BASIC DESIGN STUDY FOR THE DEVELOPMENT OF THE INFRASTRUCTURE FOR A FISHING BASE IN THE MARSHALL ISLANDS

December 1983

JAPAN INTERNATIONAL COOPERATION AGENCY

BASIC DESIGN STUDY FOR THE DEVELOPMENT OF THE INFRASTRUCTURE FOR A FISHING BASE IN THE MARSHALL ISLANDS

December 1983

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

In response to the request of the Government of the Marshall Islands, the Government of Japan decided to conduct a basic design study on the Infrastructure for Fishing Base Construction Project and entrusted the study to the Japan International Cooperation Agency. The J I C A sent to the Marshall Islands a study team headed by Mr. Eiji ISHIHARA, Deputy Director, Coastal Fisheries Division, Fisheries Promotion Department, Fisheries Agency from September 21 to October 10, 1983.

The team had discussions with the officials concerned of the Government of the Marshall Islands and conducted a field survey in Majuro Island.

After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

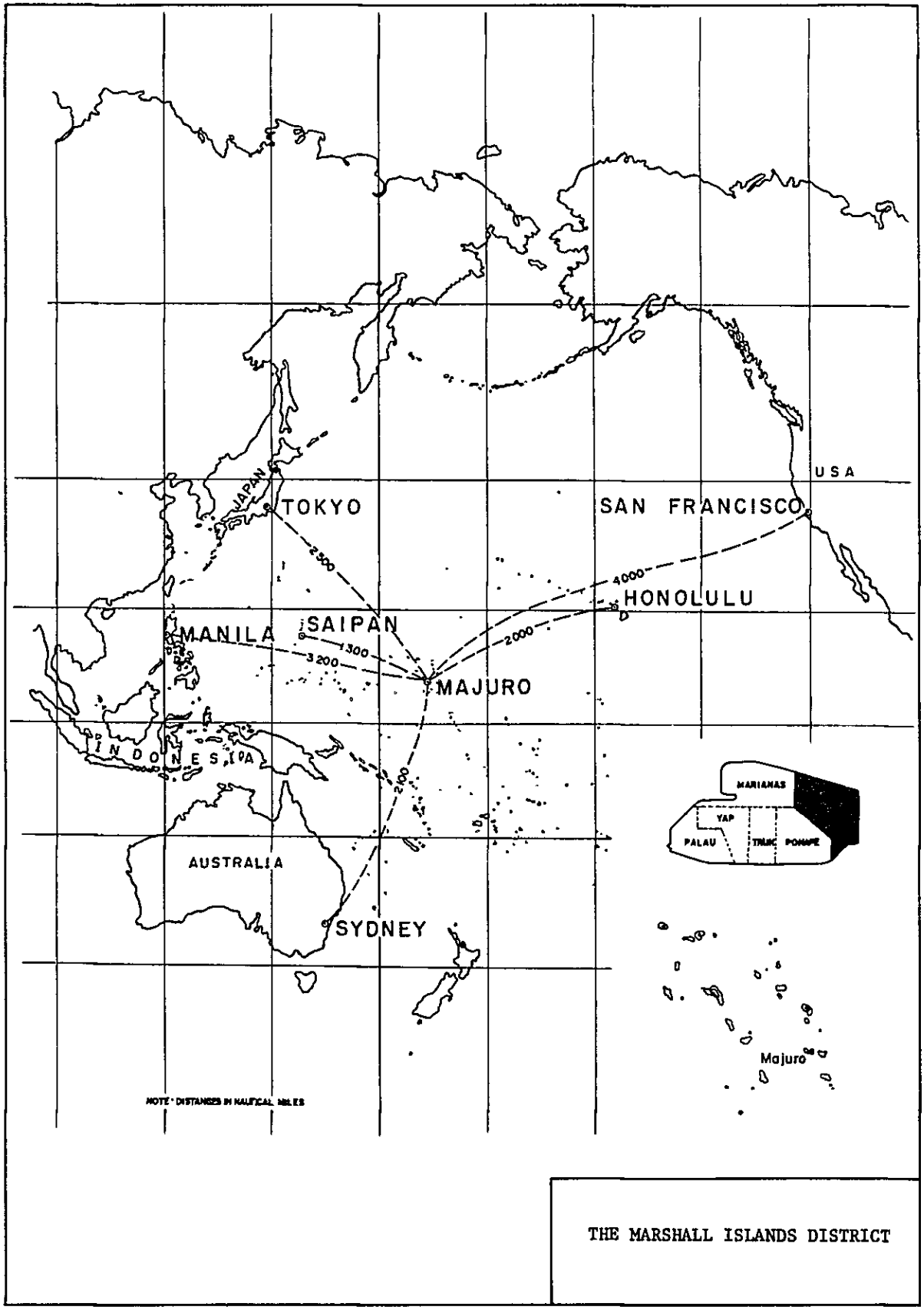
I wish to express my deep appreciation to the officials concerned of the Government of the Marshall Islands for their close cooperation extended to the team.

December , 1983

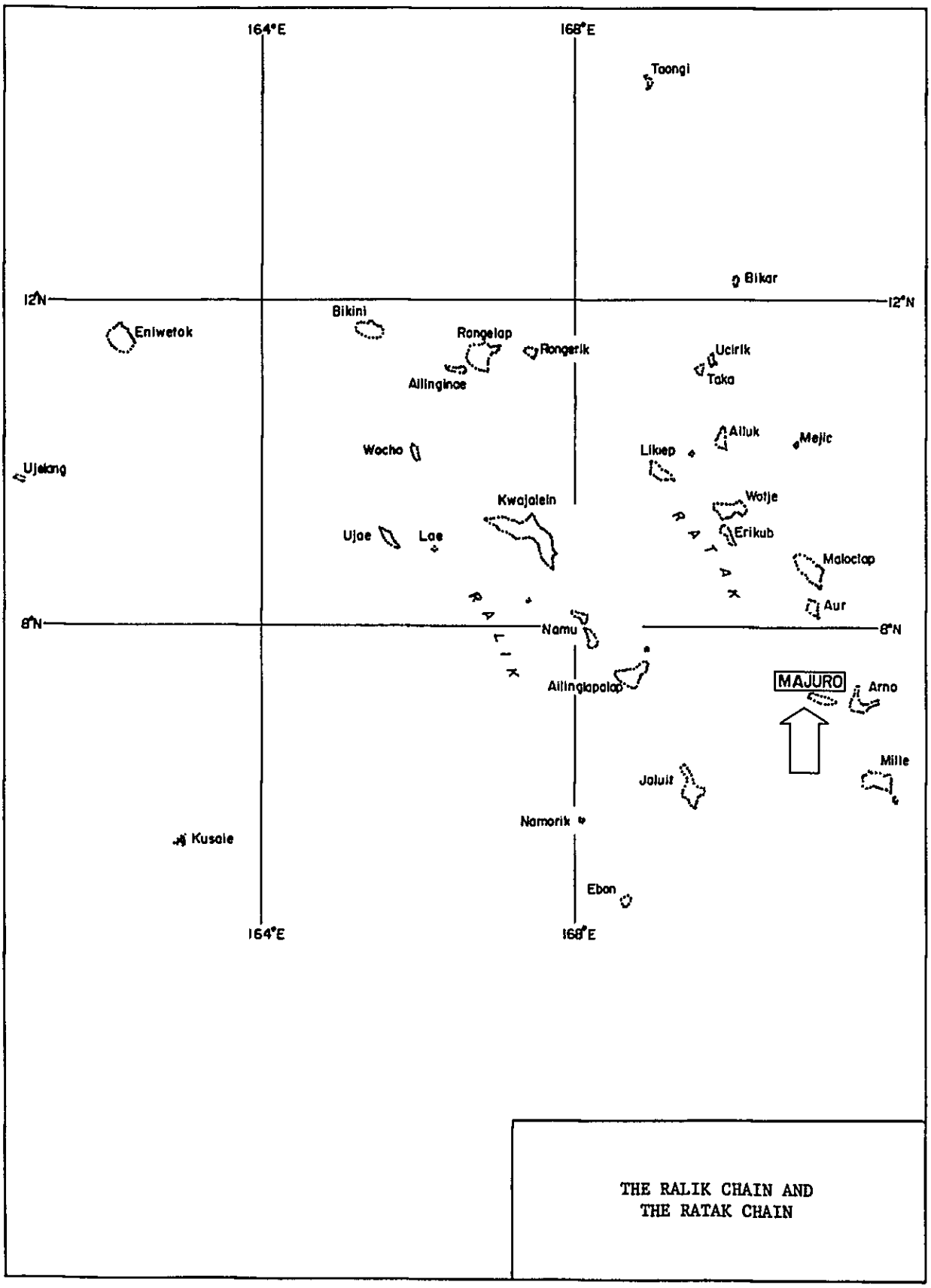
Keisuke Arita

President

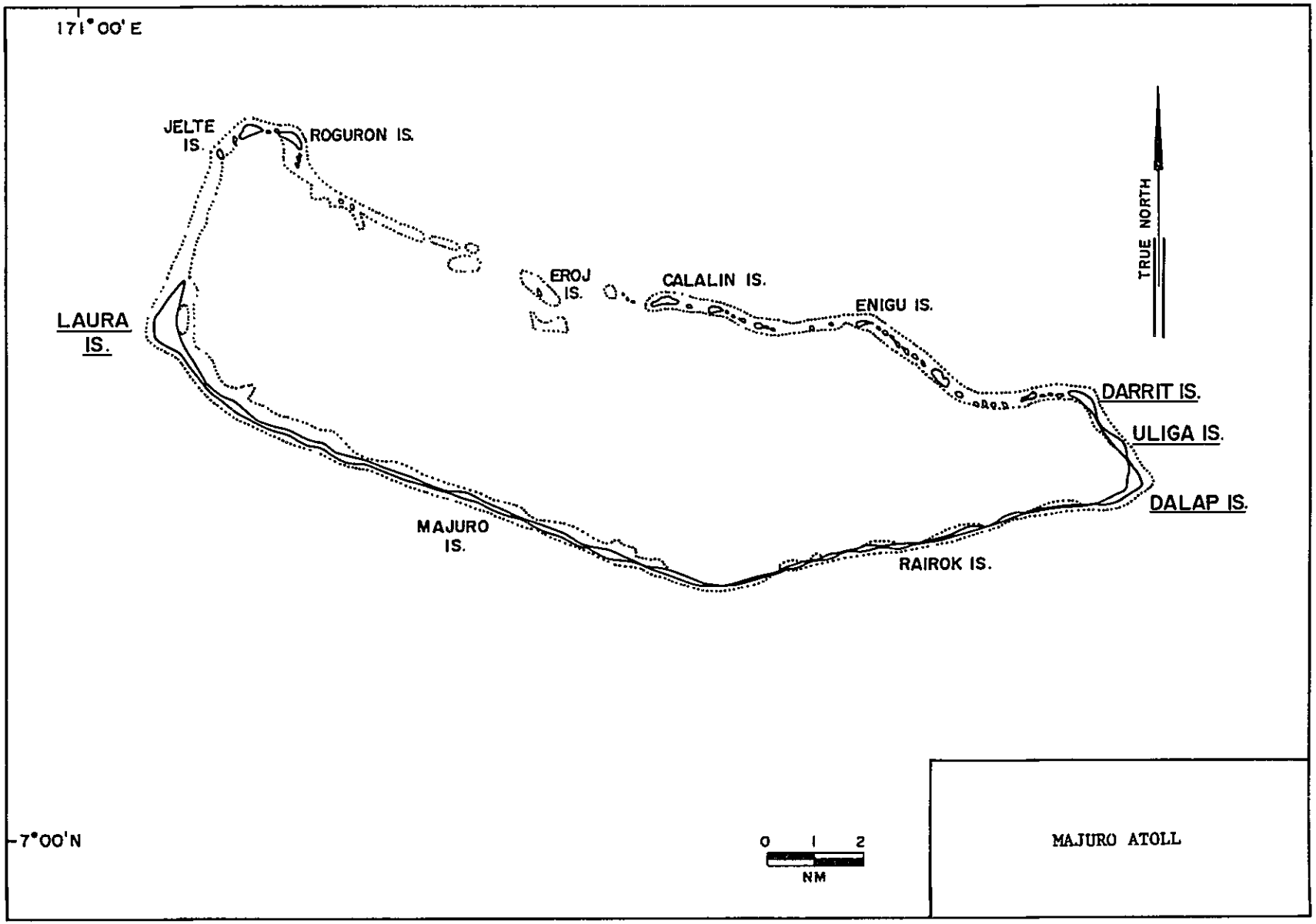
Japan International Cooperation Agency

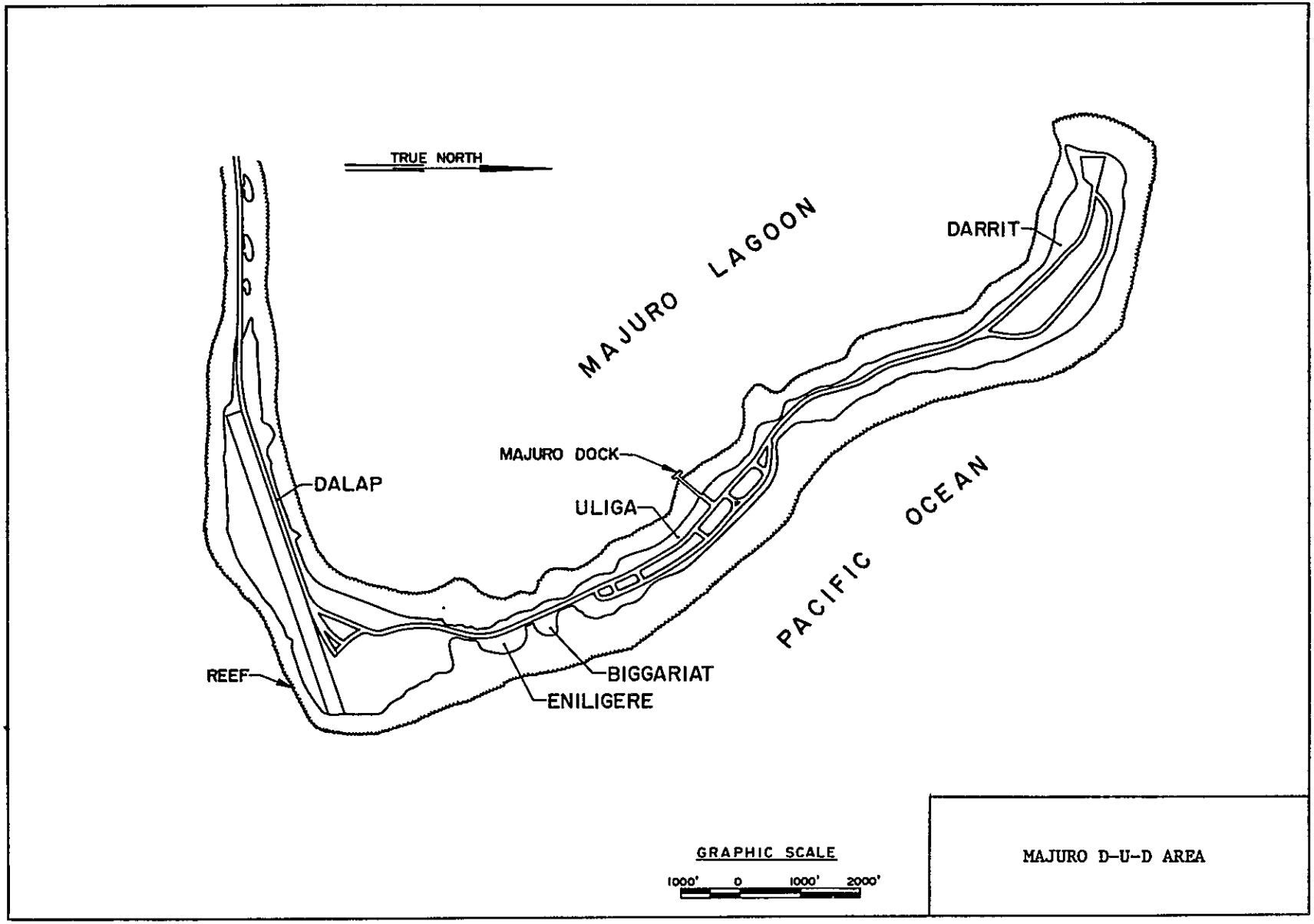


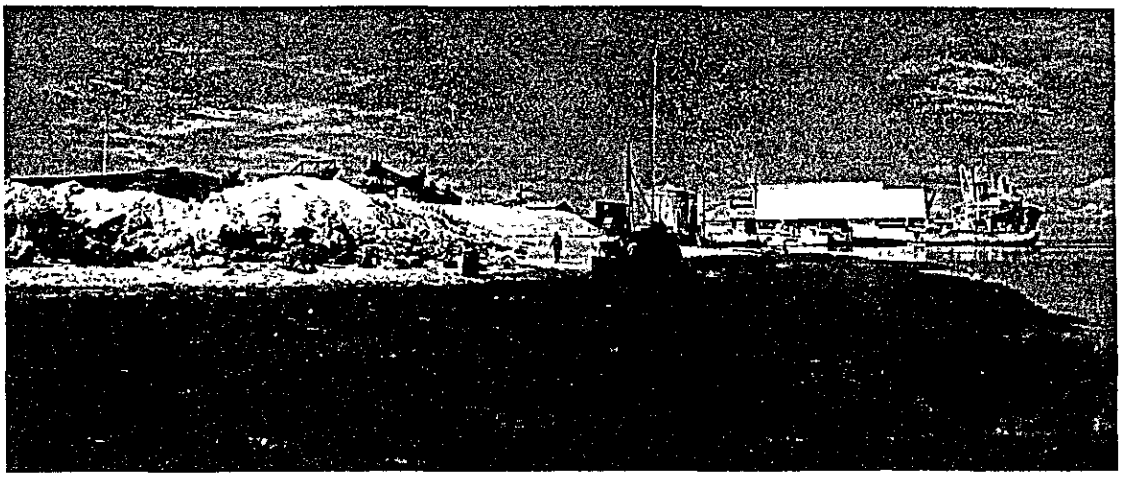
THE MARSHALL ISLANDS DISTRICT



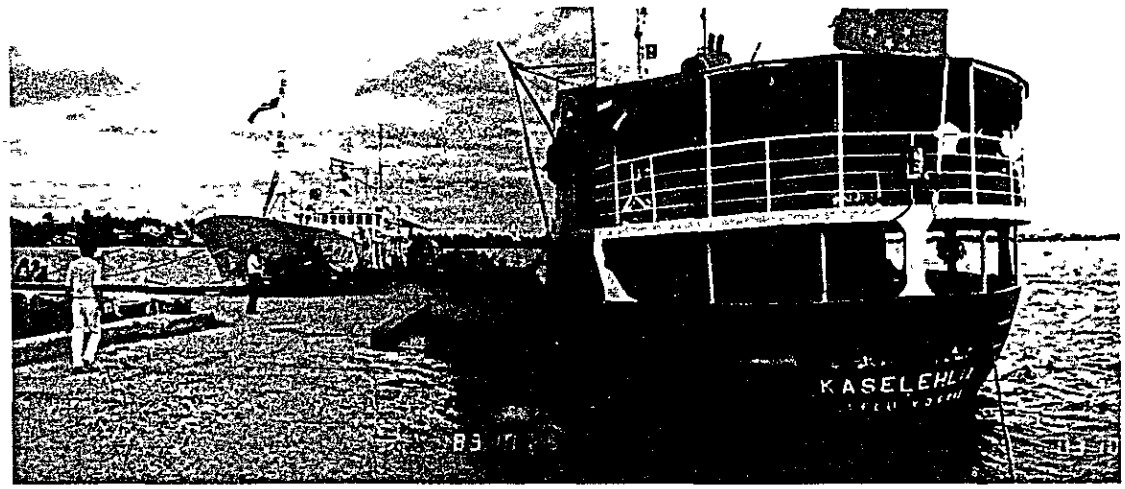
THE RALIK CHAIN AND
THE RATAK CHAIN


171°00' E
JELTE IS.
ROGURON IS.
EROJ IS.
CALALIN IS.
ENIGU IS.
LAURA IS.
TRUE NORTH
DARRIT IS.
ULIGA IS.
DALAP IS.
MAJURO IS.
RAIROK IS.
7°00'N
0 1 2
NM
MAJURO ATOLL


TRUE NORTH
MAJURO LAGOON
DARRIT
MAJURO DOCK
DALAP
ULIGA
PACIFIC OCEAN
REEF
BIGGARIAT
ENILIGERE
GRAPHIC SCALE
1000' 0 1000' 2000'
MAJURO D-U-D AREA



DISTANT VIEW OF NEW PORT



OLD PORT

PROJECTED SITE

SUMMARY

SUMMARY

The Marshall Islands have an abundant fish resource with the surrounding seas abounding in skipjack and tuna. Not limited to local exploitation, fishing vessels from other countries also enjoy a plentiful catch.

However, because the catch taken is insufficient, the islands must import most of their foodstuff. It is expected that with the forseeable increase in population, the use of fish resources will play a large part in the development of the economy, since there are no other significant resources.

From this scenario the Government of the Marshall Islands (GMI) has issued a scheme for the promotion of the fisheries industry. Proposals for future fisheries promotion include, wharfs, refrigeration, an ice making plant, repair facilities etc., and the establishment of a fisheries base. To accomplish this, the Japanese Government has been requested to provide a grant to aid in the financing. In response to this request the Japanese Government appointed the Japan International Cooperation Agency to cover, and subsequently a survey team was sent to the Marshall Islands from September 21, to October 10, 1983.

The team collected documents, investigated the requirements for basic design and on returning to Japan analysed the results to provide an evaluation of the project and its appropriateness.

The investigation, in the light of the request, considers carefully the coordination of a high level scheme, resulting in a demand forecast for the immediate future. It also lays down the principles governing the applicability of expanding new facilities within the expressed limits.

A. Basic Works

1. Wharf for medium-sized fishing vessels
   Minimum water depth 5.0 m, Length 76.0 m, Crown height 3.60 m
2. Wharf for small fishing vessels
   Minimum water depth 2.0 m, Length 46.0 m, Crown height 2.60 m
3. Additional works (illumination, oil and water supply facilities)

B. Operational Works

1. Repair of existing ice making plant (5 ton a day)
2. New refrigerator of 50 ton capacity and holding temperature of -35°C
3. Set of fittings (Shelf carts, push carts, fish baskets etc.)

Considering the geography and geology of the project site, a sheet pile tie-back wall has been chosen for the wharf. This will be attached at right angles and extend out from the eastern end of the small fishing vessel wharf already in use. From there it is to run parallel to the beach and provide berthing for medium sized fishing vessels.

The refrigeration plant includes the repair of the existing ice-making machinery and cooler store. At the same time a new 50 ton, capacity refrigerator is to be provided. Further, an ante-chamber will be added to the refrigerator to minimize the effect of opening and closing the main door when storing fish temporarily. The establishment of wharfing, refrigeration facilities and a fishery base is expected to make a significant contribution to the promotion of marine industries. In addition the project gives a measure of, the reduction in ships-at-anchor at the old port, and with the development of fisheries, related industries increasing employment opportunities.

It is hoped that the grant to be provided by Japan will be of significance in the recommendation of this project.

The Marshall Islands Public Works will oversee the overall job while the post-construction operation of the wharf and the refrigeration plant will be the responsibility of the Ministry of Transportation and Communications, and the Ministry of Resources and Development respectively.

CONTENTS

APPENDIX TABLES

I. INTRODUCTION

INTRODUCTION

The Marshall Islands is a country comprising some 1.3 million km^2 of the Central Pacific Ocean made up of 1152 atolls and islands, with an abundance of fish resources and fishing labour.

However, the present catch is not enough to give self-sufficiency to the islands and the dependence on imported foodstuffs is estremely high. If the population should increase dramatically in the immediate future, the dependence of animal protein on fish products will increase proportionately, making fisheries an invaluable industry.

Apart from copra the country has no other resources, so that the development of fisheries is important. Also any such development will be of benefit to the economic development of the country.

From this scenario the Government of the Manshall Islands (GMI) has prosposed the establishment of a Fisheries Related Infrastructure based on future fisheries promotions. Special emphasis has been laid on the construction of a fisheries base and to this end the Japanese Government has been requested to provide aid in financing.

The request includes the following items.

1. Fishing vessel wharf
2. A 1,000 ton capacity refrigerator (with capability up to 5,000 tons in future)
3. Ice making plant
4. Vessel repair facilities
5. 2 Pole and line fishing vessels of approximately 100 tons

Following receipt of the request the Japanese Government appointed the Japan International Cooperation Agency to cover. In response, Mr. Eiji Ishihara, Deputy Director, Coastal Fisheries Division, Fisheries Promotion Department, Fisheries Agency, was appointed head of a survey team (Appendix I) sent to the Marshall Islands. The team was there from September 21 to October 10, 1983, carrying out a detailed investigation in concert with officials of

GMI (Appendix 2). Requirements for a basic design were determined and data collated (Appendix 3).

The survey was as follows, with the items discussed and agreed to by the officials of GMI, entered into Minutes of Meetings.

1. Revision of background to the request
2. Revision of request contents
3. Investigation of local marine industries
4. Investigation of local marine management
5. Investigation of local government plans
6. General miscellanea

This report is an analysis of the above items based on the results of the survey. Investigation of the appropriateness, and an evaluation of the project is also done, with the most suitable proposal for the basic design

Ⅱ. BACKGROUND TO THE PROJECT

II. BACKGROUND TO THE PROJECT

1. Outline of Fisheries and Fisheries Promotion Plans

1.1 Fisheries of the Marshall Islands

1.1.1 State of the Islands

Present industries are extremely limited in the Marshall Islands, with only the copra industry very active, sharing 90% or more of the total export. However, since land size is limited, large growth of industry cannot be expected. Also, since the land is barren, agricultural activities are extremely low and most vegetables and fruits must be imported. There is no particularly important mineral resource.

The fishery operation is on a small scale at present, not yet reaching the level of self-subsistence. However, much is expected with the rich fishery resources in the surrounding oceanic area, if various fisheries promotion plans are established as described later.

1.1.2 Outline

The fishery operation in the Marshall Islands is on a small scale, the major catches being pelagic fishes that approach the islands, bottom fishes of the lagoon and reef fishes. Majuro Atoll forms the center of the Marshall Islands fisheries and the catches are usually distributed to consumers through the Fishermen's Cooperative Association (closed in February, 1983) and retail stores. Fisheries in other atolls and islands exist solely for home supply and local consumption.

The major fishers trawl for pelagic fishes in the ocean area outside Majuro Atoll, spear or net fishing of reef fishes around the reef, and hook fish or rod fish bottom fishes in the lagoon. The major fish species are shown in Table 2.1.

Table 2.1 Fisheries and Major Fish Species of Majuro Atoll

Fishing ground	Fishing method	Major species
Ocean area	Trawling	Pelagic fish Skipjack tuna, Yellowfin tuna, Bigeye tuna, Wahoo, Dolfin, Marlin, Mackerel, Needle fish, Flying fish
Reef	Spear or net fishing	Reef fishes Parrot fish, Wrasse, Surgeon fish Rabbit fish, Mullets, Bat fish
Lagoon	Hook or rod fishing	Bottom fish Groupers, Snappers, Emperors, Big eyes, Soldier fish

1.1.3 Fishing boats

Most of the fishing boats in the Majuro Atoll are small motor boats of 5 to 6 m long equipped with one or two outboard engines of 55 to 100 HP. It is difficult to determine the exact number of these boats, but the total number is taken to be about 70 (Appendix Table 2.6).

1.1.4 Fishermen

About 280 fishermen landed catches at the Fishermen's Cooperative Association in 1978, with about 20 of them full time. The catches of these full time fishermen provided the majority of the catch landed at the Association. Those who work on fisheries as a side job fish for self-consumption mainly selling their catch to the Association or foodshops for additional income only when they have a surplus (Appendix Table 2.7).

1.1.5 Catches and landing

As shown in Table 2.2, the annual landing at the Association varies from 38 to 173 ton, and has been decreasing rapidly since 1980. Pelagic fish are the majority, sharing 55 to 80% of the total catch.

The major blame for the decrease in landed catch since 1980 is placed on the refrigerating and ice-making facilities which experienced frequent troubles, the landing of the catch at the Association and ice supply to fishing boats having had to be restricted. An additional reason for the decrease is probably the measures taken by retail shops to engage in transactions that bypass the Association, such as the display of fish purchase prices, cash payment upon delivery, etc.

Table 2.2 Landing at the Association

Unit: Ton

Year	Pelagic fish	Reef fish	Bottom fish	Sea crayfish	Total
1978	94.3	30.7	10.6	0.2	135.8
1979	135.7	24.4	12.4	0.1	172.6
1980	41.7	16.1	3.9	0.1	61.8
1981	36.0	18.6	5.8	-	60.4
1982	20.8	14.6	3.0	-	38.4

(Refer to Appendix Tables 2.8 through 2.12.)

The wharf (berth length 110 m) in front of the Association was used for the landing of catches at the Association. After landing the catch, each boat leaves the wharf and is moored (anchored or landed on shore) close to the individual fisherman's house. Landing of catches for other than the Association is conducted in the mooring areas.

Table 2.3 shows the number of landings at the Association and quantity per landing while the Association was still operating.

Table 2.3 Frequency of landing at the Association and quantity per landing

	Pelagic fish	Reef fish	Bottom fish
Average landing frequency (times/month)	66.6	129.5	56.9
Average quantity per landing (kg/landing)	111.2	29.5	22.5

(Refer to Appendix Tables 2.13 and 2.14.)

1.1.6 Fish distribution

It is estimated that, in 1978 and 1979 when the Association was operating normally, about 65% of the total catch in the Majuro Atoll was landed at the Association. Most of the landed fishes were sold directly to consumers as fresh fish. The surplus was frozen and sold when fresh fish were in short supply. Since 1980, the quantity of fish bypassing the Association and sold directly to consumers either by cash on delivery to fishermen or to retail shops located in densely populated areas has been increasing. Nowadays, much of the catch is sent to retail shops and restaurants directly. While the Association used to buy up the whole catch, it now takes time for fishermen to sell the catches or they have unsold catch after the stores have purchased what they need.

1.1.7 Fish prices

Retail prices of local fish (fresh or frozen) are in the range of $0.8 to $1.4 per pound (¥400 to ¥700 per kg). Prices of canned food per pound of contained solid are $0.8 to 1.0 for mackerel, $0.8 to 1.1 for sardine. As a comparison the price of chicken meat is $0.8 to 1.0 per pound. Local fish are priced slightly higher than those of canned mackerel or sardine and chicken meat. Appendix Table 2.15 shows the retail prices of fish, canned fish, meat and the purchase prices for fish.

1.1.8 Fish consumption

Protein foodstuff consumed in the Majuro Atoll consists of fish and meat. The fish can be divided into local fish, imported canned fish and imported frozen fish. The annual import is about 152 tons of canned fish and about 12 tons of frozen fish (1982, Appendix Table 2.16).

The consumption of fish per capita is calculated as follows.

$$Ct = C1 + C2 + C3$$

$$C1 = \frac{1,000 \times Y1}{P1 \times r}, \quad C2 = \frac{1,000 \times Y2}{P2 \times e}, \quad C3 = \frac{1,000 \times Y3}{P2}$$

Ct : Total fish consumption per capita (kg/year)
C1 : Local fish consumption per capita (kg/year)
C2 : Canned fish consumption per capita (kg/year)
C3 : Imported frozen fish consumption per capita (kg/year)
Y1 : Quantity landed at the Association (ton/year)
(Average landed quantity in 1978 and 1979 = 154.2 ton)
Y2 : Imported quantity of canned fish
(151.6 ton imported in 1982)
Y3 : Imported quantity of frozen fish
(12.0 ton imported in 1982)
P1 : Population of Majuro Atoll
(Average of 1978 and 1979: 10,400 persons)
P2 : Population of the Marshall Islands
(33,385 persons in 1982)
r : Ratio of quantity landed at the Association against the total catch of Majuro Atoll (65% as estimated by FAO)
e : Fish yield (0.53 as shown in the Japan Food Supply and Demand Table)

$$C1 = \frac{1,000 \times 154.2}{10,400 \times 0.65} = 22.8 \text{ kg/year}$$

$$C2 = \frac{1,000 \times 151.6}{33,385 \times 0.53} = 8.6 \text{ kg/year}$$

$$C3 = \frac{1,000 \times 11.6}{33,385} = 0.4 \text{ kg/year}$$

The calculated values of fish consumption per capita by food type are shown in Table 2.4.

Table 2.4 Fish consumption per capita

Unit: kg/year/capita

	Gross	Net
Local fish	22.8	12.1
Canned fish	8.6	4.6
Imported frozen fish	0.3	0.2
Total	31.7	16.9

Net = Gross x yield (0.53)

1.1.9 Fishermen's Cooperative Association

The Majuro Fishermen's Cooperative Association (MFCA) was established in 1977 and closed in 1983. The Association was an external department of the Ministry of Resources and Development and operated on a self-supporting basis. The history from the start to closing is as follows.

The operation was started in July, 1977 using the facilities constructed by American firms. The operation was fair in the first two years or so, but the power supply situation became unsteady in 1980, experiencing excessive voltage fluctuation. As a result, three refrigerators (semi-closed type) broke down and were replaced with new ones. In 1981, the American made ice-making machine broke down but was replaced by a Japanese made one presented by the Japan Skipjack Fisheries Association. Since then, the refrigerators have became successively inoperative with the ice-making machine also breaking down. A new power plant was completed and started supplying power in November 1982 improving the power supply situation, but in December of the same year, all machines again stopped. The Association was finally closed down in February 1983.

1.2 Fishing by Foreign Fishing Boats

1.2.1 Operation of foreign fishing boats

Most of the foreign fishing boats permitted to operate in the fishing

grounds of the Marshall Islands are Japanese boats which longline tuna and pole and line skipjack. About 200 longline tuna boats and about 120 to 150 pole and line skipjack boats enter the fishing ground yearly during fishing operations (Appendix Table 2.17), with the total number of operations in the Marshall Islands fishing ground at about 320 of the former and 300 to 500 of the latter (Appendix Table 2.18).

The majority (85% of the total) of the tuna trawling boats are smaller than 80 ton. All pole and line skipjack boats are in the size range of over 200 tons but less than 500 ton.

The Japanese fishing boats catch about 20,000 ton yearly of fish in the Marshall Islands fishing ground. Skipjack caught by pole and line skipjack boats take up about 70% of the whole catch, while yellowfin and bigeyed tuna caught by longline tuna boats make up the majority of the remaining 30% (Appendix Table 2.19).

1.2.2 Conditions governing calls by foreign fishing boats

Boats that call at Majuro use the old port (jetty type pier) or the new port (parallel type pier). However, since the oil supply facilities are at the old port, Japanese fishing boats call at the old port for oil. As shown in Table 2.5, an average of about 21 Japanese fishing boats call at the Majuro port and in most cases the purpose is for oil supplies (Appendix Table 2.20).

Table 2.5 Port calls by Japanese fishing boats

Purpose	Number of boats per month		Boat type
	Average	Maximum	
Oil supply	17.9	34	Mostly longline tuna boats
Others *	3.4	8	Mostly pole and line skipjack boats

* "Others" represents cases calling for repair, purchase of repair parts, or medical care of crew.
(Refer to Appendix Table 2.20.)

When a fishing boat calls at the port for oil, she leaves the day after entry. However, since inter-island cargo-passenger vessels owned by the government frequently use the old port, oil supply to Japanese fishing boats is not efficient and at times, the old port becomes congested by Japanese fishing boats.

The fees that a Japanese fishing boat must pay on calling at the port are as follows.

Fishing fee	$450 per call
Entry fee	$20 per call
Dockage fee	$20 per 24 hours

The old port is becoming rather obsolete, with a large part of the pier damaged due to being struck by some large boat resulting in the support for the pier taking on a list.

1.3 Fisheries Promotion Plans

GMI has set the following targets to promote the nation's fisheries.

i) Improvement of the fishery base
ii) Promotion of domestic fisheries
iii) Promotion of existing small scale fisheries

An outline of these targets is given in the following.

1.3.1 Fishery base improvement plan

This plan schedules improvement of the fishery base to be provided for Japanese and other fishing boats by extending Majuro New Port. When the wharf for fishing boats is complete, foreign fishing boats are to call and receive oil at the new port, the old port to be used exclusively by local boats.

The government plans to install oil supply facilities, refrigerating facilities for the purpose of transshipping the catch, fishing boat repair facilities (dry dock with slipway), and processing facilities for the catch at the fishery base. The oil supply facilities [10 tanks with total capacity of 6.15 million gallons (22,710 kℓ), including an oil tank for the power station] have already been completed.

The financing necessary to complete the fishery base is estimated to be $10 to 30 billion (¥2,300 to 7,000 billion). Sources of funding 1) Government of USA, 2) Japanese Government, 3) Pacific Tuna Development Foundation (SPC), and 4) international financing organs such as the International Monetary Fund (IMF) or American International Development Bureau (AID) are taken up in the schedule.

Among the items requested by GMI, items of the first, second and fourth priority sequence (wharf, refreigerator and repair facilities) form a part of this fishery base improvement plan.

1.3.2 Local fisheries promotion plan

The government is planning to increase fisheries production by introducing a medium-size pole and line skipjack boat, thereby decreasing the import of fishes and canned meat. According to the plan, the fish are to be caught among the atolls of the outer islands, and the catches (skipjack and others) are to be supplied to the densely populated area although, some of the catch will be shipped out to markets like USA with transfer at the Majuro port.

Among the items requested by GMI, the fifth priority item (pole and line skipjack boats) forms a part of this domestic fisheries promotion plan.

1.3.3 Promotion plan for existing small scale fisheries

The government is planning to expand small scale fisheries which are a very important element of the foundation for the fishery economy of the Marshall Islands, mainly in the outer islands, thereby increasing job opportunities. What is needed to realize this plan is a supply of small boats equipped with outboard motor and fishing equipment, installation of ice-making machines and small freezing machines, and the improvement of related infrastructures (wharf and the like). In addition, the government plans to improve the physical distribution system for transportation of catches in the outer islands to densely populated areas.

Among the items requested by GMI, the third priority item (ice-making facilities) forms a part of promotion plan of existing small scale

fisheries.

1.3.4 Miscellaneous

1) Plan for improving infrastructure related to fisheries

2) Plan for surface sea aquaculture researches

3) Plan for catching fish in the outer island areas

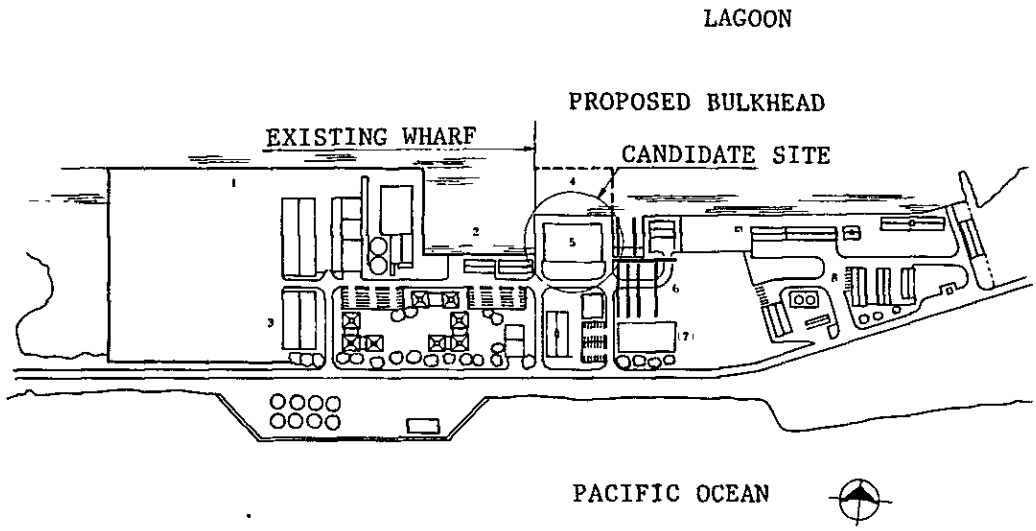
4) Fisheries training plan (fishing method, fishing boat repair, port management)

Ⅲ. OUTLINE OF THE PROJECT SITE

III. OUTLINE OF THE PROJECT SITE

1. Project Site

The wharf site proposed by the government of the Marshall Islands is located on the adjacent east side of the small fishing boat wharf at the new Majuro port. This site is scheduled to be No. 6 berth, and installation of a slipway at the next site at the east is being planned (Fig. 3.1).



① WHARF FOR BIG SHIP
② WHARF FOR SMALL FISHING BOAT
③ NEW POWER PLANT
④ WHARF FOR MEDIUM-SIZE FISHING BOAT
⑤ REFRIGERATING FACILITY
⑥ SLIPWAY
⑦ REPAIR SHOP
⑧ WAREHOUSE ETC.

Fig. 3.1 LOCATION MAP OF CANDIDATE SITE IN MASTER PLAN

2. Geography and Geology

2.1 Geography

Since the land part of the proposed site is reclaimed, it is almost flat (+3.60 m). There is a shore reef shelf (reef flat) which dries up by about 0.70 m at ebb tide. This shelf descends gradually toward the lagoon, and the slope becomes sharp at a point 40 to 50 m from the land.

The sea bottom is not uniform geographically. The west side from the proposed wharf site deepens gradually, but the central part drops sharply, and on the east side, there is a shoal (-1.50 m) about 90 m from land. Fig. 3.2 shows the representative cross-section.

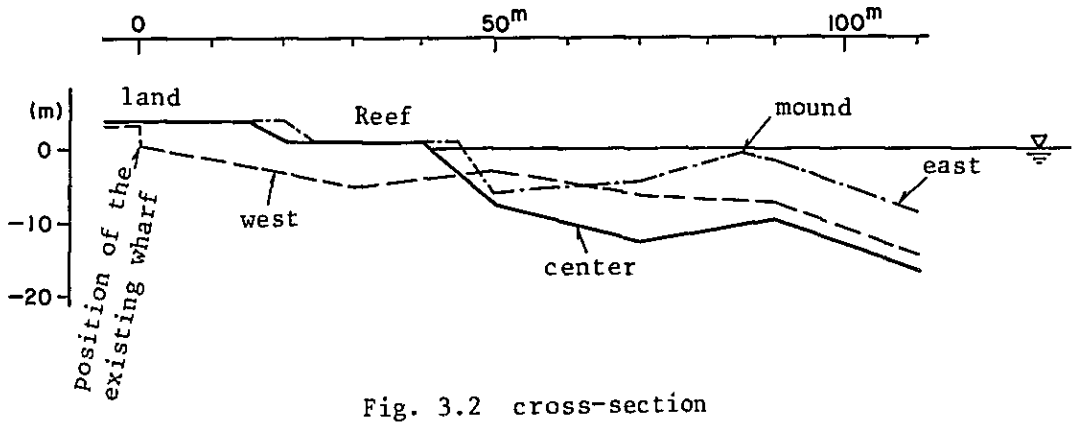
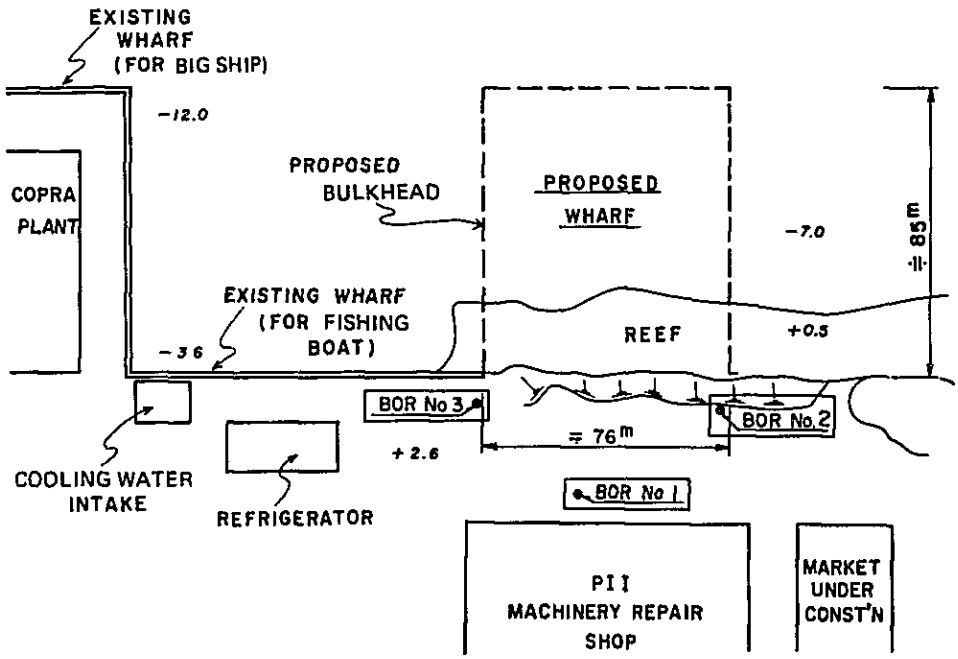


Fig. 3.2 cross-section

2.2 Geology

Boring surveys were conducted at three places on land. The positions were chosen so as to determine the geological configuration three-dimensionally. Refer to the figure below.



Majuro Atoll consists of alternating layers of the coral limestone and gravel layers. The thickness and position (depth) of these complex layers vary and the results of the boring surveys at the three places chosen are not the same. In No. 1 boring, the soil for about 2 m from the surface (+3.70 m) is gravel containing coral debris and boulders, this being the layer of earth brought from other places for reclamation. There is a coral limestone layer of about 2.3 m thick under the first layer. It seems that the extension of this rock layer is connected to the exposed shore reef shelf.

Under this rock layer, there is a gravel layer of about 3.8 m thick, and under that there is the coral limestone layer.

No. 2 and No. 3 boring also showed alternate coral limestone layers and gravel layers but the thickness and position (depth) of these layers were different in each case.

3. Tide Levels

The following values are used for tide levels.

	Tide Level	Design Elevation
M.H.W.L	+ 1.95 m	E.L. + 1.95 m
H.S.W.L	+ 0.90 m	E.L. + 0.90 m
M.L.L.W.L	± 0 m	Design reference level
M.L.W.L	- 0.03 m	E.L. - 0.03 m

M.H.W.L : Maximum High Water Level

M.S.W.L : Mean Sea Water Level

M.L.L.W.L : Mean Low Lower Water Level

E.L : Elevation

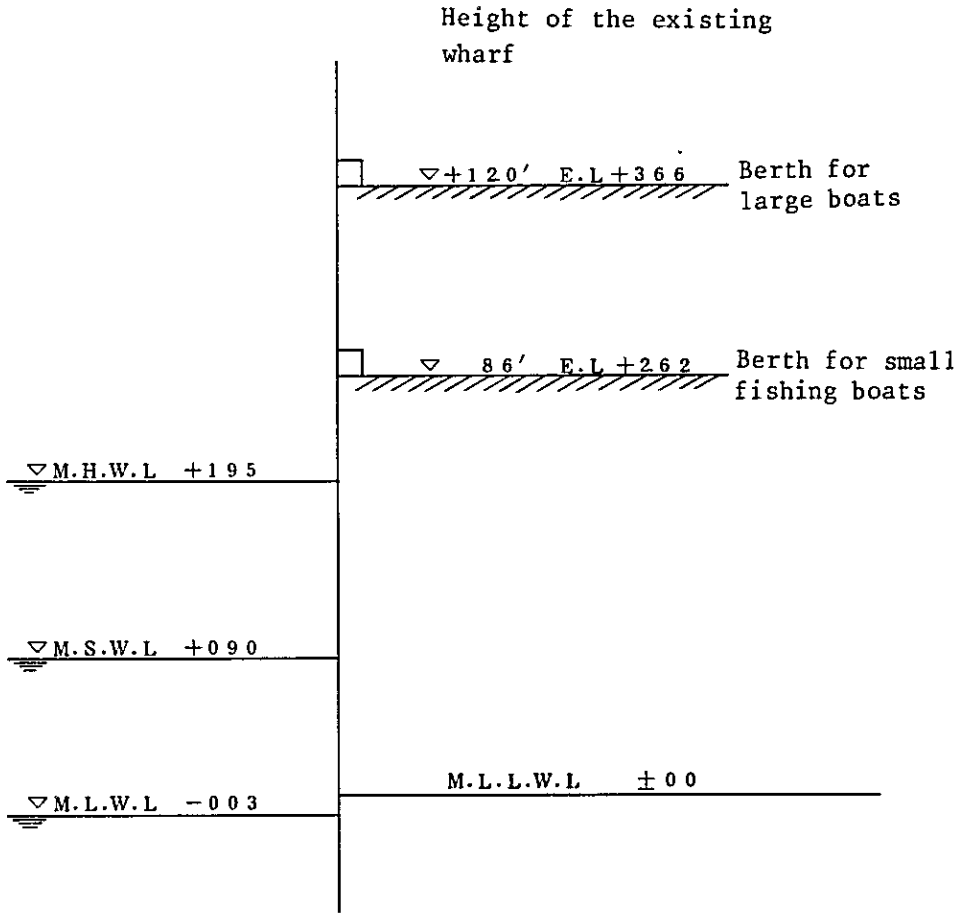


Fig. 3.3 Program of tide levels

4. Condition of the Sea Bed and Ecology

4.1 Project Site

The state of the sea bed down to 20 m and the related ecology were determined by a method of submerged observations. The results are outlined in Fig. 3.4.

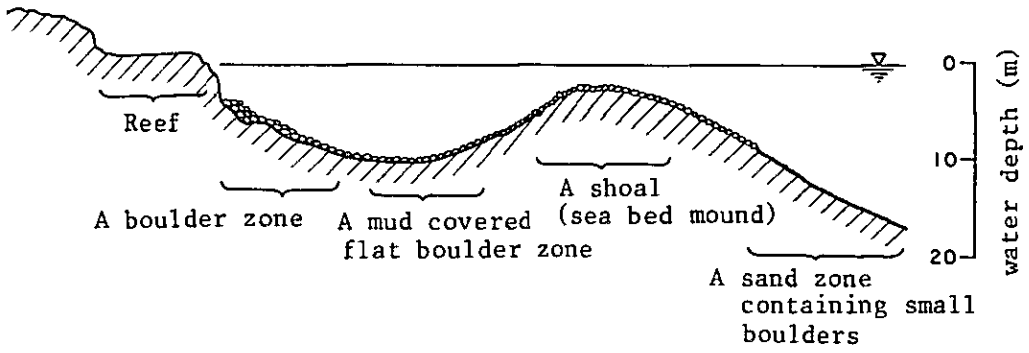


Fig. 3.4 State of the sea bed

The coast line region is a reef flat of dead coral, with the reef edge (outskirt of reef flat) a sharp slope levelling out to form a gently sloping boulder zone.

There is a rich growth of brown algae (phaeophyceae) in the boulder zone and many small reef fish were observed. The sea bed at about 30 m from the coast is a mud covered flat boulder zone of about 10 m deep where fish and seaweed were rarely observed. The outer side of the boulder zone is a shoal (sea bed mound) of 1.0 to 1.5 m deep, with many small reef fish observed, resembling the boulder zone in the region of coast line. The outer side of the shoal is a gentle sloping boulder zone, which is followed by a mud covered boulder zone and sand zone containing small boulders. Generally, there are not many living corals.

4.2 Area Surrounding the Project Site

Submerged observations were conducted in the neighborhood of the channel for small fishing boats.

Before the channel for small fishing boats was constructed, very few fish and living corals were seen in this area. Introduction of clear oceanic water as the result of excavating the channel has greatly improved the environmental conditions, and the formation of new coral reefs and the presence of fish species have become quite luxuriant.

5. State of Related Facilities

5.1 Existing Freezing, Refrigerating and Ice-Making Facilities

5.1.1 Freezing, refrigerating and ice-making facilities belonging to MFCA

MFCA (Majuro Fishermen's Cooperative Association) was closed in February, 1983, but the major facilities it owned are as follows.

(1) Scale

Freezing:	- Blast freezer	-30°C	Daily	3.0 ton
Refrigeration:	- Blast freezer	-30°C		27.0 ton
	- Freezer	-20°C		46.0 ton
	- Chilling	- 1°C		10.0 ton
	(for vegetables)	- 1°C		15.0 ton
Total capacity calculated in accordance with the warehouse law of Japan				98.0 ton
Ice making:	- Plate ice		Daily	5.0 ton
	- Cube ice		Daily	0.2 ton
Ice storage:				2.0 ton

1) Building structure and type

Steel frame, metal siding, a part block laid, metal roofing, a part in two floors.

Pre-fabricated panel type refrigerating chamber.

2) Building area and eaves height

370 m^2 x 3.6 m (1st floor) x 7.2 m (2nd floor)

(2) Present conditions

1) Building:

As a whole, the building is still sound. It is corroded and broken in places, allowing leakage of rainwater, but this can be repaired.

2) Refrigerator:

Pre-fabricated panel type, 100 mm thick.
Both inside and outside are covered by galvanized iron sheets, and rust is hardly noticeable. The insulation door however is corroded.

3) Ice storage:

Some broken parts on the inside wood and heat insulation (The wood part is worn out).

4) Freezer and refrigerator cooling unit:

Separate-type cooling unit, with many parts worn or broken.. Especially, the outdoor unit which is a solid-type unit for the freezer and air cooling condenser is excessively corroded by salt.

5) Ice-making machine:

With the Japanese-made ice-making machine, no wear is observable on the icing plate, freezer or air-cooling condenser. All parts and wires inside the automatic control panel have been removed.

6) Ice storage cooling unit:

Two Japanese-made machines have been provided. These machines operated normally up to the time the plant was closed.

7) Ice storage screw conveyor:

This broke down in 1979, and has not been used since. Instead, ice has been shovelled out manually.

(3) Maintenance control and repair

1) Operation control:

One of the employees had responsibility for controlling the operation. He had no ability in operating the plant and did not even keep a daily operation record.

2) Periodic inspection:

The maintenance system was insufficient. Inspection of each machine was done only when there was trouble.

3) Repair

An engineer in the private sector was commissioned to repair defective machinery as a side job. In this way both time and expense were spared. No spare parts exist for the freezing and ice-making machines.

4) Technical ability (Engineers and repair shops)

Private enterprises have the ability to repair electric refrigerators and room coolers and they can work on the overhaul of small fully closed freezing machine. However, they have no experience with repairing large freezing machines and their repairing skill is assumed to be undeveloped.

5.1.2 Freezing, refrigerating and ice-making facilities belonging to private enterprises

Each enterprise possesses 2 to 4 freezing/refrigerating containers and these are used to store imported foodstuff. One of them has a 50-ton pre-fabricated refrigerator with a Philipino maintenance engineer. No private enterprise has a large ice-making machine as installed in MFCA. Small cube ice making machines possessed by supermarket stores are otherwise the only ice-making machines existing in the Marshall Islands.

5.2 Majuro New Port

The existing facilities of Majuro New Port are as follows.

5.2.1 Berth for large boats

Extension (Parallel to land)	L = about 260 m
Upper elevation	Above M.L.L.W + 12' 0 = about +3.6 m
Sea bed elevation	Below M.L.L.W -36' 0 = about -11.0 m

5.2.2 Berth for medium-size boats

Extension (Square to land)	L = about 85 m
Upper elevation	Above M.L.L.W. + 12' 0 = about 3.6 m
Sea bed elevation	Below M.L.L.W. -36' = about -11.0 m

5.2.3 Berth for small boats

Extension (Parallel to land)	L = 100 m
Upper elevation	Above M.L.L.W + 8' 60 = about +2.60 m
Sea bed elevation	Below M.L.L.W -12' 0 = about -3.6 m

* M.L.L.W stands for Mean Lower Low Water and it is the design reference level.

All wharfs are constructed with connected sheet piles and are the anchor rod counterfort type. The bulkhead is constructed with reinforced concrete and rubber fenders are placed at about 10 m intervals.

5.3 Power Plant

A new thermal power plant located close to Majuro New Port began operation November 1982. The power supply now is stabilized.

5.3.1 Generator

4 units, generating capacity 3,270 KW per hour each unit (1 unit only is operating at present.)

5.3.2 Oil tanks

* 750,000 gallon (2,800 kℓ) 8 tanks
  (For heavy oil, 2 tanks only are used at present.)
* 50,000 gallon (190 kℓ) 1 tank
  (Diesel oil)
* 10,000 gallon (38 kℓ) 1 tank
  (Lubrication oil)

6. Construction

6.1 Contractors

The most representative contractor in Majuro is Pacific International Inc. (P.I.I.) which is a joint venture with an American construction company. In addition to general construction work, P.I.I. procures sand (coral) and crushed stones from the islands, purchases cement from Japan and others, manufactures and sells ready-mixed concrete. While P.I.I. owns various construction machines, these machines break down often and the operation efficiency is low.

6.2 Construction Materials and Equipment

6.2.1 Construction machines

Construction machines owned by the government (Ministry of Public Works) can be rented. The majority of these machines are supplied by Japan on grant and since they are comparatively new the operation efficiency is high. Leasing charges for major machines are as follows.

o 50-ton crane	$95.00 per hour
o 25-ton forklift	$80.00 per hour
o 9-ton forklift	$60.00 per hour
o Loader 966	$70.00 per hour
o Bulldozer	$60.00 per hour
o Dump truck	$40.00 per hour
o 0.5-ton pickup truck	$7.00 per hour

These charges include operator wage and fuel cost.

6.2.2 Workers' wages

Skilled indigenous laborers are extremely limited, and hence skilled labor must be obtained from the Philippines when necessary. The current labor charges are as follows.

o General earth worker	$2.50 ∿ $3.50 per hour
o Class 1 carpenter	$5.50 ∿ $7.50 per hour
o Steel frame worker Welder	$5.50 per hour
o Plasterer	$7.50 per hour
o Operator	$5.00 per hour
o Supervisors	$12.00 per hour

6.2.3 Material prices

Material prices are as follows.

o Sand (coral)	$20.00/$m^3$, including transportation
o Crushed stones	$20.00/$m^3$, including transportation
o Fill	$6.50/$m^3$, including transportation
o Cement	$7.50/40 kg, made in Japan
o Ready-mixed concrete	$118.00/$m^3$ (160 kg/cm^2)
	$144.00/$m^3$ (180 kg/cm^2)
	$180.00/$m^3$ (210 kg/cm^2)

6.3 Current Construction Projects

The major construction projects being implemented in Majuro at present are as follows.

- o Transmission line laying (between airport and Laura, by Nine (9) group)
- o Yacht harbor (Darrit area by P.I.I.)
- o Hospital (Dalap area by P.I.I.)
- o Hotel (Dalap area by a New Zealand contractor)

Ⅳ. SCHEME CONTENT

IV. SCHEME CONTENT

1. Objective

Establishment of a large size refrigerator for the transshipment of catches is one of the purposes of the Fisheries Base Plan. Together with this GMI has planned for the construction of a fishing vessel wharf.

However, even with the establishment of a base and refrigerator, from the aspects of profitability and handling techniques, the chances of Japanese fishing vessels transshipping at Majuro are slight. Also as far as other foreign vessels (e.g. American fishing boats) are concerned there are still some features lacking in the transshipment set-up and it is predicted that it will take some time until it runs smoothly. Also, even if a refrigerator is installed, it is important, considering the high running costs and high level of management required, that the persons in charge be well trained. Hence it would be advisable to re-investigate the refrigerator installation after the schemes for domestic catch development or the transshipment of foreign catches have been put into practice.

On the other hand, ever since the original refrigerator was closed down due to failure, the existing small fishing industries have been unstable, with a subsequent slow down in money circulation observed. The stability and promotion of these existing industries requires that a refrigerator be installed so that the Fisheries Association or a substitute can be re-instated.

Hence with respect to the refrigerator requested a detailed analysis and investigation of suitability is undertaken bearing in mind the following.

(1) Be in conjunction with the Fisheries Base Plan.
(2) Be combined with the purpose of promoting the existing small fishing industries.
(3) Running costs be minimized.
(4) Be consistent with local maintenance abilities.
(5) Satisfy any forseeable future fishing demands.

Next the size of wharf requested (85m x 76m) is larger than that proposed before the installation of the refrigerator, in the 1975 Majuro Port Scheme (at that time 38m x 76m. See Figure 3.1). As explained above it is

advisable to have a future re-investigation of the refrigerator installation and that the scale of the present wharf in the Majuro Port Scheme be re-investigated, so that the most suitable size can be determined.

Furthermore the wharf at present used at the old port is getting old and due to a collision by a large vessel while mooring, the piles supporting the jetty are listing and the wharf has shifted about 60cm to one side, so that it is no longer safe. It is therefore considered that it can not be used for much longer.

2. Demand Forecast

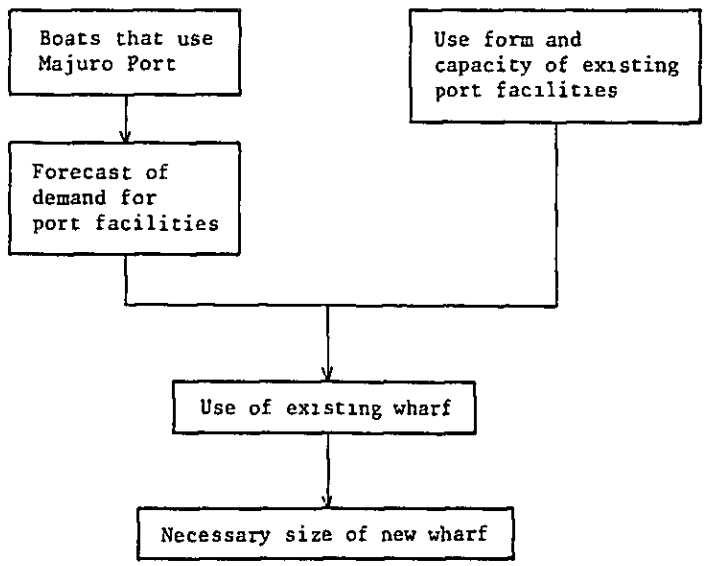
2.1 Wharf for Fishing Boats

2.1.1 Basic concept

Based on an estimation of the demand for the Majuro port by boats, especially fishing boats the necessary size of wharf for boats that call at Majuro Port in excess of the existing port facilities can be calculated.

2.1.2 Forecast procedures

Forecast procedures



(1) Boats that use Majuro Port

1) Large boats

i) Local cargo-passenger boats

The local cargo-passenger boats are owned by the government and run between islands. These boats generally use the old port for the loading and unloading of cargo, passengers and oil supplies. When the number of boats calling at the old port exceeds the capacity (2 boats), boats must anchor at the container pier of the new port.

ii) Foreign cargo-passenger boats

Foreign cargo-passenger boats call at Majuro Port to load/unload cargo and use the container pier of the new port.

2) Medium-size fishing boats

Medium-size fishing boats that enter Majuro Port range from 50 to 500 ton (mostly foreign fishing boats), and these anchor in the old port.

3) Small fishing boats

Small fishing boats range from 5 to 6 m. They are equipped with outboard motors and are used for fishing in the Majuro sea area.

(2) Demand forecast of wharf for fishing boats

1) Medium-size fishing boats

Fishing boats that call at Majuro Port come for oil supplies and other purposes such as, repair, waiting for repair parts or medical care of crew. They normally anchor at the old port. The majority of fishing boats that call are longline tuna boats, and these take on oil once per fishing operation. However, there are some fishing boats which operate in the Marshall fishing ground that do not take on oil at Majuro Port and some fishing boats enter the Majuro Port to take on oil even though they do not operate in the

Marshall fishing ground. The variance in the number of medium-size fishing boats that enter Majuro Port and the frequency of entry are forecasted with these conditions considered.

i) Forecast Details

a) Possibility of the increase in the number of fishing boats that take on oil in Hawaii.

It is assumed that tuna fishing boats which enter the Marshall fishing ground but do not take on oil at Majuro do so in Hawaii. Since fuel in Hawaii is about 20% cheaper than in Majuro and since there are other inducements (hospitals and recreational facilities) in Hawaii, this project has not much to offer these boats.

b) Possibility of the increase in the number of fishing boats that take on oil in neighboring countries

Fishing boats that take on oil at Ponape, Truk and Guam rarely operate in the area surrounding the Marshall fishing grounds. Also, there is a small probability that fishing boats calling at Majuro Port take on oil at Ponape. Accordingly, this project has not much to offer boats that take on oil in neighboring countries.

c) Possibility of the increase in the number of fishing boats operating in the western fishing grounds

Japanese fishing boats that operate in the region of the 180° longitudinal from ports such as Kiribati are already using Majuro Port as a supply depot on their navigation route, and the possibility of increasing the number of oil supply occasions with these boats is small even with the Majuro Port facilities are expanded.

d) Possibility of the increase in the number of fishing boats for other than oil supply

Entry of fishing boats for other than oil supply, like repair, waiting for repair parts, patients or wounded, involves many uncertain factors, and it is difficult to forecast the number of boats entering the Majuro Port for these purposes. Generally, however, the probability of accidents becomes greater as the navigation period increases. In recent years, the length of each navigation period has remained unchanged, the possibility of fishing boats entering the Majuro Port for other than oil supply is rather small.

ii) Result

a) Number of boats calling

Based on observations as outlined above, we determined that there is only a slight possibility of the number of medium-size fishing boats entering the Majuro Port increasing even though a new wharf be installed for medium-size fishing boats. Accordingly assuming that the number of boats will remain at the current level, we estimate that the total number of boats calling would be 255 (215 for oil supply and 40 for other purposes), based on records for the period of from June 1982 to August 1983 (refer to Table 2.20).

b) Frequency of the number of calling boats

The frequency of the number of medium-size fishing boats entering Majuro Port per day has been estimated. However, since we were unable to obtain the actual entry/departure record, we calculated the frequency assuming that the frequency would be indicative of the probability distribution. The calculation result is shown in Table 4.1

Table 4.1 Frequency distribution of the number of medium-size fishing boats

Number of entering boats	Probability	Days/month	Days/year
0	0.4974	14.9	182
1	0.3531	10.6	129
2	0.1195	3.6	44
3	0.0256	0.8	9
4	0.0039	0.1	1
$5 \leq$	0.0005	0.0	0

iii) Number of necessary berths

As shown in Table 4.1, the number of anchor-days (number of days on which 2 or more boats enter) is 54 per year on a wharf having one berth. This becomes 10 days (number of days on which 3 or more boats enter) on a wharf having two berths. If the wharf has three berths, the number of boats anchoring is almost zero. On the other hand, the number of idle berths increases. Therefore, two berths (76 m) is the appropriate number of berths for medium-size fishing boats.

2) Small fishing boats

In order to promote the local fisheries using small boats, the Fishermen's Cooperative Association must be rebuilt. The necessary extension of the wharf for small fishing boats is estimated assuming that the Association is re-established. In calculating the demand forecast, structural changes to the local fisheries are not taken into consideration and the catch by small fishing boats is assumed to satisfy the demand for fish in Majuro.

i) Forecast method

a) Conditions

① Increase in the catch is to be realized by increasing the number of operations while the catch landed per operation will remain unchanged.

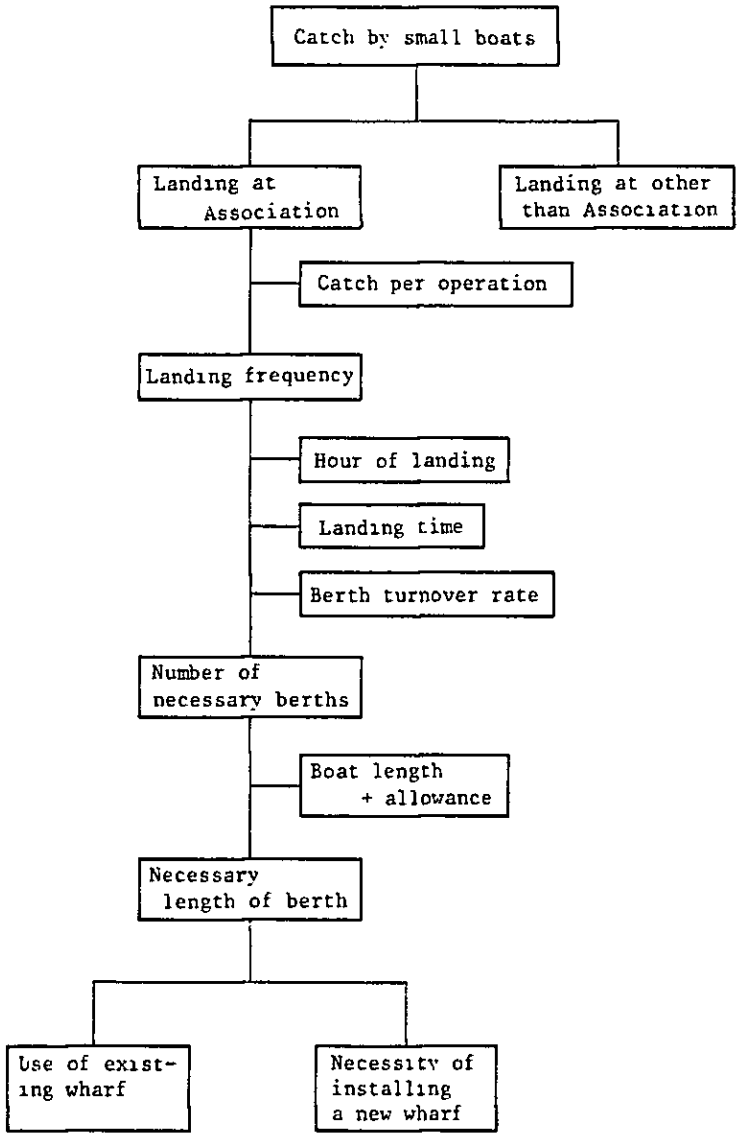
② The configuration ratios of fish species (three types of pelagic, reef and bottom fishes) in the catch will remain unchanged.

③ 65% (current ratio) of the total Majuro catch will be landed using the wharf in front of the Association and the wharf in this project.

ii) Calculation procedures

The necessary length of wharf for small fishing boats is calculated according to procedures shown in Table 4.2.

Table 4.2 Method of calculation for the necessary length of wharf for small fishing boats



iii) Method

a) Demand forecast

Table 4.3 shows the demand for fish caught by small boats.

Table 4.3 Demand for fish caught by small boats

Year	1983	1993	2003
Population (persons)	13,004	17,755	25,068
Demand (kg/year/capita)	24.3	29.7	36.0
Total demand (ton/year)	316	527	902

(Basis: Refer to 1.1.8 Fish consumption and Appendix Tables 4.1 and 4.2.)

b) Estimated landing at the Association

Table 4.4 shows the estimated landing at the Association.

Table 4.4 Landing at the Association

(Unit: Ton/year)

Year	1978/79	1993	2003
Pelagic fish	115.1	255.9	437.9
Reef fish	27.6	61.3	104.8
Bottom fish	11.5	25.6	43.9
Total	154.2	342.7	586.6

(Basis: Refer to Appendix Table 4.3.)

c) Frequency of landing at the Association

Table 4.5 shows the frequency of landing at the Association. The quantity of catch per operation is 111.2 kg for pelagic fish, 29.5 kg for reef fish and 22.5 kg for bottom fish.

Table 4.5 Frequency of landing at the Association

Landing frequency	Fish type	1978/79	1993	2003
Number of landings per year	Pelagic fish	1,035	2,301	3,938
	Reef fish	934	2,076	3,553
	Bottom fish	513	1,139	1,950
Average number of landings per day *	Pelagic fish	4.1	9.2	15.8
	Reef fish	3.7	8.3	14.2
	Bottom fish	2.1	4.6	7.8
Number of landings per day during fishing season **	Pelagic fish	6.2	13.8	23.7
	Reef fish	5.6	12.4	21.3
	Bottom fish	3.1	6.9	11.7

(Basis: Refer to Appendix Tables 4.3 and 4.4.)

* The number of days that catches can be landed at the Association is 250 days a year.

** During the fishing season, the landing quantity (number of landings) is 1.5 times the average value.

iv) -Number of necessary berths

a) Landing time

Pelagic and reef fish are caught during the daytime and the catches are landed toward the evening. The landing time is set at between 3.00 and 6.00 p.m. Bottom fish are caught at night and the catches are landed in the morning. Since the landing of bottom fish is not frequent and does not interfere with the landing of pelagic and reef fish, landing of the bottom fish is excluded when calculating the number of necessary berths.

b) Landing time and berth turnover rate

The time between a boat tying up at the wharf and leaving it is set at one hour, and the turnover rate of berth is set at 3 times a day.

c) Number of necessary berths

The number of necessary berths is calculated based on the landing frequency per day during fishing season for 2003.

Number of necessary berths (N)

$$= \frac{\text{Number of landings of pelagic fish and reef fish}}{\text{Turnover rate}}$$

$$N = \frac{23.7 + 21.3}{3} = 15.0$$

Accordingly, the number of necessary berths is calculated to allow the tying up of 15 boats (refer to Appendix Table 4.5).

v) Required length of berth

a) Necessary length of berth per vessel

Each ship is to be anchored with its side in contact with the wharf, the average boat length being 6 m. The necessary length of berth is calculated two ways by allowing an extra 3 m or 2 m to the average boat length.

b) Required length of berth

Case 1

Required length of berth (for side in contact)
Boat length + allowance: 6 m + 3 m = 9 m
Required length of berth
Number of necessary berths x berth length
= 15 x 9 m = 135 m

Case 2

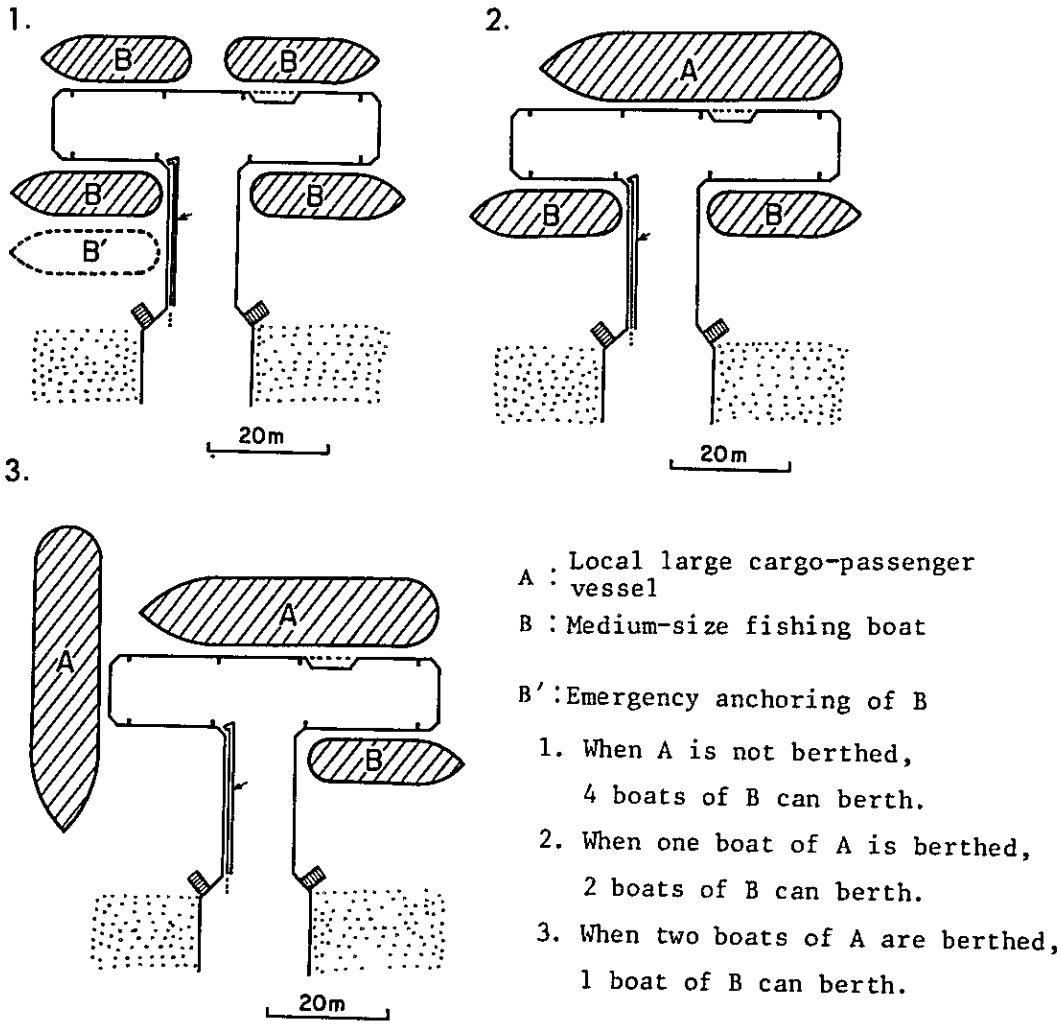
Required length of berth (for side in contact)
Boat length + allowance: 6 m + 2 m = 8 m
Required length of berth
Number of necessary berths x berth length
= 15 x 8 m = 120 m

(3) Layout of Majuro Port

1) Old port

The old port is a T-shaped jetty pier, Fig. 4.1 shows the method of tying up the boats to the pier.

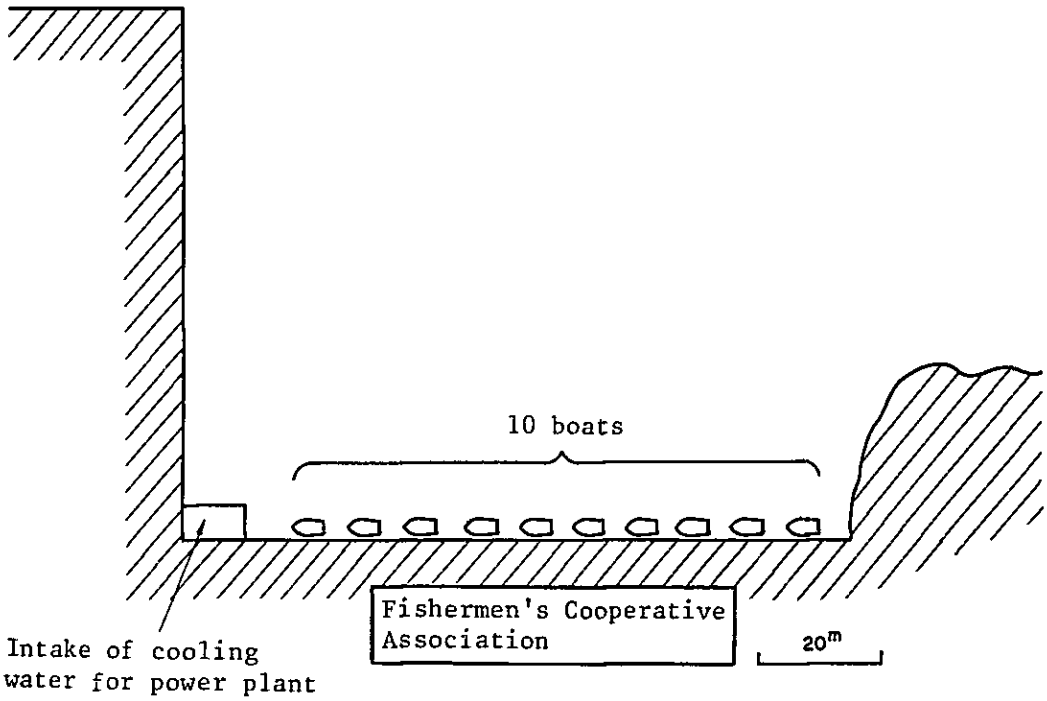
Fig. 4.1 Method of tying up boats to the pier at Majuro old port



2) Wharf for small fishing boats

The existing wharf for small fishing boats is 100 m long and the crown elevation is 2.6 m. A cooling water intake for the power plant is installed at one end of the wharf so that no boat can berth at this point. The method of berthing at the wharf is shown in Fig. 4.2.

Fig. 4.2 Method of berthing for small fishing boats



3) Container pier for large vessels

The container pier for large vessels is a parallel type pier, having a length of 260 m and a crown height of 3.6 m.

(4) Number of boats that can use the existing port facilities

1) Old port

The estimated number of medium-size fishing boats that can use the old port is as follows.

i) Conditions

a) The number of medium-size fishing boats that can enter the Majuro Port yearly is 255 (215 for oil supply and 40 for other purposes).

b) The number of anchor-days is 1 (24 hours) which is the average number of anchor days for fishing boats that call for oil. The number of anchor days for boats that call for other purposes is also set at 1 day.

c) The number of local cargo-passenger boats that anchor at the old port is as shown in Table 4.6.

Table 4.6 Frequency of anchoring at the old port by local cargo-passenger vessels

Number of boats staying in port	0	1	2
Days per year	52	98	215
(%)	(14.2)	(26.9)	(58.9)

(Basis: Refer to Appendix Fig. 4.1, Appendix Tables 4.6 and 4.7.)

ii) Method

The probability of use of the old port by medium-size fishing boats can be expressed as follows.

$$P = \sum_{xi=1}^{4} Pi\ (Xi\ /\ 0) + \sum_{xi=1}^{2} Pi\ (Xi\ /\ 1) + P_1\ (X_1\ /\ 2)$$

P : Probability of use of the old port

Xi : Number of calling fishing boats

Pi (Xi / 0): Probability of "i" (number of fishing boats) entering the port while "0" local cargo-passenger boats are in the port.

iii) Result

It is estimated that up to 213 medium-size fishing boats could use the old port per year but that any more than 42 boats would cause congestion.

2) Wharf for small fishing boats

The wharf for small fishing boats has a height of about 1 m from high water level to the top surface of wharf. Since the difference in tide elevation is 2 m, a long mooring rope having enough slack must be used with a boat that anchors at low tide. Also, there is no mooring post to take the rope at the wharf, and hence a drainage hole is used. Accordingly, an extra length of 3 m would need to be provided to give the necessary berth length of 9 m. In such a case, the number of small fishing boats that can concurrently ride at the wharf is 10 (Fig. 4.2).

2.1.3 Forecast result

The necessary size of new wharfs to be constructed is as follows.

1) Wharf for medium-size fishing boats

If medium-size fishing boats are to continue using the old port in the future, it is anticipated that 42 boats per year would cause congestion at the port. This trouble can be eliminated almost completely by installing a wharf for one berth. If all medium-size fishing boats are to use the new port only, annually 65 boats will be the congestion level at the port, but if a wharf having two berths is constructed, this problem will be eliminated almost entirely.

The possibility of continuously using the old port has been studied. However, the old port is already wearing out and in addition, with the listing pier pile caused by a collision with a large vessel, it seems that the old port has already exceeded its usefulness and to further use it for an extend time is not advisable.

For these reasons, it is considered best that all medium-size fishing boats use the new port, and size of wharf for medium-size fishing boats should be 76 m, or the length of two berths.

2) Wharf for small fishing boats

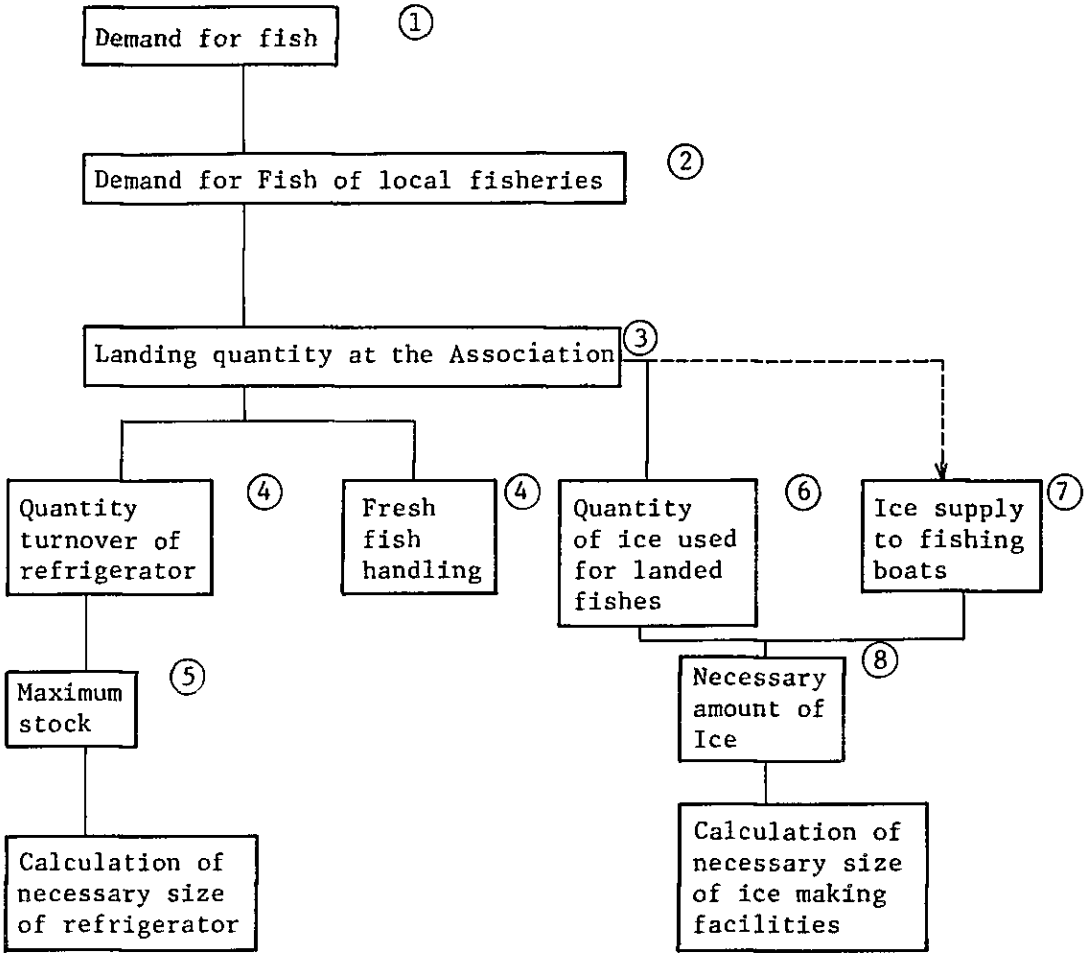
It is estimated that the existing wharf for small fishing boats will not be large enough as a wharf to land the catches of local small boats, a key factor in the promotion of the fisheries of Majuro in the future. The shortage can be eliminated by installing a new five berth wharf. A wharf suitable for berthing small fishing boats should have a minimum length of 8 m plus an extra 2 m. Therefore, the necessary extension length is some 40 m. Although the existing wharf for small fishing boats can yet be used for some time, its crown elevation is high and it has no mooring facility. Loading/unloading of fishing boats, together with unloading of catches and loading of ice onto fishing boats, is thus not easy. It is desirable that any new wharf for small fishing boats has sufficient mooring facilities and level differences or steps to facilitate loading and unloading.

2.2 Refrigerating and Ice-Making Facilities

2.2.1 Basic concept

Assuming that the facilities of the Fishermen's Cooperative Association are re-opened or new ones installed, the necessary sizes of refrigeating and ice-making facilities can be calculated. The basic concept we have for this calculation is that the refrigeration facilities should be used for storage of catches by local small fishing boats and the ice-making facilities should be used for ice supply to fishing boats and for storage of landed fish catches.

2.2.2 Forecast procedures



① Forecast of demand for fish

The consumption of fish grows at the same pace as the population growth and increase of income. The demand for fish is estimated as follows (Appendix Table 4.2).

$$DTt = Dto \times \frac{Pt}{Po} \times (1 + a \times f)^n$$

$$Et = Eo\ (1 + a)^n$$

DT : Demand for fish

P : Population

E : GDP per capita

a : Rate of increase (set to 0.022)

f : Income elasticity value for fish consumption (set to 0.7.)

Eo : E of reference year (E of 1983 set to $1,044)

Et : E after t years (E of 2003 set to $1,614)

DTo : DT of reference year (DT of 1983 set to 428 ton/year)

② Forecast of demand for fish from local fisheries

Considering that canned fish meat is a luxury item, the demand growth was ignored and the consumption per capita kept at the current level for the forecast. The quantity of imported frozen fish is only 12 tons a year (1982), and since it is small, it was excluded in our estimation of the future demand. The growth of demand for fish is to be managed by an increase in catch by the local fisheries. Based on these conditions, the demand for fish caught by local fisheries is estimated as follows.

$DLt = DTt - bxPt$

DL : Demand for fish caught by local fisheries

Dt : Total demand for fish

P : Population

b : Consumption of canned fish meat per capita (set to 8.6 kg/year)

③ Forecast of quantity landed at the Association

The condition set is that 65% of the total catch in Majuro is landed at the Association (current situation). This means, the quantity of fish that is handled through the Association and the quantity of fish that is consumed through other than the Association (handling of private foodstuff shops and catch of fish for self-consumption) increases at about the same pace as the demand (catch) increases. It must be noted that in the future, if new private enterprises participate in the distribution and their competitive power is strong, the value (65%) that is handled by the Association will decrease. Accordingly, the estimate shown here is based on the condition that the competitive power of private concerns remains at the current level. The quantity landed at the Association is estimated as follows.

$DMt = C \times DLt$

DM : Quantity landed at the Association

DL : Demand for fish caught by local fisheries

c : Ratio landed at the association (set at 0.65)

④ Forecast of refrigerator turnover and quantity of fresh fish handled

The average quantity landed at the Association per day is set at the quantity of fresh fish handled (sold) per day. Any excess is to be stored in the refrigerator in this project and any shortage is to be filled with stored fish. Quantities during the period from September 1977 to August 1978 are assumed as follows.

Quantity landed at Association	156 ton (100%)
Fresh fish handled	107 ton (68.4%)
Entry to refrigerator	49 ton (31.6%)
Maximum stock	14 ton

(Refer to Appendix Tables 4.9 through 4.15.)

The quantity to be stored in the refrigerator is estimated as follows.

$$DRt = d \times DMt$$

DRt: Quantity stored
DM : Quantity landed at the Association
d : Ratio of storing (set to 0.316)

⑤ Forecast of maximum stock

The maximum stock increases as the quantity landed at the Association increases.

The maximum stock is estimated using the current rate of increase.

$$DSt = e \times DMt$$

DSt : Maximum stock
DMt : Quantity landed at the Association
e : Maximum stock against the quantity landed (set at 0.091)

The demand quantity, landed quantity, quantity of entry to storage and stock quantity forecasted the next 10 and 20 years respectively are summarized in Table 4.7 below.

Table 4.7 Forecast of quantities landed, entry to storage and stock

	1993	2003
Demand for fish (Ton/year)	680	1,118
Demand for fish of local fisheries (Ton/year)	527	902
Landed at the Association (Ton/year)	343	586
Entry into refrigerator (Ton/year)	108	185
Maximum stock (Ton)	32	53

⑥ Quantity of ice used for landed fish

The quantity of ice used for fish landed at the Association is set at half of the landed quantity.

⑦ Ice supply to fishing boats

The quantity of ice to be supplied to fishing boats is set at the quantity landed at the Association.

⑧ Necessary amount of ice

Table 4.8 shows the estimated amount of ice used for catches landed at the Association and the ice supplied to fishing boats.

Table 4.8 Necessary amount of ice

	Unit	1993	2003
Landing at the association	Ton/year	343	586
Ice used with landed catches	"	171.5	293
Ice supplied to fishing boats	"	343	586
Annual ice consumption	"	514.5	879
Average consumption per day	Ton/day	2.1	3.5
Average consumption per day during fishing season	"	3.1	5.2

(Refer to Appendix Table 4.8.)

2.2.3 Forecast result

The necessary sizes of refrigerator and ice-making machine are as follows.

(1) Refrigerator

With the propsect of Majuro local fisheries being as they currently are and supposing that 65% of the catch are landed at the Association, the maximum stock 20 years from now is estimated to be around 50 tons. Accordingly, we determine that the necessary capacity of refrigerator is 50 ton.

(2) Ice-making machine

The durable life of an ice-making machine is 10 years, and the necessary size (capacity) of an ice-making machine is estimated to be 3 ton a day. Since the capacity of the ice-making machine owned by the Association, (not operating at present), is 5 tons a day, enough ice can be supplied for the next 20 years. Accordingly, it has been decided to use the existing machine after repairing it.

3. Plan Specifications

3.1 Extent of Wharfs for Fishing Boats

The size of each wharf based on the demand forecast as described above is as follows.

(1) Wharf for medium-size fishing boats

Size of boat	:	G.T. $\leqq$ 500 ton
Number of berths	:	2 berths
Berth length	:	2 x 35.0 + 6.0 = 76.0 m
Minimum depth	:	Below low water level -5.00 m
Wharf crown level	:	Above low water level +3.60 m

(2) Wharf for small fishing boats

Size of boat	:	G.T. $\leqq$ 30 ton
Number of berths	:	5 berths
Berth length	:	5 x 8.0 + 6.0 = 46.0 m
Minimum depth	:	Below low water level -2.00 m
Wharf crown elevation	:	Above low water level +2.60 m

3.2 Extent of Refrigerating Facility

Based on the demand forecast described above, the size of the refrigerating facility is set at 50 ton (actual containing capacity) and the

temperature kept at -35°C. The refrigerator will be provided with an ante-chamber so that the influence of the outside air is kept to a minimum when opening/closing the door. Fresh fish can be temporarily stored there.

3.3 Design Standards

3.3.1 Wharfs for fishing boats

(1) Wharf layout

The wharf for small fishing boats (46.0 m long) is connected to the east end of the existing wharf for small fishing boats.

The wharf for medium-size boats (76.0 m long) is attached installed to the wharf for small fishing boats.

(2) Route of medium-size fishing boats

The approach and turning distance of medium-size fishing boats is less than 60 m from both edges of the wharf.

(3) Passage along wharf

The width of passage along the wharf is to be 8.0 m, and be paved with concrete.

(4) Wharf structure

The wharf is to be constructed on a sheet pile tie-rod counterfort system. The bulkhead is to be built with reinforced concrete.

(5) Design standards

The design conforms to the technical standards of harbor structures in Japan.

3.3.2 Refrigerating facility

Capacity	50 ton (Net)
Inside volume	306 m^3
Outside dimensions	10.8 m x 10.8 m x 3 m

Retention temperature	-35°C
Atmospheric conditions	33°C and 78% relative humidity
Ante-chamber	1 ton/day, slow freezing
Loading method	Frozen fish, manual loading/unloading, stored height 2 m (Shelf carts with casters are used for the freezing of fresh fish.)
Machinery	To conform with the High Pressure Gas Control Law and Warehouse Enterprise Law, Japan.
Insulation facilities	To conform with Japanese standards

4. Basic Design

4.1 Wharf for Fishing Boats

4.1.1 Wharf structure

(1) Structure type

The wharf is of the sheet pile tie-rod counterfort type.

(2) Total length (L) of sheet pile wharf

The total length of wharf (L) consisting of the berth for small fishing boats (46.0 m), berth for medium-size fishing boats (76.0 m) and sand guard section (30.0 m) on the reef shelf at the east side, is as follows.

$$L = 46.0 + 76.0 + 30.0 = 152.0 \text{ m}$$

(3) Crown height and driven depth of sheet pile

The crown height (EL) of the sheet piles is +2.0 m above low water. The driven depth is a minimum of 3.0 m for small fishing boat berths and sand guard section, and a minimum of 6.0 m for medium-size fishing boat berths.

(4) Bulkhead

The bulkhead is made of reinforced concrete, the unconfined compression strength of the concrete being 210 kg/cm^2. The crown height is 3.60 m for medium-size fishing boat berths and 2.60 m

for small fishing boat berths.

The height of the bottom face is determined to be -0.60 m taking into account corrosion resistance. The sand guard section at the east side is the same as that for medium-size fishing boat berths.

4.1.2 Auxiliary structures

(1) Wheel guard

A wheel guard of size 300 mm x 250 mm and made of reinforced concrete is to be installed on the crown of the bulkhead.

(2) Mooring pillar

A mooring pillar as described below is attached to the wharf.

i) Berth for medium-size fishing boats

2-head (or a set of two pillars) bollard
Traction power: 20 ton 12 units (7.6 m intervals)

ii) Berth for small fishing boats

Single pillar (or iron hoop) bit
Traction power: 2 ton 10 units (4.0 m intervals)
Traction power: 15 ton 1 unit (Auxiliary)

The traction power from the bollard for medium-size fishing boats is taken by a structure other than the sheet pile.

(3) Fender

i) Berth for medium-size fishing boats

G.T. = 500 ton, Contacting speed V = 0.30 m/sec
Number of units: 8 (about 10.0 m intervals)
Made of rubber (0.3 x 2.0 m)

ii) Berth for small fishing boats

G.T. = 30 ton, Contacting speed V = 0.45 m/sec
Number of units: 10 (about 4.0 m intervals)
Made of rubber (0.3 x 2.0 m)

(4) Paving and Curb

The passage along the wharf is to be paved with reinforced concrete 10 cm thick and 8.0 m wide.

One side of the pavement will be proviced with reinforced concrete curb of size 300 mm x 250 mm.

(5) Retaining wall

There is a difference of 1 m in the height between the crown height (EL = +2.60 m) of existing wharf for small fishing boats and the planned wharf. Therefore, a retaining wall of length 40 m is to be installed at the back of, and along the berth for small fishing boats. Also, a retaining wall 30 m long is to be installed along the boundary between the passage way and the pier site.

The retaining wall is to be made of reinforced concrete.

4.1.3 Auxiliary facilities

(1) Illumination

Lamps	250W mercury lamps, 5 units
Wire length	350 m
Conductor diameter	50 mm, protected by concrete
Minimum soil coverage	500 mm

(2) Water supply

Water pipe diameter	100 mm
Pipe length	280 mm
Minimum soil coverage	1,000 mm

(3) Oil supply

Oil pipe diameter	150 mm
Pipe length	280 m
Minimum soil coverage	1,000 mm

4.1.4 Dredging

The range of dredging to be done is an area of 60 m east from the

eastern edge of the wharf and the area in front of the berth for medium-size fishing boats.

Dredging depth is to an elevation of -5.00 m.

4.2 Refrigerating Facility

4.2.1 Construction plan

(1) Structure type

1) Main structural body

The main structural body is a planar rigid steel frame.

2) Foundation

Since the site is reclaimed, the soil will be sufficiently compacted, developed to the extent of not needing piling.

3) Wall

The wall is to be steel-plate siding which is light weight and easy to construct. The materials used are to be of good quality having resistance to weather. An air duct is to be installed at the upper and lower parts of the wall for good ventilation.

4) Roof

Since it rains often, the roof is to be given sufficient slope, and iron roofing being used because it is light weight and easy to use.

The materials used are to be of good quality having resistance to weather.

(2) Architectural and finishing materials

All structural and finishing materials must be selected with respect to the location, weather conditions (weather resistance and humidity resistance), so that maintenance is easy and the facilities are useable for a long period. The major materials to be used are as follows.

Structural materials	Zinc immersion plated steel
Roofing	Corrugated galvanized iron plate, 1.0 mm
Outer surface:	Coated with fluorine plastic and baked
Inside surface:	Colored steel-plate, bonded with insulation material
Outer wall	Angular corrugated galvanized iron plate, 0.6 mm
Outer and inner surfaces:	To be finished in the same way as the roofing.
Building window	Aluminum
Floor	Reinforced concrete, trowel finished.

(3) Building size and area

Building size	15.7 m (L) x 12.0 m (W) x 4.4 ∿ 6.0 m (H)
Building area	188 m^2

4.2.2 Insulation facility plan

We have adopted a pre-fabricated panel assembly system using rigid urethane sandwiched panels (keystone panel core). The standard of this material is high since it is manufactured by a continuous process plant. The material has superior insulation and humidity resistance as well as the merit of quick construction.

(1) Insulation layer thickness: 127 mm + 25 mm (keystone part)

(2) Finish:
- Outer surface: Colored aluminum
- Inside surface: 127 mm thick flat panel

(3) Floor: Concrete with wire mesh and finished by trowelling

(4) Insulation door: 1200 mm (W) x 1800 mm (H), manual sliding door
Rigid urethane/100 mm thick insulation, stainless steel

(5)	Frost-heaving prevention device:	150ϕ VP is installed in 1.5 m pitches to avoid frost-heaving of the floor
(6)	Floor heater	A floor heater is installed in the entrance to the refrigerator to avoid freezing of the floor.

4.2.3 Chilling machine plan

(1) Capacity

Since the climate of Majuro persists with high temperatures and humidity throughout the year, two chilling machines, each having the capacity of 70% of the required chilling capacity are installed taking into account the durability, breakdown of machinery and overhauling. With this arrangement, even if one unit is defective and only one unit is operating, the refrigerator can fulfill its requirements.

(2) Type

A fluoric type refrigerant is used. Each unit is built as a separate type (separated into three parts: freezer, air cooling condenser and unit cooler), and to overcome salt corrosion, the freezer is installed in the machinery room, with salt-resistant treatment given to the air cooling condenser.

(3) Machine capacity

① Chilling machine for main chamber

Chilling capacity:	8,700 Kcal/hr at TE = -45°C, TC = +45°C
Output:	20.8 kW
Number of units:	2

② Chilling machine for ante-chamber

Chilling capacity	3,200 Kcal/hr
Output	2.29 kW
Number of units	1

4.2.4 Electric facility plan

(1) Power supply equipment

For power supply, a transmission line is to be connected to the incoming panel of the project facilities at the expense of GMI.

The voltages to be supplied are 3-phase 3-wire 220 V, 60 Hz and single-phase 110 V, 60 Hz.

The loads drawn by particular facilities are as follows.

1)	Refrigerating	68.3 KW
2)	New wharf power	12.0 KW
3)	Freezing	2.8 KW
4)	New wharf illumination	8.0 KW

(2) Wiring at the primary side of power and illumination facilities

A trunk line is installed from the incoming panel to each power control distribution board with the lighting power board and wires laid from the power boards to all machines and equipment.

(3) Motors

All motors are the fully-closed reverse sector type, and treated for use in tropical zones.

(4) Illumination equipment and outlets

Lighting inside the refrigerator is by means of incandescent arc lamps and at other places by fluorescent lamps. Outdoor lighting is by mercury lamps.

Waterproof type outlets are installed at the wharf power distribution board.

(5) Lightning conductor

Lightning conductor equipment is to be installed.

4.2.5 Water supply and drainage plan

(1) Water supply facilities

No water supply facility has been included in this project. However, a 10-ton capacity water tank made of FRP is to be installed and a water supply column attached.

(2) Drainage plan

Miscellaneous waste water (floor washing) is discharged into the sea through floor gradients.

4.2.6 Fixtures

(1)	Shelf cart with casters (for fresh fish freezing)		5 carts
(2)	Hand car (fresh food transportation)		5 carts
(3)	Fish basket		20 baskets
(4)	Platform scale	100 kg	1 unit

5. Basic Design Drawings

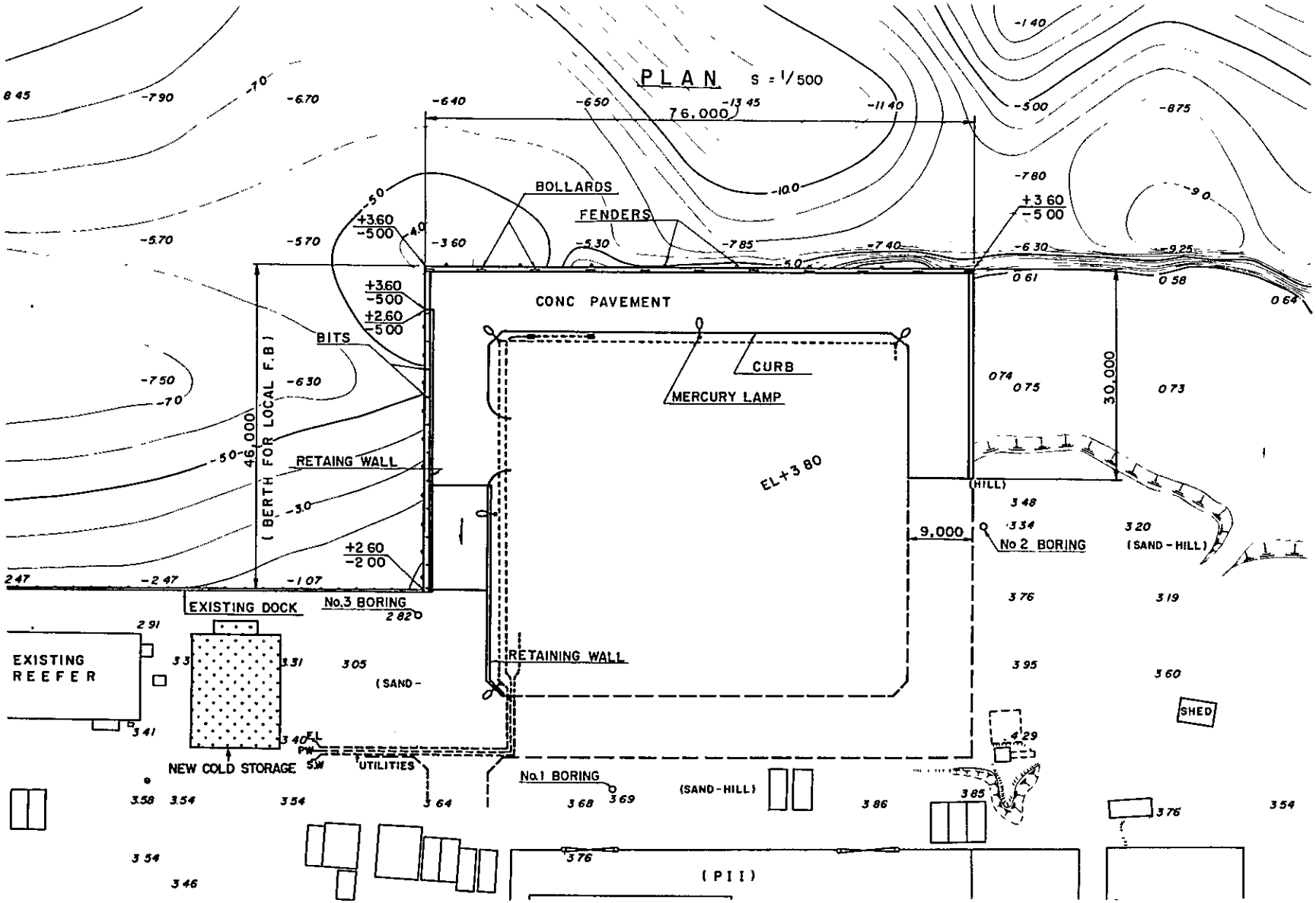

PLAN S = 1/500
76.000
BOLLARDS
FENDERS
+3.60
-5.00
CONC PAVEMENT
CURB
MERCURY LAMP
EL+3.80
BITS
RETAING WALL
(BERTH FOR LOCAL F.B)
46.000
30.000
9.000
+3.60
-5.00
+2.60
-5.00
+2.60
-2.00
EXISTING DOCK
No.3 BORING
2.82
No.2 BORING
(SAND - HILL)
(HILL)
EXISTING
REEFER
NEW COLD STORAGE
UTILITIES
RETAINING WALL
No.1 BORING
(SAND-HILL)
(SAND-
SHED
(PII)

Fig.-4-3 PLAN

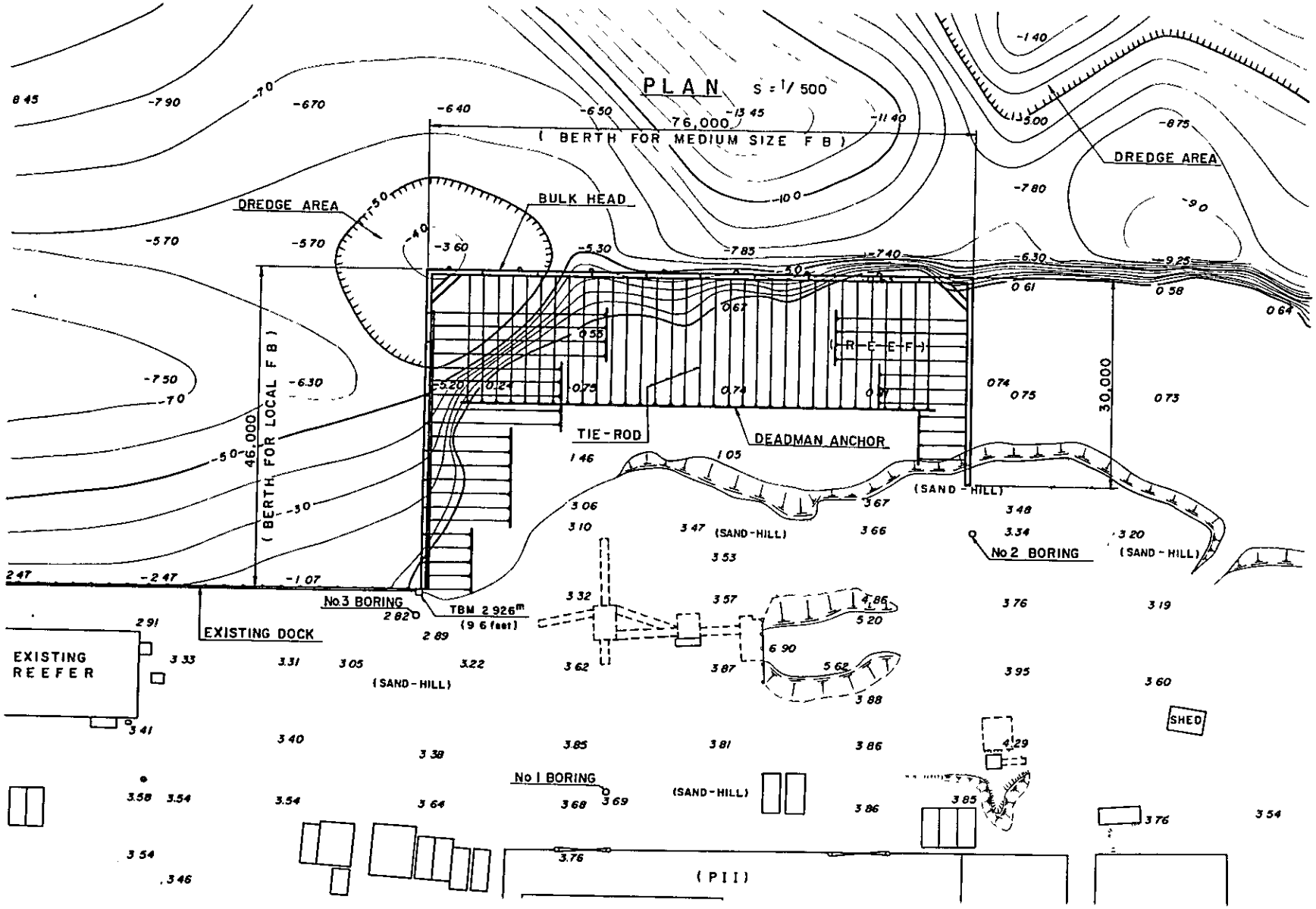


Fig.- 4-4 SECTION

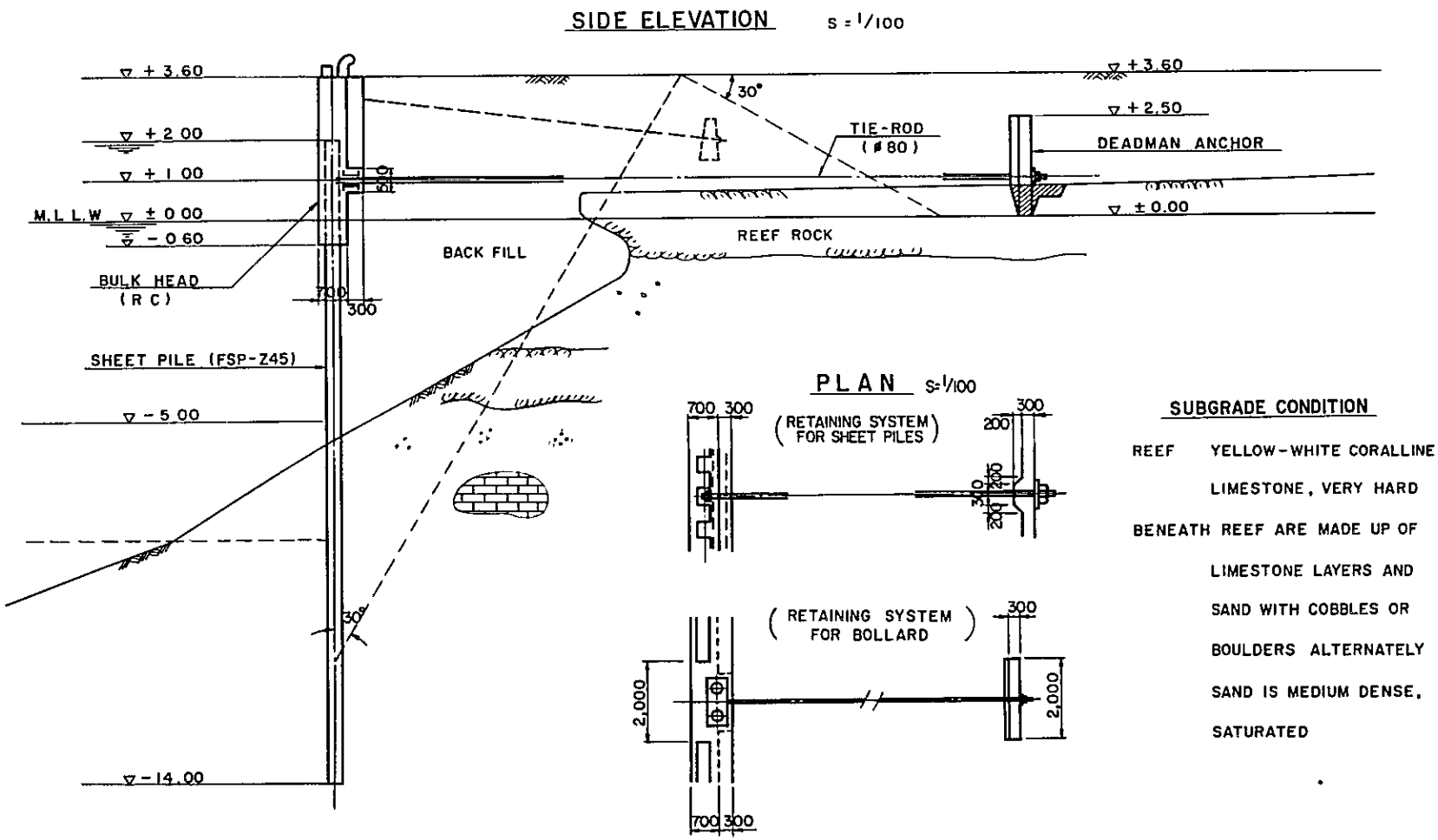


Fig.-4-5 SIDE ELEVATION

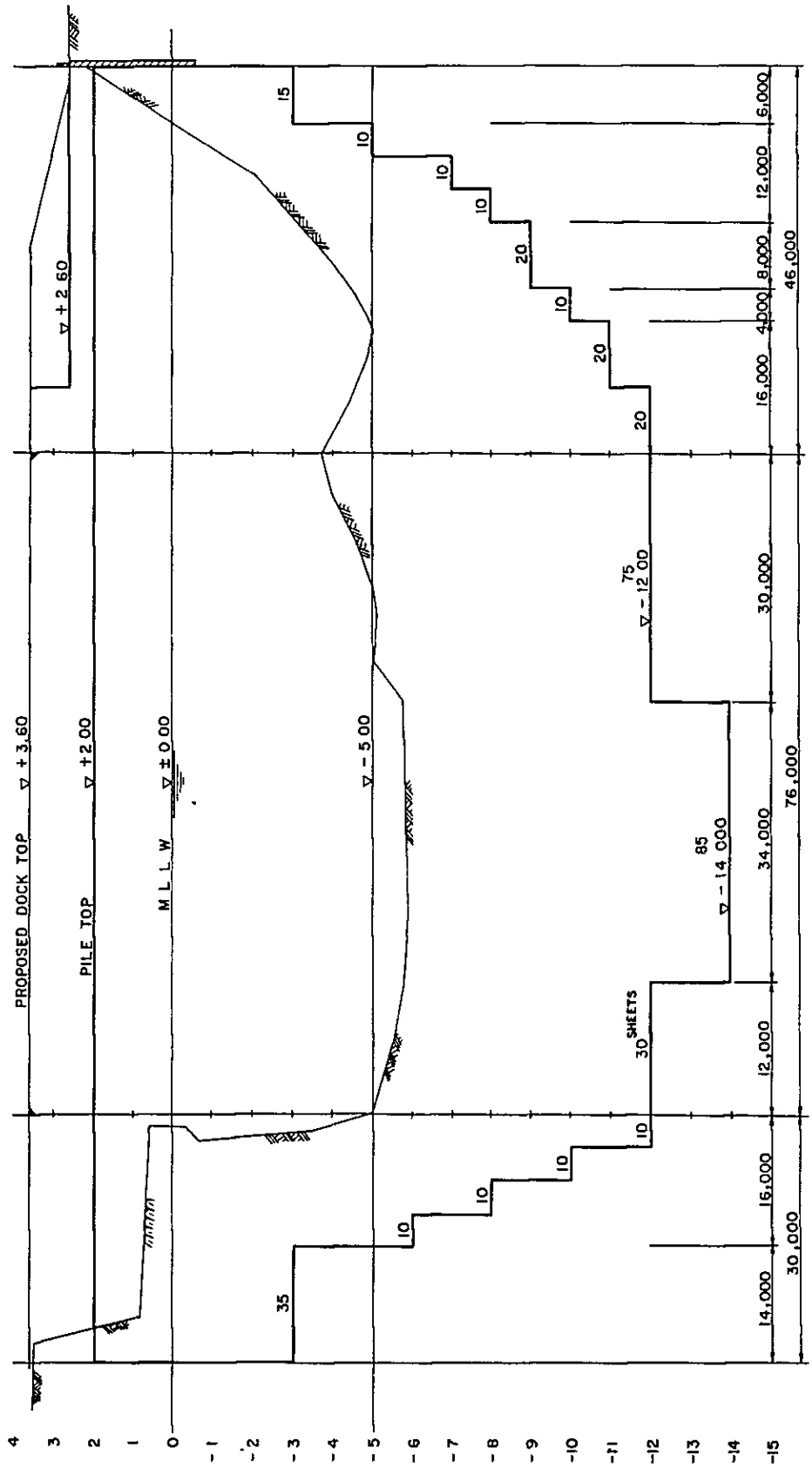


Fig.-4-6 FRONT ELEVATION

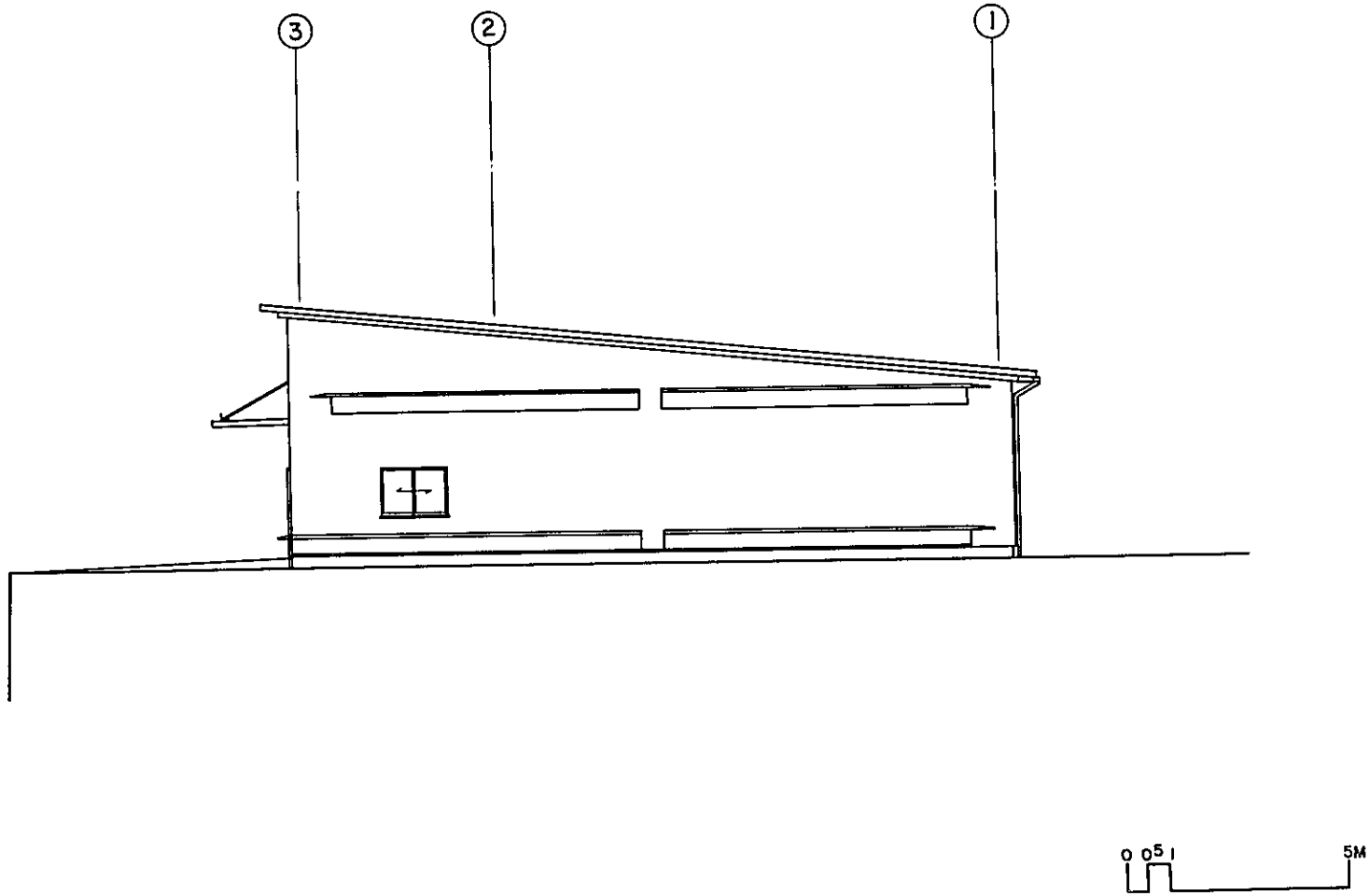
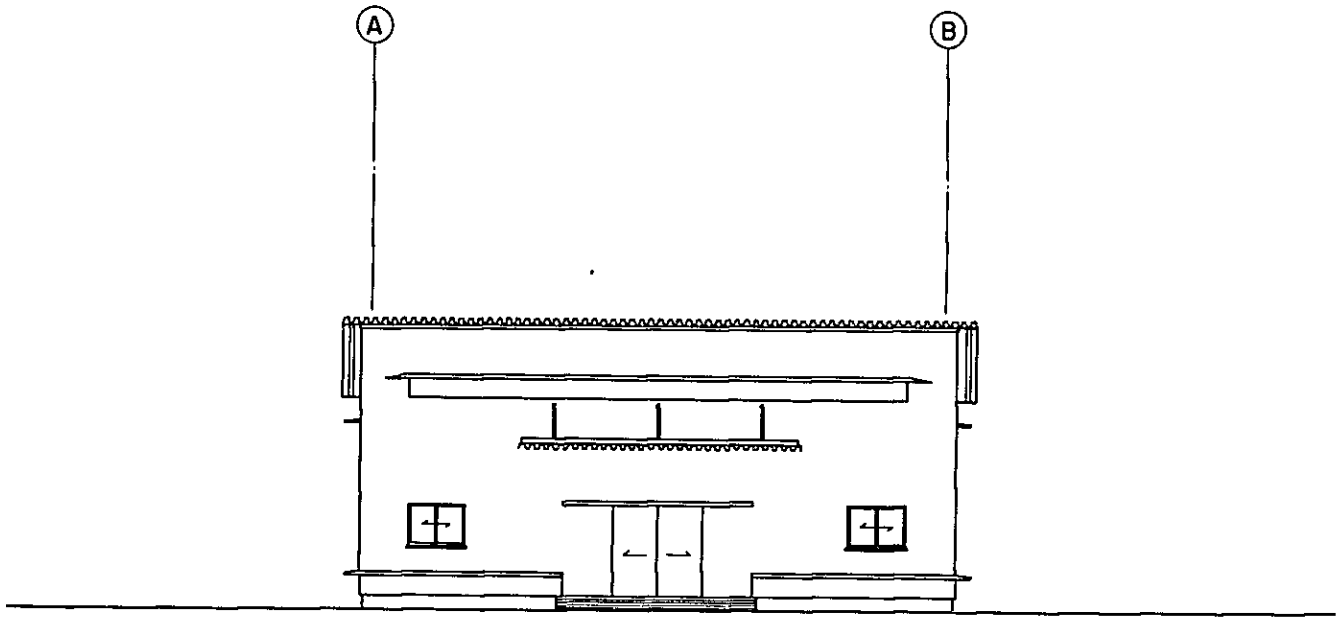


Fig.-4-7 WEST ELEVATION



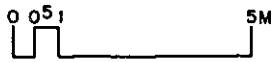


Fig.-4-8 NORTH ELEVATION

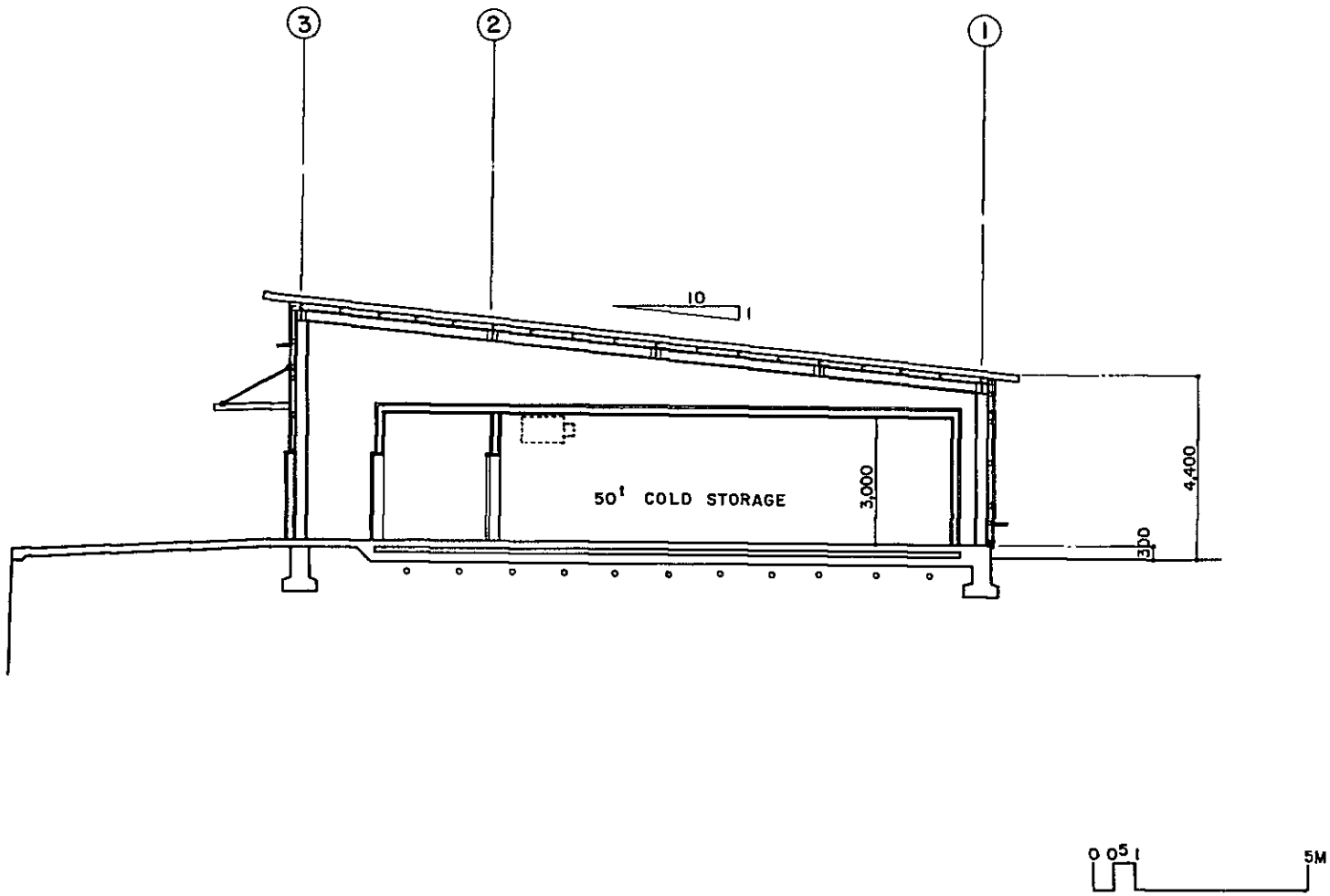


Fig.-4-9 SECTION

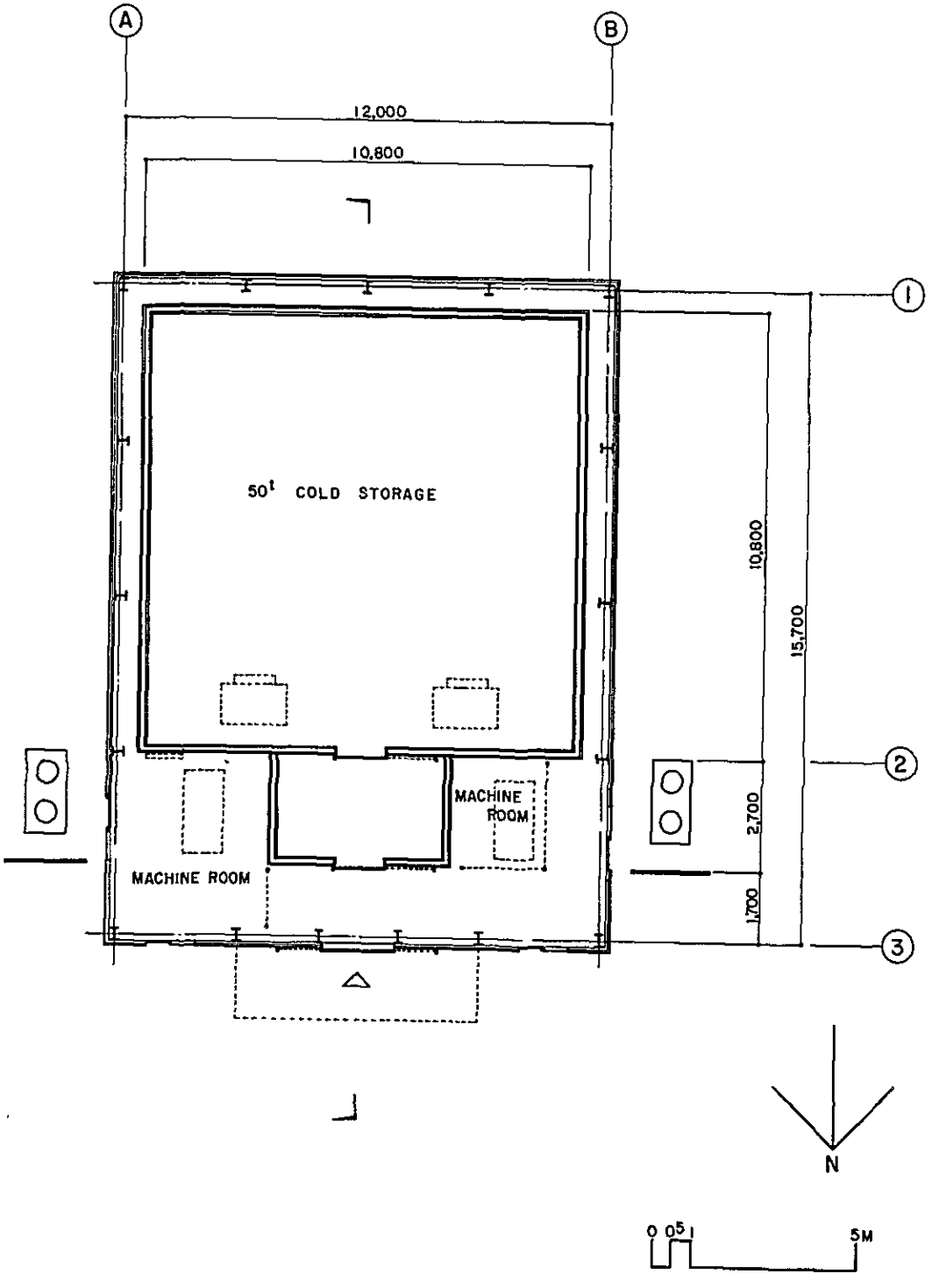


Fig.-4-10 FLOOR PLAN

V. PROJECT ORGANIZATION

V. PROJECT ORGANIZATION

1. Department Responsible for Implementation

The GMI department of responsible for implementation of the project will be the Ministry of Public Works.

The detailed design and supervision of the construction work shall be under the responsibility of the Japanese consulting engineer, and the construction work shall be carried out by a Japanese construction firm working as the contractor. However, on partial construction works, local construction companies may be employed as subcontractors.

2. Scope of Work

The works to be carried out under the scope of Japan's grant aid are as follows.

A. Basic facilities

1. Wharf for medium-size fishing boats (Minimum depth -5.0 m) 76.0 m long
2. Wharf for small fishing boats (Minimum depth -2.0 m) 46.0 m long
3. Auxiliary facilities (Illumination, oil and water supply)

B. Functional facilities

1. Repair of existing ice-making facilities
2. Installation of a new refrigerator, actual capacity 50 ton (retaining temperature -35°C).
3. Fixtures (shelf cart, cart, fish basket) 1 set

3. Plan for the Execution of Works

3.1 Wharf Construction

A barge shall be made by connecting about 30 steel floats (size of each float being 2.50 m wide, 5.00 m long and 1.25 m high), on which a crawler crane shall be installed for the excavation of coral and the driving of sheet piles. Tie-rod counterfort work and

covering concrete placement shall be conducted, and after leveling the site, the curbstone work and mooring pillar work shall be conducted.

3.2 Backfill Soil Work

Banking and compaction shall be conducted within a workable range corresponding to the progress of wharf construction. The necessary amount of backfill soil is approximately 10,000 m^3.

3.3 Dredging

A clamshell shall be attached to the crawler crane on the barge and the mounting area shall be dredged to a minimum depth of -5.0 m.

3.4 Paving

A concrete pavement of width 9.0 m shall be laid out along the wharf. This pavement will permit the passage of 20-ton trucks.

3.5 Auxiliary Facilities

These include illumination, oil and water supply, and fenders.

3.6 Refrigerating and Ice-Making Facilities

The existing ice-making facilities (ice-making machine and ice storage) shall be repaired and one refrigerator (actual capacity 50 ton, retaining temperature -35°C) shall be installed.

4. Construction Schedule

Month	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th	9 th	10 th	11 th	12 th	13 th
E/N	→												
Detailed design	D.D												
Tender		Tender											
Preparation Work			Material assignment Transpotation to the site										
Wharf construction					Sheet pile work. Counterfort work Concrete placement					Curbing work. Finishing work Mooring pillar construction			
Backfill soil work							Banking and compaction						
Dredging							Dredging						
Paving												Paving	
Auxiliary works										Illumination, oil and water supply,			
Refringerating and ice-making facilities							Construction, Adiabatic and Apparatus Construction						

5. Maintenance and Management

5.1 Wharfs for Fishing Boats

While the wharf does not require maintenance and management, periodic inspection and repair must be given to illumination, oil supply and water supply facilities. Local engineers are fully capable of conducting these maintenance and management works, and the new port facilities can be managed by the Ministry of Transporation and Communications, same as for the old port.

5.2 Refrigerating and Ice-Making Facilities

The Ministry of Resources and Development, or its subordinate section (Fishermen's Cooperative Association) will take responsibility for the maintenance and management of the refrigerating and ice-making facilities. Periodic inspection is essential on these facilities, and actual work should be conducted by local engineers who have been trained. It is preferable that engineers are dispatched from Japan for overhaul or replacement of a machine.

6. Material Acquisition

6.1 Wharfs for Fishing Boats

6.1.1 Local materials

- o Backfill soil
- o Ready-mixed concrete

6.1.2 Major materials to be imported

- o Sheet piles and channel steels
- o Tie-rods and accessories
- o Reinforcement bars and wires
- o Plywood for form work and square wood pieces
- o Fenders
- o Illumination equipment
- o Pipes
- o Electric cables

6.2 Refrigerating facility

Except for the foundation concrete of the building, all refrigerating facilities shall be brought in from Japan.

VI. PROJECT EVALUATION

VI. PROJECT EVALUATION

1. Significance of Project

Fishing boats that enter the Majuro Port in general use the old port. The number of fishing boats that call is about 255 a year, and since the old port is used by local large cargo-passenger vessels also, about 42 fishing boats a year have trouble entering the port. Also, the old port is becoming dilapidated and it is already passed its useful life span since a support of the pier is listing as the result of a collision by a large vessel. Continued use of the old port in the future will be difficult, but if the two berths projected for medium-size fishing boats are constructed, the fishing boats that have been using the old port will be able to use the Majuro Port without being subjected to the obstacles that currently exist. Also, the existing wharf for small fishing boats imposes difficulties to loading and unloading work since the wharf is not equipped with mooring facilities and the crown is high. As the fisheries develop in the future, a shortage of berths is anticipated, and the construction of a new wharf for small fishing boats which is equipped with appropriate mooring facilities and which provides easier loading and unloading work will solve the problem of congestion at the port. Accordingly, we consider that the construction of new wharfs for fishing boats will greatly contribute to the elimination of congestion at the port and that it will effectively replace the old port.

Since the cessation of operations by the Majuro Fishermen's Cooperative Association in February 1983 due to the breakdown of the refrigerating and ice-making facilities, the distribution of fish caught by local small boats in the islands has become very unstable. The most important jobs of the Association are purchasing, sales and temporary storage of the catches, so that an important consideration at present is the recovery of the Associations functions by installing new refrigerating facilities and repairing or installing new ice-making facilities. Thus, the improvement of refrigerating and ice-making facilities has the effect of restoring the activities of the Association to the condition before it was closed together with expansion of those functions corresponding to the increase in local demand for fish.

In addition to the main effects described above, the following secondary effects can be expected from implementation of this project.

(1) Installation of new wharfs for fishing boats and rehabilitation of the Cooperative Association will develop the local fisheries by improvement of the fishery base.

(2) An area behind the wharf will be developed for use by fishing boats, and it is probable that various industries related to the fisheries will develop.

(3) Construction of wharfs for fishing boats will encourage larger and more modern local fishing boats.

(4) When the function of the Cooperative Association is restored and expanded, the amount handled by the Association will increase and the domestic fish distribution system, in which the Association plays the leading part, will be improved.

(5) Installation of the refrigerating facilities will enable the storage of fish in a fresh state for an extended period, and this will stabilize the supply situation and price structure.

2. Financial Evaluation of the Designed Scope

The operation result and financial internal profit rate are estimated, and the scale of the project based on the basic design is evaluated. The calculation methods employed are shown in the [REFERENCE].

2.1 Wharfs for Fishing Boats (Case 1)

(1) Conditions

Once the wharf is constructed, all medium-size fishing boats are to use the new wharf. This condition, however, is based on the premise that oil supply facilities (extension of the oil pipeline from the existing facility to the wharf for fishing boats) are installed, the main purpose of entry of medium-size fishing boats being to refuel.

(2) Expected operational result (Table 10)

The profitability is good. The operation will bring in a profit both on a yearly basis and as an accumulation. The project is possible even as an independent enterprise.

(3) Financial internal profit rate

3.7%

2.2 Refrigerating and Ice-Making Facilities (Case 2)

(1) Conditions

In the demand forecast clause, we proposed installing a new 50-ton capacity refrigerator and the repair of the existing 5-ton ice-making machine. In this clause, we give a financial evaluation and study the eligibility of the design scope on suppositions that a 100-ton capacity refrigerator is introduced in anticipation of future changes to the fisheries structure and that a new ice-making machine having the necessary 3-ton a day capacity is installed.

The following four cases are assumed.

Case	Refrigerator *1	Ice-making machine *2	Index of project expenses *3
2A-1	50 ton	5 ton/day	100
2A-2	100 "	5 "	123
2B-1	50 "	3 "	145
2B-2	100 "	3 "	180

*1 : Refrigerator actual capacity

*2 : Ice making capacity. 5-ton a day machine represents repair of the existing machine, and 3-ton a day represents new installation.

*3 : Case 2A-1 is the standard. On Cases 2B-1 and 2B-2, expenses for construction of cargo handling yard and office are included.

(2) Estimated operation result (Table 11 ∿ 14)

The year at which the operation brings a profit on each case is shown in Table 6.1.

Table 6.1 Year of initial profit

Case	2A - 1	2A - 2	2B - 1	2B - 2
Profit before depreciation				
Single year profit	3rd	4th	3rd	4th
Cumulative profit	4th	5th	4th	5th
Profit after depreciation				
Single year profit	7th	8th	8th	10th
Cumulative profit	12th	15th	15th	18th

All cases have the period (3 to 4 years) during which the cumulative result before depreciation is deficit, causing shortage in the operating fund. However, the profit made on the operation of wharfs for fishing boats may be used during the period. Even if the operation fund is borrowed for the shortage from the government or banks, the loan can be paid back after the fourth to fifth year.

(3) Financial internal profit rate

Case 2A-1 : 6.2%
Case 2A-2 : 3.9%
Case 2B-1 : 3.1%
Case 2B-2 : 1.2%

We also calculated the financial internal profit rate by a sensitivity analysis on the lower limit of the profitability for the case where the Association operates at lower margins in order to be more competitive with private distribution enterprises. The result is shown in Table 6.2 below.

Table 6.2 Financial intrnal profit rate when operating at lower margins

Sales margin	Case 2A-1	Case 2A-2	Case 2B-1	Case 2B-2
25¢	6.2	3.9	3.4	1.2
24¢	5.0	2.7	2.3	0.2
23¢	3.6	1.5	1.1	-
22¢	2.2	0.1	-	-
21¢	0.7	-	-	-

Note: "-" shows that the financial internal profit rate is below 0%.

The initial investment of this project is to be made by a grant from Japan, requiring no loan. If the financial internal profit rate is positive, the project is possible. In all these cases, operation of the project is possible at the current sales margin, but the level of competitive power drops in the order of 2A-1, 2A-2, 2B-1 and 2B-2. For this reason, Case 2A-1 is preferable from the financial viewpoint in which a new 50-ton refrigerator is installed and the existing 5-ton ice-making machine is repaired. The project scale set based on the demand forecast is considered to be appropriate.

Ⅶ. CONCLUSIONS AND PROPOSALS

VII. CONCLUSIONS AND PROPOSALS

The Marshall Islands have rich fishery resources and the sea surrounding it provides favorable fishing grounds for skipjack and tuna. Utilization of these rich fishery resources is expected to greatly promote economic development of the Marshall Islands. To this end GMI is establishing various fisheries promotion plans. As has been described in the foregoing, the implementation of this project will have a significant affect on the development of fisheries of the country.

From this viewpoint, we consider that this project is justified as a project eligible for Japanese aid.

However, to ensure smooth operation and management of the facilities completed and to efficiently operate these facilities, we request that the GMI gives sufficient study and preparation to the following two points.

(1) In consideration that one of the reasons for the Majuro Fishermen's Cooperative Association being forced to stop the operation was improper maintenance and management of the facilities, we recommend that the GMI dispatches a prospective technical manager for the refrigerating and ice-making facilities to Japan prior to starting operation for the purpose of training on the refrigerating and ice-making facilities for about a month and half (one month on refrigerating and half month on ice-making).

(2) The refrigerating and ice-making facilities completed by this project will be operated by the Fishermen's Cooperative Association. We consider that the service of the Association to fishermen in the past was not up to the service level of private distribution enterprises on the payment method and locational conditions. In order to ensure the Association becomes stronger in competition with private enterprises, the Association must make an effort to render better services, such as, quicker payment for deliveries, higher purchase prices and lower sales prices to consumers.

[REFERENCE]

Financial Evaluation of the Designed Scope
(Estimation Method of Operation Results)

[REFERENCE]

Financial Evaluation of the Designed Scope (Estimation Method of Operation Results)

1. Project period

The objective facilities are to be constructed in 1984, and the economical durability of the facilities is set at 25 years for the wharf and 20 years for the refrigerating facilities.

2. Revenue

Case 1: Entry fee, dockage fee and commission on oil supply resulting from the entry of medium-size fishing boats

Cases 2A, 2B: Profit on sales of fresh fish, frozen fish and ice

3. Expenditure

Personnel expenses, utility (electricity and water) charges, maintenance and management expenses, and depreciation cost are calculated as normal operating expenses. For machines on which the life period terminates during the project period, expenses for re-investment are calculated.

4. Conversion of currencies

The conversion between Japanese Yen and local currency (US dollars) is made at the rate of ¥240:US$1.00, which was the conversion rate at the time of investigation (September - October, 1983).

5. Main factors affecting the financial analysis

(1) Wharfs for fishing boats (Case 1)

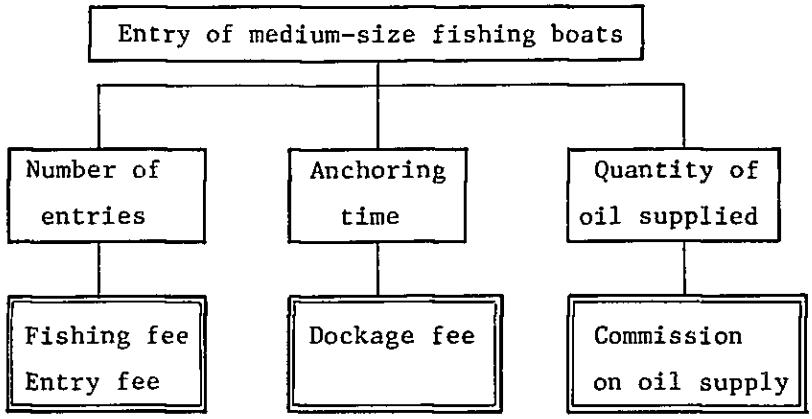
1) Number of medium-size fishing boats making calls.

The number of medium-size fishing boats that call at the wharf is set to 255, which is broken down to 215 boats for oil supply and 40 boats for other than oil supply.

2) Revenue calculation system

The fishing fee, entry fee, dockage fee and commission on oil supplies are the scheduled revenue items. The system of calculation of these incomes is shown in Fig. 1 below.

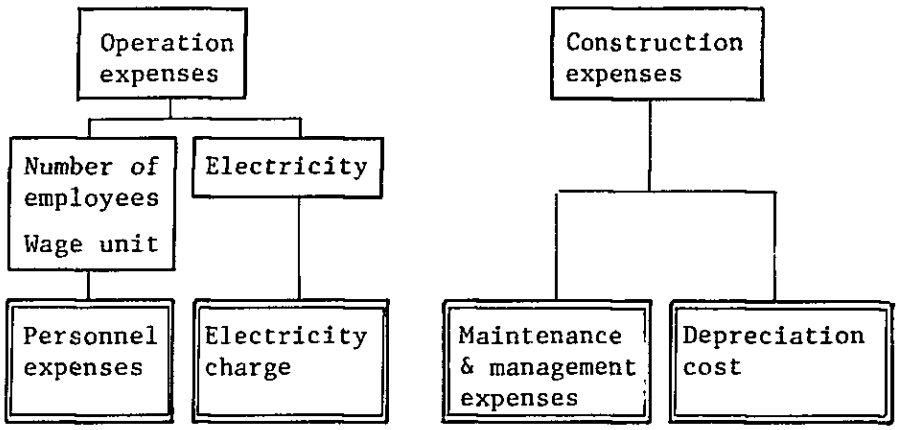
Fig. 1 Revenue calculation



3) Expenditure calculation system

Personnel expenses, electricity charges, maintenance and management expenses and depreciation cost form the scheduled expenditure items. The method of calculation of these expenditures is shown in Fig. 2.

Fig. 2 Expenditure calculation



4) Revenue calculation

i) Fishing fee and entry fee

These fees are collected from medium-size fishing boats that enter the port. The amounts are fixed to $450 (fishing fee) and $20 (entry fee) for medium-size fishing boats of all types and sizes.

Annual revenue ($) = (450 + 20) x number of entries

ii) Dockage

This fee is collected from medium-size fishing boats that berth at the wharf. The amount is fixed ($20/24 hours) for medium-size fishing boats of all types and sizes.

Annual revenue ($) =

$$20 \times \frac{1}{24} \times \text{Average anchoring time} \times \text{Number of boats}$$

iii) Commission on oil supply

This is the user charge for oil supply facilities on the diesel oil supplied to medium-size fishing boats. The unit price is $0.025 per gallon ($6.6 per kℓ).

Annual revenue ($) =

$$6.6 \times \text{Average quantity of supplied oil (kℓ)} \times \text{Number of boats supplied with oil}$$

iv) Revenue calculation

The total annual revenues is as shown in Table 1 below.

Table 1 Revenue calculation

(Unit: ¥1,000)

Revnue item	Annual income
Fishing fee, Entry fee	28,764
Dockage fee *1	1,224
Commission on oil supply *2	14,031
Total	44,019

*1 : Anchoring time is set at 24 hours/boat.

*2 : The quantity of oil supplied is set at 41.2 kℓ/boat.

5) Expenditure calculation

i) Personnel expenses

Table 2 shows the estimated personnel expenses.

Table 2 Estimation of personnel expenses

Job type	Number of employees	Expenses
Manager	1	$5,250/year/person
Office clerk	1	4,200 " "
Mooring operator	2	3,500 " "
Sr. oil supply operator	1	4,200 " "
Oil supply operator	1	3,500 " "
Total	6	24,150/year

ii) Electricity

The expenses for electricity for lighting the wharfs is estimated as follows.

Unit price	9¢/kw/hour
Consumption	21 kw hours/day, or 7,665 kw hours/year
Charge	¥166,000/year

iii) Maintenance and management expenses

While the wharfs do not require maintenance, the administrative office and oil supply facilities do. To cover these expenses, 0.5% of the construction cost is set as the maintenance and management expense.

iv) Depreciation cost

The physical durable life of basic facilities is set at 25 years, and the depreciation cost is calculated on the fixed installment method with the residual value set at zero.

v) Expenditure calculation

The total annual expenses are as shown in Table 3 below.

Table 3 Expenditure calculation

(Unit: ¥1,000)

Expenditure item	Annual expenses
Personnel expenses	5,796
Electricity charge	166
Maintenance & management	5,180
Depreciation	20,720
Total	31,862

(2) Refrigerating and ice-making facilities

1) Quantity of fish handled

Table 4 shows the quantity of fresh fish and frozen fish handled.

Table 4 Quantity of fish handled

Unit: Ton

Year	1985	1990	1995	2000	2003
Fresh fish *	155	199	261	342	401
Frozen fish *	72	92	121	158	185
Total	227	291	382	500	586

* The ratios of fresh fish and frozen fish are set at 68.4% and 31.6% respectively. (Refer to (4) Forecast of refrigerator turn over, in IV, 2.2.2 Forecast procedures.)

2) Quantity of ice handled

Table 5 shows the quantity of ice handled.

Table 5 Quantity of ice handled

Unit: Ton

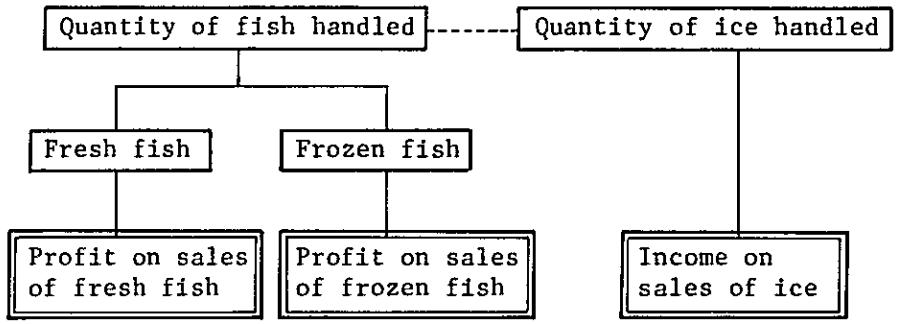
Year	1985	1990	1995	2000	2003
Supply to fishing boats	227	291	382	500	586
Use for fresh fish	114	146	191	250	293
Total	341	437	573	750	879

(Refer to Appendix Table 4.8.)

3) Income calculation

Profit is earned from sales of fresh fish, frozen fish and ice. The income calculation method is shown in Fig. 3.

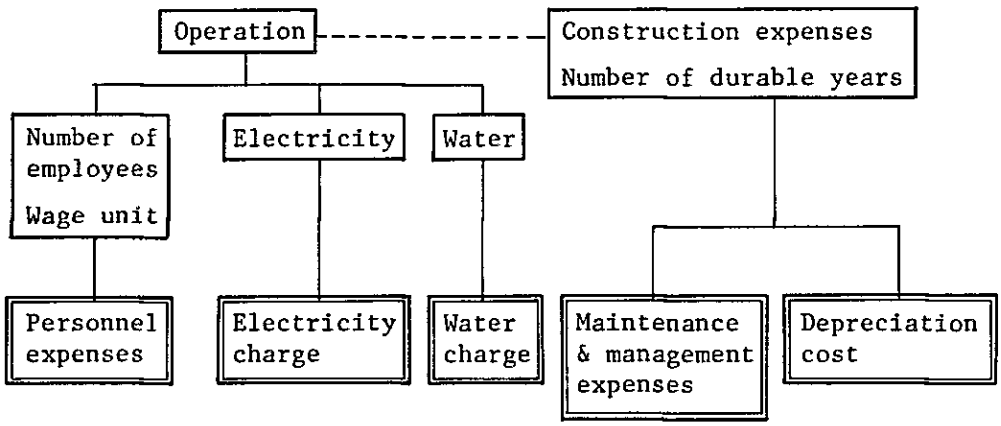
Fig. 3 Income calculation system



4) Expenditure calculation system

The expenses here are personnel expenses, electricity charges city water charges, maintenance and management expenses and depreciation costs. For machines on which the life period terminates during the project period, expenses for re-investment have been calculated.

Fig. 4 Expenditure calculation system



5) Income calculation

i) Profit on the sales of fresh fish and frozen fish

By making reference to the purchase and sales prices of fish species at retail stores shown in Appendix Table 2.15, the margin on the sale of fish is set at 25¢/lb (about ¥132/kg) which is the margin charged at present to skipjack and yellowfin tuna, the two most sold species. Since fish freshness can be maintained by storing these fishes in ice up to the time of selling and extra fish can be kept in the refrigerator in good condition, we consider that the portion to be disposed of would be small. The disposal rate is placed outside the financial evaluation.

Profit on sales = Quantity handled x margin

ii) Income on sales of ice

The unit price used is 50¢ per 4 gallons, which is the price that the Association charged before it closed down operations. However, since the volume of ice (plate ice) is about half that of water by weight, the final price used is ¥15/kg.

Income on sales of ice =

$$\text{Quantity supplied to fishing boats} \times \text{Sales price}$$

iii) Income calculation

Table 6 shows the annual income.

Table 6 Income calculation

(Unit: ¥1,000)

Year	1985	1990	1995	2000	2003
Profit on sales of fresh fish	20,566	26,363	34,608	45,298	53,089
Profit on sales of frozen fish	9,500	12,180	15,988	20,927	24,527
Income on sales of ice	3,405	4,365	5,730	7,500	8,790
Total	33,471	42,908	56,326	73,725	86,406

6) Expenditure calculation

i) Personnel expenses

Table 7 shows the estimated personnel expenses.

Table 7 Estimation of personnel expenses

Job type	Number of employees	Expenses ($/year/person)
Manager	1	5,250
Clerk	1	4,200
Engineer	1	4,200
Operator	3 *	3,500
Total	6 *	24,150 *

* Two more operators are employed from the eleventh year, making the total number of employees 8, and expenses $31,150.

ii) Electricity charges (Unit: ¥1,000)

Unit price 9¢/ kw hour

Consumption	Refrigerator	531.7 (618.5) kw·h/day
	Ice making facilities	449.3 kw·h/day
	Illumination	6.2 kw·h/day
Charge	Refrigerator	¥4,192 (4,876)/year
	Ice making facilities	¥3,542/year
	Illumination	¥49/year
	Total	¥7,783/year

Note) The numerals in parentheses are the consumption and electricity charges when a 100-ton capacity refrigerator is installed.

iii) Water supply

Since the water supply situation in Majuro is poor, we are studying the installation of water supply facilities using rainwater. However, this financial analysis is made supposing the use of city water supplies.

a) Unit price: $1.32 per ton

b) Consumption

. Living use water

The water quantity consumed by employees and sellers is set at 1 ton per day.

. Operations water

The quantity of water used to wash fish and in the market is set at 4 tons a day.

. Water for ice making

The quantity of water used to make ice is set at 2.5 ton a day.

Table 8 shows the estimated water charges.

Table 8 Estimation of water charges

Item	Annual consumption (ton/day) *	Charges (¥1,000)
Living use water	250	79
Operation water	1,000	317
Ice making	625	198
Total	1,875	594

* The number of operating days is 250 per year.

iv) Maintenance and management expenses

Although 15% of the normal machinery price is included in the initial construction expense for spares of machinery in general because of the difficulty of obtaining spares for this project, we are calculating 30% as the spare expense, and use the rate of 1.2% of the construction expenses as the maintenance and management expenses. The maintenance and management of the existing ice-making machine of the Association is set at 1.2% of the construction expense of the ice-making machine included in the case of a new installation.

v) Depreciation cost

The durable period of the building is set at 20 years and that of machinery at 10 years. The depreciation cost is calculated considering that the residual value is zero and using the fixed installment method.

vi) Expenditure calculation

Table 9 shows the expenditure calculation.

Table 9 Expenditure calculation

(Unit: ¥1,000)

Expenditure item	Amount
Personnel expenses	24,150 (31,150) *
Electricity charges	7,783
Water charge	594
Maintenance & management expenses	1,865
Depreciation cost	10,297
Total	44,689 (51,687) *

* Numerals in parentheses are annual expenses during the period of eleventh to twentieth years.

6. Estimation of Operation Result

The estimated operation result for each case is shown in Tables 10 through 14.

Table 10 Estimation of operation result (1)
Wharfs for fishing boats (Case 1)

Table 11 Estimation of operation result (2)
Refrigerating and ice making-facilities (Case 2A-1)

Table 12 Estimation of operation result (3)
Refrigerating and ice making-facilities (Case 2A-2)

Table 13 Estimation of operation result (4)
Refrigerating and ice-making-facilities (Case 2B-1)

Table 14 Estimation of operation result (5)
Refrigerating and ice-making facilities (Case 2B-2)

Table 10 Estimation of operation result (1)

Wharfs for fishing boats (Case 1)

YEAR	1	2	3	4	5	6	7	8	9	10	11	12
REVENUE	44019	44019	44019	44019	44019	44019	44019	44019	44019	44019	44019	44019
OPERATION COST	11142	11142	11142	11142	11142	11142	11142	11142	11142	11142	11142	11142
DEPRECIATION	20720	20720	20720	20720	20720	20720	20720	20720	20720	20720	20720	20720
TOTAL EXPENSES	31862	31862	31862	31862	31862	31862	31862	31862	31862	31862	31862	31862
INCOM BEF.D&I	32877	32877	32877	32877	32877	32877	32877	32877	32877	32877	32877	32877
PROFIT	12157	12157	12157	12157	12157	12157	12157	12157	12157	12157	12157	12157
ACCUMULATED PROFIT	12157	24314	36471	48628	60785	72942	85099	97256	109413	121570	133727	145884
BALANCE AT BEGINNING	0	32877	65754	98631	131508	164385	197262	230139	263016	295893	328770	361647
GOVERNMENT FUND	0	0	0	0	0	0	0	0	0	0	0	0
DEPRECIATION	20720	20720	20720	20720	20720	20720	20720	20720	20720	20720	20720	20720
PROFIT	12157	12157	12157	12157	12157	12157	12157	12157	12157	12157	12157	12157
TOTAL SOURCE	32877	65754	98631	131508	164385	197262	230139	263016	295893	328770	361647	394524
GOV. FUND REPAYMENT	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL USE	0	0	0	0	0	0	0	0	0	0	0	0
BALANCE AT END	32877	65754	98631	131508	164385	197262	230139	263016	295893	328770	361647	394524
BALANCE OF GOV.FUND	0	0	0	0	0	0	0	0	0	0	0	0

YEAR	13	14	15	16	17	18	19	20	21	22	23	24
REVENUE	44019	44019	44019	44019	44019	44019	44019	44019	44019	44019	44019	44019
OPERATION COST	11142	11142	11142	11142	11142	11142	11142	11142	11142	11142	11142	11142
DEPRECIATION	20720	20720	20720	20720	20720	20720	20720	20720	20720	20720	20720	20720
TOTAL EXPENSES	31862	31862	31862	31862	31862	31862	31862	31862	31862	31862	31862	31862
INCOM BEF.D&I	32877	32877	32877	32877	32877	32877	32877	32877	32877	32877	32877	32877
PROFIT	12157	12157	12157	12157	12157	12157	12157	12157	12157	12157	12157	12157
ACCUMULATED PROFIT	158041	170198	182355	194512	206669	218826	230983	243140	255297	267454	279611	291768
BALANCE AT BEGINNING	394524	427401	460278	493155	526032	558909	591786	624663	657540	690417	723294	756171
GOVERNMENT FUND	0	0	0	0	0	0	0	0	0	0	0	0
DEPRECIATION	20720	20720	20720	20720	20720	20720	20720	20720	20720	20720	20720	20720
PROFIT	12157	12157	12157	12157	12157	12157	12157	12157	12157	12157	12157	12157
TOTAL SOURCE	427401	460278	493155	526032	558909	591786	624663	657540	690417	723294	756171	789048
GOV. FUND REPAYMENT	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL USE	0	0	0	0	0	0	0	0	0	0	0	0
BALANCE AT END	427401	460278	493155	526032	558909	591786	624663	657540	690417	723294	756171	789048
BALANCE OF GOV.FUND	0	0	0	0	0	0	0	0	0	0	0	0

Table 11 Estimation of operation result (2)

Refrigerating and ice making-facilities (Case 2A-1)

YEAR	1	2	3	4	5	6	7	8	9
REVENUE	33471	35241	36863	38927	40844	42908	45267	47774	50575
OPERATION COST	34579	34579	34579	34579	34579	34579	34579	34579	34579
DEPRECIATION	10297	10297	10297	10297	10297	10297	10297	10297	10297
TOTAL EXPENSES	44876	44876	44876	44876	44876	44876	44876	44876	44876
INCOM BEF.D&I	-1108	662	2284	4348	6265	8329	10688	13195	15996
PROFIT	-11405	-9635	-8013	-5949	-4032	-1968	391	2898	5699
ACCUMULATED PROFIT	-11405	-21040	-29053	-35002	-39034	-41002	-40611	-37713	-32014
BALANCE AT BEGINNING	0	0	0	1838	6186	12451	20780	31468	44663
GOVERNMENT FUND	1108	0	0	0	0	0	0	0	0
DEPRECIATION	10297	10297	10297	10297	10297	10297	10297	10297	10297
PROFIT	-11405	-9635	-8013	-5949	-4032	-1968	391	2898	5699
TOTAL SOURCE	0	662	2284	6186	12451	20780	31468	44663	60659
GOV. FUND REPAYMENT	0	662	446	0	0	0	0	0	0
TOTAL USE	0	662	446	0	0	0	0	0	0
BALANCE AT END	0	0	1838	6186	12451	20780	31468	44663	60659
BALANCE OF GOV.FUND	1108	446	0	0	0	0	0	0	0

YEAR	10	11	12	13	14	15	16	17	18	19
REVENUE	53377	56326	59422	62666	66205	69891	73725	77854	81982	86406
OPERATION COST	41579	41579	41579	41579	41579	41579	41579	41579	41579	41579
DEPRECIATION	10297	10297	10297	10297	10297	10297	10297	10297	10297	10297
TOTAL EXPENSES	51876	51876	51876	51876	51876	51876	51876	51876	51876	51876
INCOM BEF.D&I	11798	14747	17843	21087	24626	28312	32146	36275	40403	44827
PROFIT	1501	4450	7546	10790	14329	18015	21849	25978	30106	34530
ACCUMULATED PROFIT	-30513	-26063	-18517	-7727	6602	24617	46466	72444	102550	137080
BALANCE AT BEGINNING	60659	37517	52264	70107	91194	115820	144132	176278	212553	252956
GOVERNMENT FUND	0	0	0	0	0	0	0	0	0	0
DEPRECIATION	10297	10297	10297	10297	10297	10297	10297	10297	10297	10297
PROFIT	1501	4450	7546	10790	14329	18015	21849	25978	30106	34530
TOTAL SOURCE	72457	52264	70107	91194	115820	144132	176278	212553	252956	297783
GOV. FUND REPAYMENT	0	0	0	0	0	0	0	0	0	0
TOTAL USE	34940	0	0	0	0	0	0	0	0	0
BALANCE AT END	37517	52264	70107	91194	115820	144132	176278	212553	252956	297783
BALANCE OF GOV FUND	0	0	0	0	0	0	0	0	0	0

Table 12 Estimation of operation result (3)

Refrigerating and ice making-facilities (Case 2A-2)

YEAR	1	2	3	4	5	6	7	8	9
REVENUE	33471	35241	36863	38927	40844	42908	45267	47774	50575
OPERATION COST	35769	35769	35769	35769	35769	35769	35769	35769	35769
DEPRECIATION	12336	12336	12336	12336	12336	12336	12336	12336	12336
TOTAL EXPENSES	48105	48105	48105	48105	48105	48105	48105	48105	48105
INCOM BEF.D&I	-2298	-528	1094	3158	5075	7139	9498	12005	14806
PROFIT	-14634	-12864	-11242	-9178	-7261	-5197	-2838	-331	2470
ACCUMULATED PROFIT	-14634	-27498	-38740	-47918	-55179	-60376	-63214	-63545	-61075
BALANCE AT BEGINNING	0	0	0	0	1426	6501	13640	23138	35143
GOVERNMENT FUND	2298	528	0	0	0	0	0	0	0
DEPRECIATION	12336	12336	12336	12336	12336	12336	12336	12336	12336
PROFIT	-14634	-12864	-11242	-9178	-7261	-5197	-2838	-331	2470
TOTAL SOURCE	0	0	1094	3158	6501	13640	23138	35143	49949
GOV. FUND REPAYMENT	0	0	1094	1732	0	0	0	0	0
TOTAL USE	0	0	1094	1732	0	0	0	0	0
BALANCE AT END	0	0	0	1426	6501	13640	23138	35143	49949
BALANCE OF GOV.FUND	2298	2826	1732	0	0	0	0	0	0

YEAR	10	11	12	13	14	15	16	17	18	19
REVENUE	53377	56326	59422	62666	66205	69891	73725	77854	81982	86406
OPERATION COST	42769	42769	42769	42769	42769	42769	42769	42769	42769	42769
DEPRECIATION	12336	12336	12336	12336	12336	12336	12336	12336	12336	12336
TOTAL EXPENSES	55105	55105	55105	55105	55105	55105	55105	55105	55105	55105
INCOM BEF.D&I	10608	13557	16653	19897	23436	27122	30956	35085	39213	43637
PROFIT	-1728	1221	4317	7561	11100	14786	18620	22749	26877	31301
ACCUMULATED PROFIT	-62803	-61582	-57265	-49704	-38604	-23818	-5198	17551	44428	75729
BALANCE AT BEGINNING	49949	24847	38404	55057	74954	98390	125512	156468	191553	230766
GOVERNMENT FUND	0	0	0	0	0	0	0	0	0	0
DEPRECIATION	12336	12336	12336	12336	12336	12336	12336	12336	12336	12336
PROFIT	-1728	1221	4317	7561	11100	14786	18620	22749	26877	31301
TOTAL SOURCE	60557	38404	55057	74954	98390	125512	156468	191553	230766	274403
GOV. FUND REPAYMENT	0	0	0	0	0	0	0	0	0	0
TOTAL USE	35710	0	0	0	0	0	0	0	0	0
BALANCE AT END	24847	38404	55057	74954	98390	125512	156468	191553	230766	274403
BALANCE OF GOV.FUND	0	0	0	0	0	0	0	0	0	0

Table 13 Estimation of operation result (4)

Refrigerating and ice-making-facilities (Case 2B-1)

YEAR	1	2	3	4	5	6	7	8	9
REVENUE	33471	35243	36863	38927	40844	42908	45267	47774	50575
OPERATION COST	34579	34579	34579	34579	34579	34579	34579	34579	34579
DEPRECIATION	7614	7614	7614	7614	7614	7614	7614	7614	7614
TOTAL EXPENSES	42193	42193	42193	42193	42193	42193	42193	42193	42193
INCOM BEF.D&I	-1108	662	2284	4348	6265	8329	10688	13195	15996
PROFIT	-8722	-6952	-5330	-3266	-1349	715	3074	5581	8382
ACCUMULATED PROFIT	-8722	-15674	-21004	-24270	-25619	-24904	-21830	-16249	-7867
BALANCE AT BEGINNING	0	0	0	1838	6186	12451	20780	31468	44663
GOVERNMENT FUND	1108	0	0	0	0	0	0	0	0
DEPRECIATION	7614	7614	7614	7614	7614	7614	7614	7614	7614
PROFIT	-8722	-6952	-5330	-3266	-1349	715	3074	5581	8382
TOTAL SOURCE	0	662	2284	6186	12451	20780	31468	44663	60659
GOV. FUND REPAYMENT	0	662	446	0	0	0	0	0	0
TOTAL USE	0	662	446	0	0	0	0	0	0
BALANCE AT END	0	0	1838	6186	12451	20780	31468	44663	60659
BALANCE OF GOV.FUND	1108	446	0	0	0	0	0	0	0

YEAR	10	11	12	13	14	15	16	17	18	19
REVENUE	53377	56326	59422	62666	66205	69891	73725	77854	81982	86406
OPERATION COST	41579	41579	41579	41579	41579	41579	41579	41579	41579	41579
DEPRECIATION	7614	7614	7614	7614	7614	7614	7614	7614	7614	7614
TOTAL EXPENSES	49193	49193	49193	49193	49193	49193	49193	49193	49193	49193
INCOM BEF.D&I	11798	14747	17843	21087	24626	28312	32146	36275	40403	44827
PROFIT	4184	7133	10229	13473	17012	20698	24532	28661	32789	37213
ACCUMULATED PROFIT	-3683	3450	13679	27152	44164	64862	89394	118055	150844	188057
BALANCE AT BEGINNING	60659	37517	52264	70107	91194	115820	144132	176278	212553	252956
GOVERNMENT FUND	0	0	0	0	0	0	0	0	0	0
DEPRECIATION	7614	7614	7614	7614	7614	7614	7614	7614	7614	7614
PROFIT	4184	7133	10229	13473	17012	20698	24532	28661	32789	37213
TOTAL SOURCE	72457	52264	70107	91194	115820	144132	176278	212553	252956	297783
GOV. FUND REPAYMENT	0	0	0	0	0	0	0	0	0	0
TOTAL USE	34940	0	0	0	0	0	0	0	0	0
BALANCE AT END	37517	52264	70107	91194	115820	144132	176278	212553	252956	297783
BALANCE OF GOV.FUND	0	0	0	0	0	0	0	0	0	0

Table 14 Estimation of operation result (5)

Refrigerating and ice-making facilities (Case 2B-2)

YEAR	1	2	3	4	5	6	7	8	9
REVENUE	33471	35241	36863	38927	40844	42908	45267	47774	50575
OPERATION COST	35769	35769	35769	35769	35769	35769	35769	35769	35769
DEPRECIATION	9018	9018	9018	9018	9018	9018	9018	9018	9018
TOTAL EXPENSES	44787	44787	44787	44787	44787	44787	44787	44787	44787
INCOM BEF.D&I	-2298	-528	1094	3138	5075	7139	9498	12005	14806
PROFIT	-11316	-9546	-7924	-5860	-3943	-1879	480	2987	5788
ACCUMULATED PROFIT	-11316	-20862	-28786	-34646	-38589	-40468	-39988	-37001	-31213
BALANCE AT BEGINNING	0	0	0	0	1426	6501	13640	23138	35143
GOVERNMENT FUND	2298	528	0	0	0	0	0	0	0
DEPPECIATION	9018	9018	9018	9018	9018	9018	9018	9018	9018
PROFIT	-11316	-9546	-7924	-5860	-3943	-1879	480	2987	5788
TOTAL SOURCE	0	0	1094	3138	6501	13640	23138	35143	49949
GOV. FUND REPAYMENT	0	0	1094	1732	0	0	0	0	0
TOTAL USE	0	0	1094	1732	0	0	0	0	0
BALANCE AT END	0	0	0	1426	6501	13640	23138	35143	49949
BALANCE OF GOV.FUND	2298	2826	1732	0	0	0	0	0	0

YEAR	10	11	12	13	14	15	16	17	18	19
REVENUE	53377	56326	59422	62666	66205	69891	73725	77854	81982	86406
OPERATION COST	42769	42769	42769	42769	42769	42769	42769	42769	42769	42769
DEPRECIATION	9018	9018	9018	9018	9018	9018	9018	9018	9018	9018
TOTAL EXPENSES	51787	51787	51787	51787	51787	51787	51787	51787	51787	51787
INCOM BEF.D&I	10608	13557	16653	19897	23436	27122	30956	35085	39213	43637
PROFIT	1590	4539	7635	10879	14418	18104	21938	26067	30195	34619
ACCUMULATED PROFIT	-29623	-25084	-17449	-6570	7848	25952	47890	73957	104152	138771
BALANCE AT BEGINNING	49949	24847	38404	55057	74954	98390	125512	156468	191553	230766
GOVERNMENT FUND	0	0	0	0	0	0	0	0	0	0
DEPRECIATION	9018	9018	9018	9018	9018	9018	9018	9018	9018	9018
PROFIT	1590	4539	7635	10879	14418	18104	21938	26067	30195	34619
TOTAL SOURCE	60557	38404	55057	74954	98390	125512	156468	191553	230766	274403
GOV. FUND REPAYMENT	0	0	0	0	0	0	0	0	0	0
TOTAL USE	35710	0	0	0	0	0	0	0	0	0
BALANCE AT END	24847	38404	55057	74954	98390	125512	156468	191553	230766	274403
BALANCE OF GOV.FUND	0	0	0	0	0	0	0	0	0	0

Ⅷ. REFERENCE MATERIALS

Table-1. Members of the Team

Name	Speciality	Present Department
Mr. Eiji ISHIHARA	Team Leader	Coastal Fisheries Div., Fisheries Promotion Department, Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries
Mr. Takahide NARUKO	Grant Aid	Second Economic Co-operation Div., Grant Aid Dept., Ministry of Foreign Affairs
Mr. Katsuhiro SASAKI	Project Coordinator	Kanagawa International Fisheries Center, JICA
Mr. Mikio HIGAI	Construction Planner	Chodai Co., Ltd.
Mr. Iwao CHIKARAISHI	Civil Engineer	Chodai Co., Ltd.
Mr. Shigeru SHIMURA	Fisheries Development Planner	Chodai Co., Ltd.
Mr. Teruo YABANA	Cold Storage Engineer	Chodai Co., Ltd.

Table-2. Related Parties of the Marshall Islands

	NAME	PRESENT TITLE
1.	Honorable TOKE SAWEJ	Acting President, Minister of Finance
2.	" CHARLES T. DOMINIC	Minister of Public Works
3.	" KUNAR ABNER	Minister of Resources and Development
4.	" THOMAS KIJINER	Minister of Education
5.	" ANDREW HISAIAH	Minister of Health Service
6.	" ATLAN ANIEN	Speaker of Parliament
7.	" RUBON ZACHRIAS	Minister of Internal Security
8.	Mr. BERNARD REIHER	Act. Secretary of Public Works
9.	Mr. TONY deBRUM	Secretary of Foreign Affairs
10.	Mr. RUDY MULLER	Port Director
11.	Mr. BRYANT S. ZEBEDY	Act. Secretary of Resources and Development
12.	Mr. OSCAR MILNE	Weather Station Majuro, Official in Charge
13.	Mr. JOHNNY LASAO	Civil Engineer of Public Works
14.	Mr. PHILLIP MULLER	Deputy Secretary of Foreign Affairs
15.	Mr. STEVE MULLER	Act. Secretary of Foregin Affairs
16.	Mr. EDINAL JORKAN	Act. Secretary of Foregin Affairs
17.	Mr. LAURENCE EDWARDS	Staff of Foreign Affairs
18.	Mr. LANINMO JACOB	"
19.	Mr. RESTA KATTIL	"
20.	Mr. JEWON LEMARI	Staff of Resources and Development

Table-3. Schedule of Field Survey

DAY	DATE	DAY	CITY OF STAY	CONTENTS OF STUDY		
				A	B	C
1	Sept. 21	Wed	Guam			
2	22	Thu	Majuro	Courtesy call on Consulate General in Agana		
3	23	Fri	"	Courtesy call on the Government of the Marshall Islands		
4	24	Sat	"	Site survey and data collection		
5	25	Sun	"	Team Meeting		
6	26	Mon	"	Site survey and data collection		
7	27	Tue	"	"		
8	28	Wed	"	to Guam	Site survey and Data collection Topographical survey	
9	29	Thu	"	Meeting with Consulate General in Agana	"	
10	30	Fri	"		"	
11	Oct. 1	Sat	"		"	
12	2	Sun	"		"	
13	3	Mon	"		"	
14	4	Tue	"		Discussion and signing of minutes of meeting	
15	5	Wed	"		to Guam	Site survey and data collection
16	6	Thu	"		Meeting with Consulate General in Agana	"
17	7	Fri	"			"
18	8	Sat	"			"
19	9	Sun	Guam			to Guam
20	10	Mon	Tokyo			Meeting with Consulate General in Agana

A : Grant Aid

B : Team Leader, Fisheries Development Planner, Cold Storage Engineer

C : Project Coordinator, Construction Planner, Civil Engineer

Table 2-1 Atmospheric Temperature Data

Unit: °C

Month	1	2	3	4	5	6	7	8	9	10	11	12	Through the year
Highest in a day	29.3	29.5	29.6	29.6	29.8	29.7	29.7	30.0	30.1	30.0	29.8	29.7	29.7
Lowest in a day	25.0	25.2	25.1	24.9	25.0	24.8	24.8	25.0	24.8	24.8	24.9	25.0	24.9
Monthly average	27.1	27.3	27.3	27.3	27.4	27.2	27.2	27.5	27.4	27.4	27.3	27.3	27.3

Table 2-2 Precipitation Data

Unit: mm

Month	1	2	3	4	5	6	7	8	9	10	11	12	Through the year
Monthly average	228	177	235	262	309	309	346	299	366	406	391	302	3629
1982	321	247	338	119	291	431	372	298	481	208	485	81	2670
Max. in a month (Year)	558 ('61)	466 '57	470 '55	790 '71	565 '56	448 '75	475 '64	425 '56	536 '64	616 '55	598 '78	630 '68	-
Min. in a month (Year)	20 '73	10 '70	44 '70	73 '70	125 '67	138 '81	136 '61	135 '59	166 '79	181 '69	115 '72	58 '57	-

Table 2-3 Humidity Data ty Data

Unit: %

Month / Hour	1	2	3	4	5	6	7	8	9	10	11	12	Through the year
00:00	80	80	81	83	84	84	83	82	82	82	82	81	82
06:00	81	80	82	84	85	85	84	84	83	83	83	82	83
12:00	75	74	75	78	78	78	77	77	76	76	77	76	76
18:00	78	77	78	80	82	80	80	78	78	79	80	79	79

Table 2-4 Wind Data

Month	1	2	3	4	5	6	7	8	9	10	11	12
Average wind speed (m/sec)	5.7	6.1	5.9	5.4	4.9	4.4	3.8	3.3	3.2	3.4	3.9	5.6
Wind direction	ENE	ENE	ENE	ENE	ENE	ENE	ENE	ENE	E	E	E	ENE
Max. wind speed in a minute (m/sec)	17.0	15.6	16.1	15.6	17.0	17.0	15.2	14.3	16.1	15.6	20.1	17.0
Wind direction	NE	E	NE	E	E	NE	E	NE	E	NW	SW	E
(Year)	67	'62	'59	'63	'62	'64	'73	'70	'73	'63	'82	'73

Table 2-5 Daytime Weather Data

Number of days

Month	1	2	3	4	5	6	7	8	9	10	11	12	Total
Clear and fine	1	1	1	1	1	*	1	1	1	1	1	1	11
Fair	6	7	7	5	6	7	6	8	6	6	6	6	76
Cloudy	24	20	23	24	24	23	24	22	23	24	23	24	278

* Less than half day

Table 2-6 : Number of Fishing Boats in Majuro Atoll

Area	Number of fishing boats
Darrit	25
Uliga	10
Laura	15
Others	5
Total	70

Remarks: Number of fishing boats, four to nine meter long and powered with outboard engines or diesel engines, were estimated from the interview with the former manager of the Majuro Fishermen's Cooperative Association.

Table 2-7 : Number of Fishermen and Related Hauls by Fishing Method

Fishing method	No. of fishermen (persons)	Fish landing (lbs)		
		Max.	Min.	Average
Trawling	45	70,078	4	4,588
Spear	133	3,815	6	322
Hook	103	2,714	9	207
Net	133	2,521	5	198

Remarks: (1) Number of fishermen is 282, in total.

(2) Compiled from unpublished data on fish landing by individual fishermen by fishing method in 1978 obtained from the Majuro Fishermen's Cooperative Association.

Table 2-8 : Monthly Catch by Major Fish Group at MFCA in 1978

Month	Pelagic fishes		Reef fishes		Bottom fishes		Lobsters		Total	
	Quantity (lbs)	Value ($)	Quantity (lbs)	Value ($)	Quantity (lbs)	Value ($)	Quantity (lbs)	Value ($)	Quantity (lbs)	Value ($)
Jan.	5,533	3,209	5,640	3,328	1,841	1,086	0	0	13,014	7,623
Feb.	19,844	11,655	3,745	2,215	1,727	1,026	122	98	25,438	14,994
Mar.	26,611	15,745	6,410	3,802	1,620	985	9	8	34,650	20,540
Apr.	14,964	8,360	4,975	2,955	2,329	1,417	12	10	22,280	12,742
May	16,400	9,860	6,365	3,539	1,126	635	5	4	23,896	14,038
June	12,132	5,913	7,107	3,685	1,385	678	0	0	20,622	10,276
July	23,215	11,762	8,653	4,555	728	338	80	63	32,666	16,718
Aug.	19,298	9,857	4,830	2,344	1,379	679	73	73	25,580	12,953
Sept.	20,255	10,284	6,707	3,196	2,644	1,221	25	21	29,631	14,722
Oct.	17,315	8,987	7,140	3,489	4,508	2,094	45	41	29,008	14,611
Nov.	19,515	10,463	4,101	2,047	1,969	965	15	14	25,600	13,489
Dec.	13,122	7,952	1,992	1,247	2,148	1,184	29	29	17,291	10,412
Total	208,204	114,047	67,665	36,402	23,402	12,308	405	361	299,676	163,118
Total (kg)	94,316		30,652		10,601		183		135,753	

Source: Unpublished data, obtained from the Majuro Fishermen's Cooperative Association in December 1981.

Table 2-9 : Monthly Catch by Major Fish Group at MFCA in 1979

Month	Pelagic fishes Quantity (lbs)	Pelagic fishes Value ($)	Reef fishes Quantity (lbs)	Reef fishes Value ($)	Bottom fishes Quantity (lbs)	Bottom fishes Value ($)	Lobsters Quantity (lbs)	Lobsters Value ($)	Total Quantity (lbs)	Total Value ($)
Jan.	15,010	9,694	4,516	2,992	4,100	2,736	4	4	23,630	15,426
Feb.	20,601	13,948	4,245	2,843	3,217	2,092	0	0	28,063	18,883
Mar.	45,699	28,719	3,303	2,059	2,042	1,185	0	0	51,044	31,963
Apr.	18,043	11,053	4,090	2,635	1,457	865	0	0	23,590	14,553
May	31,588	19,165	6,502	4,083	2,351	1,375	0	0	40,441	24,623
June	44,076	24,318	3,322	1,840	2,323	1,321	3	3	49,724	27,482
July	36,860	19,858	8,202	4,672	5,581	2,591	11	10	50,654	27,131
Aug.	34,034	17,925	10,157	5,651	4,294	2,354	48	44	48,533	25,974
Sept.	17,882	9,413	3,869	2,410	824	444	56	50	22,631	12,317
Oct.	19,030	10,156	1,888	1,055	519	206	0	0	21,437	11,417
Nov.	14,895	7,840	3,036	1,819	557	310	0	0	18,488	9,969
Dec.	1,912	1,054	781	519	191	104	0	0	2,884	1,677
Total	299,630	173,143	53,911	32,578	27,450	15,583	122	111	381,119	221,415
Total (kg)	135,732		24,421		12,435		55		172,647	

Source: Unpublished data, obtained from the Majuro Fishermen's Cooperative Association in December 1981.

Table 2-10 : Monthly Catch by Major Fish Group at MFCA in 1980

Month	Pelagic fishes		Reef fishes		Bottom fishes		Losters		Total	
	Quantity (lbs)	Value ($)	Quantity (lbs)	Value ($)	Quantity (lbs)	Value ($)	Quantity (lbs)	Value ($)	Quantity (lbs)	Value ($)
Jan.	2,291	1,590	1,294	869	364	234	0	0	3,949	2,693
Feb.	4,571	3,344	1,313	971	487	332	0	0	6,371	4,647
Mar.	1,120	892	1,544	1,207	245	181	4	4	2,913	2,284
Apr.	1,262	1,044	2,140	1,717	288	224	0	0	3,690	2,985
May	10,811	9,242	2,641	1,989	703	528	0	0	14,155	11,759
June	1,039	425	4,168	3,210	839	526	4	4	6,050	4,165
July	17,091	13,996	9,688	7,075	1,940	1,325	27	27	28,746	22,423
Aug.	13,078	7,696	5,890	4,033	1,239	754	61	61	20,268	12,544
Sept.	9,053	5,095	3,304	2,302	1,714	1,090	77	67	14,148	8,554
Oct.	22,473	12,002	1,374	1,012	486	309	6	6	24,339	13,329
Nov.	5,424	2,859	1,779	1,419	228	132	0	0	7,431	4,410
Dec.	3,952	2,073	352	240	74	60	0	0	4,368	2,373
Total	92,155	60,258	35,487	26,044	8,607	5,695	179	169	136,428	92,166
Total (kg)	41,746		16,076		3,899		81		61,802	

Source: Unpublished data, obtained from the Majuro Fishermen's Cooperative Association in December 1981.

Table 2-11 : Monthly Catch by Major Fish Group at MFCA in 1981

Month	Pelagic fishes		Reef fishes		Bottom fishes		Total	
	Quantity (lbs)	Value ($)	Quantity (lbs)	Value ($)	Quantity (lbs)	Value ($)	Quantity (lbs)	Value ($)
Jan.	7,829	5,085	1,052	856	277	215	9,158	6,156
Feb.	2,934	1,885	590	490	1,531	1,374	5,055	3,749
Mar.	2,812	2,514	1,474	1,159	944	534	5,230	4,207
Apr.	5,713	4,688	1,736	1,409	330	234	7,779	6,331
May	9,736	6,898	4,079	3,070	943	594	14,758	10,562
June	1,039	637	4,168	3,210	839	526	6,046	4,373
July	4,545	3,716	5,317	3,760	1,378	870	11,240	8,346
Aug.	9,217	6,626	7,337	5,446	2,222	1,921	18,776	13,993
Sept.	8,609	6,896	4,088	2,535	1,265	728	13,962	10,159
Oct.	4,049	3,180	7,166	6,309	1,555	1,038	12,770	10,527
Nov.	16,721	13,786	2,865	1,936	1,358	981	20,944	16,703
Dec.	6,446	5,456	1,102	1,015	237	199	7,785	6,670
Total	79,650	61,367	40,974	31,195	12,879	9,214	133,503	101,776
Total (kg)	36,081		18,561		5,834		60,477	

Source: Unpublished data, obtained from the former manager of the Majuro Fishermen's Cooperative Association in September 1983.

Table 2-12 : Monthly Catch by Major Fish Group at MFCA in 1982

Month	Pelagic fishes		Reef fishes		Bottom fishes		Total	
	Quantity (lbs)	Value ($)	Quantity (lbs)	Value ($)	Quantity (lbs)	Value ($)	Quantity (lbs)	Value ($)
Jan.	6,527	5,809	1,601	1,403	768	668	8,896	7,880
Feb.	3,643	3,455	1,182	1,060	3,043	2,697	7,868	7,212
Mar.	6,820	6,186	3,312	2,685	216	155	10,348	9,026
Apr.	8,714	6,192	2,400	2,187	167	109	11,281	8,488
May	820	818	1,183	984	355	278	2,358	2,080
June	3,919	3,192	3,605	3,384	250	179	7,774	6,755
July	6,618	5,890	3,291	2,941	476	334	10,385	9,165
Aug.	3,908	3,512	5,031	4,446	590	407	9,529	8,365
Sept.	2,840	2,544	3,837	3,366	441	303	7,118	6,213
Oct.	1,337	1,203	3,784	3,472	221	154	5,342	4,829
Nov.	721	549	2,677	2,490	178	121	3,576	3,160
Dec.	0	0	299	292	0	0	299	292
Total	45,867	39,350	32,202	28,710	6,705	5,405	84,774	73,465
Total (kg)	20,778		14,588		3,037		38,403	

Source: Unpublished data, obtained from the former manager of the Majuro Fishermen's Cooperative Association in September 1983.

Table 2-13 : Number of Landing Times by Major Fish Group at Majuro Fishermen's Cooperative Association

	Pelagic fish	Reef fish	Bottom fish	Total
1977				
Sept.	78	378	198	654
Oct.	97	163	68	328
Nov.	62	156	60	278
Dec.	66	125	49	240
1978				
Jan.	34	101	32	167
Feb.	68	67	30	165
Mar.	-	-	-	-
Apr.	57	69	41	167
May	69	78	24	171
June	53	96	35	184
July	-	-	-	-
Aug.	82	62	32	176

Source: Compiled from unpublished data on daily catches by major fish group from September 1977 to August 1978 (data lacking in March and July 1978) obtained from the Majuro Fishermen's Cooperative Association.

Table 2-14 : Monthly Average Catch per Operation at Majuro Fishermen's Cooperative Association

Month	Pelagic fishes		Reef fishes		Bottom fishes	
	lbs	kg	lbs	kg	lbs	kg
1977						
Sept.	200.4	90.9	56.0	25.4	57.7	26.2
Oct.	258.7	117.3	63.8	28.9	30.8	14.0
Nov.	234.0	106.0	70.0	31.8	36.4	16.5
Dec.	238.9	108.4	63.4	28.8	51.5	23.4
1978						
Jan.	183.8	83.4	57.4	26.0	57.0	25.9
Feb.	294.0	133.3	56.0	25.4	58.0	26.3
Mar.	-	-	-	-	-	-
Apr.	247.1	112.1	72.4	32.8	56.6	25.7
May	253.5	115.0	81.4	36.9	49.8	22.6
Jun.	232.5	105.5	76.5	34.7	42.0	19.1
Jul.	-	-	-	-	-	-
Aug.	272.5	123.6	89.7	40.7	47.8	21.7

Remarks; - : No data

Source: Compiled from unpublished data on daily catches by major fish group from September 1977 to August 1978 (data lacking in March and July 1978) obtained from the Majuro Fishermen's Cooperative Association.

Table 2-15 : Retail Price of Local Fish, Canned Fish and Imported Meat

Item	Selling Price ($)	Buying Price ($)
Local fish		
Skipjack (round)	1.00/lb.	0.85/lb.
Yellow fin tuna	1.10/lb.	0.85/lb.
Flying fish	0.80/lb.	0.65/lb.
Parrot fish	0.75/lb.	0.60/lb.
Reef fish	1.20/lb.	0.85/lb.
Sardines	1.30/lb.	1.00/lb.
Canned fish		
Mackerel	0.78-0.89/425 g.	
Sardine	0.75-1.10/425 g.	
Tuna	0.92-1.40/200 g.	
Meat (Poultry)		
Frying chicken	0.99/lb.	
Duck	1.60/lb.	
Turkey	1.40/lb.	

Source: Price at the Robert Reimers Super Market in October 1983.

Table 2-16 : Imports of Canned and Frozen Fish in 1982

Item	Amount	Metric ton
Canned fish		
Sardine	3090 ctn*	31.5
Mackerel	3710	75.7
Tuna	4620	44.4
Total ***	----	151.6**
Frozen fish		
Sardine	2,680 lbs	1.2
Other fishes	22,960	10.4
Total ***	25,640	11.6

* 24 cans/ctn of sardine (425 g/can) and 48 cans/ctn of mackerel (425 g/can) and tuna (200 g/can).

** 151.6 tons of canned fish meat correspond to 286.0 tons of whole fish (Edible ratio of whole fish is estimated 0.53 on the average).

*** Per capita imported fish consumption is estimated 8.57 kg/year for canned fish and 0.36 kg/year for frozen fish in gross weight (The population of the Marshall Islands is 33385 in 1982, based on Majuro Development Plan, 1981).

Source: Unpublished data obtained from the Office of Planning and Statistics in October 1983.

Table 2-17 : Number of Japanese Fishing Vessels operated Within 200 Mile Fishing Zone of the Marshall Islands

Year	Type of vessel		
	Longline	Pole and line	Total
1977	201	213	414
1978	247	254	501
1979	222	162	384
1980	220	164	384
1981	195	154	349
1982	196	123	319

Source: Fisheries Agency

Table 2-18 : Number of Vessels and Trips of Japanese Fishing Vessels Within 200 Mile Fishing Zone of the Marshall Islands

Year	1980	1981	1982
Longliner			
No. of vessels	220	195	196
No. of trips	311	328	346
Pole and liner			
No. of vessels	164	154	123
No. of trips	416	500	349

Source: Fisheries Agency

Table 2-19 : Fish Catch by Japanese Fishing Vessels Within 200 Mile Fishing Zone of the Marshall Islands

Unit: MT

Year	Type of vessel		
	Longline	Pole and line	Total
1977	4,866	21,364	26,230
1978	7,695	28,820	36,515
1979	6,324	6,344	12,668
1980	6,884	12,471	19,355
1981	7,250	18,881	26,131
1982	7,538-7,700*	13,557-13,700*	21,095-21,400*

*: estimated

Source: Fisheries Agency

Table 2-20 : Number of Port Calls at the Port of Majuro

Month	Foreign fishing vessel			Other * Vessels	Grand total
	for fuel supply	for other Purposes	subtotal		
June 1982	6	2	8	12	20
July 1982	13	8	21	10	31
Aug. 1982	14	4	18	12	30
Sep. 1982	12	1	13	8	21
Oct. 1982	.... NO DATA				
Nov. 1982	34	5	39	11	50
Dec. 1982	26	1	27	10	37
Jan. 1983	16	2	18	7	25
Feb. 1983	26	6	32	11	43
Mar. 1983	23	5	28	9	37
Apr. 1983	30	4	34	10	44
May 1983	17	3	20	9	29
June 1983	13	2	15	9	24
July 1983	13	1	14	10	24
Aug. 1983	8	3	11	13	24
Total	251	47	298	141	439
Total x $\frac{12}{14}$	215	40	255	121	376

* Four local vessels (Militobi, Micro Chief, Micro Palm, Micro Pilot) are included.

Table 4-1 Projected Population and Demand of Local Fish at Majuro in 1993 and 2003

Item	Year 1983	1993	2003
Population *1	13,004	17,755	25,068
Per capita GDP *2 (US$)	1,044	1,298	1,614
Local fish consumption index (100 in 1983)°3	100	117	136
Fish demand (in gross weight)			
Total fish (ton/year)	428	680	1118
Total local fish (ton/y)	316	527	902
Per capita (kg/year)			
Total fish	32.9	38.3	44.6
Local fish	24.3	29.7	36.0
Canned fish	8.6	8.6	8.6

Source

*1: First Five Year Development Plan 1983-1987, Republic of the Marshall Islands (1982)

*2: First Five Year Development Plan 1982-1987, Republic of the Marshall Islands (1982); current price in 1981. The projected growth rate of per capita GDP is estimated to 2.2% (a=0.022) based on "Low case growth of GNP per person in 1980-1990 of middle-income oil importing developing countries" in "World Development Report, 1981".

*3: Income elastisity of fish: e=0.7

Index: $100(1+axe)^n$, a=0.022, e=0.7, n=10, 20.

Table 4-2 : Projected Fish Demand and Total Catch of Local Fish by Small Fishing Boats at Majuro

Year	Population (person)	Fish demand per capital (kg/year)			Total local fish (ton/year)	Fish landing at MFCA* (ton/year)
		Total fish	Local fish	Canned fish		
1980	11,893	31.4	22.8	8.6**	271	176
1981	12,252	31.9	23.3	8.6**	285	185
1982	12,622	32.4	23.8	8.6	300	195
1983	13,004	32.9	24.3	8.6	316	205
1984	13,396	33.4	24.8	8.6	332	216
1985	13,801	33.9	25.3	8.6	349	227
1986	14,217	34.4	25.8	8.6	367	239
1987	14,646	34.9	26.3	8.6	385	250
1988	15,089	35.5	26.9	8.6	406	264
1989	15,544	36.0	27.4	8.6	426	277
1990	16,010	36.6	28.0	8.6	448	291
1991	16,572	37.1	28.5	8.6	472	307
1992	17,153	37.7	29.1	8.6	499	324
1993	17,755	38.3	29.7	8.6	527	343
1994	18,378	38.9	40.3	8.6	577	362
1995	19,023	39.5	30.9	8.6	588	382
1996	19,691	40.1	31.5	8.6	620	403
1997	20,382	40.7	32.1	8.6	654	425
1998	21,098	41.3	32.7	8.6	690	449
1999	21,839	42.0	33.4	8.6	729	474
2000	22,610	42.6	34.0	8.6	769	500
2001	23,401	43.3	34.7	8.6	812	528
2002	24,220	43.9	35.3	8.6	855	556
2003	25,068	44.6	36.0	8.6	902	586

*: 65% of total local fish
**: Estimated

Table 4-3 Estimated Demand of Local Fish and Estimated Number of Landing Times at the Majuro Fishermen's Cooperative Association (MFCA)

Year		1978/79	1993	2003
Demand of local fish(kg/year) (Fish catch in 1978/79)		237,230	527,323	902,448
Fish landing at MFCA (65% of demand) (kg/year)				
Total	(100.00%)	154,200	342,760	586,591
Pelagic fish	(74.65%)	115,110	255,870	437,890
Reef fish	(17.87%)	27,556	61,251	104,823
Bottom fish	(7.48%)	11,534	25,638	43,877
Quantity of fish landing per operation (kg)				
Pelagic fish		111.2	111.2	111.2
Reef fish		29.5	29.5	29.5
Bottom fish		22.5	22.5	22.5
Number of fish landing times at MFCA				
Pelagic fish				
per year		1,035	2,301	3,938
per month		86	192	328
per day **		4.1	9.2	15.8
Reef fish				
per year		934	2,076	3,553
per month		78	173	296
per day		3.7	8.3	14.2
Bottom fish				
per year		513	1,139	1,950
per month		43	95	162
per day		2.1	4.6	7.8
Sub total (Pelagic + Reef)				
per day (average)		7.8	17.5	30.0
per day (fishing season)**		11.7	26.2	45.0

* 250 days for fish landing per year

** 1.5 times of average landing times. (Maximum quantity of monthly fish landing is about 1.5 times of Monthly average, based on fish landing data at MFCA in 1978/79.)

Table 4-4 : Monthly Average Catch per Operation and Number of Landing Times by Major Fish Group at MFCA

Month	Pelagic fish		Reef fish		Bottom fish	
	Quantity per landing (lb)	Landing times	Quantity per landing (lb)	Landing times	Quantity per landing (lb)	Landing times
Sept. 1977	200.4	78	56.0	378	57.7	198
Oct. 1977	258.7	97	63.8	163	30.8	68
Nov. 1977	234.0	62	70.0	156	36.4	60
Dec. 1977	238.9	66	63.4	125	51.5	49
Jan. 1978	183.8	34	57.4	101	57.0	32
Feb. 1978	294.0	68	56.0	67	58.0	30
Mar. 1978	--	--	--	--	--	--
Apr. 1978	247.1	57	72.4	69	56.6	41
May 1978	253.5	69	81.4	78	49.8	24
June 1978	232.5	53	76.5	96	42.0	35
July 1978	--	--	--	--	--	--
Aug. 1978	272.5	82	89.7	62	47.8	32
Average	245.5 (111.2 kg)	66.6	65.0 (29.5 kg)	129.5	49.7 (22.5 kg)	56.9

Source: compiled by unpublished data on daily catch by major fish group from September 1977 to August 1978 (data lacking in March and July 1978) obtained from the Majuro Fishermen's Cooperative Association in December 1981.

Table 4-5 : Estimated Berth Length Required for Local Small Fishing Boats Catch Landing

Year	1978/1979	1993	2003
Number of landing times for pelagic and reef fish per day (fishing season)*	15.3	26.2	45.0
Landing hour for pelagic and reef fish (hour)*	3 (3-6 pm)	3 (3-6 pm)	3 (3-6 pm)
Duration required for fish landing (hour)	1	1	1
Turnover rate (times/day)	3	3	3
Berth required for (number of boats)	6	9	15

* Fishing operation for bottom fish is usually conducted at night and the catch is landed in the morning. Number of landing times of bottom fish is less frequent than those of pelagic and reef fishes and is considered neglible for the purposes of estimation of berth length.

Table 4-6 : Bunkering of Local Vessels at the Port of Majuro (I)

Name	Bunkering		
	times/year	days/time	days/year
Militobi	9.4	16.0	150
Micro Palm	12.8	14.6	187
Micro Pilot	10.3	14.5	149
Micro Chief	17.1	10.8	185

(See also Figure 4-1)

Table 4-7 : Bunkering of Local Vessels at the Port of Majuro (II)

Number of vessels at bunkering	0	1	2	3	4
Days/year	52	98	86	107	22
Frequency (%)	14.3	26.8	23.5	29.3	6.1

(See also Figure 4-1)

Table 4-8 : Projected Ice Demand

Year	Fish landing (ton/year)	Projected ice demand: Use for landed fish (ton/year)*1	Sale for fishermen (ton/year)*2	Total (ton): Per year	per day*3: average	per day*3: maximum*4
1985	227	113.5	227	340.5	1.36	2.04
1986	239	119.5	239	358.5	1.43	2.15
1987	250	125	250	375	1.50	2.25
1988	264	132	264	396	1.58	2.38
1989	277	138.5	277	415.5	1.66	2.49
1990	291	145.5	291	436.5	1.75	2.62
1991	307	153.5	307	460.5	1.84	2.76
1992	324	162	324	486	1.94	2.92
1993	343	171.5	343	514.5	2.06	3.09
1994	362	181	362	543	2.17	3.26
1995	382	191	382	573	2.29	3.44
1996	403	201.5	403	604.5	2.42	3.63
1997	425	212.5	425	637.5	2.55	3.82
1998	449	224.5	449	673.5	2.69	4.04
1999	474	237	474	711	2.84	4.27
2000	500	250	500	750	3.00	4.50
2001	528	264	528	792	3.17	4.75
2002	556	278	556	834	3.46	5.00
2003	586	293	586	879	3.48	5.22

*1: 50% of fish landed

*2: 100% of fish landed

*3: 250 days for fish landing per year

*4: 1.5 times of average demand (Maximum quantity of monthly fish landing is about 1.5 times of monthly average, based on fish landing data at MFCA in 1978/79.)

Table 4-9 Daily Landing and Estimated Turn Around of Catches and Stock at the M.F.C.A. (Sept. 1977 to Aug. 1978) (1)

Unit: lb

Date	Cumulative days	Landed quantity	Shipped out	Entry	Stock	Date	Cumulative days	Landed quantity	Shipped out	Entry	Stock
Sept. 1	1	2831	0	1873	1873	Oct. 1	31	1933	0	975	20433
	2	814	144	0	1729		32	180	778	0	19655
	3	5933	0	4975	6704		33	665	293	0	19362
	4	212	746	0	5958		34	1959	0	1001	20363
	5	530	428	0	5530		35	1723	0	765	21128
	6	1588	0	630	6160		36	1896	0	938	22066
	7	1589	0	631	6791		37	1282	0	324	22390
	8	738	220	0	6571		38	1717	0	759	23149
	9	1139	0	181	6752		39	1098	0	140	23289
	10	2486	0	1528	8280		40	1900	0	942	24231
	11	367	591	0	7689		41	1391	0	433	24664
	12	1313	0	355	8044		42	727	231	0	24433
	13	2690	0	1732	9776		43	1263	0	305	24738
	14	1822	0	864	10640		44	1847	0	889	25627
	15	3403	0	2445	13085		45	4521	0	3563	29190
	16	2115	0	1157	14242		46	964	0	6	29196
	17	4005	0	3047	17289		47	1330	0	372	29568
	18	479	479	0	16810		48	1102	0	144	29712
	19	976	0	18	16828		49	458	500	0	29212
	20	962	0	4	16832		50	336	622	0	28590
	21	1303	0	345	17177		51	1118	0	160	28750
	22	1276	0	318	17495		52	469	489	0	28261
	23	1233	0	275	17770		53	10	948	0	27313
	24	1935	0	977	18747		54	714	244	0	27069
	25	231	727	0	18020		55	1380	0	422	27491
	26	829	129	0	17891		56	1312	0	354	27845
	27	1332	0	374	18265		57	993	0	35	27880
	28	1709	0	751	19016		58	698	260	0	27620
	29	907	51	0	18965		59	954	4	0	27616
Sept. 30	30	1451	0	493	19458		60	89	869	0	26747
						Oct. 31	61	1574	0	616	27363

The daily landed quantity is assumed to be the quantity of sales. The stock quantity is calculated by taking the landed quantity in excess of the sales quantity as the entry into stock and when the landed quantity is smaller than the sales quantity, the shortage is filled by shipping out the equivalent quantity from the stock.

Table 4-10 Daily Landing and Estimated Turn Around of Catches and Stock at the M.F.C.A. (Sept. 1977 to Aug. 1978) (2)

Unit: lb

Date	Cumulative days	Landed quantity	Shipped out	Entry	Stock	Date	Cumulative days	Landed quantity	Shipped out	Entry	Stock
Nov. 1	62	900	58	0	27305	Dec. 1	92	944	14	0	30053
	63	2551	0	1593	28898		93	1119	0	161	30214
	64	585	375	0	28523		94	1100	0	142	30356
	65	994	0	36	28559		95	56	902	0	29454
	66	753	203	0	28354		96	73	885	0	28569
	67	278	680	0	27674		97	1188	0	230	28799
	68	1061	0	103	27777		98	1129	0	171	28970
	69	1059	0	101	27878		99	1533	0	575	29545
	70	2072	0	1114	28992		100	1402	0	444	29989
	71	1118	0	160	29152		101	1114	0	154	30145
	72	982	0	24	29176		102	694	264	0	29881
	73	1489	0	531	29707		103	1190	0	232	30113
	74	556	402	0	29305		104	2170	0	1212	31325
	75	923	35	0	29270		105	850	108	0	31217
	76	1925	0	967	30237		106	998	0	40	31257
	77	400	558	0	29679		107	307	651	0	30606
	78	183	775	0	28904		108	446	512	0	30094
	79	538	420	0	28484		109	345	613	0	29481
	80	1243	0	285	28769		110	693	265	0	29216
	81	46	912	0	27857		111	266	692	0	28524
	82	646	312	0	27545		112	693	265	0	28259
	83	1131	0	173	27718		113	3165	0	2207	30466
	84	2291	0	1333	29051		114	964	0	6	30472
Nov. 24	85	597	361	0	28690		115	441	517	0	29955
Nov. 27	88	124	834	0	27856		116	0	958	0	28997
	89	2505	0	1547	29403		117	0	958	0	28039
	90	2301	0	1343	30746		118	959	0	1	28040
Nov. 30	91	279	679	0	30067		119	992	0	34	28074
							120	305	653	0	27421
							121	457	501	0	26920
							122	466	492	0	26428

The daily landed quantity is assumed to be the quantity of sales. The stock quantity is calculated by taking the landed quantity in excess of the sales quantity as the entry into stock and when the landed quantity is smaller than the sales quantity, the shortage is filled by shipping out the equivalent quantity from the stock.

Table 4-11 Daily Landing and Estimated Turn Around of Catches and Stock at the M.F.C.A. (Sept. 1977 to Aug. 1978) (3)

Unit: lb

Date	Cumulative days	Landed quantity	Shipped out	Entry	Stock	Date	Cumulative days	Landed quantity	Shipped out	Entry	Stock
Jan. 1	123	0	958	0	25470	Feb. 1	153	208	750	0	10780
	124	35	923	0	24547		154	990	0	32	10812
	125	192	766	0	23781		155	1245	0	287	11099
	126	505	453	0	23328		156	977	0	19	11118
	127	98	860	0	22468		157	839	119	0	10999
	128	12	946	0	21522		158	2891	0	1933	12932
	129	45	913	0	20609		159	2421	0	1463	14395
	130	451	507	0	20102		160	2503	0	1545	15940
	131	546	412	0	19690		161	1265	0	307	16247
	132	1375	0	417	20107		162	221	737	0	15510
	133	1165	0	207	20314		163	963	0	5	15515
	134	1203	0	245	20559		164	131	827	0	14688
	135	1044	0	86	20645		165	27	931	0	13757
	136	606	352	0	20293		166	375	583	0	13174
	137	162	796	0	19497		167	1925	0	967	14141
	138	123	835	0	18662		168	134	824	0	13317
	139	769	189	0	18473		169	1260	0	302	13619
	140	332	626	0	17847		170	648	310	0	13309
	141	0	958	0	16889		171	176	782	0	12527
	142	464	494	0	16395		172	1053	0	95	12622
	143	909	49	0	16346		173	506	452	0	12170
	144	0	958	0	15388		174	1174	0	216	12386
	145	554	404	0	14984		175	855	103	0	12283
	146	340	618	0	14366		176	960	0	2	12285
	147	438	520	0	13846		177	838	120	0	12165
	148	695	263	0	13583		178	23	935	0	11230
	149	298	660	0	12923		179	492	466	0	10764
	150	1327	0	369	13292	Feb. 28	180	219	739	0	10025
	151	34	924	0	12368						
Jan. 30	152	120	838	0	11530						

The daily landed quantity is assumed to be the quantity of sales. The stock quantity is calculated by taking the landed quantity in excess of the sales quantity as the entry into stock and when the landed quantity is smaller than the sales quantity, the shortage is filled by shipping out the equivalent quantity from the stock.

Table 4-12 Daily Landing and Estimated Turn Around of Catches and Stock at the M.F.C.A. (Sept. 1977 to Aug. 1978) (4)

Unit: lb

Date	Cumulative days	Landed quantity	Shipped out	Entry	Stock	Date	Cumulative days	Landed quantity	Shipped out	Entry	Stock
Mar. 1	181	242	716	0	9309	Apr. 1	212	2235	0	1277	16243
	182	150	808	0	8501		213	480	478	0	15765
	183	1202	0	244	8745		214	966	0	8	15773
	184	611	347	0	8398		215	412	546	0	15227
	185	184	774	0	7624		216	585	373	0	14854
	186	252	706	0	6918		217	590	368	0	14486
	187	446	512	0	6406		218	368	590	0	13896
	188	603	355	0	6051		219	0	958	0	12938
	189	864	94	0	5957		220	180	778	0	12160
	190	588	370	0	5587		221	744	214	0	11946
	191	1773	0	815	6402		222	1819	0	861	12807
	192	359	599	0	5803		223	1111	0	153	12960
	193	416	542	0	5261		224	1729	0	771	13731
	194	2146	0	1188	6449		225	596	362	0	13369
	195	651	307	0	6142		226	908	50	0	13319
	196	496	462	0	5680		227	838	120	0	13199
	197	842	116	0	5564		228	296	662	0	12537
	198	1026	0	68	5632		229	214	744	0	11793
	199	174	784	0	4848		230	53	905	0	10888
	200	292	666	0	4182		231	325	633	0	10255
	201	755	203	0	3979		232	433	525	0	9730
	202	946	12	0	3967		233	1024	0	66	9796
	203	1511	0	553	4520		234	149	809	0	8987
	204	1486	0	528	5048		235	1359	0	401	9388
	205	1944	0	986	6034		236	752	206	0	9182
	206	300	658	0	5376		237	282	676	0	8506
	207	3533	0	2575	7951		238	372	586	0	7920
	208	1989	0	1031	8982		239	1725	0	767	8687
	209	5374	0	4416	13398		240	462	496	0	8191
	210	1967	0	1009	14407	Apr. 30	241	406	552	0	7639
Mar. 31	211	1517	0	559	14966						

The daily landed quantity is assumed to be the quantity of sales. The stock quantity is calculated by taking the landed quantity in excess of the sales quantity as the entry into stock and when the landed quantity is smaller than the sales quantity, the shortage is filled by shipping out the equivalent quantity from the stock.

Table 4-13 Daily Landing and Estimated Turn Around of Catches and Stock at the M.F.C.A. (Sept. 1977 to Aug. 1978) (5)

Unit: lb

Date	Cumulative days	Landed quantity	Shipped out	Entry	Stock	Date	Cumulative days	Landed quantity	Shipped out	Entry	Stock
May 1	242	314	644	0	6995	Jun. 1	273	797	161	0	2760
	243	1581	0	623	7618		274	612	346	0	2412
	244	1933	0	975	8593		275	928	30	0	2384
	243	1796	0	838	9431		276	89	869	0	1515
	246	203	755	0	8676		277	953	5	0	1510
	247	619	339	0	8337		278	1607	0	649	2159
	248	130	828	0	7509		279	951	7	0	2152
	249	901	57	0	7452		280	799	159	0	1993
	250	567	391	0	7061		281	770	188	0	1805
	251	178	780	0	6281		282	1309	0	351	2156
	252	1785	0	827	7108		283	145	813	0	1343
	253	268	690	0	6418		284	380	578	0	765
	254	79	879	0	5539		285	1571	0	613	1378
	255	162	796	0	4743		286	1227	0	269	1647
	256	1156	0	198	4941		287	1969	0	1011	2658
	257	1087	0	129	5070		288	256	702	0	1956
	258	174	784	0	4286		289	304	654	0	1302
	259	1798	0	840	5126		290	38	920	0	382
	260	464	494	0	4632		291	358	382	0	0
	261	3507	0	2549	7181		292	586	0	0	0
	262	336	622	0	6559		293	272	0	0	0
	263	793	165	0	6394		294	798	0	0	0
	264	580	378	0	6016		295	81	0	0	0
	265	158	800	0	5216		296	48	0	0	0
	266	576	382	0	4834		297	28	0	0	0
	267	416	542	0	4292		298	224	0	0	0
	268	1016	0	58	4350		299	518	0	0	0
	269	11	947	0	3403		300	980	0	22	22
	270	501	457	0	2946		301	1981	0	1023	1045
	271	1382	0	424	3370	Jun. 30	302	1540	0	582	1627
May 31	272	509	449	0	2921						

The daily landed quantity is assumed to be the quantity of sales. The stock quantity is calculated by taking the landed quantity in excess of the sales quantity as the entry into stock and when the landed quantity is smaller than the sales quantity, the shortage is filled by shipping out the equivalent quantity from the stock.

Table 4-14 Daily Landing and Estimated Turn Around of Catches and Stock at the M.F.C.A. (Sept. 1977 to Aug. 1978) (6)

Unit: lb

Date	Cumulative days	Landed quantity	Shipped out	Entry	Stock	Date	Cumulative days	Landed quantity	Shipped out	Entry	Stock
Jul. 1	303	2039	0	1081	2708	Aug. 1	334	385	573	0	4908
Jul. 2	304	2356	0	1398	4106		335	428	530	0	4378
Jul. 4	306	1904	0	946	5052		336	824	134	0	4244
	307	836	122	0	4930		337	2496	0	1538	5782
	308	822	136	0	4794		338	1410	0	452	6234
	309	680	278	0	4516		339	895	63	0	6171
	310	2178	0	1220	5736		340	1196	0	238	6409
	311	426	532	0	5204		341	1600	0	642	7051
	312	1261	0	303	5507		342	1119	0	161	7212
	313	1816	0	858	6365		343	630	328	0	6884
	314	926	32	0	6333		344	575	383	0	6501
	315	1326	0	368	6701		345	1333	0	375	6876
	316	4120	0	3162	9863		346	37	921	0	5955
	317	3103	0	2145	12008		347	0	958	0	4997
	318	98	860	0	11148		348	1183	0	225	5222
	319	1310	0	352	11500		349	2290	0	1332	6554
	320	583	375	0	11125		350	1308	0	350	6904
	321	597	361	0	10764		351	2722	0	1764	8668
	322	1098	0	140	10904		352	675	283	0	8385
	323	966	0	8	10912		353	313	645	0	7740
	324	680	278	0	10634		354	141	817	0	6923
	325	82	876	0	9758		355	505	453	0	6470
	326	794	164	0	9594		356	344	614	0	5856
	327	611	347	0	9247	Aug. 24	357	468	490	0	5366
	328	356	602	0	8645						
	329	463	495	0	8150						
	330	248	710	0	7440						
	331	257	701	0	6739						
	332	26	932	0	5807						
Jul. 31	333	632	326	0	5481						

The daily landed quantity is assumed to be the quantity of sales. The stock quantity is calculated by taking the landed quantity in excess of the sales quantity as the entry into stock and when the landed quantity is smaller than the sales quantity, the shortage is filled by shipping out the equivalent quantity from the stock.

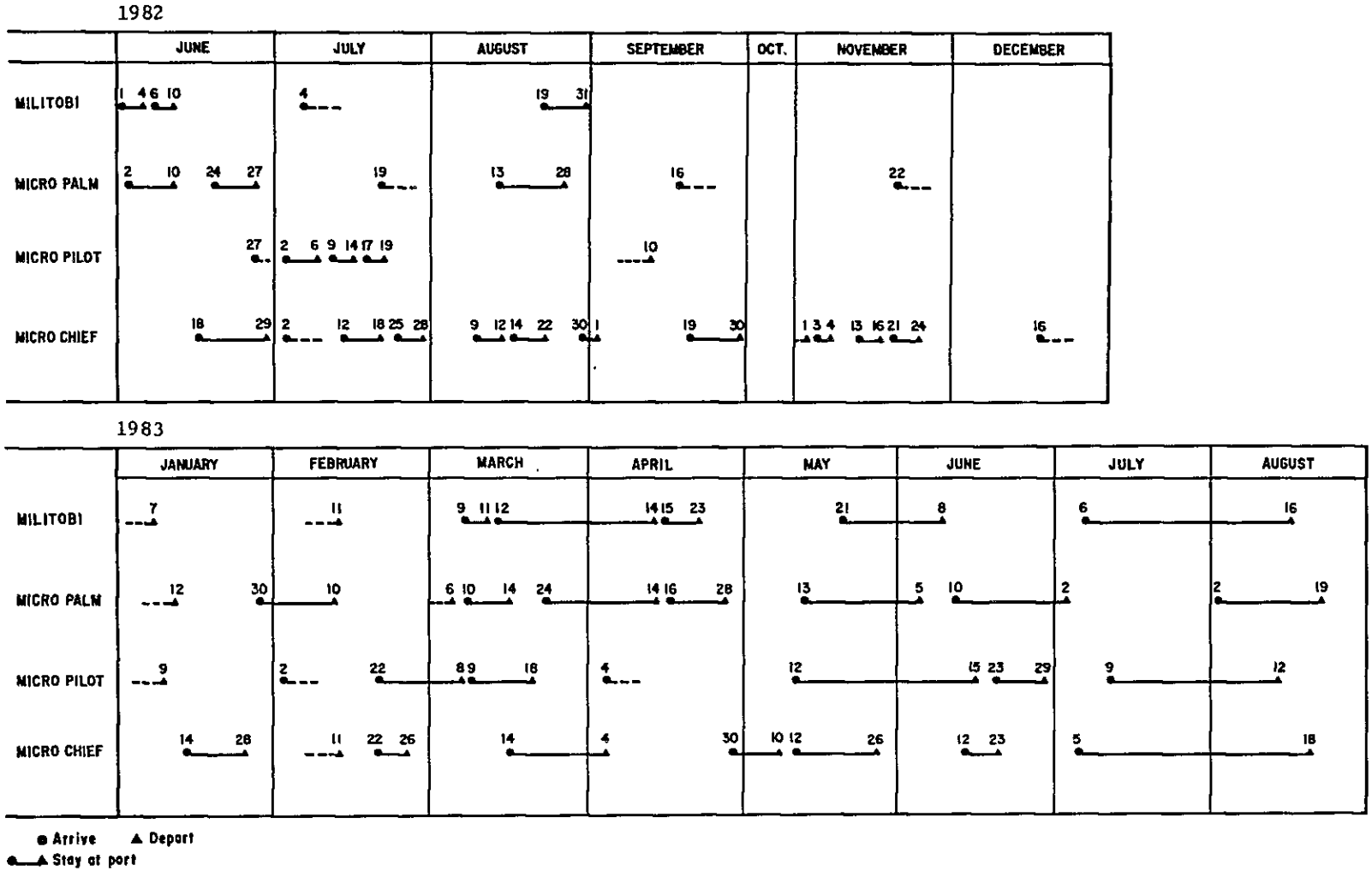
Table 4-15 : Monthly Catch and Estimated Quantity of Fish for Storage at MFCA

unit: lb.

		Estimated monthly total quantity of fish		Under storage *	
		put into storage	taken out from storage	Minimum	Maximum (kg)
Sept. 1977	48,198	22,973	3,515	--	19,458 (8,814)
Oct. 1977	36,291	13,143	5,238	19,362	29,712 (13,460)
Nov. 1977	29,528	9,310	6,606	27,305	30,746 (13,928)
Dec. 1977	26,059	5,611	9,250	26,428	31,325 (14,190)
Jan. 1978	13,842	1,324	16,222	11,530	25,470 (11,538)
Feb. 1978	25,318	7,173	8,678	10,025	16,247 (7,360)
Mar. 1978	34,619	13,972	9,031	3,967	14,966 (6,780)
Apr. 1978	21,413	4,304	11,631	7,639	16,243 (7,358)
May 1978	24,980	7,461	12,179	2,901	9,431 (4,272)
June 1978	22,119	4,520	5,814	0	2,760 (1,250)
July 1978	32,594	11,981	8,127	2,708	12,008 (5,440)
Aug. 1978	29,549	7,077	7,192	4,244	8,668 (3,927)
Total	344,510 (156,063 kg)	108,849 (49,309 kg)	103,483 (48,878 kg)		

Remark: *: maximum/minimum quantity of fish under storage of the month.

Figure 4-1 : Port Calls of Four Locally Based Vessels at Majuro from June 1982 to August 1983



Source: Unpublished monthly records of port calls at the Port of Majuro, obtained from the Port Director

〔MINUTES〕

MINUTES OF DISCUSSION FOR BASIC DESIGN STUDY ON THE INFRASTRUCTURE FOR FISHING BASE IN THE REPUBLIC OF THE MARSHALL ISLANDS

In response to the request made by the Government of the Marshall Islands for Grant Aid for Fishing Base Infrastructure Construction Project, (hereinafter referred to as "the Project"), the Government of Japan has sent, through the Japan International Cooperation Agency (JICA), a survey team headed by Mr. Eiji ISHIHARA, Fisheries Agency of Japan, to carry out a basic design survey for the project from September 21 to October 10, 1983. The team carried out a field survey, including soil investigation by boring, had a series of discussion and exchanged views about the project with concerned authorities of the Government of the Marshall Islands.

As a result of the study and discussions, both parties have agreed to recommend to their respective Governments and the authorities concerned the result of the survey as attached herewith toward the implementation of the project.

4 October 1983

Eiji Ishihara
Team Leader
The Japanese Survey Team

Charles T. Dominick
Minister of Public Works
The Republic of the Marshall Islands

MINUTES

ATTACHMENT

1. The objective of the Project is to construct necessary infrastructure for fishing base at the proposed site.
2. The proposed site of the Project will be located in the New Port (hereinafter referred to as "the Project site").
3. The Japanese Survey Team will convey to the Government of Japan the desire of the Government of the Marshall Islands that the former take necessary measures to cooperate in implementing the Project and provide port facilities listed in Annex I in order of priority within the limit of Japanese Grant Aid.
4. The Government of the Marshall Islands will take the following necessary measures in the event that the Grant assistance by the Government of Japan is extended to the project:
    a) to provide data and information necessary for the design and construction of fishing base facilities.
    b) to secure the lands necessary for the construction of the facilities.
    c) to clear and level the Project site before the start of the construction.
    d) to provide the other items listed in Annex II.
    e) to ensure prompt unloading and custom clearance in the Marshall Islands of imported materials and equipment for the construction and to facilitate their internal transport.

f) to exempt the Japanese personnel concerned from custom duties, internal taxes and other fiscal levies imposed in the Marshall Islands for the supply of goods and services to complete construction.

g) to provide and accord necessary permission, licenses and other authorizations deemed advisable for carrying out the project.

h) to bear all expenses, other than those to be borne by the Grant, necessary for the construction of the Fishing Base Facilities.

i) to clear the earth moving permit of the Corps of Engineers, USPOD, and the environmental permit of the Trust Territory Environmental Protection Board before start of construction.

ANNEX I

Items, requested by the Government of the Marshall Islands in order of priority.

1. Wharf
2. Cold storage
3. Ice making plant
4. Slipway with repair shop
5. Vessel for fishing

ANNEX II

Items, the cost of which will be borne by the Government of the Marshall Islands.

1. Water supply mains to the Project site.
2. Electrical power main line to the Project site
3. Fuel and water supply main to the boat to the Project site.
4. External drainage and sewage line to the Project site.
5. Exterior facilities, like access road, and other incidental facilities.
6. Provision of space necessary for such construction as temporary office working area stockyards, etc.
7. Item (1) and (2) shall be completed prior to the start of site work.
8. Telephone line and equipment.