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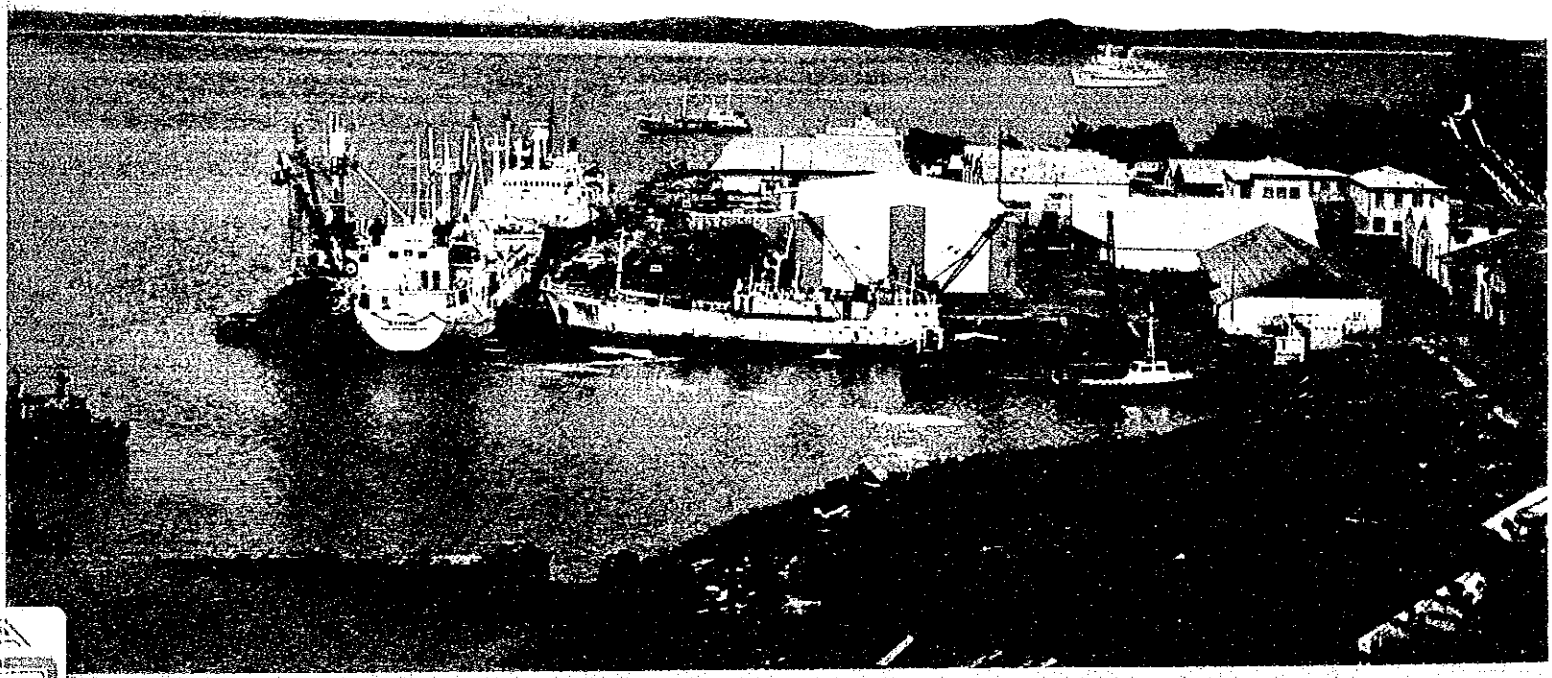
TEH DEMOCRATIC REPUBLIC OF MADAGASCAR

No. 52

FINAL REPORT

THE STUDY ON THE DEVELOPMENT OF THE PORT OF ANTSIRANANA IN MADAGASCAR

SUMMARY



DECEMBER 1994

THE OVERSEAS COASTAL AREA DEVELOPMENT INSTITUTE OF JAPAN (OCDI)
NIPPON TETRAPOD CO.,LTD.(NTC)

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF TRANSPORT AND METEOROLOGY
TEH DEMOCRATIC REPUBLIC OF MADAGASCAR

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DECEMBER 1994

CURRENCY EXCHANGE RATE

1 US Dollar = 1,860 Madagascan Franc = 108 Japanese Yen

(As of October, 1993)

PREFACE

In response to a request from the Government of Democratic Republic of Madagascar, the Government of Japan decided to conduct a feasibility study on the Development of the Port of Antsiranana in Madagascar and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent a study team to Madagascar three times between August 1993 and September 1994. The study team was headed by Mr. Toshiaki Okada and composed of members of the Overseas Coastal Area Development Institute of Japan (OCDI) and the Nippon Tetrapod Co., LTD (NTC).

The team held discussions with the officials concerned of the Government of Madagascar and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

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

I wish to express my sincere appreciation to the officials concerned of the Government of Democratic Republic of Madagascar for their close cooperation extended of the team.

December, 1994

Kimio Fujita
President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

December, 1994

Mr. Kimio Fujita
President
Japan International Cooperation Agency

Dear Mr. Fujita:

It is my great pleasure to submit herewith the Report for the Study on the Development of the Port of Antsiranana in Madagascar.

The study team which consists of the Overseas Coastal Area Development Institute of Japan (OCDI) and Nippon Tetrapod Co., Ltd (NTC), headed by myself, conducted a survey in Madagascar from October 1993 to September 1994 as per the contract with the Japan International Cooperation Agency.

The findings of this survey were fully discussed with the officials of the Ministry of Transport and Meteorology of Madagascar and Other authorities concerned to formulate the Master Plan for the period up to the year 2010 and to formulate and examine the feasibility of the Short-Term Plan for the period up to the year 1998, and were then compiled into this report.

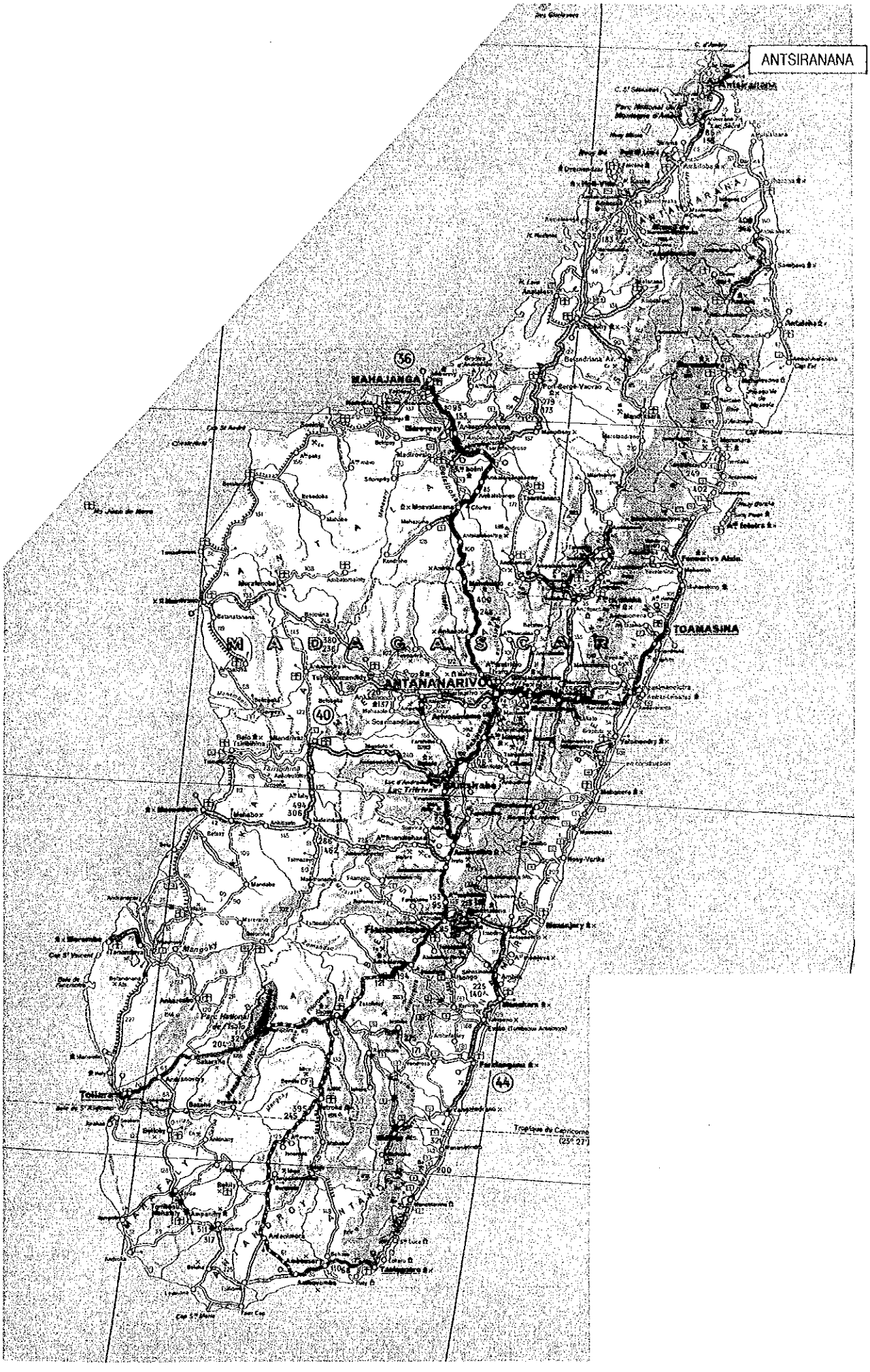
On behalf of the study team, I would like to express my deepest appreciation to the Government of Madagascar and other authorities concerned for their brilliant cooperation and assistance and for the heartfelt hospitality which they extended to the study team during our stay in Madagascar.

I am also greatly indebted to the Japan International Cooperation Agency, the Ministry of Foreign Affairs, the Ministry of Transport and the Embassy of Japan in Madagascar for giving us valuable suggestions and assistance during the preparation of this report.

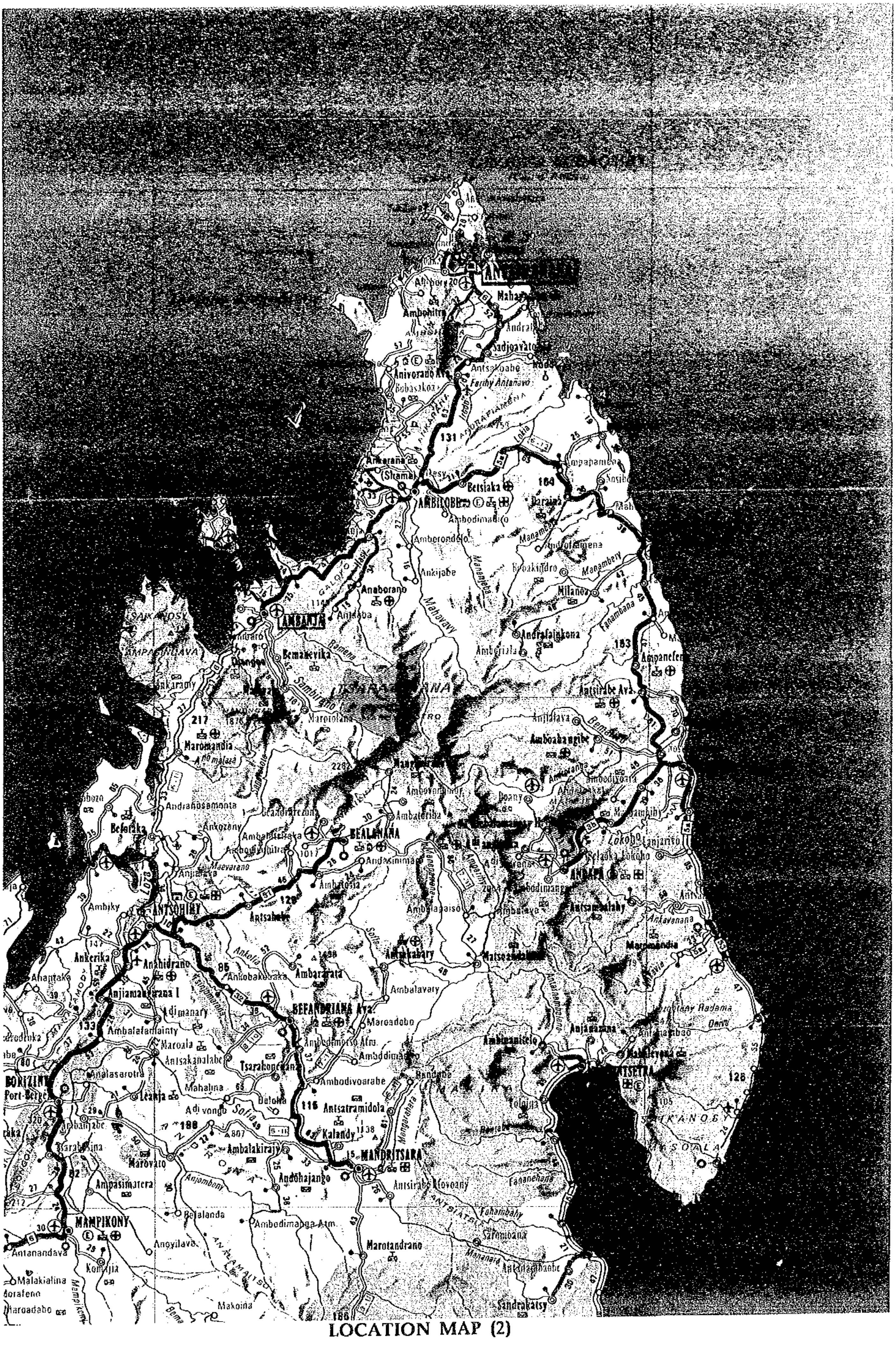
Respectfully,

Toshiaki Okada

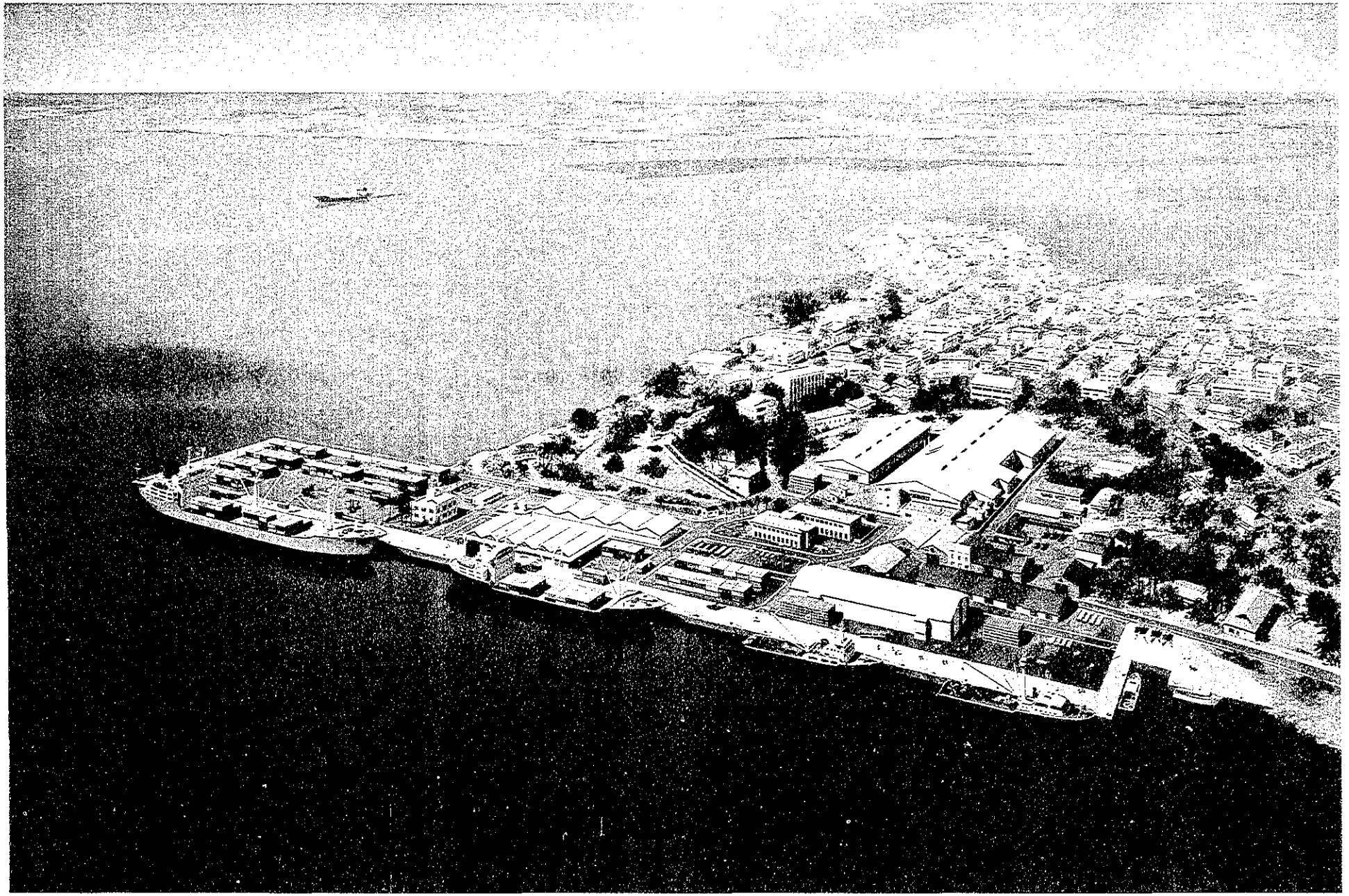
Toshiaki Okada
Leader of the Study Team for the Study on Development of Antsiranana Port



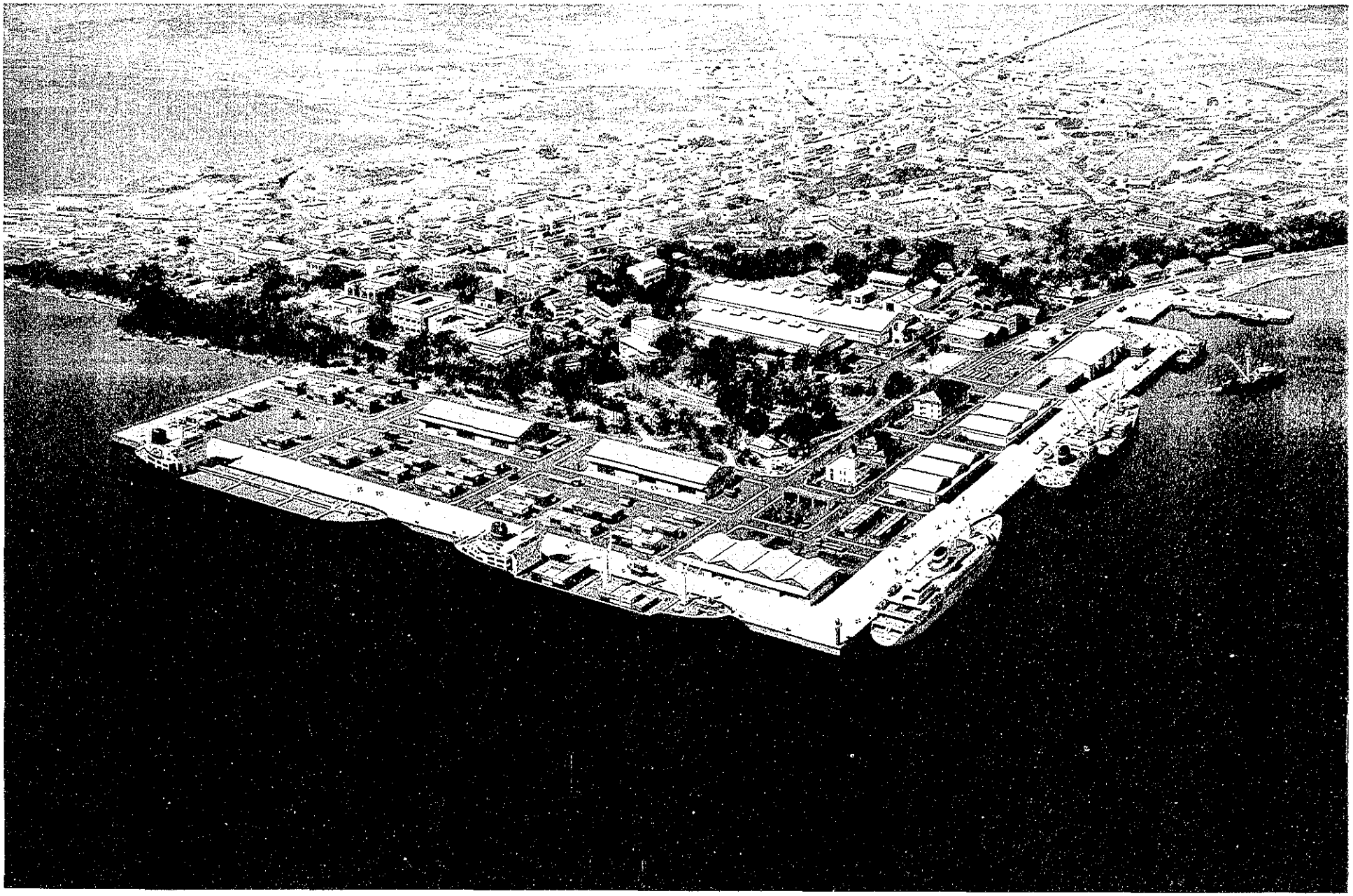
LOCATION MAP (1)



LOCATION MAP (2)



SHORT-TERM DEVELOPMENT PLAN



MASTER PLAN

ABBREVIATIONS

French/Malagasy

AUXIMAD	Société Auxiliaire Maritime de Madagascar
CCI	Chambre de Commerce et d'Industrie
CGM	Compagnie Générale Maritime
CMDM	Compagnie Malgache de Manutention
CMN	Compagnie Malgache de Navigation
CSM	Compagnie Salinière de Madagascar
DTM	Direction des Transports Maritimes
JIRAMA	Jiro sy Rano Malagasy
MTM	Ministère des Transports et de la Météorologie
ONE	Office National de l'Environnement
PFOI	Pêche et Froid Océan Indien
RNCFM	Réseau National des Chemins de Fer Malagasy
SECREN	Société d'Étude de Construction et de Réparation Navales
SIRAMA	Société Siramany Malagasy
SMC	Société Malgache de Cabotage
SMTM	Société Malgache des Transports Maritimes
SOLIMA	Solitany Malagasy
TST	Taxe sur les Transactions
TUT	Taxe Unique sur les Transactions

English

CDL	Chart Datum Line
CFC	Conversion Factor for Consumption
CFL	Conversion Factor for Labor
CIF	Cost Insurance and Freight
COD	Chemical Oxygen Demand
dB	Decibel
DMC	Developing Member Countries
DO	Dissolved Oxygen
DWT	Dead Weight Tonnage
ECU	European Currency Unit
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EPZ	Export Processing Zone
FIRR	Financial Internal Rate of Return

FMG	Madagascan Franc
FOB	Free on Board
FTZ	Free Trade Zone
GDP	Gross Domestic Product
GL	Ground Level
GNP	Gross National Product
GRT	Gross Registered Tonnage
IALA	*International Association of Lighthouse Authorities*
IEE	Initial Environmental Examination
IMF	International Monetary Fund
JICA	Japan International Cooperation Agency
MLWL	Mean Low Water Level
MOL	Mitsui OSK Line
MSC	Mediterranean Shipping Company
MT	Metric Ton
NRT	Net Registered Tonnage
OD-Survey	*Origin and Destination Survey*
OECF	The Overseas Economic Cooperation Fund
PH/ph	Potential of Hydrogen
SCF	Standard Conversion Factor
SDR	Special Drawing Rights
SS	Suspended Substance
TEU	Twenty-foot Equivalent Unit
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
US$	*US Dollar*

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SUMMARY OF THE STUDY

CONCLUSIONS AND RECOMMENDATION

Through the course of the Study, the Study Team had many opportunities to hold discussions with counterpart personnel and has made various comments and suggestions on construction, maintenance, operation and management of the port. Conclusions and recommendations for the project prepared on the basis of the discussions are summarized herewith.

CONCLUSIONS

1) Background of the project (Major issues to be solved)

(1) The problem areas of the existing port facilities

The port of Antsiranana is located at the end of the wide bay on the northernmost part of the island of Madagascar. It is one of the major ports which handles foreign trade cargo. Its hinterland, Diego-Suarez Faritany and surroundings, is blessed with natural resources and highly valued agricultural products. Excellent and modern industries such as SECREN and PFOI are already working around the port. For that reason, the region has the potential to become prosperous. However, the region is far from other cities including the capital, Antananarivo, and it is nearly isolated, especially during the rainy season because of the poor land transportation system and communication system. Therefore, the port is extremely vital for promoting the economic activities in the northern part of country.

Presently, the existing facilities have many problems as illustrated below:

- Superannuation and deterioration of facilities

Almost all facilities are aged without adequate maintenance or rehabilitation. Most of them are damaged or obsolete and require repair or improvement. If necessary rehabilitation works are not carried out, these facilities will soon be out of use.

- Insufficient of quay length and depth

The length of quay is insufficient for the mooring of ocean-going vessels which call the port of Antsiranana. The existing quay depth is also insufficient to accommodate 10,000 DWT class vessels in full load, even though frequent calls of over 10,000 DWT class vessels are recorded. Some tankers are forced to handle oil products off the quay in the bay.

- Shortage of facilities and equipment to cope with containerization

The wave of containerization has reached Madagascar and container cargo traffic at the port of Antsiranana is gradually increasing. On the other hand, the port is not well equipped to receive containers. For example, open yard is unpaved and undulated with improper layout of the transit sheds.

Therefore, it is urgently required to prepare a new port development plan of Antsiranana, which shows directions for quickly solving the existing problems and ensuring the present roles or functions and, in addition, coping with the additional future demand for the port flexibly.

(2) Organizational matters

In principle, the following points are very important for port management and operation; ensuring efficient utilization of the port facilities, and providing reliable services at reasonable charges.

To realize the above, the port management body requires an adequate organization with talented people and appropriate competence and necessary budget. From such points of view, at present, the DTM branch of the port of Antsiranana has a lot of problems. It is under severe budgetary constraints together with considerable shortage of able staff to maintain facilities in good working condition. In addition, the available port statistics are totally substandard and administrative capability of DTM and its branches seems to be inadequate to deal with issues related to daily usage of facilities.

Therefore, in order to secure proper management and operation of the port after completion of the proposed project, organizational deficiency mentioned above should be corrected.

2) Master Plan (target year: 2010)

- The rehabilitation of the existing facilities and expansion needed to cope with forecast cargo demand comprise the main components of the Master Plan. The extension of quay is also necessary to handle cargo smoothly while the existing facilities are under rehabilitation.

-The major components of the scheme are as follows:

Component	Unit	Quantity	Remarks
Total quay length	m	1,040	This length contains the existing quay, 301 m, and the ongoing project, 47.5 m, under the French aid.
Maximum quay depth	m	12	The maximum calling ship is 30,000 DWT.
Rehabilitation	m	301	The Old Quay and the New Quay
Dredging	m^2	62,000	Berthing and Turning area
Reclamation	m^3	825,000	
Road	m	700	
Fence and Gate	m	1,100	
Container stacking yard	m^2	9,150	7,200 m^2 and 1,950 m^2 for laden and empty containers respectively
Open yard	m^2	100	
Light marker	set	1	
Tugboat	set	1	
Building	set	2	Port office and Custom office
Transit shed	set	5	Total area is 11,700 m^2.

- The planned quay in the Master Plan is extended 211.5m northward from the existing quay, and is then further extended 480 m eastward, taking into account the current port activities, natural conditions around the site and construction cost.

- In principle, each berth is specified for use by international vessels, coastal vessels, fishery boats and basin of small crafts.

- Construction cost is estimated at about 119.5 million US dollars.

3) Short-Term Development Plan (target year: 1998)

- In formulation of the Short-Term Development Plan, as many of the existing facilities as possible will be retained after necessary rehabilitation works in order to minimize the total construction cost.

- The proposed layout plan slightly differs from that of the Master Plan. It should be understood as a result of the need to minimize the construction cost.

- The major components of the Short-Term Development Plan, i.e., the first stage of the Master Plan, are as follows:

Component	Unit	Quantity	Remarks
Total quay length	m	560	This length contains the existing quays, 301 m, and the ongoing project, 47.5m, under the French aid.
Maximum quay depth	m	10	The maximum calling ship size is 10,000 DWT.
Rehabilitation	m	301	The Old Quay and the New Quay
Dredging	m^2	36,000	Berthing and Turning area
Reclamation	m^3	122,000	
Road	m	1,062	The road is included port access road with 608 m length.
Fence and gate	m^2	300	
Container stacking yard	m^2	4,925	3,275 m^2 and 1,650 m^2 for laden and empty containers respectively
Open yard	set	100	
Light maker	set	1	
Building	set	3	Two residences and their attached warehouse
Transit shed	set	5	Rehabilitation works by private sector

Note: Besides the above, oil pipeline and water supply line are to be constructed by private sectors.

- The principle of usage of the berths, in which each berth is specified for the use of international vessels, coastal vessels and fishery boats, is also applied.

- The Short-Term Development Plan ensures that port activities continue even during rehabilitation works.

- The total construction cost is estimated to be about 30.9 million US dollars, of which about 26.2 million US dollars is the public portion and the remainder(transit sheds, oil pipeline and water supply line) is the private portion.

- As to management and operation, there are a lot of problems to be solved urgently in order to make good use of the port. The relationship between central and local branches of DTM, the relationship between public and private sectors, level of port tariff and administration of port facilities are identified as main issues. Some measures to tackle the above problems have been proposed.

- According to the results of the economic analysis, the EIRR of the project is 14.2 % and shows 11.4 % in the most severe case of the sensitivity analysis. Judging from the above and other analyses in other countries with similar economic conditions, it is appraised that the project is feasible. Moreover, as superannuation of the existing facilities will continue to be a problem, it is thought that at least rehabilitation works should be implemented as soon as possible.

- According to the results of the financial analysis, the FIRR is -4.1%. This means that the project is not financially feasible. Port charges cannot be substantially raised if the port is to compete successfully with neighboring ports and alternative modes of transportation. And thus in spite of strenuous efforts to reduce the construction costs, the amount of investment will far surpass port revenues.

Considering the significance of the project, however, possible alternative countermeasures including the introduction of foreign aid should be taken to implement the project.

If the necessary amount of investment for the entire project cannot be attained, at least a part of the Short- Term Development Plan should be implemented as the first step to solve the most urgent problems the port faces at present.

- From the above point of view, the urgent improvement plan is proposed. The main items are as follows:

rehabilitation works of the existing facilities

extended quay length 120 m

construction cost 16.9 million US dollars

construction period after works within two years

- EIA identifies that the project will not cause any serious problem for the environment. The drainage from the tuna canning factory, however, needs to be paid full attention to avoid water contamination.

RECOMMENDATION

The proposed Short-Term Development Plan, in particular, rehabilitation works, is required to be completed very urgently to maintain present operational levels of facilities. It is appraised to be very significant from the economic point of view. Considering the present situation of budgetary and financial constraints, the critical factor is how and when the necessary budget becomes available. The following recommendations mainly concern operational aspects.

1) Strengthening of the port management body

- The existing port management body is not adequately functioning in managing and operating the port appropriately to serve and support the socio-economic activities of the hinterland. There is an insufficient number of staff responsible for statistics or maintenance of the facilities and so on.

Therefore, strengthening of the port organization through introducing the appropriate number of well-trained staff and adequate budgetary arrangement is required.

It is recommended that the Madagascan government reinforce the organization in the port of Antsiranana. At the very least, some more staff responsible for port statistics and technicians to maintain the port facilities should be assigned. The proposed organization chart is shown in section 5.8 Management and Operation.

- Although a considerable expense is needed on a recurring basis to maintain the port facilities in normal condition, is indispensable for promoting port activities and the economy in the hinterland. As the financial analysis implies, it would be desirable for the project if operation expenditures besides non-cash charges (i.e., depreciation of fixed assets and amortization of deferred assets) were covered by operation revenues. To increase operation revenues, following alternatives should be considered;

  i) to introduce an occupancy charge which is levied on privately owned fixed assets or utilities in the port as is imposed in some other countries

  ii) to charge a part of the capital investment cost to the major port users who will benefit from this investment and so on.

- Since management and operation of the port has become more and more complicated, more operational staff should assigned, and their productivity be raised. In Madagascar, almost all statistics including the port statistics are not available. Statistics provide a basis for examining the present activities and considering the future trend or demand. Therefore, in major ports as such as Antsiranana, staffs for statistics should be assigned. In addition, there must be much more coordination or communication between concerned people or companies etc. When port activities get more active. At that time more office workers who are capable, talented and well trained will be needed.

2) Entrusting local agencies with more authority and responsibilities

- It is said that the Madagascan government is examining the possibility of entrusting local agencies with more authority. This is very important and necessary because local agencies best understand the daily port activities and demands, many of which often have to be dealt with at once. Thus, to ensure smooth and efficient operation, the local agency, in principle, should have the authority to deal with the issues related to daily operation of facilities.

- Another area in which the local agency should participate is the drafting of the future port plan.

3) Promoting communication, coordination and cooperation between public and private sectors

- It is of paramount necessity for the local agency to communicate, coordinate and cooperate with public and private organizations such as CMDM, SOLIMA and the chamber of commerce and industry, so as to ensure efficient management and operation. They are major port users. Higher productivity in cargo handling or efficient and orderly use of the port cannot be achieved without their cooperation and efforts. In the construction phase, too, DTM requires their cooperation and some coordination with them.

4) Making the nationwide policy and strategy of port development

- As to the main role of the central direction, it is strongly recommended that DTM make the nationwide policy and strategy on port development. This contains the functional allotment of ports, the long term investment and financial plan, port marketing activity and so on. Since Madagascar is an island country endowed with abundant natural resources, ports and harbors are one of the key social capitals in reaching the full potential of a country. However, DTM is suffering from budgetary constraints and has to seek foreign assistance. It will help them acquire assistance from foreign countries if they have their own long term plan.

ORGANIZATION OF THE STUDY TEAM

The Study Team consists of eleven experts. Their names and responsibilities are listed below:

Title	Name	Responsibilities
Team Leader	Toshiaki OKADA	Overall Management
Co-Leader	Kenichi OKUMURA	Port Planning, Port environment
Specialist	Shoji KATSUDA	Regional Development Planning
Specialist	Hisafumi ISHIKAWA	Demand Forecast, Economic Analysis
Specialist	Manabu SUETSUGU/ Shinichiro USHIJIMA	Management and Operation, Financial Analysis
Specialist	Koichi IGARI	Facilities Design
Specialist	Yutaka OCHI	Construction method, Cost Estimation
Specialist	Kiyotaka SASAO	Natural Condition(I)
Specialist	Kazuo YAMADA	Natural Condition(II)
Specialist	Masaru KANASASHI	Magnetic Prospecting(I)
Specialist	Yoshiaki WATABE	Magnetic Prospecting(II)
	Masahiro SATO/ Yutaka FUJII	Interpreter

INTRODUCTION

INTRODUCTION

This report is the result of "The Study on the Development of the port of Antsiranana in Madagascar" which has been conducted from August 1993 to September 1994.

1.1 Background of the Study

The port of Antsiranana is located at the end of the wide bay on the northernmost part of the island of Madagascar. It is one of the major ports which handles foreign trade cargo. Its hinterland, Diego-Suarez Faritany and surroundings, is blessed with natural resources and highly valued agricultural products. Excellent and modern industries are already working around the port. For that reason, the region has the potential to become prosperous. Taking into consideration the topography of the region, the port is extremely vital for promoting the economic activities. However, presently, the existing facilities have many problems such as superannuation and deterioration of facilities, insufficient quay length and depth, shortage of facilities and equipment to cope with containerization. In addition, there are some organizational issues to be addressed, in order to ensure efficient utilization of the facilities and provide reliable services.

To cope with the above situation, the Government of the Democratic Republic of Madagascar requested the Government of Japan to carry out the following studies.

1) To evaluate the existing facilities
2) To formulate the improvement plan of facilities, equipment and other relevant infrastructure
3) To formulate a master plan with target year, 2010
4) To conduct a feasibility study of the short-term development plan with target year, 1998

1.2 Study Objective

In accordance with the conditions described above and in response to a request from the Government of the Democratic Republic of Madagascar, the Study is carried out to achieve the following goals.

1) To formulate the Master Plan for the port of Antsiranana up to the year 2010
2) To conduct a feasibility study on the Short-Term Development Plan up to the year 1998

1.3 Study Components

The Study is comprised of the following components.

1) Formulation of the Master Plan

- To review nation-wide socio-economic conditions for identifying the expected roles and functions of the port
- To prepare demand forecast up to the year 2010
- To formulate a basic layout plan for facilities of the port
- To prepare preliminary implementation programs
- To estimate construction cost

2) Feasibility Study on the Short-Term Development Plan

First, within the framework of the Master Plan, the Short-Term Development Plan is formulated with consideration of environmental aspects.

- To identify urgent problems and to define counter measures to be taken
- To prepare cargo demand forecast up to the year 1998
- To formulate an improvement plan of port facilities and other relevant infrastructure as well as rehabilitation of the existing port facilities
- To prepare a preliminary design of newly constructed or rehabilitated port facilities
- To prepare implementation programs
- To estimate construction cost

Second, a feasibility study on the above Short-Term Development Plan will be carried out including the following;

- economic analysis
- financial analysis
- necessary recommendations

1.4 Study Execution

The Study was conducted as follows:

1) Presentation of Inception Report, the first field survey and presentation of the Progress Report; Aug.-Oct. 1993
2) Presentation of the Interim Report and the second field survey; Feb.-March 1994
3) Presentation of the Draft Final Report and the third field survey; Sep. 1994

The Final Report is made on the basis of the comments of the Draft Final Report provided by the Government of the Democratic Republic of Madagascar.

CHAPTER 1

OUTLINE OF THE DEMOCRATIC REPUBLIC OF MADAGASCAR

1. OUTLINE OF THE DEMOCRATIC REPUBLIC OF MADAGASCAR

1.1 General

The Democratic Republic of Madagascar is an island country located in the Indian Ocean about 400 km away from the African Continent separated by the Mozambique Channel.

The area of the island is 587,000 km^2, the fourth largest in the world, with 1,580 km of north-south axis and 580 km east-west axis.

The history of Madagascar is marked by six distinct periods; first, an era of monarchy, followed by a colonial period, then three republics, each separated by a transitional period. The present republic was just established in 1993.

Madagascar's administrative structure consists of six Faritany (provinces). The regional capitals are Antananarivo, Antsiranana, Fianarantsoa, Mahajanga, Toamasina and Tolialy, although regional zoning is now under restructuring.

1.2 Geography

Madagascar's relief is highly varied and complicated by undulations.

The Central Highlands is a complex combination of high plains, hills, compact massifs, big domes and basins, about 1,500 m high. The Eastern slopes, an undulating terrain (25 to 100 km in width) where small isolated plains alternate with low hills, are separated from the Highlands by steep cliffs. The Western plains and plateaux have a smooth relief. The far South is a gentle flat terrain. The North is an area of complex topography, with volcanic and karstic landforms, basins and deltas.

The area of permanent pasture is 58% and that of forest and woodland is 27% of the territory.

The coastal lines, which total 5,000 km in length, can be divided into four categories. In the north, they are rocky, fairly indented, bordered by isles. In the west, they are low and sandy but not very indented. The bay silts up. In the south, they are bordered by dangerous cliffs and dunes. In the east, they are bordered by lagoons.

Madagascar has 17 ports. Nine ports are located along the east coast where, exposed to the Indian Ocean swells, sea conditions are severe. Conversely, the eight ports

along the west coast are calm in general but many of them are suffering from siltation. Antsiranana in the north is the best natural port. Toamasina in the east is constructed on a reef and protected by a breakwater.

1.3 Climate

The climate of Madagascar greatly varies depending on the regions. The temperature in the west is higher than that in the east while it is lowest in the Highlands.

Two seasons can be clearly distinguished, from May to October, the cold season, and from November to April, the hot season.

Rainfall is usually heavy but the precipitation varies by regions and seasons.

There are two winds from the sea that bring rain. The eastern trade wind blows throughout the year and regularly brings humidity to the eastern coast of the island. As it moves down to the west, this wind loses its humidity and it becomes dryer. The north-west monsoon blows only during the hot season and brings a great amount of rainfall to the middle part of the country.

During the hot season, cyclones are sometimes generated and hit the coastal regions, in particular, ports along the east coast.

Antsiranana belongs to the east coastal area. However, the quantity of rain is exceptionally small, about 1,000 mm per year.

1.4 Socioeconomic Activities

Madagascar is faced with a deficit in the balance of payments. To remedy this situation, the Madagascan government has appealed to the IMF and World Bank several times to assist in the reformation or restructuring of its economy. Several structural adjustment programs have been executed but these have generally failed to yield the desired results.

1.4.1 Population

According to the estimation of the Madagascar Government based on the 1975 Census, the total population of Madagascar in 1992 was 11.8 million. The average

annual growth rate of the population from 1984 to 1992 was 2.6 %, relatively high compared to those of other low-income countries.

Among the provinces, Antananarivo province where the capital city is located has the largest population, about 3.739 million or about 33 % of the total. On the other hand, Antsiranana province where the port of Antsiranana is located has the smallest population, 870 thousand or about 8 % of the total.

1.4.2 National Income

The GDP at constant 1984 prices slowly increased from 1984 to 1990 with an average growth rate of 2.5 %. In 1991, when political confusion reigned due to the change of political power, GDP sharply fell.

Among the industrial sectors, the agriculture sector has a large share, about 34 % and its growth rate, 2.3 % from 1984 to 1992, is the highest. On the other hand, the secondary industrial sector is generally weak and its growth rate, 1.0 % from 1984 to 1992, is the lowest. The low level of industrial development is clearly reflected in the structure of foreign trade : agricultural and fishery products are exported, while industrial products are imported.

GDP per inhabitant at constant prices decreased gradually at an average growth rate of -1.4 % from 1984 to 1992 because the economy failed to catch up with the increase of population. A prime objective of the economic policy is to reduce sensibly the rate of poverty.

1.4.3 Trade

(1) Trade balance

In 1992, exports were valued at 500 billion FMG, while imports were about 845 billion FMG representing a trade deficit of 345 billion FMG. This trend has continued for over 20 years.

Regarding the value of 1992 exports, major cargoes are vanilla, shrimp and coffee among export commodities. Vanilla has the highest share of 19.1 %, which is valued at 95.5 billion FMG. Shrimp and coffee follow, with respective shares of 14.1 % and 11.8 %, which are valued at 70.6 billion and 58.8 billion FMG.

Regarding the value of 1992 imports, major cargoes are crude petroleum, transport equipment and machine & apparatus among import commodities. Crude petroleum has the highest share of 11.3 %, which is valued at 95.1 billion FMG. Transport equipment

and machine & apparatus follow, with respective shares of 11.1 % and 10.4 %, which are valued at 94.2 billion and 88.3 billion FMG.

(2) Cargo Volume

Regarding the volume of exports, total cargo volume reached about 420 thousand tons in 1992 and the average growth rate of total volume has recorded 3.0 % in the last decade. Mineral chromium had the highest share in 1992, representing 26.1 %. Petroleum products and coffee follow, with respective shares of 24.5 % and 11.9 %. Agricultural and fishery products are showing a tendency to increase, while the light industries are decreasing.

On the other hand, total volume of imports is about 870 thousand tons and has varied roughly between 700 and 900 thousand tons in the last decade. It is mainly in the field of petroleum and its products where volume variation has been observed. Petroleum and its products have the biggest share, about 50 % in 1992, while cement and rice follow, with respective shares of 11.4 % and 6.0 %. The increase of wheat flour and animal products is particularly remarkable while plastic materials, electric instruments & equipment and transport equipment also show sharp increases. On the other hand, the decrease of rice is particularly remarkable, followed by cooking oils and coals.

1.5 Transport

1.5.1 Road

Since the geographical feature of the country is such that mountainous and torrential areas separate communities from one another, the land transportation system is not very developed. Total length of road is about 50,000 km, however, 90 % of them are unpaved.

According to a government report, Antsiranana does not have good road connections with other cities and it is isolated during the rainy season.

The Seventh Road Project sets out an improvement program of the existing road network, but even after its completion, the road to/from Antsiranana will remain more or less in poor condition.

1.5.2 Railway

The railway in Madagascar consists of two lines, the northern and the southern

system, operated by RNCFM. The former, 693 km in length, connects Antananarivo and Toamasina, Lac Alaotra via Moramanga and Antsirabe. The latter, 163 km in length, connects Fianarantsoa and Manakara.

The railway plays an important role in land transportation, both in terms of goods and passengers. In particular, the Antananarivo-Toamasina line carries a considerable amount of hydrocarbons, chromite, miscellaneous etc. and it is expected to continue this function.

1.5.3 Maritime Transport

Maritime transport is relatively active not only in terms of domestic transport but also in terms of overseas trade.

Maritime transport in Madagascar is mainly handled by SMTM, CMN, SMC and other foreign shipping companies from France, Switzerland and Netherlands. SMTM and CMN are government enterprise. Management of all shipping companies in Madagascar is difficult because of a lack of funds, and many vessels are old and poorly maintained.

Other foreign shipping companies provide international shipping service between various countries of Africa, Europe or South East Asia.

SOLIMA, the government-owned oil company, has oil refineries in Toamasina. They distribute their products all over Madagascar by cars, trains and vessels. They own and operate three tankers.

Almost all inland cargoes are transported by coastal vessels to all ports in Madagascar, except for goods transported by road and railway to the central highlands.

According to the cargo traffic statistics, the total cargo though put of maritime transportation was 2,127 million tons, of which, 1,393 million tons or 65.5% of the total was handled at the port of Toamasina. The ports of Antsiranana and Mahajanga were the second and third largest, handling 195 thousand tons and 188 thousand tons, or 9.2% and 8.8% of the total respectively.

Almost all export goods such as coffee, vanilla, clove etc. are transported to the port of Toamasina for transshipment. Main domestic maritime networks have progressed to/from Toamasina.

1.5.4 Airline Transport

Because of the undeveloped land transportation network, air transport network is relatively developed. There are 52 airports in use.

Antananarivo Ivato airport is an international airport, where Boeing 747s land.

As to the domestic airline, the biggest plane is a Boeing 737-200. A Boeing 737 can be used in normal conditions at only seven airports. Antsiranana airport can not accommodate a Boeing 737 at full weight because of the limited length of its runway.

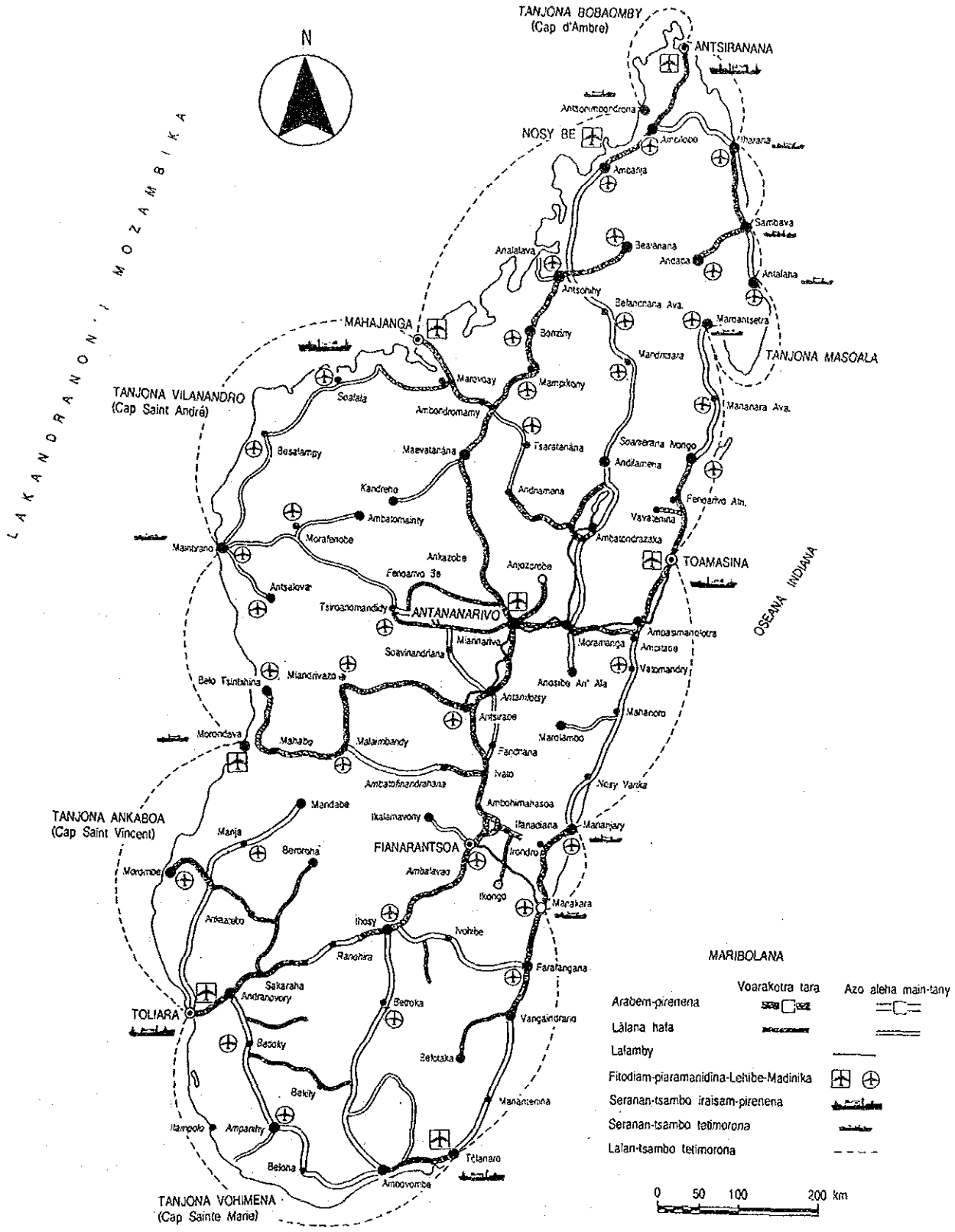

Fig. 1-5-1 Map of Transport Network

1.6 Industrial Activity

1.6.1 Agriculture

(1) Agriculture

Because of its growth potential given its vast area of arable land, and the resulting effects on the national economy, agricultural sector is destined to play an important role in the national strategy of development which aims at accelerating economic growth to struggle against poverty and food shortage.

The production of cereals which include paddy, maize and bean etc. yielded 2,542,000 tons in 1989 with an average growth rate from 1965 to 1989 of only 1.2 percent. This is smaller than the population growth rate of 2.6%.

On the other hand, the production of roots and tubers including manioc, sweet potato, potato, etc. reached 3,128,000 tons in 1989 with an average growth rate from 1965 to 1989 of 3.3 percent.

(2) Stockbreeding

In Madagascar, more than half of the territory (340,490 square kilometers) is covered by permanent pasture. There are many heads of cattle(bovines), pigs (porcines), sheep/goats, and poultry (chicken, duck, etc.) in the vast area of permanent pasture.

The heads of livestock have not increased in the last decade. There were 10,276,000 heads of bovines, 1.493 million heads of porcines, 2,081,000 heads of sheep/goats and 19,995 thousand heads of poultry as of 1992.

1.6.2 Fishery

The quantity of fishery products reached 104 thousand tons in 1990 (this includes catches from both freshwater and saltwater sources). The fishery production is increasing every year.

1.6.3 Industry

Industrial sector in Madagascar is relatively undeveloped. Principal main industries are textile, clothing, canning stuffs, beverages, shoes and pharmaceutical products. The clothing and shoe sectors are the most suited to orientate themselves towards export. The regime of free zone or investment code has been established to further export.

1.6.4 Mining

Madagascar has rich mineral resources of coal, chrome, graphite, brown mica, titan, gold, etc. These minerals, however, are under exploited.

1.6.5 Water and Energy

The east coast is abundant in water resources thanks to sufficient rainfalls. The rivers which empty into the sea along the west coast area are comparatively rich water resources because of rain falling from the east coast area to the central mountainous area. Water in the south-west area is scarce; this area is almost a desert. The province of Antsiranana is generally abundant in water except for the northern part of the province.

The province of Antsiranana has power plants and sources of water in eight districts.

In Madagascar, coal and petroleum are not produced at all now and are entirely imported from foreign countries. Therefore, many woods are cut and used for fuel.

1.6.6 Tourism

Between 1985 and 1990, the number of foreign visitors increased from about 23,500 to nearly 53,000. Seventy percent of the foreign visitors in 1990 came from Europe (especially France and East Germany). Hotels offered 1,597 rooms in 1985 and 3,040 in 1991. Though the income generated from tourism fell from 40 million dollars in 1990 to 29 million dollars in 1991, this was still greater than the income generated from the export of coffee.

1.7 Regional Development

1.7.1 Industrial Development Plan in Madagascar

In 1977, The Madagascan government established a long-term economic target(1978-2000) which aimed at doubling GDP per capita. They divided the development period into three phases and set the average growth rate of GDP up to 6.3 % throughout the period.

Though GNP per capita peaked in 1980 at US$ 430, GNP per capita decreased steadily thereafter, and in 1990 it was scarcely US$ 210.

1.7.2 Industry of the Province of Antsiranana

Madagascar's industry is dominated by the food relevant industry. In particular, the production of salt(CSM), sugar(SIRAMA), beef and soap are remarkable. These products are also mainly produced in Faritany Antsiranana. The salt products of Faritany Antsiranana account for 90% of the total in Madagascar. The sugar products of Faritany Antsiranana account for over 50% of the total in Madagascar. In addition, PFOI established a tuna canning factory in March, 1991 and production by 1992 had already reached about 15,000 tons. SECREN is the one and only ship-repair and shipbuilding company in Madagascar. SECREN has some development programs such as plywood industry and wood processing products. SIRAMA(sugar refining and alcohol brewing) and STAR(beer brewing) have already commenced the modernization plan which will reduce maintenance costs and increase productivity.

1.7.3 Movement of Export/Import Goods of the Province of Antsiranana

1) Movement of the export/shipment goods of Faritany Antsiranana

The main export goods in Faritany Antsiranana are agricultural products such as coffee, cacao, cashew nuts, vanilla, clove, vegetable and foods which are mainly exported to Europe. The other export goods are lumber, salt, tuna and general merchandise. In 1991, PFOI began exporting canned tuna.

The main outbound goods in Faritany Antsiranana are salt, sugar, and beer. Salt loaded at the port of Antsiranana is transported to various ports except Faritany Toliala. Sugar loaded at Port Saint Louis near Ambilobe and the port of Hell Ville in Nosy-Be is transported to Toamasina and other ports.

2) Movement of the import/shipment goods of Faritany Antsiranana

The main import goods are construction materials such as cement and metal products, food(rice and flour), and fertilizer.

The main inbound goods are general cargoes from the port of Toamasina.

1.7.4 The direction for industrial development of the Province of Antsiranana

The main industries of Faritany Antsiranana have been the food processing industries, salt, sugar, alcohol, crops and etc. These industries of Faritany Antsiranana currently face some problems. However, there is a high potential for developing industry in Faritany Antsiranana and it is strongly expected to resolve the problems and reach its potential.

Madagascar government has earmarked the following industries for further

development:

- The food processing industry
- Light industry such as spinning and weaving, textile, clothes and etc.
- Leather and leather processing industry
- Fertilizer and forage
- Construction materials, cement, iron products etc., which are currently imported from foreign countries.
- Wood processing industry

1.7.5 Subjects to be coped with for further development

To promote the above industries, the Madagascar government is focusing on the following items:

- Expanding the urban area and strengthening the connection with the satellite cities
- Cultivating the new markets
- Developing a large economic bloc by linkage of the coastal area and strengthening urban function of Antsiranana
- Enlarging its international distribution role by developing the port of Antsiranana

CHAPTER 2

PRESENT SITUATION OF THE PORT OF ANTSIRANANA

2. PRESENT SITUATION OF THE PORT OF ANTSIRANANA

2.1 Natural Conditions

2.1.1 Topography

The bay of DIEGO-SUAREZ has a total surface area of 250 square km and a total coastal length of 150 km. The mouth is situated at the east side of the bay facing the Indian Ocean, where opposite shores are separated by a distance of only 1,200 meters. This bottleneck shape makes a safe basin for vessels seeking shelter from ocean waves. The port of Antsiranana is located at the opposite side of Cap Diego at the south of the bay, and is connected to the mouth by an approach channel of about 10 km. The topographic map of the port of Antsiranana and its vicinity is shown in Figure 2-1-1.

The port has a land area of approximately 36,000 square meters and a water area of approximately 200 hectares. The land area is bounded on the east by a residential quarter and downtown, and on the south by a navy port base. The boat basin has more than 8 meters depth. Several shipwrecks are scattered.

2.1.2 Meteorology

According to the meteorological data from 1961 to 1990, the mean annual temperature is about 25.9 degrees C, the mean temperature in summer season from December to February is 26.7 degrees C, and that in winter season from June to August is 24.4 degrees C, indicating that temperatures vary little throughout the year. The mean annual rainfall is 1,197 mm and the monthly variation is remarkably large, registering 337.5 mm in January, the rainy season, and only 8.8 mm in September, the dry season.

The mean annual wind velocity is 5.8 m/s. That in summer season is the lowest, 4.0 m/s, and that from August and October is the highest, 8.1 m/s. Because of the trade wind blowing from the Indian Ocean, the predominant wind direction throughout the year ranges from east to south-east with a frequency of occurrence of 74 %.

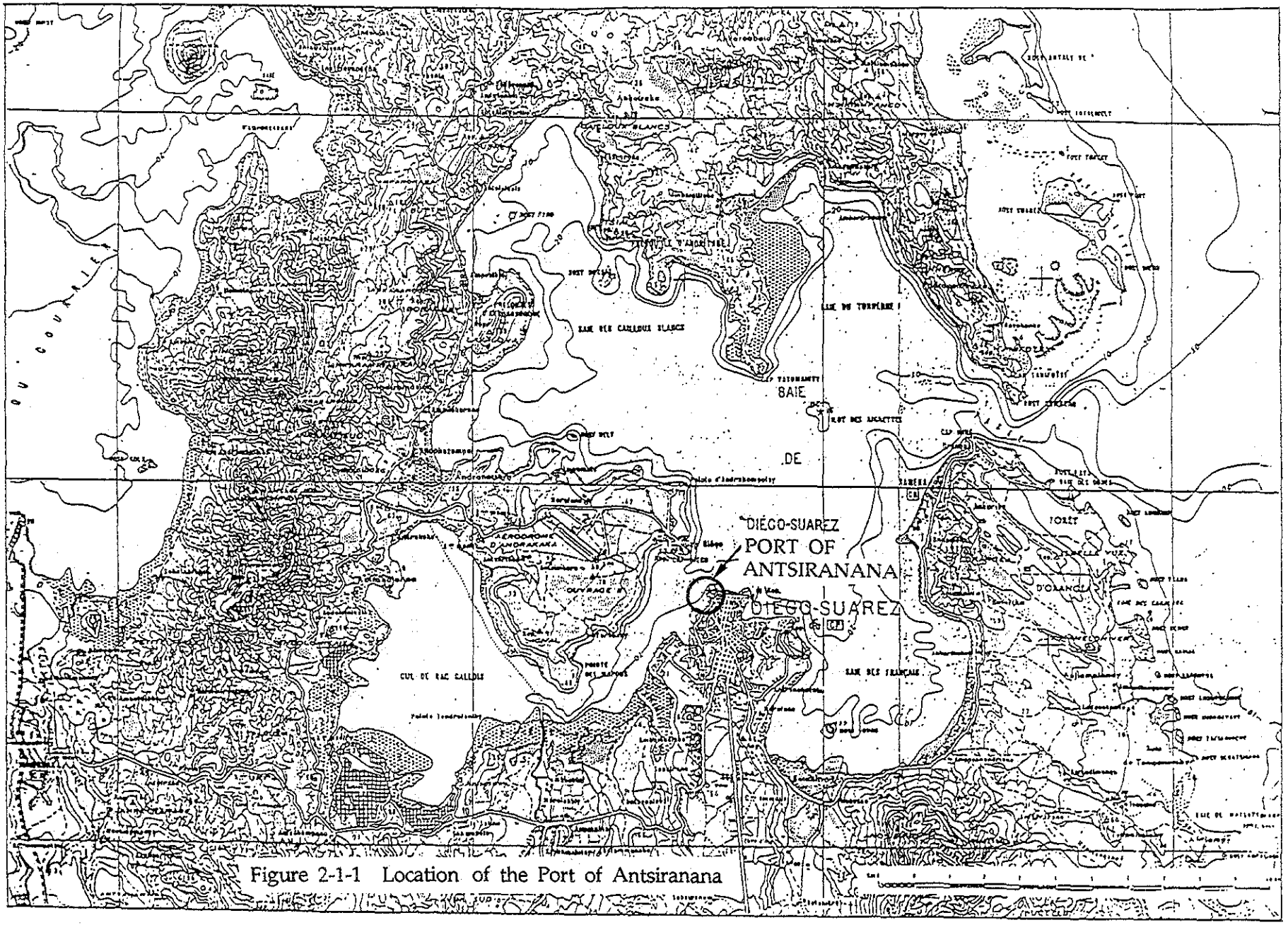

Figure 2-1-1 Location of the Port of Antsiranana

2.1.3 Sea Conditions

(1) Tide and Tidal Current

The tidal range at the port of Antsiranana is 1.8 meters at spring tide, and 0.6 meters at neap tide with appearance of a typical pattern of semi-diurnal tide.

The tidal current, which is influenced by the south-east trade wind, ranges in direction from west-north-west to west-south-west at flood tide and north-north-west at ebb tide. The current speed ranges from 0.6 to 0.8 knots at flood tide and 0.5 knots at ebb tide.

(2) Wave

Waves under ordinary wind condition are largely influenced by the wind waves generated inside of the bay. According to computation results, frequency of deep water wave with a height of over 0.5 meters is 5.29 %. While the maximum wave height is not more than 1.0 meter.

The wave under extraordinary wind condition caused by cyclones is 1.6 meters in height and 3.9 seconds in period.

2.1.4 Soil Conditions

The soil investigation yields the following characteristics: the soil in the front area of the existing quay of the port of Antsiranana is generally of poor mechanic characteristics for the surface layer consisting of silt, soft clay and shaly sand mainly. But the soil from the north to the north-east area of the port is of relatively good mechanic characteristics including friction stratum with good texture of sand having N-value of 20 to 50 except some parts such as sandy soft clay. The foundation layer consisting of limy marl, which is found in the entire surveyed area, has a high N-value of more than 30 and can be considered as a very reliable bearing foundation.

Consequently the area between the north and the north-east area of the port has good friction and bearing strata, so that the steel sheet pile structure, steel pipe pile structure and gravity type structure can be adopted. On the other hand, the area between the north end of the existing quay and boring No. 5 has a soft soil layer and a bearing stratum thereunder.

2.1.5 Environment

(1) Quality of Sea Water

From the field survey and interviews with people concerned, the most influential source of water pollution to the port area is the tuna tin factory, because it usually discharges waste water to the front water area of the port with no treatment. However the sewage from the factory is not remarkably large in volume and is diffused in a short time and thus the water area around the port has not received serious damage.

(2) Ecosystem

Within a radius of 3 km from the port, there is a factory zone, military zone and a residential quarter, beyond which there spreads a wide pasture area for cattle, dwellings, farmhouses, and so on. As for endemic fauna and flora, only a few mangroves and baobab are found about 5 km away from the port.

2.1.6 Magnetic Prospecting

The study team carried out a magnetic prospecting survey in the port area and vicinity for the confirmation of the existence of shipwrecks.

The survey recorded one large magnetic detection in the port area that seemed to be a shipwreck, which is located 100 meters offshore from the quay. A more detailed survey with diving prospecting will be recommended.

2.2 Port Facilities

2.2.1 Existing Facilities

The existing facilities in the port of Antsiranana are shown in Figure 2-2-1. The main berth is located in the center of the Port, running from north-south. In the south side of the Port, the quay is allocated for the coasters and small-boats. The mooring jetty is located at the north end of the quay. A small basin for pilot boat mooring is in front of the port office, protected from intruding waves by the mooring jetty and breakwater. A large portion of the land area is occupied by sheds, magazines and tuna cold storage.

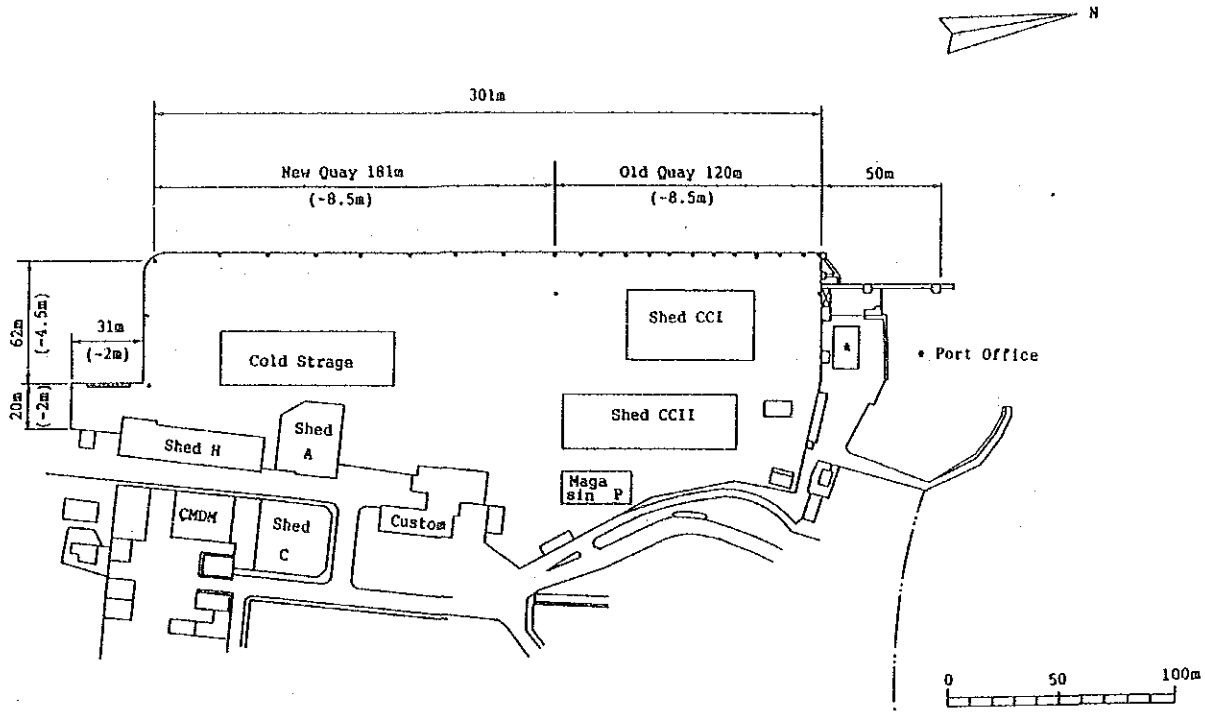

Figure 2-2-1 Existing Facilities of the Port of Antsiranana

The total berth length of the quay is about 414 meters as shown in Table 2-2-1. The ocean-going vessels quay is 301 meters in length and 8.5 meters in depth. The depth of the quay seems to be somewhat reduced in the north area at present. The coasters quay is 62 meters in length, and has a water depth of 4.5 meters. The small boat quay is 51 meters in length and the water depth of the quays is 2.0 meters.

The land area of the port is about 36,000 square meters, including 9,500 square meters of shed and magazine area, and 17,000 square meters of open yard.

Table 2-2-1 Berthing Facilities

Name	Length (m)	Depth (m)	Built
Ocean-going vessels quay	301	8.5	
Old quay	(120)	(8.5)	1932
New quay	(181)	(8.5)	1966
Coasters quay	62	4.5	1966
Small-boat quay	31 20	2.0	1966
Total	414		

2.2.2 Superannuation and Deterioration of Facilities

(1) Old Quay

Old quay is of reinforced concrete piled structure and 120 meters in length. This quay was constructed in 1932, and then in 1972 the slab of reinforced concrete was reconstructed. Recently, an overlay with asphalt concrete was executed (1989-1990).

From the result of the field survey carried out with regard to the structural transformation, breakage and deterioration of the quay, the repair items are listed as follows:

- Stability : Beam BM, Slab S2
- Safety : Front Wall, Fender, Bollard, Curbing.

(2) New quay

New quay is of steel sheet-pile cellular-bulkhead structure and 181 meters in length. This quay was constructed in 1966.

Deterioration appears in the superstructure concrete. The situation of the concrete is not so severe compared to the old quay but a part of the capping concrete of the quay is damaged.

Steel sheet-piles are corroded, particularly in the splash zone. Remaining thickness of the steel sheet-pile was examined based on the result of the survey with ultra sonic type thickness meter. The results of measurement are shown in Table 2-2-2. Remaining thickness is from 8 to 10 mm. Assuming the initial thickness is 12 mm, corroded thickness is from 2 to 4 mm and corrosion rate is about 0.1 mm/year (=3.0/27), which is the same as the ordinary value.

Table 2-2-2 Results of the Thickness Measurement of Steel Sheet-piles

Measured Location		Original Thickness T1(mm)	Measured Thickness T2(mm)	Corroded Thickness T1-T2(mm)	Remarks
No 1	+2.5m	12.0	8.9	3.1	Cell 19
	+0.5m	12.0	9.7	2.3	
	-1.5m	12.0	10.5	1.7	
No 2	+2.5m	12.0	8.2	3.8	Arc between
	+0.5m	12.0	9.5	2.5	Cell B and CD
No 3	+2.5m	12.0	10.0	2.0	Cell K
	+0.5m	12.0	10.4	1.6	

Note: The original thickness is assumed to be 12 mm.

From the result of the field survey, the repair items are listed as follows:

- Stability : Cellular-bulkhead
- Safety : Capping concrete, Fender, Bollard, Curbing.

2.3 Cargo Handling Volume

(1) General merchandise cargo

1) Loaded cargo

Among these commodities, major cargoes are tuna and salt. Until 1990, tuna was mainly transhipped from fishing boats to refrigerator vessels for export. But since the tuna factory behind the port began its production in March 1991, a portion of tuna has been exported by container as canned food. Salt of Madagascar is mainly produced in Antsiranana and its export volume is comparatively stable according to the trade statistics.

Most of rice, flour, cement and fertilizer in the loaded cargoes are domestic cargoes and they are mainly imported for transhipment to other ports. The volume of these cargoes fluctuates.

Other items consist of coffee, cacao, cashew nuts, general merchandise, container and others. The contents of general merchandise and container in other items are unavailable in the statistics of DTM. It seems that the volume of other items has been steadily increasing.

Table 2-3-1 Trend of Loaded Cargo Volume Excluding Petroleum Products

(Unit:ton)

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Total	36,131	44,521	46,718	55,617	52,031	32,960	62,171	71,603	78,174	87,595
tuna(tranship)	674	1,945	4,629	17,312	18,447	4,007	16,735	35,058	41,161	51,841
Salts	20,603	28,982	30,299	32,959	24,863	21,803	30,732	23,402	20,980	10,916
Rice	0	5,050	1,688	466	0	1	0	0	0	2,001
Flour	30	35	270	0	52	189	181	66	0	868
Cement	3,353	957	553	0	23	0	224	200	0	31
Fertilizer	2,282	2,363	1,408	0	2,491	5	1,310	0	0	0
Canned food	0	0		0	0	0	0	0	2,273	6,059
Others	9,189	5,189	7,871	4,880	6,155	6,955	12,989	12,877	13,760	15,879

Source: DTM

NOTE: Tuna data in 1991, 1992 are based on PFOI data and others

2) Unloaded cargo

Among these commodities, major cargoes are rice, flour, tuna, cement and fertilizer. In the statistics of trade in Madagascar, the import volume of rice decreases, while that of flour and cement increases. For several years, the unloaded volume of rice, flour and cement at the port of Antsiranana has been comparatively stable.

An import cargo before 1984, rice became a domestic unloaded cargo between 1985 and 1991, but reverted to an import cargo again in 1992. Most flours in the unloaded cargoes are domestic cargoes and constitute transhipment cargo from other ports. In the unloaded volume of cement, the proportion of import for inbound is different each year. Before 1989, fertilizer was mainly an import cargo, but since this year fertilizer has not been handled. Most tuna was transhipment cargo for export before 1990, but since this year part of it is unloaded for the canning factory.

The majority of coffee is transhipment cargo for export from other ports, and the volume is not stable. For several years, the volume of other items which consist of general merchandise, container and others has been comparatively stable with the exception of 1991.

Table 2-3-2 Trend of Unloaded Cargo Volume Excluding Petroleum Products

(Unit:ton)

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Total	47,075	32,157	37,940	23,621	36,843	24,781	45,684	63,436	79,863	89,879
Rice	15,855	11,846	10,637	0	3,130	3,939	5,609	4,868	4,044	4,872
Flour	1,124	1,275	1,528	1,626	2,328	2,295	1,389	2,017	2,041	1,053
Tuna(including tranship)	1,446	1,265	4,128	19,518	19,172	4,007	16,735	35,058	47,036	66,537
Cement	11,220	4,137	9,951	175	2,433	3,726	6,707	7,862	7,118	6,947
Coffee	4,753	803	1,557	0	0	0	1,968	1,383	0	303
Fertilizer	3,343	2,153	1,938	0	2,237	118	1,628	0	0	0
Animal & Vegetable oil	1,208	1,602	1,131	0	1,173	1,405	588	1,445	0	482
Metal products	1,174	1,646	952	518	438	949	1,553	1,666	1,222	1,211
Others	6,952	7,430	6,118	1,784	5,932	8,342	9,507	9,137	18,402	8,474

Original Source: DTM
Note: Tuna data are based on PFOI data and other

(2) Petroleum products

SOLIMA deals exclusively with most refining, transportation and sales of petroleum and its products in Madagascar. SOLIMA has only one refinery in Toamasina. About 45 % of petroleum products refined there are transported by ship from the port of Toamasina to other ports and the rest is mainly transported by railway to inland capital

areas. To make up for a deficiency, complementary petroleum products are imported mainly through the port of Antsiranana. About 70 % of imported volume in 1992 was transhipped off shore from an ocean tanker to coastal tankers and then transported to other ports.

Table 2-3-3 Trend of Petroleum Cargo Volume

(Unit:ton)

	Import			Cabotage	Total	Cabotage	Grand Total			
	Total	Unload	Tranship	Unload		Load	Unload	Load	Tranship	Total
1988	16674	9792	6882	12862	29536	5200	22654	5200	6882	34736
1989	6676	6676	0	6752	13428	0	13428	0	0	13428
1990	0	0	0	9902	9902	2030	9902	2030	0	11932
1991	29887	9732	20155	9546	39433	2840	19278	2840	20155	42273
1992	81122	24269	56853	12567	93689	5890	36836	5890	56853	99579

Source: SOLIMA

2.4 Calling Vessels

2.4.1 Frequency of Calling Vessels

According to the statistics, the number of calling vessels highly fluctuates not only per month but also per year. It is guessed that the former mainly reflects fishery boats calling and the latter the economic situation. Particularly the decline seen in the late half of 1991 is influenced by the political and economical confusion in Madagascar.

2.4.2 Category of Vessel Type

There are various types of vessels calling the port of Antsiranana. They can be categorized into ocean-going cargo vessels, coastal cargo vessels, fishery boats and others. Furthermore, others are divided into two types. One is related to calling and waiting to be repaired by SECREN and the other is for refuge or rest.

Characteristics by vessel type such as staying time at the port and vessel size are fairly different from one another.

2.4.3 Staying time by vessel type

Average staying time in 1990 by vessel type is as follows:

- Ocean-going cargo vessel (75 vessels) 1.62 days

- Coastal cargo vessel (75 vessels) 2.33 days
- Fishery boat (80 vessels) 5.25 days
- Vessels related to SECREN (70 vessels) 3.02 days
- Others (28 vessels) 17.38 days

2.4.4 Vessel Size by Vessel Type

The distributions of gross tonnage and overall length for categorized vessel type are analyzed.

For ocean-going cargo vessels, predominant vessel size is 12,000 GRT class and under 5,000 GRT class, while there are several 20,000 GRT class vessels calling.

For coastal cargo vessels, 72 % of all are under 2,000 GRT but over 2,500 GRT vessels are continuously calling. As to overall length, it is noted that the 100 m class accounts for more than one-third of the total.

For fishery boats, both ship size and overall length do not have vast distributions. Predominant vessel size is from 700 GRT to 1,800 GRT and overall length is from 50 m to 80 m. However, another report says that a fishery cargo vessel with freezers is 4,000 GRT class.

2.5 ADMINISTRATION, MANAGEMENT AND OPERATIONS

At Antsiranana Port, Port Master grants permission for port use and berth assignment and levies appropriate port charges such as entering the port, wharfage and cargo handling charge, etc.

All cargo handling operations are conducted by COMPANIE MALAGACHE DE MANUTENTION(CMDM) which is a private company created by French capital.
In general, derricks or crawler are used for loading/unloading of cargoes into/from vessels. To handle cargo including containers at apron or open yard, fork lifts or yard tractors are used.
SOLITARY MALAGASY(SOLIMA), a private company created by government funds and having an oil refinery, transfers their products by pipeline between the port and their tanks.

Organization chart of Antsiranana Port is shown in Figure 2-5-1.

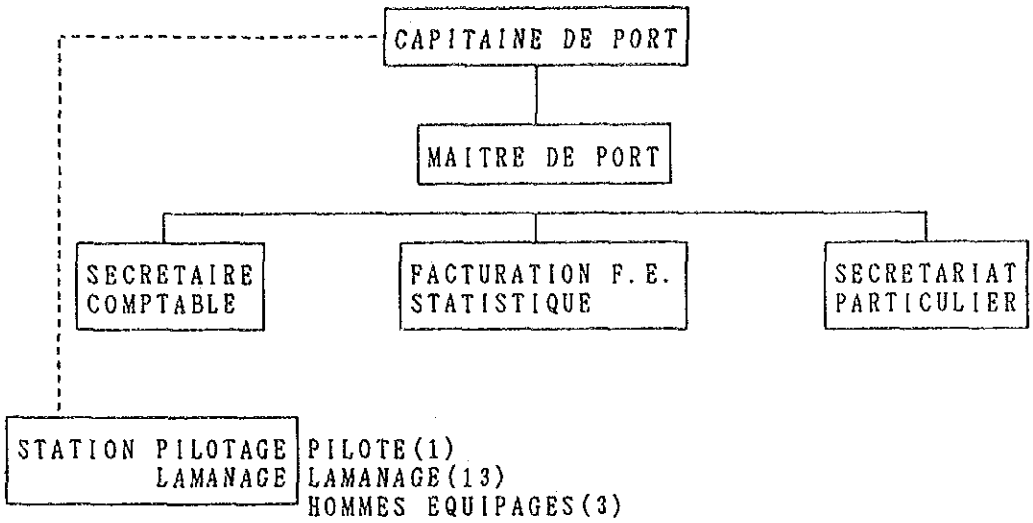

Figure 2-5-1 Organization Chart of the Port of Antsiranana

CHAPTER 3

MASTER PLAN OF THE PORT OF ANTSIRANANA

3. MASTER PLAN OF THE PORT OF ANTSIRANANA

3.1 Background of the Port Development

(1) Problems to be solved with the existing facilities

- Superannuation or deterioration of facilities

The port of Antsiranana has two quays whose total length is 414 m. It has been a long time since construction and all quays as well as transit sheds are superannuated or deteriorated more or less. They very urgently require necessary rehabilitation works.

- Shortage of quay length and depth

The length of the quay is insufficient for mooring of ocean-going vessels. They are often moored out of "the Old Quay", about 50 m northwards using mooring dolphins. As to the water depth of the quay, it is not sufficient to accommodate 10,000 DWT class vessels in full load though they call every month. Some of SOLIMA's tankers are forced to handle oil products off the quay in the bay.

- Containerization

Container cargo traffic volume in the port of Antsiranana is gradually increasing. However, even now, the port of Antsiranana is not well equipped to receive containers because open yard is unpaved and undulated with improper layout of the transit sheds.

(2) Development required to support the regional and national prosperity

The port of Antsiranana is one of the most important infrastructures for its hinterland to become prosperous. The role of the port will become more important in future.

At present, it is strongly required to formulate a port development and implementation plan on the basis of the long term viewpoint.

3.2 Concept of the Port Development

3.2.1 The roles and functions of the port

The present roles and functions of the port of Antsiranana are summarized as follows:

- to deliver daily necessities to the hinterland
- to collect goods to be supplied to other districts in Madagascar or to be exported
- to support the industrial activities for the hinterland
- to supplement the port of Toamasina, for example, to import oil products
- to provide a place for vessels to refuge, rest or wait to be repaired by SECREN

It is necessary and important to ensure the above roles and functions both now and in the future.

3.2.2 Orderly and efficient management and operation of the port

Each type of vessel that calls the port has its own particular characteristics. For example, vessel size, staying time, the peak and offpeak period of calling and so on differ largely by the types of vessels. The appropriate principles need to be established for orderly and efficient operation and management of port facilities. One possible means to that end may be to assign specific berths or wharves according to the different types of vessels. This means that port area should be divided, in principle, into several specified parts such as for ocean-going vessels, coastal cargo vessels, fishery boats and others.

3.2.3 Background of the port development

It is very important to incorporate the idea of supporting regional and national prosperity into the port plan. In this sense, the Master Plan should be flexible enough to meet any contingency, for example, a change in hinterland conditions.

3.3 Alternative Sites for the Port Development

As to possible sites for the port development, the area in the vicinity of Anse Melville (Site A) and the area around the present port (Site B) are selected as possible alternatives (Figure 3-3-1).

Site B is the most suitable place for the port development from various points of view. It has a deep water area northwards and in front of the existing quay, while the

southward area is shallow and extremely calm. In addition, at Site B, there would be no problems in terms of accessibility to and communication with the existing port services.

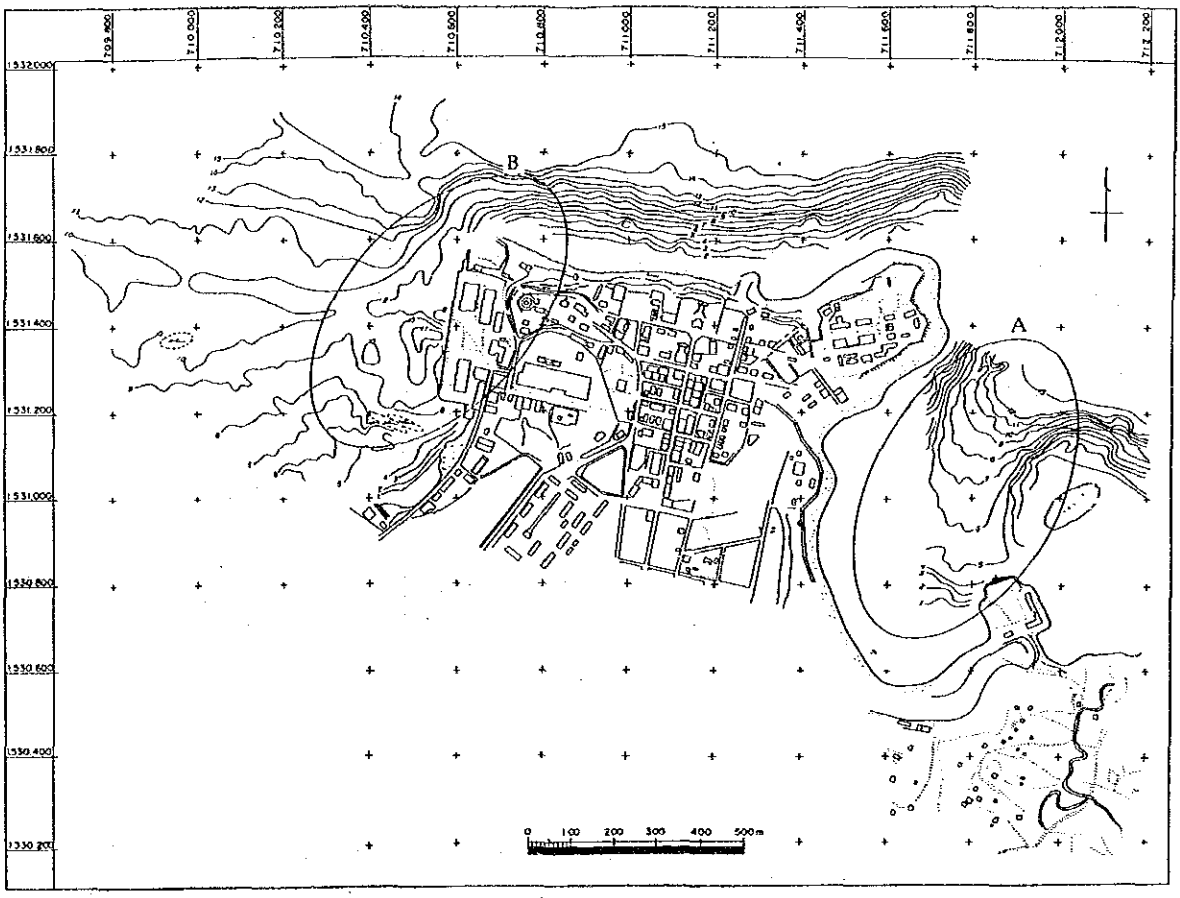

Figure 3-3-1 Alternative Sites for the Port Development

3.4 Demand Forecast

3.4.1 Future Socioeconomic Framework

(1) Population

1) Madagascar

Based on the estimation of the Madagascan government and the World Bank's Report, the future population framework is estimated as follows.

Table 3-4-1 Results of Population Forecast

Year	Population (thous pers)	Ave increase rate (%)	Remark
1992	11,797	2.7	1999/1992
1999	14,180		Madagascar government
2000	14,520	2.4	2025/1999
2010	18,410		The World Bank

2) Antsiranana province

Based on the past trend of population, the future population framework of Antsiranana province is estimated as follows.

Table 3-4-2 Results of Population Forecast in Antsiranana Province

Year	Population(thousand person)			Ave increase rate (%)
	West	East	Total	
1992	434	714	1148	2.2
1998	494	814	1308	
1999	506	834	1340	2.4
2010	657	1082	1739	

(2) GDP of Madagascar

It is expected that the average growth rate of GDP in the future is 6 %, the same as the average growth rate of low-income countries from 1980 to 1990. But it is assumed that the growth rate will have 3 phases because it will take a long time before Madagascar obtains a GDP growth rate of 6 %.

Table 3-4-3 Results of GDP Forecast in 1990 Price

(UNIT:BILLION FMG, %)

YEAR	AGRICULT		INDUSTRY		SERVICE		TOTAL	
	PRICE	SHARE	PRICE	SHARE	PRICE	SHARE	PRICE	SHARE
1992	1383	33.6	577	14.0	2155	52.4	4115	100
1998	1651	33.6	709	14.4	2554	52.0	4914	100
2003	1961	32.0	971	15.9	3193	52.1	6125	100
2010	2581	28.0	1833	19.9	4793	52.1	9207	100
Ave growth rate								
1998/1992	3.0		3.5		2.9		3.0	
2003/1998	3.5		6.5		4.6		4.5	
2010/2003	4.0		9.5		6.0		6.0	
2010/1992	3.5		6.6		4.5		4.6	

3.4.2 Hinterland

(1) The present situation

Based on the actual road network and the activities of maritime transportation, it is assumed that the hinterland connected directly to the port of Antsiranana is the western part of Antsiranana province, while its secondary hinterland is the whole country.

(2) The future situation

It is thought that the future hinterland of the port of Antsiranana will not discernibly change from the present situation because the Government does not have an improvement plan of roads connecting Antsiranana city with the eastern part of Antsiranana province and with Mahajanga province, nor does it have a definite plan which reinforces the coastal transportation in Madagascar.

3.4.3 Cargo Volume Forecast

Judging from the major cargoes handled at the port of Antsiranana, the handling cargoes are classified into 4 categories, that is, tuna-related cargoes, salt, petroleum products and other general cargoes. Future cargo volume is forecast for each category.

1) Tuna-related cargoes

Tuna factory cargoes

PFOI has a factory expansion plan to raise the production capacity of canned tuna from 55 million to 100 million by 1996. Based on this new capacity, tuna factory related cargoes are forecast. Since PFOI has not yet formulated the next expansion plan after 1996, however, the capacity of the tuna factory is not expected to change further until 2010.

Transhipment volume of tuna

Considering the data of Association Thoniere Commission de l'ocean Indien, the volume of tuna handled in the future at the port of Antsiranana is forecast to increase.

As it is thought that most of the increased cargo will be carried into the canning factory, transhipment volume of tuna after 1994 will remain the same as that in 1992.

2) Salt

Based on an interview with CSM, it controls 95 % of the country's entire

production and domestic consumption has a large share. Therefore, the future production volume is forecast by correlation of the past production volume with the total Madagascan population.

3) Petroleum products

Regarding supply and demand of petroleum products in Madagascar, based on SOLIMA data, volume of products made of crude petroleum fails to meet the demand. To make up for the deficiency, kerosine and gas oil are imported and overproduced fuel oil is exported. Based on an interview with SOLIMA, volume of import crude petroleum is decided by consumption of gasoline, and shares of products made of crude petroleum are nearly constant.

The cargo volume handled at the port of Antsiranana is forecast for each product on the premise that the capacity of refinery in Toamasina is expanded in the future according to the increase in demand.

4) Other general cargoes

Other general cargoes consist of rice, flour, cement, fertilizer, coffee, cooking oil, metal products and other cargo, and are forecast based on the correlation with economic indices and the past volume handled at the port of Antsiranana.

(3) Results of cargo volume forecast

Results of cargo volume forecast are shown in Table 3-4-4, and Figure 3-4-1, 3-4-2.

Table 3-4-4 Results of Cargo Volume Forecast in 2010

(UNIT: MT)

	Load	Unload	Tranship	Total
FOREIGN	89,100	74,600	0	163,700
TUNA-related	15,200	8,000	0	23,200
SALTS	25,600	0	0	25,600
PETROLEUM	0	36,500	0	36,500
OTHERS	48,300	30,100	0	78,400
DOMESTIC	60,000	87,300	0	147,300
TUNA-related	0	37,000	0	37,000
SALTS	29,900	0	0	29,900
PETROLEUM	12,200	19,100	0	31,300
OTHERS	17,900	31,200	0	49,100
TRANSHIP	0	0	164,000	164,000
TUNA-related	0	0	52,000	52,000
PETROLEUM	0	0	112,000	112,000
TOTAL	149,100	161,900	164,000	475,000
TUNA-related	15,200	45,000	52,000	112,200
SALTS	55,500	0	0	55,500
PETROLEUM	12,200	55,600	112,000	179,800
OTHERS	66,200	61,300	0	127,500

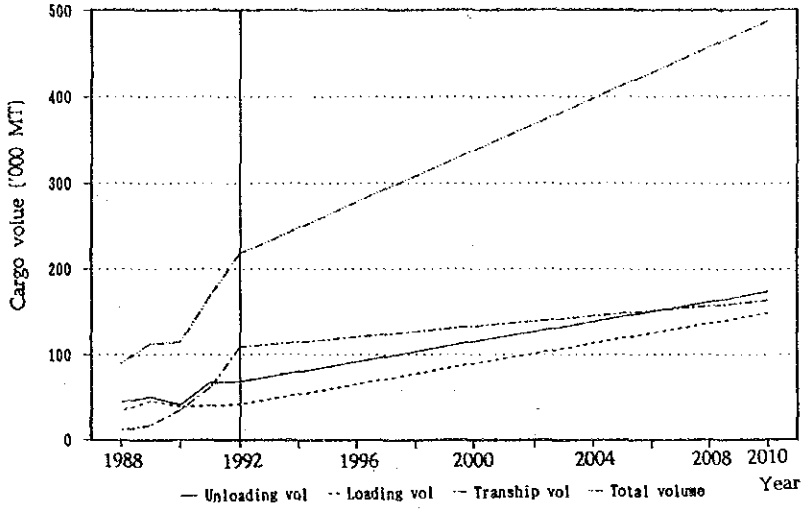

Fig. 3-4-1 Results of Cargo Volume Forecast (1)

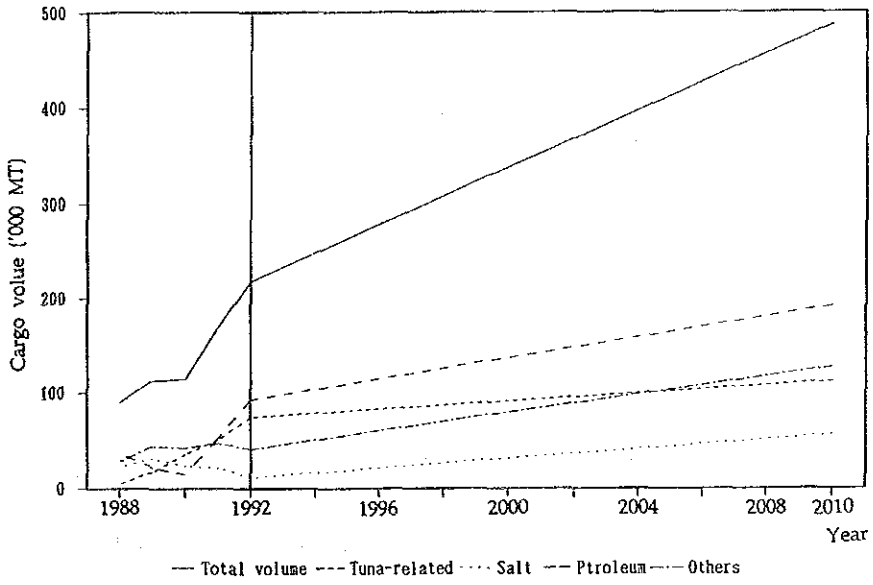

Fig. 3-4-2 Results of Cargo Volume Forecast (2)

3.5 Required Port Facilities and Equipment

3.5.1 Forecast of Vessel Size by Vessel Type

The maximum ship size by ship type in terms of dead weight tonnage is determined as follows:

(i) The maximum size of ocean-going vessel is 30,000 DWT, including tankers.

(ii) The maximum coastal vessel size is 10,000 DWT. In addition, it is considered that the predominant coastal vessel size is estimated as 5,000 DWT and this situation is considered in the Master Plan.

(iii) The maximum fishery boat size is equivalent to 5,000 DWT cargo vessel.

(iv) The ship size of vessels for refuge, rest or repair is 2,000 DWT.

3.5.2 Required Berth Dimension by Vessel Size

Standard dimensions of vessels by type and standard berth dimensions provided in Lloyd's Register are adopted here.

3.5.3 Required Number of Berths

In this Study, a method considering the frequency of ship entry and cargo handling productivity is used.

This method is summarized as follows:

Number of berths = (Total number of berthing days) / (Annual number of workable days * Berth occupancy ratio)

where

-Total number of berthing days:(Number of vessel calls) * (Average berthing days per vessel)

-Number of vessel calls:(Annual cargo volume handled) / (Average cargo volume handled per vessel)

-Average berthing days per vessel:(Average cargo volume handled per vessel) / (Average cargo handling productivity per vessel per day) + (Number of days necessary other than cargo handling)

Referring to the UNCTAD report (Port development, A handbook for planners in developing countries), the berth occupancy ratio will be determined.

The parameters necessary to adopt the above mentioned formula will be given based on the forecast cargo volume, present situation of calling vessels or cargo handling etc.

As a result, the total required number of berths is 6, of which, in principle, two berths are assigned for international and coastal cargo handling respectively, one berth for fishery cargo handling and one berth for both coastal and fishery cargo handling.

As to berths for vessels to refuge, rest or wait to be repaired by SECREN, basin for small crafts may be used, and its required berth length is about 30/35 m.

3.5.4 Required Scale of Facilities

(1) Required Scale of Berths

Based on the results mentioned from sections 3.5.1 to 3.5.3, required scale of berths is as follows:

	maximum ship size (DWT)	number of berth	depth (m)	total length (m)
For international cargo	30,000	2	12	480
For coastal cargo	10,000 and 5,000	1 and 2	10 and 7.5	430
For fishery cargo	5,000	1	7.5	130

Note: Berths for coastal cargo handling are flexibly assigned for both international and fishery cargo handling.

The issues of vessels to refuge, rest or be repaired by SECREN is expected to be dealt with by the ongoing project, which is the 47.5m extension of the existing quay southward.

(2) Required Scale of Water Basin

In general, up to 5,000 DWT class vessels can maneuver without assistance of tugboats, while over 5,000 DWT class vessels use tugboats when turning in the water

basin in front of the berth.

Based on the above mentioned, required water basin is proposed in the Master Plan.

(3) Required Scale of Storage Area

Containers, iron and metal products are stored in open yards, while almost all cargoes except oil products are usually stored in transit sheds. The required scale of storage area is as follows:

Transit sheds	: 11,700 m^2
Open yard for general cargoes	: 100 m^2
Open yard for laden containers	: 7,200 m^2
Open yard for empty containers	: 1,950 m^2

(4) Protective Facilities for harbors

Judging from the field survey, it is thought unnecessary to plan a breakwater in the Master Plan.

3.5.5 *Safety Back-up Facilities*

(1) Navigation marks

In order to secure the maneuvering, proper navigation marks are indispensable. According to the interview and survey, navigation marks are installed in the right places in the proper way.

(2) Tug boat

In the case of the port of Antsiranana, where the maximum vessel is estimated at 30,000 DWT, the provision of one 2,000 ps tug boat is recommended.

(3) Pilotage system

It is important to maintain the pilot boat and the pilotage system properly.

3.5.6 System for Cargo Handling

CMDM is the only stevedore and handles all cargoes except oil products at the port of Antsiranana.

Present cargo handling system is a typical conventional style. This style will not change considering the cargo type and volume at the target year.

As to the pipelines for oil products, extension or renewal is required by SOLIMA in correspondence with implementation of the new port plan.

3.5.7 Other Infrastructures and Utilities

In addition to major facilities, other infrastructures and utilities are necessary to operate and manage the port. The main infrastructures and utilities are as follows:

Office(Port office, Custom office, Workshops)
Lighthouse
Road(from a main road to the terminal)
Parking for vehicles
Fence and checkpoint at the terminal entrance and exit
Electricity transmission line(within the terminal)
Electricity transformer station
Water supply line(from a main pipeline to the terminal)
Oil supply pipeline
Drainage
Fire department

3.6 Proposed Master Plan

In the formulation of the Master Plan, the following factors are considered essential:

- Careful consideration of the actual geographical, meteorological and sea condition
- Securing sufficient area for cargo handling and storage
- Keeping low level of construction costs
- Ensuring potential for the future usage or expansion

Considering the above, the layout is envisioned as follows:

- The quay line is extended 211.5 m northward, from the existing quay, and is then further extended 480 m eastward.
- In principle, each berth will be specified in the following way: part of the "New Quay" and the extension southward are for fishery boat use, the left part of the existing quay and the planned extension northward are for coastal vessel use and the vertically crossed extension part, which is planned east and westward, is for

international vessel use. However, this principle does not preclude exceptional usage.

- In the layout of the international commercial berths, it will be borne in mind that multi-purpose or container vessels will be accommodated in future so that transit sheds will be placed so as not to block the movement of handling equipment.
- The face line of transit sheds and open yards will be unified.

As a result, the Master Plan is proposed as follows (Figure 3-6-1):

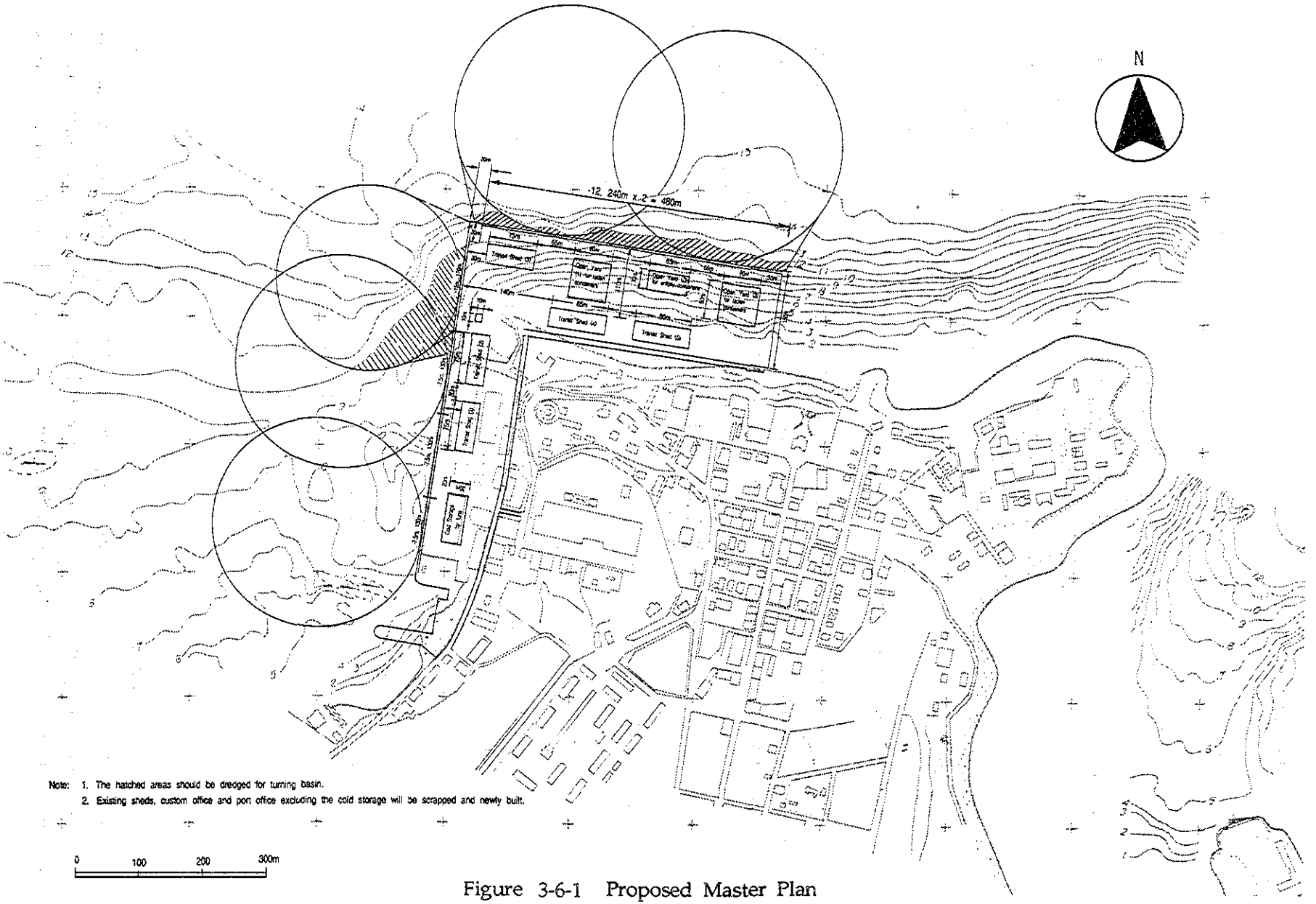

Figure 3-6-1 Proposed Master Plan

3.7 Structural Design

3.7.1 Existing Port Facilities

(1) Rehabilitation of Old Quay

The deterioration is concentrated on the superstructure, and the beam BM and the slab S1 have severely deteriorated and their load-carrying capacities have dropped to the half of their initial value. Therefore, to maintain the stability of the old quay, two alternatives for rehabilitation, reconstruction of slab S2 and reinforcement of beam BM are compared. From the result of the comparison, the reconstruction of slab S2 is preferable and adopted for the rehabilitation plan of the old quay.

(2) Rehabilitation of New Quay

The new quay is of a steel sheet pile cellular-bulkhead structure and is stable under the present situation. It is considered that only preventing the corrosion of steel sheet piles is required. Two alternatives for anti-corrosion, cathodic protection method and painting and lining method, are compared. From the comparison, cathodic protection method is preferable and adopted for the rehabilitation plan of the new quay.

3.7.2 Planned Port Facilities

(1) Fundamental design conditions

The fundamental design conditions for the planned facilities are as follows:

- Tidal Level : H.W.L.+2.35 m, L.W.L.+0.52 m
  CDL 0.00 m
- Wave Height : H= 1.6 m, T= 3.9 sec
- Seismic Coefficient : Kh= 0.0
- Crown Height of Wharf: +4.00 m
- Surcharge : -10 m Berth : 2.0 tf/m^2
  -12 m Berth : 3.0 tf/m^2
- Life Time : 50 years

(2) Soil Conditions

1) North area of the port

The surface soft soil layer consisting of soft clay, plastic clay or silty sand is ignored in designing and soft limy marl or basalt boulders and pebbles which has an N-value of less than 15 is also ignored. Limy marl layer with N-value of over 50 is

considered to be a reliable bearing stratum.

2) North-east area of the port

Considering the result of the soil survey at the site and the slope of the sea bottom, the same soil conditons as in the north area are accepted to the structural design of the quay for ocean-going cargo vessels.

(3) Main Port Facilities

The three basic alternatives of the new berths, gravity wall, steel sheet pile and steel pipe pile type, are compared. From the comparison, steel sheet pile type is chosen as the fundamental structure.

A typical cross-section of a quay for coastal cargo vessels and a quay for ocean-going cargo vessels is shown in Figure 3-7-1.

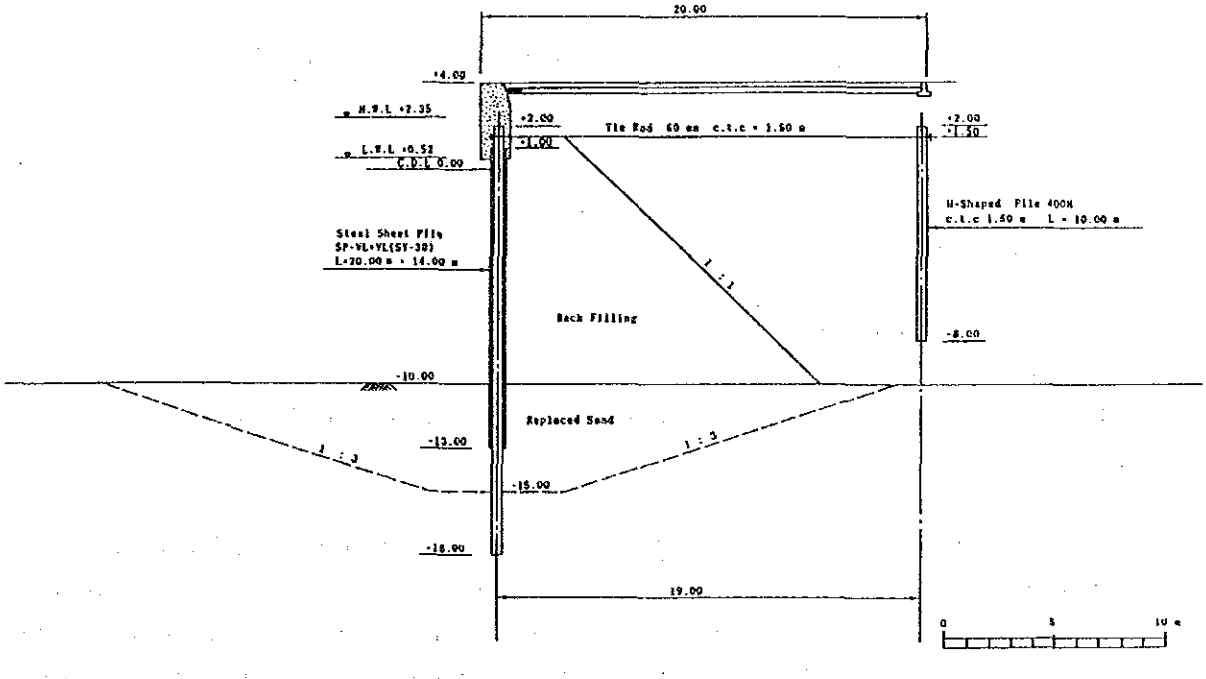

Figure 3-7-1(1) Typical Cross-section of Quay for Coastal Cargo Vessels

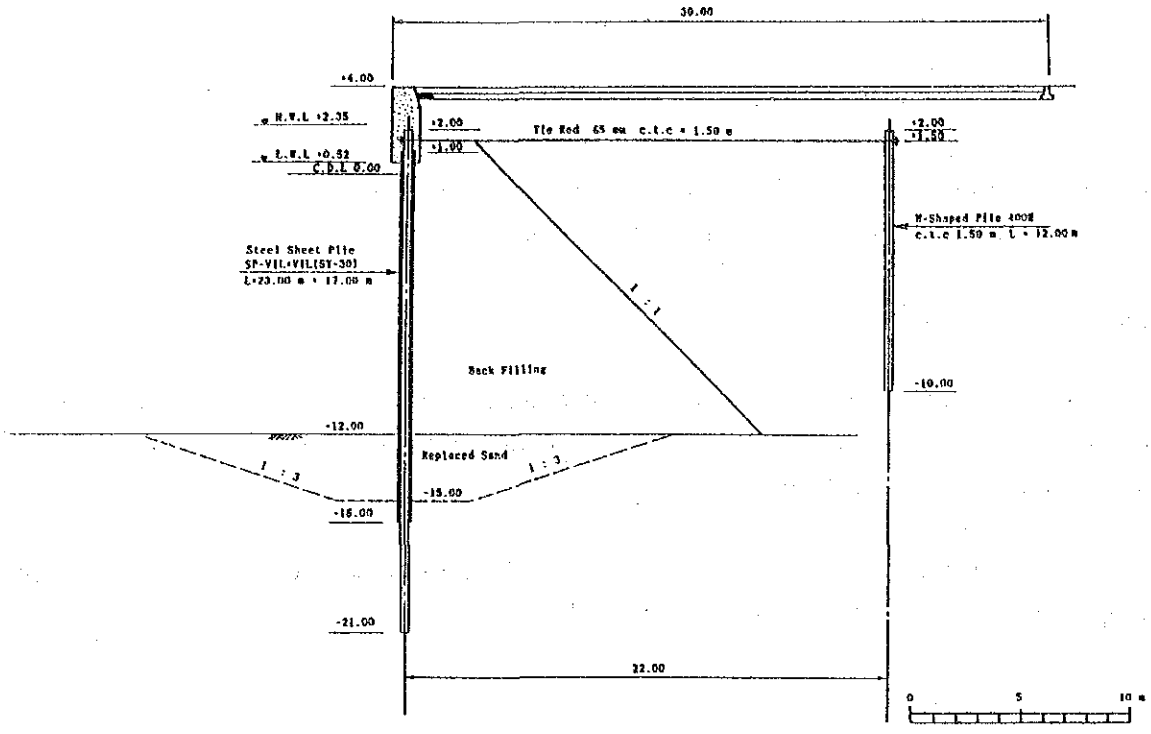

Figure 3-7-1(2) Typical Cross-section of Quay for Ocean-going Cargo Vessels

3.8 Construction Plan

3.8.1 Construction Schedule

The construction schedule of the quay and the relevant port facilities is presented in Table 3-8-1.

Experience in the construction of port facilities is quite limited in Madagascar, so the port facilities proposed in the project will be conducted in co-operation with foreign engineers. Respecting to the port construction works, large-sized construction machinery and equipment, construction vessels and skilled labor for special works will have to be procured from other countries.

Table 3-8-1 Construction Schedule

Facility		Construction Year																
Item	Sub Item	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1.Dredging	(1)-12.0m Berth																	
	(2)-10.0m Berth																	
2.Reclamation																		
3.Quays	(1)-12.0m Berth																	
	(2)-10.0m Berth																	
	(3)-7.5m Berth																	
	(4)Revetment																	
4.Rehabilitation	(1)Old Quay																	
	(2)New Quay																	
5.Road	(1)Road																	
	(2)Fence and Gate																	
6.Buildings	(1)Port office																	
and	(2)Custom Office																	
Transit Sheds	(3)Transit Shed(No.1)																	
	(4)Transit Shed(No.2)																	
	(5)Transit Shed(No.3)																	
	(6)Transit Shed(No.4)																	
	(7)Transit Shed(No.5)																	
7.Land	(1)Open Yard(No.1)																	
	(2)Open Yard(No.2)																	
	(3)Open Yard(No.3)																	
	(4)Open Yard(No.4)																	
	(5)Pavement																	
8.Aids to	(1)Light Marker																	
Navigation	(2)Tug Boat																	
9.Demolition	(1)Maritime Structure																	
	(2)Land Structure																	

3.9 Cost Estimation

3.9.1 Estimation Basis

Some limits for the estimation are as follows:

i) The costs of the main port facilities proposed in the Master Plan are estimated.
ii) Land rents, compensation and insurance costs are excluded.
ii) Rehabilitation of existing quay is included.
iv) Extension of the fishery quay planned individually is excluded .
v) The demolition of the existing buildings such as the port office, the custom office and the warehouses is included. Removal of wrecked vessels and submerged obstacles is excluded.
vi) Road and utilities such as electricity, water supply, drainage and so forth connected outside of the port area are excluded.
vii) Physical contingency is included.

3.9.2 Estimation Result

The construction cost of each of the major facilities is listed in Table 3-9-1. The estimation procedure of the project cost of the Master Plan is as follows:

i) Prices in Japan are used for the estimation of the costs of imported materials and goods.

ii) If the prices are unavailable, they are estimated by comparing the prices of other goods both in Madagascar and Japan.

iii) The project costs of the Master Plan are estimated considering the new wage rates released on January 25,1994.

vi) An administration cost is fixed as 20 % of the total construction cost.

v) The new additional tax rate (T.S.T.) which is imposed on the materials and the rental construction machinery produced locally at site is estimated as 7.5 % and 15 % respectively.

Table 3-9-1 Construction Cost of the Facilities

Facility		Unit	Quantity	Construction Cost
Item	Sub Item			(US$)
1.Dredging	(1)-12.0m Berth	m^3	38,000	1,471,000
	(2)-10.0m Berth	m^3	24,000	929,000
	Sub-total	LS	1	2,400,000
2.Reclamation	(1)Reclaimed Area	m^3	825,000	14,336,000
	Sub-total	LS	1	14,336,000
3.Quays	(1)-12.0m Berth	m	500	25,485,000
	(2)-10.0m Berth	m	170	8,954,000
	(3)-7.5m Berth	m	41.5	3,006,000
	(4)Revetment	m	450	9,007,000
	Sub-total	LS	1	46,452,000
4.Rehabilitation	(1)Old Quay	m	120	1,907,000
	(2)New Quay	m	181	865,000
	Sub-total	LS	1	2,772,000
5.Road	(1)Road	m	700	1,504,000
	(2)Fence and Gate	m	1,100	207,000
	Sub-total	LS	1	1,711,000
6.Buildings and Transit Sheds	(1)Port office	m^2	500	1,180,000
	(2)Custom Office	m^2	3,000	7,075,000
	(3)Transit Shed(No.1)	m^2	2,250	5,306,000
	(4)Transit Shed(No.2)	m^2	2,250	5,306,000
	(5)Transit Shed(No.3)	m^2	2,250	5,306,000
	(6)Transit Shed(No.4)	m^2	2,550	6,016,000
	(7)Transit Shed(No.5)	m^2	2,400	5,660,000
	Sub-total	LS	1	35,849,000
7.Land	(1)Open Yard(No.1)	m^2	3,600	570,000
	(2)Open Yard(No.2)	m^2	1,950	216,000
	(3)Open Yard(No.3)	m^2	3,600	570,000
	(4)Open Yard(No.4)	m^2	100	17,000
	(5)Pavement	m^2	61,000	8,047,000
	Sub-total	LS	1	9,420,000
8.Aids to Navigation	(1)Light Marker	set	1	47,000
	(2)Tug Boat	set	1	3,024,000
	Sub-total	LS	1	3,071,000
9.Demolition	(1)Maritime Structure	LS	1	58,000
	(2)Land Structure	LS	1	989,000
	Sub-total	LS	1	1,047,000
Total				117,058,000
Tax				2,416,000
Grand Total				119,474,000

3.10 MANAGEMENT AND OPERATION

3.10.1 Administration and management

In the development of a port, it is important to harmonize management with planning and construction. Administration of ports is the responsibility of DTM: all commercial ports are under its control. Port management and operation is the responsibility of SERVICE DE L'EXPLOITATON MARITIMES while port planning and maintenance is the responsibility of SERVICE DE PROJET PORTUAIRE. Their budgets and policies regarding port management and port planning are prepared independently without harmonization. Ports are operated (including minor maintenance) with the revenue from port charges, but all investment projects identified by port planning are financed by foreign cooperation capital. In particular, all revenue has been spent solely on port operating costs without new investment. In order to improve the above situation, following items need to be carefully considered for effective port management and operation.

- Strengthening the organization and establishment of adequate budgetary system to promote harmonized port management and operation and port planning.
- Making effort of increase the port revenue (reconsider the port tariff)
- Preparing the nationwide development and improvement plans.

3.10.2 Operations

In Madagascar, the works of port operation are divided broadly into two parts which are public and private works. Public works are as follows;

- Berth assignment
- Levy of charge
- Permission to use port facilities
- Coordination between public authority and private company concerned with port management

At the present time, there are only two types of private works, cargo handling and pilot service.

The problem concerning port operation is that all important decisions are made by DTM, while local agencies including Antsirananan Port have no authority to participate in the decision-making. Therefore, port operation isn't adapted to the actual condition.

The local agency should have more authority to deal the issues related to daily usage of facilities.