No. 1

# BASIC DESIGN STUDY REPORT
# ON
# THE PROJECT FOR LOCAL FISHERY DEVELOPMENT
# IN
# THE REPUBLIC OF THE MARSHALL ISLANDS

July 1989

JAPAN INTERNATIONAL COOPERATION AGENCY

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# PREFACE

In response to the request of the Government of the Republic of the Marshall Islands, the Government of Japan has decided to conduct a Basic Design Study on the Project for Local Fishery Development and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to the Marshall Islands a survey team headed by Mr. Satoshi Kamise, Deputy Director, Construction Division, Fishing Port Department, Fishery Agency, Ministry of Agriculture, Forestry and Fisheries from February 27 to March 27, 1989.

The team exchanged views with the officials concerned of the Government of the Marshall Islands and conducted a field survey in Majuro Atoll and Arno Atoll areas. After the team returned to Japan, further studies were made. Then, a mission was sent to the Marshall islands in order to discuss the draft report and the present report has been prepared.

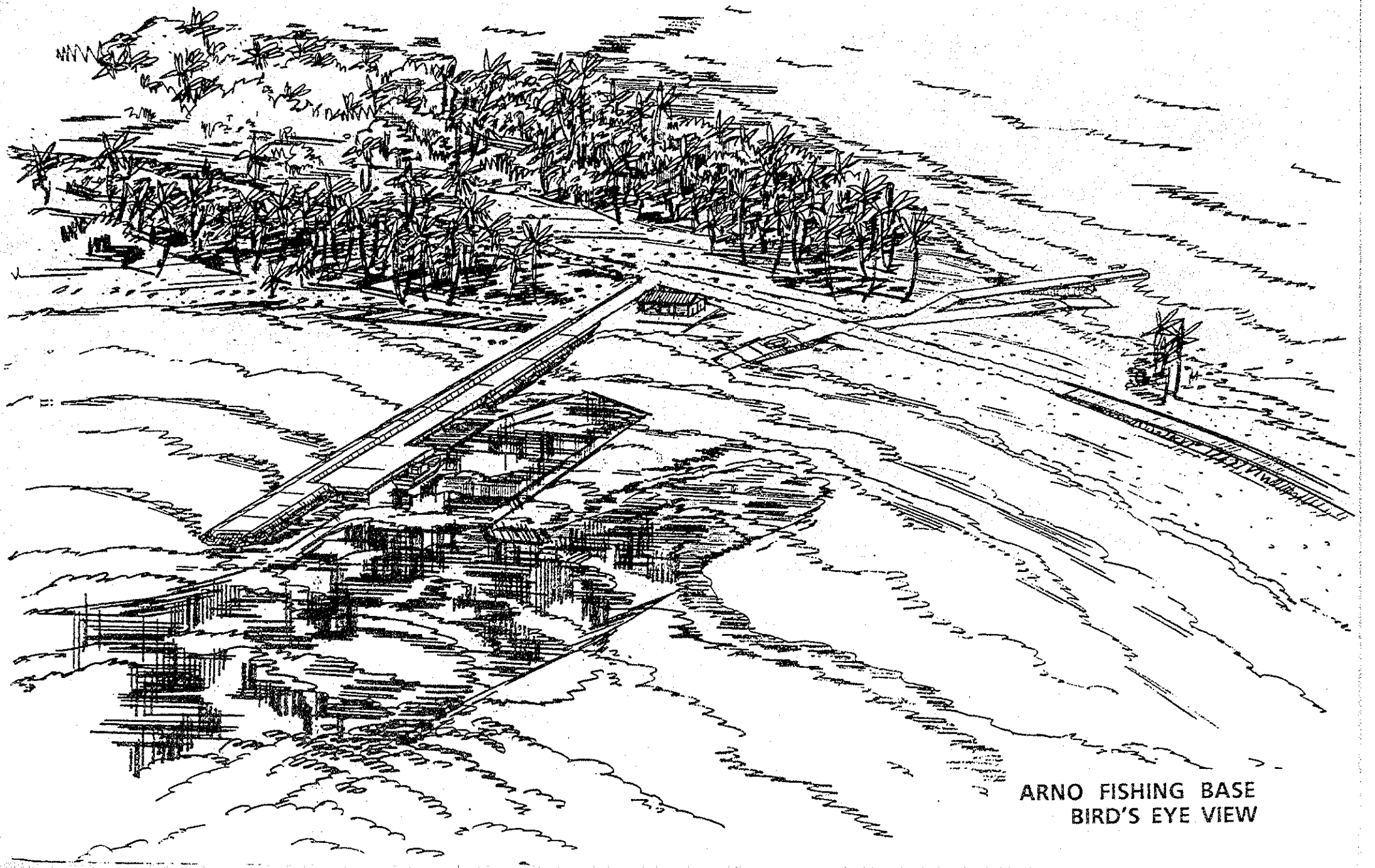
I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

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

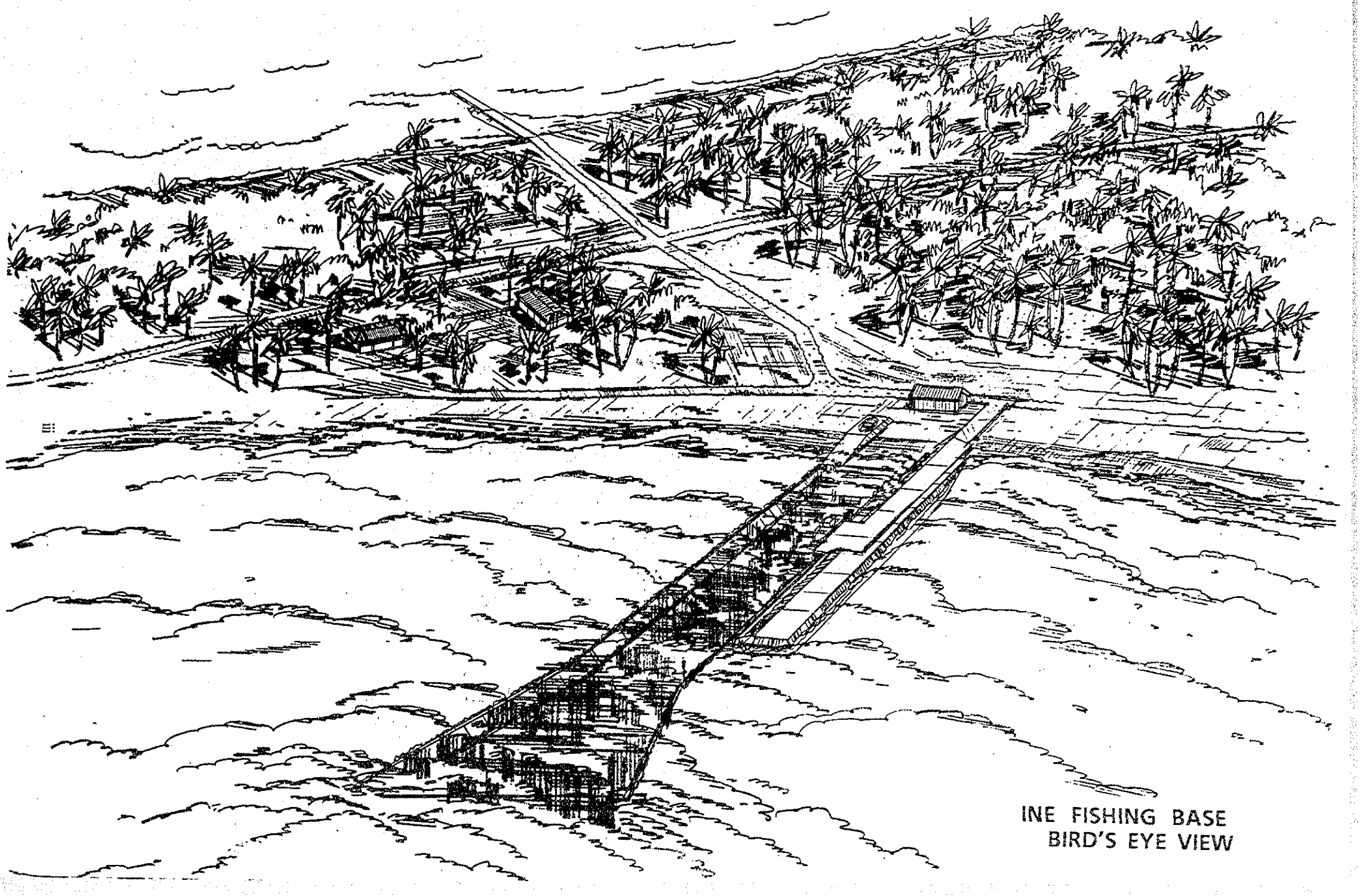
July, 1989

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency



ARNO FISHING BASE
BIRD'S EYE VIEW



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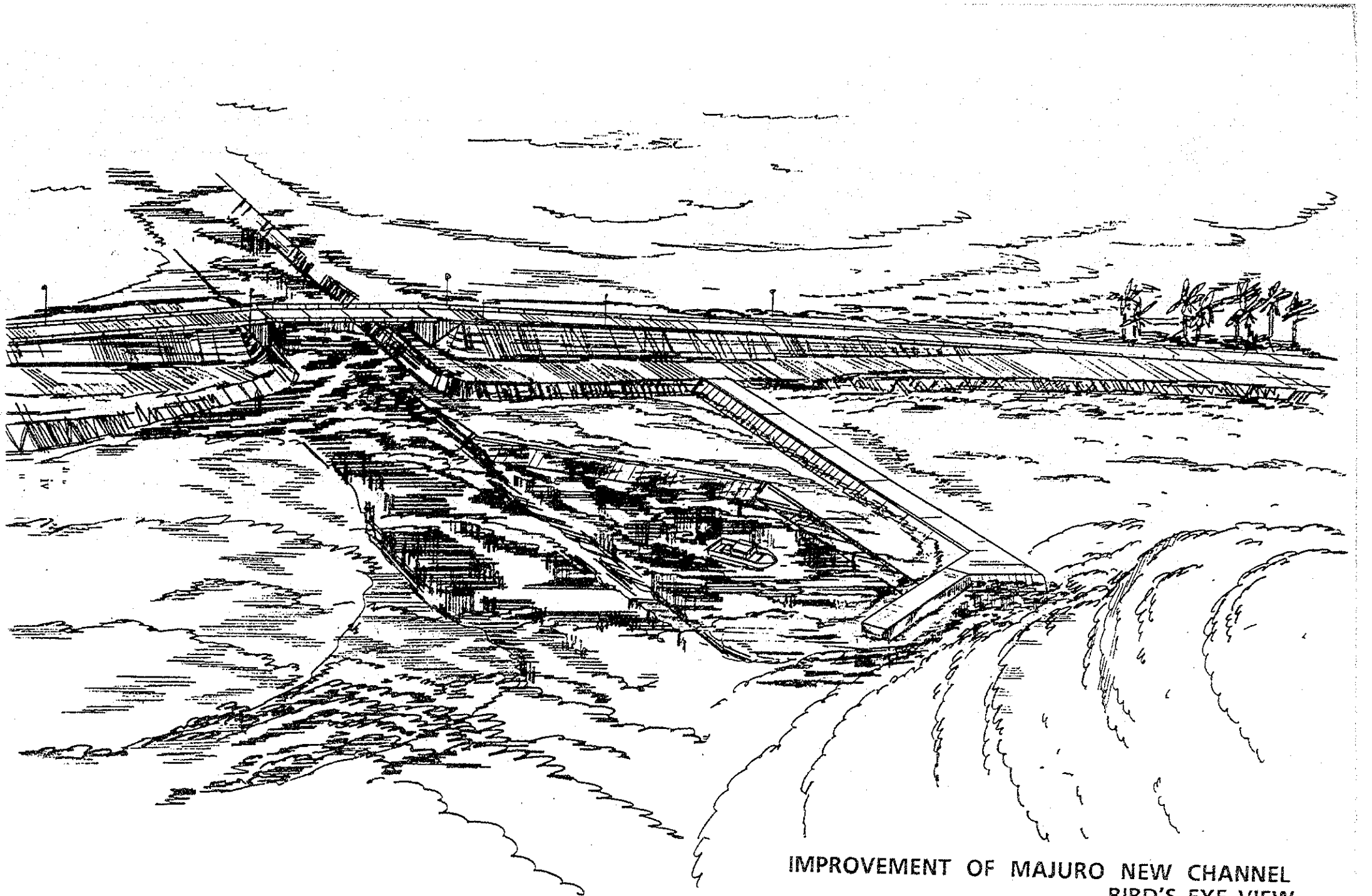
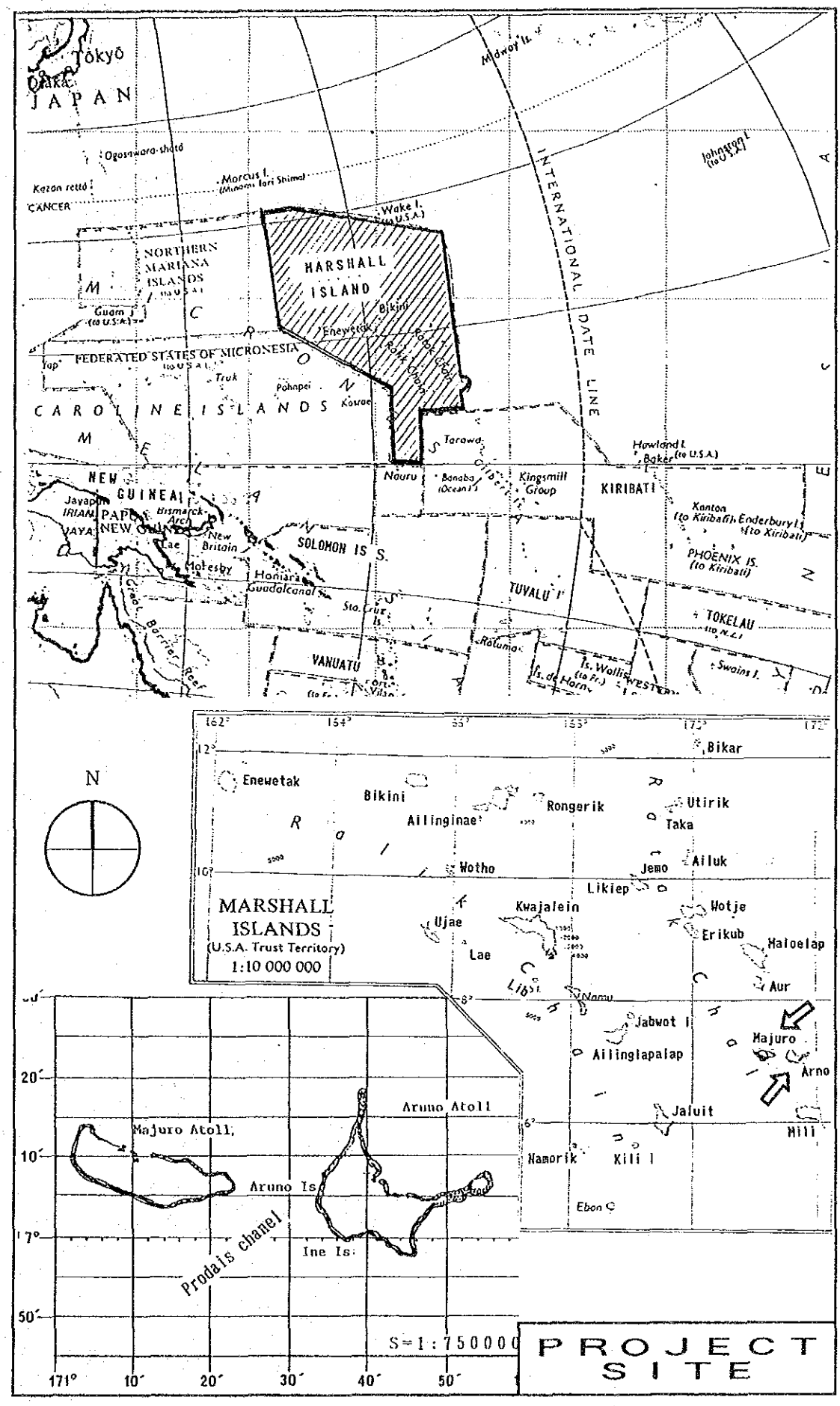


IMPROVEMENT OF MAJURO NEW CHANNEL
BIRD'S EYE VIEW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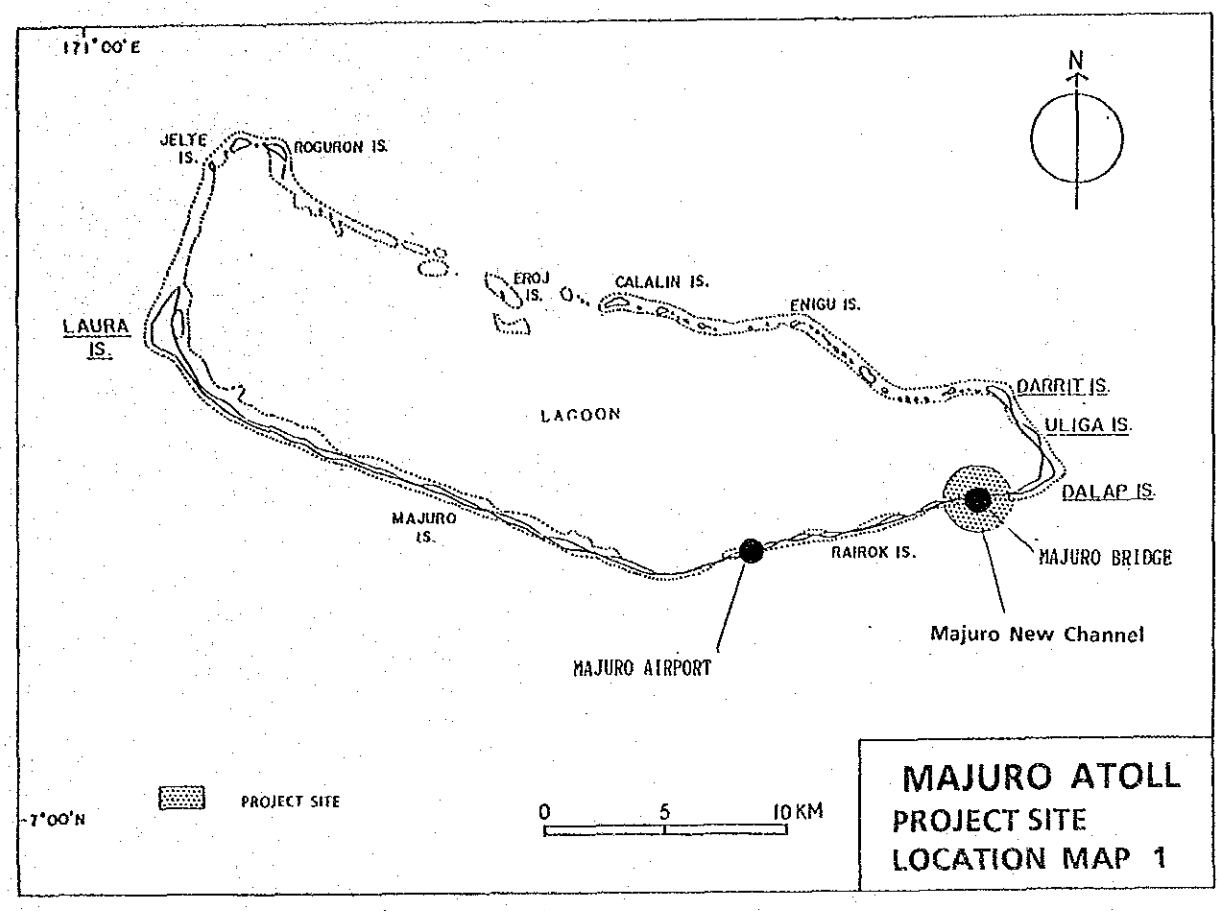
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MAJURO AIRPORT
PROJECT SITE
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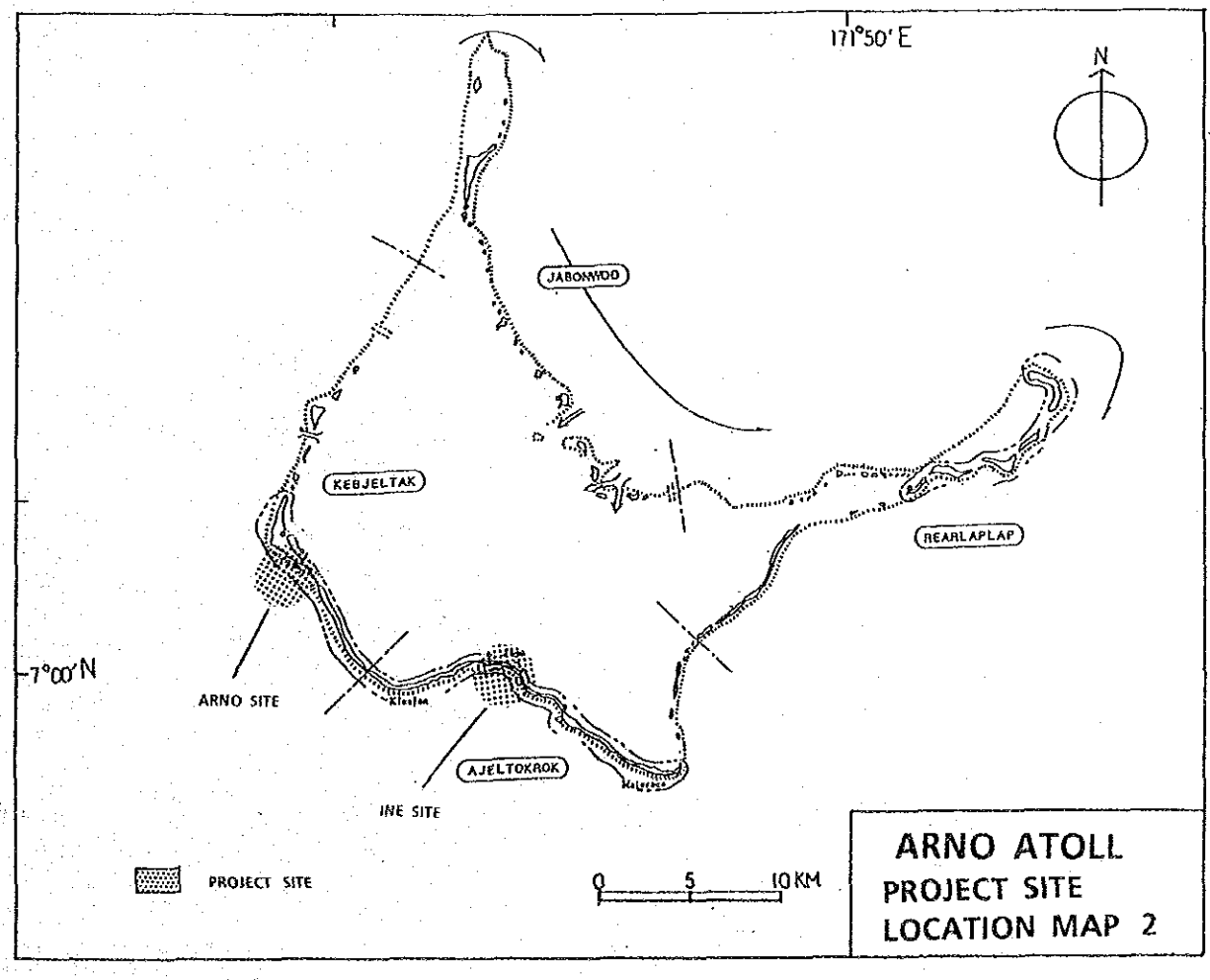
MAJURO ATOLL
PROJECT SITE
LOCATION MAP 1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ARNO ATOLL
PROJECT SITE
LOCATION MAP 2

# SUMMARY

# SUMMARY

The Marshall Islands consists of two parallel chains of 29 atolls and 5 islands in the Central Pacific between 4 and 14 degrees North latitude and 160 and 173 degrees East longitude. The total land area of the atolls and islands is 182 $km^2$ and its territorial waters are more than 1.94 million $km^2$. The climate is oceanic tropical with an average temperature of 27 °C and a daily range of less than 7 °C. The humidity is also high.

The total population at the time of 1988 census was 43,335 and there has been an increase of 12,462 persons or 40.4 percent, since the last census in 1980. Two thirds of the population are concentrated in Majuro Atoll and Kwajalein Atoll. The population in Majuro Atoll has increased by 67.0 percent since 1980. The opportunities of cash income and development of infrastructure in urban areas are the main cause for the concentration of population.

Since copra production is the only main industry of the country, its economic base has always been fragile. Hence its economy is dependent on a large amount of grant assistance by the U.S. Government.

The total recurrent expenditure for fiscal year 1987 was US$84.6 million. Revenue was US$84.2 million (excluding bond sales), of which US$14.5 million was derived from domestic revenues, and US$69.7 million was received mainly in the form of grants under the Compact of Free Association agreement with the U.S. and other sources.

The basic strategy of the Rephased First Five-Year Development Plan (1986/87-1990/91) is to develop the country's social infrastructure and thereby utilize domestic resources such as fisheries, minerals, etc. to meet consumption and investment needs.

The total amount of funds required for development is US$131.7 million, of which the economic sector is allocated US$9.1 million (6.9%), the social sector US$26.9 million (20.4%), the infrastructure sector US$79.6 million (60.5%), and the government sector US$16.1 million (12.2%). The high allocation of funds for the infrastructure sector indicates the importance of building up the nation's infrastructure in order to achieve self-reliance. Particularly the suppression of population concentration in the urban areas, through the development of infrastructure and thereby generating industry in the outer islands, is one of the basic policies of the nation's development. For fisheries

development, 45% (US$4.116 million) of the budget in the economic sector has been allotted since the fisheries sector has significant potential for increased production.

The development objectives of the fisheries sector during the plan period are:

- to increase domestic fish production in order to replace imports and increase exports;
- to develop the fisheries sector as a major component of the country's economic base, by encouraging the development of artisanal fishing as well as locally based large scale commercial fishing;
- to promote locally based fish processing activities both on a small and large scale;
- to develop Majuro's international dock area for use by foreign fishing fleets as a base;
- to enhance the country's surveillance capacity within its Exclusive Economic Zone.

Based on the aforementioned objectives, the development projects are categorized into priority A and B. The outer island fisheries development project is included in priority A.

Although the country has rich fisheries resources within its economic zone of approximately 1.94 million $km^2$, only subsistence fishing is undertaken in almost all the outer islands except Majuro Atoll where the capital is located. A major part of the fisheries production in this economic zone is due to the operation of foreign fishing vessels. The supply of fresh fish is insufficient in Majuro where the population is concentrated, and about 40 percent of fish consumption is mainly supplemented by imported canned fish. The price of fresh fish caught by commercial fishery is comparatively expensive. There is a potential for fish production in the outer islands. However, with the slow development of basic fishing and marketing facilities, this potential has not been fully developed.

In view of this situation, the Project for Local Fishery Development (hereafter referred to as the Project) was formulated with the objective of shifting the fishing activities of the main fishing villages in Arno Atoll from subsistence fishing to commercial fishing. This atoll is near

Majuro, the largest consumption center with a comparatively large population. The Government of Marshall Islands has requested the Government of Japan for grant aid to provide the necessary infrastructure to modernize the fishing community, and to provide facilities to achieve smooth distribution of fishery products.

The objectives of the Project are to encourage fishing activities and upgrade the livelihood of people in Arno Atoll by providing fisheries infrastructure. It is also the intention to suppress the volume of imported canned fish, in other words, to suppress the outflow of foreign exchange.

Japan's Overseas Fishery Cooperation Foundation (OFCF) has been implementing the "Coastal Fisheries Development Project" since October 1988. Its purpose is to encourage fishing activities in Arno Atoll, which is basically the same as this Project. The main activities of the OFCF project are the provision of equipment and technical guidance. In this Project, the contents mainly focus on formulating fisheries infrastructure development.

The basic design was based on the results of a field survey made on each facility and equipment. Local management conditions in operation and maintenance, technical level, natural conditions, conditions in construction, etc. were taken into consideration.

An outline of the designed facilities is shown below.

(1) Construction of the Arno fishing base

| Facilities | Contents/scale | Location | Purpose/condition |
|---|---|---|---|
| 1. Multipurpose Work Building | | | |
| 1) Multipurpose working space (with ice crusher) | Approx. 52.5 $m^2$ | Ocean side land section of southeast end of Arno Island | Collection, washing, sorting of fish, repair of fishing gear, meeting and training |
| 2) Fuel drum depot (with wing pump) | Approx. 4 $m^2$ | - ditto - | Fuel supply for generator, fishing boats, vehicles |
| 3) Ice cold storage | 2-ton capacity | - ditto - | Short time storage (Max. 3 days) |
| 4) Fish cold storage | 2-ton capacity | - ditto - | Short time storage (Max. 3 days) |
| 5) Machinery room | Approx. 12 $m^2$ | - ditto - | Generator (15KVA) and pumps |
| 6) Office with storeroom | Approx. 24 $m^2$ | - ditto - | Storing equipment, resting room for night time work and office |
| 7) Toilet & shower room | Approx. 7 $m^2$ | - ditto - | For shower, etc. |
| 8) Water tank | Approx. 8 $m^3$ | - ditto - | For washing, toilet and shower |
| 2. Jetty for fish loading for Majuro | | | |
| Length of groyne : | Approx. 100 m | Ocean side land section of southeast end of Arno Island | For transport vessel carrying fish to Majuro and for small fishing boats |
| width : | 5 m | | |
| Road length : | 80 m | | |
| width : | 6 m | | |
| (wharf : | 20 m) | | |
| Anchorage width : | 30 m | | |
| depth : | - 2.0 m | | |
| 3. Slipway width : | 5 m | - ditto - | For lifting small fishing boats |
| 4. Landing jetty | | Lagoon side of southeast of Arno Island | Loading/unloading for small fishing boats |
| width : | 3 m | | |
| length : | 40 m (Jetty 15 m) | | |
| 5. Slipway width : | 5 m | - ditto - | For lifting small fishing boats |

Remarks: Facilities from 1)-7) will be in one building (approximately 120 $m^2$).

(2) Construction of the Ine fishing base

| Facilities | Contents/scale | Location | Purpose/condition |
|---|---|---|---|
| 1. Multipurpose Work Building | | | |
| 1) Multipurpose working space (with ice crusher) | Approx. 35 $m^2$ | Ocean side of land section of center of Ine Island | Collection, washing, sorting of fish, repair of fishing gear, meeting and training |
| 2) Fuel drum depot (with wing pump) | Approx. 2.5 $m^2$ | - ditto - | Fuel supply for generator, fishing boats, vehicles |
| 3) Ice storage (with cooling unit) | 1-ton capacity | - ditto - | Short time storage (Max. 2-3 days) |
| 4) Fish storage (with cooling unit) | 1-ton capacity | - ditto - | Short time storage (Max. 2-3 days) |
| 5) Machinery room | Approx. 10 $m^2$ | - ditto - | Generator (15KVA) and pumps |
| 6) Office with storeroom | Approx. 16 $m^2$ | - ditto - | Storing equipment resting room for night time work and office |
| 7) Toilet & shower room | Approx. 4 $m^2$ | - ditto - | For shower, etc. |
| 8) Water tank | Approx. 8 $m^3$ | - ditto - | For washing, toilet and shower |
| 2. Loading jetty<br>Length of groyne :<br>width :<br>Road length :<br>width :<br>(wharf :<br>Anchorage width :<br>depth : | <br>Approx. 90 m<br>5 m<br>55 m<br>6 m<br>10 m)<br>15-30 m<br>- 0.5 m | Ocean side of center of Ine Island | Loading/unloading for small fishing boats |
| 3. Slipway<br>width : | <br>5 m | - ditto - | For lifting small fishing boats |
| 4. Loading jetty<br>width : | <br>3 m<br>45 m<br>(Jetty 15 m) | Lagoon side of center of Ine Island | Loading/unloading for small fishing boats |

Remarks: Facilities from 1)-7) will be in one building (approximately 80 $m^2$).

(3) Construction of the causeway between Arno and Ine

| Facilities | Contents/scale | Location | Purpose/function |
|---|---|---|---|
| 1) Causeway (east side) | Extension length : 250 m<br>width : 4 m | Between Ine and Eneenerikku | Inland transportation |
| 2) Causeway (west side) | Extension length : 150 m<br>width : 4 m | Between Eneenerikku and Arno | - ditto - |

(4) Improvement of Majuro new channel

| Facilities | Contents/scale | Location | Purpose/function |
|---|---|---|---|
| 1) Groyne (rubble mounted type) | Extension length : 80 m<br>width : 5 m | Majuro channel on ocean side | Wave breaking |
| 2) Jetty (concrete type) | Approx. length : 29 m<br>width : 6 m | - ditto - | - ditto - |
| 3) Channel widening | width : 15-30 m<br>depth : -2 to -3m | - ditto - | Improvement of traffic safety |

The portion of construction cost to be borne by the Government of the Marshall Islands is estimated at US$2,714.

The construction period will be divided into two phases; the planned period for phase 1 is 10 months and for phase 2 is 11.5 months. An outline of each phase is shown below.

| Phase | Contents |
|---|---|
| Phase 1 | Construction work of marine and on-land facilities in Arno and Ine,<br>Construction of causeway between Arno and Ine |
| Phase 2 | Improvement of Majuro new channel |

The executing agency, Marshall Islands Marine Resources Authority (MIMRA) will be responsible for the operation and maintenance of all facilities provided in the Project, with the exception of the Majuro new channel which will be under the Ministry of Public Works.

A semi-public organization consisting of MIMRA staff and members from the private sector is planned to be set for the operation and maintenance of each fishing base and the sales of its fish catch. This organization will be under the guidance of a Board of Directors consisting of representatives of relevant government agencies. The operation cost for the implementation of the Project will be allocated as part of the current budget of the executing agency.

The Project will play an effective role to reduce constraints that are hampering the implementation of outer islands development and fisheries development in the Marshall Islands. The Project is also expected to contribute to the development in terms of modernization and activation of fisheries, increasing domestic protein supply, decreasing imported fishery products, and increasing opportunities to export fishery products in future. Consequently the implementation of the Project by a Japanese grant aid is a significant contribution.

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# 1. INTRODUCTION

# 1. INTRODUCTION

Although the Marshall Islands is endowed with rich fisheries resources within its economic zone of approximately 1.94 million $km^2$, only subsistence fishing is undertaken in almost all the outer islands, with the exception of Majuro Atoll where the capital is located. The operation of foreign fishing vessels contributes to a major part of fisheries production in the economic zone. The supply of fresh fish is insufficient in Majuro where the population is concentrated, and about 40 percent of the fish consumption is mainly supplemented by imported canned fish. The price of fresh fish caught by commercial fishery is comparatively expensive. There is a potential for fish production in the outer islands. However, with slow development of basic fishing and marketing facilities, this potential has not been fully developed.

The Government intends to promote industry by developing the infrastructure in the outer islands to upgrade the living standard of people there. Development of infrastructure is one of the basic policies of the national development. Consequently, the Government formulated the Project for Local Fishery Development (hereafter referred to as "the Project") in order to activate the fishing activities of main fishing villages in Arno Atoll which is nearest to Majuro, and is the largest consumption centre with a comparatively large population; and thereby upgrade the living standard by shifting from subsistence fishery to commercial fishery.

In response to the request, the Government of Japan decided to conduct a basic design study in order to examine the significance and appropriateness of the Project, and to formulate the most suitable plan. The Japanese International Cooperation Agency (JICA) dispatched a basic design study team headed by Mr. Satoshi Kamise, Deputy Director, Construction Division, Fishing Port Department, Fishery Agency, Ministry of Agriculture, Forestry and Fisheries from February 27 to March 27, 1989.

During the study the team confirmed the relevancy of the request and objectives of the Project, explained the grant aid system to relevant government officers of the Marshall Islands, and confirmed the undertaking by both governments. Based on the study which analyzed the appropriateness of the sites, the present condition of infrastructures, the state of fisheries development, the construction conditions, etc., and

by evaluating the significance and appropriateness of the Project, the basic design of the Project was formulated.

JICA dispatched a final draft report mission headed by Mr. Satoshi Kamise, Deputy Director, Construction Division, Fishing Port Department, Fishery Agency, Ministry of Agriculture, Forestry and Fisheries from May 22 to 31, 1989 for explanation and final discussion of the contents of the basic design report of the Project.

This report is the summation of the results of the above described surveys. Members of study teams, itineraries and minutes of discussions are attached in the Appendices 1.1 - 1.4.

# 2. BACKGROUND OF THE PROJECT

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## 2.1 General Description of the Marshall Islands

### 2.1.1 Profile of the Country

The Marshall Islands consists of two parallel chains of 29 atolls (19 inhabited and 10 uninhabited) and 5 islands (4 inhabited and 1 uninhabited); the eastern Ratak (Sunrise) group and the western Ralik (Sunset) group, in the Central Pacific between 4 and 14 degrees North latitude and 160 and 173 degrees East longitude. The total land area of the atolls and islands is 182 $km^2$ and they are flat and low lying with an elevation to about 3 m above sea level and are composed of coral rock and sand. Majuro has a land area of about 9.2 $km^2$ and Arno has about 13 $km^2$ which is the third largest among the outer islands.

The country has Exclusive Economic Zone of more than 1.94 million $km^2$ surrounding the atolls and the islets.

The country is at a disadvantage in terms of its isolation from major population centers. The distance from Majuro the capital, to Honolulu to the east is 3,418 km, and to Tokyo to the north west is 3,680 km. The capital to the former Trust Territory, Saipan, lies 3,222 km to the west.

(1) Climate

The climate is humid and hot with an average temperature of 27°C and a daily range of less than 7°C. The prevailing trade winds drifting across the wide expanse of ocean cools down the occasional high temperature. Rainfall averages 305-380 mm per month and the wettest months are from October to November and the driest are from December to April.

(2) Population

The total population at the time of 1988 census was 43,335 and this represents an increase of 12,462 persons or 40.4 percent, since the last census in 1980 (Table 2.1). The average annual growth rate has been 4.24 percent. Two thirds of the population are concentrated in Majuro Atoll (19,695 or 45.5 percent) and Kwajalein Atoll (9,254 or 21.4 percent). The population in Majuro Atoll has increased by 67.0 percent during the intercensal period at an average annual growth rate of 6.41 percent. The

population in Kwajalein Atoll has increased by 39.7 percent and the average annual growth rate is 4.18 percent. Arno Atoll which is the objective area of the Project, has a population of 1,653.

2.1.2 National Economy

The major agricultural resource is 22,000 acres of coconut plantations covering over 60 percent of the land area of the country. The estimated acreage in production in 1987 was approximately 16,000 acres, and the total production of copra was 5,401 tons; Arno accounted for 941 tons, the largest among the atolls amounting to US$141,315 (Table 2.2). Copra processing is the most important single activity in manufacturing; without copra the manufacturing sector is almost non-existent. The government is currently seeking assistance for a survey on potential mineral resources particularly phosphate, polymetallic nodules and oil on the sea bed. The resources with the greatest potential is the Exclusive Economic Zone. An average annual catch of 23,000 tons has been reported by foreign vessels within the waters between 1977 and 1982. In contrast, the local fisheries activity has been on a subsistence level.

The gross domestic product (GDP) shows an increase from US$34.90 million in 1981 to US$46.36 million in 1984 (Table 2.3). The GDP per capita has increased from US$1,004 (1981) to US$1,284 (1984) in spite of the rapid increase in population. Wages, salaries and other compensation paid to employees from the urban sector based in the Djarrit-Uliga-Dalap (DUD) of Majuro and the U.S. base in Ebeye Island of Kwajalein Atoll are the major determinants of the GDP. In 1984 they contributed 51 percent (US$23.5 million) of the GDP. The operating surplus contributed about 36 percent and it is derived mainly from private components (17%) that are confined to dividends, service and manufacturing activities, and the traditional sector (13%). In the traditional sector, the activities are mainly subsistence consisting of copra production, fishing, and growing of rootcrops, breadfruit and vegetables.

The balance of trade is always in the deficit as the country is heavily dependent on imports of consumer goods, raw materials and capital goods (Table 2.4). The deficit has been increasing in recent years, from US$14.68 million in 1980 to over US$26.7 million in 1985, mainly due to the stagnation of exports which is limited to copra cake and coconut oil, and a constant increase of imports.

The total recurrent expenditure for fiscal year 1987 was US$84.6

million and the revenue was US$84.2 million (excluding bond sales), of which US$14.5 million was derived from domestic revenues, and US$69.7 million was received mainly in the form of grants under the Compact of Free Association agreement with the U.S. and other sources. However with the bond sales of US$65 million, the total revenue was US$134.7 million.

The economy of the Marshall Islands is very dependent on grants and assistance from the U.S. government. However, the Government of the Marshall Islands endeavors to upgrade and develop the social infrastructure in order to build its economic base and to become self reliant.

### 2.1.3 Compact of Free Association and National Development Plan

#### (1) Compact of Free Association

The Compact of Free Association is an agreement between the Governments of Marshall Islands and the United States of America. This agreement defines the political, military and economic relationship between the two nations following the termination of the Trusteeship, and it has been implemented since October 1986. The Compact Agreement is for an initial period of 15 years and is renewable thereafter. The government is empowered to operate under its own constitution and conduct its own domestic and foreign affairs, while the full authority and responsibility for defense and security matters are given to the U.S. The U.S. government will provide annual financial grants during the 15-year period, and the annual grants are divided into three specific categories: Capital Account Assistance, Grant Assistance and Program Assistance. The assistance under the agreement is intended to strengthen the various sectors and to promote self-reliance.

#### (2) First Five-Year Development Plan

This plan originally covered the 1985-89 period, and it was subsequently rephased to cover the five year period 1986/87 - 1990/91 as recommended by the Micronesia Interagency Working Group for the plan document necessary for the Compact of Free Association agreement with the United States.

The long term national development objectives of the Plan can be summarized as follows:

- economic self reliance
- building of a sound economy

- creation of productive employment opportunities
- equitable development
- preservation of cultural and environmental heritage.

The government has set up development programs in order to achieve its objectives and to build a sound economic base. Its basic strategy is to develop the country's social infrastructure and thereby utilize domestic resources such as fisheries, minerals, etc. to meet consumption and investment needs.

The total amount of funds required for development is US$131.7 million, of which the economic sector is allocated US$9.1 million (6.9%), the social sector US$26.9 million (20.4%), the infrastructure sector US$79.6 million (60.5%) and the government sector US$16.1 million (12.2%)(Table 2.5). The high allocation of funds for the infrastructure sector indicates the importance of building up the nation's infrastructure as a primary base for self-reliance. Particularly the suppression of population concentration in the urban areas, through the development of infrastructure and thereby generating industry in the outer islands, is one of the basic policies of the nation's development. For fisheries development, 45% (US$4.116 million) of the budget in the economic sector has been allotted since the fisheries sector has significant potential for increased production (Table 2.6).

The government faces severe funding constraints for implementation of its development programs. The funds available through the development budget is significantly below the amount required. The total requirement is US$201.5 million as compared to US$154.9 million of total available funds.

The government revenues during the Plan period will be derived basically from two sources (Table 2.7): domestic revenue and revenue from the U.S. Government. Domestic revenue will consist of tax (such as on income, business revenue, imports) and non-tax revenues (fishing rights, philatelic sales, user charges, etc.). Fishing rights are expected to contribute US$4.4 million during the Plan Period. The total revenue provided by the U.S. Government for the planned period is estimated to be US$356.4 million.

## 2.2 Description of the Fisheries Sector

### 2.2.1 Fisheries Activities

(1) General Fisheries Condition

The Marshall Islands has an economic sea zone of approximately 1.94 million $km^2$ which is rich in fisheries resources. Most of the people undertake fishing for subsistence. Fish is the main source of animal protein particularly in the outer islands, and hence fishing is indispensable to their livelihood.

Fisheries activities can be classified into two areas; fishing operation of foreign vessels from Japan, Taiwan, Korea, U.S.A., etc. for skipjack and tuna, and fishing by the Marshalleses themselves. Fishing operation by foreign vessels are quite active, and the income from fishing licenses is a valuable source of national revenue. On the other hand, commercial fishery by the Marshallese is seldom seen in the country except in urban areas such as Majuro and Kwajalein.

It is estimated that the per capita consumption of fish in the outer islands is about 99 kg (approx. 218 pounds) according to a FAO record. However, in urban centers where imported canned food, frozen meat and dairy products are available, the ratio of fish consumption is comparatively less than that of the outer islands.

(2) Fisheries in Majuro Atoll

Majuro is the country's capital where 45 percent of the country's population is concentrated. The major source of income for the people is from salary and wages, and income from copra production or fishing is small. Hence, there exists a direct sale method in the commercial fishery structure where full-time and part-time fishermen directly supply their catch to the supermarket and retail stalls.

It is difficult to clearly evaluate the fishery structure of Marshall Islands because there are no fishery statistical figures on fishermen, fishing boats and fish landings. Useful reference materials outlining the Majuro fishery structure are the landings and sales record of Majuro Fishermen's Cooperative Association (hereafter referred to as MFCA) which operated from September 1977 to February 1983. From this survey it can be seen that Majuro's fishery structure and marketing system has changed little in the last 10 years. Hence the following outline is a summary of Majuro's fishery based on the MFCA records.

- Fishing

In the ocean of Majuro Atoll, trolling is conducted for pelagic fishes, and spear, enclosure net, cast net, etc. are used on the reef. Hand lines and pole lines are used for bottom fishes in the lagoon. The major type of fish harvested are shown below.

| Fishing Ground | Fishing Method | Major Species |
|---|---|---|
| Ocean | Trolling | Pelagic fish<br>Skipjack, bigeye tuna, yellowfin tuna, marlin, barracuda, dolphin fish |
| | Spearing | Flying fish |
| Reef | Spear<br>Nets<br>(cast net and enclosure net) | Reef fish<br>Parrot fish, surgeon fish, rabbit fish, mullets, bat fish |
| Lagoon and ocean side reef slope | Hand lines<br>Pole and lines | Bottom fish<br>Groupers, snappers, big eyes, soldier fish |

- Fishing boats

Most of the fishing boats in Majuro are 5-6 m long and motor equipped with one to two outboard engines of 35-75 PS. Since there is no registration system for fishing boats, it is rather difficult to obtain an accurate number. The interview survey conducted in 1982 estimated approximately 70 boats (Table 2.8). According to this interview survey of full-time fishermen, there has been no significant change in the number of fishing boats in the last several years.

- Fishermen

All in all 353 fishermen landed fish to MFCA during the first two years from September 1977 to August 1979 when landings to MFCA were large. About 20 of them were full-time fishermen whose fish catch was large and occupied a substantial share of the landings to MFCA. Fishing by part-time fishermen was conducted mainly for self-consumption, and any surplus was sold to MFCA or fish stalls. This generated extra income for them (Table 2.9).

- Fish catch and landings

The annual fish landing of MFCA is shown in the table below. Pelagic

fish occupied a large share amounting to 55-80 percent of the total. The landing showed a peak of 173 tons in 1979 and after 1980 it declined remarkably. The main reasons are believed to be restrictions by MFCA on the purchase of fish and the suspension of ice supply to fishing boats due to frequent breakdowns of the ice plant and cold storage facilities. Furthermore, retail stalls purchase fish catch directly from fishermen and bypass the MFCA by offering better prices to the fishermen and cash payment upon delivery.

Unit: tons

| Year | Pelagic fish | Reef fish | Bottom fish | Lobsters | 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 Table 2.10)

The frequency of fish landings by major fish groups to MFCA and the average catch per landing are shown in the table below.

Unit: tons

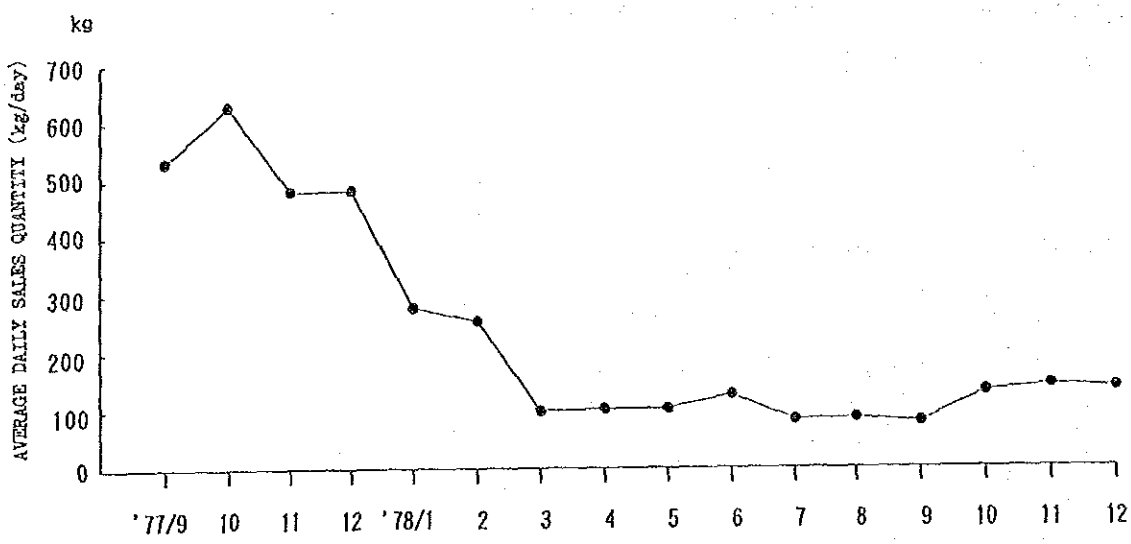
| | Pelagic fish | Reef fish | Bottom fish |
|---|---|---|---|
| Average number of landings per month | 66.6 | 129.5 | 56.9 |
| Average quantity of catch per landing | 111.2 | 29.5 | 22.5 |

(Refer Tables 2.10 and 2.11)

- Fish marketing

Fish landed to MFCA was sold mainly as fresh fish to consumers, retail stalls and restaurants. The surplus was frozen and sold when fresh fish was in short supply. However it was unpopular and created an

accumulation of frozen fish. According to the sales record of MFCA, the average daily sales quantity was stable for the first four months after commencement and amounted to approximately 530 kg (1170 pounds). However, from the fifth month, the average daily sales quantity declined sharply, and became stagnant from March 1978, amounting to approximately 100 kg (200 pounds) as shown in the figure below.




This fact indicates that a large amount of fresh fish was being sold by fishermen to other places bypassing MFCA except for the short period immediately following the commencement of MFCA operations. As evidenced from the MFCA sales record, there were no large quantity purchases by supermarkets, retail stalls and restaurants recorded after March 1978. Since the closure of the MFCA in February 1983, the buying and selling of fish catch have been conducted directly between fishermen and purchasers. Presently landed fish are brought for sales to 24 places such as supermarkets, restaurants and retail stalls in Majuro Island.

- Fish price

The price of fresh fish varies according to the species; mullets and rabbit fish are first class fish, snappers and skipjack are second class fish and parrot fish are third class fish. The retail price of fresh fish ranges from US$0.99-US$1.69 per pound (about US$2.18-$3.72/kg). On the other hand, the retail price of canned fish in terms of the net weight content per pound are US$2.33-$2.64 for tuna, US$1.02-US$1.16 for mackerel, US$0.89-$1.01 for sardines. The price of fresh fish is more expensive compared to imported canned mackerel and sardines.

- Import quantity of canned fish

As mentioned above, since canned mackerel and sardines are cheaper than fresh fish, large quantities of canned fish have been imported from Japan. In 1977 the quantity of imported canned fish was equivalent to 456 tons of fresh fish. In recent years with the high yen appreciation, the price of canned fish has increased. As a result the import of canned mackerel and sardines has declined. However surprisingly, the import of canned tuna though more expensive than fresh fish has increased. Hence, import quantity has remained unchanged, and in 1988 the imported canned fish was equivalent to 477 tons of fresh fish per year (APPX.2.2.1).

The import of cheap canned mackerel and sardines is decreasing while imports of frozen chicken, turkey tail, etc. are increasing, though the details are not clearly known.

The increase in imports of high priced canned tuna can be explained as an increase in the preferences of the middle and high income groups, whereas the increase in food substitutes for cheap canned sardines and mackerel is attributed to decrease in price elasticity in the low income group.

(3) Fisheries in Arno Atoll

The fisheries structure of each island in the Arno Atoll is quite similar and is composed of subsistence fisheries in the form of spearing, hook and line, surrounding net and trolling (Table 2.13). Fishing boats are mostly non-motorized canoes with an outrigger. They are safe when the sea is calm, but are unstable in ocean fishing or in rough seas. Almost all male adults are engaged in copra production, and also undertake fishing. Fishing is done during the intervals of copra production, or when a large school of fish is in the proximity, or when they need fish for their own consumption. Normally fishing is conducted 3 - 5 times a week; day time operations are from 8 AM to 3 PM and night time operations are from 8 PM to 12 midnight or till morning. The average catch per person per trip is 20-30 kg (50-60 pounds). When a large quantity of fish is caught, some are given to neighbors, or some are salted or dried, and transported to Majuro for sales to supermarkets and retail stalls. The sales price by fishermen varies with the size and the species; the price per piece ranges from US$0.60-US$1.00 which is rather expensive in comparison to other food items.

2.2.2 Fisheries Related Facilities

(1) Fisheries Related Facilities in Majuro

In Majuro there are three facilities; the old MFCA facilities, the new fishing base adjacent to it, and the Majuro new channel. An outline of these facilities is given below.

1) The old MFCA facilities

They are located about 1.5 km westwards from the end of DUD, facing the lagoon. The old MFCA building and the wharf for fish landing is about 100 m in length. The building was constructed in July 1977 under the assistance of the U.S. The building has a floor area of about 370 $m^2$, and consists of an ice making room (5 tons/day), cold storages (100-ton capacity and -1 to -20 $^{o}C$), an office, and a working space with fish display tables on a concrete floor. The ice making room and the cold storages have not been used since a breakdown in 1983. Presently the building is under the management of the Marshall Islands Marine Resources Authority (hereafter referred to as MIMRA) and is used for storage and as a repair work space. The landing wharf is still currently used by small fishing boats, copra transport vessels, etc. from the outer islands. There is a plan by MIMRA to reutilize the building for fish landings. The ice making machine and the cold storages are to be repaired with U.S. assistance in the near future.

2) The new fishing base

The new fishing base was constructed under a Japanese grant aid in 1985 and consists of cold storages, an ice making plant and a landing wharf (about 120 m in length). The ice making plant is still in operation. Cold storage is currently not used for stocking fish but is used for stocking ice, ice cream, etc. These facilities currently require maintenance. Hence, Japan's Overseas Fishery Cooperation Foundation will provide spare parts and is scheduled to dispatch mechanics this year to repair the facilities. The government is considering leasing to private firm is the best way for the effective use of the facilities.

3) The Majuro new channel

The Majuro new channel was constructed under a Japanese grant aid in 1983, to facilitate the trips of small fishing boats out of the lagoon. The waves on the ocean side of the opening portion of the channel are

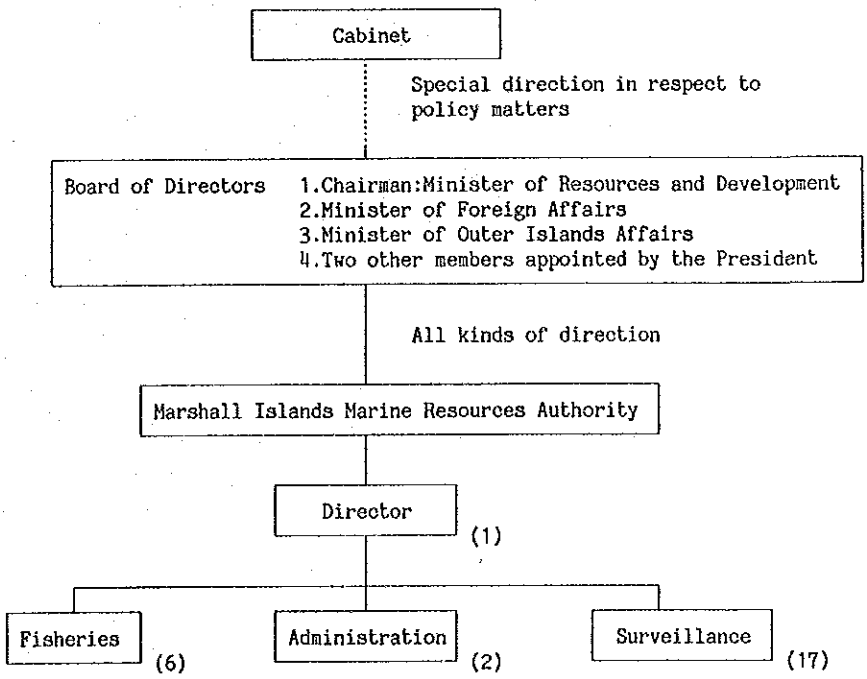
broken due to the dynamics of the ocean swell and the tide level. This is dangerous for the passage of small boats because the rudder cannot be controlled. Improvements in the safety level of the passage is envisaged. (For details refer to 3.2 Condition of Majuro New Channel).

### 2.2.3 Fishery Administration

Earlier the responsibility for the protection, management and development of marine resources was divided among several agencies. For example the Office of Marine Resources was responsible for the development of the local fishing industry while the Ministry of Foreign Affairs was responsible for the conclusion of foreign fisheries agreements. Interior and Outer Island Affairs was in charge of advising local councils for the control and development of fishing in the outer islands. Since 1986, the organizational structure has been substantially reorganized. In order to bring all these different agencies under one common umbrella and to coordinate their efforts in the development of the fishing industry, the Marshall Islands Maritime Authority (MIMA) was established in 1986. This is a statutory body responsible for all aspects of marine resource development including the patrolling of the Exclusive Economic Zone. In 1988 the MIMA's legal status, power and duties, and budgetary system were again evaluated, and Marshall Islands Marine Resources Authority (MIMRA) was established based on "the MIMRA Act 1988".

The contents of the MIMRA Act are summarized as follows.

Organization




Remarks: Figures in parentheses indicate present number of staff at present

Power and Duties

The Authority shall have the following power and duties:

- to conserve, manage and control the exploration and exploitation of all living and non-living resources in the fishery waters and seabed and subsoil thereunder
- to establish and implement an Exclusive Economic Zone management program
- to issue fishing licenses in accordance with the provisions of the Act
- to issue licenses for the exploration and exploitation of seabed and subsoil of the fishery waters
- to negotiate and conclude foreign fishing agreements; and
- six other items

Budget

A new "Marshall Islands Marine Resources Authority Fund" has been established, and the sources of this fund are as indicated below:

- all monies appropriated by the Nitijela for the purposes of the Authority
- all monies designated by the U.S. Compact Agreement for fisheries or related activities, including surveillance
- all monies received or recovered by way of license fees, fines, etc.
- all monies or goods received by the Authority by way of loans, grants, contributions, etc.
- such other monies received by the Authority pursuant to this Act

The allocated budgets of MIMRA for 1988 and 1989 are as follows.

Unit: US$

| | 1988 | 1989 |
|---|---|---|
| 1. National budget | - | 100,000 |
| 2. A portion of grant provided by the Compact with U.S.A | 371,400 | 371,400 |
| 3. Special fund* | 662,000 | - |
| | 1,033,400 | 471,400 |

* Special fund allocated at the time of establishment of MIMRA in 1988

## 2.3 Outline of Fisheries Development Plan

### 2.3.1 Fisheries Development Plan in Rephased First Five-Year Development Plan

The development objectives of the fisheries sector during the plan period (1986/87-1990/91) are:

- to increase domestic fish production in order to replace imports and to increase exports
- to develop the fisheries sector as a major component of the country's economic base, by encouraging the development of artisanal fishing as well as locally based large scale commercial fishing
- to promote locally based fish processing activities both on a small and large scale
- to develop Majuro's international dock area for use by foreign fishing fleets as a base
- to enhance the country's surveillance capacity within its Exclusive Economic Zone

Based on the aforementioned objectives, the development projects in priority A and B in the Plan are indicated below.

Priority A

(1) Outer Island Fisheries Development: To modernize Arno Atoll fishery by shifting from subsistence to commercial through the development of infrastructure and provision of equipment for fishing and marketing (same project contents as the requested contents of this Project)
(2) Mariculture Laboratory: Facilities for fry/juvenile production of mollusks and other species
(3) Outer Island Rearing Pen: Facilities of pen culture for mollusks and crustacean
(4) Patrol Boats: First patrol boat for surveillance
(5) Project Operation Center: A center to manage fisheries development programs effectively
(6) Air Surveillance Equipment: Aircraft for surveillance within the Exclusive Economic Zone

Priority B

(1) Patrol Boats: Second patrol boat for surveillance
(2) Ebeye Fishing Base: Fishing base infrastructure for development of fisheries in Ebeye Island of Kwajalein Atoll

Funding source and manpower requirement during the Plan period are shown in Tables 2.14 and 2.15, respectively.

### 2.3.2 Plans Related to this Project

Since 1977 Japan's Overseas Fishery Cooperation Foundation (hereafter referred to as OFCF) has been intermittently providing technical cooperation for fisheries development in the Marshall Islands. As an ongoing project by OFCF, "The Coastal Fisheries Development Project" is being implemented since October 1988. This project is an experimental operation for the development of coastal fisheries in Arno Atoll based on the "Memorandum of Understanding between the Ministry of Resources and Development of the Republic of the Marshall Islands and the Overseas Fishery Cooperation Foundation of the Coastal Fisheries Development" which mutually agreed on following the recommendation of the preliminary survey report on "Marshall Islands Coastal Fishery Development Project" which was

carried out in June 1988 by OFCF. Accordingly the purpose of this Project and OFCF project is basically the same.

(1) Activities

Experimental fishing practices by small fishing boats at 1-2 fishing bases in Arno Atoll and trials of transporting and selling the fish catch to Majuro will be implemented. For this purpose experts on fishing, marketing and facility management will be dispatched for technical guidance.

(2) Execution Period

The ongoing project is scheduled till March 1990. However the period can be extended if there is mutual agreement between both sides.

(3) Provision of Equipment

The main equipment to be provided are shown in the table below.

| Items | Quantity | Remarks |
|---|---|---|
| 1. 20-foot FRP vessel | 9 | Open deck type |
| 2. Outboard engine 25HP/27HP | 9 | For 20-foot FRP boat |
| 3. Outboard engine 8HP | 9 | Replacement/supplement |
| 4. Boat trailer | 4 | For drawing up boats |
| 5. 33-foot FRP vessel | 1 | For training and surveillance |
| 6. Fish finder | 1 | For training and surveillance vessel |
| 7. Fishing gear (trolling, vertical line, gill net, etc.) | Adequate amount | |
| 8. FAD materials | 4 | For Arno Atoll |
| 9. Storage | 1 | For Arno base |
| 10. Storage for equipment | 1 | For Arno base |
| 11. Ice box | 36 | |
| 12. Radio (SSB) | 3 | For Majuro base and Arno base survey vessel |
| 13. Weather facsimile | 1 | For Arno base |
| 14. Generator | 2 | For Arno base |
| 15. Pick-up truck | 2 | For transportation of fish and equipment (Majuro base and Arno base) |
| 16. Spare parts for existing freezing and cold storage | Adequate amount | |
| 17. Spare parts for existing transportation vessel | - ditto - | |
| 18. Tools, spare parts and consumables | - ditto - | |

(4) Present Conditions of Implementation

Since October 1988 three experts have been dispatched to Majuro. At the end of March 1989, the aforementioned equipment arrived, and now they are ready to implement technical guidance in full-scale. Main activities by OFCF experts are focused on experimental fishing practices in Arno Atoll and the marketability survey of the fish catch in Majuro. For this purpose a small scale fishing base has been established in Arno Island of Arno Atoll to implement fishing using the provided equipment, to transport fish catch to Majuro, and to try to supply fresh fish mainly to public institutions such as schools, hospitals, etc.

Under the OFCF plan, fishermen will be supplied not only fishing gear such as fishing boats/fishing gears and operation costs in fishing such as fuel/ice, but also technical follow up such as fishing techniques and quality control of fish. The necessary costs in transporting fish to Majuro such as manpower and maintenance, will also be supplied. Based on the aforementioned cooperation method, the commercialization of Arno Atoll fishery will be tried by setting up a marketing method and proper fish prices in Majuro through discussions with the Government of the Marshall Islands.

(5) Relationship to this Plan

Basically the objective of this Project and that of the ongoing OFCF project are the same. The OFCF project is mainly centered around the provision of equipment and technical guidance. The contents of this Project have been formulated keeping in mind the activities of the OFCF.

## 2.4 Background and Contents of the Project Request

### 2.4.1 Background of the Request

In the Marshall Islands, urbanization has progressed only in Majuro Atoll where the capital is located, and in Kwajalein Atoll where the U.S. Army base is located. This has increased the opportunities for cash income and as a result two thirds of the total population are concentrated in these two atolls. Since copra production is the only main industry in the country, its economic base has always been fragile. Hence, the economic balance is dependent on the large of amount grant aid by the U.S. government. In order to improve this economic environment, the government

has a policy to achieve economic self reliance through the development of infrastructure and subsequently generate industry in the outer islands. It has especially planned to commercialize the fishing industry and to increase the income of the people on the outer islands, by supplying fresh fish to urban centers where the fresh fish supply is insufficient, and is aiming to reduce the import of fishery products.

In view of the above background, the Project for the Local Fishery Development was established with the objective of activating the fishing activities of main fishing villages in Arno Atoll which is nearest to Majuro, the large consumption center with a comparatively large population, and to shift from subsistence fishing to commercial fishery. The government of Marshall Islands has requested the Government of Japan for grant aid to provide the infrastructure to modernize the fishing community, and to provide facilities to achieve smooth distribution of fishery products.

### 2.4.2 Contents of the Request

The contents of the request that have been finally confirmed between both Governments, based on the results of the field survey conducted by the basic design study team, are shown in the table below.

| Items | Majuro | Arno |
|---|---|---|
| 1. Fishing Equipment | | |
| 1) Fishing vessel | - | 0 |
| 2) Fishing gear | - | 0 |
| 3) Others | - | 0 |
| 2. Supporting Facilities | | |
| 1) Storage for ice and fish | - | 0 |
| 2) Water tank | - | 0 |
| 3) Fuel supply facility | - | 0 |
| 4) Lighting | - | 0 |
| 5) Others | - | 0 |
| 3. Infrastructure | | |
| 1) Jetty and pier | - | 0 |
| 2) Slipway | - | 0 |
| 3) Causeway | - | 0 |
| 4) Improvement of Majuro channel | 0 | - |
| 5) Multipurpose work space | - | 0 |
| 6) Others | - | 0 |

REMARKS: 0 = the objective site for provision of facilities and equipment

# 3. OUTLINE OF PROPOSED SITES

# 3. OUTLINE OF PROPOSED SITES

## 3.1 Description of Arno Atoll

### 3.1.1 Present Conditions of the Proposed Site

(1) General

Arno Atoll is situated about 20 km east of Majuro Atoll; and it extends about 40 km north to south and about 50 km east to west, and consists of long and narrow islands with an elevation of 3 m above sea level. Total land area is about 13 $km^2$.

The atoll has four administrative districts; Kebjeltak (Arno), Ajeltokrok (Ine), Rearlaplap (Malel) and Jabonwod (Dodo). Arno Island and Ine Island are connected by a sand bar during low tide but are connected with other islands only by boats.

There are houses scattered within the islands. However, even at the center of an island where school, church and health center are located, only 10-20 houses exist. There are one or two private cars in the main islands used for transportation. Unpaved roads run intermittently from one end to another in each island. There are electrically powered facilities, with the exception of main public buildings such as schools, churches which have solar power facilities on roof tops for lighting purposes. Kerosene lamps are used in ordinary houses for lighting. Rain water is collected from roof tops and stored in concrete tanks and is used for drinking.

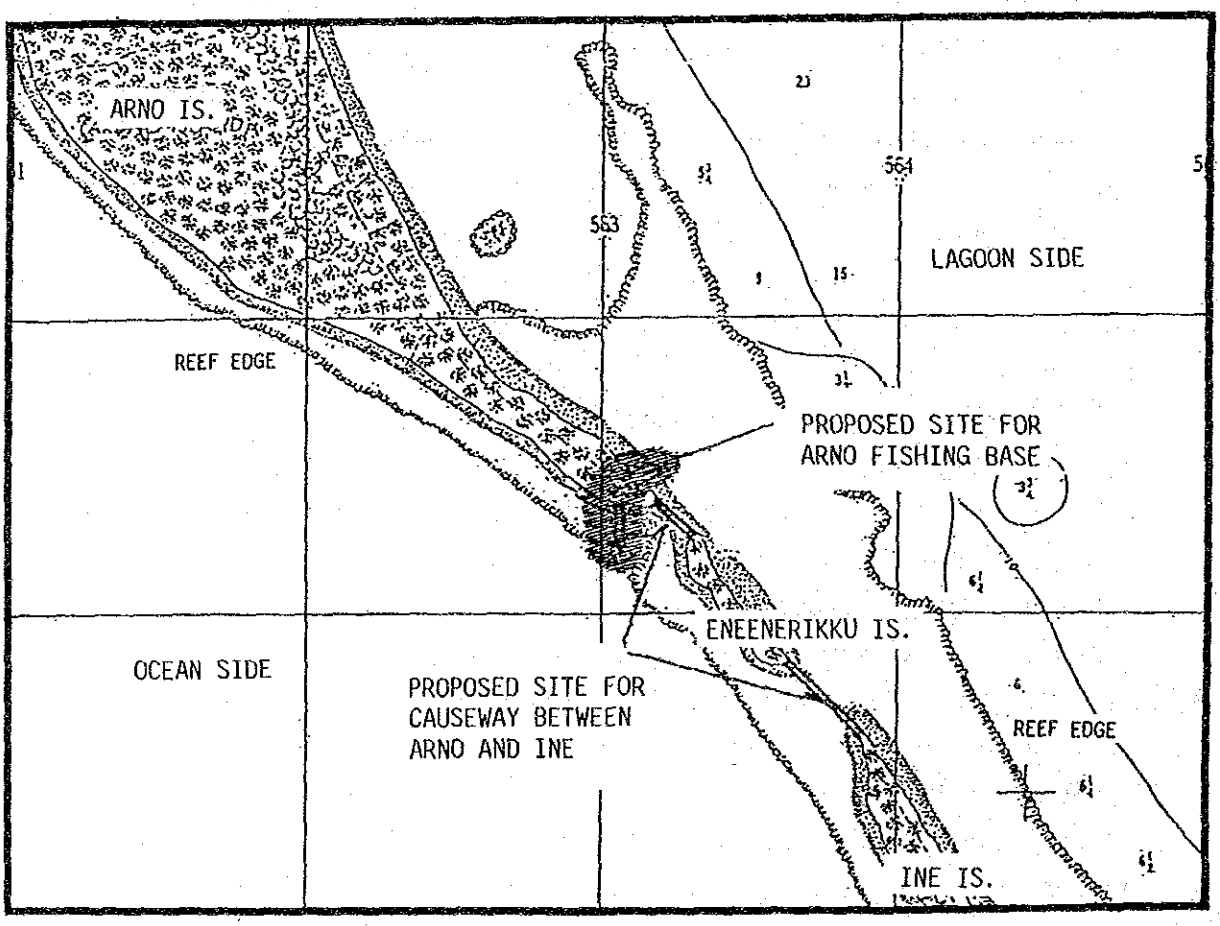
The main form of transportation between Majuro and the atoll are airplanes and copra transport vessels (approximately 5 GT). In Ine and Malel there is an unpaved runway, and a Marshall Air propeller plane (carrying capacity of 15 - 16 persons) which operates a round trip regularly twice a week. A flight between Ine and Majuro International Airport takes approximately 20 minutes.

The trips by a copra transport vessel is irregular. After its delivery of copra to Majuro, it freights back with food and other commodities to Arno. It takes about two and half hours from the Majuro fishing base through the Majuro new channel to Arno. Other larger inter-island transport vessels visit 8-10 times a year.

(2) Arno Island

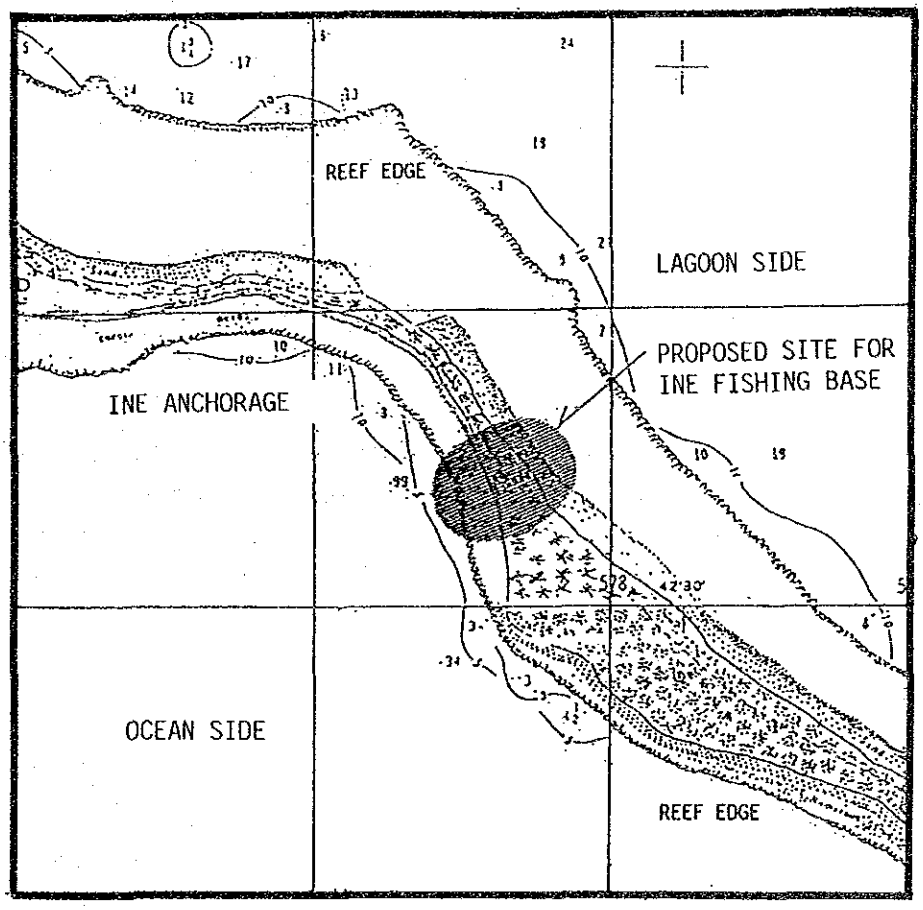
Arno Island is located southwest of the atoll and is the nearest to Majuro. Coral reefs have developed along both the ocean side and the lagoon side, and each extends 100 - 150 m and 300 - 500 m wide, respectively. The coastal line of the ocean side at the south end of the island faces south and forms a calm sea area uninfluenced by the ocean swells from the north. In this coast there is a natural inlet with a width of about 50 m which does not have any coral development. This is the only inlet being used as an anchorage in the ocean side of Arno Island.

This point is also the shortest to the north end of Ine Island. Between Arno and Ine islands there is an uninhabited island named Eneenerikku connecting both the Arno and Ine islands by sand bars of 150 m and 250 m in length. As the elevation of the sand bars are approximately +2.0 m and +1.0 m respectively, they emerge from the sea during low tide.



(3) Ine Island

Ine Island is situated southeast of Arno Atoll. The conditions of coral reef development along the coast resembles that of Arno Island. The reef facing the ocean is more or less flat (+ 0.50 m) with a width ranging from 100 - 200 m. The lagoon side is sloping (approx. 1/150) with a width of 300 - 500 m. There is a coast called Ine Anchorage facing the ocean side at the central part of the island. It was used by a Japanese trading company for shipment of copra during World War II. Since the coast line is facing south and is curved at this anchorage, the influence of swells from the north is minimized, and the sea surface is calm. Furthermore the influence of trade winds blowing from east to northeast is also reduced by the island itself.



3.1.2 Natural Conditions

(1) Weather Conditions

There is no climatic data on Arno Atoll. However, weather conditions are nearly similar to that of Majuro Atoll. Majuro has typical tropical oceanic weather with trade winds blowing throughout the year. Since February of 1914 it has not experienced any typhoon, however strong winds known as tropical storms occur often in April-March and October-November.

Rain is usually in the form of tropical showers, but prolonged rain is also not unusual. Rainfall is high with an annual average of 3400 mm. The temperature is uniform around 27 $^{o}$C with an average monthly difference of less than 0.5 $^{o}$C. The temperature seldom rises even in the daytime and in general the climate is mild due to constant blowing of the trade winds (Refer to 3.2 Present Condition of Majuro New Channel).

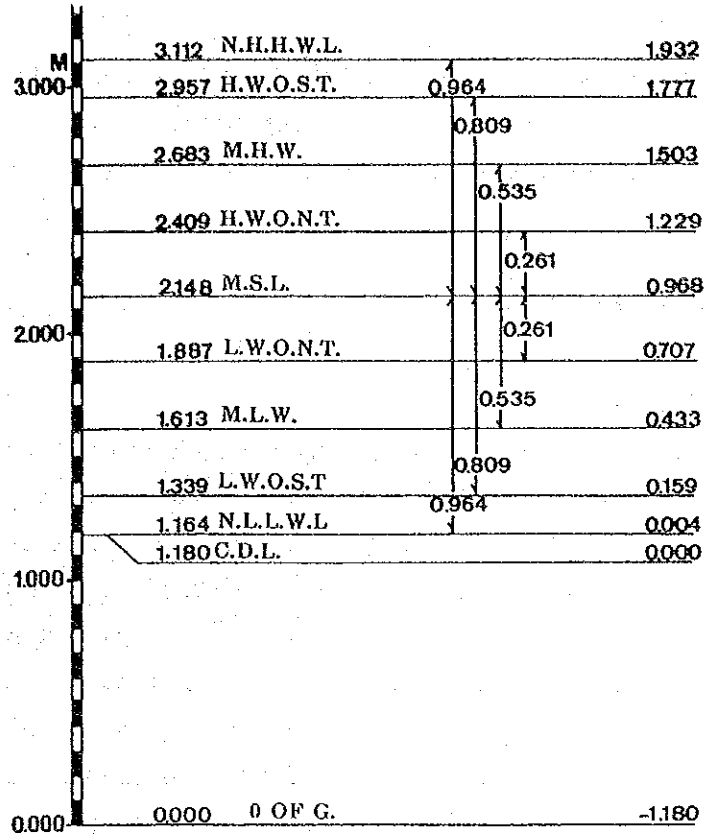
(2) Sea Conditions

1) Tidal current

The ocean around Arno and Majuro atolls is influenced by an equatorial current with a width of 300 miles. The current moves eastward and normally has a speed of 2 knots but in this area the speed is 0.4-1.0 knots.

2) Tidal fluctuation

At the proposed site facing the ocean at the south end of Arno Island, the tide level was measured every one hour for 15 days. The reading was taken by the tide staff from March 11 to March 25, 1989. Based on the harmonic analysis of the readings, the following tide fluctuation was obtained (refer to Appendix 2.3 Results of Natural Conditions Survey).




3) Swells and waves

Swells with a wave height of 5-6 m moving from north to south were always observed and measured by the eye when crossing the Hurodaisu channel during the study period. The waves on the ocean side in Majuro and Arno atolls had wave heights of 1.5-2.0 m with wave cycles of 8-12 seconds. After breaking inside the lagoon, they were 0.5-1.0 m with wave cycles of 3-4 seconds.

(3) Soil

The coral sand at the proposed site of the causeway construction was sampled and analysed for its grain distribution and specific gravity. About 80% of the sand consisted of fine sand (74-420 micrometers) which indicates high fludity. The specific gravity is about 2.83 and it is heavier than ordinary soil (refer to Appendix 2.3 Results of Natural Conditions Survey).

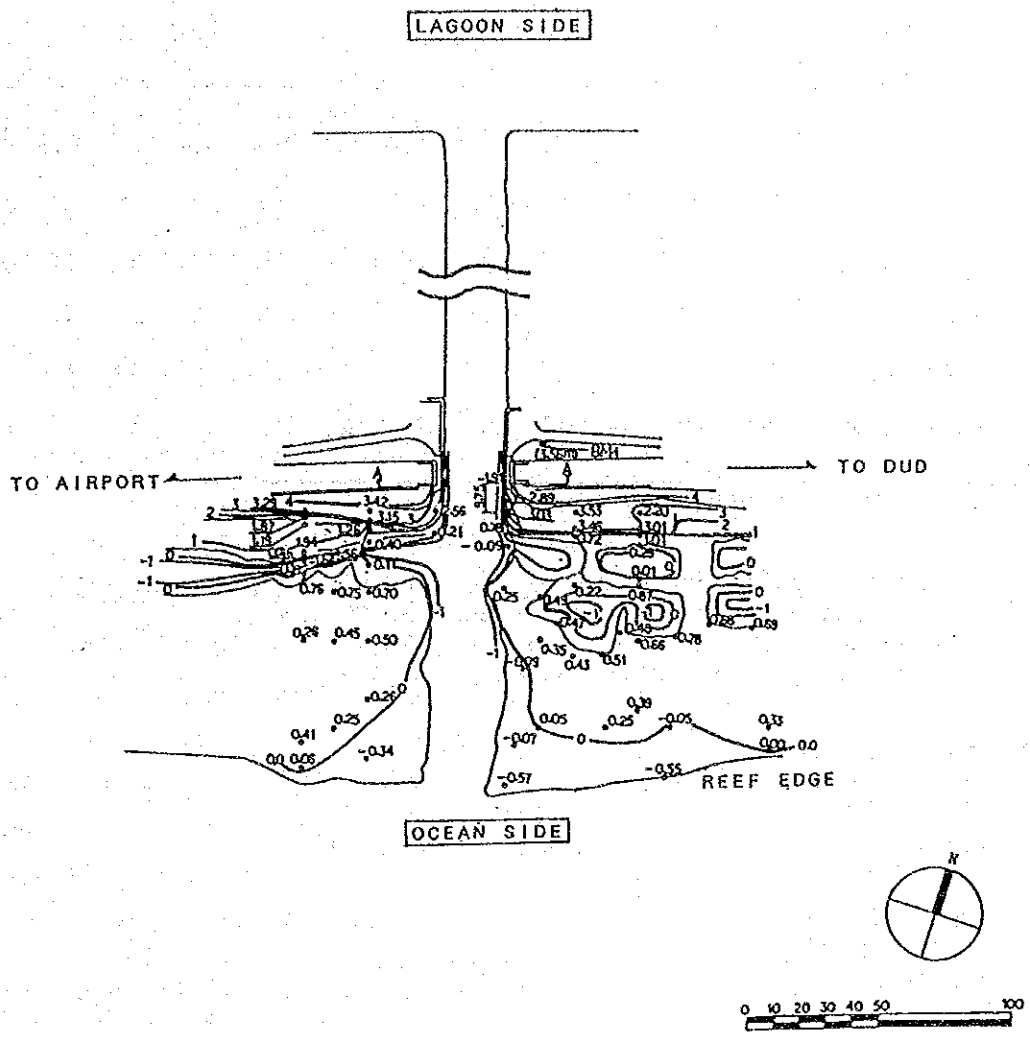
### 3.1.3 Construction Conditions

There are almost no construction machines in Arno. The machines are brought from Majuro when needed. The airway strip is the only existing infrastructure and it is simply leveled and compacted.

## 3.2 Majuro New Channel

### 3.2.1 Present Conditions

The Majuro Atoll is oval in shape extending approximately 40 km east to west and 10 km north to south. The area of the atoll is about 410 $km^2$ and the greater part is occupied by the lagoon. The land area is only 11 $km^2$. Nearly all facilities and 75 percent of the Majuro population is concentrated in DUD district (Darrit, Uliga and Dalap) which is located at the east end of the atoll. Majuro new channel is located at about 3 km south of DUD district. The channel is functioning as an entrance/exit between the lagoon and ocean for fishing boats and transport vessels. The road to the airport and Laura district crosses the channel. Transport volume is comparatively large. The maximum velocity of the water current in the channel reaches 2 knots and is generated by water level differences between the lagoon and the ocean side following tidal fluctuation. Particularly during low tide, the current flows to the ocean side and often creates mixed conditions of strong current and broken waves at the ocean side exit. The channel is orginally designed to be used under calm stream conditions. However it is so convenient that it is also used under rough conditions. Furthermore the ocean side exit of this channel is slightly narrow and shallow. Hence, when these combined conditions of tide level, channel current and swells badly overlap, the passage of vessels becomes dangerous. There are incidents of transport vessels bumping onto reefs and fishing boats capsizing, resulting in deaths (refer the following figure).




The ocean side reef is flat with a width of about 100 m. However the reef near the channel is not flat because there are spotted pits of excavated coral rocks. The reef consists of alternating layers of coral rock and coral gravel. The slope of the sea bottom at the reef edge is steep at 30 degrees with a depth of 5 m and the incline is 60 degrees at a depth of 10 m.

### 3.2.2 Natural Conditions

(1) Climate

The climatic data of Majuro is shown below (refer to Appendix 2.3 Results of Natural Conditions Survey).

| Months | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Annual Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature °C | 27.1 | 27.2 | 27.3 | 27.2 | 27.3 | 27.2 | 27.2 | 27.4 | 27.4 | 27.4 | 27.3 | 27.1 | 27.3 |
| rainfall mm | 203 | 176 | 223 | 277 | 288 | 310 | 327 | 295 | 318 | 365 | 339 | 287 | 3,408 |
| Humidity % (6 hours) | 81 | 80 | 81 | 84 | 85 | 84 | 84 | 84 | 83 | 83 | 83 | 82 | 83 |
| Humidity % (12 hours) | 75 | 73 | 74 | 77 | 78 | 78 | 77 | 76 | 76 | 76 | 77 | 76 | 76 |
| Wind speed m/sec. | 5.7 | 6.1 | 5.9 | 5.4 | 5.0 | 4.5 | 3.8 | 3.3 | 3.2 | 3.4 | 4.0 | 5.6 | 4.6 |
| Wind direction (1963) | ENE | ENE | ENE | ENE | ENE | ENE | ENE | ENE | E | E | E | ENE | ENE |

REMARKS: Average temperature and rainfall based on data from 1955 to 1988
Average humidity based on record of 32 years
Average wind speed based on 1987 data
Average wind direction based on 1963 data

(2) Sea Conditions

1) Tidal current

Tidal current is similar to that of Arno Atoll.

2) Tide fluctuation

The tide fluctuation used during the excavation of the Majuro new channel was as follows.

| | | |
|---|---|---|
| M.H.W.L | (Mean High Water Level) | + 1.80 |
| M.W.L | (Mean Water Level) | + 0.90 |
| M.L.L.W.L | (Mean Lower Low Water Level) | ± 0.00 |

(3) Current Speed in Majuro New Channel

The current speed in the channel varys with the tidal flucuations. When measured during the spring tide using current meter, the maximum velocity was 1.75 knots (refer Appendix 2.3 Results of Natural Conditions Survey).

3.2.3 Construction Conditions

(1) Infrastructural conditions

In the capital of Majuro, electricity, water and roads are sufficiently provided, and main public facilities such as government offices, new and old ports, hospitals, schools, churches, and commercial

facilities such as hotels, shops, offices, etc. are concentrated in the DUD district. With the exception of a scheduled electrical shutdown needed to exchange a transformer on an electric pole, there was no electric failure or voltage drop throughout the survey period. Aside from this, the electric power supply appears to be in good condition. A two-way paved road passes from the DUD to the Laura district. Transportation is by private cars, minibuses, and taxis.

(2) Construction Conditions

The executing organizations of public works in the Marshall Islands are the Ministry of Public Works and Capital Improvement Programs (CIP). The former is responsible for the budget of public works, maintenance of public facilities and the leasing of construction machines. The latter is under the jurisdiction of MIDA (Marshall Islands Development Authority) and is responsible for designing, tendering, and construction supervision that are solely contracted to American consultants.

Private construction firms are Pacific International Inc. (PII), Robert Reimers Enterprises (RRE), and Nine Group, United Atoll General Contractor, McConnel Dowell, etc. Firms currently undertaking construction work are PII (U.S.A), RRE (Local), McConnel Dowell (New Zealand). Nine Group (Taiwan) has not obtained any work, since the sewerage works contract two years ago. PII, the largest firm, and McConnel Dowell have undertaken a joint-venture for almost all the projects and thereby maintains a monopoly on large projects. RRE is usually engaged in work related to their associated companies. United Atoll General Contractors has recently gone independent from RRE, and does not appear to be doing well.

Most of existing construction equipment and machines are owned by PII or the Ministry of Public Works. However, those of the latter are not well maintained. Many of them can not be used because they have either broken down or are under repair.

The following are main construction equipment and machines that can be procured in the Marshall Islands.

- Concrete batching plant
- Truck crane (65 ton, 12.5 ton, 8 ton)
- Bulldozer
- Mortar grader
- Dump truck
- Backhoe (small)

- Breaker (small)
- Welder
- Generator
- Compressor
- Landing craft, etc.

Marshalleses, Filipinos, Americans and New Zealanders are available for local construction works. Most Marshalleses are employed as ordinary construction labourers; foremen and technicians are Filipinos; construction supervisors and managers are American and others. Labour cost in the private sector is higher than that regulated by law.

Locally produced construction materials are limited to aggregate (coral sand and rock), and concrete block (using imported cement). Other materials are all imported. The following are imported stockpile. This stockpile will not meet an urgent demand in large quantities without the additional import.

- Cement (Taiwan and Korea)
- Timber and plywood (U.S.A.)
- Steel (Korea)
- Roofing materials (U.S.A.), etc.

# 4. CONTENTS OF THE PROJECT

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## 4.1 Objectives of the Project

The objectives of the Project are to encourage fishing activities and to upgrade the livelihood of people in the Arno Atoll by development of fisheries and marketing infrastructure. The objective is also to suppress the volume of imported of canned fish, i.e., to suppress the outflow of foreign exchange.

## 4.2 Evaluation of the Requested Project

### 4.2.1 Evaluation of the the Plan

(1) Relationship between the OFCF project and the Project

The contents of the Project request are described in section 2.4.2 and were confirmed by both governments during the field survey conducted by the basic design team. The details are given in section 2.4.2. The contents are roughly categorized as follows:

1) Provision of equipment for fishing and commercialization of Arno fishery
2) Construction of support facilities for Arno fishery
3) Construction of fishing bases for Arno fishery
4) Improvement of Majuro new channel

In view of the lack of modernized fishing and fisheries infrastructure such as landing jetties, slipway, etc. in the Arno Atoll, it is justifiable to respond to the aforementioned objectives of the request. However, as indicated in section 2.3.2, OFCF has been cooperating with the same objectives as the Project and has been providing fisheries equipment and dispatching experts for technical guidance. Consequently, in this Project it is justifiable to undertake items 2), 3) and 4).

(2) Infrastructural development of Arno fishery

Development of fisheries infrastructure was requested in each of the four administrative districts (Arno, Ine, Malel and Dodo) in the Arno Atoll. However, it is essential that districts and facilities are chosen

on a priority basis in order to activate Arno fishery in stages throughout this Project.

(3) Selection of the Project site

In order to select a project site for stagewise development of fishing infrastructure and promotion of commercial fisheries, the following four proposed sites were evaluated using the following selection criteria:

- suitable site for anchorage and access to the ocean
- accessibility to Majuro
- economic potential in terms of population and land area
- accessibility by each district

Based on the evaluation, an integrated area of islands excluding Dodo and Malel, were recommended as the most appropriate project site for the development of a fishing base (Table 4.1).

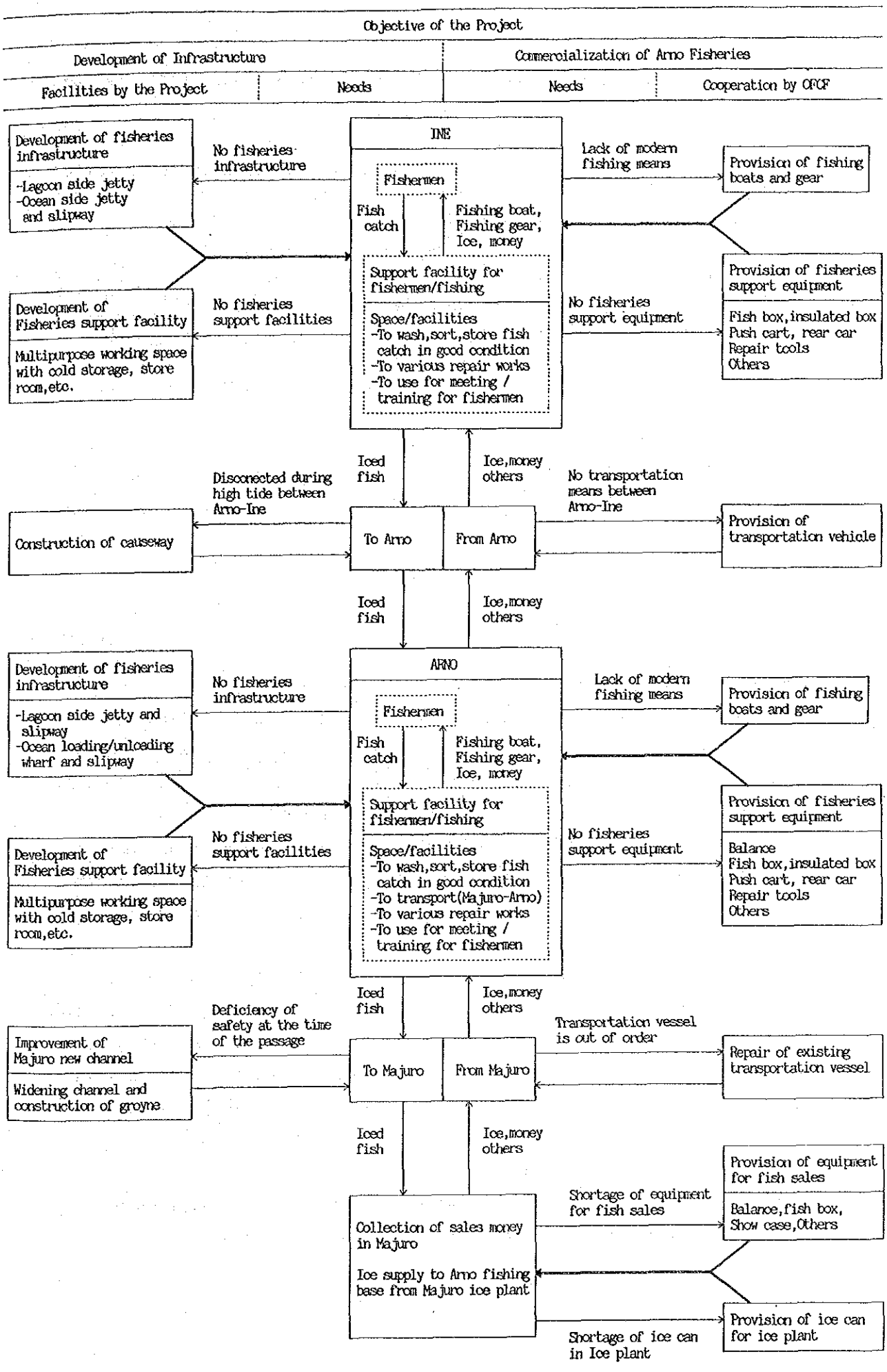
(4) Basic plan for commercializing Arno fishery

There is an ice plant having a 5-ton/day capacity at the new fishing base in Majuro, and a transport vessel for fresh fish will be provided (Vessel's name: HUSTON, is presently inoperable and to be repaired by OFCF). Under these conditions, installing an ice plant at the Arno site is not recommended. It is much more economical to transport ice from Majuro and store it in Arno. Due to the route taken by transport vessels between Majuro and Arno, Arno Island will be a transit point since its ocean side anchorage is the closest to Majuro. Meanwhile the Ine Island facilities will be the fish collection, storing and shipping point for Arno.

4.2.2 Evaluation of the Facilities

(1) Evaluation of the facilities in the Project

Based on the results of the evaluation mentioned in section 4.2.1 (1) (Relationship between the OFCF project and the Project), the type of facilities to be introduced in this Project, its objectives, the needs of the project site, and its relationship to the work of the OFCF project are shown in the following figure.


Objective of the Project
Development of Infrastructure
Commercialization of Arno Fisheries
Facilities by the Project
Needs
Needs
Cooperation by OFCF
Development of fisheries infrastructure
-Lagoon side jetty
-Ocean side jetty and slipway
No fisheries infrastructure
INE
Fishermen
Fish catch
Fishing boat, Fishing gear, Ice, money
Support facility for fishermen/fishing
Space/facilities
-To wash,sort,store fish catch in good condition
-To various repair works
-To use for meeting / training for fishermen
Lack of modern fishing means
Provision of fishing boats and gear
Provision of fisheries support equipment
Fish box,insulated box
Push cart, rear car
Repair tools
Others
No fisheries support equipment
Development of Fisheries support facility
Multipurpose working space with cold storage, store room,etc.
No fisheries support facilities
Iced fish
Ice,money others
Disconected during high tide between Arno-Ine
No transportation means between Arno-Ine
Construction of causeway
To Arno
From Arno
Provision of transportation vehicle
Iced fish
Ice,money others
Development of fisheries infrastructure
-Lagoon side jetty and slipway
-Ocean loading/unloading wharf and slipway
No fisheries infrastructure
ARNO
Fishermen
Fish catch
Fishing boat, Fishing gear, Ice, money
Support facility for fishermen/fishing
Space/facilities
-To wash,sort,store fish catch in good condition
-To transport(Majuro-Arno)
-To various repair works
-To use for meeting / training for fishermen
Lack of modern fishing means
Provision of fishing boats and gear
Provision of fisheries support equipment
Balance
Fish box,insulated box
Push cart, rear car
Repair tools
Others
No fisheries support equipment
Development of Fisheries support facility
Multipurpose working space with cold storage, store room,etc.
No fisheries support facilities
Iced fish
Ice,money others
Deficiency of safety at the time of the passage
Transportation vessel is out of order
Improvement of Majuro new channel
Widening channel and construction of groyne
To Majuro
From Majuro
Repair of existing transportation vessel
Iced fish
Ice,money others
Provision of equipment for fish sales
Balance,fish box, Show case,Others
Shortage of equipment for fish sales
Collection of sales money in Majuro
Ice supply to Arno fishing base from Majuro ice plant
Provision of ice can for ice plant
Shortage of ice can in Ice plant