT)	374	1,972	4,481
		(1,000TEU)	46	192	443
	Bulk	(1,000MT)	581	22,419	44,242
Domestic	Total	(1,000MT)	40	132	1,249
	Container	(1,000MT)	23	101	263
		(1,000TEU)	4	19	48
	Bulk	(1,000MT)	17	31	986
Total	Total	(1,000MT)	995	24,523	49,972
	Container	(1,000MT)	397	2,073	4,744
		(1,000TEU)	50	211	491
	Bulk	(1,000MT)	598	22,450	45,228

The container vessel traffic is forecasted to increase from current 97 calls per year to 1,085 calls per year in 2030 (base case), whereas the calls of bulk carriers increase from 109 to 785.

3.5. Port capacity and development scale

The estimated quay side capacity of the container terminal for three scenarios of productivity improvement is:

Current productivity: 114,445 TEUs
Improved productivity: 248,857 TEUs
Highly-improved productivity: 354,536 TEUs

Thus, the existing quays have more than double the capacity of the current handling volume even when the quay side productivity remains unchanged. The result of assessment on yard capacity shows that the current yard capacity still is sufficient the container throughput increases up to the quay side capacity for current productivity. However, when the quay side productivity improves, the capacity of yard is not sufficient.

Based on the demand forecast (base case), the assessment on current capacity and the target of productivity improvement, the Study Team proposes that one Panamax container berth, two cape-size bulker berths for mineral products, one small cape-size bulker berth for grain and three multi purpose Panamax berths be additionally constructed by 2030.

3.6. Space for port development in Nacala Bay

Since the eastern side of the bay is deeper than the western side, basically the Nacala side is more suitable for deep sea port development. However, the land available for port development is very limited because the cliff rises sharply from the sea. The area to the north of the existing port facilities are the only available space for expansion of the deep-sea commercial port in Nacala Bay and Fernao Veloso Bay. Therefore, this area should be reserved for future development, and urbanization of this area should be restricted.

3.7. Dimensions and basic layout of port facilities

(1) Dimensions of port facilities

Based on the forecast of size of vessels deployed, the required dimensions of berths are proposed as follows:

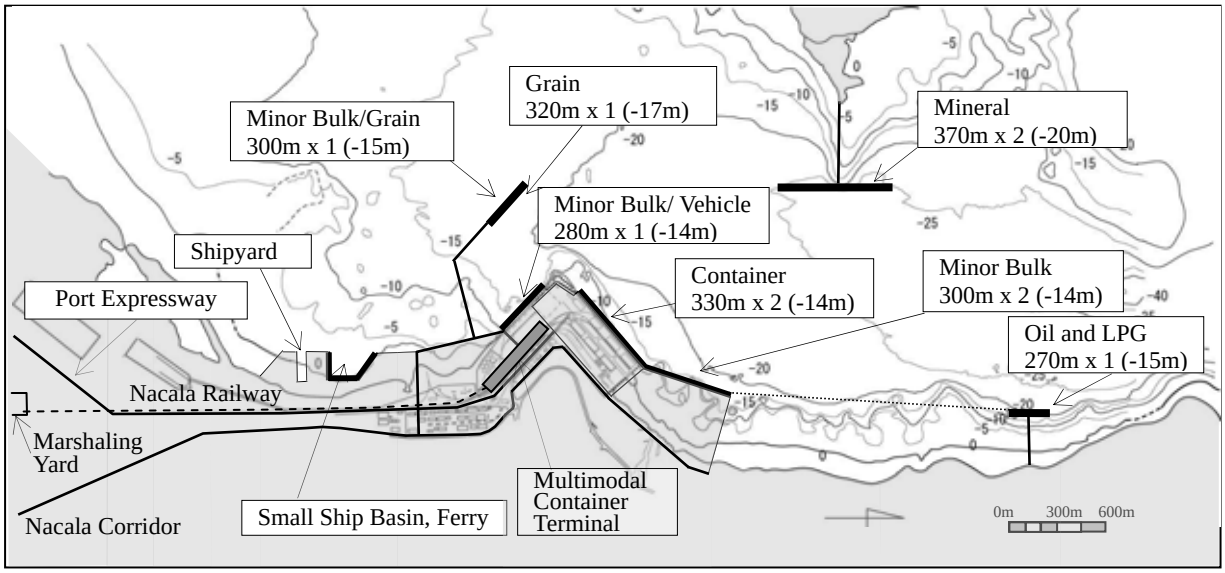
	Design Vessel	Length per Berth (m)	Water Depth (m)
Container terminal	50,000 DWT	330	-14
Grain terminal	90,000 DWT	320	-17
Mineral terminal	150,000 DWT	370	-20
Oil and LPG terminal	70,000 DWT	270	-15
Minor bulk/vehicle terminal	55,000 DWT	280	-14
	70,000 DWT	300	-15

(2) Basic layout

The function of the commercial port (which excludes the mineral terminal) should be concentrated basically in existing footprint of the Port and its vicinity. The layout plan of the Port in the target year of 2030 is shown in Figure B. The main items of the plan are as follows:

- Concentration of container handling function on the North Wharf
- Utilization of the South Wharf as a break and dry bulk terminal
- Relocation of the fuel terminal to the northern end of the future development area
- Construction of a bulk terminal to the north of the North Wharf
- Construction of a deep water grain berth to the west of the South Wharf
- Construction of a multimodal container terminal
- Construction of a shipyard and a local ferry terminal to the south of the existing footprint

There is an idea in which the fuel terminal would be relocated to the south of the existing port facilities. However, the Study Team cannot endorse this idea considering the maritime safety and environmental protection. It is unlikely that the relocation is required before 2020. There is enough time to discuss this issue among all stakeholders and find the best solution.



Source: Study Team

Figure A Layout plan of port facilities

3.8. Improvement of access to the Port

(1) Separation of traffic flow by cargo types

- The perimeter of the container terminal shall be clearly defined. Non-container trucks shall be prohibited from entering the container terminal. A dedicated container terminal gate equipped with a gate operation system shall be constructed.
- The access road to the container terminal gate shall be separated from access roads for conventional cargoes. The container access road shall by-pass the existing roundabout in front

of the existing port entrance to avoid traffic congestion.

- A new access road to the South Wharf, which will be used for dry bulk and break bulk (vehicles) handling, shall be constructed.

(2) Improvement of rail access

- A new multimodal terminal equipped with modernized operation systems shall be constructed in the Port. The rail terminal in the Port shall be utilized only for loading/unloading seaborne cargoes. Therefore, all shunting lines in the port terminal shall be demolished basically. A depot and a marshalling yard shall be newly constructed outside the Port along the main line.
- Since the direct operation between ship and rail wagon is inefficient and old-fashioned, all rail tracks along quays shall be demolished.

(3) Integration of the Port and the SEZ

- The Port Expressway shall be constructed, which directly connects the SEZ including IFZs with the Port without passing through the urban area of Nacala.
- Trucks should be able to come and go easily between bonded areas in IFZs and the Port with a very simplified and computerized procedure.

3.9. Roadmap for modernization and expansion of the Port

The time schedule of the development of the Port is proposed as follows:

Urgent Rehabilitation Project	by 2015,
Short-term Development Project	by 2020,
Medium-term Development Project	by 2025
Long-term Development Project	by 2030.

3.10. Projects for modernization and expansion of the Port

The performance of the port operation is a key element in terms of attracting cargoes. Therefore, it is most rational to give the priority to the following items:

- Restoration and repair the existing infrastructure
- Construction of a mineral terminal at Nacala-a-Velha
- Upgrading container handling productivity by repairing the existing facilities
- Expansion of handling capacity of container and bulk cargoes
- Further expansion of the Port

4. Short-term Port Development Plan and Urgent Port Rehabilitation

4.1. Assessment and repair of existing wharves

(1) Open-type wharf on vertical concrete piles (container and general cargo terminals)

From the structural analysis, the quay seems to be structurally serviceable, especially as the anchor and rear walls remain structurally effective though the piles hold no durability against bending moment. It should be noted, however, that the quality of concrete of the front/rear walls is definitely deteriorated. Concrete neutralization has progressed during the 36 years from commencement of the quay services. Deterioration will be rapidly accelerated. Accordingly, it should be emphasized that the piling system is now situated in the "*vulnerable*" stability category.

The realistic method of overall repair of the concrete pile structure would be to demolish the entire structure and to construct a new structure.

The minimization of external forces is recommended for extending the life. Container handling should be shifted to a new berth, and lighter bulk cargoes will be handled at the present wharf. Fenders should be installed urgently. Approaching velocity of ships should be restricted to less than 10cm/sec.

It is crucial to monitor the structure regularly in order to prevent loss and damage that an unexpected collapse could bring.

(2) Gravity type of wharf (concrete block type) and steel sheet piling wharf

Major structural defects were not found in the two types of wharves.

4.2. Alternative plans for port rehabilitation

Since the deteriorated South Wharf is the main and the busiest berthing facility of the Port, it cannot be repaired or reconstructed until alternative berthing facilities are operational. Therefore, it is recommended that a container berth should be newly constructed prior to the rehabilitation of the damaged pier. The southern part of the North Wharf was selected as the location of a new container berth by comparing six (6) options.

4.3. Formulation of short-term development plan

The Study Team has drawn the Short-term Development Plan to cope with the cargo traffic foreseen in 2020 as follows:

(1) Infrastructure

1) North wharf

- New container wharf, see Figure B [1]
  - Demolishing of warehouse No. 0, 1 and 2
  - Demolishing of the damaged pier in the North Wharf
  - Pier structure (320 m x 40 m, water depth; -14m)
  - Dredging the berth up to -14 m [2]
  - Construction of container yards [3]
- Repair of the pavement of Apron and curbstones [4]
- Repair of pavement of port road [5]
- Grading and ground leveling of open storage yard [6]

2) South wharf

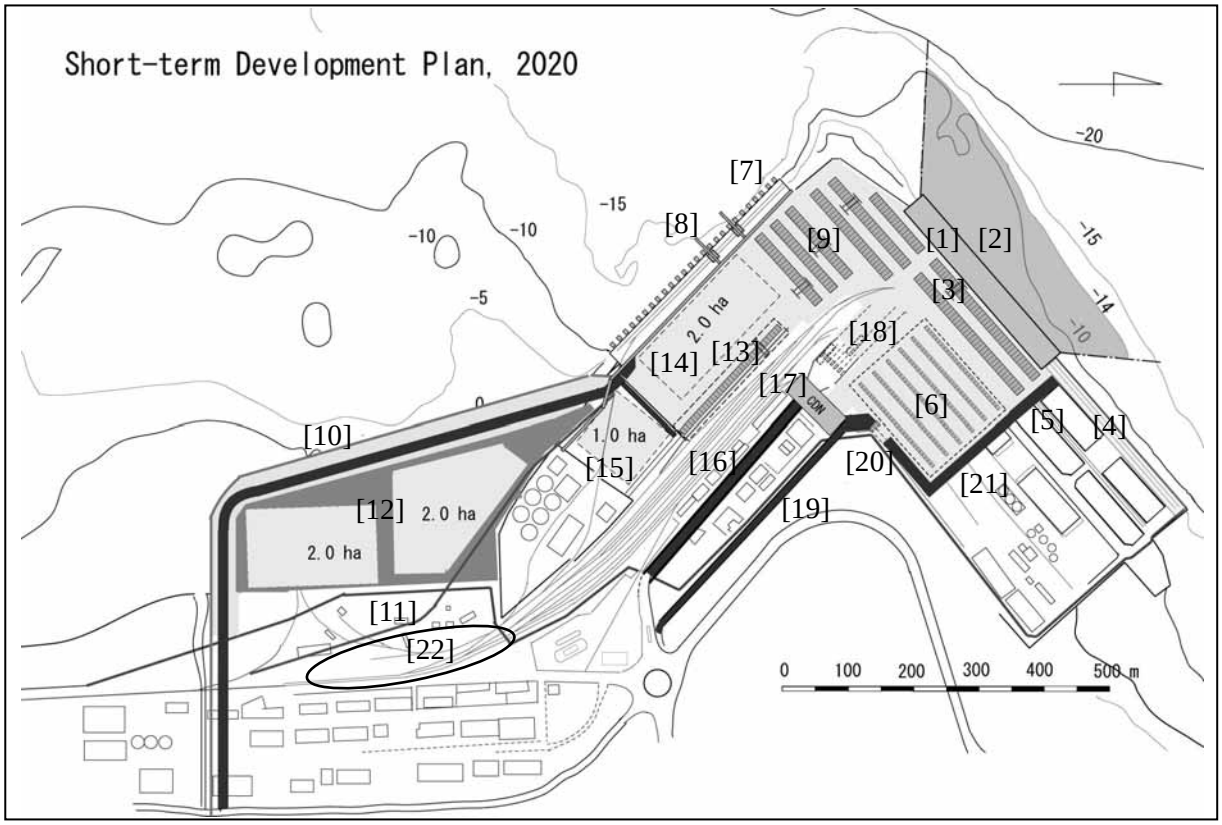
- Installation of fenders to the damaged container pier [7]
- Installation of grain unloader and belt conveyer [8]
- Container yards (Foundation for RTG's) [9]
- New access road and railway to the South Wharf (about 1 km)
  - Construction of road [10]
  - Rail access track to the South Wharf [11]
  - Reclamation [12]
- Rail container terminal [13]
- Removal of rail container gantry crane and pavement of storage yard [14]
- Open storage of bulk cargoes [15]

3) Main gates, road and railway

- Widening of entrance road, [16]
- Construction of One Stop Service Building (port administration building) [17]
- Construction of new gates (including truck scale) and pavement [18]
- Construction of another access road (for general cargoes) and gate [19], [20] and [21]
- Expansion of rail shunting area [22]

(2) Equipment

・ Reach stacker	4 units
・ Tractor-head and yard chassis	12 units
・ RTG	8 units (four-high)
・ Mobile crane	1 unit (100 ton)



Source: Study Team

Figure B Short-term development plan (target year: 2020)

4.4. Urgent Rehabilitation Project

Those project components that need to be implemented in the early stage of the project shall be packaged as the Urgent Rehabilitation Project.

Prior to the start of the construction of the new pier at the western side of the North Wharf, it is vital to enhance the capacity of the container and the dry bulk handling at the South Wharf so that the Port will be able to handle all the container and dry bulk cargoes without using the western half of the North Wharf. To this end, those project components intended to enhance the handling capacity of the South Wharf should be completed before the construction of the new container wharf starts at the western part of the North Wharf. Thus, those project components that are the preparatory works are chosen as the first part of the Urgent Rehabilitation Project: the package of these components is called the Urgent Rehabilitation Part-1, hereafter. The components to be implemented as the second part of the project are those related to the construction of the new wharf. Those components that facilitate the effective use of the new wharf should also be included in the Urgent Rehabilitation Project. The package of these components is called the Urgent Rehabilitation Project Part-2.

With these criteria, the chosen components of the Urgent Rehabilitation Project are shown below.

Project Component	Item No. in Figure B
Part 1	
By-pass access road,	[10]
Installation of fenders,	[7]
Foundation of RTG's,	[3]
Widening of entrance road,	[16]
Gate construction,	[18]
Pavement ,	[9]
Pavement of apron	[4]
Equipment (reach stacker 4, yard chassis 12, RTG 2)	[9]
Part 2	
Landfill and ground leveling,	[11]
Construction of rail track,	[12]
Ground leveling,	[6]
Repair of yard and road pavement,	[15]
Rail container terminal,	[13]
Container yard pavement ,	[14]
Reconstruction of wharf (320m x 40m),	[1]
Dredging (-14m),	[8]
Road pavement	[5]
Equipment (RTG 2),	[9]
Demolishing of warehouses (No. 0,1 and 2).	[15]

4.5. Preliminary design

(1) New container berth

Based on the comparative evaluation of structural adaptability, suitability for subsoil conditions, durability, the construction method, the construction period and the overall cost, steel pipe sheet pile walls are recommended for the new container berth structure.

In the course of detail design, sampling of sediment should be done not only on the surface sea bed but also in the sub-layers of the sea bed for the purpose of identifying the extent of the contaminated area and depth. It is also recommended to carry out chemical analysis of the toxic substance. With these additional information and data, the volume of the contaminated sediments and the method of placement of dredged material will be determined.

The result of boring showed that the soil condition at the western part of the North Wharf is quite complicated and varies considerably along the face line of the wharf. Accordingly, it is recommended to carry our additional boring prior to the detail design of the wharf.

(2) Rehabilitation of South Wharf

An appropriate fender system along the South Wharf is recommended for minimization of impacts from docking ships of 50,000DWT. Rubber fenders of the cylinder type, which bears 320 kN-m of berthing energy, are installed.

(3) Rehabilitation of oil terminal

The present structure of Oil Terminal is assessed to be stable. Based on the analysis, rehabilitation of the oil terminal is to be conducted for the facilities below:

- Coping concrete to be renovated
- Fenders bearing 50,000DWT tankers' berthing energy to be newly installed
- Bollards bearing 1,000 kN by 50,000DWT tankers to be newly installed

(4) Road and pavement

Considering the present conditions of the pavements in the container yard, stabilization with cement is applied to the base courses. In terms of the by-pass road, reinforced concrete pavements are applied with cement stabilization of the subgrades on the new filled up ground.

4.6. Construction plan

(1) Important scope of work

1) Bypass access road

Since the road will be constructed on the coast, the revetment works will be needed before the road construction works. Estimated total volume of rubble and armor stone deposition for the revetment is around 64,000 m3; it will be executed by using a barge with a crane. One-way backfilling work will be executed from the landside to the South Wharf.

2) Pavement of apron at the northeast side of the North Wharf

The northeast side of the North Wharf is used for oil terminals; therefore, the use of fire is strictly prohibited in this area. Accordingly, it is necessary to relocate the oil handling function to the southwest side of the North Wharf temporarily for the duration of the construction.

3) Reconstruction of the North Wharf

The southwest side of the existing berth in the North Wharf will be demolished and a new berth will be constructed by the steel pipe sheet pile method. Furthermore, a new container yard will be constructed behind the new berth.

4) Dredging (-14 m)

Dredging works will be carried out by a grab dredger up to the elevation of -14 m. However, the bottom soil to be dredged includes pollution. Therefore, it is necessary to study appropriate countermeasures to prevent diffusion of the pollution into seawater. Dredged material will be transported by barge to the landfill yard enclosed by the bypass road.

(2) Countermeasures for mitigating the hindrance of port operation by the construction

Prior to the construction, a temporary construction road and gate will be constructed to the east of the entrance road. Since all trucks and vehicles related to the construction will not pass through the port gate, regular port operations will not be affected.

Before construction, the transportation routes of the barges on the sea near the Port will be decided through discussions between the contractor and the related persons in the Port. The working area will be marked by buoys. In addition, a safety patrol boat will be arranged to prevent accidents.

Before construction, a meeting will be held between the contractor and related persons in the Port to discuss mitigation methods to avoid hindering regular port operations. Suitable actions, such as partial execution, specifying the execution areas and employment of a safety guard will be required.

4.7. Estimation of capital cost

The estimated result is shown in the table below. Import duties and VAT are excluded in the estimation.

Items	Cost Estimation (USD)
Part 1	**69,678,000**
Facilities	**57,561,000**
Mobilization & Temporary works	2,325,000
By-pass Access Road	32,338,000
Installation of Fenders	5,176,000
Foundation of RTG's	3,647,000
Widening of Entrance Road	450,000
Gate Construction	2,287,000
Pavement of Road in the Port	410,000
Pavement of Apron	5,521,000
Loading & unloading arm for liquid	3,932,000
Firefighting System	1,475,000
Equipment	**12,117,000**
Reach Stacker*4	4,215,000
Yard Chassis*12	3,951,000
RTG*2	3,951,000
Part 2	**160,911,000**
Facilities	**150,637,000**
Mobilization & Temporary works	1,162,000
Dredging, Landfill & Ground Leveling	25,413,000
Construction of Rail Track	1,234,000
Ground Leveling	195,000
Repair of Yard and Road Pavement	702,000
Rail Container Terminal	2,041,000
Container Yard Pavement	16,350,000
Reconstruction of Wharf	99,137,000
Environment Consideration Work	4,403,000
Equipment	**10,274,000**
RTG*3	5,927,000
Mobile Crane*1	4,347,000
Engineering Fee	**16,395,000**
(Subtotal)	246,984,000
Physical Contingency	**12,349,000**
Total Cost Estimation	**259,333,000**

4.8. Implementation schedule

The implementation schedule covering the preparatory stage of the project and construction stage has been prepared based on the construction plan and also taking into consideration the time required for the EIA approval, arrangement of finance, selection of consultant, contract bidding and approval of the contract by financing agencies. Milestones of the project implementation are as follows:

- Completion of the feasibility study; June 2011
- EIA approval; August 2011
- Completion of financial arrangements; March 2012
- Selection of consultant; August 2012
- Detail design; Start, September 2012, Completion, August 2013
- Contract procedure for Part-1; Start, October 2012, Completion, December 2013
- Contract procedure for Part-2; Start, February 2012, Completion, March 2014

- Construction work Part-1; Start, January 2014, Completion, April 2015
- Construction work Part-2; Start, March 2014, Completion, May 2016

4.9. Project packages

Since the construction sites of Part-1 and Part-2 are at different locations, Part-1 and 2 can be implemented independently from each other. In addition, the facilities to be completed in Part-1 should be turned over to the owner of the facilities unless it is necessary to wait for the completion of Part-2 components. Therefore, it is recommended to implement the project in two packages, namely, Part-1 and Part-2. The project can also be implemented in three packages by packaging the procurement and installation of equipment. However, in such case, careful coordination among the three packages is very important to avoid interruptions of construction.

4.10. Economic analysis

(1) Economic feasibility of the Project

The feasibility of the Project is evaluated using a Cost Benefit Analysis method from the viewpoint of socio-economics for Mozambique. EIRR is given as 13.50%. The present value of benefits amounts to USD 268,579,000.

For the sensitivity analysis, following factors were considered as the hidden risk in the Project, and the result is obtained as follows:

Case A (Initial investment costs overrun by 10%) : EIRR=12.47%
Case B (Lower benefits by 10%) : EIRR=12.14%
Case C (Initial investment costs (+10%) + Benefits (-10%)) : EIRR=11.17%

It is commonly understood among the funding agencies that 10% to 12% would be the threshold of EIRR applicable to the infrastructure projects in developing countries. As the EIRR calculated above exceeds that rate level in every case, the Project is deemed to be economically viable.

(2) Impact of the Project on the regional economy of southern Africa

When the Project is regarded as a multi-national infrastructure development project, it is expected to generate some benefits beyond national borders. The Study Team evaluates the amount of those benefits from a multi-national viewpoint. The result of evaluation indicates that the present value of benefits amounts to USD70,843,000, which is 26.3% of the same of Mozambique.

4.11. Financial plan

(1) Debt sustainability of Mozambique

According to the assessment by IMF, Mozambique is expected to continue to face a low risk of debt distress. The increase of external debt through the implementation of the Urgent Rehabilitation Project in Nacala Port is assessed to remain within the margin of the indicative thresholds. Furthermore, the project is expected to increase exports and GDP minimizing negative impacts on the country’s debt sustainability.

However, it should be noted that the scale of the Project is not very small considering the scale of the country’s GDP, and that if the Port fails to improve operational efficiency and to generate outcomes of the Project, the negative impact on the debt sustainability would not be negligible. Therefore, it is important that the Government be making its utmost effort to intensify the competitiveness of the Port, and continuously monitor the operational efficiency of the Port.

(2) Financial plan of executing agencies

The potential financial resources required for PMB to invest in the project are supposed as those from the GOM, MTC, multi-lateral financial institutes including AfDB and bi-lateral financial institutes including JICA. For TOC, the potential financing institutions for the project will be commercial banks.

4.12. Financial analysis

(1) FIRR of the Project

The result of calculation of FIRR is 12.8% and Net Present Value is 674 million USD; under weighted average cost of capital on the Project: 2.3%. The result of sensitivity analysis for Cases A (initial investment cost increases by 10%), Case B (demand decreases by 10%) and Case C (Case A & B) are shown in the table below.

Threshold level	Case A	Case B	Case C
2.3 %	11.7%	11.9%	10.8%

Thus, the Project itself is judged financially viable.

(2) Financial soundness of the executing agency

FIRR for PMB and NPV for each entity are evaluated as follows:

	Threshold level	Base case	Case A	Case B	Case C
FIRR: PMB	*1.1 %*	6.1%	5.8%	6.0%	5.6%
NPV: PMB	---	316 M US$	315 M US$	310 M US$	309 M US$
NPV: TOC	---	193 M US$	180 M US$	170 M US$	158 M US$

The resulting FIRR of PMB on Base case and sensitivity analysis exceeds the interest rate of the loan as the threshold level. In addition, NPV of PMB and TOC also shows positive results.

As to the cash flow, PMB will have cash shortages of about US$ 0.2~0.5 million/year up to 2014. It is assessed that PMB has the capacity to bear the expense based on revenue information of CFM. On the other hand, TOC will have profits from the first year of operation of the urgent rehabilitation project with new facilities and equipment because of the grace period.

Thus, both of PMB and TOC are judged financially viable.

4.13. Evaluation of environmental and social impacts

During the construction phase, dredging works will be one of the most significant sources of impact, if conducted in an uncontrolled manner. This could lead to degradation of the local ecosystem and reduction in fishery resources. These impacts could be further aggravated as the bottom sediments around the Port are contaminated. Various measures are planned to minimize dredging impacts, which will be mainly achieved by minimizing the area of sediment dispersion (e.g. installation of silt curtain, use of enclosed-type grab bucket and water quality monitoring). The local fishermen should be consulted regularly to confirm whether the construction works are not causing any adverse impacts on their activities. During the construction phase, implementation of most of the countermeasures will be the responsibility of the construction contractor.

Fundamentally, impacts after the port expansion/rehabilitation will be similar to the impacts that occur at present. However, the magnitude of these impacts will become greater as the volume of cargo is expected to grow significantly; hence more likelihood of air pollution, noise pollution, sediment pollution, accidents and so on. The risk of pollution/accidents should therefore be minimized by strengthening the Port's environmental management and safety measures.

4.14. Operational and managerial improvement

(1) Port administration framework in Mozambique

Considering the vital importance of Mozambican ports in the development of the country's economy, the role of the Government (MTC and CFM) shall be intensified. In this context, the Government should:

- Establish a law on ports which prescribes basic principals on administration, management, development and planning of ports; and,
- Establish the comprehensive port policy aiming at intensifying competitiveness of

Mozambican ports.

Based on the principals and a procedure prescribed by the law on ports including consultation with stakeholders, legally binding plan for Nacala Port development shall be established, which regulates the use of land and basin.

In accordance with the principals prescribed by the law on ports and the comprehensive port policy, the revised scheme of ownership and operation of Nacala Port shall be prepared aiming at promoting competition among private operators and securing the public interest. Paying due attention to debt sustainability, the public investment in port development projects shall be secured.

(2) Financial scheme of the operation in Nacala Port

It is most important to collect concession fees from TOC to avoid going overdue on the loan repayment of the project from PMB to the loan syndication. To guarantee the collection of concession fees, it is said that opening reserve accounts is an effective measure to control cash flow of a project. The account is used to cover a cash flow shortage. The new concession agreement, therefore, should stipulate that reserve accounts be opened for the payment of concession fees and maintenance expenditure.

(3) Technical improvement of port operation

The separation of gates by cargo type is important. At the container terminal, the gate operation shall be fully computerized. A maximum waiting time of 30 minutes in the queue at the terminal gate shall be a benchmark for the productivity improvement of gate operation. An integrated terminal operating system which covers planning, monitoring of all movements of containers, controlling gate operation, and issuing documents is required. Since the cause of low productivity of quay side operation is the insufficient number of reachstackers and inefficient movement of reachstackers, the operational efficiency of reachstackers shall be improved. Continuous capacity building is required for CDN to reduce the time of ships' staying at the Port and the dwell time of cargoes.

(4) Maintenance and repair of port facilities

Port facilities including those provided by the Urgent Rehabilitation Project shall be maintained in good condition by conducting regular maintenance based on an established plan.

Especially, the monitoring of the deteriorated structure of the South Wharf is crucial for securing safety and sustainability of port operation. Changes of piles, i.e. surface cracks or deformation of piles, should be regularly monitored. For confirming function of the rear walls, visual inspection should be conducted in the range of the whole rear walls to identify development of the existing and new stripped concrete. For confirming stability of the anchor walls, joints between the container yard and the slab deck at six locations should be monitored every month. In addition, elevations around six anchor walls should be surveyed. For monitoring stability of the deck structure, surveys of elevations and coordinates of fixed points are proposed. In case that any specific changes are found, detailed inspection should be made and suspension of cargo handling operation will be required.

4.15. Operation and Effect Indicators

The following indicators were selected as Operation Indicators which measure quantitatively the operational status of the Project:

- Annual container throughput of the dedicated container berth in the North Wharf
- Annual total cargo throughput of the berths located at the eastern shore of Nacala Bay

The following indicators were selected as Effect Indicators which measure quantitatively the effects generated by the project:

Principal Indicators:

- Annual container throughput of the dedicated container berth in the North Wharf

- Annual total cargo throughput of the berths located at the eastern shore of Nacala Bay

Auxiliary Indicators:

- Annual total transit container volume to/from Malawi handled in the Port
- Ratio of Annual total transit container throughput to/from Malawi handled in the Port to that handled in Beira
- Annual average cargo handling volume per vessel staying time
- Annual average container handling volume per vessel staying time
- Annual average cargo handling volume per vessel-quay operation hour
- Annual average container handling volume per vessel-quay operation hour

The target values of Operation Indicator and Effective Indicator were proposed based on the cargo demand forecast.

4.16. Institutional framework for the project implementation

During the implementation stage of the Project, the collective work among the relevant agencies is vital. The MTC and the CFM should establish a task force for the budget arrangement, implementation of EIA, establishment of a project management unit (PMU), etc.

The PMU is a government organization established for the purpose of smooth and swift implementation of the project and, therefore, it is given the legal power by the implementing agency of the Project to conclude the contract and to disburse. The PMU has the responsibility not only to supervise and monitor the progress of the Project, but also to ensure the safety of the construction and to monitor the impact on the social and natural environment over the period of project implementation. To this end, the PMU should be based at Nacala. The PMU should keep in close touch with CFM and MTC, and should have a liaison office in Maputo.

5. Conclusions and recommendations

To respond to the current issues of the Port, the Study Team proposed the Urgent Rehabilitation Project, which is consistent with the Medium/long-term Development Plan of the Port.

The Study Team recommends that the Government of Mozambique implement the Urgent Rehabilitation Project in cooperation with international development partners. The Study Team would also recommend that the following policies be taken in parallel with implementation of the Urgent Rehabilitation Project.

(1) Improvement of port administration
- Capacity building for the port administration
- Legislation for the port development plans

(2) Promotion of the port related business
- Integration of SEZ and the Port
- Strategic invitation of grain terminal
- Enhancement of the inter-modal connection between rail and the Port
- Cold chain for the export of agricultural products

(3) Modernization of the Port
- Establishment of strict delineation of container terminal
- Removal of all the conflict of the traffic flow
- Improvement of the productivity of cargo handling
- Upgrading of ship traffic control
- Enhancement of port security
- Promotion of container transshipment
- Reduction of burden of customs inspection

(4) Preservation of function of the South Wharf
(5) Monitoring of financial status of CDN
(6) Environmental consideration

SUMMARY

1. Background, Objectives and Outline of the Study

1.1. Background of the Study

Mozambique has three major commercial ports - Maputo, Beira and Nacala. In 2009, Maputo Port handled 8.2 million tons of cargo, while Beira handled 3.0 million tons, and Nacala 1 million tons. Among these three ports, Maputo and Beira need constant dredging for the accretion of sand, and therefore the capability of the ports to accept large vessels is limited. Meanwhile, Nacala Port (hereinafter referred to as 'the Port') is a natural port with sufficient depth for accommodating large vessels. In order to respond to the rapid increase in the traffic volume of the Nacala Corridor (hereinafter referred to as 'the Corridor') which is under upgrading work, the Port is expected to be the principal gateway providing efficient logistics services for the landlocked countries in its hinterland as well as for the northern provinces of Mozambique. Furthermore, the Port has the potential to become a hub port which serves for the larger areas in south-eastern Africa, taking advantage of its deep water basin.

The existing terminals of the Port, however, are significantly degraded due to insufficient maintenance. In addition, insufficient understanding of terminal operation as well as lack of modernized cargo-handling machinery is hindering the productive operation of the Port. High indirect costs such as X-ray scanning fee also render the competitiveness of the Port very low. For these reasons, the Port has not been able to reach its potential.

Furthermore, the current dimensions of the container terminal are not suitable for modern container handling, and the depth of the basin alongside the conventional terminal is utterly insufficient for bulk cargo handling. These will be the serious bottlenecks for the growth of the Port and the Corridor. Therefore, the development of the Port to enhance its handling capability is urgently required.

From the viewpoint of regional development of Northern Mozambique, the Port is expected to play a crucial role as the driving force of the development. The Northern provinces are populous but less developed than other regions in the country. The development of this region so as to fully realize its high potential in agriculture, forestry and mining is one of the top priorities of the nation. If the Port is entirely rehabilitated, fully furnished, and properly operated, the Port will be able to play a large role in accelerating the socio-economic development of the region.

Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched a mission to Mozambique from November 16 to December 4, 2009. The mission prepared the Scope of Works and the Implementing Arrangements for the Preparatory Survey on Nacala Port Development Project in the Republic of Mozambique, hereinafter called "the Study" based on the investigation of the Mission. The "Scope of Works" was agreed upon between the Ministry of Transportation and Communications (hereinafter referred to as "MTC") and JICA on February 16, 2010.

In accordance with the "Scope of Works", JICA has selected a study team composed of OCDI, ECOH, Oriental Consultants and Ides (hereinafter referred to as 'the Study Team').

1.2. Objectives of the Study

The objective of the Study is to enhance transaction capability by rehabilitating/expanding terminals and providing new handling facilities at the Port, with a larger goal of facilitating trade and economic development of the Nacala Corridor area.

1.3. Outline of the Study

1.3.1 Scope of the Study

The Scope of the Study covers the following items which were agreed upon between MTC and JICA on February 16, 2010.

[1] Analysis of the Existing Conditions
[2] Formulation of Medium/Long-term Port Development Plan (Target Year: 2030)
[3] Formulation of Short-term Plan/Urgent Project for Rehabilitation of the Port

1.3.2 Study schedule

The study schedule is shown in Figure 1.3-1

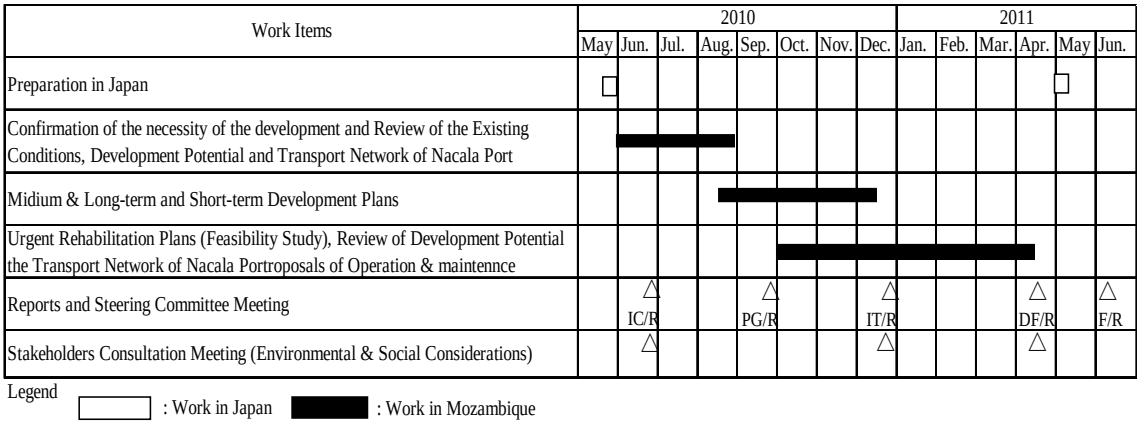


Figure 1.3-1 Work schedule

1.3.3 Members of the Study Team

The Study Team consists of four members from the Overseas Coastal Area Development Institute of Japan, three members from Oriental Consultants Co., Ltd, three members from ECOH CORPORATION and three members from Ides Inc.

1.3.4 Counterparts

The Study Team collaborates with counterparts listed hereunder;

Ministry of Transport and Communications (MTC)
Portos e Caminhos de Ferro de Mocambique (CFM)
Corredor de Desenvolvimento do Norte (CDN)

2. Status Quo of Nacala Port and Logistics in Southern Africa

2.1. Socioeconomic trends of Mozambique and neighboring countries

2.1.1 Mozambique

(1) Demography

The latest data from the Census of Population and Housing in 2007 indicate that the country currently has a population of 20.5 million, of which 52% are women. Around 45% of the Mozambican population is under the age of 15 years. The population is growing at a rate of 2.4% per annum and the birth rates are estimated at around 5 children per woman. Life expectancy is much shorter than the average in Africa.

(2) Economy

Mozambique's recent history has been an example of a successful post-conflict recovery and economic takeoff. The proportion of the population living in absolute poverty is falling continuously. The recent annual GDP growth rate is around 7%. GDP per capita increased from 297 USD in 2004 to 478 USD in 2008.

(3) Industry

Agriculture is the main activity of the Mozambican population. Approximately 84% of the economically active population in Mozambique works in agriculture. Although the share of the agricultural sector in GDP is higher then the Sub Saharan average (14.6%), the share is not high enough considering the high percentage of agricultural employment in the total work force of the country. Exploitation of agricultural resources is way below their potential with only 4.9 million ha (12%) of the estimated 36 million ha of cultivatable land area in Mozambique actually under cultivation. The most common crops cultivated by subsistence farmers include cassava, maize and beans, while commercial farmers focus on sugarcane, cotton, cashew nuts and tobacco.

According to the assessment by EU, productive forests in Mozambique occupy an area of about 20 million hectares or 20% of the national territory. Wood resources are used by commercial and artisanal logging operations and as an energy source by the rural and urban populations. It is estimated that Mozambique forests have the capacity to support about 500,000 m3/year of sustainable logging, but logging operations only account for around 127,000 m3/year at present.

The country's industrial sector is dominated by basic metal, namely aluminum production, which accounts for 55% of the total production of the industrial sector. The traditional food and beverage industry is the second largest industry, which accounts for 20% of total production. Thus the diversification of industry is a most important issue.

(4) Energy and natural resources

No crude oil is imported since there is no refinery in the country. The country produces natural gas, and almost all of it is exported to South Africa. Hydro power generated in Cahora Bassa power station is an important energy source of the country. This is utilized by the aluminum industry in Matola. Fuel wood consumption in Mozambique is reported to be the highest in the SADC region, and is the most important source of domestic energy in the country.

Though Mozambique has a rich reserve of natural resources such as coal, natural gas and heavy sand, the amount of production is still rather small. The Government continues to promote the rational exploitation and use of these resources for development.

(5) Trade

External trade balance has shown a deficit like most Sub Saharan countries. The low efficiency of the economy is responsible for this deficit. Although exports have been growing rapidly, imports have been growing at the same time. The mega-projects are responsible for the growth in both exports and imports, with the main imports being fuel, machinery, transport equipment, plastic, iron, and steel.

The Netherlands is the most important trade partner for exports, since almost all of aluminum is exported there. As for imports, South Africa has the largest share. Besides these countries, China and India are important partners both in import and export. Top 10 countries account for 81 % of total exports and 78 % of total imports.

Aluminum accounts for 55 percent of total exports, followed by mineral fuel (10 %). Mineral fuel also occupies the largest portion of imported goods. The exported mineral fuel is natural gas to South Africa, and the imported items are oil products. Thus, the exported commodities are very limited, and this makes the country's economic structure fragile. Mozambique is implementing the SADC Trade Protocol, which should boost trade in the region,

(6) Transport

The transport sector contributes around 10% of Mozambique's GDP, ranking third among economic sectors.

Mozambique has a road network of 30,400 km. Road density is 7.6 km /1,000 sq km of arable land, which is relatively low in Sub Saharan countries.

The road mode occupies a large share and its share has been increasing in recent years. The

railway mode also has a relatively high share, though its share has been decreasing. Despite Mozambique's long coastal line, modal share of maritime transport is rather small.

In 2009, MTC established the National Strategy for the Development of Integrated Transport System. The main objectives of the strategy are to develop an interconnected transportation system to facilitate investment, to develop tourism, to lead regional economic integration and to expand opportunities for development.

2.1.2 Neighboring countries

Main indicators of Mozambique's six neighboring countries (Tanzania, Zambia, Malawi, Zimbabwe, South Africa, and Swaziland) are shown hereinafter.

South Africa is demographically, spatially and economically the largest nation in the region. Mozambique, Tanzania and Zambia are almost the same in terms of the land area and GDP per capita. However, the population of Tanzania is twice that of Mozambique, and more than three times that of Zambia.

Table 2.1-1 Socioeconomic indicators of neighboring countries

	Population (millions)	Land area (thousands of sq km)	GDP per capita Constant 2000 prices		Life expectancy at birth (years)	Under-five mortality rate (per 1,000)	Gini index	Adult literacy rate (% of ages 15 and older)		Net official development assistance per capita (current $)
			(USD)	Average annual growth (%)				Male	Female	
	2008	2008	2008a	2000-08	2007-08b	2007	2000-07b	2007	2007	2008
Tanzania	42.5	886	362	3.9	55.9	116	34.6	79.0	65.9	54.9
Zambia	12.6	743	387	2.9	45.9	170	50.7	80.8	60.7	86.0
Malawi	14.3	94	165	1.6	48.3	111	39.0	79.2	64.6	63.9
Zimbabwe	12.5	387	-	–5.7	45.1	90	-	94.1	88.3	49.0
South Africa	48.7	1,214	3,764	3.1	50.5	59	57.8	88.9	87.2	23.1
Swaziland	1.2	17	1,559	1.7	46.4	91	50.7	-	-	57.7
Mozambique	21.8	786	365	5.6	42.1	169	47.1	57.2	33.0	91.5

a. Provisional
b. Data are for the most recent year available during the period specified
Source: WB

2.2. Present conditions and development trends of Nacala Corridor area

2.2.1 Outlines of the Corridor area

In this Study, "Nacala Corridor area" is defined as the area for which Nacala Port has a potential to serve as the principal gate way port. Accordingly, the Corridor area includes the three Northern Provinces as well as Tete Province in Mozambique, Malawi, and Zambia. Key statistics of the Corridor area are as follows.

1. Population; 36,000 (x1000 habitants)
2. Area; 1,260 (x1000 km^2)
3. GNI total; 18,400 (million USD)

2.2.2 Industry and investment

(1) Manufacturing industry

1) Northern Mozambique

Northern Provinces, which include the most populated province of Nampula, are less developed than the rest of the country. Therefore industrial development in the Northern Provinces is one of the most important strategies of the nation. Nacala Special Economic Zone (SEZ) Development Project is a key project for the industrial development of the Northern Provinces.

The Government of Mozambique promulgated Decree No.76/2007 on establishment of Nacala

SEZ on December 18, 2007. The Decree designated two districts as Nacala SEZ, Nacala District located to east of Nacala Bay and the less developed district of Nacala-a-Velha located to the west of the bay. Twenty (20) entities have been approved in the SEZ as of December 2010 since 2009.

GAZEDA has nominated two areas as IFZs in the SEZ, but as of 2010 neither have been developed. Establishment of a long term master plan of the SEZ including detailed zoning and infrastructure development (roads, water and electric supply, telecommunication, sewage system, etc.) are vital for materializing the IFZ plan. The master plan of the SEZ, urban plans of Nacala and Nacala-a-Velha, and Nacala Port long and medium term shall be harmonized with each other.

2) Malawi

Despite remaining one of the poorest and least developed countries in Africa, Malawi is beginning to make real progress in terms of laying the foundations for further industrial growth and more effective poverty reduction. Malawi's main industries consist of tobacco, tea, sugar, sawmill products, cement and consumer goods.

3) Zambia

Zambia's main industries consist of copper processing, construction, foodstuffs, beverages, chemicals, textiles and fertilizer.

(2) Agriculture and Fisheries

1) Northern Mozambique

70% of the population is living in agricultural areas in Nampula Province. Most of them are smallholders. Agricultural methods are mainly manual and very little agricultural technology has been introduced. Inland Nampula Province has fertile loamy soil that is perfect for cultivation. In Nampula Province, food crops such as cassava, maize, beans, peanuts, sorghum, millet and cash crops such as cashew, cotton, sesame, tobacco are cultivated.

Land area of Nampula province is 8,160,600 (ha) and agricultural land under cultivation covers 4,500,000 (ha) within Nampula province land. Only 1.6% of the agricultural land (about 74,000ha) has been irrigated. Annual crops occupy an area of 899,000 hectares, representing 20% of the total agricultural area of the province, and are basically worked by the household sector. Permanent crops occupy an area of about 260,000 hectares, accounting for 6% of the total area.

International development partners including JICA have been assisting the agricultural development in the Province.

Fisheries are one of the most important sectors in Nampula Province. In 2007, the artisanal component had 357 associations, operating 7,880 fishing vessels. In recent years greater emphasis is being placed on the capture of shrimp. In 2009, 17,854.4 tons of fishing products were caught against 13,224 tons caught in the previous year 2008, representing an increase of 35%.

2) Malawi

Agriculture sector is the main impetus of Malawi economic development. This sector shared 32.6% of GDP by sector in 2006. Agricultural products consist of tobacco, sugarcane, cotton, tea, corn, potatoes, cassava (tapioca), sorghum, groundnuts, macadamia nuts and livestock such as cattle and goats.

3) Zambia

In Zambia, agriculture sector shared 19.7% of GDP. Agricultural products of Zambia consist of corn, sorghum, rice, peanuts, sunflower seed, vegetables, flowers, tobacco, cotton, sugarcane, cassava (tapioca), coffee and livestock such as goats, pigs and cattle.

(3) Forestry

1) Northern Mozambique

Northern Provinces have favorable natural conditions for forestry, such as rainfall of 1,100mm to 1,500mm per year, suitable temperature range, well-drained soil condition and suitable altitude. Therefore, forestry-related industries are prospering in Northern Mozambique compared with those in the middle and southern parts of Mozambique. Foreign capital has been pouring into the forestry sector of these regions, especially into Niassa Province.

2) Malawi

In Malawi, forests and woodlands cover an estimated 2.6 million ha, or 27% of the land area. Natural forests are in the high-altitude regions and the Forestry Department is engaged in a softwood forestation program. However, Malawi's annual rate of deforestation was 2.4% during 1990–2000. Sizable plantations of pine, cypress, and cedar have been established.

3) Zambia

In Zambia, 66.5% or about 49 million ha is forested, according to FAO. National forests are extensive as annual precipitation ranges from 800mm to 1400mm. Forestry sector in Zambia has a lower share compared to other industrial sectors such as mining.

(4) Mining

1) Northern Mozambique and Tete Province

Heavy sand mining in Moma is the most important mining project in Northern Mozambique. The project produced a total of 492.141 tons of ilmenite, zircon and rutile. Besides heavy sand in Moma, around 790 thousand tons of minerals were produced in Nampula Province in 2009, though they were dominated by sand for construction. At present, the amount of mineral production in Northern Mozambique and Tete is rather small; however, the production is expected to grow rapidly.

Vale is interested in mining phosphate deposits in Nampula Province. An economic feasibility study will be carried out in 2011 although mining of the deposits is not expected to begin before 2014. Phosphates have many industrial and agricultural applications, namely production of fertilizers. Vale will also annually produce 1 million tons of iron concentrate when it begins exploiting mines in the Monapo District of Nampula Province. Iron deposits located at Evate in Monapo District are sufficient to be exploited for an estimated 28 years.

In Tete province, large scale coal mining projects are progressing. The projects include the development of the country‘s three largest coal deposits - Moatize-Minjova, Senangoe, and Mucanha-Vuzi. Some of the coal is high-value coking coal used in steel production. According to Vale Mozambique, they will produce 12,000,000 tons of coking and thermal coal annually in Phase-1 from year 2011. The coal will be transferred to Beira and shipped onto an off-shore self loading vessel. In Phase-2, Vale will use Nacala Bay since Beira Port will reach full capacity. Accordingly, the branch railway to Nacala-a-Velha and a coal loading jetty will be constructed by the year 2014 at the earliest. In addition, the Revuboe project is progressing in Tete Province adjacent to Vale’s Moatize project. About 5 million tons of coal will be produced in 2014 from the Revuboe. The Benga project is also progressing. They will commence to produce 6 million tons of coal in 2011 in Tete. Furthermore, exploration activities of Zambeze project are ongoing by Riversdale in Tete. Coal resources here are estimated at 9 billion tons.

In Niassa Province, coal explorations are being carried out by various companies. In Cabo Delgado Province, exploitation of graphite deposits is planned, besides on-going hydrocarbon development.

2) Malawi

Apart from industrial mineral production, Malawi does not have a well-developed minerals industry. However, Malawi does have potential heavy mineral sand, bauxite, phosphate, uranium, and

rare earth element deposits. Several mineral deposits exist in Malawi which can be mined on a small scale. The Malawi Government has embarked on an economic empowerment programme aimed at promoting and supporting small-scale mining in areas of import substitution and value-adding services.

3) Zambia

Copper and cobalt are the key commodities produced by Zambia, with the Zambian copper-belt remaining the focus of mining and development activities. The area contains the world's highest grade copper and cobalt deposits. Zambia is ranked as the world's seventh largest producer of copper, and the world's second largest producer of cobalt (19.7%). It also has significant quantities of selenium and silver together with minor gold and platinum group elements which are produced as important by-products of the copper mining and processing.

2.2.3 Transport

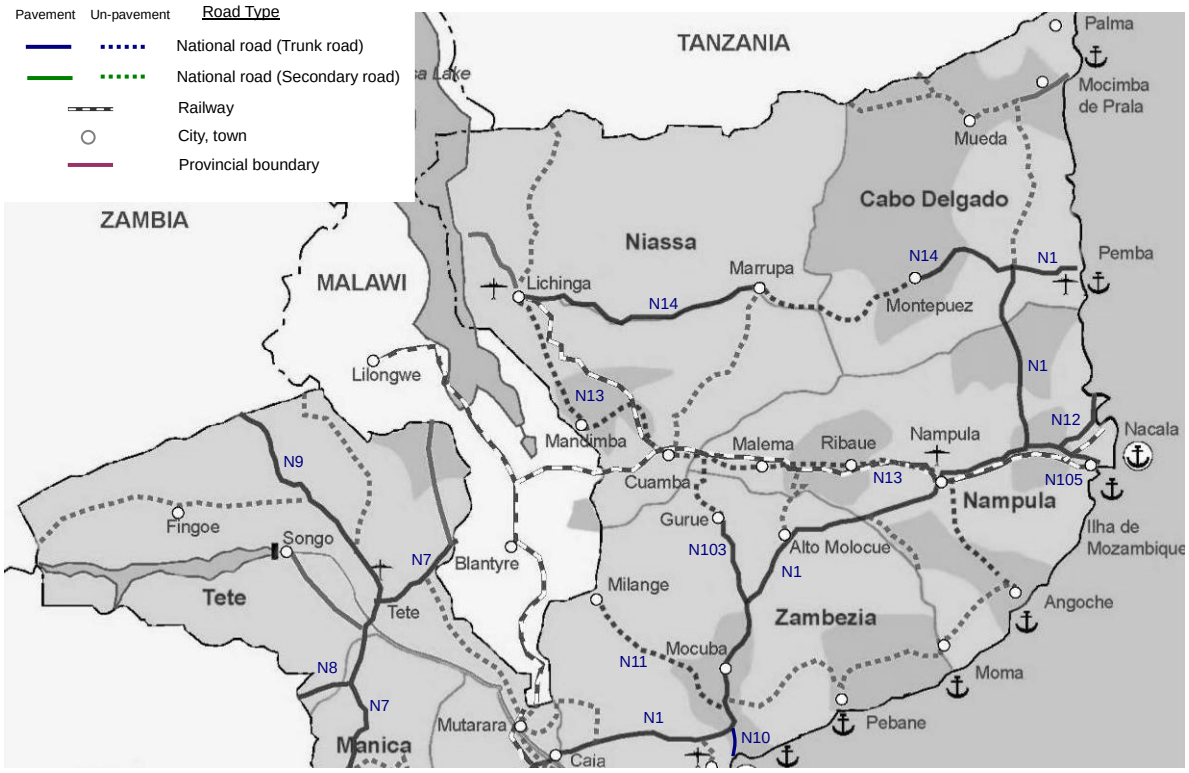
(1) Road

The road network in Northern Mozambique is relatively feeble compared with that in the southern region of the country. Its conditions also have remained poor as gravel surface is mainly observed except the N1 and some sections which have been improved by international funds from AfDB, EU and Japan.

The national roads, N1 from Nacala to Nampula and N13 from Nampula to Mandimba, the border with Malawi, are the core routes of Nacala Corridor in Mozambique. N1 constructed by EU fund is a paved road and well maintained, while N13 is still a gravel surface and in poor condition. The road condition on N13 becomes so bad during the rainy season that vehicles are forced to drive slowly or divert to other roads.

Consequently, despite being the shortest way to Nacala Port from/to landlocked Malawi, the Nacala Corridor has hardly been used as an international road transportation route due to the above conditions.

The road of Nacala Corridor in Malawi is in better condition than Mozambique, but there are some sections that need to be rehabilitated.

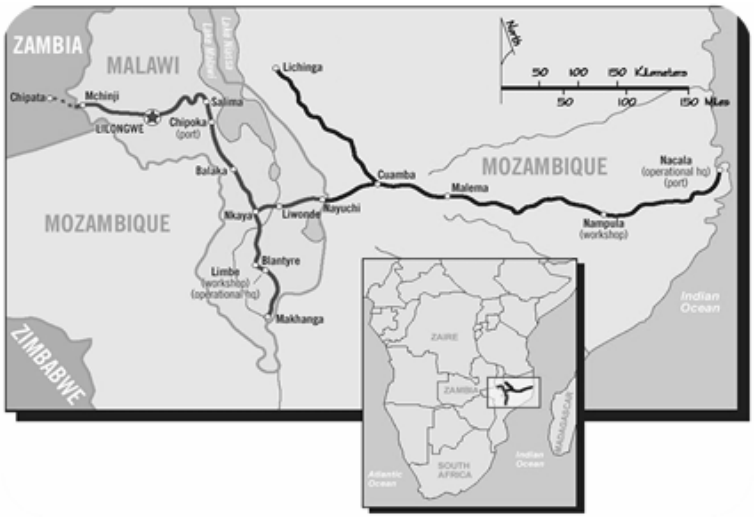


Source: Study Team

Figure 2.2-1 Road network in northern Mozambique

(2) Railway

The railway along the Nacala Corridor, consisting of Malawi's railway and the railway in Mozambique, was concessioned in stages, beginning with the creation of Central East African Railways (CEAR) in 1999 in Malawi and continuing with the concessioning of Mozambican railway to Corredor de Desenvolvimento do Norte (CDN) in 2005. Vale, a Brazilian mining company, purchased a 51% stake in Sociedade de Desenvolvimento do Corredor do Norte SA (SDCN) in 2010. SDCN in turn holds 51% of CDN and CEAR.



Source: CDN

Figure 2.2-2 Railway along Nacala Corridor

Following is a brief explanation of the major links of the Mozambican section of Nacala

railways:

Nacala – Cuamba (533 km)

This section was completely rehabilitated with funds from France, Portugal and the European Union. Normally three trains run each day in both directions.

Cuamba – Entre Lagos (77 km)

As the maintenance work has not been sufficient, the railway operation for passenger is not operated and railway for cargo travels at a considerably slow speed. However, it is expected that this section will be fully rehabilitated and upgraded before 2014 now that Vale is participating in the management of CDN.

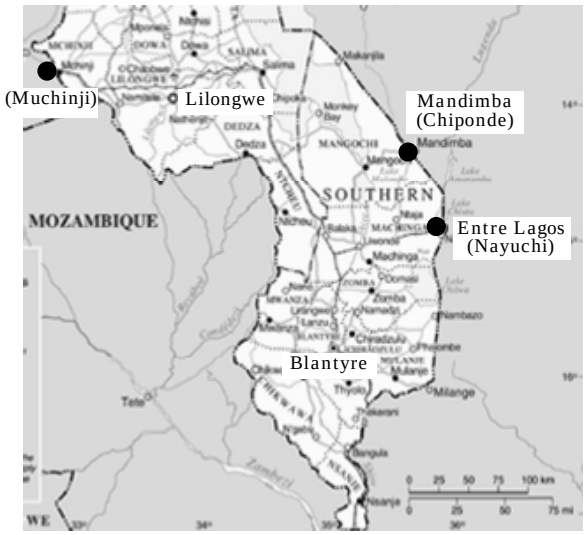
Cuamba – Lichinga (262 km)

Mixed passenger/cargo trains circulate regularly once or twice a month. This track is essential for the development of the Niassa Province and it is now undergoing consolidation works. The operation of this line is susceptible to flooding.

In Malawi, CEAR operates the whole of the 797 km railway line, whereas the railway infrastructure is owned by the government. The network spreads from Mandimba in the Nacala Corridor to Chipata in Eastern Zambia through the Mchinji border in the west side, and Maruka in the south side, however, the bridge was washed out because of flood, and thus the railway is operated only to Luchneza for cargo and Makhanga for passenger at this moment. The rail link between Chipata and Mchinji, of which Zambian section is also operated by CEAR, was commissioned in 2010 aiming at facilitating transport of import and export goods from landlocked Zambia through the port of Nacala. Freight trains are operated based on client's requests rather than a regular schedule.

(3) Cross border post

There are two three (3) cross border posts on the Nacala Corridor as shown in Figure 2.2-3. Entre Lagos border post is used mainly for the railway crossing.



Source: Study Team

Figure 2.2-3 Border posts on Nacala Corridor

(4) Airport

In northern Mozambique, there are five international airports, namely Pemba, Lichinga, Nampula, Quelimane and Tete. Malawi has one major international airport outside its capital, Lilongwe. The country's commercial capital, Blantyre, also has an airport used primarily for regional flights. Zambia has one major international airport outside Lusaka and a smaller airport in Livingstone,

which is used for regional flights.

In order to improve accessibility to the northern area of Mozambique, the Nacala International Airport will be constructed by 2013 by transforming the current Nacala military air base built in 1962.

2.3. Trends of inland goods distribution in/around Mozambique

2.3.1 Cargo flow on road/railway network

(1) Cargo flow on road network

In 2009, the OD survey at 4 border posts was conducted by JICA in order to grasp cross-border cargo transportation. The characteristics and OD pattern of trucks for each border post are as follows:

Zobue/Mwanza (Mozambique/ Malawi)

The travel distance for vehicles passing through Zobue/Mwanza border tends to be longer than that through other borders. For going into Malawi, the origin of 37% of trucks is Beira Port and 28% is from South Africa. For coming from Malawi, the destination of almost half of trucks is Beira Port. This border is used by the trucks which travel between Tete and Niassa Province as the transit traffic.

Milange/Muloza (Mozambique/ Malawi)

Milange/Muloza border is mainly used by the vehicles engaged in a short trip around the border area. There are some trucks going to the ports in Nacala and Quilimane for exportation to overseas. It is considered that the route to Nacala Port through Milange/Muloza is more convenient than the route through Mandimba due to the road condition.

Mchinji (Mozambique/ Malawi)

Almost all trucks through the Mchinji border are driven between Malawi and Zambia. No trucks coming from or going to Mozambique's ports were counted during the survey. In terms of passenger cars, it seems that the tourist cars, visiting South Luangwa National Park, the east of Zambia, from Lilongwe in Malawi, are largely included in this traffic.

Mamdinba/Chiponde (Malawi/ Zambia)

The traffic volume at the Mandimba/Chiponde border is least among surveyed borders. Most of trucks are provided from the tobacco company to transport tobacco leaf to Tete which is grown in Niassa Province. Although trip length is relatively short to go out from Mozambique, some trucks traveling a long distance such as from South Africa to Namplula and Nacala are included going into Mozambique.

The rate of loaded truck shows that the majority of trucks entering into Malawi carry some kind of goods but there are many empty trucks exiting Malawi. The average weight of freight is heavier on Zobue and Milange borders comparing to the Mchinji border.

Based on the survey data, the annual freight volume at the Zobue border is estimated to be 577 thousand tons to Malawi and 146 thousand tons from Malawi. The volume at other borders is considerably lower and the volume at the Mandimba border remains less than 50 thousand tons.

Table 2.3-1 Volume of cargoes closing borders to Malawi

Vehicle/day

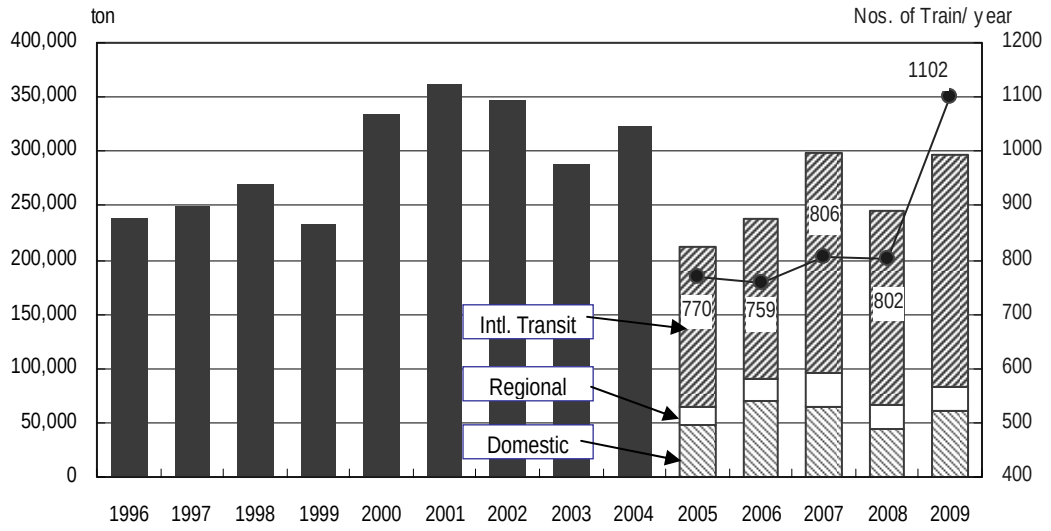
Border	Direction	Nos. of heavy truck	Nos. of loaded heavy truck	Rate of loaded truck (%)	Average weight of freight (t)	Estimated annual freight volume (t)
Zobue/ Mwanza	From Malawi	49	16	32.7	**25.0**	**146,000**
	To Malawi	68	64	94.1	**24.7**	**577,000**
Milange /Muloza	From Malawi	13	5	38.5	**30.3**	**55,300**
	To Malawi	5	4	80.0	**24.5**	**35,700**
Mchinji	From Malawi	10	2	20.0	**18.0**	**13,100**
	To Malawi	8	7	87.5	**15.8**	**40,300**
Mandimba /Chiponde	From Malawi	11	5	45.5	**26.1**	**47,632**
	To Malawi	7	6	85.7	**17.2**	**37,600**

Source: Final Report of the Preparatory Survey on Road Improvement Plan in Nacala Development Corridor, JICA (2009)

(2) Cargo flow on railway network

To date, the cargoes through the Nacala Corridor has been largely conveyed by railway due to the poor road condition. According to the record for 2009 regarding the railway operated by CDN, 403 freight trains, consisting of 228 trains to Malawi and 175 trains to Mozambique, have been operated for the international transport annually. In terms of the haulage volume, almost three hundred thousand tons were transferred by railway in total. The international transit, meaning the import and export of Malawi through Nacala Port, accounts for 72% of the total haulage.

According to the historical data from 1996, it is clear that the haulage volume has not increased steadily as shown in Figure 2.3-1. This would be because of the poor condition of infrastructure, lack of locomotives and inefficient management.



Source: CDN (1999-2009), CFM-Norte (1996-1998)

Figure 2.3-1 Cargo transportation on Nacala Railway (1996-2009)

2.3.2 Hinterland transport of seaborne cargoes

(1) Transport route of seaborne cargoes to/from LLCs

1) Container cargoes

Based on the total TEU figures given above and various statistical data sources, the Study Team

compiled the cargo distributions to the 5 gateway ports as per the Table 2.3-2 below.

56.2% of containers to/from Malawi are moving through Beira, while only 14.8% are through Nacala. Dar es Salaam handles 11.9%, while Walvis Bay has NIL.

Major gate port for Zambia is Dar es Salaam which handles 56% of its import/export container cargoes moving through Tazara Corridor. 8.1% are via Walvis Bay through Trans Caprivi Corridor which is being developed rapidly. Beira handles 12.2%, while Nacala is not functioning as a gateway port of Zambia at this moment.

Table 2.3-2 Container cargo volume in 2008 by gateway port

			Nacala	Beira	Durban	Dar es Salaam	Walvis Bay	Total
Malawi	Export	TEU	3,244	8,500	4,701	208	0	16,652
		Share	19.5%	51.0%	28.2%	1.3%	0.0%	100.0%
	Import	TEU	2,969	15,046	4,215	3,000	0	25,231
		Share	11.8%	59.6%	16.7%	11.9%	0.0%	100.0%
	Total	TEU	6,213	23,546	8,916	3,208	0	41,884
		Share	14.8%	56.2%	21.3%	7.7%	0.0%	100.0%
Zambia	Export	TEU	0	753	3,220	12,000	705	16,678
		Share	0.0%	4.5%	19.3%	72.0%	4.2%	100.0%
	Import	TEU	0	6,411	10,702	20,989	4,083	42,185
		Share	0.0%	15.2%	25.4%	49.8%	9.7%	100.0%
	Total	TEU	0	7,164	13,922	32,990	4,788	58,864
		Share	0.0%	12.2%	23.7%	56.0%	8.1%	100.0%
Total	Export	TEU	3,244	9,252	7,921	12,208	705	33,330
		Share	9.7%	27.8%	23.8%	36.6%	2.1%	100.0%
	Import	TEU	2,969	21,458	14,917	23,989	4,083	67,416
		Share	4.4%	31.8%	22.1%	35.6%	6.1%	100.0%
	Total	TEU	6,213	30,710	22,838	36,197	4,788	100,747
		Share	6.2%	30.5%	22.7%	35.9%	4.8%	100.0%

Source: Nacala, Beira, Maputo : CFM "Informação Estatística Annual 2009"
Dar es Salaam : TPA web site
Durban, Walvis Bay : JICA "Preparatory Survey on the Walvis Bay Port Container Terminal Development Project in the Republic of Namibia
All reorganized by the Study Team

2) Bulk cargoes

Port selection for bulk cargoes to/from Zambia and Malawi were estimated in the same way as the container cargoes. The result is shown in Table 2.3-3.

The result has the same tendency as containers basically. As for Malawi, the share of Durban is smaller compared with the container share, because the maritime network has little significance in bulk transport unlike in container transport, and Durban has less advantage. A large amount of imported fuel oil through Beira Port pushes up the port's share.

The result of Zambian cargoes is somewhat unexpected. A large amount of mineral products exported through Durban Port thrust up the port's share. Imported crude oil through the Tazara pipeline helps the share of Dar es Salaam remain high.

Table 2.3-3 Bulk cargo volume in 2008 by gateway port

			Nacala	Beira	Durban	Dar es Salaam	Walvis Bay	Total
Malawi	Export	Metric tons	28,300	11,300	28,613	0	0	68,213
		Share (%)	41.5%	16.6%	41.9%	0.0%	0.0%	
	Import	Metric tons	134,600	467,200	25,903	65,942	0	693,645
		Share (%)	19.4%	67.4%	3.7%	9.5%	0.0%	
	Total	Metric tons	162,900	478,500	54,515	65,942	0	761,857
		Share (%)	21.4%	62.8%	7.2%	8.7%	0.0%	
Zambia	Export	Metric tons	0	55,600	503,108	20,421	0	579,129
		Share (%)	0.0%	9.6%	86.9%	3.5%	0.0%	
	Import	Metric tons	0	26,600	187,122	558,227	0	771,949
		Share (%)	0.0%	3.4%	24.2%	72.3%	0.0%	
	Total	Metric tons	0	82,200	690,229	578,648	0	1,351,077
		Share (%)	0.0%	6.1%	51.1%	42.8%	0.0%	
Total	Export	Metric tons	28,300	66,900	531,721	20,421	0	647,342
		Share (%)	4.4%	10.3%	82.1%	3.2%	0.0%	
	Import	Metric tons	134,600	493,800	213,024	624,169	0	1,465,593
		Share (%)	9.2%	33.7%	14.5%	42.6%	0.0%	
	Total	Metric tons	162,900	560,700	744,745	644,590	0	2,112,935
		Share (%)	7.7%	26.5%	35.2%	30.5%	0.0%	

Source: Nacala, Beira, Maputo : CFM "Informação Estatística Annual 2009"
Dar es Salaam : TPA web site
Durban, Walvis Bay : JICA "Preparatory Survey on the Walvis Bay Port Container Terminal Development Project in the Republic of Namibia
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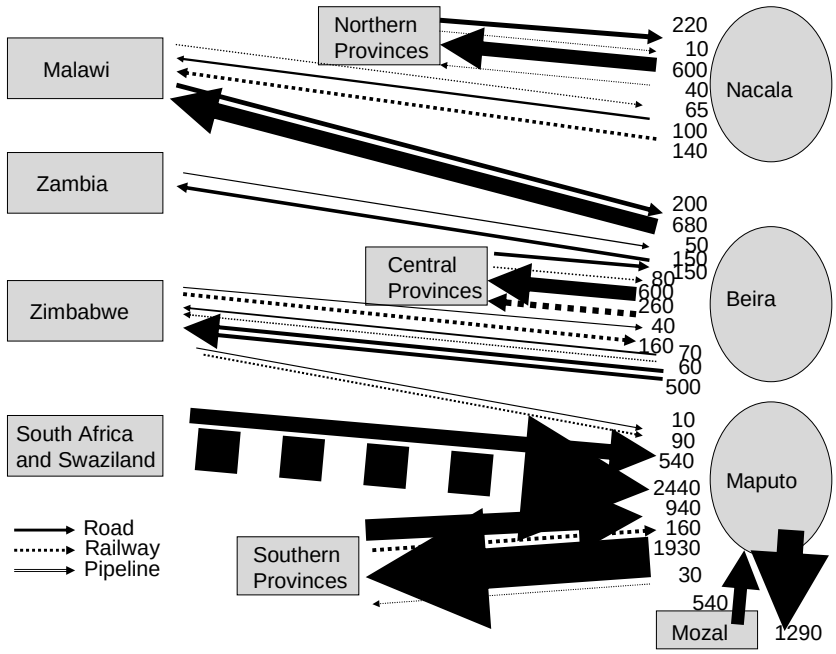


Source: Study Team Unit: 1000 tons

Figure 2.3-2 Estimated hinterland cargo flow to/from Mozambican major ports in 2009

(2) Hinterland transport of seaborne cargoes loaded or discharged in Mozambican ports

The result of the estimation is shown in Figure 2.3-2. The links from South Africa to Maputo and from Maputo to its domestic hinterland are the busiest routes. Except cargoes via Maputo Port, inbound cargo traffic is heavier than outbound flow. The transit traffic volume via Nacala Port is rather small comparing with the cargo volume to/from its domestic hinterland due to unfavorable conditions

of the Corridor.

2.4. Trends of maritime transport in/around Mozambique

2.4.1 Container Transport Network in Southern Africa

The areas in/around Mozambique covered by main line container services are classified into 4 port groups; 1) Mozambican ports, 2) South African ports and Walvis Bay, 3) Tanzanian ports and 4) Indian Ocean Islands (IOI). Current situations of vessel deployment for those areas are summarized in Table 2.4-1.

Table 2.4-1 Vessel Deployment by Port Group in Southern Africa

Mozambican ports

Trade lane	Number of vessels deployed	Fleet capacity (TEU)	Average vessel size (TEU)	Number of voyages /year	Fleet capacity /year (TEU)	Number of callings /year					
						Maputo	Beira	Nacala	Pemba	Quelimane	Durban
Main Line Total	57	95,778	1,680	416	695,871	285	98	145	46		139
East Asia	38	66,090	1,739	284	488,056	222	74	74	46		76
Middle East/South Asia	9	15,080	1,676	70	116,690		24	70			
Europe	10	14,608	1,461	63	91,125	63		2			63
Feeder Total	11	8,042	731	240	202,949	156	134	59	12	39	177
Total 18 services by 13 shipping lines	68	103,820	1,527	656	898,820	440	232	205	58	39	316

South African ports/Walvis Bay

Trade lane	Number of vessels deployed	Fleet Capacity (TEU)	Average vessel size (TEU)	Number of voyages /year	Fleet capacity /year (TEU)	Number of callings /year						
						Durban	Richards Bay	East London	Port Elizabeth	Ngqura	Cape Town	Walvis Bay
Main Line Total	245	725,760	2,962	1,644	4,629,305	1,378	66	37	261	209	780	327
East Asia	114	339,728	2,980	764	2,341,706	611			104		285	156
South America	54	203,765	3,773	261	968,273	313			52	104	104	
Europe	34	103,311	3,039	231	744,560	179	37	37	52	104	245	89
Middle East/South Asia	28	53,214	1,901	202	420,974	165						52
North America	15	25,742	1,716	186	153,793	111	29		52		146	29
Feeder Total	30	31,311	1,044	489	511,526	419				70	232	139
West Africa Feeder	16	19,440	1,215	221	271,803	151				70	232	139
East Africa Feeder	14	11,871	848	268	239,723	268						
Total 52 services by 35 shipping lines	275	757,071	2,753	2,132	5,140,830	1,797	66	37	261	278	1,011	465

Indian Ocean Island ports

Trade lane	Number of vessels deployed	Fleet capacity (TEU)	Average vessel size (TEU)	Number of voyages /year	Fleet capacity /year (TEU)	Number of callings /year								
						Moroni	Mutsamudu	Longoni	Toamasina	Madagascar others	Port Victoria	Port Louis	Mauritius others	Reunion
Main Line Total	48	94,085	1,960	409	751,522		83	53	129		39	233		151
East Asia	35	73,405	2,097	281	587,386				129		39	233		151
Middle East/South Asia	13	20,680	1,591	128	164,136		83	53						
Feeder Total	13	11,335	872	376	208,348	55	49	105	212	105	64	303	46	247
Total 16 services by 10 shipping lines	61	105,420	1,728	785	959,870	55	131	158	341	105	103	536	46	397

Tanzanian ports

Trade lane	Number of vessels deployed	Fleet capacity (TEU)	Average vessel size (TEU)	Number of voyages /year	Fleet capacity /year (TEU)	Number of callings /year			
						Dar es Salaam	Zanzibar	Tanga	Mtwara
Main Line Total	60	100,808	1,680	522	951,211	440	152	109	
Middle East/South Asia	27	53,748	1,991	272	523,702	189	152	83	
East Asia	29	41,860	1,443	224	393,616	224		26	
Europe	4	5,200	1,300	26	33,893	26			
Feeder Total	4	3,196	799	3,196	41,662	52			
Total 15 services by 18 shipping lines	64	104,004	1,625	3,718	992,873	492	152	109	

Source: Study Team

2.4.2 Assessment on the status of Mozambican ports in the container transport network

(1) Analysis on slot allocations

Analysis on the slot allocation for a port in the total fleet capacity will give an idea on the relative position of the port in terms of the cargo source among other calling ports in the trade lanes. Table 2.4-2 compares the allocations by port group in Southern Africa.

The allocation of 13.7% for Mozambican ports is the lowest among all those areas, which means Mozambican ports are more "dependent" on other ports' cargo sources from the viewpoint of vessel deployment.

Table 2.4-2 Average vessel allocations for Southern Africa

Port Group	Throughput (TEU) A	Total Capacity (TEU) B	B×2 (TEU) C	Allocation (%) A÷C
Mozambican Ports	246,803	898,820	1,797,640	13.7%
South African Ports/Walvis Bay	3,979,597	5,140,830	10,281,660	38.7%
Indian Ocean Islands Ports	847,379	997,815	1,995,630	42.5%
Tanzanian Ports	364,000	992,873	1,985,746	18.3%

Source: Study Team

When the same calculation is applied to Maputo, Beira and Nacala, following results are given respectively:

Table 2.4-3 Average vessel allocations for Mozambican ports

	Throughput (TEU) A	Total Capacity (TEU) B	B×2 (TEU) C	Allocation (%) A÷C
Maputo	85,851	597,100	1,194,201	7.2%
Beira	91,029	249,283	498,566	18.3%
Nacala	52,088	188,371	376,742	13.8%

Source: Study Team

The consideration above reveals that no port in Mozambique can be served alone and needs to be combined with some other ports in the adjacent areas such as in South Africa, IOI and Tanzania/Kenya.

Despite the shipping industry's positive trend, Mozambican ports have some disadvantages besides those derived from infrastructures. Following weak points were revealed through the interviews by the Study Team with the various parties concerned.

1) Inbound transshipments hampered by customs regulations

Under current customs regulations in Mozambique (Ministerial Diploma No.10/2002), shipping lines are required a huge amount of bond when they transship the inbound containers at Mozambican ports. The bond needs to be furnished to the customs at full amount of import duties on the cargoes to be transshipped. This seems to be discouraging the shipping lines who want to transship inbound containers at Mozambican ports.

2) Lack of domestic feeder line

Empresa Moçambicana de Navegação, S.A.R.L. ceased its coastal service in 2007. Since then, all coastal services have been undertaken by foreign shipping lines. It is observed that,

due to the profit-oriented policy of those lines, the small ports such as Quelimane have a difficulty to secure the vessels for the exports of local products.

(2) Evaluation by UNCTAD

Trade Facilitation Working Group of UNCTAD started to release "Liner Shipping Connectivity Index (LSCI)" in 2004 to evaluate the availability of maritime networks for a country. The LSCI score represents how a country is attractive or convenient to the shipping lines and the traders in view of the opportunity of shipping to/from a country. In 2009, Mozambique ranked 85th among 162 countries in the world. Mozambique is below Mauritius, Namibia and Kenya, but nearly matches Tanzania. It is notable that Namibia, located on the opposite coast side of Southern Africa, has steadily been improving its LSCI score, which would be attributable to Walvis Bay's strategic policy and well-organized actions to induce transit cargoes to/from adjacent landlocked countries or transshipment cargoes from shipping lines.

(3) OD analysis of containers to/from Mozambican ports

Table 2.4-4 shows the breakdown of export/import container volume to/from Mozambican ports by trade region. The figures are roughly estimated by the Study Team based on the current region-wise vessel deployment and the "trade value" statistics for the year 2009 obtained from National Institute of Statistics (INE).

Table 2.4-4 OD of containers to/from Mozambican ports

Destination of export / Origin of import	Export		Import	
	TEU	Share	TEU	Share
Eastern/Southeastern Asia	51,500	46%	56,000	46%
Europe	31,600	28%	29,000	24%
Southern Asia	13,000	12%	10,700	9%
Southern Africa	4,600	4%	6,400	5%
Western Asia	3,800	3%	7,300	6%
Eastern Africa	2,500	2%	3,700	3%
Southern/Central America	2,200	2%	2,200	2%
Northern America	1,800	2%	2,800	2%
Western/Northern Africa	600	1%	1,400	1%
Oceania	200	0%	1,000	1%
Total	111,800	100%	120,500	100%

Source: Study Team

2.4.3 Bulk cargo transport

Table 2.4-5 shows the volume of international bulk cargoes handled in ports in/around Mozambique in 2008. Richards Bay Port is by far the largest bulk port in the region. The port handles a huge amount of exported coal. Regarding inbound flow, Durban Port handles the largest volume. More than 70% of imported bulk cargoes are petroleum and its products. In Mozambique, Maputo Port is the largest bulk port, which handles transit bulk cargoes (coal, magnetite, ferrochrome, etc.) from South Africa, and imported alumina to Mozal. Beira Port handles a large amount of fuel, especially transit to Zimbabwe utilizing the advantage that the port is connected with its capital city by a pipeline. Handling volume of bulk cargo in Nacala Port is still very small.

Table 2.4-6 shows origin and destination of international bulk cargoes handled in Mozambican ports. Europe and Eastern Asia are the dominant export partners for Mozambique. As for Europe, coal and magnetite exported from South Africa via Maputo Port and Aluminum produced by Mozal in Maputo are the main contributors. The principal exported commodities to Eastern Asia are mineral products such as magnetite, ferro-chrome and chrome ore. They are exported from South Africa or Zimbabwe via Maputo. The import partners are more diversified than those of export destinations. The import volume from Western Asia is the largest followed by Oceania. Imported commodity from West Asia is oil products, whereas that from Oceania is Australian alumina which is the raw material for

Mozal aluminum smelter. Substantial amount of wheat, oil products and clinker are imported from Europe.

Table 2.4-5 International bulk cargo handled in ports in/around Mozambique in 2008

(1000 tons)

	Export			Import		
	Dry/Break	Liquid	TOTAL	Dry/Break	Liquid	TOTAL
Dar es Salaam	122	52	174	1,493	2,142	3,635
Mtwara	29	0	29	34	6	40
Pemba	0	0	0	0	0	0
Nacala	56	0	56	331	119	450
Quelimane	0	0	0	0	0	0
Beira	247	0	247	695	974	1,669
Maputo	3,650	89	3,739	1,966	638	2,604
Rechards Bay			78,008			6,123
Durban			8,598			30,504

Source: Study Team

Table 2.4-6 Origin and destination of bulk cargoes to/from Mozambican ports in 2008

EXPORT

DESTINATION	SHARE	MAJOR COMMODITIES (1,000 tons)
Europe	57%	COAL (550), ALUMINUM (540), SUGAR (310), MAGNETITE (260), FERRO-CHROME (100), CITRUS (80), CHROME ORE (70)
Eastern Asia	32%	MAGNETITE (540), FERRO-CHROME (310), CHROME ORE (230)
Americas	4%	FERRO-CHROME (50), CHROME ORE (50), COAL (20), SUGAR (20)
Western Asia	2%	COAL (80)
Eastern Africa	2%	SUGAR (50), COAL (20)
Southern Asia	2%	SUGAR (40), COAL (30)
Northern Africa	1%	COAL (30)

IMPORT

ORIGIN	SHARE	MAJOR COMMODITIES (1,000 tons)
Western Asia	26%	FUEL OIL (920), FERTILIZER (120)
Oceania	25%	ALUMINA (1,000)
Europe	11%	WHEAT (190), CLINKER (110), FUEL OIL (100), FERTILIZER (30)
Southern Africa	10%	FUEL OIL (190), SULPHUR (160), FERTILIZER (40)
Southern Asia	10%	FUEL OIL (190), CLINKER (110), PET COKE (110)
South Eastern Asia	9%	CLINKER (280), FUEL OIL (80)
Americas	9%	FUEL OIL (160), WHEAT (120), PET COKE (100)

Source: Study Team

2.5. Present conditions of Nacala Port and major ports in/around Mozambique

2.5.1 Nacala Port

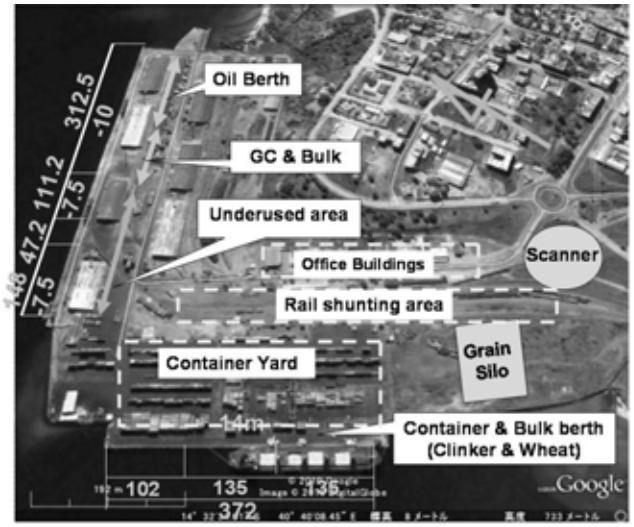
(1) Port facilities and equipment

The Port has a container terminal (South Wharf) and a conventional cargo terminal (North Wharf) as shown in Figure 2.5-1. The northern part of the conventional terminal is dedicated to liquid bulk handling.

The North Wharf has a length of 620 m, while the South Wharf has a length of 372 m. The water depth of the former varies from -7.5 m to -10 m. The latter has a water depth of -14 m over the full length. The South Wharf accommodates two container vessels at a time. Large draft dry bulkers carrying wheat and clinker are also moored at the South Wharf hampering container operation.

Rail shunting area and the main port road run parallel to the South Wharf, and divide the Port into two zones, the North and the South Wharves. Since there is no marshalling yard or depot for the railway out side the Port, all railway operation is conducted inside the port terminal.

The specifications of the container terminal are summarized in Table 2.5-1. The maximum storing capacity when three high (full) and four high (Empty) and using all overspill and pre-stacking areas is 6.722 TEUs. The Port has an inland empty container stock yard outside the port area.



Source: Study Team

Figure 2.5-1 Berth allocation of the existing Nacala Port

Table 2.5-1 Specifications of the container terminal

Quay length:	:	372 m (2 quays)
Maximum draft	:	14 m
Handling capacity	:	75.000 TEUs/year
Storage capacity	:	3.750 containers
Electric points	:	21 for refer containers
Lifting Equipment	:	3 (2x45 tons and 1x9 tons)
Reachstackers:	:	3x45 tons
Trailers	:	2
Tractors	:	1
Electrical cranes	:	1 with 22 tons capacity
Gantry crane	:	1 rail/truck transfer gantry crane with 25 ton handling capacity

Source: CDN (Reorganized by the Study Team)

The specifications of the conventional terminal are shown in Table 2.5-2.

Table 2.5-2 Specifications of the conventional terminal

Quay length:	:	620 m (4 quays)
Maximum draft	:	10 m
Handling capacity	:	2.400.000 tons/year
Warehouses	:	8 with storing capacity of 50.000 tons
Electrical cranes	:	4 (2x5 tons, 1x10 tons and 1x20 tons)
Forklifts	:	3 (1x3 tons and 2x2.5 tons)
Bagging Machines	:	3
Trimming Machines	:	1
Grabs	:	7
Hoppers	:	6
Front-end-loaders	:	2

Source: CDN

(2) Cargo throughput and vessel traffic

Figure 2.5-2 shows the historical change of cargo handled in Nacala Port. The average growth rate of the total handling volume in the last ten years is 7.6%, whereas the average growth rate of container cargoes in the same period is 8.8%. The container growth rate in the last five years recorded 12.3%. Domestic cargoes have been decreasing. More than 95% of cargoes are international cargoes including transit and transshipment cargoes. The volume of inbound cargoes is larger than that of outbound cargoes both in Mozambican cargo and transit cargo.

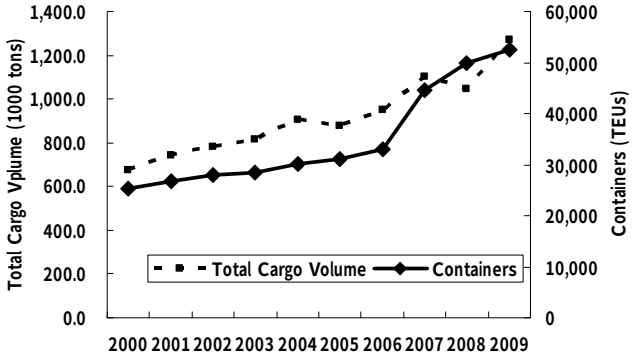
Around three quarters of total containers are international cargoes to/from Mozambique, and the percentage of the transit cargo is around 10%. The ratio of transit containers is rather small compared with Maputo or Beira due to the condition of roads and railways connecting with LLCs.

It is remarkable that the Port handles transshipment cargoes, even though the quantity is very small. Nacala is the sole Mozambican port which handles transshipment containers.

Table 2.5-3 is the breakdown of commodities handled in the Port. Almost all of exported cargoes from Mozambique are containerized. Around one third of imported cargoes are containers. Other major imported commodities are clinker, fuel, cereal and cement. Outbound transit cargoes consist of containers and bugged sugar. Inbound transit cargoes are more diversified, which consist of containers, fertilizer, fuel, cereal, and miscellaneous conventional cargoes.

The share of railway for transit transport is very large. The railway transport account for around 70 % of total transit traffic, and almost all outbound transit cargoes are transported by railway. On the other hand, the modal share of railway for domestic transport of exported or imported cargoes to/from Mozambique is very small.

The Port received 299 vessels including 108 container vessels in 2009. 50,000 DWT-class vessels call at the Port almost every month and occasionally even larger vessels enter the Port.



Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Total Cargo Volume (1000 tons)	673	743	780	818	907	875	950	1,100	1,046	1,270
Domestic					95	73	79	75	59	44
International - Moz					628	616	741	784	699	878
International - Transit					175	185	108	218	253	303
International - Transship					9	2	23	23	35	45
Containers (TEUs)	25,307	26,709	28,063	28,527	30,225	31,118	33,128	44,687	49,770	52,620
Domestic					5,625	4,955	5,344	4,793	3,787	4,356
International - Total					24,600	25,849	26,788	37,558	43,104	48,264
- Mozambique					18,869	21,691	22,879	31,515	36,896	38,262
- Transit					5,153	4,158	3,909	6,043	6,208	6,178
- Transship					578	314	996	2,336	2,879	3,824

Source: CFM (reorganized by the Study Team)

Figure 2.5-2 Historical change of cargoes handled in Nacala Port

Table 2.5-3 Breakdown of commodities handled in Nacala Port

(1000 tons)

	NACIONAL		INTERNACIONAL-MOZ		TRANSIT		TRANSSHIP	
	2008	2009	2008	2009	2008	2009	2008	2009
TOTAL	58.6	44.2	699.4	877.6	256.4	307.5	31.5	40.9
LOADED								
SUB TOTAL	28.5	23.5	222.8	234.0	72.9	65.5		
CONTAINERS	8.8	8.3	194.8	225.4	44.6	49.8		
FUEL	19.34	15.2						
AGRICULTURAL PROD.			8.8	3.6	28.2	15.7		
Sugar					28.2	15.7		
OTHERS	0.3	0.0	19.4	5.0				
DISCHARGED								
SUB TOTAL	30.1	20.7	476.7	643.6	183.5	242.0		
CONTAINERS	29.3	18.7	165.5	201.5	45.1	49.8		
FUEL	0.0	1.7	93.5	117.8	25.2	35.3		
AGRICULTURAL PROD.			80.5	128.6	3.0	57.1		
Cereal			54.0	89.7	0.0	49.9		
Others			26.5	38.9	3.0	7.2		
MINERAL PROD.			133.6	134.3				
Clinker			133.6	134.3				
CEMENT			0.0	53.8				
FERTILIZER					30.0	43.4		
OTHERS	0.8	0.3	3.6	7.6	80.2	56.4		

Source: CFM (reorganized by the Study Team)

(3) Operation and management

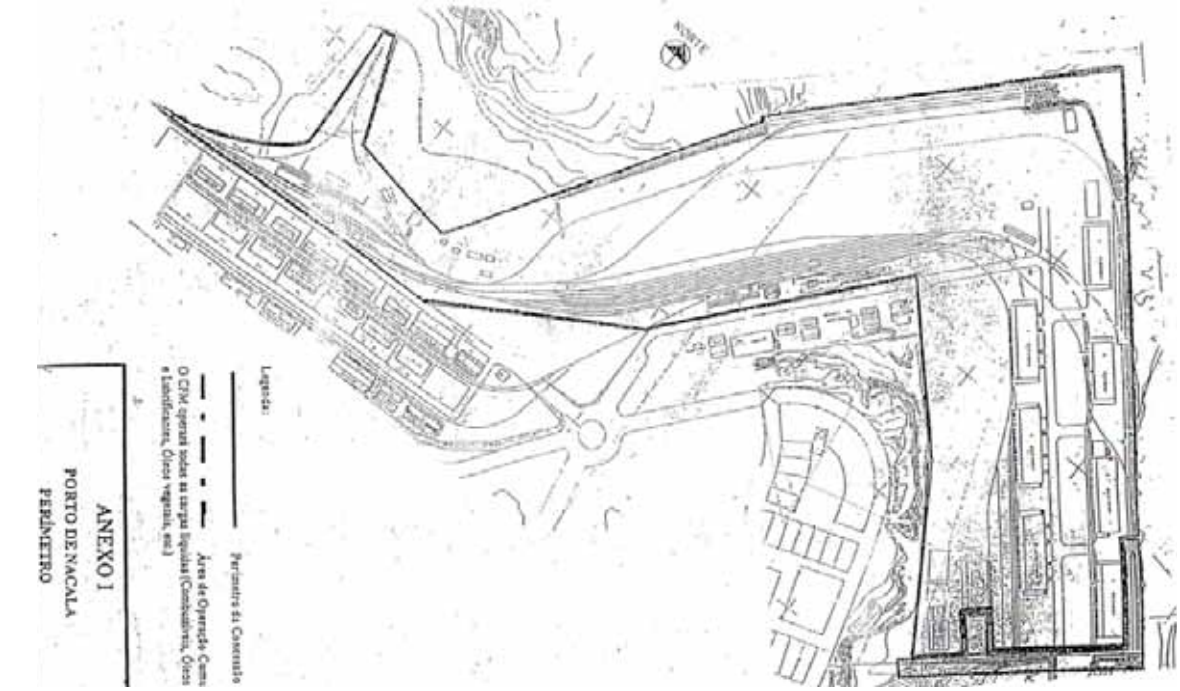
1) Framework of operation and management

The concession agreement was entered into the 29th day of September 2000 between GOM including CFM and the CDN. In 2005 facilities of the Port were taken over by CDN. CDN has responsibilities, rights and duties to manage/operate/rehabilitate the Port for a 15-year concession from the day of take over and an option for a further 15 years. In 2010 Insitec sold the major part of its share of CDN to Vale Mozambique, which requires rehabilitation of the railway and construction of a new port terminal for the coal mining project in Tete Province.

The concessioned area includes both the container terminal and conventional terminal; however, the oil terminal is excluded from the concessioned area as shown in Figure 2.5-3. The oil terminal is managed and operated directly by CFM, like other major ports in the country.

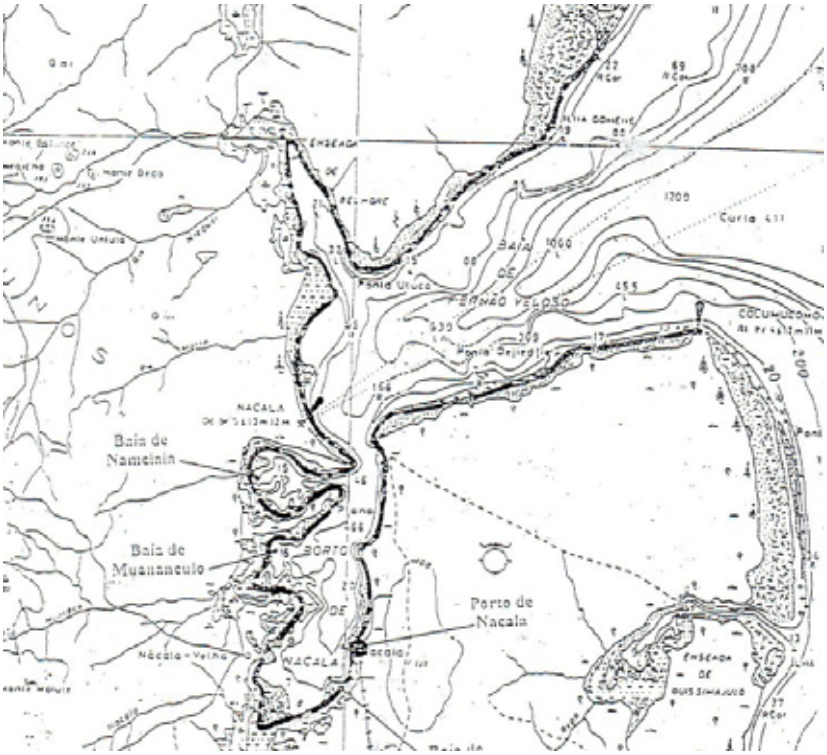
Operation works in the container terminal and conventional terminal are contracted out to a stevedoring company. The role of CDN in terminal operation is planning and instruction. Maritime services such as pilotage and tug assistance are provided by CDN. CDN is authorized to carry out the maritime services as the exclusive operator in the area under jurisdiction of the Port. (see Figure 2.5-4) The power of port authority exercised by CFM in the area of port jurisdiction was ceased as of the date when CDN's operation began.

The total number of employees in CDN Port is 233 of which the operation department has 61 people engaged in documentary examination and works related to the container terminal and conventional terminal. Since operation works are contracted out to a stevedoring company, the number of staff members in charge of terminal operation is rather small.



Source: CDN

Figure 2.5-3 Concessioned area of the Port



Source: CDN

Figure 2.5-4 The area under jurisdiction of the Port

2) Port tariffs and dues

CDN has rights and obligations to establish a policy on port tariffs and dues. The setting, adjustment, charging and collection of such port tariffs and dues etc. are stipulated in the Nacala Port

Concession Contract as follows:

- CDN shall be free to set and revise the tariffs.
- The tariffs shall be sufficient to cover the long-term costs.
- The tariffs may include reductions intended to increase traffic.
- CDN may adjust tariffs as part of a promotional offer
- CDN shall be allowed to charge and collect tariffs in Dollars on foreign registered ships and transit traffic.
- CDN shall provide clients with at least fourteen (14) days notice of any changes to tariffs levels.

Thus, in terms of tariff policy, commercial operation of the Port is guaranteed by the concession. Although the concession allows the introduction of volume-discount, CDN has not introduced it.

3) Operation of container cargoes

The Port doesn't have an integrated terminal operation system which covers planning of yard, monitoring of all movement of containers, controlling gate operation, and issuing documents.

Containers are unloaded and loaded by ship cranes. While unloaded containers from a container carrier are once placed on the apron of the quay and then loaded on a chassis by a reachstacker and hauled to the container yard, those containers, which are to be loaded on board, are stacked behind the apron prior to the arrival of the ship, and moved by a reachstacker to the ship side for loading on board.

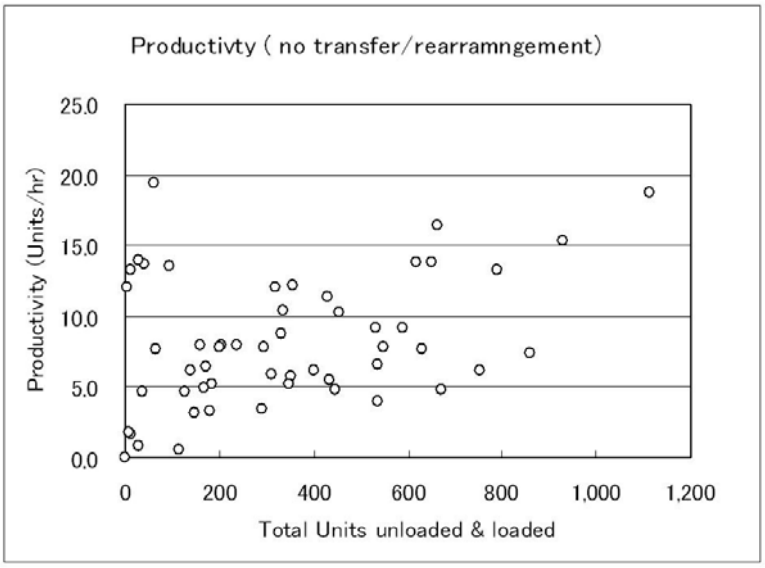
The container handling productivity observed in 2009 is shown in Figure 2.5-5. It widely varies from a few units/hour/ship to 20 units/hour/ship. On average the container handling productivity is about 8 units/hour/ship.

In general, for those occasions when a container ship stays at the wharf alone, the handling productivity is higher than those occasions when another ship stays simultaneously. Higher productivities are also observed for some occasions with another container ship. On such occasions, the productivity of the container handling of the other ship is generally lower than the average.

According to CDN, the average dwell time of container cargoes is as follows;

Import	:	10 days on average
Export	:	5 days on average
Transit (by railways)	:	25-30 days on average

The reason why the dwell time for transit container cargoes by railway tends to be as long as 25-30 days is a lack of locomotives.



Source: CDN, Edited by Study Team

Figure 2.5-5 Container handling productivity (Units/hour/ship)

4) Dry/break bulk cargo handling

While Nacala Port has no export dry bulk cargo, in 2009 it handled a large amount of imported dry bulk cargoes such as clinker (187,000 tons), wheat (116,999 tons), fertilizer (42,000 tons) and plaster (5,800 tons). While clinker and wheat are brought by large bulkers which dock at the container wharf, other dry bulk cargoes are unloaded at the general cargo wharf.

Clinkers and grains are generally unloaded by grabs of ship cranes and directly loaded on either dump trucks or rail wagons. Wheat for Malawi is stored in silos in the Port, and then delivered by railway. Grains are sometimes once stored in transit shed on general cargo wharf before they are delivered to the warehouses outside of the Port. Fertilizer and plaster are generally once stocked in the transit shed or open storage. They are packed in the Port and then moved out of the Port or shipped again from the Port.

The commodities handled as break bulk cargoes have been becoming fewer over the past five years. (In fact, the loaded general cargoes in 2009 were only the bagged cargoes such as sugar and wheat bran or scrap from Malawi and no export general cargoes from Mozambique). The major commodities of the unloaded cargoes were cement (54,000 tons) and rice (17,000tons).

5) Liquid bulk handling

Liquid bulk unloaded at Nacala Port includes petroleum and edible oil. For petroleum unloading, pipe lines are installed from the northern end of the general cargo wharf to the storage tank area to the south of the Port. CFM is the operator of liquid bulk handling. Edible oil is stored in the tanks on the north perimeter of the general cargo wharf.

6) Port security

To comply with the ISPS code, CDN has prepared a port facility security plan and has appointed a port facility security officer (PFSO). The Port is surrounded by an electric wire fence. CCTV system is installed at the gate for monitoring

Scanning inspection for all inbound and outbound trucks (including containers, dry bulk cargoes, break bulk cargoes, liquid bulk cargoes, and empty tanks) has been conducted in the Port since 1 May 2010. Though the inspection cost is different for each type of cargo, it is extraordinarily expensive. For example, it costs 100 dollars per container cargo. The cost is a very big burden for port users, and it can spoil the competitiveness of the Port.

(4) Financial status

In accordance with the agreement, CDN is subject to pay concession fees to the GOM and CFM. The concession fees consist of three portions; initial fee, fixed fee and variable rent. The initial fee is a once-off fee paid on the taking over date. The fixed fee is a quarter basis fee which is in return for the use of the utilities and facilities provided by the GOM and CFM, and for the exclusive right given to CDN to act as the operator of the Port. The variable rent (revenue fee) is a half year basis fee which is profit share for the GOM and CFM.

CDN has been preparing consolidated financial statements (the Port and the railway) since its operation began. CDN has continued to show negative net worth from 2005 and the heavy loss of equity continues to be MT 100 million per year. To improve its financial situation, CDN should firstly tackle the problem of the inadequate revenue it generates from operation.

The U.S. Overseas Private Investment Corporation ("OPIC") provided CDN with US$ 13.5 million of financing for a project that includes rehabilitation of the railway and refurbishment of the Port. CDN and BCI bank signed an additional loan agreement in 2009 so the total amount of bank loan at present is almost 17 million USD. CDN expended about 70% of the OPIC loan for operational cost of railway sector as a working capital between 2005 and 2007, not for investment of the railway and/or the Port.

The Study Team estimated balance sheets and income statements of CDN-Port. These data indicate CDN-Port is profitable. Return on Net Fixed Assets is about 109%. Return on Equity (ROE) is about 55%. The Operating Ratio of 82% is unsatisfactory. These figures mean that an inefficient operation has been performed under creaky facilities. Thus, the financial sustainability of the Port is very precarious.

CDN prepared financial statements for the first six (6) months of 2009 in accordance with Generally Accepted Accounting Principle (GAAP) in Mozambique. CDN has not yet adopted the International Financial Reporting Standards (IFRS). In Mozambique, large companies are required to prepare financial statements in accordance with the IFRS in and after 2011. CDN is listed as a large company.

(5) Hinterland access

1) Trucks

Port-related traffic and urban traffic are separated to some extent. The port-related trucks are regulated to use only a two-lane road along the coast. Trucks to/from the Port cannot enter the downtown area. The port road joins Nacala Corridor at 4 km to the south of the Port. The port road is also used by urban traffic.

The Port has only one gate, and all traffic to/from the Port concentrates at the gate. Although the cargo handling volume in the Port still remains rather small, traffic congestion is always observed around the port gate.

2) Train

The Port is directly connected with its hinterland in northern Mozambique, Malawi, and Zambia (only eastern border town of Chipata) by Nacala Corridor Railway.

The facilities and equipment of rail transfer station in the Port are in very poor condition. A gantry crane for rail transfer is not operational. The railway doesn't have a rail yard and depot outside the Port. Accordingly the port terminal is used for shunting, marshalling and waiting of trains. This is an impediment to efficient land use of the Port. The very old-fashioned rail alignment in the Port such as rails on aprons hampers port operation.

The schedule for train is not fixed; it depends on the situation of transit cargoes. The schedule is determined on the day before needed.

(6) Land use

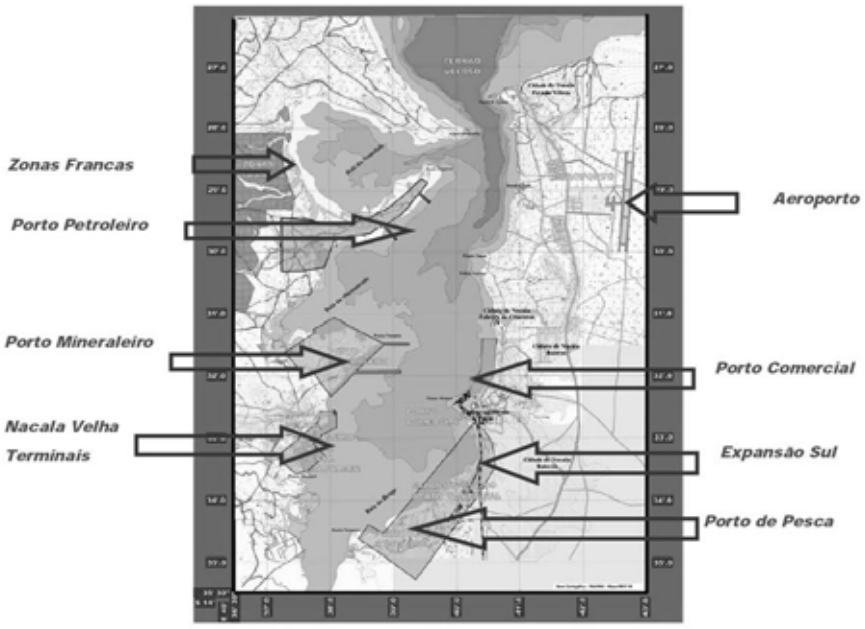
CFM owns the coastal area, within 10 km to the south of the Port and 5 km to the north. No one is allowed to build a house within 100 meters from shoreline (at high tide).

(7) Development plans

A master plan for the long-term development of the whole Nacala Port area (the area under jurisdiction of the Port) has never been formulated.

A master plan for the development of the Nacala Bay was prepared in 1974, just after the completion of the existing port facilities, by CFM and "Hidrotécnica Portuguesa", a Portuguese consulting firm. The master plan includes an integrated zoning plan of the Nacala Bay for various functions of the port: Commercial Port, Petroleum Terminal, Mineral Terminal, and other port facilities such as facilities for domestic shipping and fishing port as well as Industrial Free Zones (see Figure. 2.5-6).

CFM has reviewed the previous Nacala Master Plan, and updated Nacala Master Plan to provide the facility layout of petroleum terminal, mineral terminal, domestic shipping terminal, fish port, and tourism and free zone developments. The updated Nacala Master Plan prepared by CFM is still a conceptual master plan and no quantitative background data or development time schedule are presented.



Source: CFM Presentation material " Moçambique Nacala 2002 Monografia of CFM

Figure 2.5-6 Master Plan for Nacala Bay Development

The concession contract requires CDN to prepare its development plan of the Port over the concession period, i.e. up to 2019 on the basis of the 1974 Nacala Master Plan. However, CDN has not formulated a development plan.

2.5.2 Major ports in/around Mozambique

The major ports in/around Mozambique ports are outlined in Table 2.5-4. Durban Port is by far the largest port in terms of infrastructure and container traffic. Regarding total cargo volume, Richards Bay Port, which handles a considerable amount of exported coal, is the largest port. Cape Town and Port Elizabeth also attract many containers. Compared with these South African ports, Mozambican ports are still very small in terms of both infrastructure and cargo throughput. Generally the cargo handling volume per berth in Mozambican ports is smaller than that in South African or Tanzanian

ports.

Table 2.5-4 Outlines of major ports in/around Mozambique

Country	Port	Total Quay Length (m)	Maximum Depth Alongside Quays (m)	Total Cargo Handled (1000 tons)	Container Througput (TEUs)
Tanzania	Dar es Salaam	2,014	10.5	7,421	354,587
	Mtwara	385	9.8	90	9,247
Mozambique	Pemba	185	7.5	101	9,295
	Nacala	982	14.0	1,046	49,770
	Quelimane	210	3.5	66	4,172
	Beira	1,994	11.8	3,037	85,716
	Maputo	3,310	12.6	7,375	74,729
South Africa	Richards Bay	5,248	19.0	84,591	9,350
	Durban	13,765	12.8	61,171	2,642,165
	Port Elizabeth	2,697	12.2	8,365	423,885
	Cape Town	6,231	13.1	8,568	767,501
Namibia	Walvis Bay	1,413	12.8	4,795	194,102

Note: Total cargo volume in South Africa is estimated by the Study Team since Transnet doesn't disclose the weight of containerized cargoes. In the estimation, the weight of one TEU of container is assumed to be 10 tons. Cargo volumes are as of 2008 (for Mtwara as of 2007).
Source: the Study Team

2.5.3 Demarcation of Mozambican ports

The present function and the expected role in the future of ports in Mozambique are summarized as follows:

Nacala Port
(Status quo)

- The domestic hinterland of the Port is Northern Mozambique, of which the industrial development is falling behind. Consequently, the handling volume of the Port is the smallest among the three major ports in the country.
- The Port serves only for the landlocked country of Malawi besides its domestic hinterland, though the handling volume of transit cargoes is rather small despite the geographical proximity due to the poor conditions of Nacala Corridor as well as the inefficient port operation.
- The deep water bay of Nacala is suitable for bulk cargo handling for which large vessels has an economic advantage. However, the Port doesn't have a dedicated bulk terminal with deep-water quays, and the handling volume of bulk cargoes is very limited.
- Container trunk lines connecting Asia call at the Port. However, the provision of feeder service connected with Durban is still an important function of the Port.
- Nacala Port is the sole Mozambican port which handles transshipment containers.

(Expected role)

- Industrial development in the Northern Provinces is one of the highest priorities in the country. The Port is expected to be a driving force of the industrial development of the region. Above all, the role of the Port is crucial for SEZ development in Nacala, agricultural development in Nampula Province, forestry development in Niassa Province, and mineral development in Tete Province and Niassa Province.
- Rehabilitation and upgrading of the road and railway network in Nacala Corridor are on-going. This is expected to increase the share of Nacala Port in the transit cargo market in Malawi and Zambia, if the Port is efficiently operated and its deteriorated infrastructure is rehabilitated or reconstructed.
- Fully utilizing the advantage of the depth of the basin, the Port is expected to become a bulk hub

which serves a larger region than the Port's present hinterland. Some commodities such as grains can be transshipped at the Port.

- Coupled with Dar es Salaam and Mombasa, the Port is expected to increase the main line container service connecting Asia.
- The Port is located at the place where the Eastern African loop and the Southern African loop of international maritime container network cross each other. The location is advantageous for transshipment of containers, and the Port is expected to enhance its container transship function using this geographical advantage.

Maputo Port

(Status quo)

- Maputo Port is the largest port in the country in terms of total cargo handling volume.
- The port has two functions. One is the function as a commercial port serving for the metropolitan area. The other is the function as an industrial port serving for Matola Industrial Zone, the largest industrial zone in the country.
- The port also serves for landlocked northern region of South Africa including its metropolitan area, as well as Zimbabwe and Swaziland. In the past, Maputo port was the principal gateway for the northern region of South Africa. However, the current share of the port in the South African market is much smaller than at its peak, although a substantial amount of transit cargoes (virtually export only) are still handled in the port.
- Coupled with Durban, Maputo Port provides main line container service connecting with Asia and Europe. Provision of feeder service connected with Durban is also an important function of the port.

(Expected role)

- Maputo Port is expected to continue to be the gateway port for the metropolitan area, and to be the industrial port supporting the country's key industries.
- The port is expected to increase its share in transit cargo market by facilitating transit traffic and increasing port capacity (especially depth of the basin). Existence of Maputo Port providing an alternative route to the other continents would accelerate productivity improvement in Durban
- Port and contribute to the development of the regional economy.
- Maputo Port has enjoyed advantageous location in the maritime network as trunk lines can call with little detour from Durban Port. Although some hub port functions will be shifted to Ngqura Port, Durban Port will continue to be a hub port, and the advantage of Maputo in the maritime network will remain unchanged basically.
- Increase of coal production in the northern provinces of South Africa (Limpopo and Waterberg) and recovery of the Zimbabwean economy are important opportunities for Maputo Port.
- Botswana is seeking alternative access to the world's maritime network, and the two Governments agreed to develop a new deep sea port in a green field in Maputo Province and to construct its railway link. It is expected that the port will be able to serve for Botswana in the long run, though it requires a huge amount of investment in infrastructure.

Beira Port

(Status quo)

- Beira Port is the second largest port in the country in terms of total cargo handling volume, but the port is the largest port as a container port.
- Beira functions as the principal gateway for Zimbabwe utilizing its railway link and fuel pipeline, though the cargo volume is smaller than that in the period before the dislocation of Zimbabwean economy. Beira Port also serves for Malawi and Zambia. Beira is the sole Mozambican port which serves for mineral rich Zambia at present, and is dominant in the transit market in Malawi because the condition of its competitor, Nacala Corridor, is extremely poor.
- The principal function of the Port on maritime container network is the provision of feeder service connected with Durban or Maputo, though the direct service to Asia is available.
- The growth of the port has been hindered by the shallowness of basin due to sedimentation.

(Expected role)

- Centrally located in the country, Beira will have to keep competing with other Mozambican ports in the transit cargo market as well as domestic market. The competition among the country's ports would improve overall efficiency and competitiveness of the port network in Mozambique and would bring economic benefit to the country as well as to the Southern African region.
- It would not be easy to continue to enjoy Beira's dominant status in the Malawian market because the present conditions of Nacala Corridor and Nacala Port are the poorest, and the share of Nacala will increase somewhat even in the pessimistic scenario of efficiency improvement in Nacala. But it can be expected that the both ports can increase their share in the transit market when the competitiveness of the country's port system is improved through the fair competition among Mozambican ports. Despite the forecasted decrease in market share in Malawi, the cargo handling volume of the port is expected to keep increasing due to economic development of the domestic hinterland driven by agriculture and agro-industry, and recovery of the Zimbabwean economy from the long lasting recession.
- Considering the shallowness of basin and the distance from the main container ports on the Southern African loop and Eastern African loop, namely Durban and Mombasa, the port is expected to remain as a feeder port, though some direct service to Asia would be available. .
- Beira Port, as well as Nacala Port, is expected to play an important role in the development of mineral resources in Tete Province.

Quelimane Port

(Status quo)

- The port is serving partially for the second most populous province of Zambezi in central Mozambique.
- Despite the completion of rehabilitation, the cargo throughput of the port is decreasing sharply due to the suspension of cabotage transport service provided by Navique (former state owned shipping company).
- In the past, the port handled a substantial amount of domestic transshipment cargoes between river transport on Zambezi and maritime transport. However, this flow has ceased completely due to improvement of the land transport network connecting the Zambezi valley directly with Beira Port.
- The port has newly acquired transit cargoes from Malawi, though the cargo volume is still very small. Quelimane Port is the nearest seaport from Malawi.

(Expected role)

- Despite the proximity to Malawi, it is difficult to expect that the port will become a principal international gateway due to shallowness of basin and navigation channel.
- Development of the Zambezi waterway has been discussed; however, it would be very difficult to materialize the project due to serious environmental impacts cased by the dredging of the river. Difficulty of the control of water level for navigation due to the existence of Cahora Bassa hydropower station, which is the country's most important energy source, has also been pointed out. Accordingly, the Zambezi waterway will not become a catalyst for growth of the port.
- The port is expected to be a local port for Zambezia Province providing feeder services connecting the region with Nacala, Beira, Maputo and Durban.

Pemba Port

(Status quo)

- The port serves only for a part of Cabo Delgado Province mainly to export timber to China.
- The port also functions as a supply base for offshore hydrocarbon development in the Northern area of Cabo Delgado Province.

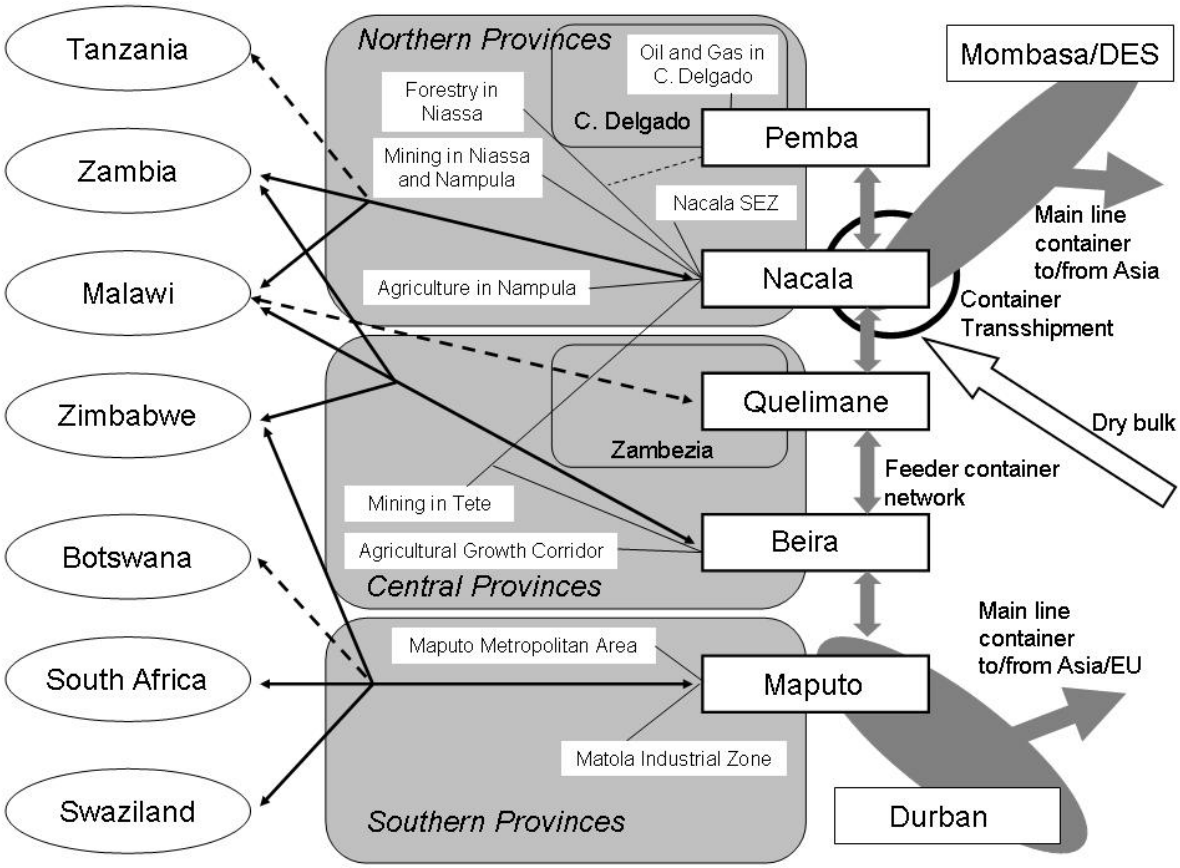
(Expected role)

- The on-going development project of Pemba Corridor connecting the port with Niassa Province which is expected to become a center of forestry production will expand the hinterland of the port. Although the capacity of Pemba Port is limited, competition with Nacala Port for the transport market of Niassa Province will occur to some extent. This will improve the market access of the

provincial industry, and will benefit the regional economy.

- Further hydro-carbon development is planned in the basin off the coast of Cabo Delgado Province, and the port is expected to strengthen its function as an offshore supply base. There is a possibility of establishment of facility for industries utilizing hydro-carbon such as fertilizer plants in the future, and the port located in the deep-water bay of Pemba has a potential to become an industrial port.

Figure 2.5-7 shows schematic views of future functional demarcation of the ports in Mozambique.



Source: Study Team

Figure 2.5-7 Functional demarcation of Mozambican ports in the future

2.6. Natural Condition

2.6.1 Topography and bathymetry

The elevation of the container berth is about 5.8m, which is about 20 cm lower than the design elevation of 6.0 m. The elevation of the general cargo berth is about 5.9 m which is about 10 cm lower than the design elevation.

The water depth in front of the container terminal is more than 15 m at the north side and about 11 to 14 m at the south side. The water depth at the north east side in front of the general cargo terminal is about 10 m and it is about 8 to 10m at the south west side.

2.6.2 Climate and meteorology

Nacala has a tropical climate characterized by high temperatures. The climate in Nacala is

divided into two periods; from May to October average rainfall is 20 mm per month (similar to a dry season) and the average temperature is about 24 degrees Celsius, while from November to April average rainfall is 150 mm per month (similar to a wet season) and the average temperature is about 28 degrees Celsius.

2.6.3 Oceanography

(1) Waves

1) Ordinary waves

Predominant direction of offshore waves is S which has an occurrence rate of approximately 50 %. Waves from NNE and ENE are also present at rates of approximately 34 % and 14% respectively. Waves in which heights exceed 1m, 2m, 3m occupy 65.7%, 14.1%, and 1.8％ respectively. Wave periods spread from 5 to 11 seconds while the predominant wave period is 6 to 9 seconds.

Predominant direction of waves generated in Nacala Bay is from S which represents approximately 40 % of all waves. Waves from E, N and W are also present at rates of approximately 25 %, 9 % and 8% respectively. Waves in which heights exceed 0.25m and 0.5m occupy 0.5% and 0.1％ respectively. The wave periods spread from 0 to 5 seconds while the predominant wave period is 1 to 2 seconds.

2) Storm waves

Storm waves which occur when a westward developing cyclone attacks Nacala sea area are examined. Maximum significant offshore wave height was 6.38 m and significant wave period was 11.8 s. The direction of the maximum wave was ESE.

Since the offshore waves are sheltered by the land area, and the wave deformation coefficient is considered less than 10%, it is understood that the maximum wave at the project point is waves generated in Nacala Bay. Therefore, the prediction of waves generated in Nacala Bay was done using wind speed of 45m/s which is the maximum wind speed generated by the maximum cyclone in the last 60 years and obtained the maximum wave height of 2.35m, the wave period of 4.25s and the wave direction of N.

(2) Tide

Tide conditions in Nacala Port are described below.

Highest High Water Level in 2010	+ 4.32 m
Mean High Water Spring (MHWS)	+ 3.88 m
Mean High Water Neap (MHWN)	+ 2.74 m
Mean Sea Level (MSL)	+ 2.25 m
Mean Low Water Neap (MLWN)	+ 1.73 m
Mean Low Water Spring (MLWS)	+ 0.62 m
Lowest Low Water Level in 2010	+ 0.26 m
Chart Datum Line (CDL)	+ 0.00 m

(3) Tidal current

Current status at the mouth of Nacala Bay was observed using floating buoy and GPS. The average current speed at spring tide was about 30 cm/sec while current speed at neap tide was about 10cm/s. Current speed is rather mild because water depth at the mouth of the bay is from 50 to 70 m which is rather deep.

2.6.4 Geotechnical conditions

Soil investigation was conducted at 12 locations of the project site. Results of standard penetration test are summarized below:

- It was found that sand layer in upper, silt layer in lower part with the depth of 6m to 8m and beneath that bearing layer is formed.
- However, at the southern part of the basin in front of the North Wharf, a sand layer was found again beneath the silt layer. Therefore, the bearing layer is assumed to be at deeper ground.

The gravity of material is approximately 2.7 and the grain size varied from 0.03 to 3.0mm. The average grain size is approximately 0.3mm

2.7. Baseline information of natural and social environment

2.7.1 Natural environment

The coastal area of Nacala Bay is comprised of a wide variety of important marine habitats such as seagrass bed, coral reef, mangrove, intertidal flat and sandy beach. Whales and dolphins are also known to be present in Nacala Bay. The main marine habitats found near the port are seagrass bed, intertidal flat and sandy beach.

2.7.2 Social environment

The Municipality of Nacala has recently approved Land Use Plan of Nacala District, which covers the upcoming 15 years. According to the proposed plan, the coastline north and south of the Port is allocated for port/industrial activities.

Artisanal fishery is one of the main economic activities in Nacala District, with approximately 3,800 fishermen and 350 fishing boats. Fishing is conducted throughout Nacala Bay, including areas near the Port. Certain sections of the beaches adjacent to the Port are used as a fish-boat landing center, as well as a base for passenger ferries.

2.7.3 Pollution

(1) Water quality

General water quality parameters

- Water temperature ranged between 25-26 ℃, and tended to be higher at shallow waters. Although water temperature was generally slightly higher at the surface layer, the temperature difference between the layers was small (less than 0.5 ℃).
- Salinity ranged between 34-35 PSU, and tended to be slightly higher at the surface layer, probably due to evaporation.
- The pH ranged approximately from 7.3-8.2. pH at St.13 was below 7 (6.78-6.90), which is low compared to typical marine waters.
- DO concentration ranged approximately from 5.7-6.1 mg/l. There were no sites or layers with signs of oxygen depletion.
- As expected, turbidity tended to be high in the inner bay and shallow areas. However, there were no strong correlations between turbidity and TSS values.

Other water quality parameters

- T-N and T-P were measured as an indicator of nutrient enrichment. T-N concentration was highly variable between sites and layers. T-P concentration ranged between <0.02-0.04 mg/l and was less variable between sites and layers compared to T-N.
- THC was measured as an indicator of oil pollution. While oil films were often observed near the shore south of the Port, total hydrocarbon concentration was either below or near the quantification limit (0.2 mg/l), except one station.
- The *E. coli* was low enough that it satisfied the European water quality standard (Directive

2006/7/EC) for 'excellent quality', which is 250 CFU/100 ml.

(2) Sediment quality

T-N, T-P and T-S

T-N, T-P and T-S were measured as an indicator of nutrient enrichment. T-N, T-P and T-S concentration were all highest at a station in front of the container berth, which was also the site with the highest silt content.

Heavy metals

Several stations in front of the North Wharf and the South Wharf were contaminated by high levels of one or more heavy metals (chromium, lead or nickel).

Organics

All the sites were contaminated by high levels of one or more harmful organic compound. Contamination was most significant in front of the North Wharf, in particular for DDT, PCBs and TBT. Although the source of these pollutants are uncertain, one possible source would be ships, as all these substances were or are still used as ingredients of ship antifouling paint.

2.7.4 Environmental management of the Port

The Environmental License issued by MICOA must be renewed every 5 years by submitting an updated Environmental Management Plan (EMP). The Port's latest Environmental License has been issued in July 2009. The Port also has obtained ISO14001 accreditation in June 2009.

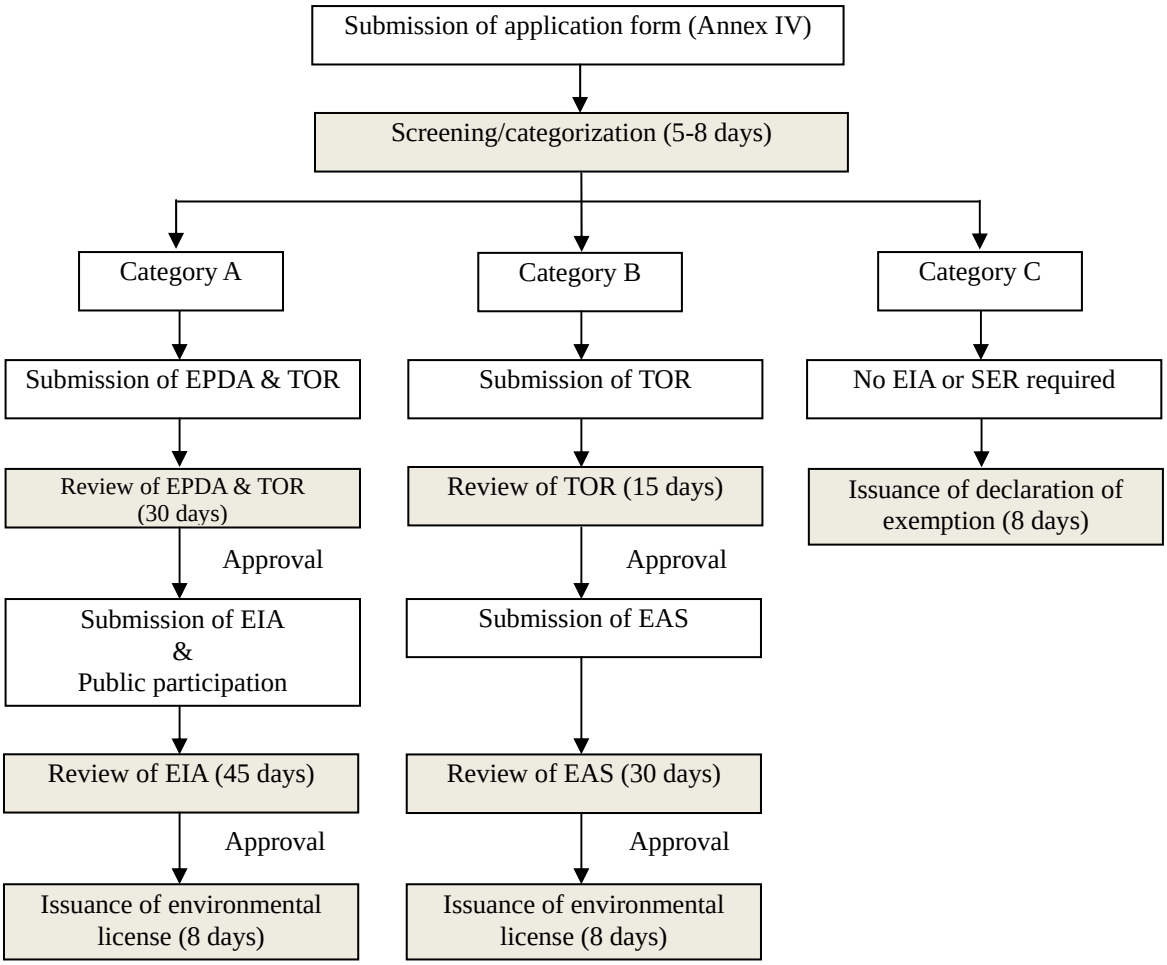
Major environmental issues of the Port are oil spillage from the oil terminal and pipeline, and dust emission from bulk-commodity handling, in particular clinker.

2.8. Environmental laws and regulations

According to the Environment Law (Law no. 20/97), an environmental license must be acquired prior to conducting any activity with potential environmental impact. The environmental license is acquired through submission of an EIA report and approval from the environmental authority. The outline of the EIA process is shown in Figure 2.8-1.

Assuming that this project will be classified as Category A, the EIA process is estimated to take in total approximately 10 months. Table 2.8-1 shows the breakdown of the estimated time schedule and responsible entities for each of the main EIA process.

Table 2.8-2 shows the environmental laws and regulations that are relevant to port development.



Note: Shaded blocks indicate task of EIA authority. The days inside the parenthesis indicate number of working days required for decision making by the EIA authority.
Source: Decree No. 45/2004

Figure 2.8-1 EIA procedure of Category A, B and C projects

Table 2.8-1 Breakdown of estimated time schedule and responsible entities for each of the main EIA process

EIA task	Estimated time schedule	Responsible organization
Screening (categorization of the project)	0.5 months	EIA authority
Tendering/selection of EIA consultant	2 months	Project proponent
Preparation/submission of EPDA & TOR	1 months	EIA consultant & project proponent
Review/approval of EPDA & TOR	1.5 months	EIA authority
Preparation/submission of EIA	3 months	EIA consultant & project proponent
Review/ approval of EIA	2 months	EIA authority

Note: The time schedule of the EIA authority was estimated to take slightly longer than the period stated in the EIA regulation.

Table 2.8-2 Environmental laws and regulations relevant to port development

Category	Title
Pollution	Decree No. 18/2004 Regulation on Environmental Quality and Effluent Emission
	Decree No. 45/2006 Regulation for the Prevention of Pollution and Protection of Coastal and Marine Environment
	Decree No. 25/2008 Regulation for the Control of Invasive Alien Species
Flora/fauna	Law No. 10/99 Law on Forestry and Wildlife
	Decree No. 12/2002 Regulation of the Law of Forestry and Wildlife
Waste	Decree No. 13/2006 Regulation on Waste Management
Fisheries	Law No. 3/90 Law on Fisheries
	Decree No. 43/2003 Regulation on Marine Fisheries
Land	Law No. 19/97 Land Law
	Decree No. 66/98 Regulation on Land Law

Source: Study Team

2.9. Construction conditions for port facilities

(1) Construction material

Rock quarries are operated at Nacala-a-Velha and Namialo where sufficient production and supply are secured for port construction in Nacala.

One cement factory is in operation and two cements factories are under construction at this moment in Nacala. Therefore, it's possible that the supply volume will have increased by the time construction begins but the current supply volume is running short. The cost was estimated assuming that cement is imported from overseas.

Reinforcing bars (D13, D16) are produced in Beira and they can be procured. However, Steel pipe sheet pile and Steel pipe pile are not produced in Mozambique.

The procurement of pipes with the length of 18 m or longer and the thickness of 19 mm or thicker is difficult even in South Africa and thus pipes exceeding these sizes shall be procured in Japan, EU or others. In view of securing sufficient quality, pipes with less butt welding are required and when they are delivered their length should be as long as possible.

There is no commercial concrete plant in Nacala; therefore it is necessary to bring the plant into project site for the production of concrete and asphalt.

(2) Construction equipment

There is no firm in Mozambique which is specializing in manufacturing or rental of large construction machinery. Although, construction firms from overseas hold general construction machinery around Maputo, these machineries are small in number and in type and expensive compared with Japan.

Therefore, it is necessary to purchase or rent the construction machinery from overseas. Even in South Africa, there is no firm specializing in manufacturing or rental of large scale construction machinery although each construction firm possesses them. The purchase or rental prices are higher than those in Japan. In addition to this, the delivery costs must also be considered.

Similarly there is no firm in Mozambique which has the vessels and boats required for the construction work. Some firms in South Africa have barges with cranes but the number and types of such vessels and boats are very limited. A grab dredger for hard soil and a piling barge which are supposed to be adopted in this project shall be purchased or leased from overseas.

3. Medium/long-term Port Development Plan (Target Year: 2030)

3.1. Development potential of Nacala Corridor and Nacala Port

3.1.1 Development targets

The Port and the Corridor are expected to play an important role in realizing the following two important targets for the development of the regional socio-economy:

(1) Industrial development of northern Mozambique
(2) Trade and transport facilitation for LLCs and landlocked region in Mozambique

3.1.2 SWOT analysis

SWOT analysis is conducted to evaluate the potential of the Port and the Corridor to realize the above mentioned development targets. The results of the SWOT are shown below:

(1) Industrial development of northern Mozambique

Strengths	Weaknesses
• Well-sheltered deep-water port • On-going road rehabilitation project • Remaining capacity of the Port if it is properly operated • Direct liner service to Asia and Middle East • Possibility of inclusion into East African Port group on the maritime network • Existence of railway link to the Port • Less congested road • Geographical proximity to Nacala SEZ • Geographical proximity to the prospective agricultural center of the country • Possibility of synergetic effects of Port, Corridor, SEZ, and agriculture • Possibility of operational improvement of port and railway • Possibility of strengthening of financial structure of CDN	• Inefficient container operation • Inefficient land use in the Port • Shortage of water depth for bulk cargo handling • Insufficient investment in port and railway • Weak financial structure of CDN • Distance from the international container trunk route • Absence of modernized dry bulk terminal in the Port • Burden of scanning • Absence of strategic port development plan • Less active domestic maritime transport • Insufficient water and energy supply in Nacala • Possibility of collapse of port facilities due to deterioration • Shortage of spatial resources in the existing footprint of the Port for future development • Capacity of urban road network in Nacala • Relatively small area of basin when port facilities are constructed on the Nacala-a-Velha side
Opportunities	**Threats**
• Increased number of factories located in the SEZ • Establishment of IFZs in the SEZ • New international airport • On-going and planned projects in agriculture sector, forestry sector and mining sector • Possible assistance from international development partners • Political stability	• Possibility of delay of improvement of investment climate (human resources, corruption, water and energy supply, telecommunication etc.) • Possibility of delay of simplification of customs procedures • A downturn in world economic activity • Environmental sustainability of Nacala Bay • Absence of well coordinated spatial plan of SEZ considering port development • Absence of dedicated IFZ • Relatively small amount of FDI in the SEZ

(2) Trade and transport facilitation for LLCs and landlocked region in Mozambique

Strengths	Weaknesses
• Good geographical position to serve Zambia and Malawi • Existence of direct railway link between the Port and LLCs • Well-sheltered deep-water port • On-going road rehabilitation project • Planned new railway line construction and improvement of existing railway tracks by Vale • Existence of a single entity operating both port and rail • Direct liner service to Asia and Middle East • Possibility of inclusion into East African Port group on the maritime network • Remaining capacity of the Port if it is properly operated • Less congested road • Possibility of operational improvement of port and railway • Possibility of strengthening of financial structure of CDN	• Inefficient container operation • Inefficient railway operation • Inefficient land use in the Port • Long dwell time for transit cargoes via railway and weak interface between rail and sea • Insufficient investment in port and railway • Weak financial structure of CDN • Absence of strategy to attract transit cargoes • Distance from the international container trunk route • Absence of modernized dry bulk terminal with deep-water quays • Deposit system of import duty for transit cargoes • Burden of scanning • Absence of pipeline connection to LLCs • Deteriorated rail tracks especially in Malawi • Absence of rail link connecting Copperbelt • Delay of introduction of OSBP • Absence of strategic port development plan • Possibility of collapse of the port facilities due to deterioration • Shortage of spatial resources in the existing footprint of the Port for future development • Relatively small area of basin when port facilities are constructed on the Nacala a Velha side
Opportunities	**Threats**
• Political stability and continued economic growth in LLCs • Relatively good political relations between Mozambique and LLCs • Possible assistance from international development partners • Overall improvement in the competitiveness of Mozambican port network through fair competition between Nacala and Beira	• Possibility of delay of simplification of customs procedures • Planned increase of port capacity in Tanzania (Bagamoyo Project) and efficiency improvement of Tazara railway • Planned development of Durban Port • Aggressive sales of Walvis Bay Port • Possibility of change of Durban's strategy focusing on transit cargoes to utilize increased capacity by the port development and Ngqura Port construction • Improvement of corridors connecting LLCs with Durban, Dar es Salaam and Walvis Bay • Restriction of the capacity of the railway for general cargoes due to increasing demand of coal transport • A downturn in world economic activity

3.2. Issues of the Port

To become a driving force of the socio-economic development of the Northern Provinces of Mozambique or greater Nacala Corridor area, the Port must:

- be competitive, and

- be sustainable.

At present, however, the Port is neither competitive nor sustainable for numerous reasons as described below:

(1) Sustainability

1) Damaged pier structure of the container terminal

The 372m long container wharf is the busiest wharf in the Port. However, the pier structure of the container terminal is seriously damaged and deteriorated. Considering the age of concrete, the deterioration will be accelerated, and continuation of container operation on the pier will become impossible. Once the container operation is suspended, container handling function of the Port will be lost completely because there is no alternative facility for container handling in the Port.

2) Shortage of functional capacity

By the development of the Corridor and its surrounding area, the Port will be required to provide new types of services such as mass transport of mineral products, sophisticated logistics services as the major component of supply chain of SEZ. However, the present port function cannot meet these requirements.

3) Shortage of spatial resources in the existing footprint of the Port for future development

Even when all unnecessary facilities are demolished and the land use is rationalized, the existing footprint of the Port doesn't have enough space for future development of the Port to meet increasing cargo demand induced by the growth of the Corridor.

4) Increase of traffic impedance of urban road network

The capacity of the road network in Nacala is not enough to meet increasing port traffic demand and urban traffic demand in the future. In particular, the capacity of the urban road network will become a major bottleneck for the synergetic development of the Port and the SEZ.

5) Lack of a growth strategy and updated master plan

The Port doesn't have a growth strategy. Consequently, it doesn't have an updated master plan to materialize growth. Without a strategy and updated master plan, it would be very difficult for the Port to achieve sustainable growth utilizing synergism with the economic development of the Corridor area.

6) Managerial and financial problems of CDN

Financial performance of CDN has been very poor. CDN has not been able to make a profit to invest in rehabilitation of port infrastructure and acquisition of handling equipment. Almost all issues of the Port listed above and below are directly or indirectly caused by inadequate management of CDN.

7) Inadequate concessional framework

The framework presumes that the concessionaire sincerely makes the utmost effort to discharge its duty. CDN, however, has never intended to rehabilitate the port facilities on the pretext of financial difficulty. The current concessional framework cannot cope with such occasion.

8) Imperfect institutional framework for port sector

However, Mozambique doesn't have a fundamental law on ports which prescribes basic framework of the sector including establishment of basic port policy, scheme of national and regional port planning, procedure of port development, functions of port authority, usage of land and basin in ports, and collaboration with stakeholders.

9) Shortage of human resources and knowledge

Considering the vital importance of sustainable growth of the port sector in the country's development policy, quantity of qualified human resources is insufficient at all levels of the sector.

(2) Competitiveness

1) Low productivity of container handling

The low productivity of overall operation is caused by a lot of factors such as:

- Insufficient investment in handling equipment.
- Lack of knowledge and skill for modernized container operation.
- Mixed operation of containers and bulk cargoes.
- Insufficient computerization of terminal operation.
- Insufficient capacity of terminal gate and inefficient gate operation.
- Inadequate layout of the terminal.
- Conflict of traffic flow in the Port, even in the container terminal.
- Unclear definition of the perimeter of container terminal.
- Lack of desire on the part of CDN to improve productivity

2) Shallowness of basin alongside quays for bulk cargo handling

The berth used for petroleum tankers has a depth of only -10 meters, and large tankers cannot dock with full load. The depth of the basin alongside the conventional terminal is also insufficient, and bulk carriers frequently dock at container quays hampering container operation.

3) Long dwell time

The dwell time of containers in the Port is excessive especially for imported transit containers to Malawi via railway. The average dwell time of 27.5 days for Malawian cargoes is far from competitive. The service is not predictable at all. This is mainly caused by shortage of locomotives and railway wagons; however, the Port is also to blame for the inefficient sea and rail interface.

4) Burden of scanning inspection

The Customs requires all trucks carrying containers (laden and empty), dry bulk, break bulk, or liquid bulk, and even empty chassis or tank trucks to be scanned. After the scanning, many containers are opened and visually inspected. The scanning fee is extraordinarily high (100 USD per laden container, for example). Though this kind of business is sometimes observed in developing countries, this can cancel out the benefit generated by the improvement of the Corridor, and impairs competitiveness of the Port and the Corridor.

3.3. Development strategy of the Port

The proposed development strategies corresponding to each development target are summarized in Table 3.3-1.

Table 3.3-1 Development strategies of the Port

Target 1. Trade and transport facilitation for LLCs and landlocked region in Mozambique
(1) Regeneration of container logistics function Relocation and expansion of the container terminal to the North Wharf Demolishing of sheds and spur lines of the railway Relocation of the oil and general cargo terminal from the North Wharf Separation of container handling and bulk cargo handling Modernization and computerization of container operation Upgrading and increase of container handling equipment Construction of a transit cargo terminal in the vicinity of the Port Capacity building (2) Creation of mega port function for bulk cargoes Expansion of port to the north, to the south and to Nacala-a-Velha Construction of a deep water terminal Introduction of efficient bulk cargo handling equipment (3) State of the art sea and rail interface Construction of a multimodal terminal equipped with modernized operation systems Concentration of the function of multi-modal terminal on sea and rail transfer Construction of a marshalling yard and a station for regional cargoes outside the Port Demolishing of all rail tracks along quays Construction of a branch rail line linking Nacala-a-Velha (4) Strengthening maritime link through introduction of container transshipment function Improvement of overall efficiency of container handling Installation of a sufficient number of quay gantry cranes Reform of customs regulation Introduction of incentive policy of port tariff Revival of domestic container network
Target 2. Industrial development of northern Mozambique
(5) Seamless supply chain between the Port and the SEZ Establishment of a basic policy of integration of the Port and the SEZ Construction of the Port Expressway linking the Port, the SEZ and the Corridor Simplification of procedure for cargo movement between the Port and IFZs Integration of operation system of the Port and IFZs (6) Port for agricultural development Efficiency improvement of the Port aiming at improving market access of the sector Quality improvement of cargo handling for sensitive agricultural products Formation of a gateway processing function by integrating the Port and the SEZ Establishment of a reliable cold chain Provision of economical route of fertilizer import Strengthening of incentive policy of port tariff for agricultural products (7) Creation of grain-hub function Construction of a grain terminal with deep water berth and modern equipment Formation of a wheat processing complex in the SEZ

Source: Study Team

3.4. Forecast of future maritime and land transport network

3.4.1 Maritime transport network

(1) Container Transport

1) Forecast of future transport network

a) For East Asia, South Asia and Middle East

For the network for East Asia, Nacala would be decoupled from Durban and even from Maputo, then incorporated into main lines of a cluster combined with IOI ports or Tanzanian/Kenyan ports. For South Asia and Middle East, Nacala would be coupled with Tanzanian/Kenyan ports.

As Beira has a rich cargo source, it will have a chance to be incorporated into those clusters if its channel/quay depth and operational efficiency are both improved. However, in case of the trade lanes for Middle East, there will be some possibility for Beira to be feedered to and transshipped at Nacala, due to its remote position from the cluster of Mombasa/Dar es Salaam/Nacala.

Since Maputo is geographically close to Durban, its current supplemental status to Durban would remain the same. Since sufficient cargoes can be secured by Durban & Maputo, discreet services from those 2 ports will be provided by the shipping lines, not involving Beira/Nacala.

b) For Europe, North America and South America

For the network for Europe, North America and South America, more main line vessels would be calling at Maputo combined with South African ports including Ngqura. Walvis Bay might be incorporated in some main lines.

Nacala would still be covered by feeders due to the long distance from those trade lanes. There is some possibility for Beira to be covered by main lines, depending on its cargo volume and operational efficiency.

2) Forecast of size of vessels calling at the Port

The enlargement of vessel size is assumed as per Table 3.4-1 below. As the Port is not equipped with gantry cranes, the vessels to call the Port are all required to have self loading gears. As the container vessels with gears are generally below 3,000 TEU capacity, the assumption below is within that range. If the Port had a gantry crane, the larger vessel (Panamax or above) might be deployed by the shipping lines who seek the economy of scale.

Table 3.4-1 Forecast of size of vessels calling at the Port

(unit: TEU/vessel)

Trade lane	Current average vessel size (as of Aug. 2010)	Average vessel size for 2020	Average vessel size for 2030
East Asia	1,160	1,723	2,218
Middle East/South Asia	1,676	2,325	2,995
Europe	1,300	1,905	2,453
Main line Total	1,408	2,017	2,597
Feeder	569	707	910
Total	1,198	1,648	2,123

Source: Study Team

(2) Bulk cargo transport

Based on the analysis of bulk ports in the region, the following two scenarios can be developed:

Scenario 1: Continuation of current pattern

When the bulk cargo demands in Mozambique, Tanzania and neighboring landlocked countries don't grow greatly, the current "milk run" pattern of bulk cargo flow, in which handymax or smaller bulkers call multiple ports in the region, would continue, and a bulk hub would not be created in the region.

Scenario 2: Creation of bulk hub function at Nacala

When the bulk cargo demands in Mozambique, Tanzania and neighboring landlocked countries grow, and appropriate infrastructure development and its efficient management is realized in Nacala, the Port of Nacala would become a bulk hub in the region. Larger bulk carriers would be deployed to transport cargo from its origin to Nacala Hub, and the cargoes would be transshipped at the hub to smaller feeder vessels bound for the ports in the region.

3.4.2 Land transport network

As most arterial roads will be paved, it is expected to shorten the travel time through the road. Especially, the international transportation between Malawi and Nacala Port will become considerably efficient by improvement of the Corridor.

The design works for the section between Nampula-Cuamba and Cuamba-Lichinga were carried out from 2006 to 2009 by JICA, then based on the result, African Development Bank (AfDB) approved the loans amounting to US$ 181 million to Mozambique and Malawi to finance the construction of the first phase of the Nacala Road Corridor, which links from Nampula to Cuamba.

The congestion of the existing Tete Bridge is one of the major bottlenecks for transportation from/to Malawi. The completion of the rehabilitation and construction of the new bridge will accelerate the international transportation between Malawi and Beira, or Durban.

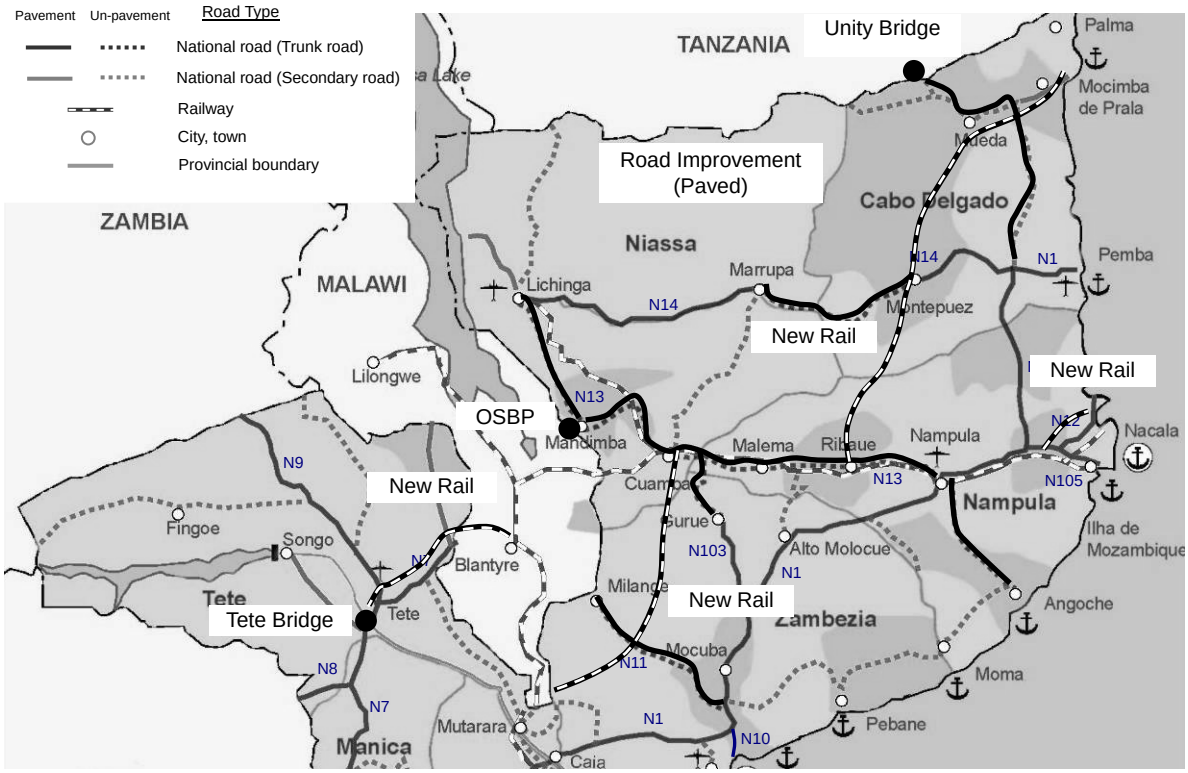
The cross border traffic will get a lot of advantages such as the simplification of border process and shortening of passing time by the establishment of OSBP at Mandimba.

The coal development area in Tete and the new coal terminal in Nacala-a-Velha will be directly connected by a rail through Blantyre, Cuamba and Mandimba. By the rehabilitation of existing railway, it is expected that the internal and regional railway transportation will also be improved.

The scales of railway development plan by Vale are as follows.

- 200 km branch line linking the coal mines of Moatize to Malawi
- Rehabilitation of existing railway in Malawi and Mozambique
- New railway line to Nacala-a-Velha, adjacent to existing Nacala port
- Rehabilitation of the branch line from Cuamba to Lichinga (Depend on the results of coal exploration in Niassa Province)

Based on the above information for both of the road and railway, the future land transport network is shown in Figure 3.4-1.

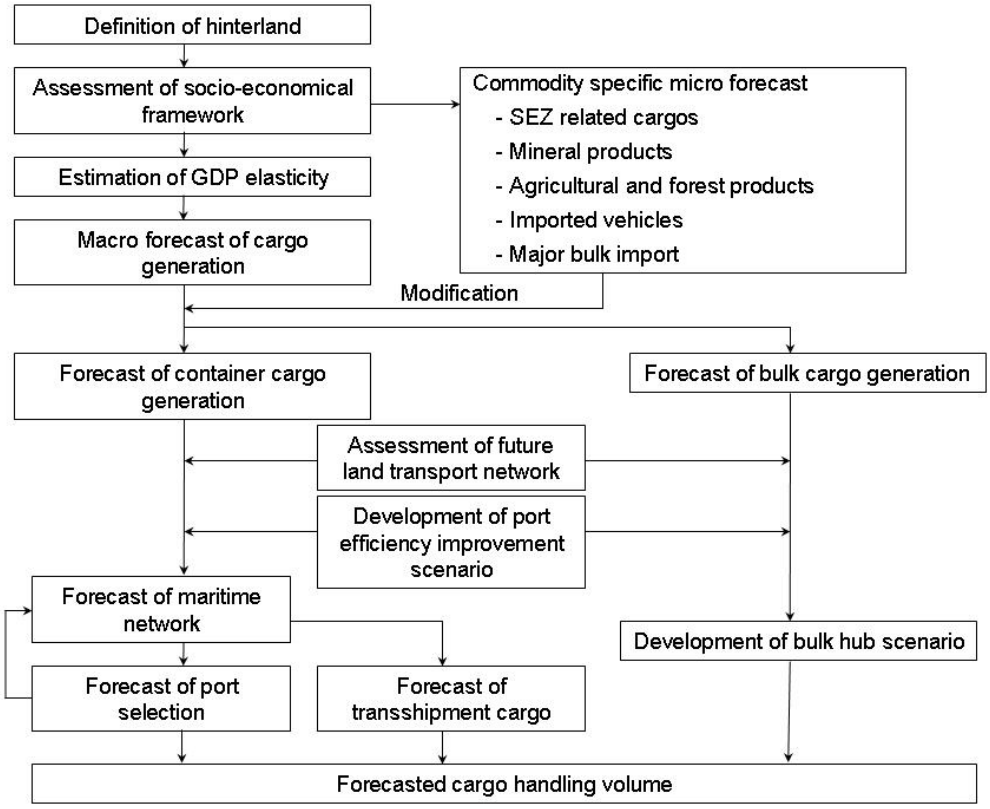


Source: Study Team

Figure 3.4-1 Future land network plan

3.5. Demand forecast

The cargo demands in Nacala Port in the target years of 2020 and 2030 were forecasted. The flowchart of the demand forecast is shown in Figure 3.5-1.



Source: Study Team

Figure 3.5-1 Flowchart of the demand forecast

3.5.1 Cargo generation

(1) Future hinterland of Nacala Port

At present, the hinterland of Nacala Port is Northern Provinces of Mozambique (Nampula, Cabo Delgado, and Niassa) and Malawi. Projects for improving road and railway network are ongoing in this region, and substantial improvement of port and railway operation is expected and must be realized. These improvements are expected to expand the hinterland of the Port. In addition to the traditional hinterland, the following region is expected to become part of the hinterland of the Port:

- Zambia
- Central and Southern Provinces of Mozambique and Southern Tanzania for grain import.
- Tete Province for coal export.

(2) Macro forecast

Macro forecast of the volume of seaborne cargoes to be generated in the hinterland of the Port was carried out based on the macro economic framework shown in Table 3.5-1 and Table 3.5-2. GDP growth rate for Northern Mozambique within the planning horizon was assumed to be 8%. The historical GDP elasticity was calculated from time series of GDP and cargo generation, and the future elasticity was assumed as shown in Table 3.5-3. The result of the macro forecast is shown in Figure 3.5-2.

Table 3.5-1 Forecast of the population growth

	2006-2010	2011-2015	2016-2020	2021-2025	2026-2030
Mozambique	2.5%	2.2%	2.0%	1.9%	1.7%
Malawi	3.0%	2.9%	2.8%	2.6%	2.3%
Zambia	2.6%	2.6%	2.6%	2.3%	2.1%
Tanzania	3.1%	3.1%	2.9%	2.6%	2.4%

Source: UN

Table 3.5-2 Assumption of percent change of real GDP by IMF

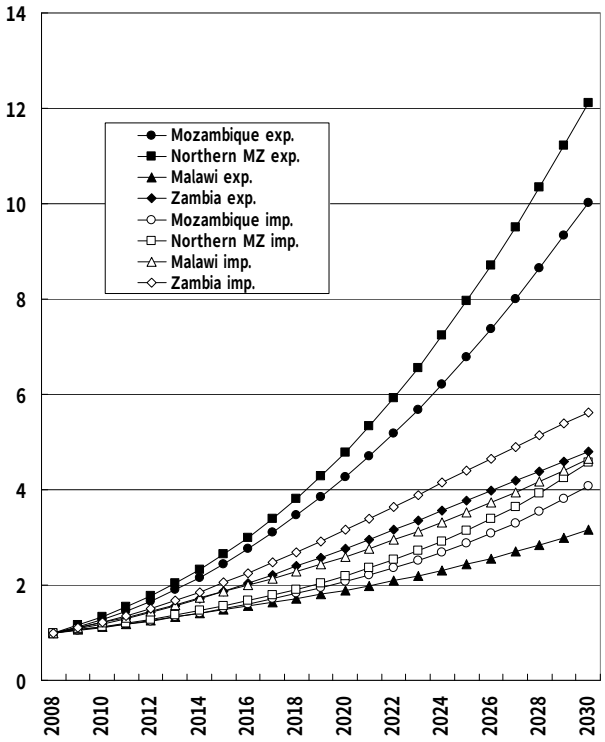
	2008	2009	2010	2011	2012	2013	2014	2015	2019	2020	2025	2029	2030
Mozambique	6.7	6.3	6.5	7.5	7.6	7.9	7.8	7.8		7.2			7.5
Malawi	9.8	7.6	6.0	6.3	6.6	6.8	7.1	5.4		5.4	5.4		5.4
Zambia	5.7	5.3	5.5	6.0	6.2	6.3	6.4		5.7			4.5	
Tanzania	7.3	6.4	5.8	6.5	7.1	7.5	7.5	7.5		7.5			7.5

Source: IMF Country Report (2009, 2010)

Table 3.5-3 Assumption of the GDP elasticity

		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Mozambique	Export	2.0	2.0	1.9	1.9	1.8	1.8	1.7	1.7	1.6	1.6	1.5
	Import	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9
Malawi	Export	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
	Import	1.5	1.5	1.4	1.4	1.4	1.4	1.3	1.3	1.3	1.3	1.3
Zambia	Export	1.7	1.6	1.6	1.6	1.5	1.5	1.5	1.4	1.4	1.4	1.3
	Import	1.9	1.9	1.9	1.8	1.8	1.7	1.7	1.6	1.6	1.5	1.5
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Mozambique	Export	1.5	1.4	1.4	1.3	1.3	1.2	1.2	1.1	1.1	1.0	1.0
	Import	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0
Malawi	Export	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Import	1.2	1.2	1.2	1.2	1.1	1.1	1.1	1.1	1.0	1.0	1.0
Zambia	Export	1.3	1.3	1.3	1.2	1.2	1.2	1.1	1.1	1.1	1.0	1.0
	Import	1.4	1.4	1.4	1.3	1.3	1.2	1.2	1.1	1.1	1.0	1.0

Source: Study Team



Source: Study Team

Figure 3.5-2 Forecasted growth ratio of seaborne cargoes generated in Mozambique, Malawi, and Zambia by the macro forecast

(3) Micro forecast

Micro forecast was carried out based on market perspective of individual commodities listed below:

- Exported forestry products
- Exported agricultural products
- Mining products
- Industrial products and raw materials to/from IFZ of Nacala SEZ
- Imported oil and gas
- Imported clinker
- Imported wheat
- Imported vehicles
- Imported fertilizer

The result of macro forecast was modified by the micro forecast, and the volumes of cargo generation in the hinterland in the target years were obtained as shown in Table 3.5-4.

Table 3.5-4 Forecasted volume of cargo generation in the hinterland

(MT)

			2008	2020	2030
Northern Mozambique	Export	Containers	152,000	726,600	1,890,700
		Bulk	28,000	10,230,000	20,723,000
		Mineral products	0	10,000,000	20,000,000
		Wood chip	0	96,000	384,000
		Others	28,000	134,000	339,000
		Total	180,000	10,956,600	22,613,700
	Import	Containers	124,000	307,600	821,700
		Bulk	311,000	1,197,000	976,000
		Fuel	90,000	190,000	360,000
		Clinker	130,000	500,000	30,000
		Wheat	70,000	400,000	310,000
		Vehicle	0	61,000	180,000
		Others	21,000	46,000	96,000
		Total	435,000	1,504,600	1,797,700
	Total	Containers	276,000	1,034,200	2,712,400
		Bulk	339,000	11,427,000	21,699,000
		Total	615,000	12,461,200	24,411,400
Other Provinces in Mozambique	Export	Coal		20,000,000	40,000,000
	Import	Wheat		1,730,000	928,000
Malawi	Export	Containers	192,000	364,000	606,000
		Bulk	68,200	129,000	215,000
		Total	260,200	493,000	821,000
	Import	Containers	328,000	760,000	1,410,000
		Bulk	694,000	1,544,000	2,590,000
		Fuel	290,000	490,000	760,000
		Clinker	50,000	0	0
		Wheat	120,000	230,000	180,000
		Vehicle	31,000	150,000	380,000
		Others	203,000	674,000	1,270,000
	Total	Containers	520,000	1,124,000	2,016,000
		Bulk	762,200	1,673,000	2,805,000
		Total	1,282,200	2,797,000	4,821,000
Zambia	Export	Containers	246,000	680,000	1,140,000
		Bulk	579,000	1,600,000	2,690,000
		Total	825,000	2,280,000	3,830,000
	Import	Containers	529,000	1,670,000	2,980,000
		Bulk	772,000	2,395,000	4,330,000
		Fuel	570,000	940,000	1,370,000
		Wheat	37,000	160,000	460,000
		Vehicle	45,000	140,000	250,000
		Others	120,000	1,155,000	2,250,000
	Total	Containers	775,000	2,350,000	4,120,000
		Bulk	1,351,000	3,995,000	7,020,000
		Total	2,126,000	6,345,000	11,140,000
Tanzania	Import	Wheat		1,720,000	2,160,000

Source: Study Team

3.5.2 Container traffic

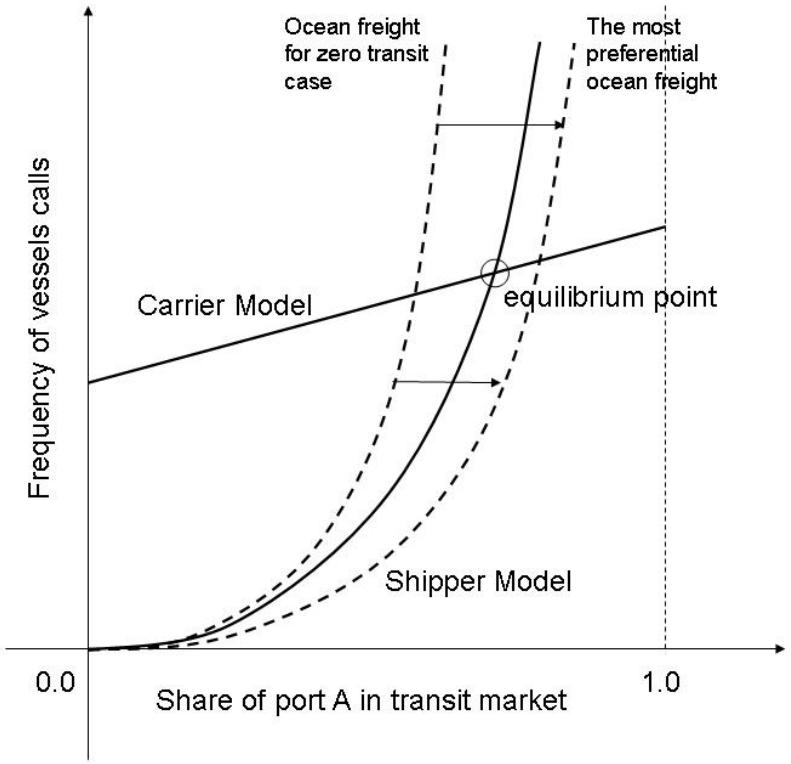
(1) International container cargoes to/from domestic hinterland

All international cargoes generated in the Northern Provinces, except some containerized timbers exported from Cabo Delgado, have been handled in Nacala Port. Notwithstanding the improvement of Pemba Corridor, the Study Team assesses that the demarcation of Nacala and Pemba in the container market of the Northern Provinces will basically remain unchanged within the planning horizon due to the limited capacity of Pemba Port.

(2) Transit containers

1) Methodology

The Study Team assessed future demarcation in transit cargo market in Malawi and Zambia by using a mathematical model developed by OCDI, which takes the efficiency of ports, corridors, and maritime network into consideration. The model allocates cargo to each route according to an aggregate logit model. The OCDI Model includes a carrier model which generates liner service frequency as an endogenous variable when cargo handling volume in a port is given. An equilibrium point can be found out as illustrated in Figure 3.5-3.



Source: OCDI

Figure 3.5-3 Conceptual illustration of OCDI Model

2) Results of the forecast

The cargo shares are forecasted as shown in Table 3.5-5. The definition of productivity of container handling in Nacala Port is as follows:

a) Current productivity

This case represents the use of current facilities (one reach stacker in the terminal with two berths) with standard operational efficiency.

b) Improved productivity (Installation of reach stackers): Base case

This case represents the productivity improvement by increasing the number of reach stackers up to 4.

c) Highly-improved productivity (Installation of quay gantry cranes)

This case represents further productivity improvement by the installation of three quay (3) gantry cranes in the terminal with two berths.

Table 3.5-5 Distribution of shares for 5 ports

Traffic	Year	Case	Nacala	Beira	Durban	Dar es Salaam	Walvis Bay	Total
Malawi Export	2008	Actual	19.5%	51.0%	28.2%	1.3%	0.0%	100.0%
	2020	Current Productivity	24.3%	64.8%	7.4%	3.6%	0.0%	100.0%
	2020	Improved Productivity (Base Case)	74.6%	21.7%	2.5%	1.2%	0.0%	100.0%
	2020	Highly Improved Productivity	79.0%	17.9%	2.0%	1.0%	0.0%	100.0%
	2030	Current Productivity	24.6%	66.9%	5.7%	2.8%	0.0%	100.0%
	2030	Improved Productivity (Base Case)	72.4%	24.5%	2.1%	1.0%	0.0%	100.0%
	2030	Highly Improved Productivity	77.0%	20.4%	1.7%	0.9%	0.0%	100.0%
Malawi Import	2008	Actual	11.8%	59.6%	16.7%	11.9%	0.0%	100.0%
	2020	Current Productivity	14.5%	74.5%	4.9%	6.2%	0.0%	100.0%
	2020	Improved Productivity (Base Case)	57.3%	37.2%	2.4%	3.1%	0.0%	100.0%
	2020	Highly Improved Productivity	62.9%	32.4%	2.1%	2.7%	0.0%	100.0%
	2030	Current Productivity	14.6%	76.6%	3.8%	5.0%	0.0%	100.0%
	2030	Improved Productivity (Base Case)	54.6%	40.7%	2.0%	2.7%	0.0%	100.0%
	2030	Highly Improved Productivity	60.1%	35.8%	1.8%	2.3%	0.0%	100.0%
Zambia Export	2008	Actual	0.0%	4.5%	19.3%	72.0%	4.2%	100.0%
	2020	Current Productivity	0.0%	17.5%	10.5%	70.3%	1.7%	100.0%
	2020	Improved Productivity (Base Case)	0.7%	17.4%	10.4%	69.8%	1.7%	100.0%
	2020	Highly Improved Productivity	0.9%	17.4%	10.4%	69.7%	1.7%	100.0%
	2030	Current Productivity	0.1%	21.0%	9.7%	67.4%	1.8%	100.0%
	2030	Improved Productivity (Base Case)	0.7%	20.9%	9.7%	66.9%	1.8%	100.0%
	2030	Highly Improved Productivity	0.9%	20.8%	9.6%	66.8%	1.8%	100.0%
Zambia Import	2008	Actual	0.0%	15.2%	25.4%	49.8%	9.7%	100.0%
	2020	Current Productivity	1.8%	24.3%	17.2%	48.1%	8.5%	100.0%
	2020	Improved Productivity (Base Case)	6.6%	23.1%	16.4%	45.8%	8.1%	100.0%
	2020	Highly Improved Productivity	7.3%	23.0%	16.3%	45.5%	8.0%	100.0%
	2030	Current Productivity	1.9%	26.3%	16.4%	46.6%	8.7%	100.0%
	2030	Improved Productivity (Base Case)	6.7%	25.1%	15.6%	44.3%	8.3%	100.0%
	2030	Highly Improved Productivity	7.4%	24.9%	15.5%	44.0%	8.3%	100.0%

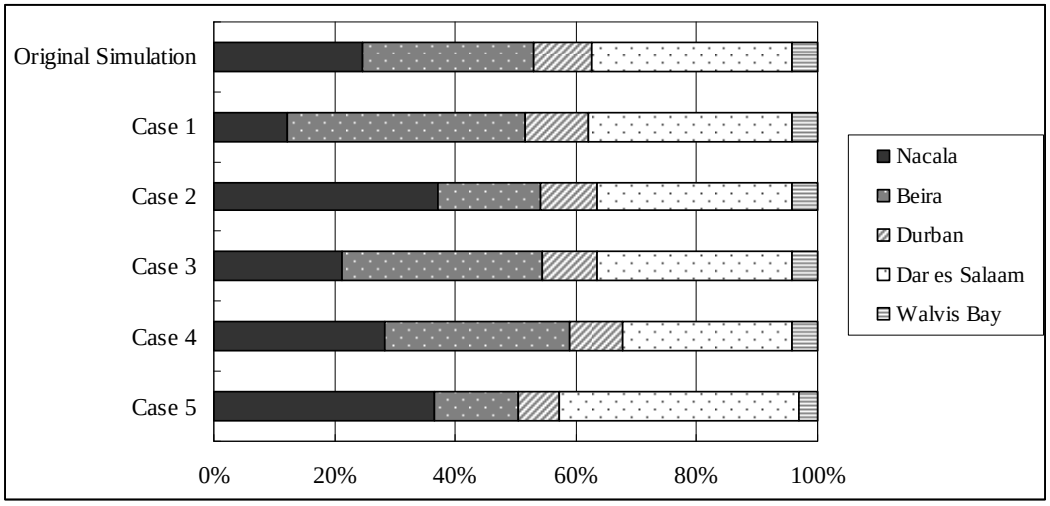
Source: Study Team

3) Sensitivity analysis

Sensitivity analysis was conducted to assess the impact on the simulation result when some changes in the competitive relations with other ports arise. Following 5 cases are considered as a variation of Improved Productivity Case for the year 2030:

Case 1: The rail portion in the inland container transportation of Nacala Corridor decreases from the current 75.3% to 50.0% due to the rapidly increased demand of coal transportation.
Case 2: The rail transit time of Nacala Corridor is reduced to 4 days from the original assumption of 8 days with the current rail portion of 75.3%.
Case 3: In addition to Case 2, Sena railway is developed to connect Lilongwe/Blantyre with Beira with the same service quality and rail portion assumed for Case 2.
Case 4: In addition to Case 3, Nacala Corridor railway is extended to Lusaka with the same service quality and rail portion assumed for Case 2.
Case 5: Export/import ocean freight rates at Nacala and Dar es Salaam are reduced to the same level as Durban, owing to the increase of competitiveness at those ports.

The result of the calculations for each case is summarized in Figure 3.5-4 below.



Source: Study Team

Figure 3.5-4 Result of sensitivity analysis

(3) Transship cargoes

In the year 2008, 2,879 TEUs of transship containers were handled at Nacala. Most of those containers were for outbound and transferred by the same shipping line between its different trade lanes; mainly from East Asia service to South Asia/Middle East service. This kind of transshipment will increase with the growth of overall cargo volume.

In addition of the above, the Study Team envisages the potential transshipment needs as follows:

1) Inbound transshipment by existing shipping line
2) Shift of the transshipment base from IOI ports
3) Shift of the transshipment base from Durban for the containers ex. Beira

It is assumed that those additional transships are obtained by the Port only in the Highly Improved Case where 3 quay gantries are equipped.

3.5.3 Break/dry/liquid-bulk traffic

All bulk cargoes generated in Northern Mozambique have been handled in Nacala Port, and this would remain unchanged in the future. In addition to cargoes to/from Northern Provinces, the Port is expected to handle coal from Moatize Mine in Tete Province and imported wheat to all regions of the country and a part of Tanzania fully utilizing an advantage of water depth.

Zambia is the only country which imports crude oil in the hinterland of the Port. However this traffic is unlikely to divert to Nacala. At present all crude oil is imported through Dar es Salaam port, and is transported to Zambia via crude oil pipeline.

Port selection of other bulk cargoes can be considered to be basically similar to that of containerized cargoes. Unlike containerized cargoes, port selection of bulk cargoes is less affected by the maritime network. Therefore the share of Nacala was calculated without considering the future increase of the frequency of vessel calls.

3.5.4 Summary of cargo forecast

Table 3.5-6 and Table 3.5-7 summarize the results of the demand forecast of the Port in the target years of 2020 and 2030. When mineral products are excluded, the cargo throughput in 2030 is still more than 10 times larger than the current throughput, which corresponds to annual growth of 11%. This represents strengthening of competitiveness of the Port due to improvement of the Corridor

and the evolution of the Port. Figure 3.5-5 and Figure 3.5-6 depict the forecasted growth of cargoes.

Table 3.5-6 Summary of cargo forecast (total cargo volume)

(1,000MT)

		2008	2020	2030
International	Total	955	24,391	48,723
	Container	374	1,972	4,481
	Bulk	581	22,419	44,242
Outbound	Total	227	21,313	43,195
	Container	187	1,003	2,338
	Bulk	40	20,310	40,857
Inbound	Total	703	2,961	5,262
	Container	162	852	1,877
	Bulk	541	2,109	3,385
Transhipment	Total	25	117	266
	Container	25	117	266
	Bulk	0	0	0
Domestic	Total	40	132	1,249
	Container	23	101	263
	Bulk	17	31	986
Total		995	24,523	49,972

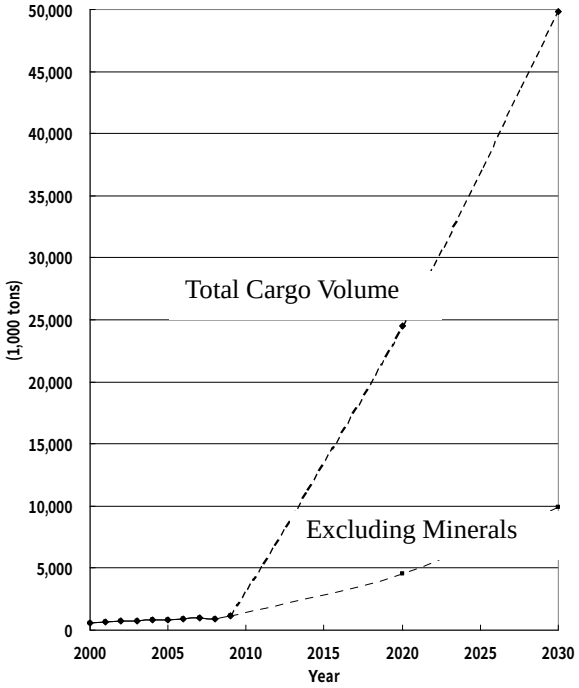
Note: Since the container statistics of CFM include tare weight, the data listed here for the base year don't coincident with CFM data.
Source: Study Team

Table 3.5-7 Summary of cargo forecast (containers)

(1,000TEU)

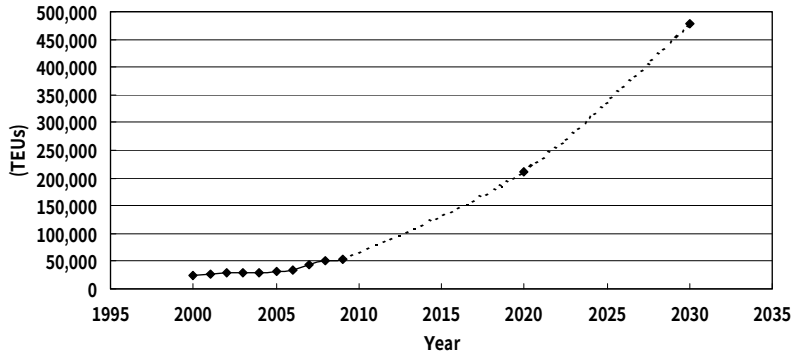
	2008	2020	2030
International	46	192	443
Outbound	22	89	205
Inbound	21	89	205
Transhipment	3	15	34
Domestic	4	19	48
Total	50	211	491

Source: Study Team



Source: Study Team

Figure 3.5-5 Forecasted growth of cargo throughput of Nacala Port



Source: Study Team

Figure 3.5-6 Forecasted growth of container handling volume

Table 3.5-8 shows the estimated breakdown of cargoes by commodity at present and in the target year.

Table 3.5-8 Summary of cargo forecast (by commodity)

(1,000MT)

	2008	2030
EXPORT from Mozambique	170	42,614
Tobacco (Nampula and Niassa)		50
Cotton (Nampula)		50
Cashew (Nampula)		40
Maize (Nampula)		80
Sorghum (Nampula)	100	90
Millet (Nampula)		10
Rice (Nampula)		50
Soybean (Nampula)		70
Cassava (Nampula)		290
Sugar (Processed in Nacala)		100
Wood chip (Niassa)	0	380
Timber (Niassa, etc.)	50	750
Coal (Tete)	0	20,000
Other mineral products including iron ore and phosphate in Nampula	0	20,000
Products in IFZ of Nacala SEZ	0	440
Scrap	5	0
Others	15	214
EXPORT from Malawi	57	568
Tobacco	0	200
Sugar	40	260
Tea	0	50
Cotton	0	30
Others	17	28
EXPORT from Zambia	0	13
Copper and Copper Ore	0	7
Others		6
IMPORT to Mozambique	500	2,726
Wheat	72	1,240
Rice	18	30
Edible Oil	40	60
Oil and Gas	105	360
Clinker	134	30
Cement	50	0
Plaster	5	20
Fertilizer	10	50
Machinery	10	120
Vehicle	30	180
Raw materials for IFZ of Nacala SEZ	0	440
Other	26	196
IMPORT to Malawi	203	1,999
Wheat	25	80
Other Agricultural Products	9	183
Oil and Gas	30	340
Clinker	52	0
Fertilizer	43	300
Other Chemical Products	6	123
Textile	6	120
Machinery	9	190
Vehicle	0	170
Others	24	494
IMPORT to Zambia	0	343
Wheat	0	20
Other Agricultural Products	0	40
Oil and Gas	0	30
Fertilizer	0	70
Metal Products	0	50
Machnery	0	40
Vehicle	0	10
Others	0	83
IMPORT to Tanzania	0	194
Wheat	0	194
TOTAL	930	48,457

Source: Study Team

3.5.5 Vessel traffic

Table 3.5-9 and Table 3.5-10 show the forecasted traffic of container vessels and bulk cargo vessels, respectively.

Table 3.5-9 Summary of container vessel traffics

2008

	Current Productivity	Improved Productivity (Base Case)	Highly Improved Productivity
International	78	148	153
Cabotage	19	21	21
Total	**97**	**168**	**174**

2020

	Current Productivity	Improved Productivity (Base Case)	Highly Improved Productivity
International	266	386	400
Cabotage	79	79	79
Total	**345**	**465**	**479**

2030

	Current Productivity	Improved Productivity (Base Case)	Highly Improved Productivity
International	663	878	905
Cabotage	207	207	207
Total	**870**	**1,085**	**1,112**

Source: Study Team

Table 3.5-10 Forecast of bulk vessel traffics

	2008		2020		2030	
	Cargo volume ('000MT)	Number of vessels	Cargo volume ('000MT)	Number of vessels	Cargo volume ('000MT)	Number of vessels
Mineral	0	0	20,000	190	40,000	267
Wood chip	0	0	96	5	384	9
Fuel	152	58	456	75	780	86
Clinker	134	n/a	500	24	30	1
Wheat	97	3	662	47	2,457	80
Vehcle	0	0	133	60	358	136
Others	215	48	603	89	1,219	180
Total	598	109	22,450	491	45,228	758

Source: Study Team

3.5.6 Traffic volume of automobiles generated in the Port

Table 3.5-11 shows the estimated traffic volume for the Base Case.

Table 3.5-11 Forecasted traffic volume of automobiles generated in the Port

	Annual Cargo Volume		Hourly Peak Traffic Volume of Automobiles (to and from) (vehicles/hr)	
	2020	2030	2020	2030
Bulk (except minerals)				
Mozambique	1,427,000 tons	2,627,000 tons	146	269
Domestic Feeder	31,000 tons	986,000 tons	-3	-101
Transit (Malawi and Zambia)	767,000 tons	1,421,000 tons	24	44
Transit (Tanzania)	155,000 tons	194,000 tons	16	20
Laden Containers				
Mozambique	87,000 TEUs	227,000 TEUs	67	174
Domestic Feeder	8,000 TEUs	21,000 TEUs	-6	-16
Transit	66,000 TEUs	121,000 TEUs	15	28
Total			258	417

Source: Study Team

3.6. Port capacity and development scale

3.6.1 Capacity of existing facilities

(1) Container terminal

Capacity of existing quays is calculated to be 114,445 TEUs. Thus, the existing quays have more than double the capacity of the current handling volume.

The required yard capacity when the container throughput reaches the limit of quay side capacity is shown in Table 3.6-1. The result shows that the current yard capacity (laden 2,230TEUs) is not sufficient to handle laden container when the container throughput increases up to the quay side capacity without improving dwell time. However, if empty container stack area is converted to the laden container stack area, the yard has enough capacity to accommodate the maximum number of containers within the quay side capacity. In this sense, the capacities of the yard and the quays are balanced even when the current very long dwell time remains unchanged.

Table 3.6-1 Summary of required stack capacity

	Total capacity of existing container terminal (TEU)	Required stack capacity (TEU)	
		(A) Current dwell time	(B) Standard dwell time
Laden container	2,230	3,210	2,181
Empty container	1,948	982	561
Total	4,178	4,192	2,742

Source: Study Team

(2) Conventional terminal

The capacity of warehouse and open yard is calculated as shown in the following table.

Table 3.6-2 Capacity of existing warehouses and open yards for each commodity

	Warehouse 1,4,B,C Open yard 2		Warehouse A		Warehouse 2,3	
	Fertilizer		Wheat		Sugar	
A (m^2)	18,040		3,800		6,680	
	Case 1	Case 2	Case 1	Case 2	Case 1	Case 2
R (times/year)	25	15	25	24	25	12
N (ton/year)	451,000	263,384	95,000	92,467	125,250	60,955

Source: Study Team

3.6.2 Target of productivity improvement

The estimated quay side capacity of the container terminal for three scenarios of productivity improvement is summarized in Table 3.6-3. The required stack area for each improvement scenario of quay side and yard productivity is shown in Table 3.6-4.

Table 3.6-3 Summary of quay side capacity at the container terminal

	Current productivity	Improved productivity	Highly-improved productivity
Equipment	1 reach stacker	4 reach stackers	3 quay gantry cranes
Design capacity of ship's gear or quay crane (moves/hr)	15	15	20
(Un)loading efficiency (%)	85	85	100
Number of cranes per vessel (cranes/vessel)	0.76	2	1.76
Handling efficiency combined cranes (%)	100	90	100
(De)berthing time (hrs/vessel)		3	
Other delays (hrs/vessel)		0	
Berth occupancy factor (BOF) (%)		65	
Berth number		2	
Parcel size (TEU/vessel)		487	
TEU factor (TEU/unit)		1.19	
Effective crane performance (moves/hr)	9.69	22.95	35.20
Total turnaround time (TAT) per call (hrs/vessel)	45.23	20.83	14.63
Available number of calls (calls/year)	235	511	728
Capacity of quays (TEU/year)	114,445	248,857	354,536

Source: Study Team

Table 3.6-4 Required stack area for each terminal productivity improvement scenario

			Current vessel (L=372m for 2 berth)			Panamax (L=330 for 1 berth)	
			Current quay side productivity	Improved quay side productivity	Highly-improved quay side productivity	mobile cranes	quay gantry cranes
Quay Capacity		TEU/year	114,445	248,857	354,536	147,330	258,646
		TEU/year/berth	57,223	124,429	177,268	147,330	258,646
Required stack capacity		TEU	2,742	5,946	8,471	3,519	6,180
Required net storage area	Reachstacker/forklift system (3high)	m2	57,582	124,866	177,891	73,899	129,780
		m (Yard depth)	155	336	478	224	393
	RTG system 3high	m2	35,646	77,298	110,123	45,747	80,340
		m (Yard depth)	96	208	296	139	243
	RTG system 4high	m2	27,420	59,460	84,710	35,190	61,800
		m (Yard depth)	74	160	228	107	187
	RTG system 5high	m2	21,936	47,568	67,768	28,152	49,440
		m (Yard depth)	59	128	182	85	150

Source: Study Team

3.6.3 Proposal of development scale

Based on the demand forecast and the target of productivity improvement, the required number of berths in the target year of 2030 is calculated as shown in Table 3.6-5.

Table 3.6-5 Required number of berths in the target years

	Numbers of berths currently available	Required numbers of berths in 2030	
		Current container productivity case	Base case and highly improved container productivity case
Container Terminal	1	3	2
Mineral Terminal	0	2	
Grain Terminal	0	1	
Vehicle Terminal	0	4	
Minor Bulk Terminal	1		
Oil and LPG Terminal	1	1	

The numbers of currently available berths and required berths are counted assuming that all berths are Panamax berths. For mineral terminal, cape size berth is considered.
Source: Study Team

3.7. Space for port development in Nacala Bay

3.7.1 Review of existing land use plans

A master plan covering the whole area of Port Jurisdiction, namely Nacala Bay and Fernão Veloso Bay, doesn't exist. CFM has a master plan for Nacala Bay Area though it is currently being revised. According to the master plan, expansion of the existing port to the north and the south is planned. On the Nacala-a-Velha side, there are plans to construct a petroleum port on Cape Oquero to unload crude oil for a planned oil refinery and a mineral port on Cape Namuaxi, as well as a port terminal in front of downtown Nacala-a-Velha. Nacala City Master Plan defines the port area the same as that given in CFM's Master Plan.

3.7.2 Evaluation of development space

Since the eastern side of the bay is deeper than the western side, basically the Nacala side is more suitable for deep sea port development. However there is a topographical disadvantage at this location. There is little land space available for port development on the eastern side because the cliff rises sharply from the sea. Therefore, for development of bulk terminals, Nacala-a-Velha side can be advantageous due to the availability of flat land. Thus, it should be noted that very limited land space is available for deep sea port development in Nacala Bay and Fernão Veloso Bay, and a well-planned rational land use of the littoral area is crucial.

3.8. Dimensions and basic layout of port facilities

3.8.1 Dimensions of port facilities

(1) Container quay

The size of container ships is expected to increase as the container traffic volume increases. Except the world container trunk route serving for the trade between the East and the West, shipping lines deploy container ships as large as 50,000 DWT, which is called "Panamax", or smaller ones. Therefore, the maximum size of the container ships calling on Nacala Port within the planning horizon is likely Panamax. Thus, the dimensions of container berths are obtained as -14 m deep and 330m long.

It is preferable that the container terminal have inland depth of 350m or more. However, in case of existence of spatial restrictions, it can be reduced to some extent if efficient container operation is carried out.

(2) Dry/liquid/break bulk quay

The required dimensions of bulk terminals depend on the kinds of good handled there. The Study Team's recommendation on the dimensions of bulk quays are summarized in Table 3.8-1.

Table 3.8-1 Proposed dimensions of port facilities

	Design Vessel	Length per Berth (m)	Water Depth (m)
Grain Terminal	90,000 DWT bulker	320	-17
Mineral Terminal	50,000 DWT bulker	370	-20
Oil Terminal	70,000 DWT tanker	270	-15
Minor Bulk/Vehicle Terminal	55,000 DWT bulker	280	-14
	70,000 DWT bulker	300	-15

Source: Study Team

3.8.2 Basic layout

Based on the assessment of development space, the Study Team proposes a zoning plan of the Port as shown in Figure 3.8-1.

The function of the commercial port (which excludes mineral terminal for coal and other ore handling) should be concentrated basically in the existing footprint of the Port and its vicinity.

The area to the north of the existing port facilities are the only available space for expansion of the deep-sea commercial port in Nacala Bay and Fernão Veloso Bay. Therefore, this area should be reserved for future development, and urbanization of this area should be restricted.

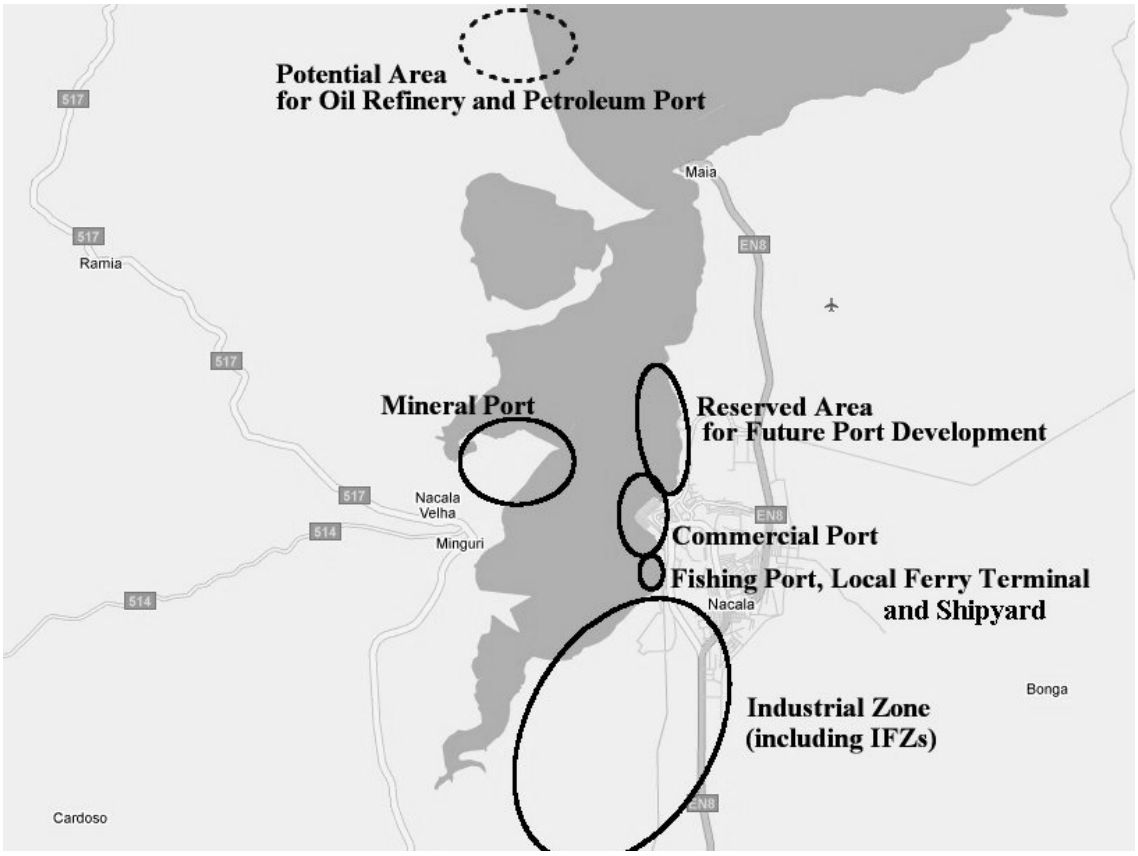
The water depth of the area to the south of the existing port facilities is not enough to accommodate large vessels, but this area is suitable for a fishing port, a local ferry terminal and a basin for small crafts due to the proximity of the city center. This location will be used for a shipyard. Considering future growth of ship's calls at the Port, it is important that a facility for ship repair exists in the Port. Utilizing the incentive scheme of SEZ, private investment in a shipyard shall be strategically promoted.

Cape Namuaxi is suitable for a mineral port handling exported coal and other minerals due to the availability of flat land and access to a deep-water pier, however due socio-environmental consideration is required in the planning and implementation of the mineral port project.

Although the Study Team forecasted that crude oil would not be handled in the Port within long term planning horizon since feasibility of an oil refinery and an oil pipeline has not been confirmed, if demands arise, a crude oil unloading facility and a refinery shall be located out of Nacala Bay.

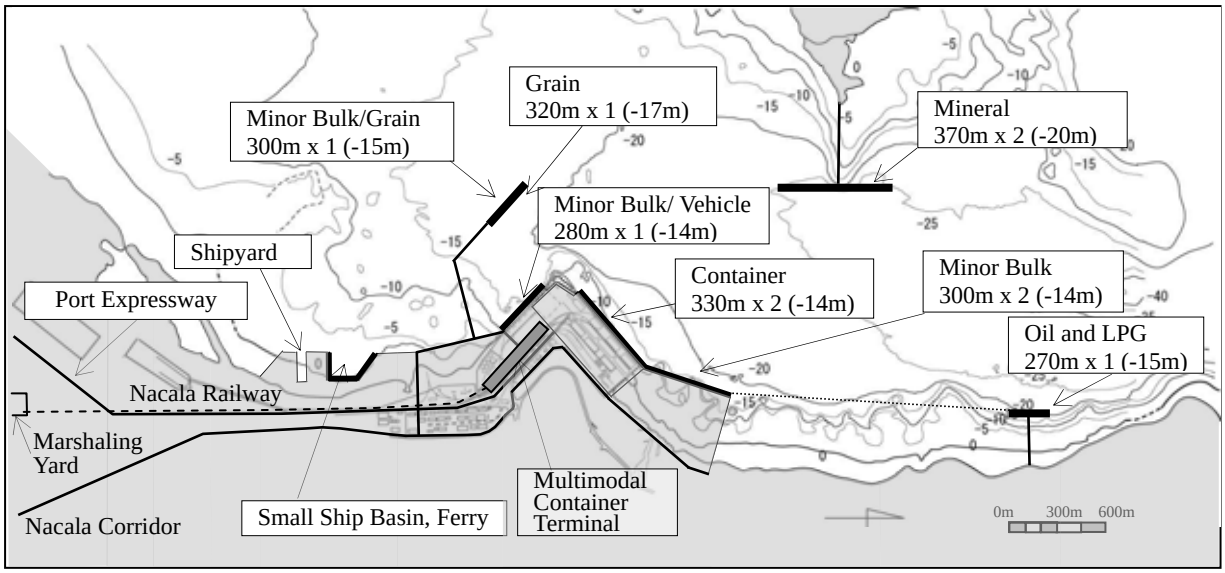
The layout plan of the Port in the target year of 2030 is shown in Figure 3.8-2. The main points of the plan are as follows:

- The whole area of the North Wharf shall be utilized as a container terminal, and all container handling function shall be relocated there.
- The South Wharf shall be used for light cargoes handling such as wood chip and vehicle in order to extend residual life of the structure.
- The fuel terminal shall be relocated to the northern end of the future development area in order to secure maritime safety and to prevent environmental hazards. There is a dispute regarding the location of new fuel terminal as described later.
- The sea to the north of the North Wharf shall be reclaimed, and a bulk terminal shall be constructed there.
- Grain berth shall be constructed to the west of the South Wharf.
- A multimodal container terminal which realizes competitive sea and rail transport shall be located in the South Wharf directly linked to the container terminal in the North Wharf.
- The shallow water to the south of the existing footprint of the Port shall be reclaimed, and the reclaimed land shall be utilized as stock yards, warehouses, a shipyard, a basin for small vessels and a local ferry terminal.



Source: Study Team, Google Map

Figure 3.8-1 Zoning plan of the Port



Source: Study Team

Figure 3.8-2 Layout plan of port facilities

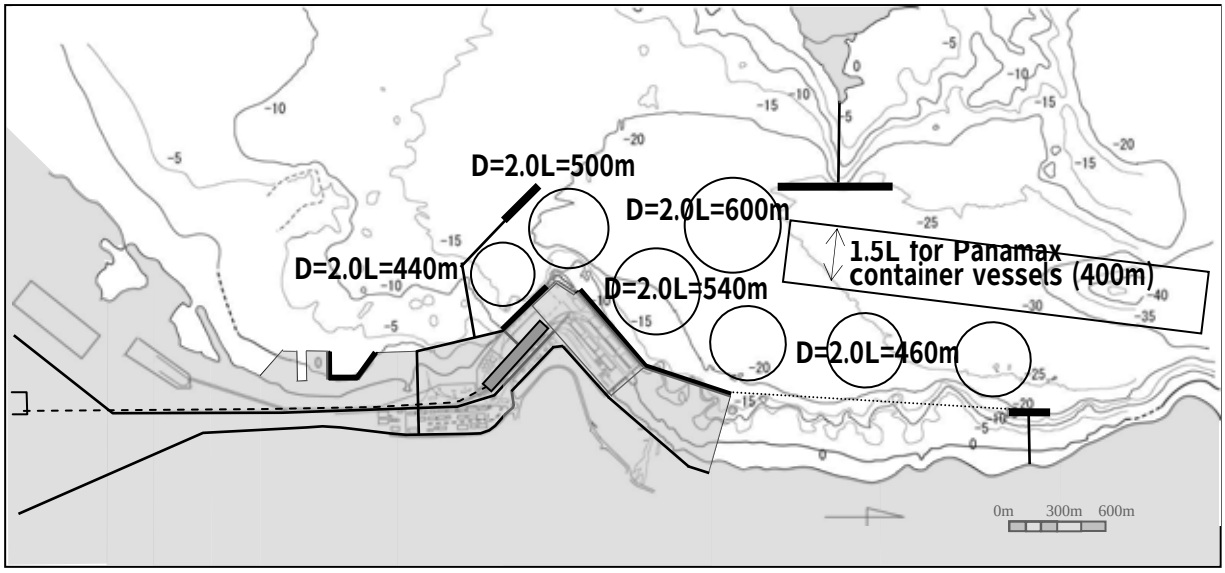
Figure 3.8-3 shows the plan of basins and a navigation channel. This figure indicates that the turning basin for mineral terminal blocks the main access channel, and that all vessels calling at the Port except those berthing at the newly developed jetties to the north of the existing footprint have to pass through the turning basin for the mineral terminal. This means that coordination for the use of basin by the harbor master is crucial in order to secure maritime safety. And this coordination and control shall be conducted in a very sophisticated manner to achieve required productivity as an

international gateway port.

There is an idea in which the fuel terminal can be relocated to the south of the existing port facilities as shown in Figure 3.8-4. However, the Study Team cannot endorse this idea because the hazard level of tankers is completely different from that of ordinary cargo vessels and a small human error can cause serious incidents. Another alternative would be to relocate to the area indicated as "Potential area for Oil Refinery and Petroleum Terminal" in Figure 3.8-1.

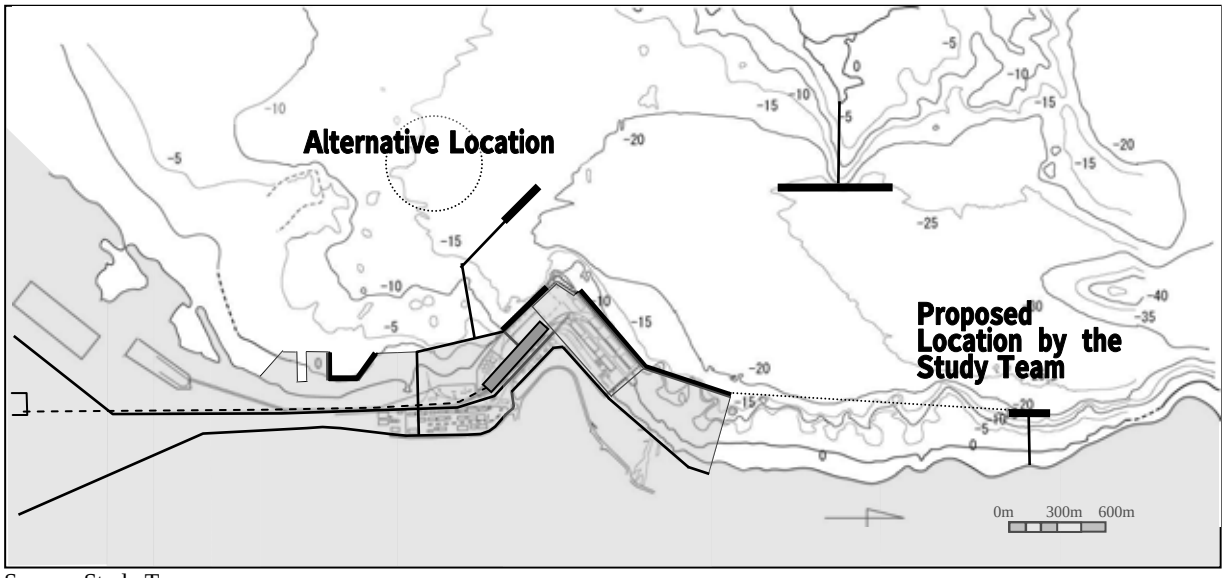
The comparison of the proposed location by the Study Team and the alternative location is shown in Table 3.8-2.

It is unlikely that the relocation is required before 2020 if the new container terminal in the North Wharf is efficiently operated. There is enough time to discuss this issue among all stakeholders and find the best solution.



Source: Study Team

Figure 3.8-3 Plan of basins and a navigation channel



Source: Study Team

Figure 3.8-4 Alternative location of a fuel terminal

Table 3.8-2 Comparison of the location of a new fuel terminal proposed by the Study Team and the alternative location

	Proposed location by the Study Team (To the north of the existing facility)	The first alternative (To the south of the existing facility)	The second alternative (The western shore of Fernao Veloso Bay)
Maritime safety and prevention of environmental hazards	Good	Poor	Excellent
Maneuverability	Good	Difficult	Excellent
Negative impact on the productivity of the mineral terminal	None	Considerable	None
Necessity of relocation of tanks	Yes	No	Yes
Necessity of construction of road and rail	Yes	No	Yes
Length of pipeline	Short (after relocation of tanks)	Medium	Short (after relocation of tanks)
Cost	High	Medium	Very high

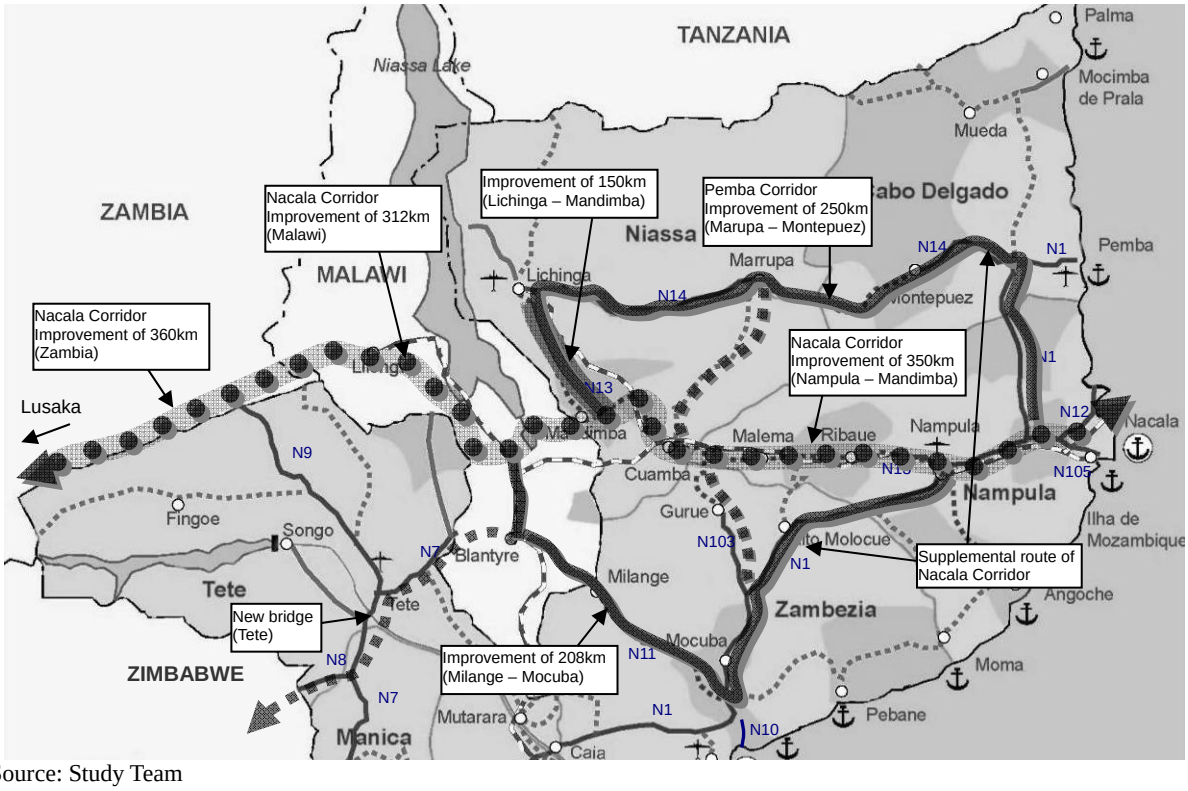
Source: Study Team

3.9. Improvement of access to the Port

3.9.1 Access from LLCs and domestic hinterland

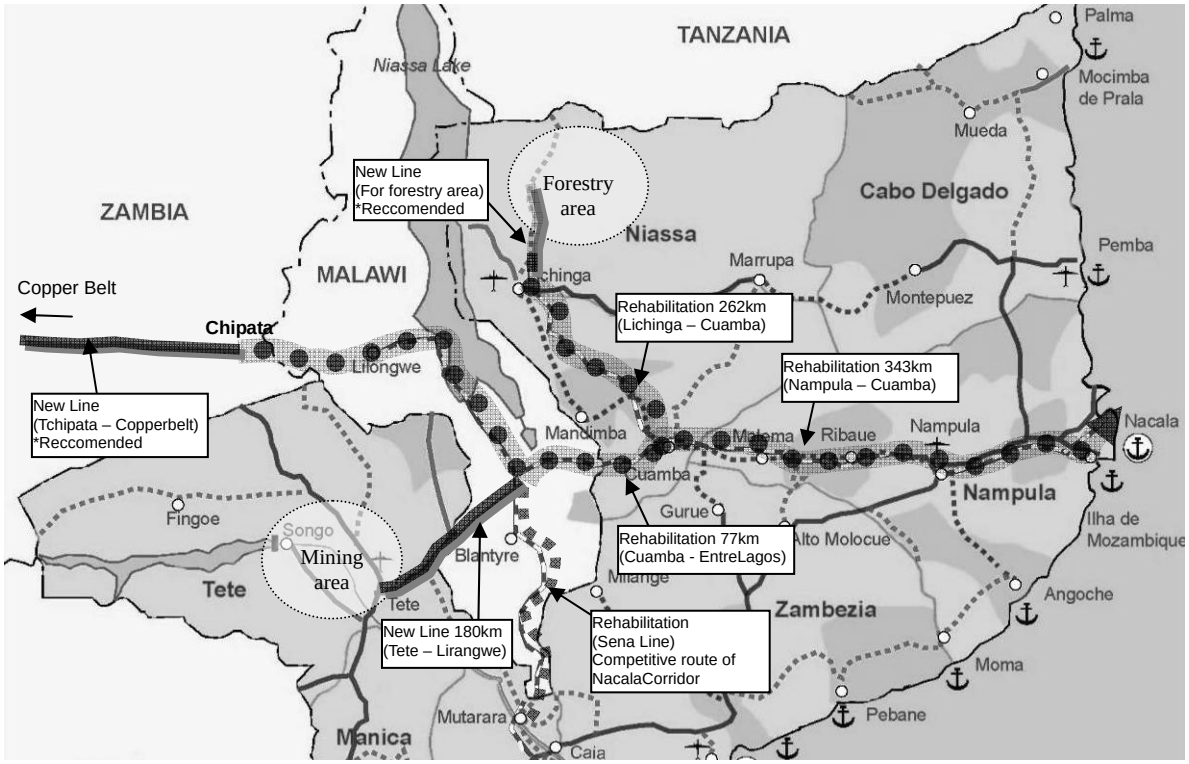
(1) Improvement plan for road network accessing to Nacala port

Figure 3.9-1 and Figure 3.9-2 show the expected future road and railway network which will greatly contribute to the achievement of the development target of Nacala Port.



Source: Study Team

Figure 3.9-1 Improvement plan for road network access from/to Nacala Port



Source: Study Team

Figure 3.9-2 Improvement plan for railway network access from/to Nacala Port

3.9.2 Road and railway improvement in Nacala

In order to improve the overall efficiency of port operation and to strengthen the competitiveness of the Port, the following three strategies for access improvement shall be adopted:

(1) Separation of traffic flow by cargo types

- The perimeter of the container terminal shall be clearly defined. Non-container trucks shall be prohibited from entering the container terminal. All movement of container vehicles in the container terminal shall be controlled and monitored.
- A dedicated container terminal gate equipped with a gate operation system shall be constructed, where all trucks receive instructions regarding their movement in the terminal automatically or semi-automatically. The gate shall be located on the ground floor of the One Stop Service Building.
- The access road to the container terminal gate shall be separated from access roads for conventional cargoes. The container access road shall by-pass the existing roundabout in front of the existing port entrance to avoid traffic congestion. The number of lanes shall be four (4) at least in the section near the container terminal gate.
- A new access road to the South Wharf, which will be used for dry bulk and break bulk (vehicles) handling, shall be constructed. Since there is no land space available for road construction, the shallow water to the south of the Port shall be reclaimed.
- A new access road to the area to the north of the Port, where a new dry bulk terminal will be developed in the future, shall be constructed. The road shall start from the existing roundabout and pass behind the new container terminal in the North Wharf without crossing the access road to the container terminal.
- The entrance of the inspection center shall be moved to the opposite side of the facility where

the new access road to the container terminal faces.

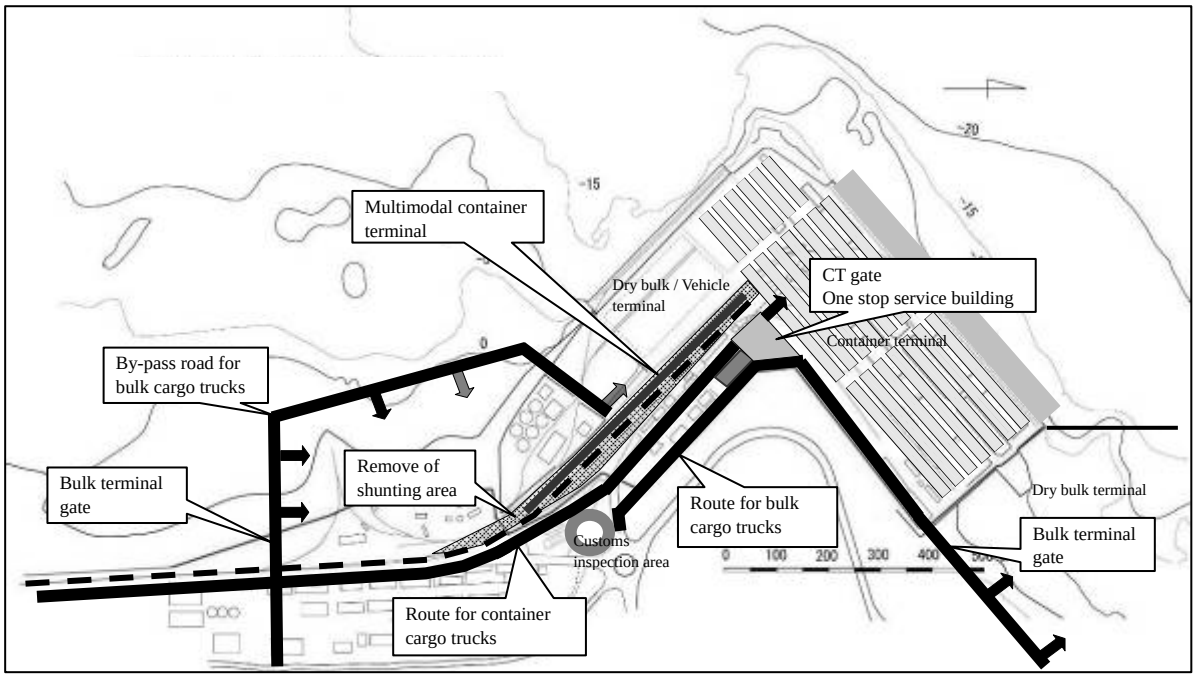
(2) Improvement of rail access

- The rail terminal in the Port shall be utilized only for loading or unloading seaborne cargoes. Therefore, all shunting lines in the port terminal shall be demolished basically, although additional shunting lines will be tentatively necessary to cope with increased rail and sea traffic until a new marshalling yard is constructed outside the Port.
- A depot and a marshalling yard shall be newly constructed outside the Port along the main line. A freight station for non-sea borne cargoes shall also be constructed adjacent to the new marshalling yard.
- A new multimodal terminal equipped with modernized operation systems shall be constructed in the South Wharf. Since a container loading/unloading facility requires a long and straight area, it shall be located at the site currently used as marshalling yard and main lines.
- Since the direct operation between ship and rail wagon is inefficient and old-fashioned, all rail tracks along quays shall be demolished. All rail tracks on the North Wharf shall be demolished because they hamper container operation.
- The new mineral terminal in Nacala-a-Velha requires railway access. Therefore a branch line to the mineral terminal shall be constructed. For efficient coal handling, a loop line system will be preferable.

(3) Integration of the Port and the SEZ

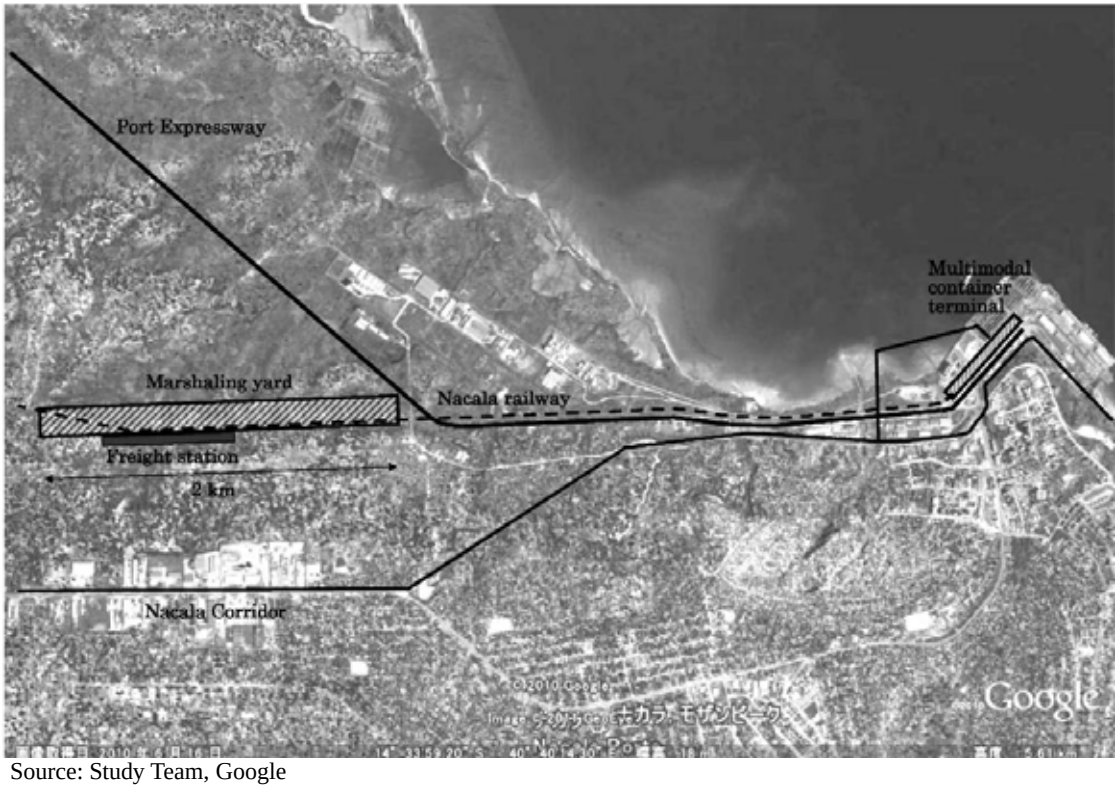
- The Port Expressway shall be constructed, which directly connects the SEZ including IFZs with the container terminal gate of the Port without passing through the urban area of Nacala. The road shall be connected with Nacala Corridor to the south of the junction to Nacala-a-Velha. Flyovers shall be adopted at railroad crossings for the safety and efficiency of transport.
- Although the Expressway will not be fenced and will be open to the public, the Expressway shall function as a virtual bonded area. Trucks should be able to come and go easily between bonded areas in IFZs and the Port with very simplified and computerized procedure.
- Optical fiber cables connecting IFZs and the One Stop Service Building shall be installed along the Expressway. The fiber cables are key infrastructure to realize electronic integration of the Port and the SEZ.
- A freight railway station shall be constructed in a bonded area of IFZ enabling bonded processing in IFZ and bonded transport from LLCs to the world’s market via Nacala Railway, Nacala SEZ and Nacala Port.

The following figures summarize the proposed improvement of road and railway access to the Port.



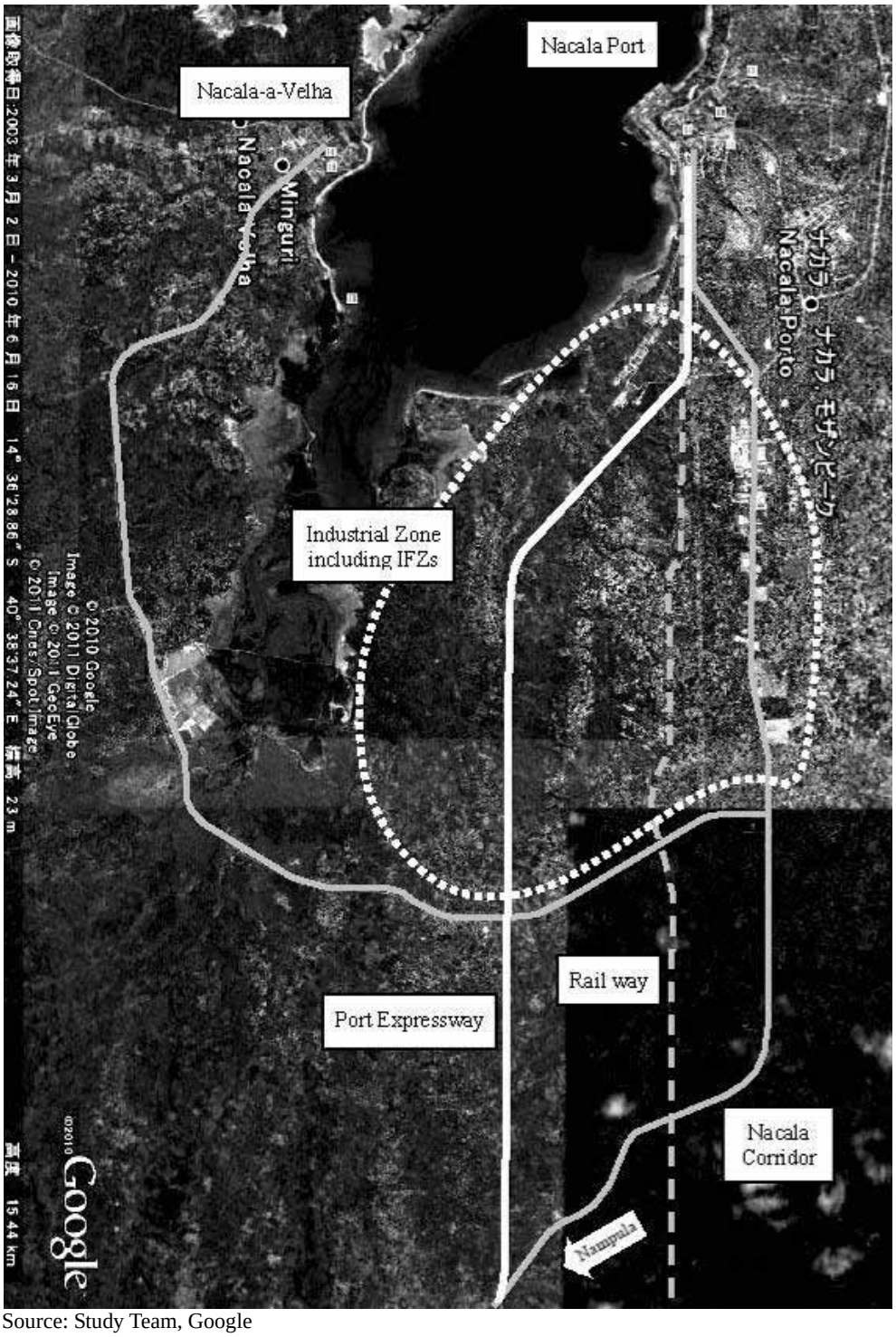
Source: Study Team

Figure 3.9-3 Access improvement in/around the Port



Source: Study Team, Google

Figure 3.9-4 Access improvement in the South of the Port



Source: Study Team, Google

Figure 3.9-5 Port Expressway connecting the Port with the SEZ

3.10. Roadmap for modernization and expansion of the Port

The time schedule of the development of the port is proposed as shown in Table 3.10-1:

Table 3.10-1 Targets of the development of the Port

(1)	Urgent Rehabilitation Project Part-1 -Upgrading container handling productivity -Traffic control in the port area	by 2013,
(2)	Urgent Rehabilitation Project Part-2 -Start of operation of a new container terminal, -Start of operation of mineral terminal at Nacala-Velha side	by 2015,
(3)	Short-term Development Project -Installation of container quay cranes, -Redevelopment of port land area (North Wharf), - Installation of grain unloaders	by 2020,
(4)	Medium-term Development Project - Relocation of oil terminal, - Completion of another container berth and the expansion of container yards - Start of the operation of a new dedicated bulk terminal (South side)	by 2025
(5)	Long-term Development Project - Completion of the expansion of container/bulk terminal (North side)	by 2030.

Source: Study Team

3.11. Projects for modernization and expansion of the Port

3.11.1 Long list of the projects

(1) Infrastructural elements to be included in the medium-and long-term development plans

A Nacala area (Commercial port)

1) Container terminal
(berths, container marshaling yards, empty container stockyard, equipment, maintenance shop, security and inspection facilities and rail container terminal)
2) Dry bulk terminal (berths and stockyards and silos)
3) General cargo terminal (berth, transit shed, open storage yard)
4) Rail terminal
5) Liquid bulk terminal
6) Supply of bunker oil, water
7) Waste management facilities
8) Inland container terminal (including CFS, truck parking)
9) Access road system
10) Access railway system
11) Port gate (including truck scales)
12) Integrated administration building

B. Nacala area (Other port facilities)

1) Fishing port
2) Ferry landing

C. Nacala-a-Velha area

1) Coal terminal (including access railways)
2) Mineral ore terminal
3) Ferry landings

D. Environmental preservation area

1) Designation of environmental preservation area and monitoring system
2) Designation of tourism reservation area and facilities for pleasure crafts

3.11.2 Prioritized projects for immediate implementation

The performance of the port operation is one of the vital elements that has a great impact on the attraction of cargoes. If the Port fails to provide effective and customer friendly service, investors are discouraged from expanding their business and the products in the Northern Provinces will lose the competitiveness. The impact is more serious for the transit cargoes of Malawi and other inland countries, because transit cargoes can be handled at Beira Port, which is the competitor of Nacala Port.

Therefore, it seems to be most rational to give the priority from the viewpoint of the magnitude of the impact on efficiency of port operation. Priority projects in the order of priority are as follows:

(1) Restoration and repair the existing infrastructure

a. Installation of fenders on the South Wharf (container wharf)
b. Repair of the pavement of aprons and curb stones of the North Wharf (general cargo wharf)
c. Repair of the pavement of the road inside the Port
d. Widening entrance port road
e. Increase gate lanes (including truck scale installation)

(2) Construction of coal & mineral terminal at Nacala-a-Velha

a. Construction of deep draft berths
b. Construction of storage yard
c. Installation of equipment (including loader, belt conveyers)
d. Construction of access railways
e. Installation of navigation aids
f. Procurement of tug boats for large dry bulk ships

(3) Upgrading container handling productivity by repairing the existing facilities

a. Container handling equipment
b. Upgrading container terminal by installing RTG’s
c. Relocation of rail container terminal
d. Construction of additional access road to by-pass bulk cargo

(4) Expansion of handling capacity of container and bulk cargoes

a. Construction of a container wharf and yard
b. Bulk cargo stockyard (with extension of rail track)
c. Repair the pavement of open storage yard on the general cargo wharf
d. Expansion of inland depot (container storage capacity and truck parking)

(5) Further expansion of the port

a. Upgrading bulk terminal (dedicated bulk terminal equipped with unloaders)
b. Relocation of liquid bulk terminal
c. Construction of another access road to the North Wharf
d. Procurement of additional tugboat for large ships

4. Short-term Port Development Plan and Urgent Port Rehabilitation

4.1. Assessment and repair of existing wharves

4.1.1 Deterioration assessment of port facilities

(1) General description of wharf structure

The container wharf was constructed in 1974. The total length of the wharf is 372m, being constructed with open-type wharf on vertical piles.

The general cargo wharf built in 1968 was functionally divided into 2 blocks: -10.0m wharf for international cargo ships and -7.5m wharf for cabotage ships. The former was constructed with concrete blocks as gravity type wharf. A part of the latter wharf is constructed with the same type of structure as the container terminal.

(2) Present situations of wharf facilities

1) Container terminal

The piles and props are seriously deteriorated. The pavement is not seriously damaged. 97.4% of all the piles are seriously deteriorated. Same damage at main piles is found at exposed concrete surfaces of about 1m or 1.5 m from the concrete deck and at least one or two props at a set of the four members, connecting main piles and support piles, are damaged.

The front vertical wall is partially damaged: re-bars are exposed at several locations. Accessories originally installed are damaged; wooden fenders and wooden corner protection were completely destroyed by berthing and mooring of ships, and sets of two tires are installed in place of the original.

2) General cargo terminal

In Block 1&2 (Concrete blocks), the structure is generally in sound conditions whilst there remain small defects that can be easily repaired. In Block 3 (Steel sheet piles), settlement of apron was found. In Block 4 (Piles and beams supporting concrete deck), 96% of all the piles were damaged or destroyed. The same deterioration of piles observed in the container terminal is observed here.

The pavement of Blocks 1, 2 and 3 in the general cargo terminal is seriously damaged, requiring lorries to be operated at slow speed there. The pavement in Block 4 is partially deteriorated. Most of the cap concrete in Blocks 1 and 2 was completely damaged. Wooden fenders and wooden corner protection were completely destroyed by ships' impacts and sets of two tires are installed.

(3) Assessment of existing port facilities

1) Open-type wharf on vertical concrete piles (container and general cargo terminals)

a) Assessment of residual capacity

The Study Team assesses that the deterioration of the structure has not been caused by the exceeding stress beyond the design criteria but caused by deterioration of durability of reinforced concrete, which occurrence of cracks has been inducing.

From the structural analysis, the quay seems to be structurally serviceable, especially as the anchor and rear walls remain structurally effective. The effective structures control displacement of the overall facility and occurrence of bending moment is minimized against external forces. Accordingly, the piling system will withstand the action of external forces by ships even if the piles hold no durability against bending moment

It should be noted, however, that the quality of concrete of the front/rear walls has definitely deteriorated. Concrete neutralization has progressed during the 36 years from commencement of the quay services. Deterioration will be rapidly accelerated. Accordingly, it should be emphasized that the piling system is now situated in the "*vulnerable*" stability category under the supports by rear and

anchor walls of deteriorated concrete.

b) Measures for extending residual life

Since the concrete of the facility is definitely deteriorated, minimization of the external forces against the facility is recommended for extending its life.

Container handling should be shifted to the new berth that will come on line soon, and lighter bulk cargoes by lighter vehicles will be handled at the present wharf to reduce surcharge loads.

Fenders should be installed urgently. At present, instead of fenders, tires are hung in front of the wharf; however, tires are seriously deformed when ships are touching the wharf. The deformation is caused by the low capacity of absorbing berthing energy. It results in transmission of a high rate of berthing energy to piles.

It is also recommended that the port manager with assistance of civil engineers of CDN take the following measures for easing the external forces and properly maintaining the facility:

- Control of approaching velocity of ships to be less than 10cm/sec.
- Clearance of loaded containers
- Prohibition of mooring ships in cyclone

In addition to the above, CDN is expected to regularly maintain the port facilities and repair concrete defects like stripping covers.

c) Monitoring of the structure

It is crucial to monitor the structure regularly in order to prevent loss and damage caused by unexpected collapse of the structure. The monitoring shall be conducted as follows:

- Regular monitoring of cracks on piles and front/rear walls once in three months
- Regular monitoring of openings between the concrete deck and container yard
- Regular measurement of compression strength of the structural members with a rebound hammer

2) Gravity type of wharf (concrete block type) and steel sheet piling wharf

Major structural defects were not found in the two types of wharves; however, joints and alignment of the blocks should be inspected by a diver for rehabilitating the wharf.

4.1.2 Repairing methods

The realistic method of overall repair of the concrete pile structure would be to demolish the entire structure and to construct a new structure.

The structural defects listed below should be repaired in stepwise plans.

- Stripped concrete covers
- Cap concrete of the concrete block wharf
- Pavement
- Settlement of ground elevation and outflow of filling material

4.2. Alternative plans for port rehabilitation

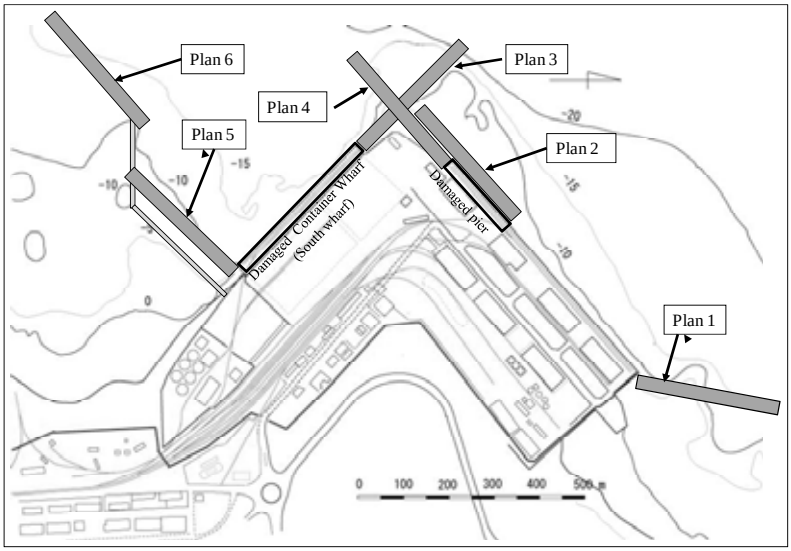
4.2.1 New construction of container berth prior to the rehabilitation of the damaged pier of the South Wharf

It is assessed that the damaged pier of the South Wharf can be used for more years if the pier is used with special care such as restriction of loads of the pier, slower ship berthing speed and the installation of fenders. Most scrupulous and continuous observation and monitoring of the wharf structures shall be conducted during the operation. Since the pier is the main and the busiest berthing facility of the Port, it cannot be repaired or reconstructed until alternative berthing facilities are operational. Therefore, it is recommended that a container berth should be newly constructed prior to

the rehabilitation of the damaged pier and that the pier should be used for bulk cargo handling, which does not require loading heavy load and equipment on the pier. Moreover, it is bulk carriers that require a deepwater wharf because of their size.

4.2.2 Alternative layout plans for a new container pier

There are six (6) locations for the construction of a new container pier taking into consideration the connectivity with the existing container yards as shown in Figure 4.2-1. The advantages and disadvantages of each plan are summarized in Table 4.2-1. Based on the evaluation, Plan 2 is recommended.



Source: Study Team

Figure 4.2-1 Alternative layout plans for a new container pier

Table 4.2-1 Impacts of alternative plans of a new container pier

	Impacts						
	Ship maneuvering	Container Terminal Operation	Traffic flow in the port	Requirement of dredging	Other impact	Relationship with the rehabilitaiton of the damaged piers	Environmental impacts
Plan 1	*Good*	Distant from the existing CY	Intersept oil pipeline	Dredging is required (Volume is small)	Easy to expand in the future	Completely separate project	･Located close to seagrass bed. ･Development of previously undisturbed area
Plan 2	*Good*	Connected to the existing CY	No change is required	Dredging is required (Volume is large)	Demolish or relocation of a warehouse is required	Complete rehabilitaion of damaged part of GC wharf	･Risk of marine pollution due to dredging (risk low)
Plan 3	*Fair*	Connected to the existing CY	No change is required	Dredging is required (Volume is small)	Soil is very soft, hard layer is very deep	First step of the rehabilitaion of Container Wharf	･Risk of marine pollution due to dredging (risk medium)
Plan 4	*bad*	Connected to the existing CY	No change is required	Dredging is required (Volume is large)	Demolish or relocation of a warehouse is required	First step of the rehabilitaion of Container Wharf	･Risk of marine pollution due to dredging (risk medium to high)
Plan 5	*Fair*	Connected to the existing CY	Made the onflict between the flows of container and bulk cargoes more serious	Dredging is required (Volume is medium)		Complete rehabilitaion of damaged part of GC wharf	･Risk of marine pollution due to dredging (risk high)
Plan 6	*Good*	Require bridge to the wharf	Made the onflict between the flows of container and bulk cargoes more serious	Dredging is required (Volume is small)		Complete rehabilitaion of damaged part of GC wharf	･Possible hinderance to local fishing activities. ･Development of previously undisturbed area

Source: Study Team

4.3. Formulation of Short-term Development Plan

The Study Team has drawn the Short-term Development Plan to cope with the cargo traffic foreseen in 2020 as follows:

(1) Infrastructure

1) North Wharf

- New container wharf , see Figure 4.3-1 [1]
  - Demolishing of Hangar No. 0, 1 and 2
  - Demolishing of the damaged pier in the North Wharf
  - Pier structure (320 m x 40 m, water depth; -14m)
  - Dredging the berth up to -14 m [2]
  - Construction of container yards [3]
- Repair of the pavement of apron and curbstones [4]
- Repair of pavement of port road [5]
- Grading and ground leveling of open storage yard [6]

2) South Wharf

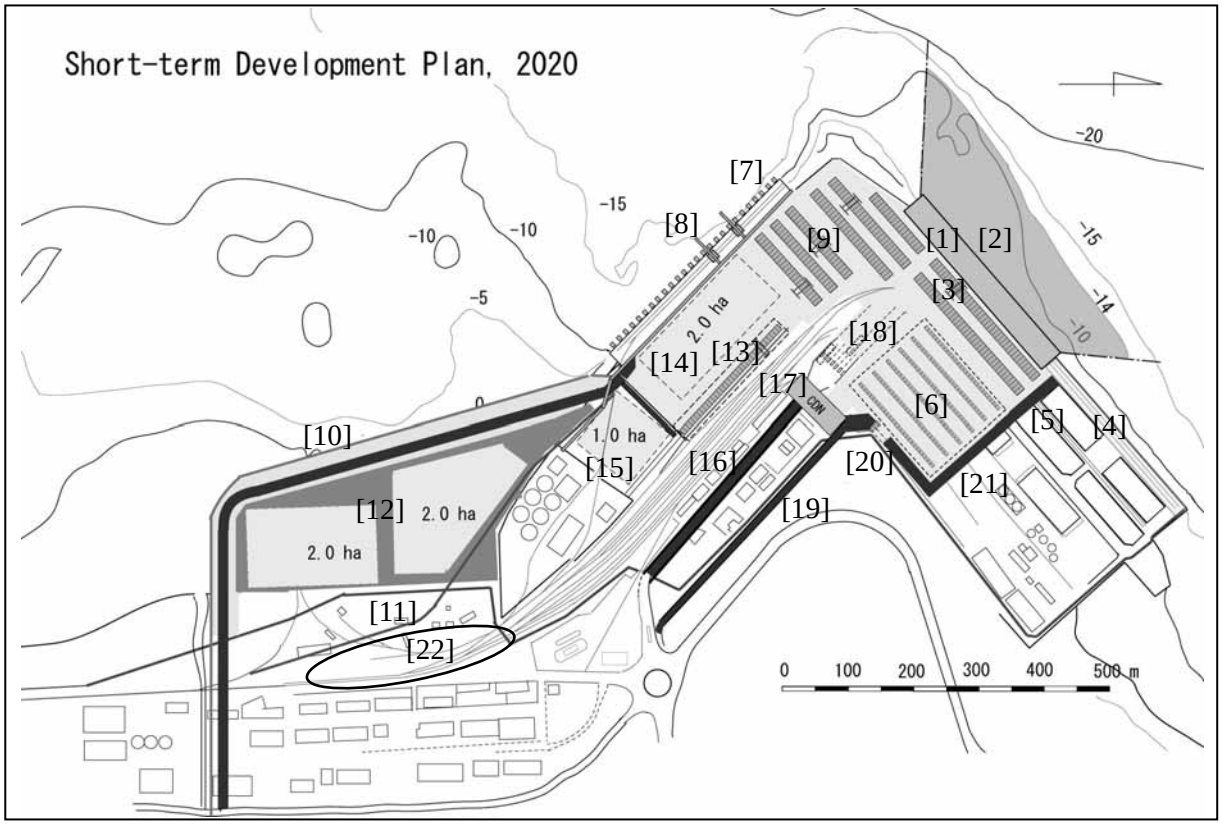
- Installation of fenders to the damaged container pier [7]
- Installation of grain unloader and belt conveyer [8]
- Container yards (Foundation for RTG's) [9]
- New access road and railway to the South Wharf (about 1 km)
  - Construction of road [10]
  - Rail access track to the South Wharf [11]
  - Reclamation [12]
- Rail container terminal [13],
- Removal of rail container gantry crane and pavement of storage yard [14]
- Open storage of bulk cargoes [15]

3) Main gates, road and railway

- Widening of entrance road, [16]
- Construction of One Stop Service Building (port administration building) [17]
- Construction of new gates (including truck scale) and pavement [18]
- Construction of another access road (for general cargoes) and gate [19], [20] and [21]
- Expansion of rail shunting area [22]

(2) Equipment

・ Reach stacker	4 units
・ Tractor-head and yard chassis	12 units
・ RTG	8 units (four-high)
・ Mobile crane	1 unit (100 ton)



Source: Study Team

Figure 4.3-1 Short-term Development Plan (target year: 2020)

4.4. Urgent Rehabilitation Project

The most practical approach is to implement the Short-term Development Plan in several phases. Those project components that need to be implemented in the early stage of the project shall be packaged as the Urgent Rehabilitation Project.

Prior to the start of the construction of the new pier at the western side of the North Wharf, it is vital to enhance the capacity of the container and the dry bulk handling at the South Wharf so that the Port will be able to handle all the container and dry bulk cargoes without using the western half of the North Wharf, which is the project site of Urgent Rehabilitation. To this end, those project components intended to enhance the handling capacity of the South Wharf should be completed before the construction of the new container wharf starts at the western part of the North Wharf.

Thus, those project components that are the preparatory works are chosen as the first part of the Urgent Rehabilitation Project: the package of these components is called the Urgent Rehabilitation Part-1, hereafter. The components to be implemented as the second part of the project are those related to the construction of the new wharf. Those components that facilitate the effective use of the new wharf should also be included in the Urgent Rehabilitation Project. The package of these components is called the Urgent Rehabilitation Project Part-2.

With these criteria, the components shown in Table 4.4-1 through 4.4-2 have been chosen as the components of the Urgent Rehabilitation Project. The numbers in the right column indicate the number used in Figure 4.3-1 to identify the location of the components.

Table 4.4-1 Project components of Urgent Rehabilitation Project Part -1

No.	Project Component	Item No. in Fig. 4.3-1
1	By-pass access road	[10]
2	Installation of fenders	[7]
3	Foundation of RTG's	[3]
4	Widening of entrance road	[16]
5	Gate construction	[18]
6	Pavement	[9]
7	Pavement of apron	[4]
8	Equipment (reach stacker 4, yard chassis 12, RTG 2)	[9]

Source: Study Team

Table 4.4-2 Project components of the Urgent Rehabilitation Project Part-2

No.	Project Component	Item No. in Fig. 4.3-1
1	Landfill and ground leveling	[11]
2	Construction of rail track	[12]
3	Ground leveling	[6]
4	Repair of yard and road pavement	[15]
5	Rail container terminal	[13]
6	Container yard pavement	[14]
7	Reconstruction of wharf (320m x 40m)	[1]
8	Dredging(-14m)	[8]
9	Road pavement	[5]
10	Equipment (RTG2)	[9]
11	Demolishing of warehouses (No. 0, 1 and 2)	[15]

Source: Study Team

4.5. Preliminary design

(1) New container berth

Among the several types of structures, a concrete caisson gravity wall, steel sheet pile walls and an open piled suspended concrete deck have been selected for evaluation. In addition, considering the subsoil conditions, steel sheet pile walls constructed 10 meters in front of the existing berth have been added for evaluation. Based on the comparative evaluation of structural adaptability, suitability for subsoil conditions, durability, the construction method, the construction period and the overall cost, steel pipe sheet pile walls are recommended for the north and south sides of the new container berth structure as shown below:

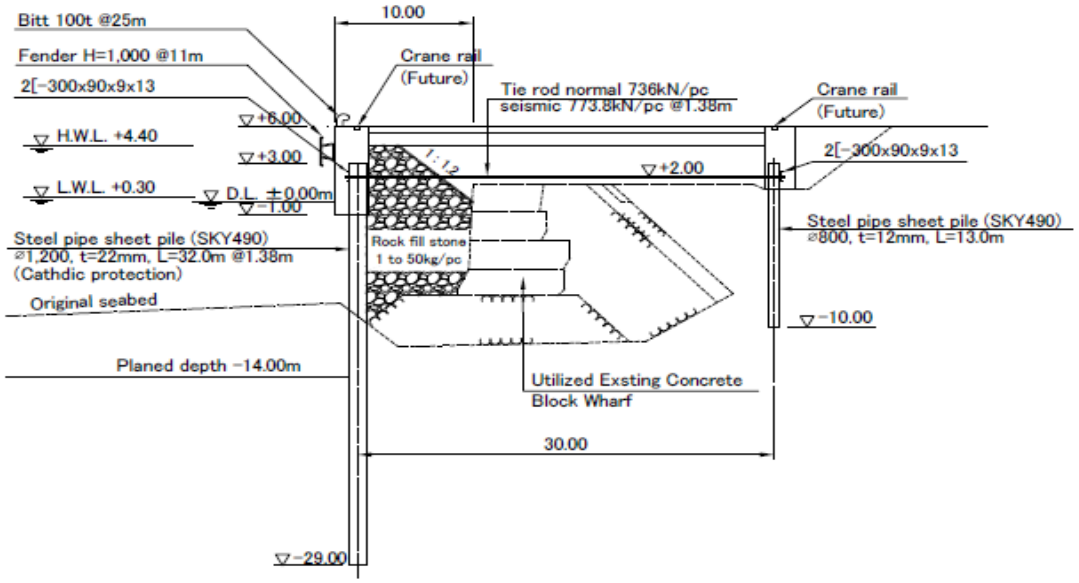


Figure 4.5-1 Steel pipe sheet pile at north side (10m widening)

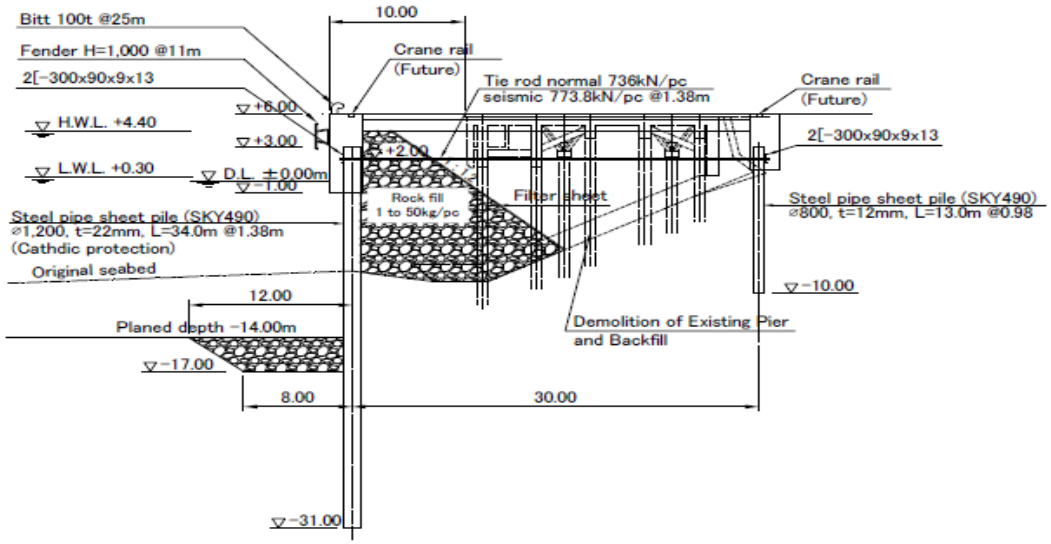


Figure 4.5-2 Steel pipe sheet pile at south side (10m widening)

(2) Rehabilitation of South Wharf

An appropriate fender system along the South Wharf is recommended for minimization of impacts from docking ships of 50,000DWT. Rubber fenders of the cylinder type, which bears 320 kN-m of berthing energy, are installed at 12- m intervals.

(3) Rehabilitation of oil terminal

The present structure of Oil Terminal is assessed through analysis of structure dynamics to be structurally stable. Based on the analysis, rehabilitation of Oil Terminal is to be conducted for the facilities below:

- Coping concrete to be renovated; demolition of cap concrete and installation of the new coping
- Fenders bearing 50,000DWT tankers' berthing energy to be newly installed
- Bollards bearing 1,000 kN by 50,000DWT tankers to be newly installed

(4) Road and pavement

1) Causeway and revetment

As a result of calculation of in-situ wave height at the location of the causeway, 1.3 m of wave height is obtained at the location. A typical cross section of causeway and revetment is shown below is recommended.

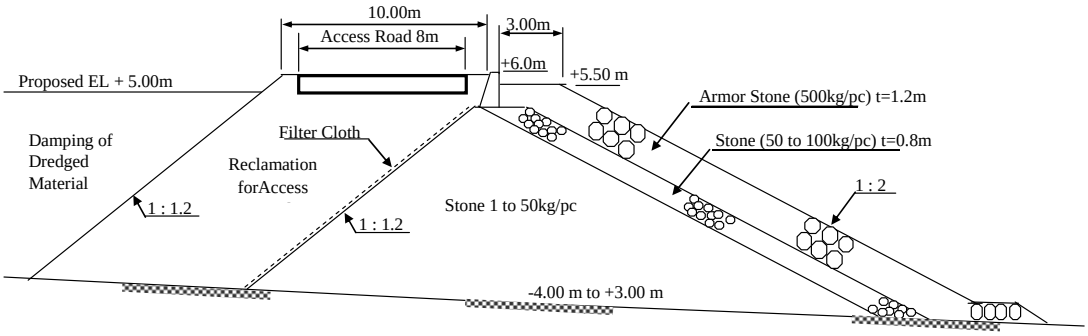


Figure 4.5-3 Typical cross section of revetment of access road

2) Pavements

Pavements in the Project are of reinforced concrete to bear loads of heavy cargo handling equipment newly introduced such as RTGs, reach stackers, etc. Considering the present subgrade conditions for the pavements of the container yards and RTGs' runways, stabilization with cement are applied to the base courses. In terms of the by-pass road, reinforced concrete pavements are applied with cement stabilization of the subgrades on the filled up ground newly constructed.

(5) Railways

The new railways in the project are laid in the reclaimed land and concrete pavements, and the following two types of tracks are proposed.

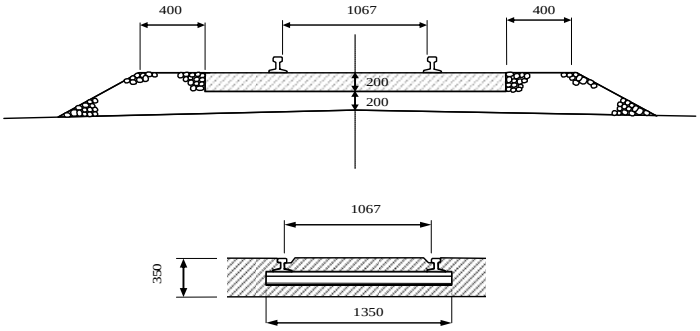


Figure 4.5-4 Typical cross sections of tracks

4.6. Construction plan

4.6.1 Construction plan of Part-1

(1) Scope of work

The scope of work of Part-1 is as follows;

i) Bypass access road
ii) Installation of fenders
iii) Foundation of RTG's
iv) Widening of entrance road

v) Gate construction
vi) Pavement of road in the port
vii) Pavement of apron
viii) Procurement of equipment

(2) Important scope of work in Part-1

1) Bypass access road

Since the road will be constructed on the coast, the revetment works will be needed before the road construction works. Estimated total volume of rubble and armor stone deposition for the revetment is around 64,000m^3; it will be executed by using a barge with a crane. Estimated total volume of backfill for the road works is around 52,000 m3. One-way backfilling work will be executed from the landside to the South Wharf.

2) Pavement of apron at the northeast side of the North Wharf

The northeast side of the North Wharf is used for oil terminals; therefore, the use of fire is strictly prohibited in this area. Accordingly, machines or work such as concrete breaking, which may cause a fire or an explosion, are not permitted for use in this area while an oil or gas tanker is berthed at the wharf. Therefore, it is necessary to relocate the oil handling function to the southwest side of the North Wharf temporarily for the duration of the construction. This scope of works includes the demolition of the existing structures/pavement, excavation, concrete pavement, coping concrete, installation of fenders, etc. All works should be finished within 2 months as soon as possible to mitigate the hindrance of the operation of the oil terminal.

4.6.2 Construction plan of Part-2

(1) Scope of work

The scope of work of Part-2 is as follows;

i) Landfill and leveling
ii) Track works
iii) Ground leveling of bulk yard
iv) Repair of yard and road pavement
v) Rail container terminal
vi) Container yard pavement at the North Wharf
vii) Reconstruction of the North Wharf
viii) Dredging (-14 m)
ix) Procurement of equipment

(2) Important scope of work in Part-2

1) Reconstruction of the North Wharf

The southwest side of the existing berth in the North Wharf will be demolished and a new berth will be constructed by the steel pipe sheet pile method. Furthermore, a new container yard will be constructed behind the new berth.

2) Dredging (-14 m)

Dredging works will be carried out by a grab dredger up to the elevation of -14 m in the area in front of the new container berth. However, the bottom soil that will be dredged includes pollution. Therefore, it is necessary to study appropriate countermeasures according to the environmental regulations to prevent diffusion of the pollution into seawater. Dredged material will be transported by barge to the landfill yard enclosed by the bypass road.

4.6.3 Countermeasures for mitigating the hindrance of port operation by the construction

(1) Temporary construction road

Prior to the construction, a temporary construction road and gate will be constructed between the existing road located on the east side of the entrance road of the Port and the east side of the CDN office in the Port. Since all trucks and vehicles related to the construction will not pass through the gate of the Port or the entrance road, regular port operations will not be affected.

(2) Construction at sea

Before construction, the transportation routes of the barges on the sea near the Port will be decided through discussions between the contractor and the related persons in the Port. The working area will be marked by buoys. In addition, a safety patrol boat will be arranged to prevent accidents.

(3) Construction in the Port

Before construction, a meeting will be held between the contractor and related persons in the Port to discuss mitigation methods to avoid hindering regular port operations. Suitable actions, such as partial execution, specifying the execution areas and employment of a safety guard will be required.

4.7. Estimation of capital cost

The estimated result is shown in Table 4.7-1.

Table 4.7-1 Cost estimation

Items	Cost Estimation (USD)
Part 1	**69,678,000**
Facilities	**57,561,000**
Mobilization & Temporary works	2,325,000
By-pass Access Road	32,338,000
Installation of Fenders	5,176,000
Foundation of RTG's	3,647,000
Widening of Entrance Road	450,000
Gate Construction	2,287,000
Pavement of Road in the Port	410,000
Pavement of Apron	5,521,000
Loading & unloading arm for liquid	3,932,000
Firefighting System	1,475,000
Equipment	**12,117,000**
Reach Stacker*4	4,215,000
Yard Chassis*12	3,951,000
RTG*2	3,951,000
Part 2	**160,911,000**
Facilities	**150,637,000**
Mobilization & Temporary works	1,162,000
Dredging, Landfill & Ground Leveling	25,413,000
Construction of Rail Track	1,234,000
Ground Leveling	195,000
Repair of Yard and Road Pavement	702,000
Rail Container Terminal	2,041,000
Container Yard Pavement	16,350,000
Reconstruction of Wharf	99,137,000
Environment Consideration Work	4,403,000
Equipment	**10,274,000**
RTG*3	5,927,000
Mobile Crane*1	4,347,000
Engineering Fee	**16,395,000**
(Subtotal)	246,984,000
Physical Contingency	**12,349,000**
Total Cost Estimation	**259,333,000**

1) Cost estimation was made based on the data as of January 2011.
2) Exchange rate: 1USD = 88.79JPY = 33.19MZN (The average rate in 2010)
3) Price escalation: Included
4) Physical contingency: 5% of the sub-total amount shown in Table 4.7-1
5) TAX: Import duties and VAT are excluded in the estimation.
6) Engineering fee: All the necessary costs for the detailed design, tender assistance and supervision of construction are included in the engineering fee.

4.8. Implementation schedule

The implementation schedule covering the preparatory stage of the project and construction stage has been prepared based on the construction plan and also taking into consideration the time required for the EIA approval, arrangement of finance, selection of consultant, contract bidding and approval of the contract by financing agencies. Milestones of the project implementation are as follows:

- Completion of the feasibility study; June 2011
- EIA approval; August 2011

- Completion of financial arrangements; March 2012
- Selection of consultant; August 2012
- Detail design; Start, September 2012, Completion, August 2013
- Contract procedure for Part-1; Start, October 2012, Completion, December 2013
- Contract procedure for Part-2; Start, February 2012, Completion, March 2014
- Construction work Part-1; Start, January 2014, Completion, April 2015
- Construction work Part-2; Start, March 2014, Completion, May 2016

4.9. Project packages

The construction sites of Part-1 and Part-2 are at different locations, i.e., at the South and the North wharves, respectively. Therefore, Part-1 and 2 can be implemented independently from each other. In addition, the facilities to be completed in Part-1 should be turned over to the owner of the facilities unless it is necessary to wait for the completion of Part-2 components. Therefore, it is recommended to implement the project in two packages, namely, Part-1 and Part-2.

The project can also be implemented in three packages by packaging the procurement and installation of equipment. However, in such case, careful coordination among the three packages is very important to avoid interruptions of construction that may occur during the installation of the equipment.

4.10. Economic analysis

4.10.1 Economic feasibility of the Project

The feasibility of the Project is evaluated using a Cost Benefit Analysis (CBA) method from the viewpoint of socio-economics for Mozambique. Calculation of net benefit and EIRR is shown in Table 4.10-1 below. EIRR is given as 13.50%. The present value of benefits amounts to USD 268,579,000.

Table 4.10-1 Calculation of net benefit and EIRR

(unit: '000 USD)

		Costs	Benefits					Net Benefit
			Saving of interest on container cargoes	Saving of inland transportation costs (containers)	Saving of inland transportation costs (bulk)	Securing profit from tranship containers	Total	
1	2012	2,969	0	0	0	0	0	-2,969
2	2013	3,235	0	0	0	0	0	-3,235
3	2014	78,378	0	0	0	0	0	-78,378
4	2015	101,593	0	0	0	0	0	-101,593
5	2016	27,825	560	6,794	6,921	41	14,316	-13,509
6	2017	7,358	605	10,387	8,490	50	19,531	12,173
7	2018	7,389	650	13,979	10,058	59	24,746	17,357
8	2019	7,419	695	17,572	11,626	68	29,961	22,542
9	2020	7,460	740	21,165	13,195	77	35,176	27,716
10	2021	7,513	860	31,256	13,917	94	46,127	38,614
11	2022	7,528	897	34,388	13,819	100	49,205	41,676
12	2023	7,529	897	34,388	13,722	100	49,107	41,578
13	2024	13,174	897	34,388	13,630	100	49,015	35,842
14	2025	7,531	897	34,388	14,048	100	49,433	41,903
15	2026	7,533	897	34,388	14,962	100	50,347	42,814
16	2027	7,535	897	34,388	15,876	100	51,261	43,726
17	2028	7,537	897	34,388	16,789	100	52,175	44,637
18	2029	18,122	897	34,388	17,703	100	53,088	34,966
19	2030	15,470	897	34,438	18,617	100	54,052	38,582
20	2031	7,534	897	34,438	19,200	100	54,636	47,101
21	2032	7,534	897	34,438	19,200	100	54,636	47,101
22	2033	7,534	897	34,438	19,200	100	54,636	47,101
23	2034	13,178	897	34,438	19,200	100	54,636	41,457
24	2035	7,534	897	34,438	19,200	100	54,636	47,101
25	2036	7,534	897	34,438	19,200	100	54,636	47,101
26	2037	7,534	897	34,438	19,200	100	54,636	47,101
27	2038	7,534	897	34,438	19,200	100	54,636	47,101
28	2039	7,534	897	34,438	19,200	100	54,636	47,101
29	2040	13,355	897	34,438	19,200	100	54,636	41,281
30	2041	7,534	897	34,438	19,200	100	54,636	47,101
31	2042	7,534	897	34,438	19,200	100	54,636	47,101
32	2043	7,534	897	34,438	19,200	100	54,636	47,101
33	2044	23,761	897	34,438	19,200	100	54,636	30,874
34	2045	15,471	897	34,438	19,200	100	54,636	39,164
35	2046	7,534	897	34,438	19,200	100	54,636	47,101
36	2047	7,534	897	34,438	19,200	100	54,636	47,101
37	2048	7,534	897	34,438	19,200	100	54,636	47,101
38	2049	7,534	897	34,438	19,200	100	54,636	47,101
39	2050	7,534	897	34,438	19,200	100	54,636	47,101
40	2051	7,534	897	34,438	19,200	100	54,636	47,101
Total		536,945	31,009	1,133,902	606,575	3,403	1,774,888	1,237,943

EIRR	**13.50%**
Present value of benefits at 10.00% discount rate ('000 USD)	**268,579**

Source: Study Team

For the sensitivity analysis, following factors are considered as the hidden risk in the Project.

- Case A : Initial investment costs overrun by 10%
- Case B : Lower benefits by 10%

- Case C : Initial investment costs (+10%) + Benefits (-10%)

Result of the EIRR calculations for the cases above is shown in the Table 4.10-2. It is commonly understood among the funding agencies that 10% to 12% would be the threshold of EIRR applicable to the infrastructure projects in developing countries. As the EIRR calculated above exceeds that rate level in every case, the Project is deemed to be economically viable.

Table 4.10-2 EIRR of sensitivity analysis

Basic case		13.50%
Case A	Initial investment costs (+10%)	12.47%
Case B	Benefits (-10%)	12.14%
Case C	Benefits (-10%) + Initial investment cost (+10%)	11.17%

Source: Study Team

4.10.2 Impact of the Project on the regional economy of southern Africa

When the Project is regarded as a multi-national infrastructure development project, it is expected to generate some benefits beyond national borders. The Study Team evaluates the amount of those benefits from a multi-national viewpoint. The result of evaluation indicates that the present value of benefits amounts to USD 70,843,000, which is 26.3% of the same of Mozambique.

4.11. Financial plan

4.11.1 Debt sustainability of Mozambique

According to the assessment by IMF, Mozambique is expected to continue to face a low risk of debt distress, its external debt levels are expected to remain below their indicative thresholds for debt distress. The increase of external debt through the implementation of the Urgent Rehabilitation Project in Nacala Port is expected to remain within the margin of the indicative thresholds. The Project is expected to increase exports and GDP minimizing negative impacts on the country's debt sustainability mainly through:

- Promotion of export from Nacala SEZ;
- Promotion of export of agricultural products from the Northern Provinces;
- Promotion of export of forestry products from the Northern Provinces; and
- Promotion of the logistics industry related to the Port and the Corridor.

However, it should be noted that the scale of the Project is not very small considering the scale of the country's GDP, and that if the Port fails to improve operational efficiency and to materialize abovementioned outcomes, the negative impact of the Project on the debt sustainability would not be negligible. Therefore, it is important that the Government be making its utmost effort to intensify the competitiveness of the Port, and continuously monitor the operational efficiency of the concessionaire of the Port.

4.11.2 Financial plan of executing agencies

(1) Potential lenders

The potential financial resources required for PMB to invest in the Project are supposed as those from the GOM, MTC, multi-lateral financial institutes including AfDB and bi-lateral financial institutes including JICA. For TOC, the potential financing institutions for the Project will be commercial banks.

1) Yen Loan

Terms and conditions of Yen Loans, as of November 2010, are shown in the table below. Effective from 1 April 2010, for Interest-free Approximation cases, the interest rate is 0.01%, and the repayment period and grace period are 40 years and 10 years, respectively. Interest during construction is included in the Yen Loan. The terms and conditions of the Yen Loan are also applicable to a consultancy fee of the detailed design of the Project.

Table 4.11-1 Terms and conditions of Yen loans

Category	GNI per Capita (2008)		Standard/ Option	Interest Rate (%)	Repayment Period (Yr)	Grace Period (Yr)	Conditions for Procurement
LDC	Under US$975	Interest-free Approximaton		0.01	40	10	Untied

Source: JICA

2) AfDB Loan

The currency of AfDB Loan is USD, EUR, Yen and ZAR. A variable interest rate for a sovereign guaranteed loan uploaded on 1 August 2010 is summarized in the table below.

Table 4.11-2 Lending rate for sovereign guarantee loan of AfDB

Variable Spread Loans (VSL) and Enhanced Variable Spread Loans (EVSL)	Loans approved before 4-May-2005 & loans approved after 21-Jan.-2009				
	(1-Aug.-2010 to 31-Jan.-2011)			(1-Aug.-10 to 31-Jan.-11)	(1-Nov.-10 to 31-Jan.-11)
	USD	EUR	YEN	ZAR	
Floating Base Rate (a)	0.678%	1.145%	0.441%	6.705% ***	6.585% **
Funding Margin [benefit (-)/cost (+)] (b)	0.060%	0.000%	0.000%	-0.240%	-0.240%
* Lending Spread (c)	0.400%	0.400%	0.400%	0.400%	0.400%
Applicable Lending Rate (a+b+c)	**1.138%**	**1.545%**	**0.841%**	**6.865%**	**6.745%**

Source: AfDB

In case of an application for a variable interest rate, the interest rate is a total of Floating Base Rate, Funding Margin and Lending Spread. The repayment period and grace period are 20 years and 5 years, respectively. A borrower (Mozambique side) generally has a burden of 10% of a project cost, excluding tax such as VAT, but a reduction of the percentage is negotiable.

3) Commercial bank loan

The potential lender for TOC is assumed as commercial banks and investors. According to the financial department of CDN, the average interest rate of commercial banks is 10% for long-term loans (US$) and the average repayment period is 10 years for capital investments, such as the purchasing of equipment.

4.12. Financial analysis

4.12.1 FIRR of the Project

(1) Premise for financial analysis of the Project

1) Project life

Considering the service life of the port facilities, the project life in the financial analysis is assumed to be 40 years from the year 2012. Neither inflation nor an increase in nominal wages is considered during the operation period of the Project's life. All costs and revenues are indicated as of 2010, when the price survey was conducted (US$ 1.00= MT 33.19).

2) Conditions of fund raising

The Study Team assumes the Urgent Rehabilitation Project will be funded by a loan syndication

of bilateral financial agencies such as the Yen Loan of JICA and a multilateral financial agency such as AfDB Loan. Regarding renewal equipment, it is assumed that TOC obtains financing from commercial banks to procure renewal equipment at the time of its expiry.

A weighted average cost of capital on the Project, which also includes an investment cost of renewal equipment, is calculated as 2.3%.

(2) Results in base case and sensitivity analysis

The result of FIRR, based on premises mentioned above, is 12.8% and Net Present Value is 674 million USD; under weighted average cost of capital on the Project: 2.3%.

Resulting FIRRs in Cases A (initial investment cost increases by 10%), Case B (demand decreases by 10%) and Case C (Case A & B) in the above sensitivity analyses are shown in the table below.

Table 4.12-1 FIRR of sensitivity analysis

Threshold level	Case A	Case B	Case C
2.3 %	11.7%	11.9%	10.8%

Source: Study Team

The resulting FIRR is 12.8% above the weighted average capital cost of the Project. In addition, even in sensitivity analyses, all of the cases substantially exceed the weighted average cost of capital. Thus, the project itself is judged financially viable.

4.12.2 Financial soundness of the executing agency

PMB implements all the initial investment of the Urgent Rehabilitation Project and receives concession fees from TOC for repayment of the loan. Revenue of PMB in the Project is only concession fees. TOC operates container and bulk terminals after the Urgent Rehabilitation Project completes and earns revenues from pilotage, towage and berthing etc., for vessels, and stevedoring to/from vessel, handling and cargo storage at yard. Regarding equipment which will expire, TOC will procure new equipment to avoid a decrease in profitability.

(1) Additional premise used in the financial model

1) Concession fee

The Study Team gave due consideration to the following matters regarding concession fees;

- TOC pays a fixed fee to PMB as a lease fee of facilities and equipment of the Urgent Rehabilitation Project. The fee is assumed to be US$ 8.6 million per annum from 2016 to 2051 (year one is a grace period).
- TOC also pays variable fee to PMB every year. The amount will be subject to share of TOC's revenue as follows;
  - 15% of gross annual returns during years one to five,
  - 20% of gross annual returns during years six to ten,
  - 25% of gross annual returns from year eleven to end of concession period.

The main reason for the high percentage of the concession variable fee is that the initial investment is assumed to be executed by PMB without any private partnership, so the variable fee is a counter value for PMB who takes the risk of initial investment.

2) Debt for capital cost of PMB

Main conditions of the loans (joint financing and national bank) are assumed and summarized as follows.

- Loan condition (joint financing and national bank)

Amount : 90% of joint financing and 10 of national bank, of the Project cost
Loan period : 30 years, including a grace period of 5 years

Interest rate : 1.1%
Repayment : Fixed amount repayment of principal

3) Debt for capital cost of TOC

For TOC's fund raising, renewal equipment investment is assumed to be raised by domestic fund. Condition of loan is assumed as follows.

- Domestic fund

Amount : 100% of renewal equipment investment
Loan period : 10 years
Interest rate : 10.0%
Repayment : Fixed amount repayment of principal
Income tax : 32%

(2) Financial soundness of each entity

1) FIRR and NPV

As a base case, FIRR and NPV are evaluated under our forecast demand, and the results are shown in the table below.

Concession fee is set at US$ 8.6 million/year (fixed fee) and variable fee is 15~25% of CDN's revenue, taking both financial conditions into account.

Table 4.12-2 FIRR and NPV of the urgent rehabilitation project

	Threshold level	Base case	Case A	Case B	Case C
FIRR: PMB	*1.1 %*	6.1%	5.8%	6.0%	5.6%
NPV: PMB	---	US$ 316 mil.	US$ 315 mil.	US$ 310 mil.	US$ 309 mil.
NPV: TOC	---	US$ 193 mil.	US$ 180 mil.	US$ 170 mil.	US$ 158 mil.

Note: FIRR of TOC, unavailable for a little cash-out on the initial stage of investment
Source: Study Team

The resulting FIRR of PMB on Base Case and sensitivity analysis exceeds the interest rate of the loan as threshold level. In addition, NPV of PMB and TOC also shows positive results.

2) Financial soundness

As to the cash flow, PMB has cash shortages of about US$ 0.2~0.5 million/year up to 2014 as indicated in the below table, the shortages from 2012 to 2014 are caused by running costs for the project preparation and implementation. It is assessed that PMB has the capacity to bear the expense based on revenue information of CFM.

Table 4.12-3 Statement of cash flow of PMB from 2012 to 2020

Statement of Cash Flows ($'000s) of PMB	2012	2013	2014	2015	2016	2017	2018	2019	2020
Cash Beginning	0	(157)	(314)	(770)	808	5,546	4,206	3,813	4,322
Cash Inflow	2,759	3,160	139,396	97,328	34,134	12,066	12,896	13,682	17,163
CASH FLOWS FROM OPERATING ACTIVITIES	(157)	(157)	(456)	1,578	11,485	12,066	12,896	13,682	17,163
Operating Income	(157)	(157)	(1,726)	(6,541)	3,366	3,947	4,777	5,563	9,044
[Total No cash Items included in Net Income (Depreciation)]	0	0	1,270	8,119	8,119	8,119	8,119	8,119	8,119
CASH FLOWS FROM FINANCING ACTIVITIES	2,916	3,317	139,852	95,750	22,649	0	0	0	0
Cash Outflow	2,916	3,317	139,852	95,750	29,396	13,406	13,289	13,173	13,056
CASH FLOWS FROM INVESTING ACTIVITIES	2,916	3,317	139,852	95,750	22,649	0	0	0	0
CASH FLOWS FROM FINANCING ACTIVITIES	0	0	0	0	6,746	13,406	13,289	13,173	13,056
Cash Inflow - Cash Outflow	**(157)**	**(157)**	**(456)**	**1,578**	4,738	(1,340)	(394)	509	4,107
Cash Ending	(157)	(314)	(770)	808	5,546	4,206	3,813	4,322	8,429

Source: Study Team

On the other hand, TOC will have profits from the first year of operation of the urgent rehabilitation project with new facilities and equipment because of the first year's grace period.

3) Conclusions

Thus, both of PMB and TOC are judged financially viable under the said conditions of concession fixed and variable fee.

4.12.3 Financial impact of the project on railway operation

Vale Mozambique has a plan to rehabilitate the railway and to construct a new port terminal for coal mining. The plan will decrease the financial burden of the railway sector for CDN, so it is expected to enable them to focus on railway operations for container and bulk cargo.

(1) Result and evaluation

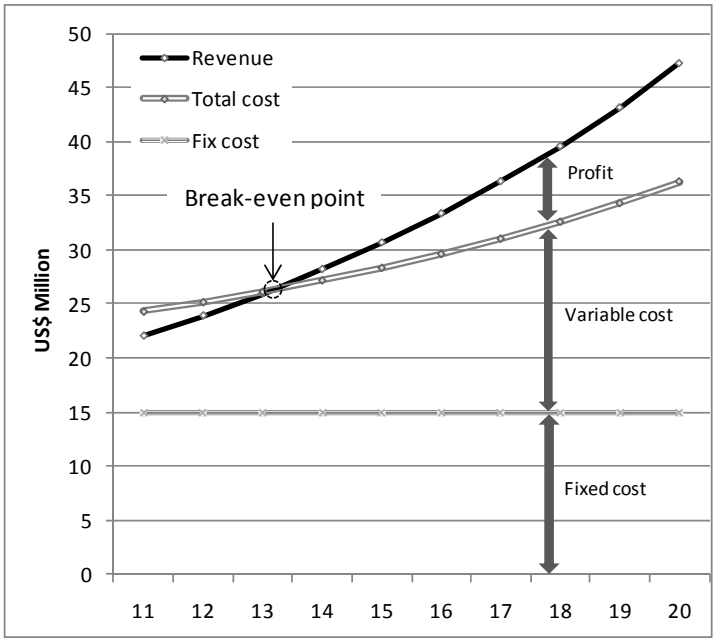
Based on the analysis, the following unit rates are determined as component of the business structure of railway operation, and will be applied to the calculation of revenue and cost for future activities.

Table 4.12-4 Unit revenue and cost of railway operation

Bulk cargo:	Revenue (to border)	52.5 US$/Ton
	Revenue (from border)	24.0 US$/Ton
	Variable Cost (concession variable fee, to border)	5.3 US$/Ton
	Variable Cost (concession variable fee, from border)	2.4 US$/Ton
	Variable Cost (fuel)	12.0 US$/Ton
Container cargo:	Revenue (full container, to border)	779.0 US$/TEU
	Revenue (full container, from border)	440.6 US$/TEU
	Revenue (empty container, to border)	319.0 US$/TEU
	Revenue (empty container, from border)	161.0 US$/TEU
	Variable Cost (concession variable fee, full container, to border)	77.9 US$/Ton
	Variable Cost (concession variable fee, full container, from border)	44.1 US$/Ton
	Variable Cost (concession variable fee, empty container, to border)	31.9 US$/Ton
	Variable Cost (concession variable fee, empty container, from border)	16.1 US$/Ton
	Variable Cost (fuel, full container)	161.0 US$/TEU
	Variable Cost (fuel, empty container)	80.0 US$/TEU
Fixed Cost	(including locomotive/wagon, personnel, concession fixed, maintenance and incidentals)	14.9 US$ million

Source: Study Team

Using the numbers in the unit revenue and cost, break-even analysis is shown in the below figure. As shown in the figure, revenue of the break-even point is about US$ 26 million in 2013 under the forecasted cargo volume.



Source: Study Team

Figure 4.12-1 Break-even analysis of railway operation

4.13. Evaluation of environmental and social impacts

Tables 4.13-1 and 4.13-2 show the planned/recommended countermeasures and responsible implementing entities for each impact expected during the construction and operation phases respectively.

Table 4.13-1 Potential environmental impacts and planned/recommended countermeasures (construction phase)

Category		Potential impact	Countermeasure	Responsible entity
Social environment	Fisheries	Temporary reduction in fish catch as marine construction works (e.g. dredging) could degrade the local water quality.	• Implementation of sediment dispersion minimization measures (see countermeasures of seawater quality).	• Construction contractor
			• Holding of regular meetings with local fishermen to discuss of any adverse impacts.	• Project proponent
	Public health	Spreading of communicable diseases due to influx of construction workers.	• Implementation of regular health checks and education programs.	• Construction contractor
Natural environment	Ecosystem	Degradation of ecosystem due to: • Resuspension/dispersal of bottom sediment (including contaminated sediments) during dredging • Inappropriate disposal of contaminated dredge spoil	<u>Sediment dispersal</u> • Implementation of sediment dispersion minimization measures (see countermeasures of seawater quality). <u>Dredge spoil</u> • Disposal of contaminated dredge spoil in a confined disposal facility.	• Construction contractor
Physical environment	Air quality	Deterioration of air quality due to fugitive dust and exhaust emissions from construction trucks.	• Use of well maintained trucks and implementation of regular vehicle maintenance • Covering of loading space with sheet cover to minimize dust spills	• Construction contractor

Category		Potential impact	Countermeasure	Responsible entity
	Noise	Increase in noise levels due to pile-driving works and construction trucks.	Pile driving • Use of hydraulic pile-driver or pile-driver with equivalent noise level Construction trucks • Use of well maintained trucks and implementation of regular vehicle maintenance • Strict abidance of speed limit and avoidance of unnecessary revving • Avoidance of night-time travelling whenever possible	• Construction contractor
	Seawater quality	Deterioration of seawater quality due to resuspension/dispersion of sediments (including contaminated sediments) through dredging works.	• Installation of silt curtains around the dredging site. • Use of dredger with frame-type silt curtain. • Use of enclosed-type grab bucket. • Implementation of water quality monitoring.	• Construction contractor
	Groundwater quality	Contamination of groundwater due to seepage from disposed contaminated dredge spoil.	• Disposal of contaminated dredge spoil in a confined disposal facility.	• Construction contractor
	Sediment quality	Deterioration of sediment quality due to resuspension/dispersion of contaminated sediments through dredging works.	• Implementation of sediment dispersion minimization measures (see countermeasures of seawater quality).	• Construction contractor
	Waste	Generation of following type of wastes: • Dredge spoil • Construction/demolition wastes • Human waste • Oily waste	Dredge spoil • Disposal of contaminated dredge spoil in a confined disposal facility. • Monitoring of effluent water quality from the confined disposal facility. • Use as landfill material of new stockyard (for non- contaminated dredge spoil) Construction/demolition wastes • Use as landfill material of new stockyard • Recycle Human waste • Installation of temporary toilets at construction sites. Oily waste • Collection/treatment by local contractor. • Reuse (e.g. lubricant).	• Construction contractor
	Accident	Increase in the risk of maritime and road accidents.	Maritime accident • Clear indication of construction zones • Prior notification to ships regarding the construction works • Priority should be given to shipping (e.g. stoppage of construction activities during departure/arrival of ships)	• Port and construction contractor
			Road accident • Notification of truck drivers of high risk areas • Strict compliance with speed limit	• Construction contractor

Source: Study Team

Table 4.13-2 Potential environmental impacts and planned/recommended countermeasures (operation phase)

Category		Potential impact	Countermeasure	Responsible entity
Social environment	Fisheries	Restriction of fishing activities due to increase in shipping traffic.	• Holding of regular meetings with local fishermen to discuss any adverse impacts.	• Project proponent
Natural environment	Ecosystem	Introduction of invasive species through ship ballast water.	• Encourage ships to exchange ballast water in offshore water or conduct onboard treatment of ballast water.	• Port and ship owner
Physical environment	Air quality	Deterioration of air quality due to: • Exhaust emissions of cargo trucks • Fugitive dust emission from bulk cargo handling and stockyard	Exhaust emission • Implementation of regular maintenance • Renewal or retrofit of old cargo trucks to less polluting trucks	• Port and truck owner
			Fugitive dust emission • Use of hopper with dust minimization devices. • Installation of dust suppression net at stockyard. • Tree plantation at stockyard • Water spraying	• Port
	Noise	Increase in noise levels due to increase in cargo trucks.	• Implementation of regular maintenance. • Renewal or retrofit of old cargo trucks to less noisy trucks. • Strict abidance of speed limit and avoidance of unnecessary revving.	• Port and truck owner
	Seawater quality	Deterioration of seawater quality due to: • Seepage from disposed contaminated dredge spoil • Rainwater runoff from the stockyard	Dredge spoil • Disposal of contaminated dredge spoil in a confined disposal facility.	• Construction contractor
			Rainwater runoff • Installation of drainage and treatment system (e.g. sedimentation pond) at the stockyard.	• Port
	Groundwater quality	Contamination of groundwater due to seepage from disposed contaminated dredge spoil and stockyard.	Dredge spoil • Disposal of contaminated dredge spoil in a confined disposal facility.	• Construction contractor
			Stockyard • Pavement of stockyard with impermeable material.	• Port
	Sediment quality	Contamination of sediment through leaching of pollutants (e.g. TBT) from ship anti-fouling paint.	• Encourage ships to refrain the use of harmful anti-fouling paint.	• Port and ship owner
	Accident	Increase in the risk of maritime and road accidents.	Maritime accident • Reinforcement of current tug boat fleet. • Prohibition of berthing during extreme weather conditions.	• Port

Category		Potential impact	Countermeasure	Responsible entity
			• Preparation of accident contingency plan including oil spill response plan.	
			Road accident • Notification of truck drivers of high risk areas. • Strict abidance of speed limits. • Installation of road mirror or traffic light at the intersection of the new and existing access roads.	• Port and truck owner

Source: Study Team

4.14. Operational and managerial improvement

4.14.1 Port administration framework in Mozambique

The Study Team would like to recommend that:

- Considering the vital importance of Mozambican ports in the development of the country's economy, the role of the Government (MTC and CFM) shall be intensified.
- In this context, the Government should:
  - Establish a law on ports which prescribes basic principals on administration, management, development and planning of ports.
  - Establish the comprehensive port policy aiming at intensifying competitiveness of Mozambican ports.
- Based on the principals and a procedure prescribed by the law on ports including consultation with stakeholders, legally binding plan for Nacala Port development shall be established, which regulates the use of land and basin aiming at their rational and effective utilization.
- In accordance with the principals prescribed by the law on ports and the comprehensive port policy, the revised scheme of ownership and operation of Nacala Port shall be prepared aiming at promoting competition among private operators and securing the public interest.
- In accordance with the principals prescribed by the law on ports and the comprehensive port policy, and paying due attention to debt sustainability, the public investment in port development projects, which is urgently required for the development of the country's economy, shall be secured.

4.14.2 Financial scheme of the operation in Nacala Port

(1) Scheme of concession fee

After expiry of the current concession agreement, TOC and GOM including PMB will enter a new concession agreement of the Port. TOC pays the following fixed and variable concession fees:

Table 4.14-1 Summary of concession fees of the Port

Status of Concession	Portion	Year				
		2010 ~ 2014	2015	2016 ~ 2019	2020 ~ 2024	2025 ~ 2051
Current	Fixed	US$ 1.5 million	US$ 2.0 million		---	---
	Varible	12.50%	15.00%		---	---
Next Phase	Fixed	---	*Grace period*	US$ 8.6 million	US$ 10.6 million	US$ 10.6 million
	Varible	---	15.00%		20.00%	25.00%
Total	Fixed	US$ 1.5 million	US$ 2.0 million	US$ 10.6 million	US$ 10.6 million	US$ 10.6 million
	Varible	12.50%	15.00%		20.00%	25.00%

Source: Study Team

(2) Cash flow control

1) Need of reserve account

PMB (CFM) has to monitor TOC's (CDN's) administration from the standpoint of a conceding authority of the project to ensure sustainable development of the port activity despite being the largest shareholder of CDN. Taking this current situation into account, it is most important to collect concession fees from TOC to avoid going overdue on the loan repayment of the project from PMB to the loan syndication. To guarantee the collection of concession fees, it is said that opening reserve accounts is an effective measure to control cash flow of a project. The account is used to cover a cash flow shortage. The new concession agreement, therefore, should stipulate that reserve accounts be opened for the payment of concession fees and maintenance expenditure.

Details of accounts and their function are shown in the below table descending in priority:

Table 4.14-2 Account details and function

Main account	
Revenue account	TOC earnings are firstly credited to revenue account. This account is the most significant and the source of cash flow for several sub-accounts. The surplus of cash flow is controlled at this account.
Sub-account	
Operation account	Operation costs such as personnel, lighting/fuel, tax and administration for present and next month is credited to this account and paid.
Concession fee account (for fixed and variable portion)	Amount of concession fixed and variable fees for the coming date of payment is credited to this account and paid to PMB. In case of semi-annual payments, one-sixth of the fee amount is reserved per month till the coming date of payment. It is set aside as an appropriation for the concession fess in advance. It can have separate accounts for the fixed and variable.
Concession fee reserve account	This reserve account is to avoid an overdue payment due to a short-term cash shortage. The reserved amount is generally equivalent to one payment.
Major maintenance reserve account	1% of civil work cost and 2% of equipment procurement cost is reserved in this account to repair, rehabilitate and maintain the facilities and equipment.
Distribution account	This amount is at the bottom of the sub-accounts. Dividend is paid from this account.

Source: Project Finance – a risk-control business -, edited by the Study Team

4.14.3 Technical improvement of port operation

(1) Terminal gate operation

First of all the separation of gates by cargo type and the increase of number of lanes are important as discussed in the previous chapter.

At the container terminal, the gate operation shall be fully computerized. The system must be connected with the terminal operation system and the customs clearance system. TV camera system should be installed to streamline damage check of containers. A maximum waiting time of 30 minutes in the queue at the terminal gate shall be a benchmark for the productivity improvement of gate operation.

(2) Container terminal operation

CDN is required to accumulate comprehensive knowledge of the port operation. Above all, continuous capacity building is required for CDN to reduce the time of ships' staying at the Port and

the dwell time of cargoes.

An integrated terminal operating system which covers planning, monitoring of all movements of containers, controlling gate operation, and issuing documents is required to conduct efficient container terminal operation.

Since the cause of low productivity of quay side operation is the insufficient number of reachstackers and inefficient movement of reachstackers, the operational efficiency of reachstackers shall be improved. As a 5 high RTG system will be introduced in the container stacking yard by the Urgent Rehabilitation Project, a sophisticated terminal operation system including yard planning system and skilled RTG operators are required.

(3) Port security

Enhancing port security, in a way, runs counter to efficient logistics and efficient port operation. But to conduct security measures properly gives a port a reputation for reliability and eventually increases a port's competitiveness. The port facility security measures of the Port are mainly supported by manpower; security guard. To ensure the port security, continuous capacity building is required for CDN. And education and training are also needed for the security guards.

4.14.4 Maintenance and repair of port facilities

Port facilities including those provided by the Urgent Rehabilitation Project shall be maintained in a good condition by conducting regular maintenance based on an established plan.

Especially, the monitoring of the deteriorated structure of the South Wharf is crucial for securing safety and sustainability of port operation.

It is understood that piles of the wharf are of only concrete without rebars and they are vulnerable against bending forces. Accordingly, changes of piles, i.e. surface cracks or deformation of piles, should be regularly monitored. For confirming function of the rear walls, visual inspection should be conducted in the range of the whole rear walls to identify development of the existing and new stripped concrete. For confirming stability of the anchor walls, joints between the container yard and the slab deck at six locations should be monitored every month. In addition, elevations around six anchor walls should be surveyed. For monitoring stability of the deck structure, surveys of elevations and coordinates of fixed points are proposed.

In case that any specific changes are found, detailed inspection should be made and suspension of handling operation will be required.

4.15. Operation and Effect Indicators

The definition of Operation and Effect Indicators by JBIC are as follows:

- Operation Indicator: An indicator to measure, quantitatively, the operational status of a project.
- Effect Indicator: An indicator to measure, quantitatively, the effects generated by a project.

(1) Operation Indicator

Freight volume is generally adopted as an Operation Indicator for port projects. For the Urgent Rehabilitation Project in Nacala Port, the freight volume is also valid, reliable and easy to access as an Operation Indicator. Considering characteristics of the Project, the Study Team proposes two types of freight volume as Operation Indicators:

- Annual container throughput of the dedicated container berth in the North Wharf: This indicator measures the operational status of the newly constructed container berth, which is the main component of the Project.
- Annual total cargo throughput of the berths located at the eastern shore of Nacala Bay: This indicator measures the operational status of all components of the Project.

The baseline data and the target value of the Operation Indicators are shown in Table 4.15-1.

Table 4.15-1 Baseline data and target value of the Operation Indicators

	Baseline Data (2009)	Target Value	
		2020	2030
Annual container throughput of the dedicated container berths in the North Wharf	52,620 TEUs *	210,000 TEUs	490,000 TEUs
Annual total cargo throughput of the berths located at the eastern shore of Nacala Bay	1,270,000 tons	5,000,000 tons	9,000,000 tons

Note: * Throughput of container berth in the South Wharf
Source: Study Team

(2) Effect Indicator

The purpose of the Urgent Rehabilitation Project is:

- To secure sustainability of port operation;
- To improve efficiency of port operation; and
- To consolidate foundation for the increase of port capacity in the next decade.

Considering the project purpose, the Operation Indicator listed in Table 4.15-1 can also be the principal Effect Indicator of the Project. It is commonly understood that cargo throughput can be the Effect Indicator as well as the Operation Indicator for port projects.

Besides the principal Effect Indicator, several auxiliary indicators are proposed as listed in Table 4.15-2, together with their target values.

Table 4.15-2 Baseline data and target value of the Effect Indicators

	Remark	Baseline Data (2009)	Target Value	
			2020	2030
Principal Indicators				
Annual container throughput of the dedicated container berths in the North Wharf	The indicator is affected by the regional and world's economy. The data can be provided by CDN.	52,620 TEUs	210,000 TEUs	490,000 TEUs
Annual total cargo throughput of the berths located at the eastern shore of Nacala Bay	The indicator is affected by the regional and world's economy. The data can be obtained from CFM statistics.	1,270,000 tons	5,000,000 tons	9,000,000 tons
Auxiliary Indicators				
Annual total transit container volume to/from Malawi handled in the Port	The indicator is affected by Malawian economy and performance of the Nacala Corridor. The data can be obtained from CFM statistics.	6,178 TEUs	57,000 TEUs	104,000 TEUs
Ratio of Annual total transit container throughput to/from Malawi handled in the Port to that handled in Beira	The indicator is affected by the performance of Beira Port. The data can be obtained from CFM statistics.	0.24	1.8	1.8
Annual average cargo handling volume per vessel staying time	The indicator is affected by configuration of cargo type. The data can be obtained from CFM statistics.	50.3 ton/hr	More than baseline data	More than baseline data
Annual average container handling volume per vessel staying time	The data can be obtained from CFM statistics.	6.7 TEU/hr	More than baseline data	More than baseline data
Annual average cargo handling volume per vessel-quay operation hour	The indicator is affected by configuration of cargo type. The data can be obtained from CFM statistics.	76.3 ton/hr	More than baseline data	More than baseline data
Annual average container handling volume per vessel-quay operation hour	The data can be obtained from CFM statistics.	8.2 TEU/hr	More than baseline data	More than baseline data

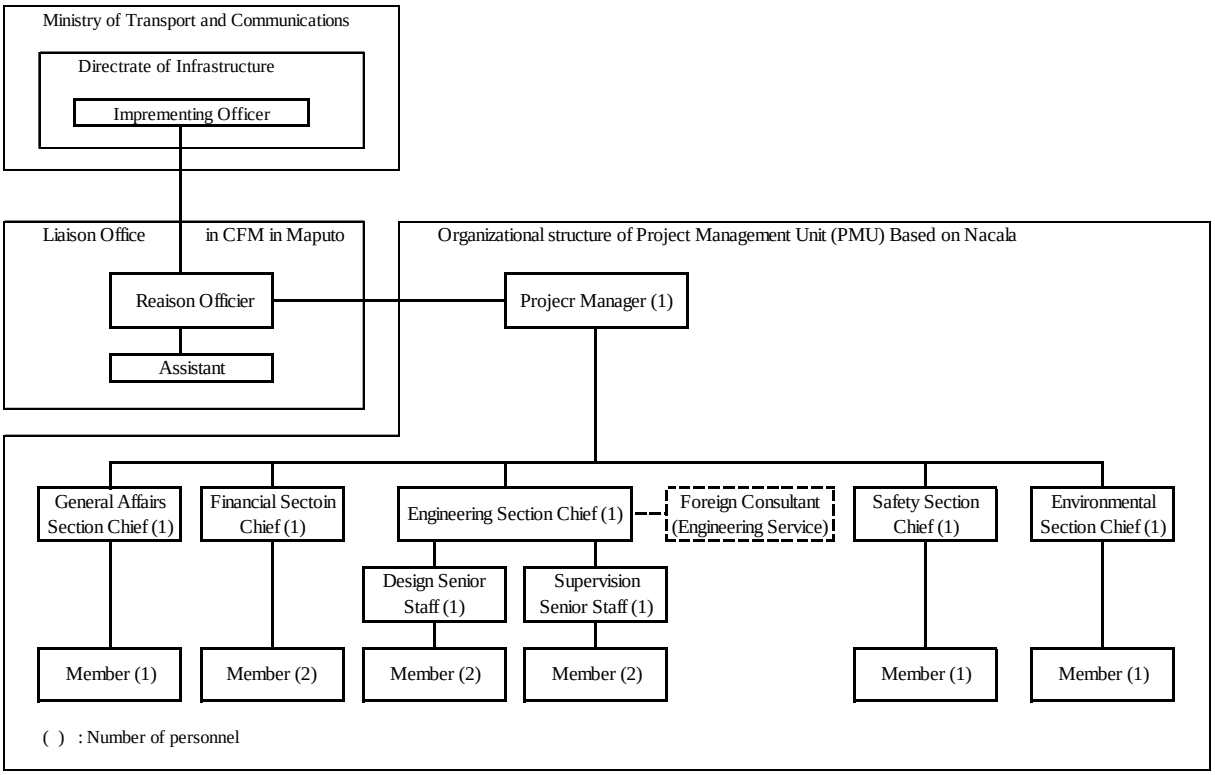
Source: Study Team

4.16. Institutional framework for the project implementation

During the implementation stage of the project, the collective work among the relevant agencies is vital. The MTC and the CFM should establish a task force for the budget arrangement, implementation of EIA, establishment of a project management unit (PMU), etc.

The PMU is a government organization established for the purpose of smooth and swift implementation of the project and, therefore, it is given the legal power by the implementing agency of the project to conclude the contract and to disburse. The PMU has the responsibility not only to supervise and monitor the progress of the project, but also to ensure the safety of the construction and to monitor the impact on the social and natural environment over the period of project implementation. To this end, the PMU should be based at Nacala. The PMU should keep in close touch with CFM and MTC, and should have a liaison office in Maputo.

The organizational structure of the PMU is shown in Figure 4.16-1: the number in the figure indicated in the parentheses shows the number of personnel of respective sections.



Source: Study Team

Figure 4.16-1 Organizational structure of PMU

5. Conclusions and recommendations

5.1. Conclusions

5.1.1 Necessity of the Urgent Rehabilitation of the container wharf of Nacala Port

With the growth of the economic activities in the Northern Provinces of Mozambique and the SEZ in the vicinity of the Port, the cargo volume of the Port has been growing. In particular, the growth of the container cargo volume is remarkable. The Study exhibited that the Port has a great potential to attract transit cargoes to and from Malawi and Zambia if the railway and highway access are improved. Thus, the Port is contributing to economic activities as the gateway of both Northern Provinces and the landlocked countries. The main cargoes loaded from the Port are containers and dry bulk cargoes, namely, clinker, grain and fertilizer. Though the volumes are comparatively small, bagged cargoes are handled, e.g., export of sugar and import of rice.

The Port has been operated by CDN under the concession contract since 2005. By the contract, CDN is responsible for the repair, maintenance, rehabilitation and reconstruction of the port infrastructures. However, due to the negligence of repair and maintenance, the wharves are in very poor condition. The South Wharf and the western part of the North Wharf are pier type structure. All the reinforced concrete piles of the pier type wharf are seriously damaged, and need repair or rather reconstruction.

In addition to the port infrastructure, there are various factors that prevent the port from achieving efficient operation. Some of those are:

- Congestion at the port entrance road
- Mixed use of the South Wharf by containers and dry bulk
- The facility layout of the Port was designed as the railway terminal and it is not suitable for transport by trucks
- The number of units of container handling equipment

It is very likely that the port will be overflowed by increasing cargoes unless proper action is taken. It is necessary to modernize and expand Nacala Port through the provision of required port facilities as well as the provision of efficient and economical cargo-handling services based on an adequate management and operation system.

5.1.2 Medium and Long-term Development Plan (target year: 2030)

(1) Zoning of port area

The port area should have separate areas to handle different types of cargoes. The South Wharf should be used for dry bulk such as grain and break bulk including vehicles, while the North Wharf should be renovated to a full container terminal. The oil terminal, which is currently situated at the north end of the North Wharf, should be relocated to a new dedicated oil terminal. The expansion of the Port should be toward the north where the configuration of the sea bed is suitable for deep water wharves. The newly developed wharf to the north of existing footprint should be used for dry bulk handling.

(2) Expansion of the container terminal

In the target year of the Master Plan, 2030, the volume of container cargoes is expected to reach 440,000 TEU including international local and transit containers, transshipment containers and domestic (cabotage) containers. The Port has to have two fully equipped container berths that can accommodate Panamax size container carriers.

The railway service will play an important role in the container transportation to and from Malawi and Zambia. The Port also has a rail container terminal for the smooth connection between the container terminal and railway.

(3) Renovation of the South Wharf to dry bulk and break bulk terminal

The existing South Wharf is seriously damaged and, therefore, container cargoes that require heavy equipment shall be removed. The South Wharf shall be renovated for the exclusive use of bulk cargoes (dry bulk and break bulk). The backup area for the bulk terminal should be expanded by reclaiming the southern part of the Port. The bypass access road and railway should be constructed for the exclusive use of bulk cargoes to prevent congestion at the main gate.

In the Long-term Plan, a new grain terminal should be constructed to cope with the increase of cargo volume. It is recommended that the new grain terminal should be constructed to the south of the existing South Wharf.

(4) New construction of dry bulk berths at the north of the Port

For the increasing volume of dry bulk other than grain, two dry bulk berths should be newly constructed to the north of the Port.

(5) Construction of a new oil and gas terminal

A fully equipped oil and gas terminal should be constructed.

5.1.3 Short-term Development Plan

The Short-term Development Plan is intended to upgrade the container cargo handling productivity. To this end, the following project components are included.

Container handling equipment
Installation of fenders at the South Wharf
Zoning of the port area
Construction of a new container berth and a container yard
Widening of port entrance road and construction of gates
Ground leveling and road system in the North Wharf
Introduction of grain unloader

5.1.4 Urgent Rehabilitation Project

Of the components listed in the Short-term Development Plan, the following components are given priority to be included in the Urgent Rehabilitation Project.

(1) Container handling equipment
(2) Installation of fenders at the South Wharf
(3) Zoning of the port area
- Bypass access roads
- Expansion of the backup area of the South Wharf.
- Additional entrance road for general cargoes.
- Pavement of apron of the North Wharf
(4) Construction of a new container berth and container yard.
(5) Widening of port entrance road and construction of gates.

5.2. Recommendations

5.2.1 Improvement of port administration

(1) Capacity building for the port administration

It is recommended to enhance the administrative capacity of the government. It was proved by the Study that Nacala Port as well as other major ports in Mozambique has great potential to serve for not only the immediate hinterland in the country but also for the adjacent landlocked countries and landlocked regions. While each major port is making efforts to attract local and international transit cargoes, the government should take proactive measures to formulate a transport network and to encourage competition among major ports in the country.

One of the possible ways to promote capacity building is to have in-house experts in MTC elaborate a strategic development plan for the port system through the cooperative work with staff of CFM. Most of the international funding agencies, including JICA, provide expert dispatch programs.

(2) Legislation for the port development plans

It will take many years to realize the Long-term Development Plan of the Port. Thus, the land and the water areas of the project sites should be reserved until the development work actually starts. It often happens that when actual development work starts the projects site is already used for other purposes. Therefore, it is recommended to authorize the development plan and to legislate against the land use for other purposes than port related businesses.

To this end, firstly MTC should establish legal procedure for the authorization of the port development plan. Secondly, MTC should draw a port development master plan taking into consideration of the Long-term Development Plan proposed in this report and authorize the master plan through the established legal procedure. In the course of the authorization of the master plan, the plan should be refined through the consultation with the agencies concerned and with the stakeholders. Once the plan is authorized and given a legal base, the use of the proposed port space, i.e., land and water areas, should be properly controlled by laws.

5.2.2 Promotion of the port related business

(1) Integration of SEZ and the Port

By utilizing the advantage of the physical proximity of SEZ and the Port, SEZ should share some part of the functions of the Port. As a logistics center, vanning (stuffing) and devanning (taking goods out of containers) can be done at the freight station in IFZ of SEZ, which is a designated bonded area where imported goods can be brought in without undergoing custom procedures.

In accordance with the increase of port cargoes, the traffic along the access road will increase. The existing road system leading to the Port is not sufficient to cope with the future traffic related to the Port. Therefore, the Port Expressway connecting the Port, the IFZs and the Corridor shall be

constructed as discussed in section 3.9. In order to reserve the land for future infrastructure development and, to secure the consistency of land use in the immediate outside area of the Port, this area should also be controlled against unrestrained development. The area should be designated as Port Related Zone, where priority of land use is given to port related businesses.

(2) Strategic invitation of grain terminal

Of the dry bulk cargoes, grain is the principal commodity of the Port. Taking advantage of the large depth of the bay, the Study identified the potential of the Port as a grain transshipment terminal. While the Port has the potential to serve as a grain terminal, it cannot be realized automatically. To realize this potential, the Government and CDN should make efforts to invite a private company to run the logistics business for grain.

(3) Enhancement of the inter-modal connection between rail and the Port

The Port was originally designed as a transit terminal between train and ship. Therefore, rail trucks extend on the aprons of the wharves. Nowadays, direct transfer between rail and ship is no longer effective due to containerization and increase of ships' size. Therefore, the rail terminal, which currently occupies a fairly large land area dividing the Port into two parts should be modernized. Accordingly, the rail terminal including shunting area should be newly constructed outside of the existing port area. The multimodal terminal in the Port should be specially designed for the convenience of transfer of marine cargoes to/from trains.

(4) Cold chain for the export of agricultural products

Various projects are on-going for the development of the agricultural sector. While some agricultural products are transported in bulk, some others, such as fruits, are transported in reefer cars. At present, fruits are transported by reefer containers. As the export volume increases, reefer ships may be employed. In such occasion, the Port should contribute to the development of a "cold chain" by providing cold storage in the Port.

5.2.3 Modernization of the Port

(1) Establishment of strict delineation of container terminal

Container terminal should be enclosed and exclusively used for container handling only. For the maximum use of the limited land area, no passage or storage of other cargoes, vanning or devanning or no long staying empty containers should be allowed. The entrance and exit of containers at the gate should be strictly controlled and recorded. All movements of containers within the container terminal should be centralized so that the location of any container can be identified at any time.

(2) Removal of all the conflict of the traffic flow

By strict zoning, all the conflicts of traffic flow in the port area should be removed. To this end, gates and access roads should be separately designated by types of cargoes. The port road system in the North Wharf should be remodeled.

(3) Upgrading of ship traffic control

With the coal terminal, which is scheduled to start operation in 2014, strict and careful control is required for the sea safety in Nacala Bay. The responsibility of the harbor master will be greater and new regulation of ship maneuvering is required.

(4) Enhancement of port security

The Port has the potential to export copper ore from Zambia. Stricter security is required for those high value commodities. It is the responsibility of the Port to ensure security.

(5) Promotion of container transshipment

The Port is situated at a strategic location where several liner service routes overlap: one from the north originated from West Asia via Middle East while the other originated from Southeast Asia

via Durban. At the Port container transship operation is performed between the two services. If the Port provides better service than in other ports, the port can expand its transshipment business.

(6) Reduction of burden of customs inspection

At present, customs office inspects all the cargo trucks coming in and going out of the Port by X-ray scanning system regardless of loaded or empty. This causes traffic congestion at the entrance of the Port. As the volume of cargo increases, it is practically impossible to scan all the trucks. It is vital to stop unnecessary scanning such as empty trucks, bulk and general cargoes. Those containers generated in the factories in IFZ can be inspected before the sealing of containers at the factories.

5.2.4 Design of a new container terminal

In the course of detail design, sampling of sediment should be done not only on the surface sea bed but also in the sub-layers of the sea bed for the purpose of identifying the extent of the contaminated area and depth. It is also recommended to carry out chemical analysis of the toxic substance. With these additional information and data, the volume of the contaminated sediments and the method of placement of dredged material will be determined.

The result of boring showed that the soil condition at the western part of the North Wharf is quite complicated and varies considerably along the face line of the wharf. Accordingly, it is recommended to carry our additional boring prior to the detail design of the wharf for the purpose of reconfirmation of the soil conditions where the new pier will be constructed.

5.2.5 Preservation of function of the South Wharf

The existing South Wharf has to be maintained to handle bulk cargoes. Therefore, CDN should keep inspecting regularly the progress of the damage of pier structure.

Even though rubber fenders will be installed as a component of the Urgent Rehabilitation Project, the berthing at the South Wharf should be carefully controlled by the harbour master so that the ship should approach parallel to the face line of the wharf and that the berthing speed should be no greater than 0.1 m /sec.

CDN should conduct periodical inspection of the fenders. Any damage should be repaired or fenders should be replaced as soon as possible.

5.2.6 Monitoring of financial status of CDN (TOC)

CFM (PMB) has to monitor CDN's (TOC's) financial account, in particular cash flow, from the standpoint of a supervisory authority of the Project for the purpose of ensuring sustainability of the port development and sound operation. It is recommended that TOC should open reserve accounts, which is an effective measure to monitor and control the cash flow of TOC. The reserve in the account should be exclusively used to cover a cash flow shortage to avoid going overdue on the loan repayment of the Project. Amendment of the concession agreement, therefore, is required to stipulate to open reserve accounts for the payment of concession fees and maintenance expenditure.

5.2.7 Important issues for the construction works of Urgent Rehabilitation Project

(1) Urgent Rehabilitation Project Part-1

1) Bypass access road

The revetment works need to be done before the construction of bypass access road, by use of a barge with crane. Backfilling work will be executed from the landside to the South Wharf.

2) Relocation of oil handling function

The use of fire is strictly prohibited near the oil terminal of North Wharf while an oil or gas tanker is berthed at the wharf. It is necessary to relocate the oil handling function to the southwest side

of North Wharf temporarily for the duration of the construction in order to mitigate the hindrance of the operation of the oil terminal.

(2) Urgent Rehabilitation Project Part-2

1) Reconstruction of the North Wharf

The southwest side of North Wharf will be demolished and a new berth will be constructed by the steel pipe sheet pile method. A new container yard will be constructed behind the new berth.

2) Dredging

Dredging works will be carried out by a grab dredger with enclosed-type of bucket. As the bottom sediments to be dredged are contaminated, it is necessary to study appropriate countermeasures according to the environmental regulations to prevent diffusion of the pollution into seawater. Dredged material needs to be transported by barge to the landfill yard enclosed by the bypass road. The consultant for engineering study and detailed design and the construction contractor should have past experiences in dredging and disposal of contaminated sediment. Especially, the past experiences to dredge PCB contaminated soil and equipment details of enclosed-type of grab bucket are to be demonstrated at the stage of preliminary qualification for the consultant and the contractor.

(3) Mitigation measures for the hindrance to the port operations

1) Temporary construction road

A temporary road and a gate for the trucks and vehicles related to the construction need to be installed prior to the construction, so that the regular port operations will not be affected.

2) Construction at sea

Before construction, the transportation routes of the barges on the sea near the Port need to be determined through discussions with the contractor and the Port officials. The working area needs be marked by buoys and a safety patrol boat needs to be arranged to prevent accidents.

3) Construction in the Port

Mitigation methods to avoid hindrance to the regular port operations need to be discussed between the contractor and the Port officials prior to the construction. Suitable actions such as partial execution, specifying the execution areas and employment of a safety guard is required to be taken.

5.2.8 Environmental issues

According to the sediment quality survey conducted by the Study Team, high levels of harmful substances such as PCBs, TBT and DDT were detected in the bottom sediments around the Port. Therefore, in the ensuing stages (e.g. D/D phase) a detailed sediment quality survey should be conducted at the proposed dredging site to identify the extent of contamination in the surface as well as subsurface levels.

Dredging of contaminated areas should be conducted in a manner that minimizes sediment dispersion. Options to minimize sediment dispersion include the use of silt curtain and enclosed-type grab bucket. Contaminated dredge spoil should be disposed in a manner that will prevent contamination of the surrounding environment. As a condition of preliminary qualification, the construction contractor should be required to have sufficient experience and expertise (e.g. use of enclosed-type grab bucket) in dredging and disposal of contaminated sediments (e.g. PCBs).

Dust emission from bulk cargo handling, in particular clinker, should be minimized by improving the handling equipment and procedures. The Port and relevant stakeholders should discuss measures to minimize environmental risks associated with ballast water discharge and harmful anti-fouling paint.

MTC should inform MICOA about the project and proceed with the EIA procedure as soon as

possible. The EIA should be approved by MICOA before the appraisal of international development partners.

The EIA should also be in compliance with JICA's environmental guideline "JICA Guidelines for Environmental and Social Considerations (April 2010)". MTC should in particular make sure that the EIA covers the check items of the "Environmental Checklist" which is part of the above guideline. A draft version of the "Environmental Checklist" is attached as Appendix-11.