No. 08

BASIC DESIGN STUDY
ON
THE SMALL-SCALE FISHERIES DEVELOPMENT
AND MARKETING PROJECT
IN
THE REPUBLIC OF PALAU

MARCH 1982

JAPAN INTERNATIONAL COOPERATION AGENCY

はしがき

近年，日本とオーストラリアの経済関係はますます緊密の度を加え，相互貿易も活潑に行われるようになりました。

オーストラリアは，多くの移住者を海外から受け入れており，昨今オーストラリア移住について相談にくる者の数も急増しております。又，移住者も毎年ゆるやかながら，増加してまいりました。

この小冊子「オーストラリア移住の案内」はオーストラリア移住についての手続き，生活，オーストラリアの歴史，一般事情などについてわかり易く解説したもので，オーストラリア移住を志す皆様のお役に立てば幸いです。

昭和59年1月

移住事業部

PREFACE

In response to the request of the Government of Republic of Palau, the Japanese Government decided to conduct a Basic Design Study on the Small Scale Fisheries Development and Marketing Project and entrusted the survey to the Japan International Cooperation Agency (JICA). The JICA sent to Palau a study team headed by Mr. Kyoshiro Ohi, Fishing Boat Div., Oceanic Fisheries Dept., Fisheries Agency, from December 11 to 24, 1981.

The team had discussions with the officials concerned of the Government of Palau and conducted a field survey in Baberudaob Island and Peleliu Island. After the team returned to Japan, further studies were made and the present report has been prepared.

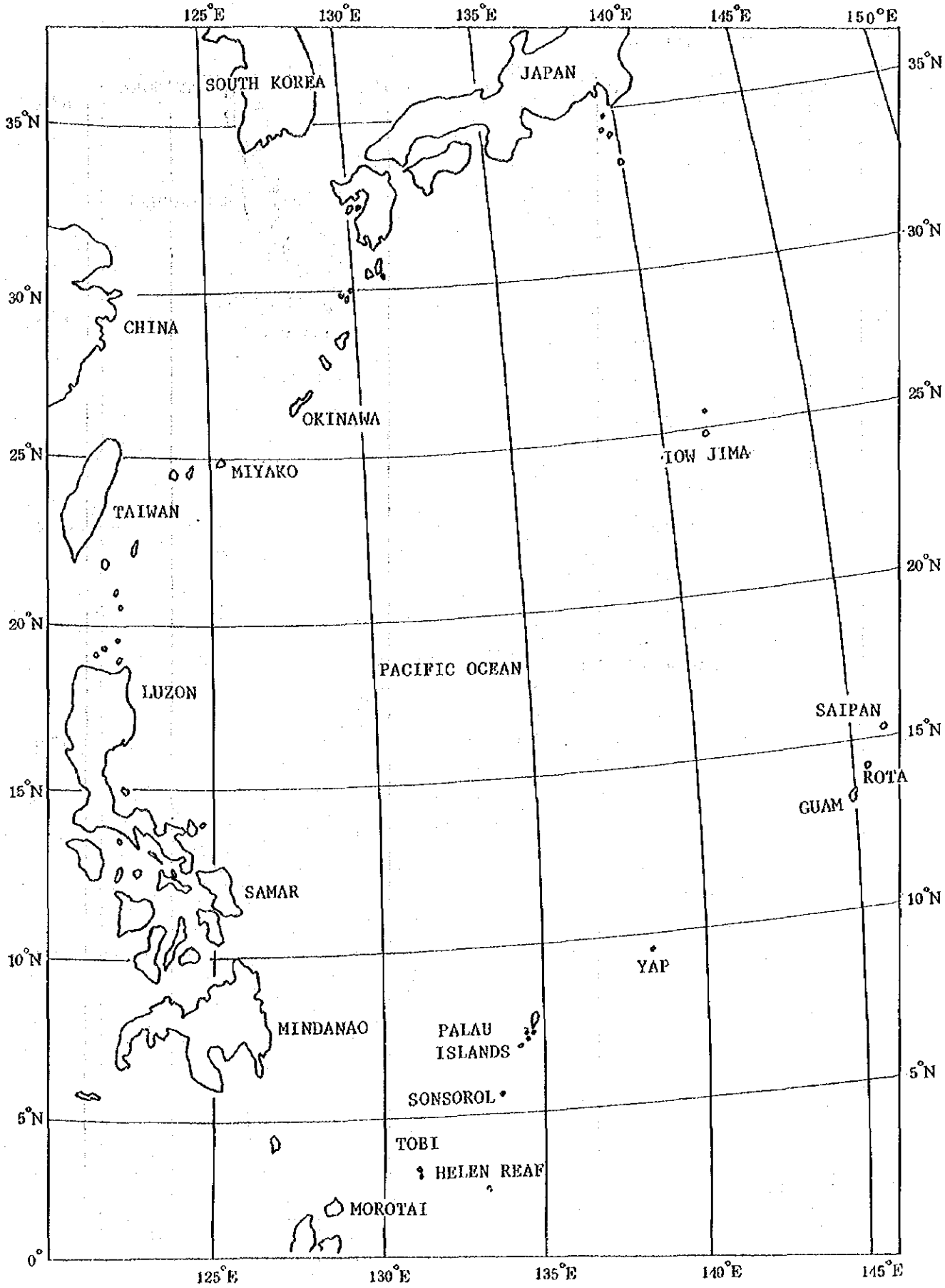
I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

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

March, 1982

Keisuke Arita

Keisuke Arita
President
Japan International Cooperation Agency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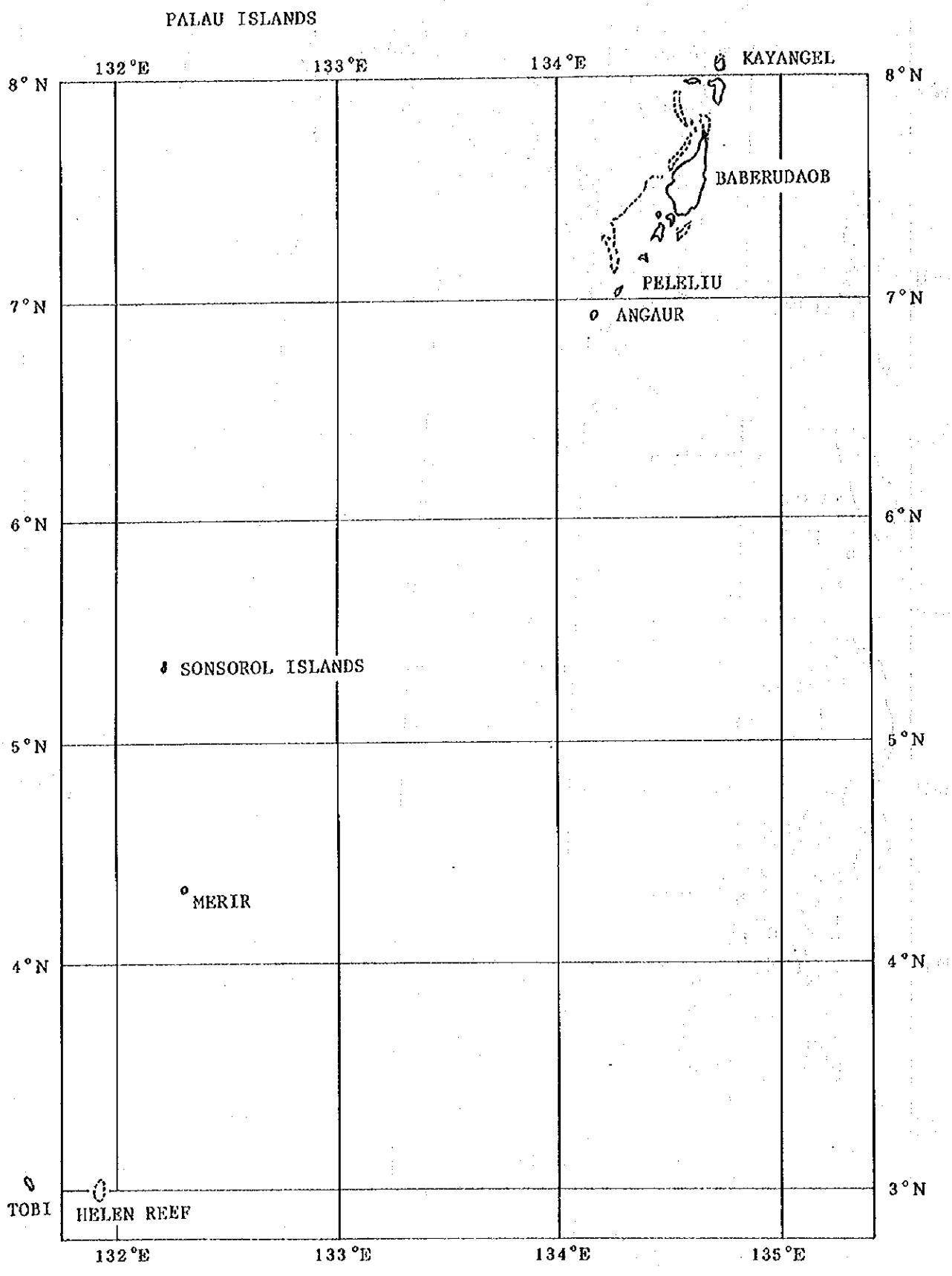
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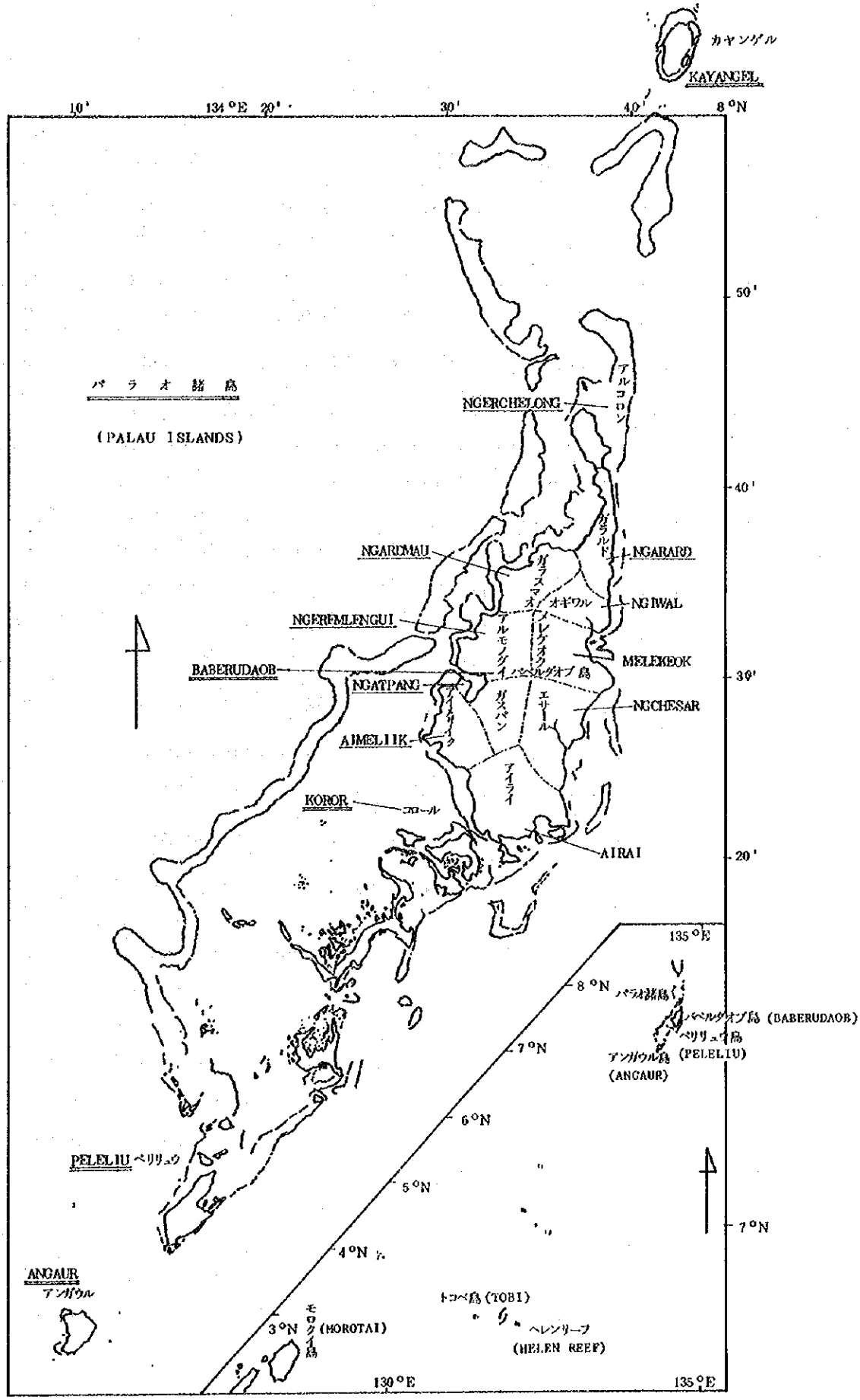
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CONTENTS

SUMMARY

The Japanese study team stayed in Koror, Palau for twelve days from December 12 to 23, 1981, for a basic design study of the Small-Scale Fisheries Development and Marketing Project. During their stay in Palau, the study team had a series of discussions with the concerned authorities of the Republic of Palau and conducted a field survey.

The Republic of Palau is an archipelago, stretching from latitude 3°N to 8°N and from longitude 131°E to 135°E in the southwestern part of the Pacific. It consists of some 350 small and large reef islands, including Koror island on which the Capital, Koror, is situated. The population of the Republic of Palau is about 15,000. Palau is a new nation, which became independent on January 1, 1981 by the provisional signing of the Compact of Free Association with the United States Government on November 7, 1980.

Lying in tropical waters, Palau is surrounded by a lagoon that almost equals Palau's total land area of about 460 km^2.

In view of this, the Government of the Republic of Palau has been endeavoring to develop primary industries, inter alia the fishing industry as the economic base of the country.

In Palau, coastal fishing relies chiefly on outboard motorboats, surround nets, spear guns, bottom hand-lines, etc., and the catches are consumed within the country.

In the 200-mile fishery zone, fishing boats from the United States, Japan, other foreign countries and from joint ventures are operating purse sein, pole and line, and longline fishing in the tuna and skipjack fishing grounds, and the catches are hauled abroad.

Considering these and other various factors, it is quite understandable that the Palauan Government has emphasized the development of small-scale fisheries and marketing and the optimum utilization of skipjack and tuna resources in its efforts to develop the fishing industry.

The Palauan Government had requested the Japanese Government to furnish a wide range of equipment and materials for fishing and marketing under the Small-Scale Fisheries Development and Marketing Project. The study team determined the specifications and quantity of the materials and supplies to be furnished, based on a basic study, after close examination of the arrangements with the Palauan Government authorities and the field survey findings.

The original requests of the Palauan Government and the materials and supplies determined by the study team are given in the following table.

Item	Palauan Government's request		Study team's recommendation	
	Specifications	Q'ty	Specifications	Q'ty
1. Small fishing boat	FRP, inboard diesel	19	FRP, inboard diesel	7
2. Skiff	FRP, outboard engine	14	FRP, outboard engine	14
3. Insulated cold storage building	Prefabricated, approx. 3 x 3 x 2 m	10	Prefabricated, 3.6 x 2.7 x 2.4 m	5
4. Insulated fish box		100	FRP, 160 lit.	100
5. Block ice plant	Approx. 20 tons per day	1	Approx. 15 tons per day	1
6. Flake ice plant	Approx. 1 ton per day	2	Approx. 1 ton per day	2
7. Diesel engine generator	For standby use	3	12 Kw for cold storage and flake ice plant	7
8. Refrigerated van	Payload, approx. 4 tons	1	Payload, approx. 4 tons	1
9. Fishing gear		1 set		1 set
10. Others	Fish weighing scale		Platform scale	13
	Block ice crusher	1	Block ice crusher	1
	Plastic fish basket		Plastic fish basket	150

The grant of the materials and supplies, including the small fishing boats, ice plants, cold storage, and fishing gear determined by the study team reflects the earnest requests of the Palauan Government, and will go a long way toward the promotion of small-scale fisheries in Palau. It is particularly significant because it will help the people of Palau secure a

stable supply of animal protein, increase national income, increase employment opportunities, and reduce dependency on the import of processed marine products.

To be useful and effective, the equipment to be granted should be carefully operated, maintained and managed. In this respect, management of the equipment will be of overriding importance.

The study team recommends, therefore, that the Government of the Republic of Palau offer relevant state governments all necessary assistance concerning manning and budgeting, etc., that the state governments and fishing cooperative associations combine efforts to establish a highly efficient administrative system, and that the Government of the Republic of Palau submit to the Japanese Government a progress report on the Project within a specified time after the grant.

CHAPTER 1: STUDY OBJECTIVES AND BACKGROUND OF THE REQUEST FOR GRANT

For the purpose of its Small-Scale Fisheries Development and Marketing Project, the Government of the Republic of Palau requested the Japanese Government for a large economic grant covering small fishing boats, ice plants, cold storage, delivery vans, fishing gear, and other materials and supplies.

In response to this request, the Japanese Government entrusted the Japan International Cooperation Agency (JICA) with a study of the basic design of the Project the FY1981 as one of its projects for the grant aid Economic Cooperation for Fisheries.

1.1 Objectives of the Study Team

The study team was dispathced to Palau to investigate the background of the Small-Scale Fisheries Development and Marketing Project and the request made by the Palauan Government for grant aid cooperation. It was to estimate the stock of the marine resources within three nautical miles from the reef line of Palau, discuss viable and rewarding methods of economic cooperation with the concerned authorities of the Palauan Government, and formulate an optimum plan including the specifications and costs of economic cooperation.

1.2 Members of the Study Team

The JICA organized a study team headed by Dr. K. Ohi, Fishing Boat Div., Oceanic Fisheries Dept., Fisheries Agency, Ministry of Agriculture, Forestry, and Fisheries, and dispatched it to Palau for a study of the basic design of the Project during the period of December 11 to 24, 1981.

Name	Title	Current affiliation
Dr. Kyoshiro Ohi	Head	Fishing Boat Dev., Oceanic Fisheries Dept., Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries
Mr. Fumio Kikuchi	Project coordinator	Tsukuba International Center, JICA

Name	Title	Current affiliation
Mr. Eiji Higuchi	Fisheries General	Taiyo Fishery Co., Ltd.
Mr. Nanao Fukuda	Cold Store & Ice Plant	Taiyo Fishery Co., Ltd.
Mr. Toshio Hosonuma	Fishing Boat	Taiyo Fishery Co., Ltd.

CHAPTER 2: STATUS OF THE FISHING INDUSTRY

2.1 Fishery Administration

In its fishery administration policies, the Palauan Government is committed to the maximum utilization of skipjack tuna resources and the small scall fisheries development and marketing.

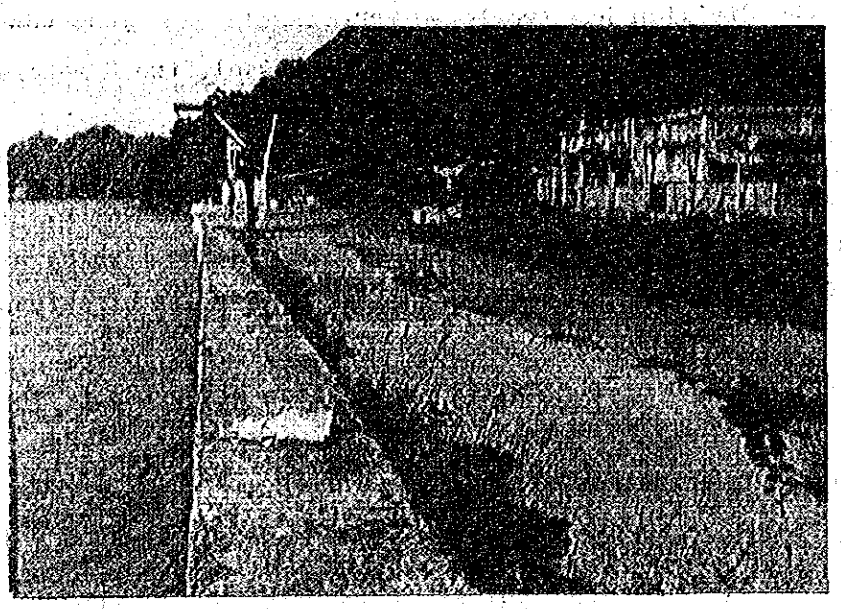
The Palauan administration system for fisheries consists of the Department of National Resources under the direct control of the President and Vice President, and minister of the Department of National Resources presides over four bureaus, including the Bureau of Resources and Development which has jurisdiction over three divisions, including the Division of Marine Resources. The Division of Marine Resources is engaged in the exploitation of marine resources, and has the following projects.

(1) Introduction of deep-sea bottom fishing technology to local fisher men.

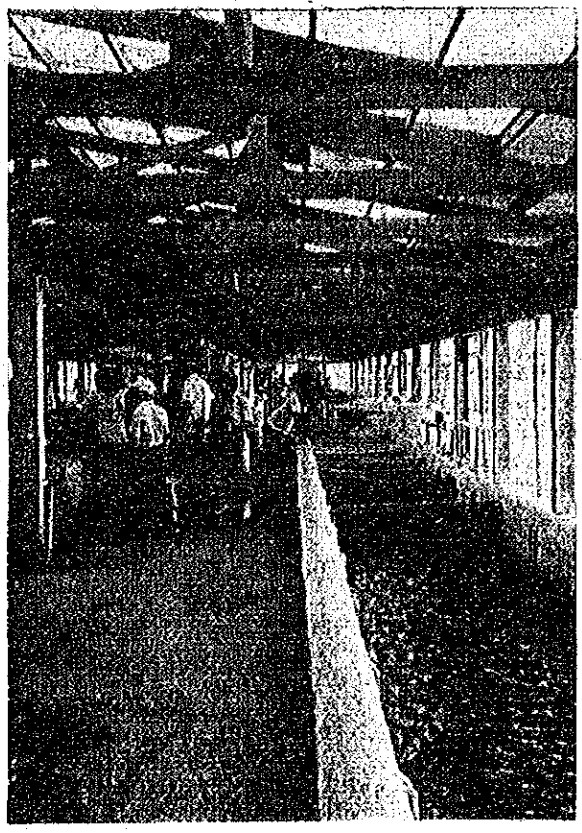
(2) Introduction of deep-sea shrimp trap-fishing technology.

(3) Fishing and utilization of sharks.

At present, milkfish are raised at five ponds in Peleliu, Baberudaob and Koror. At the Mari-Culture, in Malakal, four circular tanks, each measuring 6 meters in diameter and 1 meter in height, are used to raise trochus, another four tanks to raise rabbitfish, and one 20 meters by 1.5 meters by 1 meter rectangular tank to breed and raise rabbitfish fry.



Mari-culture (experimental fish farm)



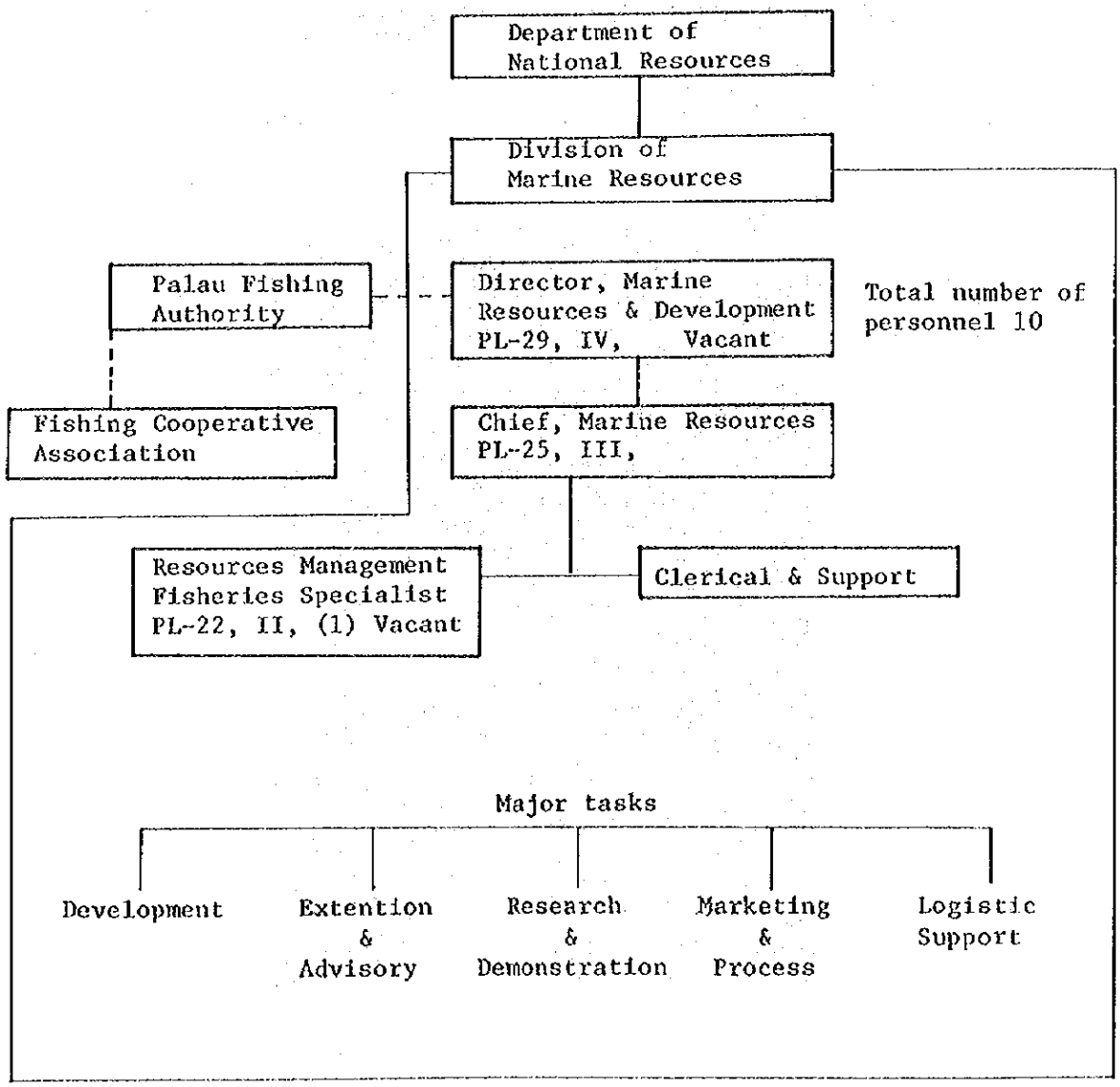
Mari-culture fish-farming tank

Also, the Division has two large FRP vessels (23 gross tons, 200 HP), one 14 meters FRP vessel, one 10 meters FRP vessel, two 8 meters FRP vessels and two speedboats for marine resources research.

Other government bodies relating to the administration of fisheries are the Palau Fishing Authority and the Palau Maritime Authority. The Palau Fishing Authority supervises, controls and guides the fishing associations, while the Palau Maritime Authority handles the affairs of skipjack and tuna fishing off the reef line.

The organization of the Division of Marine Resources is shown in Table 1.

Table 1 Organization of the Division of Marine Resources



2.2 Status of the Private Fisheries Industry

Private fishing operations in the Republic of Palau are the small-scale shallow-water fishery in and around the lagoon, purse seining of skipjack and tuna, tuna long-lining and skipjack pole and line fishing along and off the reef line.

The fishermen engaged in traditional small-scale fishing are the same those selling their catches to the Palau Federation of Fishing Associations (PFFA), and are estimated at 460 in number. The annual catches of the PFFA is near 200 tons. It is reported that there is a large number of people who engage in fishing for private consumption, but their quantity is unknown.

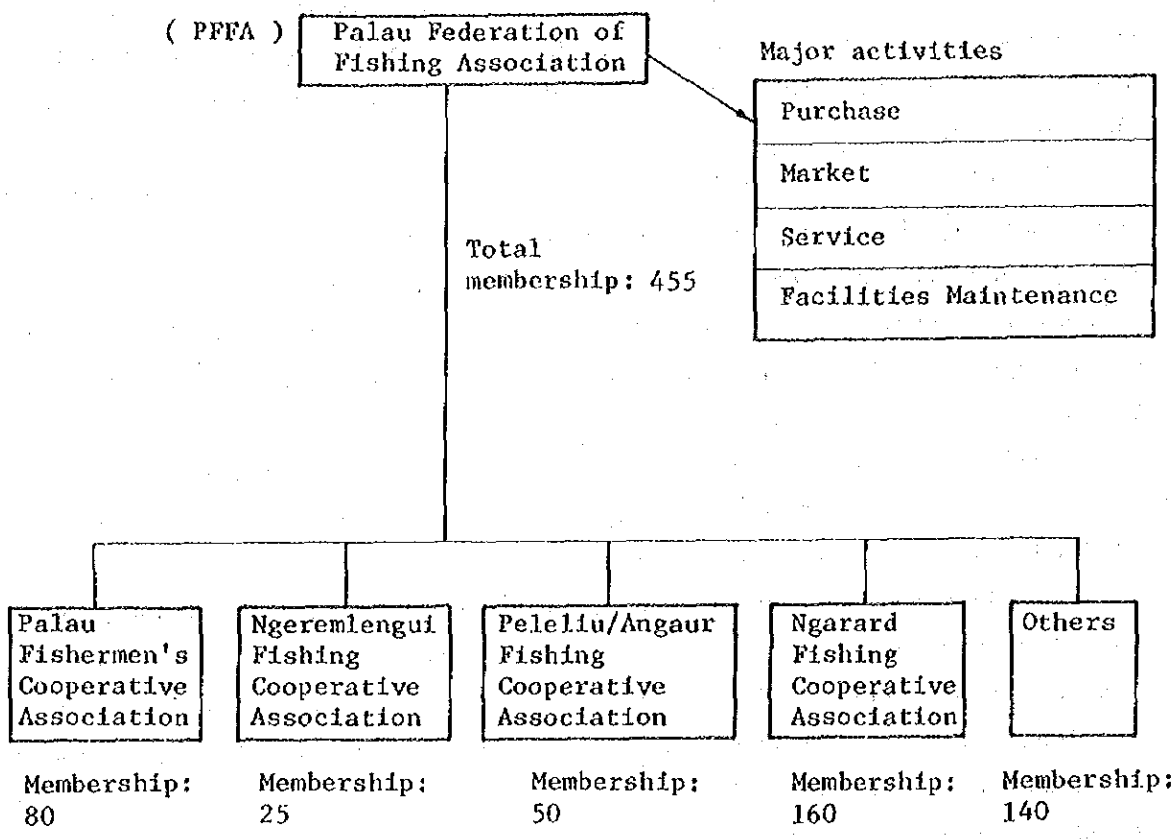
While the fishing boats used for small-scale coastal fishing are said to amount to about 200, the time spent fishing purposes seem to be very limited. In addition, bamboo rafts are widely used.

Skipjack and tuna purse seiners, tuna long-liners and skipjack pole-and line fishing boats allowed to operate in the Palauan 200 mile fishing zone as of November 4, 1981, were 16 purse seiners from the United States of America; local and Japanese fishing boats of the Caroline Fishing Company, a Palauan corporation; 9 fishing boats of the Frabelle Fishing Corporation, in the Philippines; two fishing boats from Taiwan; one skipjack factory ship and three skipjack fishing boats of the Star-Kist Foods Company; 20 local and Japanese fishing boats of the Van Camp Sea Foods Company; and one Korean-flag fishing boat of the Palau Fishing Company. In FY1980, Van Camp, one of the leading fishing companies in Palau, landed about 12,000 tons of skipjack, 3,000 tons by pole and line fishing and the remainder by purse seining.

At Malakal, there is a dried skipjack (KATSUOBUSHI) plant processing about 5 tons of skipjack a day and a button plant processing for trochus shells. In Palau, there is no large-scale fish culture operation.

The organizational chart of the fishing cooperative associations which have been playing an important part in the promotion of small-scale fisheries in Palau is shown in Table 2.

Table 2 Organization of Fishing Cooperative Associations



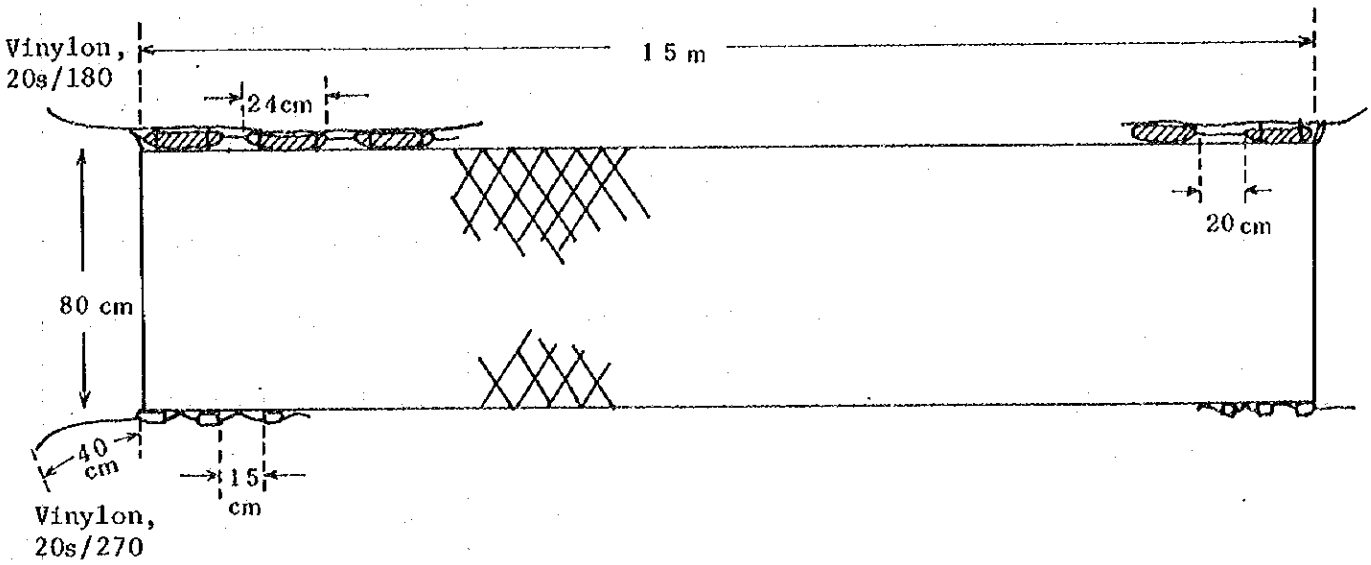
2.3 Types of Small-Scale Fishing, and Kinds of Fish

2.3.1 Types of Fishing Operations

Fishing nets used include the surround nets, which have the functions of beach seine, gill net and pound net (Muro-ami), and cast nets. For angling, troll-lines and bottom hand-lines are used. Other fishing gears include spear guns and traps.

Tuna long-lining, skipjack pole and line fishing, and skipjack and tuna purse seining are operated along and off the reef line.

Fig. 1 Surround Net



Mesh : 2"
Net : English knot, vinylon 20s/21 filaments
Float : Wooden, 24 cm long x 2 cm x 2 cm
Sinker: Lead, 27 mm long x 10 mm dia.

2.3.2 Major Fish Species

Many fish inhabit the Palauan waters and Table 3 lists the most typical of them.

Table 3

Japanese name	English name	Palauan name	Ichthyological name
Budai	White-sppoted parrotfish		Gallyodon spp.
Shimofuri Fuefuki	Red-spot emperor	Mechur	Lethrinus lentjan
Fuefukidai	Emperor	Udel	Lethrinus spp.
Kitsune Fuefuki	Longnosed emperor	Melangmud	Lethrinus miniatus
Amakuchibi	Yellow-spotted emperor	Metengui	Lethrinus kallopterus

Japanese name	English name	Palauan name	Ichthyological name
Fuefukidai	Emperor	Menges	Lethrinus spp.
Yokoshima Kurodai	Large-eyed bream	Besechamel	Monotaxis grandoculus
Hime Fuedai	Paddletail	Sebus	Lutijanus gibbus
Hiraaji	Golden Trevally	Wii	Gnathanodon speciosus
Yokoshima Sawara	Spanish mackerel	Ngelngal	Scomberomorus commersoni
Tsumuburi	Rainbow runner	Desui	Elagatis bipinnulatus
Okizawara	Wahoo	Mersad	Acanthocybium solandri
Kamasu	Barracuda	Aii	Sphyraena bleekeri
Kamasu	Barracuda	Cheduii	Sphyraena spp.
Nagaeba	Great trevally	Eropk	Caranx sexfasciatus
Hiraaji	Spotted trevally	Oruidel	Caranx melampygus
Kiwada Maguro	Yellowfin tuna	Krengab	Thnnus albacares
Iso Maguro	Dogtooth tuna	Krengob	Gymnosarda unicolor
Katsuo	Skipjack	Tekuu, Katsuo	Katsuwonus pelamis
Ohaguro Hata	Grouper	Temekai	Cephalopholis argus
Bara Fuedai	Red snapper	Kedesau	Lutjanus bohar
Nokogiri Gazami	Mangrove crab	Emang	Scylla serrata
Nishiki Ebi	Rock lobaters	Erabpruki	Panulirus argus
Shako Gai	Giant clam	Kim	Tridacna spp.
Yari Ika	Squid	Luut	Loligo peali

Source: Division of Marine Resources

2.4 Consumption and Physical Distribution

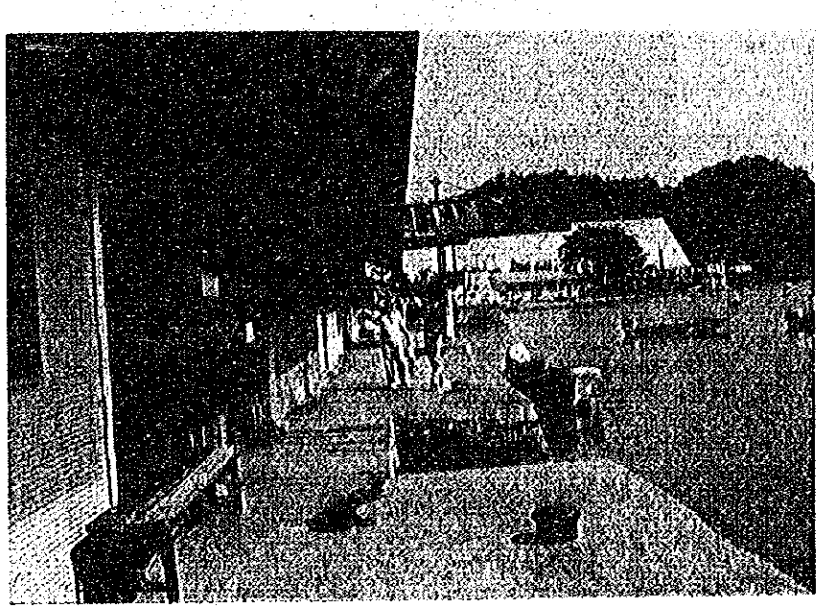
The market owned and operated by the PFFA is the only fish market avialable for landed fish in Palau. The length of its quay is about 100 meters. Table 4 shows the annual statistics of fish landed at this quay.

Table 4 PFFA's Annual Catches

(in tons)

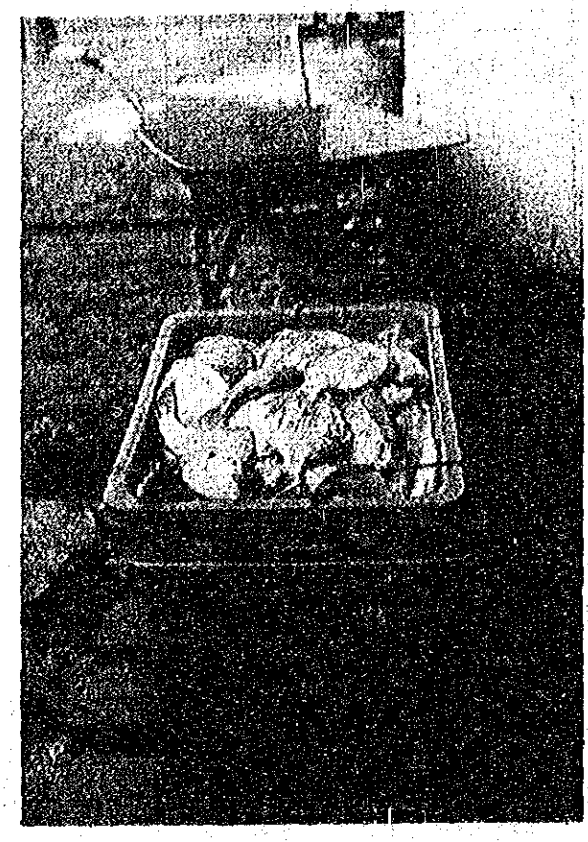
FY	Reef fish	Tuna	Crab	Lobster	Total
1975	125	21	1	1	148
1976	118	0	1	0	119
1977	120	0	1	0	121
1978	168	1	1		170
1979	192	44	2		238
1980	178	26	2		206

Source: Palau Planning Office

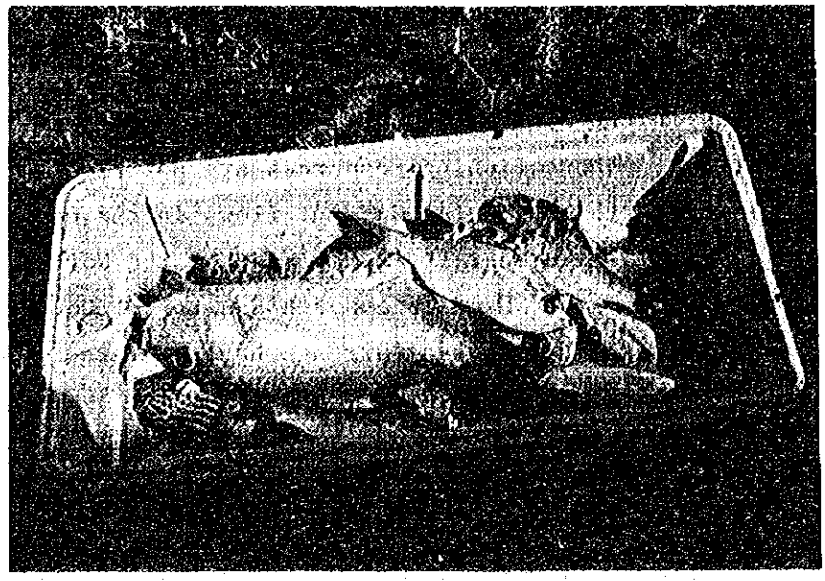


PFFA landing quay

The buying prices from the fishing boats and selling prices to consumers are determined by a committee consisting of the representatives of the respective fishing cooperative associations. As of December 1981, the fish were bought at a rate between 88 cents to $1.54 per kg, and were sold at a rate between $1.21 to $1.87 per kg. Groupers are in a cheap class, tuna and skipjack in middle, and rainbow runners are at a premium, by price categories.



Fish landed at PFFA's market



Fish landed at PFFA's market

In Koror, there is a small "central market" retailing fish and processed marine products other than PFFA's fish market.

The annual consumption of fish by Kororites is about 30 kg per capita. This figure is on a par with the average of the rest of islanders in the world. However, the Palauan Government is planning to reduce imports of processed marine products and to increase domestic products instead.

The annual per capita consumption of marine products in other countries, including Tonga and Tuvalu is shown in Table 5 for reference.

Table 5 Annual per Capita Consumption of Marine Products

(in kg)

Country	Annual per capita consumption
Tonga	21
Tuvalu	60 ∿ 80
Solomon Islands	20 ∿ 40
U.S.A.	6
U.S.S.R.	17
Japan	70
Indonesia	11
The Philippines	32

2.5 Fishing Grounds

The Palau Islands are surrounded by reef, and have no continental shelf. Like other islands in the Southern Pacific, the Palauan waters have a wide variety of fish, but inshore fishing resources are not rich.

In Winter, the North Equatorial Current flows in the northern offshore of the Palau Islands. In Summer, it is replaced by the North Equatorial Countercurrent. On the other hand, the North Equatorial Countercurrent is perennially running eastward. These currents have fostered good fishing grounds for tuna and skipjack that like warm water.

In Winter, the northeastern trade wind prevails, and the skipjack pole and line fishing is out of season. In Summer, southwesterly wind prevails, and when the season of calm days sets in, live baits (mainly Stolephorus spp.) begin to be taken and there are many chances of finding schools of skipjack.

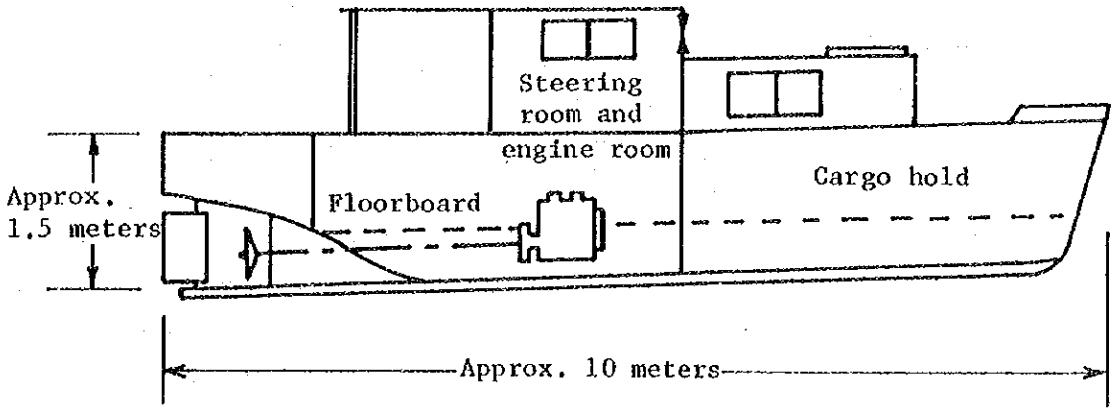
2.6 Status of the Fleet

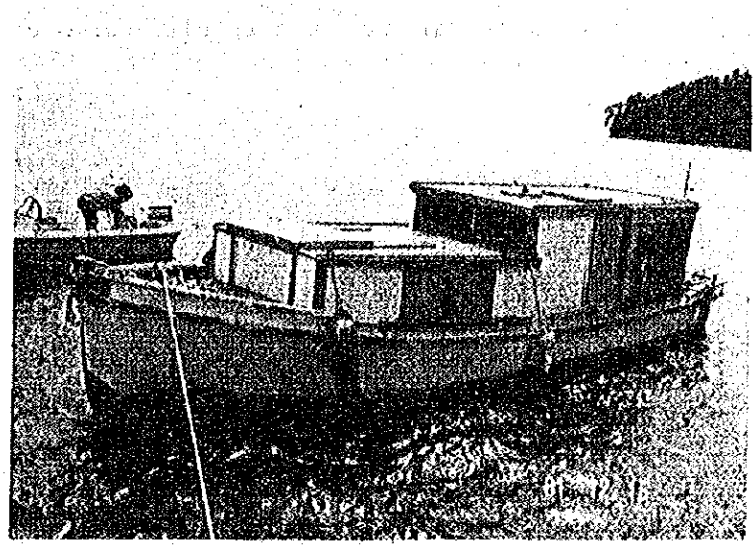
The Palauan fleet is estimated at about 200 boats. But the estimate remains a matter of conjecture, because Palau has no ship registration system instituted. The vessels are not classified into fishing boats, cargo carriers, or passenger carriers. Almost every ship is used for fishing on one occasion, for transportation on another occasion, and for passenger service on still another occasion. Generally, every ship is used for multi-purpose.

Ships are classified into two major categories by sizes and shapes. Inboard diesel vessels form one category, and are used for transporting fish, vegetables, ice, oil, other necessities and passengers between Koror and the local districts. These vessels are operated by state governments as regular carriers or trampers, but are also engaged in fishing operations when they are not used for transportation service. They are not equipped with any fishing gear. Their dimensions are 6 - 10 meters in length, 2 - 3 meters in breadth, 1 - 1.5 meters in depth, and their engines are rated at 10 - 30 HP (1 to 3 cylinders). They are of the partial single deck type, with a deck house and a steering room, but they are not installed independent engine room. The main engine is installed in the steering room. Most of these inboard diesel vessels are wooden, and are built at the shipyards in Palau. Because of the wooden structure, the variety of types are limited,

and the capacity of the main engine is small. The major drawback is their slow running speed, around 5 knots. The number of inboard diesel vessels is estimated at 30 to 40. An example of an inboard diesel vessel layout is given in Fig. 2.

Fig. 2 Layout





Typical inboard diesel vessel

In the other category are outboard powered boats. They are also used for various purposes; as fishing boats, cargo carriers and passenger carrier. They measure 3 - 7 meters in length, and are equipped with an outboard engine of 25 - 80 HP, most are over 50 HP. For their size, the outboard powered boats are overpowered as fishing boats. This is because higher speed is required when they are used as a cargo or passenger carrier. Most of the outboard powered boats in Koror are made of FRP. But in the local districts,

two-thirds are of FRP, and the remainder are wood. These boats do not have fishing gear, either. With the exception of Koror, the outboard powered boats are estimated to be about 10 in every state. This is far from enough in the north and west of Baberudaobu Island and Peleliu, because both have good fishing grounds.

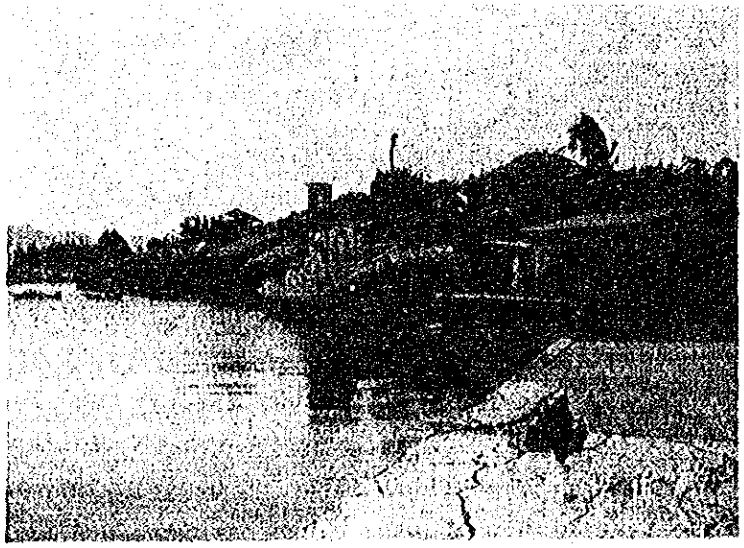
Not included in the two categories are the following three large vessels:

The Karangahp and a sister ship: 15.2 meters in length, 4.3 meters wide, 23 tons, 200 HP main engine, FRP

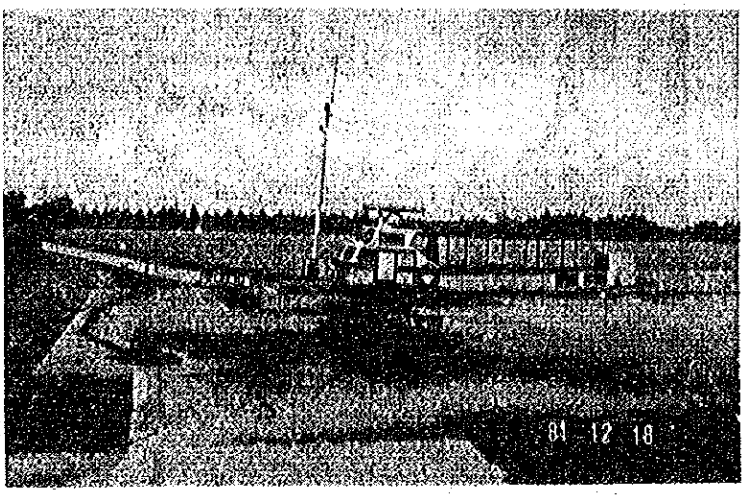
The Peleliu Princess: 18.5 meters in length, 3.4 meters wide, 20 tons, 135 HP main engine, FRP

The Karangahp and its sister-ship are skipjack fishing boats furnished by Japan according to the Japan-U.S.A.-Micronesia agreement, and are owned by the Division of Marine Resources. At present, they are chartered as skipjack pole and line fishing boats to a private fishing company.

The Peleliu Princess, originally a Japanese game fishing boat, is operated by the Peleliu State Government as a regular cargo carrier between Peleliu and Koror.



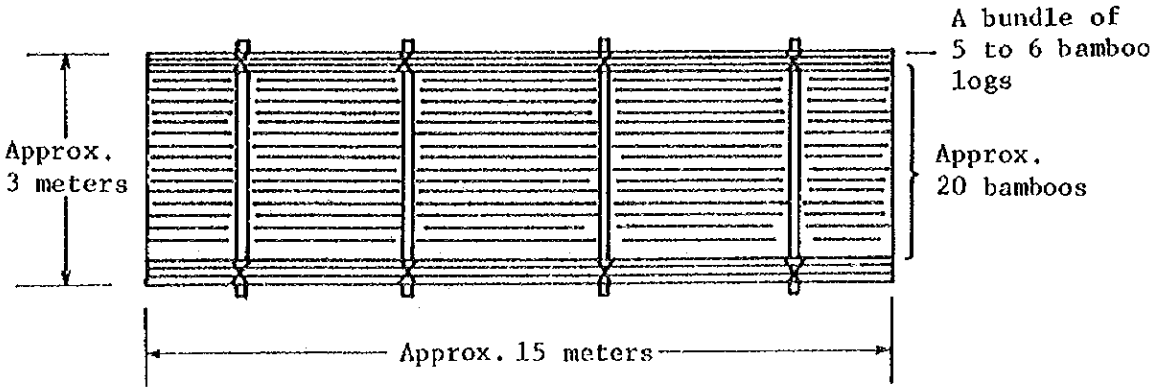
The Karangahp furnished according to the Japan-U.S.A.-Micronesia agreement



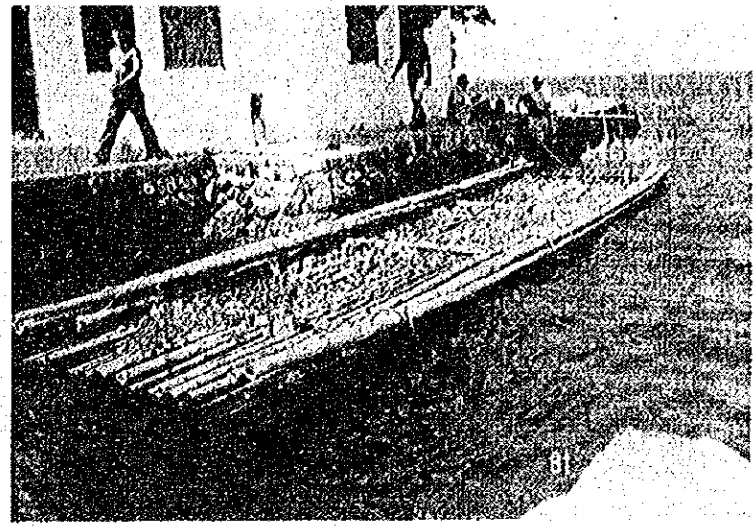
The Peleliu Princess, a regular cargo carrier run by the Peleliu State Government

Worthy of special mention is the bamboo raft, one of the Palauan legacies, see Fig. 3, although it may not be classed as a boat in the modern sense of the craft. It finds many uses, including transportation of stone blocks.

Fig. 3 A Large Bamboo Raft



It is a floating platform made up of about 20 bamboo logs, each measuring some 10 cm in diameter and about 15 meters in length, fastened together, and of bulwarks which double as spare floats that are made of bundling up 5 to 6 bamboo logs. Rafts as small as 5 meters in length and 1 meter in width are also used. While the bamboo rafts are being superseded by motorboats, they are still in use for short-distance trips or for special purposes because they are easy to make.



Traditional bamboo raft

CHAPTER 3: REQUEST BACKGROUND AND PROJECT OUTLINE

3.1 Request Background

Although politically independent, the Republic of Palau has yet to become economically independent as it is still dependent on United States for its financial aid which is about 70% of its national revenue.

In once-flourishing Angaur, the supply of phosphate rock has been greatly depleted. As in many other island countries dotting the Pacific, coconut-intensive agriculture and fishing are Palau's only viable export industries.

In an effort to achieve economic self-support, the Palauan Government plans long-term development and promotion of manufacturing industry and tourism underscored by the development of primary industries, with fishery being given the highest priority.

The Palau Islands are situated in tropical waters with rich skipjack and tuna resources, and are encircled by a far-reaching lagoon. The Palauan Government is hoping to promote the country's export business by the maximum utilization of skipjack and tuna resources, taking advantage of underutilized high-potential coastal resources to improve the standards of living, expand employment opportunities and increase tax revenue, while preserving the traditional culture and mode of life.

For the purpose of achieving these objectives, the Palauan Government is soliciting Japan's help for the introduction of small ice plants, cold storage, and insulated fish boxes to maintain the quality of caught fish at the fishing bases, a delivery van to dispatch the catches to the markets, and small fishing boats, fishing gear, and ancillary facilities necessary for increased production of marine products.

3.2 Project Outline

The specifications and quantities of equipments requested by the Palauan Government under the proposed project are shown in the following table.

Item	Specifications	Quantity
Inboard diesel fishing vessel	Simple, reliable, multipurpose diesel powered FRP fishing vessel for trolling and bottom fishing with hook and line outside of the reef, and for support of smaller craft in operations distant from fishing bases. Basic required equipment to be provided 30-50' length.	19
Outboard powered fishing skiff	Efficient outboard powered FRP fishing skiff for use in trolling and bottom fishing outside the reef where access is through shallow channels and for net fishing activties in areas reached only through reef shallows. 19-24' length with outboard engines from 25-85 HP. Basic equipment to be provided.	14
Insulated storage	Efficient, prefabricated walk-in insulated (6") storage facilities, aproximately 3 x 3 x 2 m, with minimum refrigeration equipment, for storage of ice and ice fish at satellite bases.	10
Insulated fish box	Strong, portable, insulated, FRP fish and ice storage containers for use in storage on fish boats, storage at satellite bases and transport from satellite bases to Koror.	100
Block ice plant	Simple, efficient block ice making facility with capacity for production of approximately 20T/day of 100 lb blocks.	1
Flake ice plant	Small, efficient ice making equipment for production of approximately one ton per day of shaved ice.	2
Diesel electric generator	Appropriate, economical, dependable diesel powered electric generating equipment for limited use as standby generators for small ice making and cold storage facilities.	3
Delivery van	An insulated/refrigerated truck for transporting fish to markets in Koror. Approximately 4 ton capacity.	1

Item	Specifications	Quantity
Fishing gear	Preliminary demand is for several surround nets of 3,000' x 6' by 3" mesh and braided and monofilament lines of 100-300 lb test, tuna circle hooks, troll hooks and lures, and associated hardware for trol, deep water pelagic and bottom fishing.	
Miscellaneous	Fish weighing scales, block ice crusher, plastic fish handling boxes.	

CHAPTER 4: STUDY OUTLINE

4.1 Outline of Discussions

At the meeting held on Sunday, December 13, 1981, in the presence of Vice-President Alfonso R. Oiterong who chaired the meeting and four concerned officials of the G.R.P., the study team presented an inception report and a four-item written inquiry, discussed various matters, and determined the survey schedule.

During the meeting, the study team asked their Palauan counterparts to identify the order of priority of the thirteen proposed sites with the exception of Koror, but was unable to receive a definite answer. Following this, the study team expalined Japan's economic cooperation system as a grant aid. At another meeting held the following day, the study team worked with the Palauan counterparts to confirm the contents of the request of the Government of the Republic of Palau. The Palauan counterparts made an ardent appeal for a carrier of marine products, a subject of importance which had long been tabled as it seriously affects the interests of the Republic of Palau and the Japanese Government. Both parties exchanged their opinions, and the study team indicated Japanese Government's view that the grant of such carrier and other three items was beyond the sphere of grant aid economic cooperation, to which Palauan counterparts agreed. Following this, the study team requested full support in its survey activities, and the Palauan counterparts agreed.

The study team started in the afternoon of the same day to collect information and data concerning the project, and reconnoitered eight proposed project sites in four days from December 15 (Tuesday) to 18 (Friday).

The survey findings and the results of discussions with the Palauan counterparts were summarized into minutes, which were signed by the head of the study team Ohi and Vice-President Oiterong.

4.2 Minutes

The study team had a series of discussions with the Palauan counterpart from December 13, and at the same time conducted a field survey. According to the results of discussions and survey findings, the head of the study team Ohi and Vice-President Oiterong prepared and signed the minutes covering the following four items on December 22.

(1) Proposed project sites

(2) Purposes and objectives of the project

(3) Materials and supplies to be furnished by the Japanese Government

(4) Duties and responsibilities of the Government of the Republic of Palau

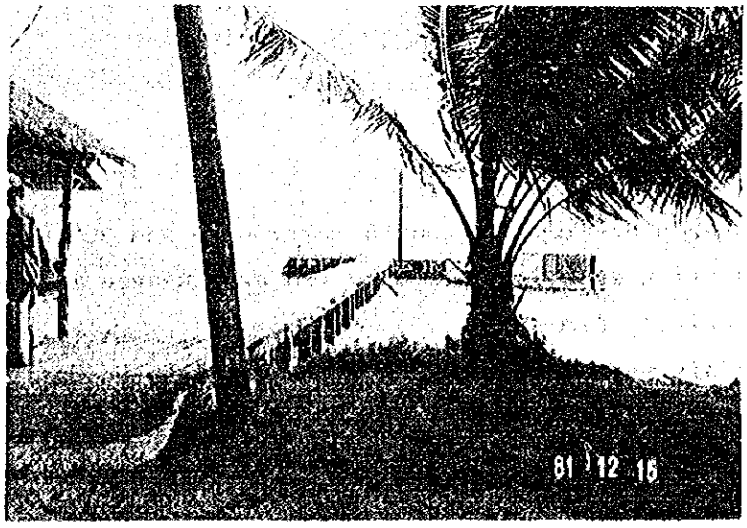
4.3 Field Survey Outline

4.3.1 Ngiwal

Ngiwal has a total population of 460 people including 10 fishermen. The fishing gear used includes spear guns and bottom hand-lines. There are ten vessels, which are not fully used. It is reported that the daily catches amount to approx. 150 lbs. (approx. 68 kg), and that almost all of the catch is consumed in Ngiwal.

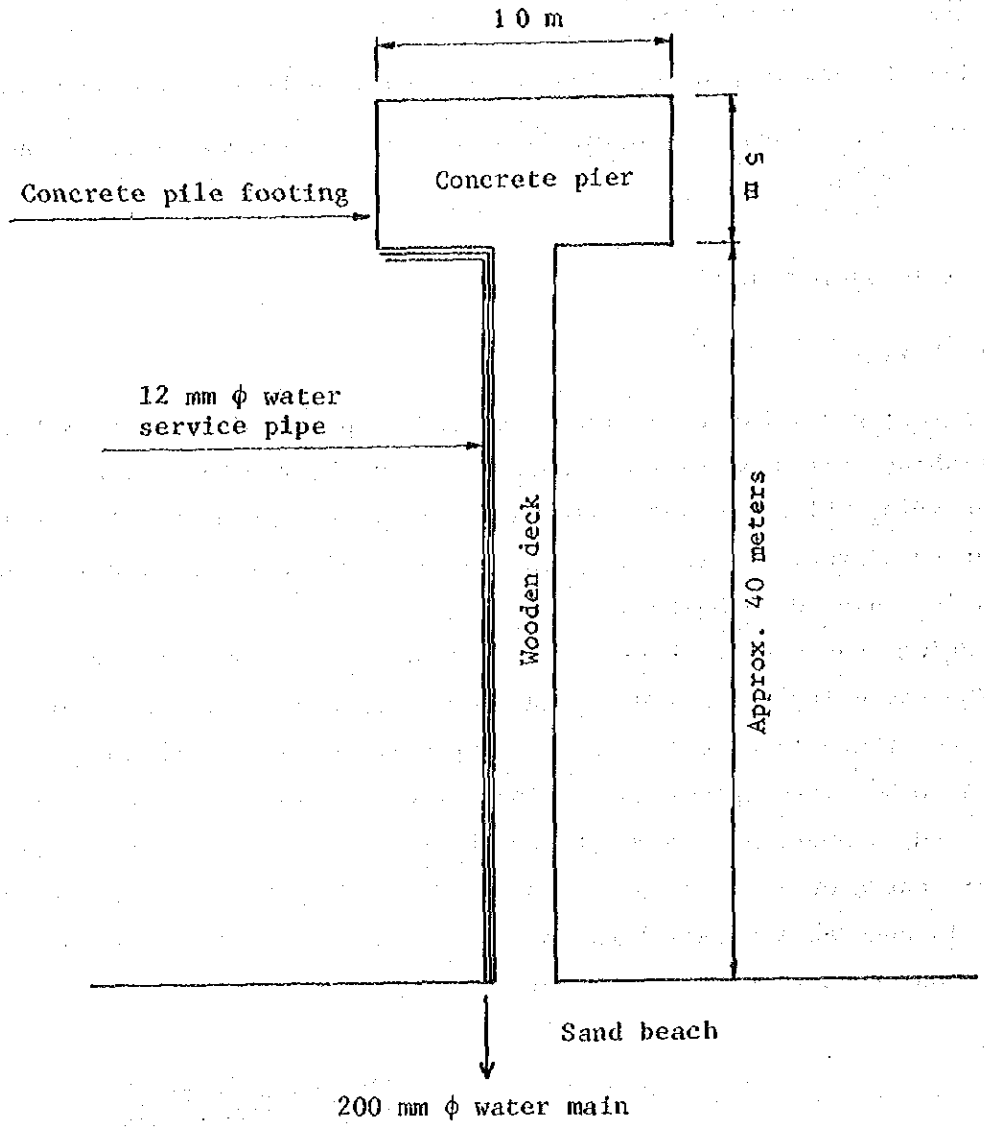
Ngiwal has a pier about 45 meter long as that is illustrated in Fig. 4. The community is formed around the school and church in front of the pier, and there is a small shipbuilding yard for wooden vessels.

A 90 Kw diesel generator is installed for electric power to the community, and is operated and maintained by two operators working in shift. The diesel generator is in service from 6 PM to 10 PM for lighting use only. Water is abundantly available. A 200 mm water pipeline is installed to supply water at sufficient pressure without pump.



Pier at Ngiwal

Fig. 4 Concrete Pier at Ngiwal



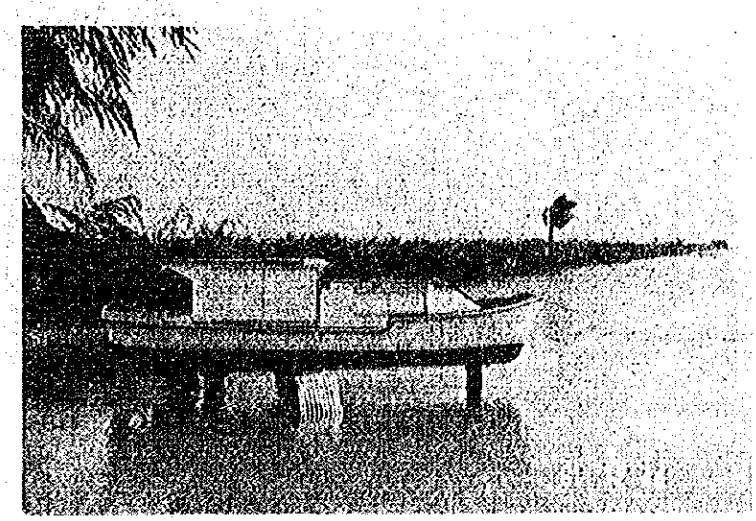
4.3.2 Melekeok

Melekeok has a breakwater about 4 meter wide and 300 meter long. Out of the total population of 440 people only two are engaged in fishing, and the remainder are chiefly farmers.

There are six vessels, and it is reported that the daily catch, about 50 lbs. (23 kg) is consumed privately.

There is one 2.5 Kw diesel generator installed at the school. Home lighting depends solely on kerosene lamps.

Water service is available, but every home is equipped with a rain water tank as the water service pump is not reliable.



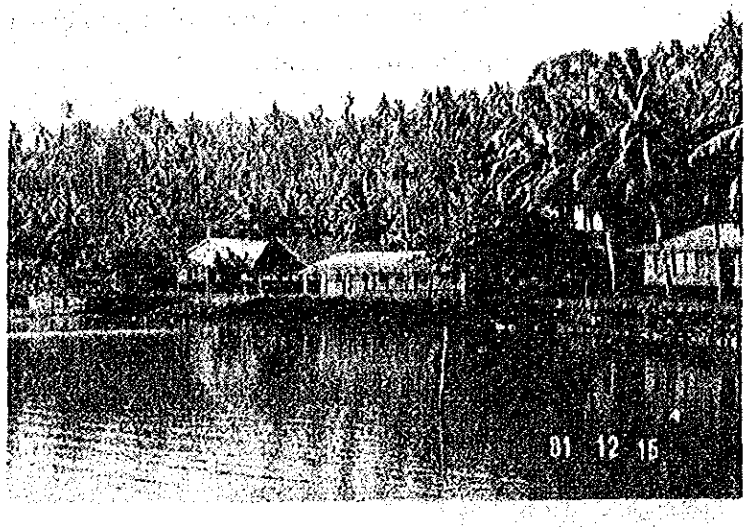
Breakwater at Melekeok

4.3.3 Ngchesar

The population of Ngchesar is 736 people, and 40% live in Koror. There are fifteen vessels, but only ten fishermen. The monthly catches are said to be about 8,000 lbs. (approx. 3,600 kg). One third of the catches is delivered to Koror in the form of dried fish because of the lack of cold storage.

There are two generators; a small-capacity unit for the school and a 10 KVA diesel for the shipbuilding yard.

There is an ample supply of water, free of charge, without the use of pump.



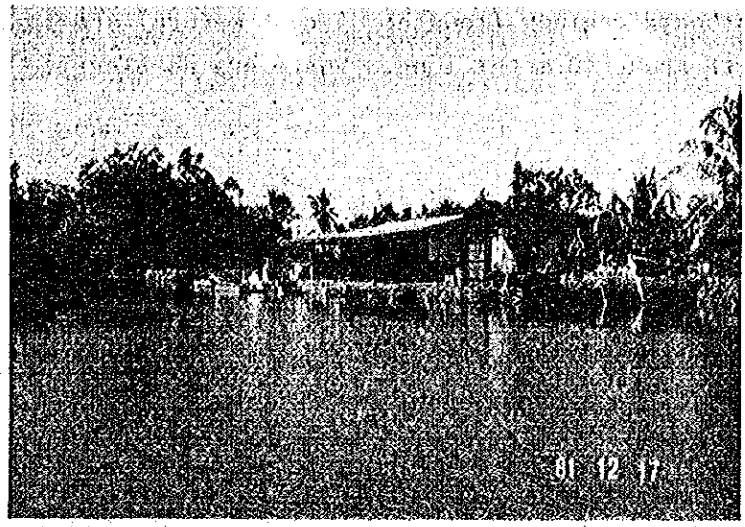
Ngchesar

4.3.4 Ngeremlengui

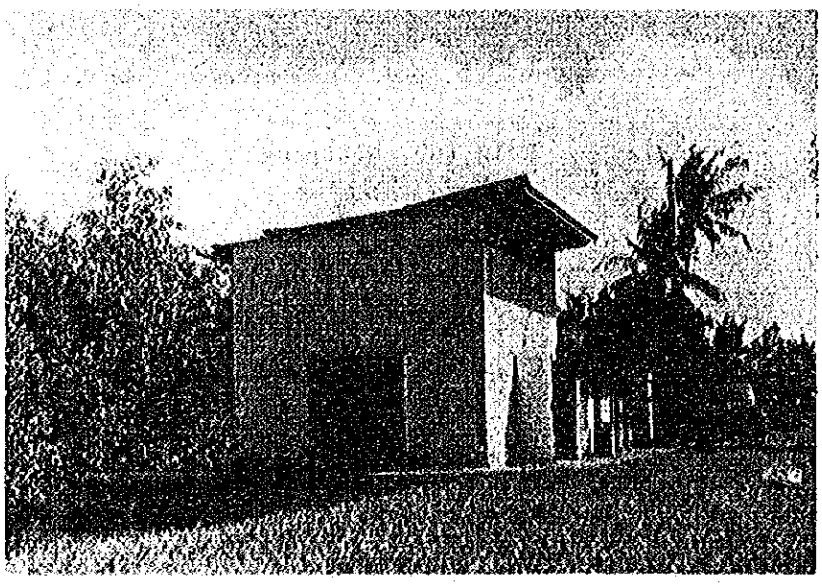
The population of Ngeremlengui is 547 people. There is a fish market with a 10 meter long quay along the creek. Fishing is rather prosperous. The fishing gear used includes spear guns, troll lines, bottom hand-lines, and surround nets.

There are fifteen FRP or wooden motorboats (length: 4 meters; outboard engine: 50 to 75 HP) which are used for fishing as well as ferry service and three wooden carriers (length: 5 to 6 meters; inboard diesel engine: 8 to 30 HP). Although there is no ship repair yard, there are people who can fix minor outboard engine troubles.

There is a 44 Kw diesel generator, which is operated for lighting from 6 PM to 9 PM. Water is pumped from a river in the remote mountainous area to a head tank for gravity feed water supply. Ngeremlengui has an ice-making plant with a daily production capacity of 1 ton, installed under a United States assistance program in 1974, thought it is dilapidated.



Fish market operated by the Ngeremlengui Fishing Cooperative Association

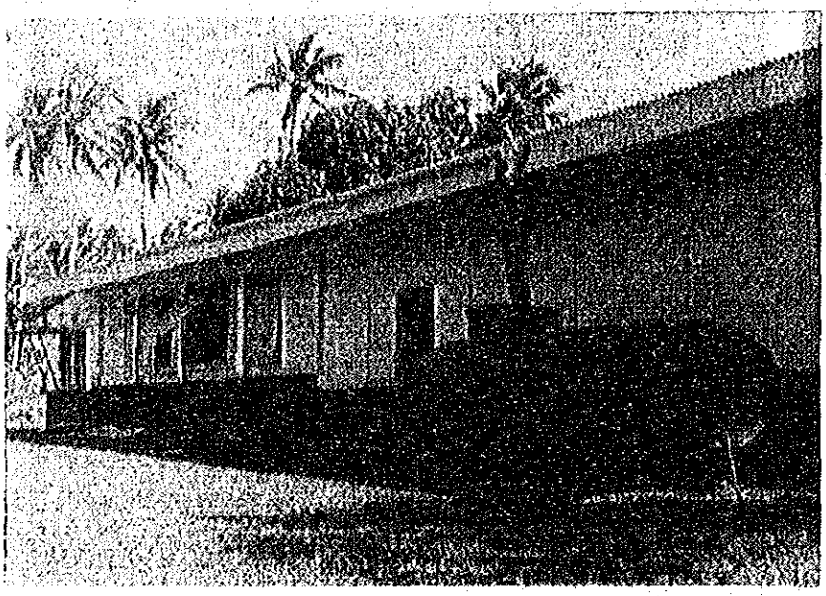


Ice-making plant and generator room, Ngeremlengui

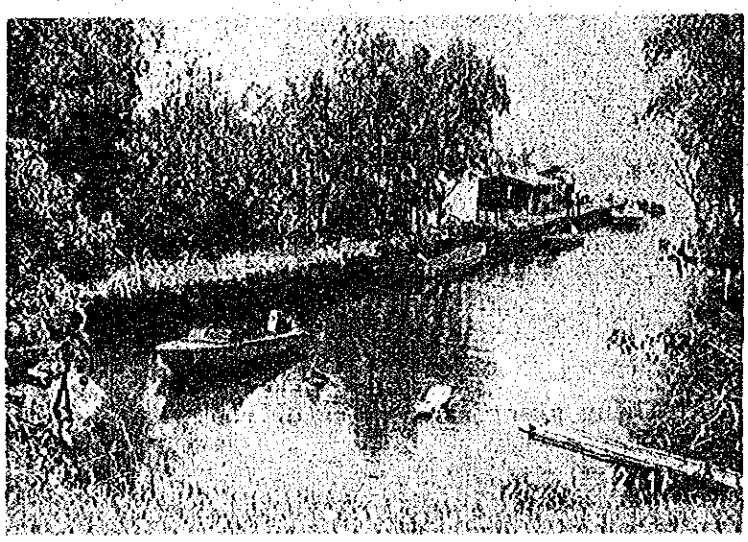
4.3.5 Ngatpang

The population of Ngatpang is 114 people including 8 fishermen. Although Ngatpang is the largest producer of mangrove crabs in Palau, it is mainly supported by agriculture, and the fishing industry is barely functioning.

There are seven vessels, but only three FRP and wooden motorboats with 25 to 50 HP outboard engines (length: 4 to 6 meters) are in commission. There is a berth about 40 meter long. There are no electric and water services.



Rain tub, Ngatpang



Berth, Ngatpang

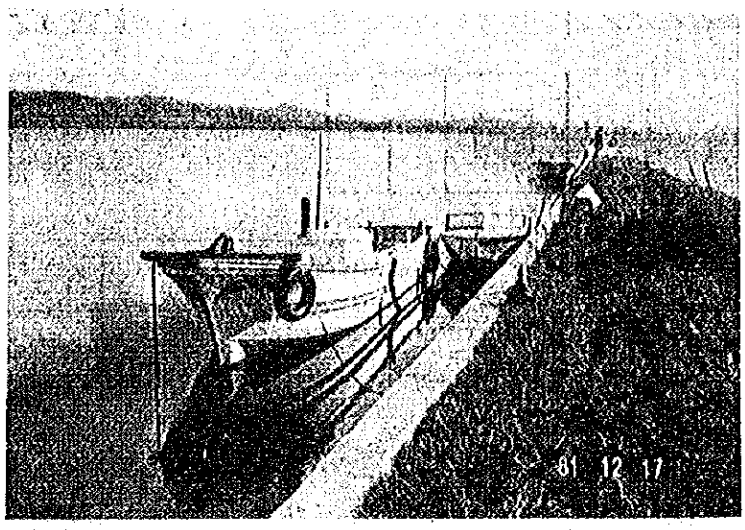
4.3.6 Aimeliik

Aimeliik has a population of 456 people. Eight of which account for the fishing force. The fishing gear used includes surround nets, casting nets, and spear guns. The average daily catch is said to be about 500 lbs. (227 kg).

The fleet consists of some ten motorboats with outboard engines and some twenty fishing vessels with 6 to 27 HP inboard diesel. Of the inboard diesel vessels, one was grant aid under an agreement between Japan, the United States of America, and Micronesia. It was designed as a bait carrier (FRP, 7 meter long, 27 HP main engine) tending skipjack fishing boats, and is said to be operating well in the transportation of fish and ice.

While there is an ample supply of water by gravity flow, only the school and a few limited families have small generators.

There is a breakwater about 300 meter long.



Breakwater, Aimeliik

4.3.7 Peleliu Island

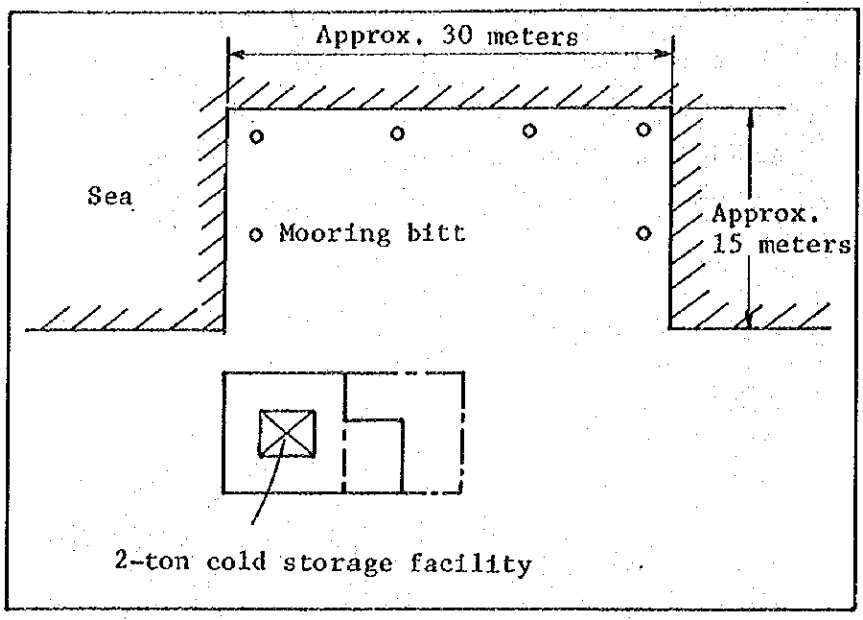
The population of Peleliu Island is 1,014 people. The fishermen number is 56, and belong to the local fishing cooperative association.

Peleliu Island has the largest fishing grounds of all the states, which are considered to be the most promising. There are ten outboard engine fishing boats ranging from 4 HP to 115 HP. The fishing gear used includes surround nets, spear guns, and bottom hand-lines.

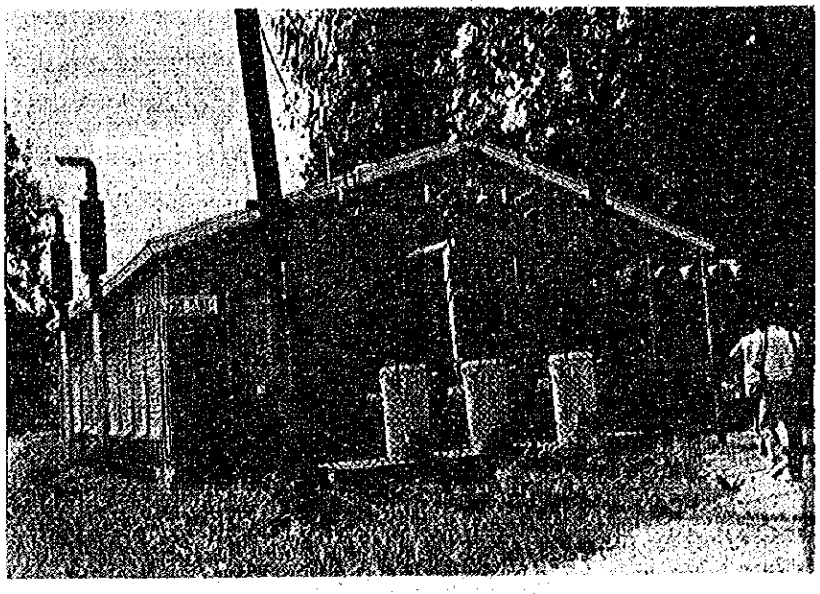
A 100 Kw diesel generator is installed, but rain water was the only source of water because the pump was out of order.

Two wooden boats and one FRP boat are run regularly by the state government to interconnect Peleliu and Koror. The ferry port for these vessels also serve as fishing port. This port is equipped with cold storage facility for about 2 tons. The concrete quay about 30 meter long and 15 meter wide that is installed at Peleliu Port is shown in Fig. 5.

Fig. 5 Peleliu Fishing Port



Cold storage near Peleliu Port



Peleliu Power Plant

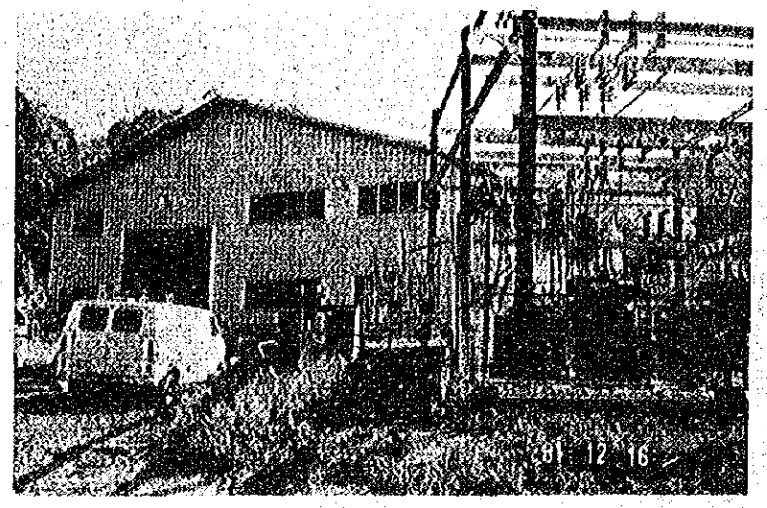
4.4 Infrastructure

4.4.1 Power Supply

There is a Government-operated diesel power paint in Koror. Its specifications are as follows.

Installed capacity	Number of units	Total
1,000 KVA	1	1,000 KVA
950 KVA	2	1,900 KVA
750 KVA	2	1,500 KVA
500 KVA	3	1,500 KVA
Grand total		5,900 KVA

Two were out of order of the eight units. The Palauan Government has a five year power supply development program, and within the next five years a power grid will cover Koror and the peripheral area including Airai and Aimeliik.



Power Plant, Koror

Other sites equipped with comparatively large power plants are Ngiwal (112 KVA), Ngeremlegui (55 KVA), and Peleliu (125 KVA). At the remaining sites, small capacity generators are used only for schools or for private purposes, and are operated only on special occasions.

A uniform tariff of 7 cents/KWH is applied to every site except Koror. In Koror, the rate is set at 6 cents/KWH for up to 2,000 KWH and 7 cents/KWH for over 2,000 KWH.

The generation cost in Koror is 21 cents/KWH, 14 cents/KWH of which is subsidized by the Koror State Government.

At the three sites other than Koror, the electric power service is limited, in principle, to four hours from 6 PM to 10 PM.

When small ice plants or cold storage buildings are to be installed at sites other than Koror, they will have to be installed with independent small capacity generators.

The power supply is rated at 220 V (primary), 60 Hz (three-phase three-wire system). It is stepped down to 110 V by a pole transformer for lighting.

4.4.2 Water Situation

The City of Koror has public waterworks, and drinking water is available in the urban area at the rate of 1.5 dollars per month regardless of actual consumption.

In the central area of the city, most houses are furnished with flush toilets, which are connected to a sewage treatment plant in Malakal via a sewage pipeline.

A service pipeline, more than 100 mm in diameter, has been laid in the eastern part of Baberudaob Island to supply water on a 24 hours basis.

In the Ngiwal and the Ngchesar districts, pressurized water is available without the aid of pumps.

Since Ngatpang in the western part of the island, has no public waterworks, rain water has to be collected via pipelines installed on the school roof and stored in a steel tank of about 20 tons capacity, for use at the public kitchen.

In Ngeremlegui, water is pumped up from a clear mountain stream to a hill top water tank. There the water is filtered and supplied to households as drinking water.

Peleliu Island is also rich in water sources. Water is pumped up to an elevated water tank and distributed to households after being filtered.

In all the districts of the Palau Islands, water supply for drinking and industrial use are furnished fairly well.

4.4.3 Fuel Oil

All kinds of fuel oil are available from Mobil Oil's four oil tanks in Koror at the following prices:

Kind	Price
Diesel oil	$0.34/liter
Kerosene	$0.40/liter
Gasoline	$0.34/liter
Gear oil #90	$8.30/liter
Gear oil #140	$8.00/liter

Table 6 summarizes the results of an analysis of the diesel oil.

Table 6 Diesel Oil Analysis Chart

(Specifications of the fuel oil supplied in Palau by Mobil Singapore)

Test	Limit	Testing method
Acid values mg KOH/g Strong acid value Total acid value	 None Max. 0.25	D974
Ash content Weight %	Max. 0.005	D482
Residual ash 10% Bottom Weight %	Max. 0.2	D524
Cetane number	Min. 53	D975, APP. II
Pour point °F	Max. 50	D97
Copper sheet corrosion 3 hrs, 212°F	No.2 copper sheet or more	FS5313
Distillation (recovery %) 90% recovery, °F (°C)	Max. 698 (370)	
Boiling point °F Specific gravity (API) $(API = \frac{141.5}{\text{Specific gravity}} - 131.5$	Min. 150 Min. 34.0 ∿ Max. 42.0 (0.855 g/cm^3 ∿ 0.816/cm^3) $\text{Specific gravity} = \frac{141.5}{API + 131.5}$	D93 D287
Hue Sulfur content (Weight %)	Max. 3 Max. 1.0	D1,500 D123
Viscosity, Saybolt-Universal seconds 100°F	Min. 33 ∿ Max. 45	D38
Water precipitation by purifier Volume %	Max. 0.05	D1,796

Mobil Oil Terminal

4.4.4 Repair Facilities

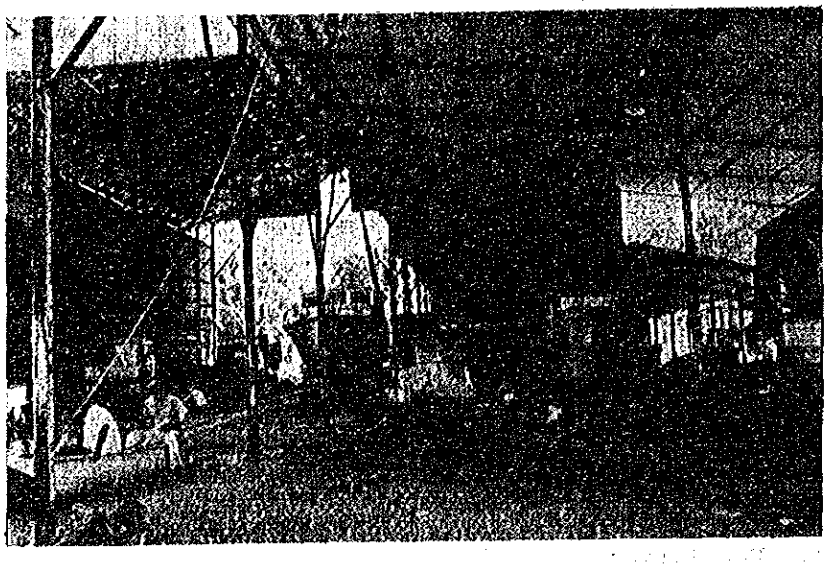
There are repair facilities for ships and engines in the center of the City of Koror. Although some shipyards for wooden boats are located in the regional districts, they are generally small and have almost no mechanical repair equipments, and lag far behind the facilities in the City of Koror in terms of technological sophistication. The primary repair facilities in the City of Koror are summarized in the following paragraphs.

(1) Micronesia Boatbuilding & Drydocking Corporation

This government-managed shipyard builds only wooden boats and repairs wooden steel and FRP boats. It is installed with two slipways of different sizes. The larger slipway is about 66 meters in length and capable of lifting up to 90 tons, while the smaller one is capable of lifting up to about 10 tons. Diesel-driven winches are provided for lifting purposes.

The shipyard employs nine people: seven carpenters and two welders.

This shipyard's mechanical facilities include lathes, drilling machines, electric welders, universal tool grinders that permit servicing of small diesel engines.



Micronesian Boatbuilding & Drydocking Corp.

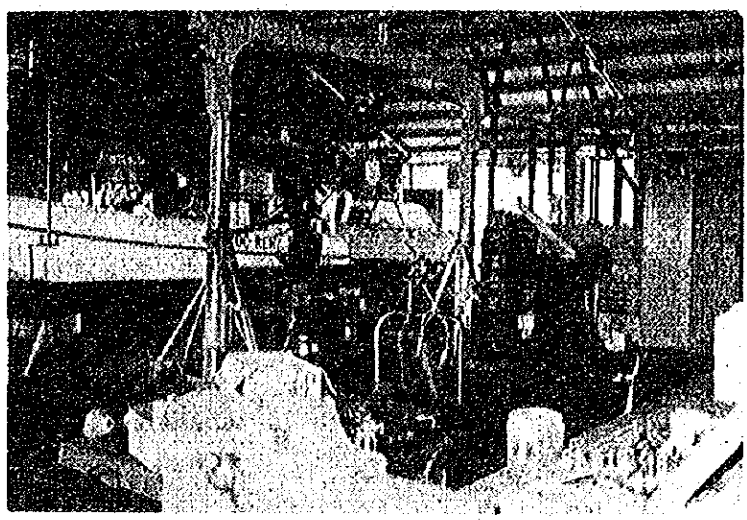
(2) Public Works

Public Works is a government-managed repair plant consisting of a main factory and an M-Dock branch. The main factory is divided into a refrigerater shop for servicing of household refrigerators, but not large refrigerating machines, and the other is a piping shop.

The M-Dock branch is separated into a boat repair shop, a heavy machinery repair shop, an auto repair shop, a chassis repair shop, and a machine shop, each staffed by about 10 employees.

The boat repair shop has a motor driven hoist, in place of a slipway, for hoisting small motorboats above the quay. It can service, FRP boats, outboard motors, and diesel engines.

The machine shop is equipped with two lathes, one grinder, five drilling machines, gas cutters, and electric welders.



Public Works M-Dock branch

(3) Abby's Marine

Abby's Marine, a private enterprise in the location adjacent to PFFA is very convenient in services to fishing boats. It is equipped with a 10 meter long slipway, but the lack of a railway or winch makes it a laborious job to lift boats for repair. Boats up to five tons can be lifted. It is capable of servicing outboard motors, diesel engines, and wooden boats, but not FRP boats.

The Micronesia Boatbuilding & Drydocking Corporation is best-equipped with berth facilities and Public Works has mechanical repair facilities.

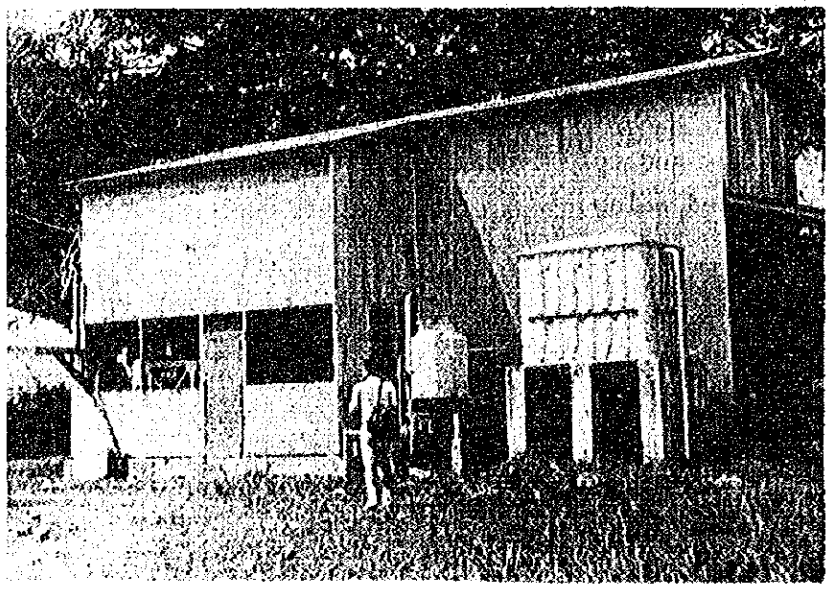
4.4.5 Ice-making and Cold Storage Facilities

The ice-making and cold storage facilities available in the City of Koror are summarized below.

Name	Ice-making capacity (tons/day)		Ice-storing capacity (tons)		Freezing capacity (tons)	Cold storage capacity (tons)
	Cube ice	Flake ice	Cube ice	Flake ice		
PFFA		6		12	20 (*1)	30 Under construction 250
Yoshida Enterprise	5		(PFFA's cold storages are used to store ice.)			
Van Camp	100				100 (*2)	2,000
Neco						30
Ngirutang Oib						300
Palau Modekngei Cooperative Association						15
Total	105	6		12	120	2,625

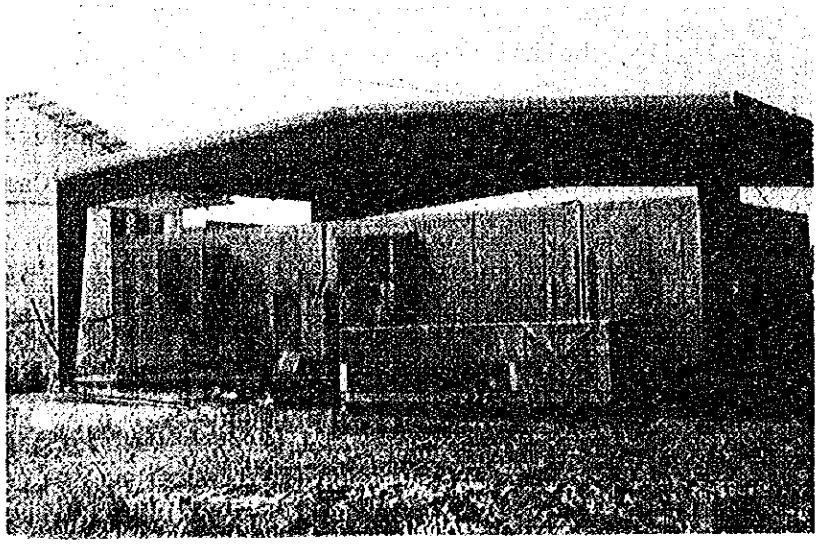
(*1) Semi-air blasting system.

(*2) Brine system.



Yoshida Enterprise's 5 tons per day ice making machine

Ice stored in a cold storage

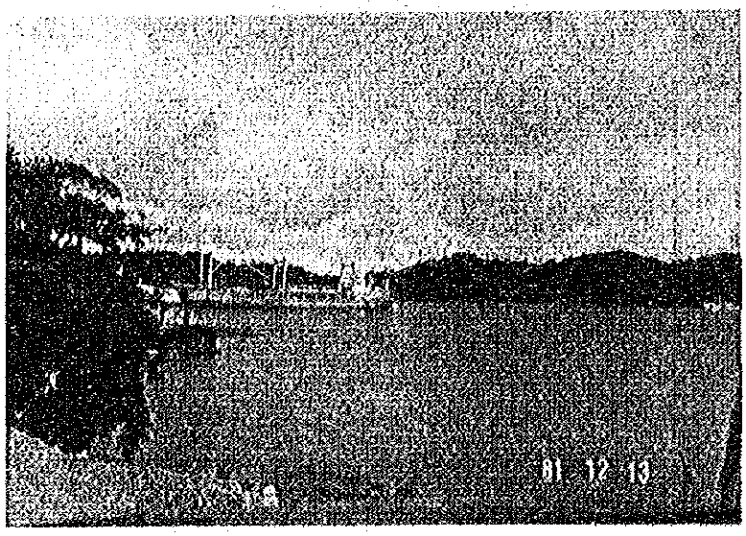


PFFA's 30 tons cold storage

4.4.6 Harbor Facilities

Representative quays in the City of Koror are: the Malakal Commercial Quay, the Van Camp Quay, the PFFA Landing Quay, the T-Dock, and the M-Dock.

The Malakal Commercial Quay is the nation's largest and only commercial quay with a length of about 400 meters. It can accommodate up to three vessels with overall lengths of 121 meters and draft up to 9.1 meters. While it is possible to supply diesel oil or pure water at this quay, no cargo-handling equipment, such as cranes, is available.

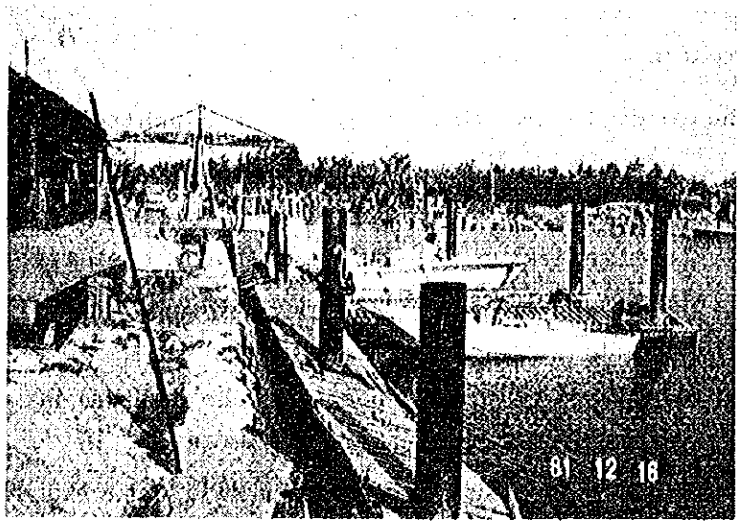


Malkal Commercial Quay

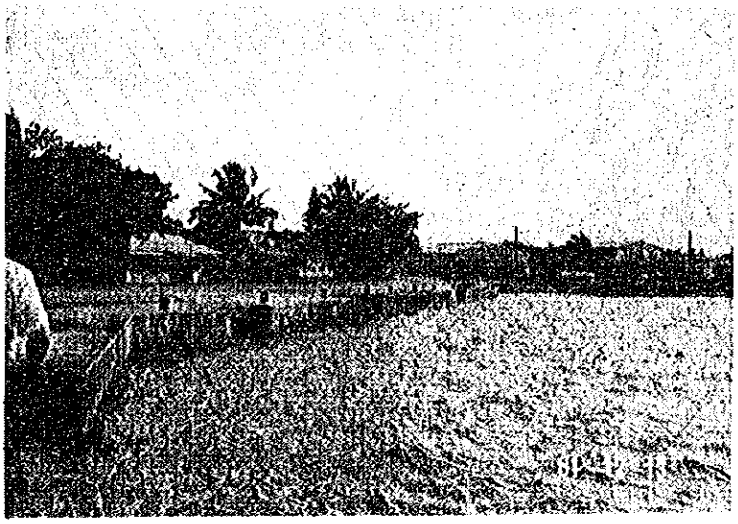
The Van Camp Quay is located adjacent to the Malakal Commercial Quay and has a length of about 200 meters. It is available to Van Camp vessels only.

The PFFA Landing Quay is also situated on Malakal Island, and its length is about 100 meters. It is Koror's only quay available for landing fish catches. After landing fish, fishing boats are supplied with ice, oil, fishing gear, etc. by PFFA. As explained in Subsection 5.4.5, this quay is furnished with ice-making facilities and cold storages.

The T-Dock in the north and the M-Dock in the south of Koror Island, have a quay length of about 150 meters each. The quays, however, cannot accommodate larger vessels because of the limitations of their shape, water depths, and waterways, and are chiefly used for receiving/dispatching carriers to and from various parts of the nation and for receiving/dispatching and mooring motorboats for the City of Koror.



M-Dock



T-Dock

Apart from Koror, there is a 30 meter long quay on Peleliu Island capable of accommodating vessels up to 30 tons.

Breakwaters built during the days of the Japanese administration are found in various parts of Baberudaob Island. Measuring 100-300 meters in length and about 4 meters in width, these breakwaters not only help to shield strong northeastern winds and associated ocean waves prevailing from December to April, each year, but also serve as a harbor for smaller vessels.

4.4.7 Road Situation

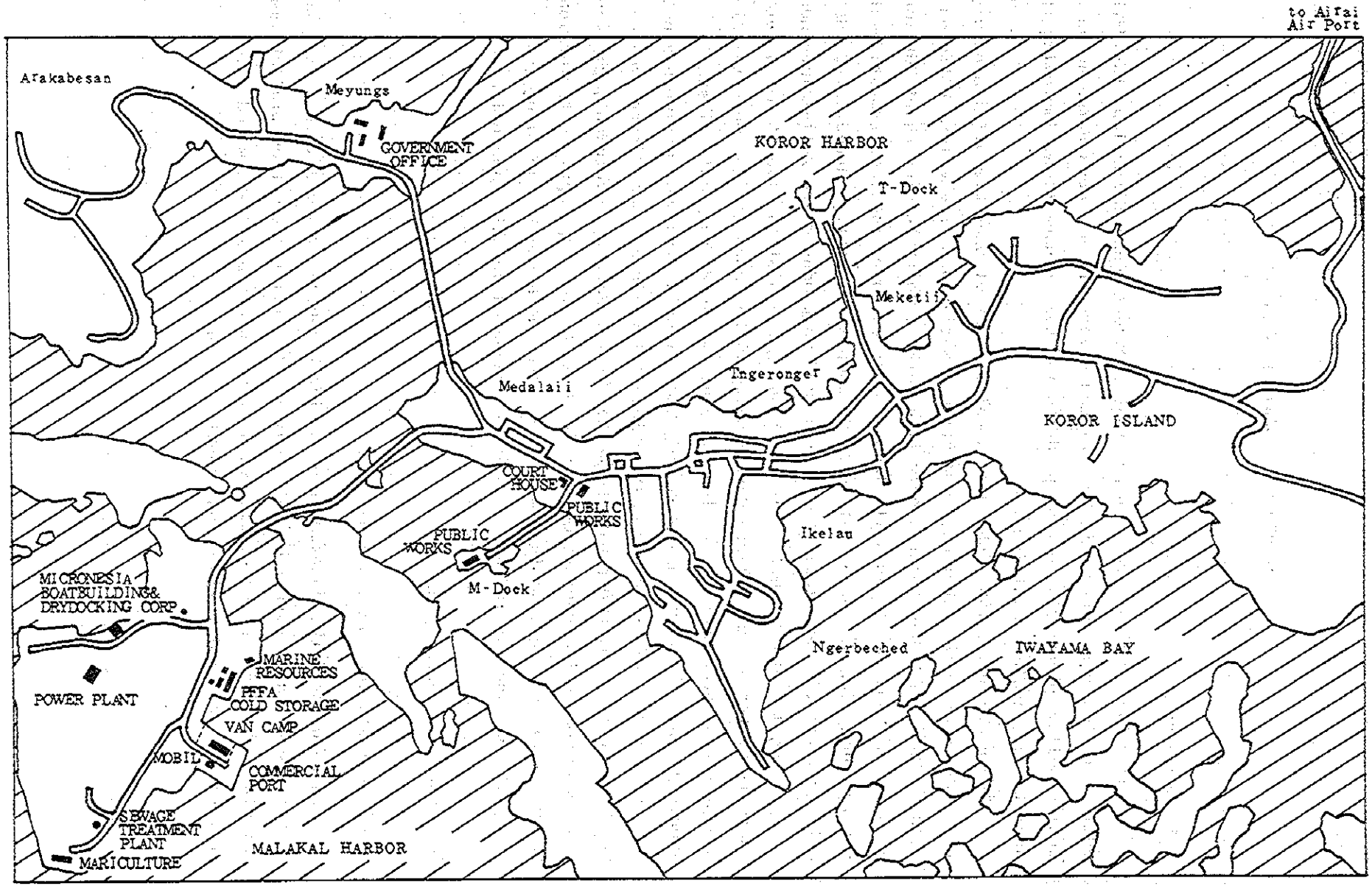
Most of the roads in the City of Koror are aspahlt-surfaced for auto traffic.

The Koror City Authority's master plan calls for a connecting road linking the city to Aimeliik to be completed in the next five years. At Airai Airport, both a road and a bridge have been opened, but some parts still need, to be paved.

Road development, however, is expected to be delayed because of shortage of construction machinery and technicians.

In other districts of Baberudaob Island, road networks are underdeveloped because the villages are concentrated along the coast lines and there is little exhange among districts. Boats are the only means of transportation among the districts.

Fig. 6 Principal Facilities in City of Koror



CHAPTER 5: BASIC DESIGN

5.1 Basic Plan

Under the Fishery Promotion Act that provides basic directions for fishery administration and management, the Palauan Government has been pursuing an active policy of securing marine products for home consumption, improving their quality and physical distribution.

There are about 450 fishermen in Palau, most of whom are affiliated with the PFFA-supervised fisheries cooperative associations in the four different areas. While PFFA has Palau's only fish market, which handles about 200 tons of catches annually, it is still insufficient to cover the requirements of the entire population of approximately 7,000 people in Koror. Furthermore, not all the facilities available for storing marine products are well-maintained.

The equipments and materials for fishing and distribution of marine products requested by the Palauan Government will be essential not only in solving the problems noted above, but also in assuring the Palau people of stable supply of animal protein and promoting the nation's export of marine products.

As a result of its close examination of the adequacy and effectiveness of the materials and equipments requested by the Palauan Government, the study team has come to the conclusion that it would be most appropriate to furnish the materials and equipments named herein from both short- and long-range perspectives, and carried out a basic design based on this conclusion.

5.2 Contents of the Plan

5.2.1 Calculation for Basic Design

On each state the assessment of marine resources was made, then exploitable resources as a target of this small-scale fishery promotion project was calculated by reducing quantities of self-consumption and estimated sales from the ascertained maximum sustainable yields.

(Unit: tons)

	Fishing ground area (within reefs and up to 3 nautical miles outside reefs)	Maximum sustainable yield	Self-consumption	Estimated sales	Exploitable resources
Kayangel	206 km^2	36	10	8	18
Ngaradmau	84 "	67	11	17	39
Aimeliik	130 "	125	18	32	75
Ngarard	192 "	110	32	25	53
Ngiwal	53 "	20	19	1	0
Ngeremlegui	80 "	55	25	9	21
Melekeok	48 "	11	10	1	0
Ngchesar	80 "	49	25	7	17
Ngerchelong	285 "	149	26	41	82
Airai	109 "	68	47	6	15
Peleliu	328 "	176	43	40	93
Ngatpang	50 "	40	11	9	20
Total		906	277	196	433

In order to ascertain maximum sustainable yield in each state fishing area of each state is divided to the area within reef line and the area outside reef line but within three miles. The former area is fishing ground for demersal and small pelagic fish and the latter is fishing ground for large pelagic fish such as skipjack and tuna.

Accordingly, any fishing ground within the reef line was assumed to have maximum sustainable yield of one ton per square kilometer for demersal fish and of 300 kg for smaller pelagic fish, and any fishing ground outside the reef line was estimated to have maximum sustainable yield of 50 kg per square kilometer for larger pelagic fish. Maximum sustainable yield of each state were ascertained as the sum of these aggregation calculated in the above.

The maximum sustainable yields per square kilometer have been determined on the basis of similar studies conducted in Caribbean Sea, Tonga, Solomon, the Philippines, and Indonesia.

5.2.2 Small Fishing Boats

The small diesel-powered fishing boat will operate chiefly as a troller bottom long-liner, or tuna long-liner in the regions outside the reef line.

In view of the absence of any kind of fishing gear on existing fishing boats, the choice was made only to a long-liner outrigger and a manual boist avoiding to recommend too-sophiscated fishing gears. The horse power of main engine was recommended about 50 HP in consideration of technical level of operation, repair and economy. The draft of boats was recommended to be minimum enough to enable navigation in the shallow water within the lagoon. As the boat may engage as a carrier, its fish hold capacity to be maximized, and a deck house to be installed for sea worthy for long navigation.

As for a small fishing boat with an outboard engine, a Japanese type wooden fishing boat was selected, which was ideal for trolling, bottom long-lining, in the outside of the reef line and for surround netting within the lagoon. Only bottom long-lining fishing gear was recommended to be installed in this boat, because of the small size of the boat, but still it would provide far superior fishing performance compared to the speed boat type fishing vessels now in use. Considering economy, the outboard motor was determined about 25 HP, which would be adequate for any fishing.

The number and model of fishing boats to be furnished was determined for each state on the basis of the following methods:

Method 1: The assumption was made that the expected annual catch per boat would be 30 tons for diesel-inboard fishing boats and 20 tons for outboard motor fishing boats. Then, the number of fishing boats required in each state was determined to meet the exploitable resources in the state by multiplication of these tonnages and number of fishing boats. Also, small diesel-powered fishing boats were allocated to those states having good fishing grounds outside the reef line.

Method 2: Considering the function as carriers, small diesel-inboard fishing boats, which would be better for long navigation, were allocated to the states in far distance from the City of Koror, and the small outboard engine fishing boats were allocated to the states nearer to Koror, as navigation would take a short time in the calm sea.

5.2.3 Ice making and Cold Storage Facilities

The geographical distribution of ice-making and cold storage facilities were decided according to the exploitable resources, geographical conditions,

power and water supply, and availability of technicians in each state.

(1) Prefabricated cold storage

Table 7 indicates the quantities of storage requirements by state, which was calculated by first determining the quantity of storage requirements per day from the exploitable resources by state and by multiplying it by five, i.e. the number of days for which the products were to be stored before being shipped to Koror.

According to the table, five states have five-day storage requirements almost equaling or exceeding 2,000 kg, while all other states have storage requirements of about 1,000 kg, at most. It is expected that cold storage could be economically operated only if certain levels of products for cold storage must be available in order to reduce running costs, and other factors.

From this consideration, the five districts of Ngardmau, Aimeliik, Ngarard, Ngerchelong, and Peleliu were selected as proposed sites for installing cold storages.

Table 7 Storage Requirements

(Unit: kg)

District	Annual exploitable resources	Storage requirements
Kayangel	18,000	900
Ngardmau	39,000	1,950
Aimeliik	75,000	3,250
Ngarard	53,000	2,650
Ngiwal	0	0
Ngremlengui	21,000	1,050
Melekeok	0	0
Ngchesar	17,000	850
Ngerchelong	82,000	4,100
Airai	15,000	750
Peleliu	93,000	4,650
Ngatpang	20,000	1,000

The anticipated maximum storage capacity is 4.65 tons as shown in Table 7. Assuming that each cold storage is to be operated at a 65% capacity utilization rate, its nominal storage capacity is 4.65 divided by 0.65, or 7.15 tons. The refrigerator's optimal external dimensions should be 3.6 meters by 2.7 meters by 2.4 meters (when rated at a nominal 7.5 ton capacity).

(2) Block ice making facilities

In Palau, consumption ratio of fish and ice was estimated one to three. From this ratio, it is estimated that a fish catch of 433 tons will require ice of three times of 433 tons, or approximately 1,300 tons.

Allowing for an additional 700 tons to be supplied to the foreign boats that PFFA represents as agent, approximately 2,000 tons of ice needs to be produced annually.

Assuming that block ice making facilities are to be operated for 250 days per year at an average capacity utilization rate of 60%, they need to have a per-day ice making capacity of 13.34 tons, which is calculated by dividing 2,000 tons by (250 days x 60%), or 15 tons per day.

(3) Flake ice making machines

The purpose of a flake ice making machine is to fill shortages of ice which may happen in times of high fishing season and also from geographical conditions. From this consideration, Ngiwal and Ngremlengui were selected as proposed sites for installing flake ice making machines, as both places are located almost halfway between the eastern and the western part of Baberudaob Island, with abundant water supply, and favourable condition of building and landing quay.

Size of these ice making machines were decided to be enough to meet the necessarily minimum requirement, since it would be unlikely to provide large amounts of ice over continuous periods.

If the estimated catch in the high fishing season was about 1.5 times of a regular fishing season, an increase of catch would be about 500 kg each than the present catch level for both the east and the west coast. Since consumption ratio of fish and ice is estimated one to two (no allowance necessary for ice consumption during transportation from Koror), the required ice making capacity was determined at 1 ton per day.

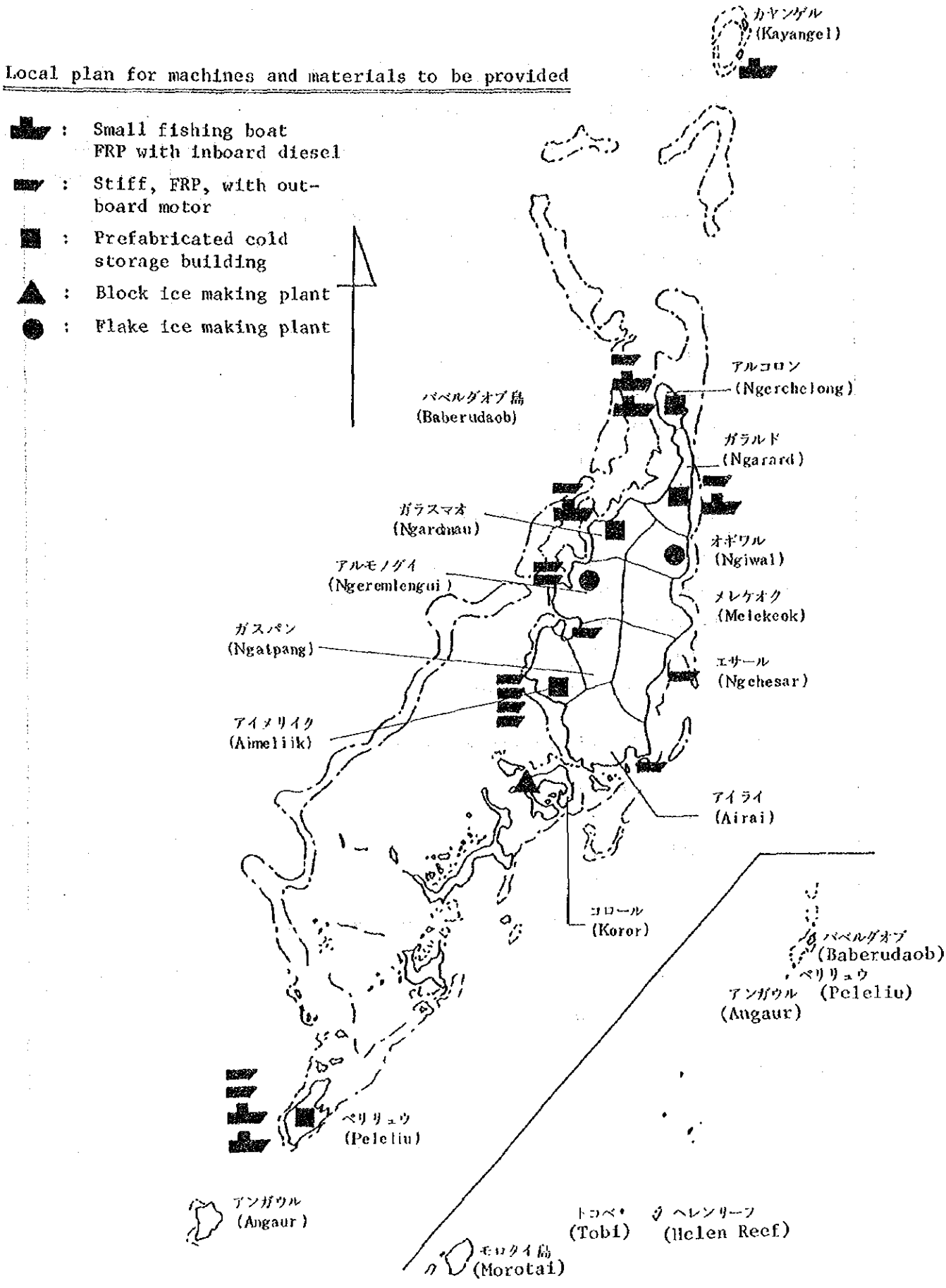
(4) Insulated fish box

Insulated fish boxes will be essential to cover the deficiency of existing cold storage facilities, and also as containers for transportation of catches to Koror. They will not require any technical difficulty. For operational use, the insulated fish box which could contain approximately 160 liters (with contents weighing about 100 kg) was recommended. The number of insulated fish boxes to be furnished was calculated for each state enough to contain 4 days of catches from the exploitable quantity of resources by state.

5.2.4 Regional Plan of Machines and Materials to be Provided

	Small fishing boat FRP with inboard diesel	Skiff, FRP, with outboard engine	Prefabricated cold storage building	Insulated fish box	Block ice plant	Flake ice plant	Diesel engine generator	Refrigerated van	Block ice crusher
Kayangel	1			4					
Ngardmau	1	1	1	8			1		
Aimeliik		4	1	15			1		
Ngarard	1	1	1	11			1		
Ngiwal				3		1	1		
Ngeremlengui		2		5		1	1		
Melekeok				3					
Ngchesar		1		4					
Ngerchelong	2	1	1	18			1		
Airai		1		4					
Peleliu	2	2	1	20			1		
Koror					1			1	1
Ngatpang		1		5					
Total	7	14	5	100	1	2	7	1	1

Local plan for machines and materials to be provided



5.2.5 List of Machines and Materials to be Provided

(All dimensional data is approximate.)

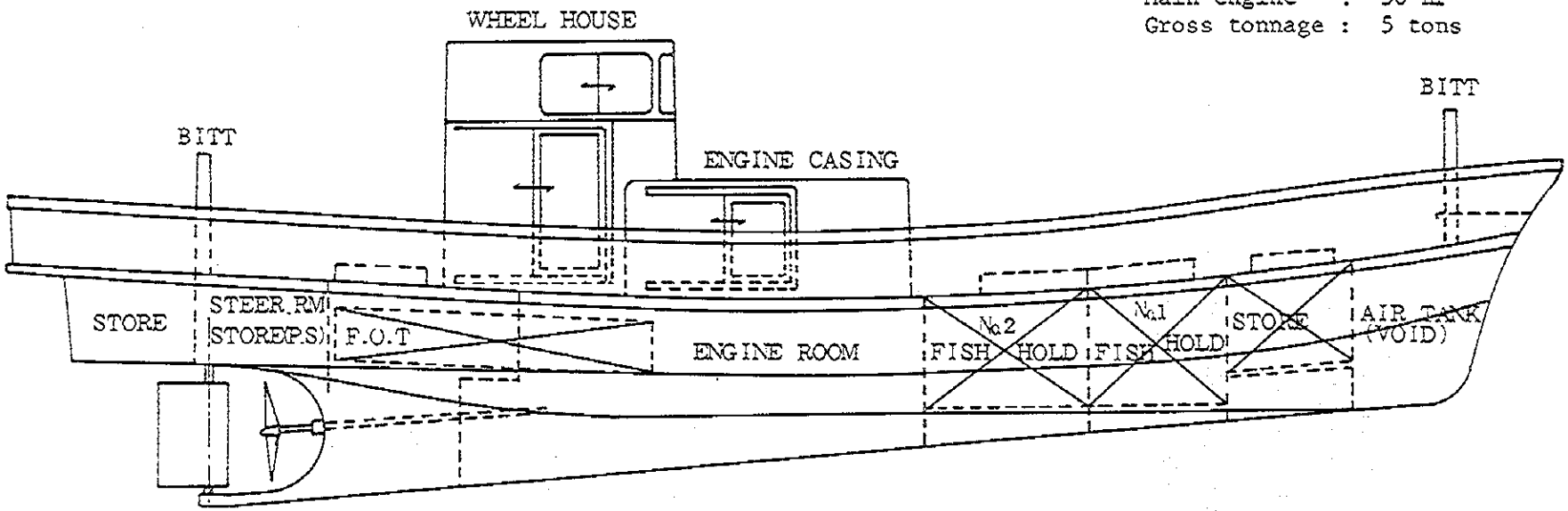
No.	Item	Quantity
1.	Small sized fishing boat, FRP, with inboard diesel Overall length: 11.8 m Width: 3.3 m Depth: 1.6 m Main engine: 50 horsepower Gross tonnage: 5 tons Fish hold: 4 m^3 Fuel tank: 1.3 m^3	7
2.	Skiff, FRP, with outboard motor Overall length: 5.8 m Width: 1.6 m Depth: 0.6 m Motor: 25 horsepower Gross tonnage: 1.3 tons	14
3.	Prefabricated cold storage building Width: 3.6 m Length: 2.7 m Height: 2.4 m Capacity: 4 tons Room temperature of the storage building: -5°C	5
4.	Insulated fish box, FRP Capacity: 160 liters	100
5.	Block ice plant Capacity: 15 tons per day	1

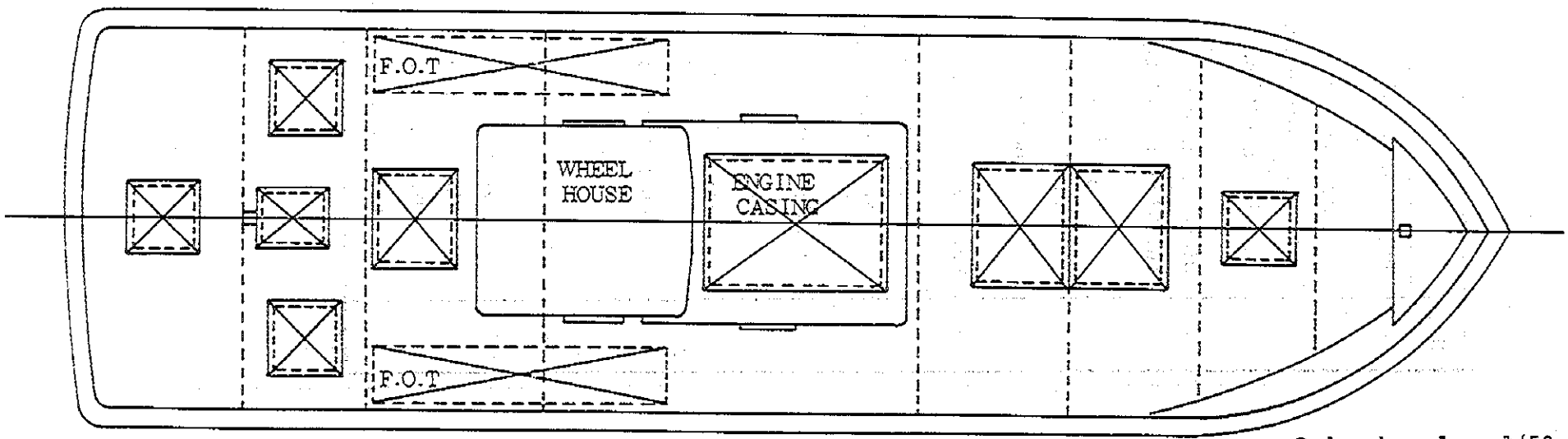
No.	Item	Quantity
6.	Flake ice plant Ice making capacity: 1 ton per day Ice storage capacity: 2.6 m^3 Rfrigerating machine: 2.2 Kw	2
7.	Diesel engine generator (for prefabricated cold storage building and flake ice making plant use) Capacity: 12 Kw Voltage: 220 V Frequency: 60 Hz	7
8.	Refrigerated van Capacity: 4 tons Refrigerating machine attached	1
9.	Fishing gear Surround net Troll lines (includes fish hooks, hydroplane, hand operated winch) Long lines for tuna Misc.	1 set
10.	Others	
	Platform scale Large size	8
	Platform scale Medium size	5
	Block ice crusher	1
	Plastic fish handling box	150

5.3 Basic Design Drawing (All data is approximate)

Small fishing boat, FRP, with inboard diesel

Overall length: 11.8 m
Width : 3.3 m
Depth : 1.6 m
Main engine : 50 HP
Gross tonnage : 5 tons

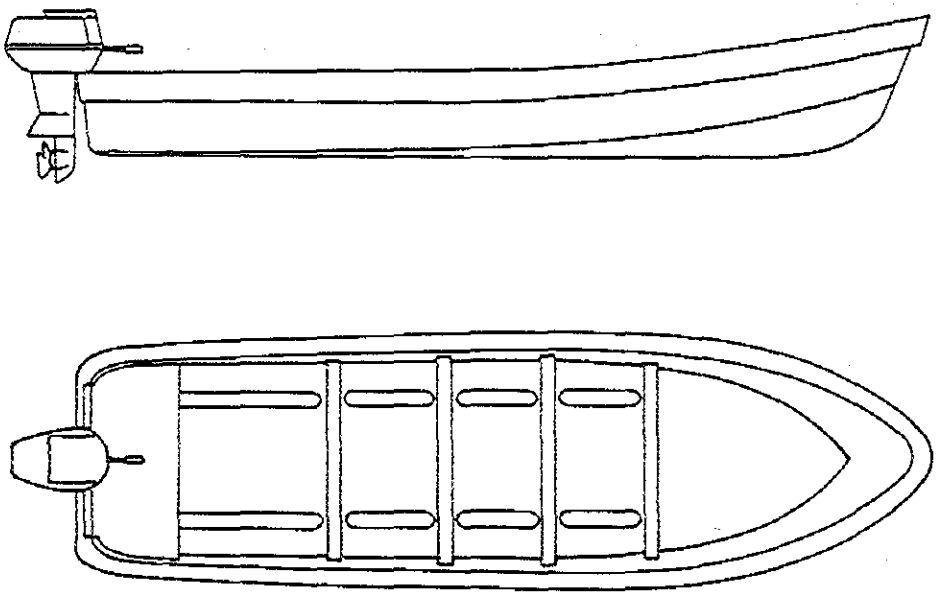




Reduced scale: 1/50

Small fishing boat, FRP, with outboard motor

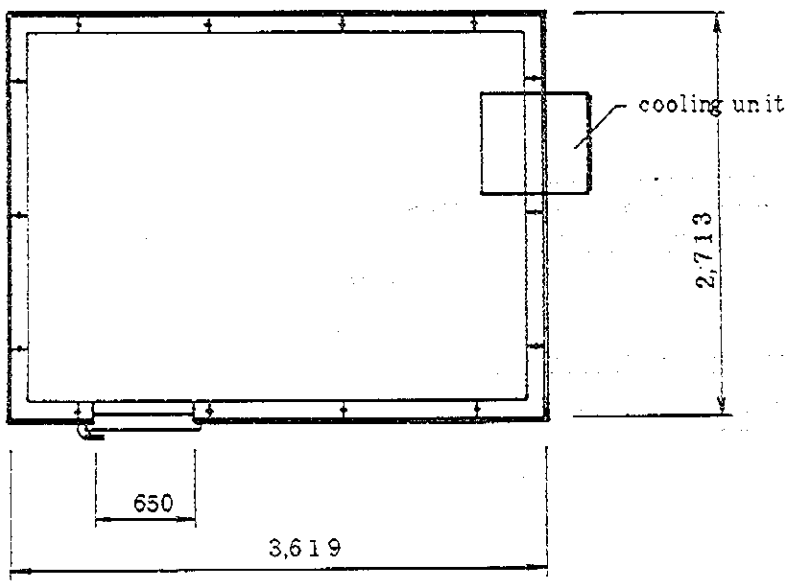
Overall length: 5.8 m
Width : 1.6 m
Depth : 0.6 m
Motor : 25 HP
Gross tonnage : 1.3 tons



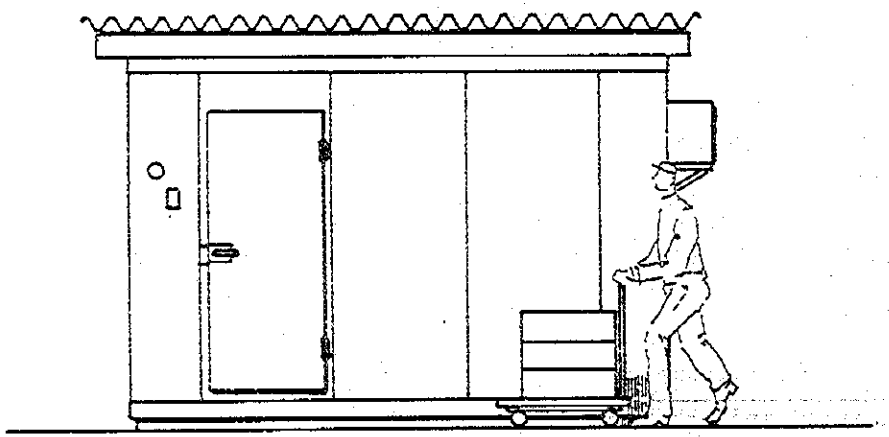
Reduced scale: 1/50

Prefabricated cold storage building

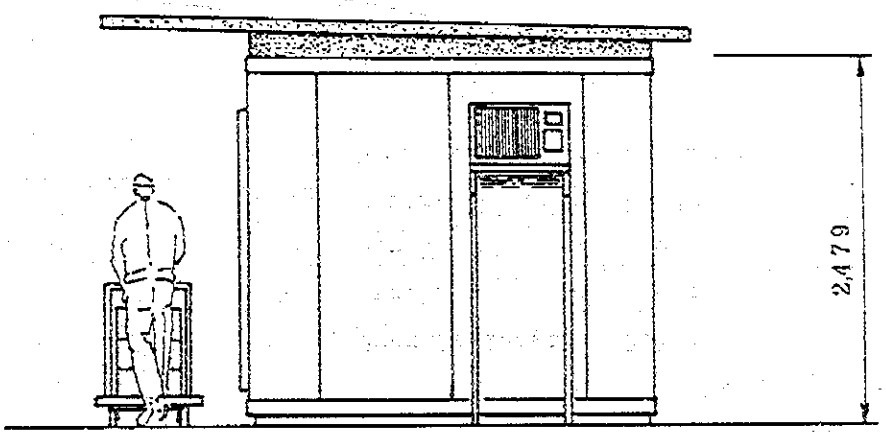
(Unit: mm)



PLAN S 1:50



FRONT VIEW S 1:50



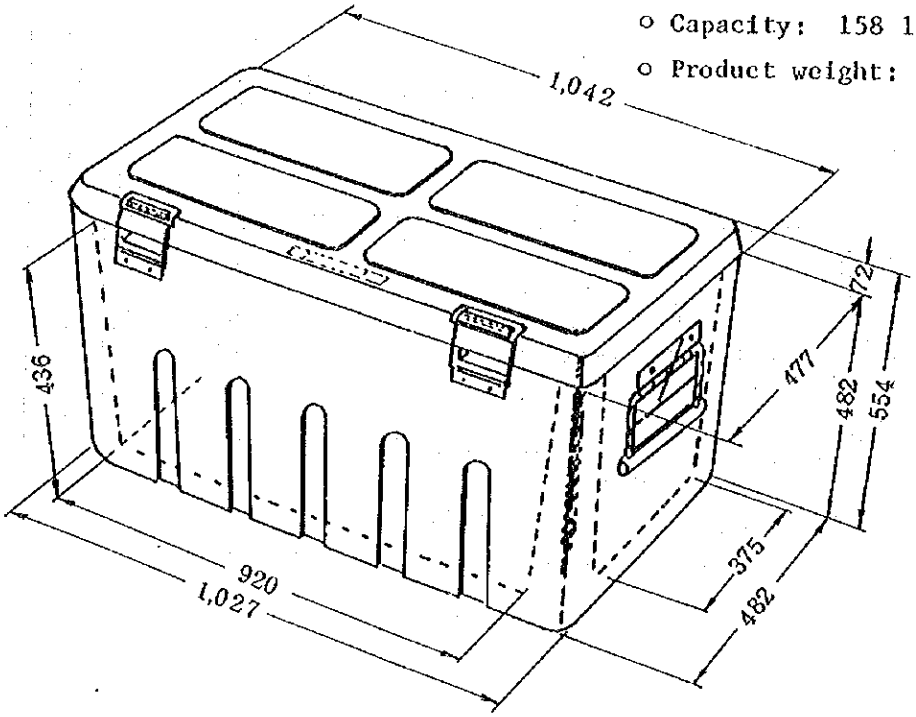
SIDE VIEW S 1:50

Insulated fish box

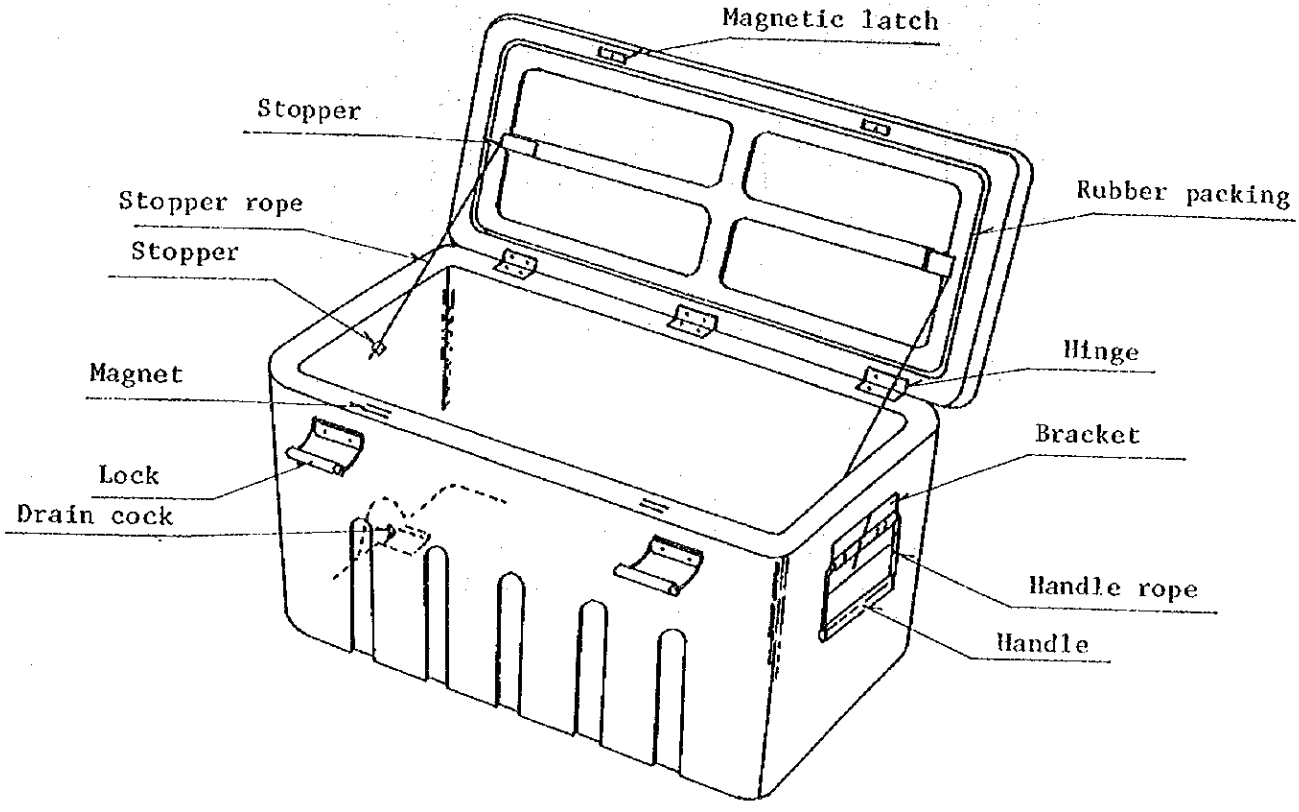
(Complete assemble drawing)

(Unit: mm)

- Capacity: 158 liters
- Product weight: 21 kg

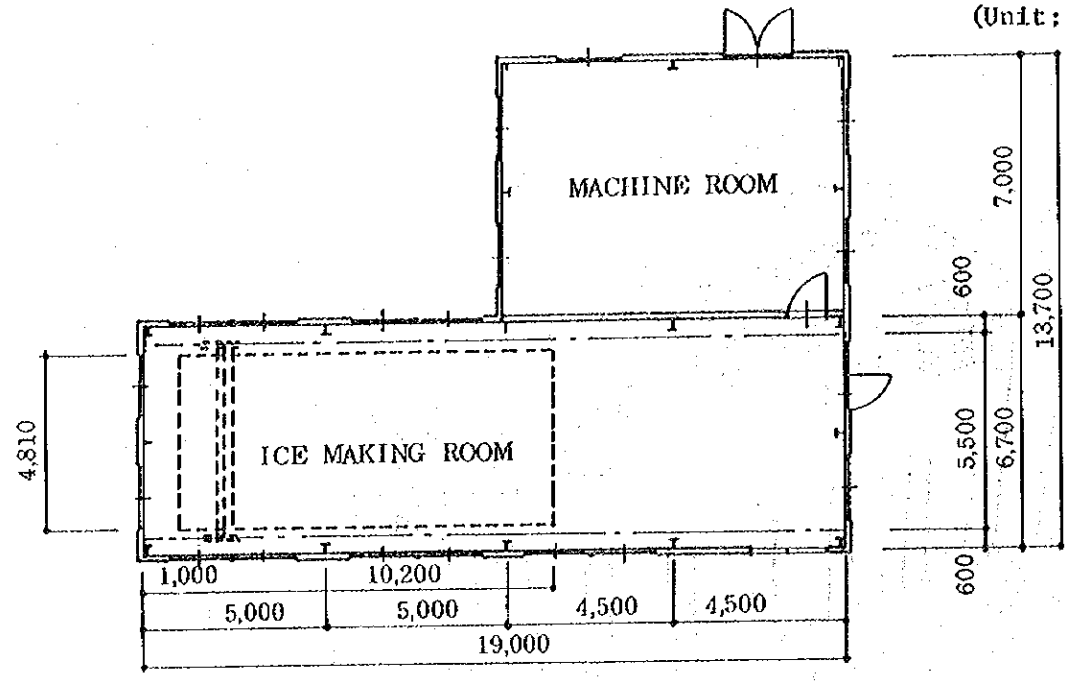


(Assemble drawing)

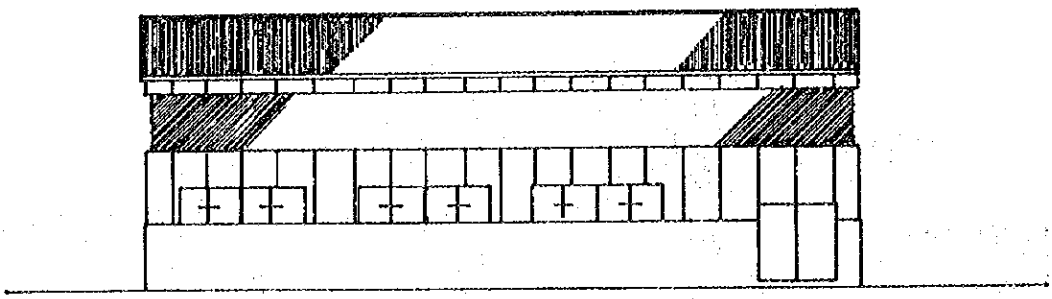


Block ice making plant

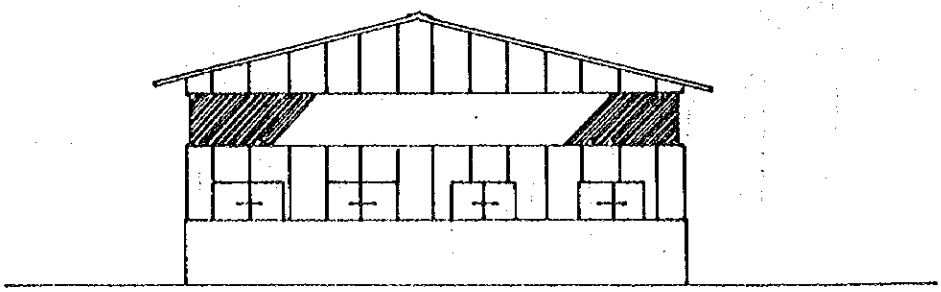
(Unit: mm)



PLAN 1:200



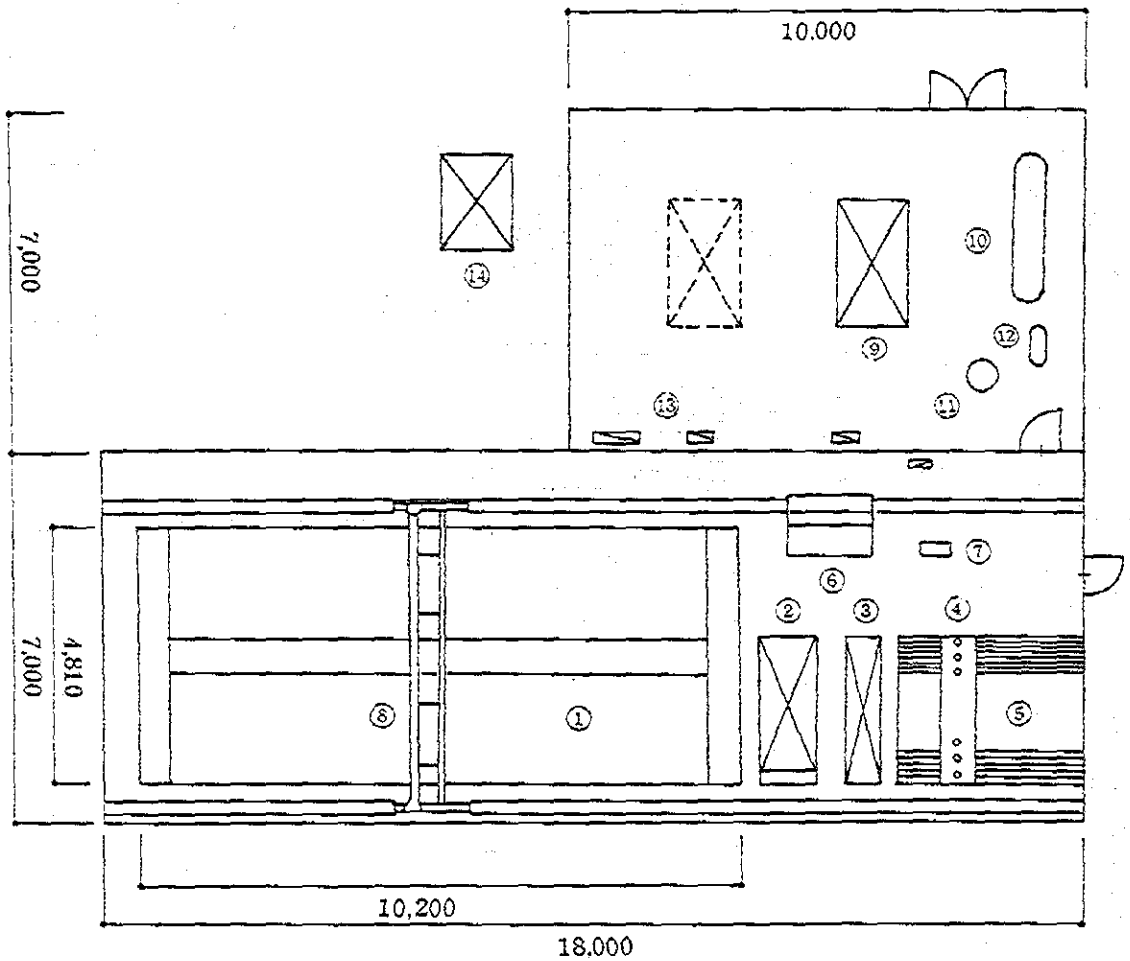
ELEVATION 1:200



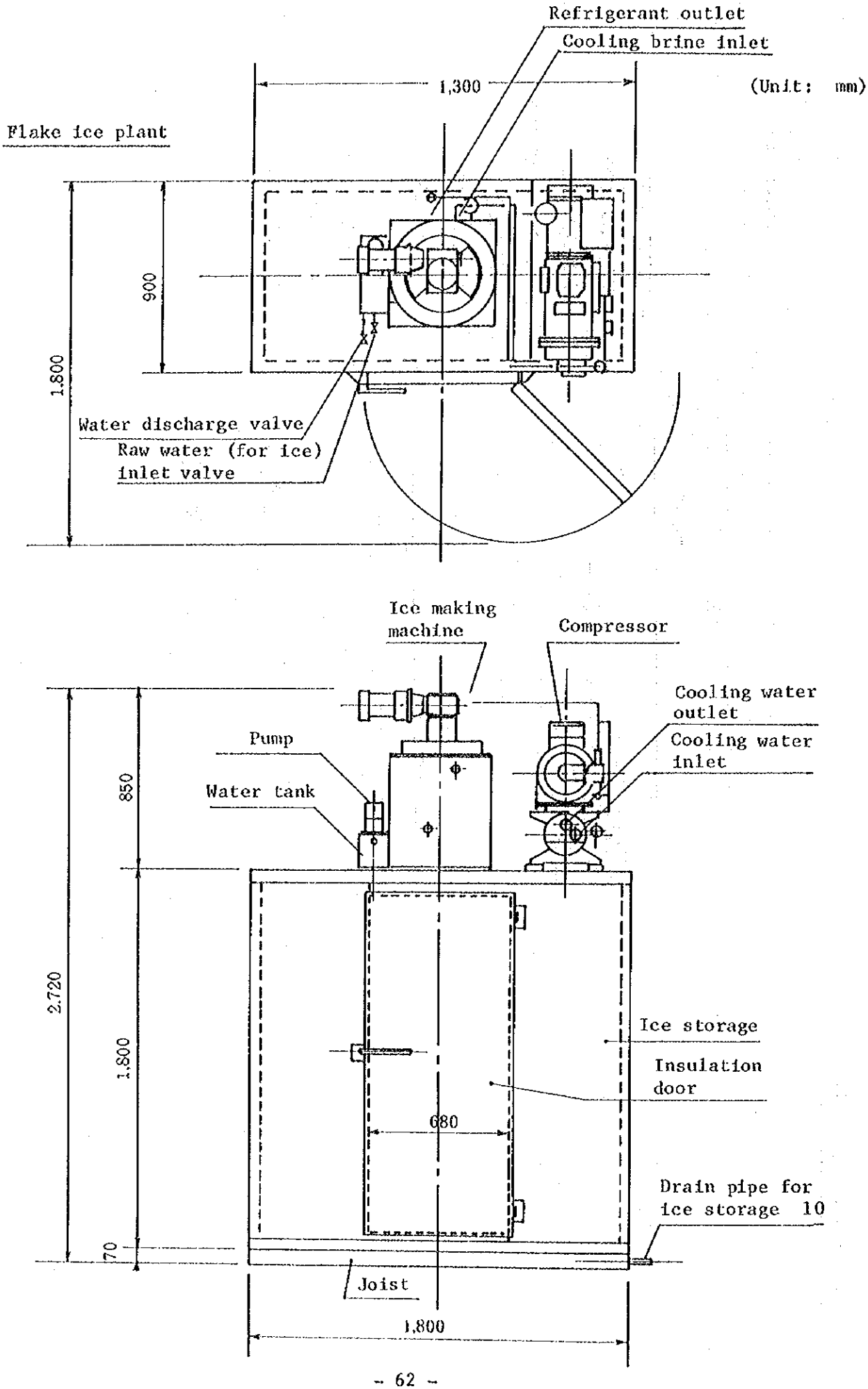
ELEVATION 1:200

Block ice making plant

(Unit: mm)

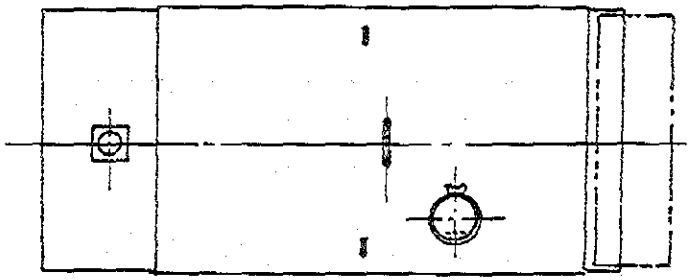


① BRINE TANK
② THAWING TANK
③ CAN DUMPER
④ FILLING WATER TANK
⑤ SLIP WAY
⑥ PRE COOLING TANK
⑦ AIR BLOWER
⑧ CRANE
⑨ NH_3 COMPRESSOR
⑩ NH_3 RECEIVER
⑪ OIL SEPARATOR
⑫ OIL DRUM
⑬ POWER & CONTROL PANEL
⑭ EVAPORATIVE CONDENSER

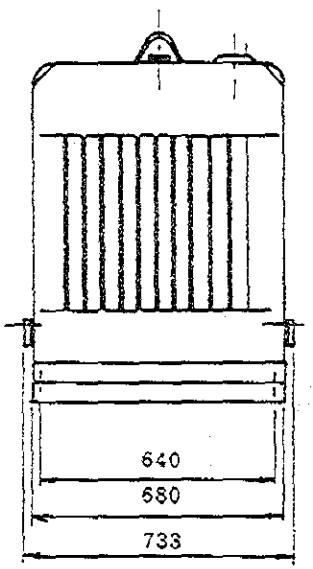

Refrigerant outlet
Cooling brine inlet
(Unit: mm)
Flake ice plant
1,300
900
1,800
Water discharge valve
Raw water (for ice) inlet valve
Ice making machine
Compressor
Cooling water outlet
Cooling water inlet
Pump
Water tank
850
2,720
1,800
70
Ice storage
Insulation door
680
Drain pipe for ice storage 10
Joist
1,800

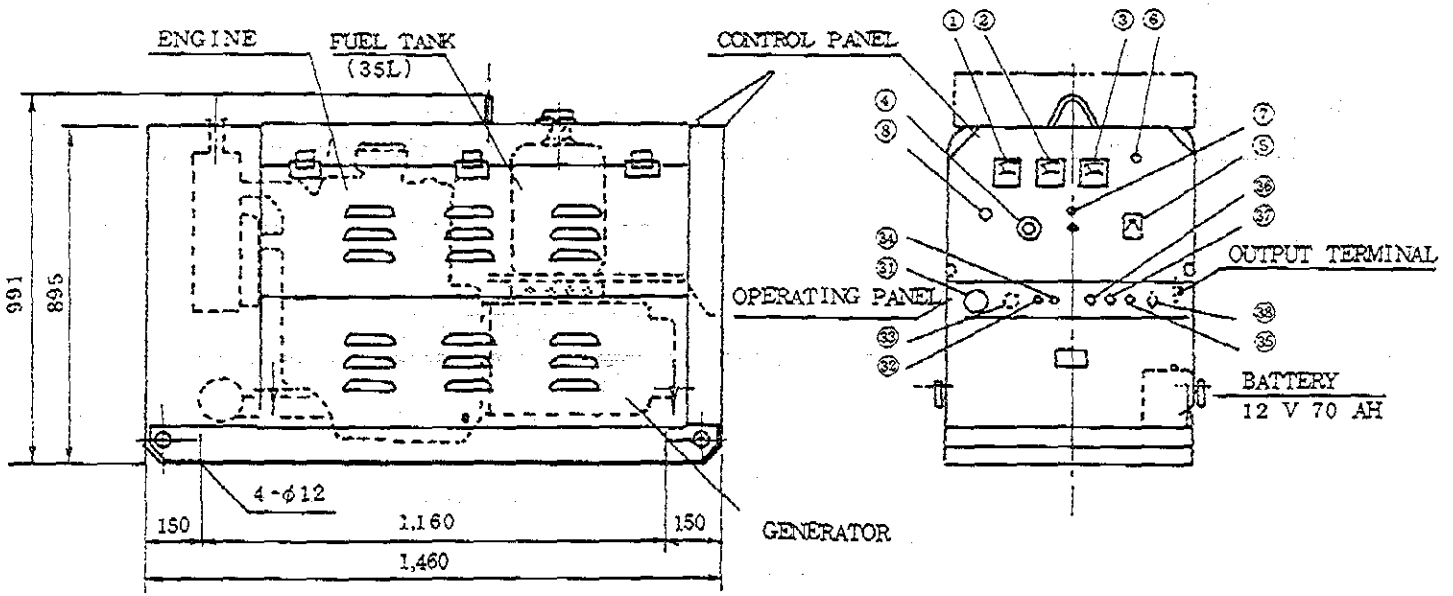
Diesel Engine Generator

(Unit: mm)



	CONTROL PANEL		OPERATING PANEL
No.	NAME	No.	NAME
1	FREQUENCY METER	31	TACHOMETER
2	AC AMMETER	32	OIL PRESSURE ALARMLAMP
3	AC VOLTMETER	33	THERMOMETER
4	VOLTAGE REGULATOR	34	CHARGING ALARM LAMP
5	CIRCUIT BREAKER	35	STARTER SWITCH
6	PILOT LAMP	36	STOP BUTTON
7	AUX.POWER RECEPTACLE	37	PREHEAT LAMP
8	BUILT-UP BUTTON	38	THROTTLE HANDLE

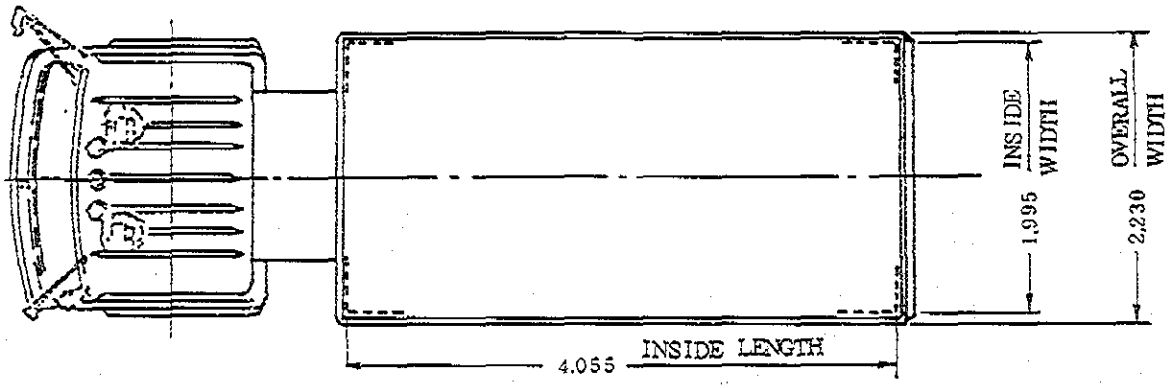


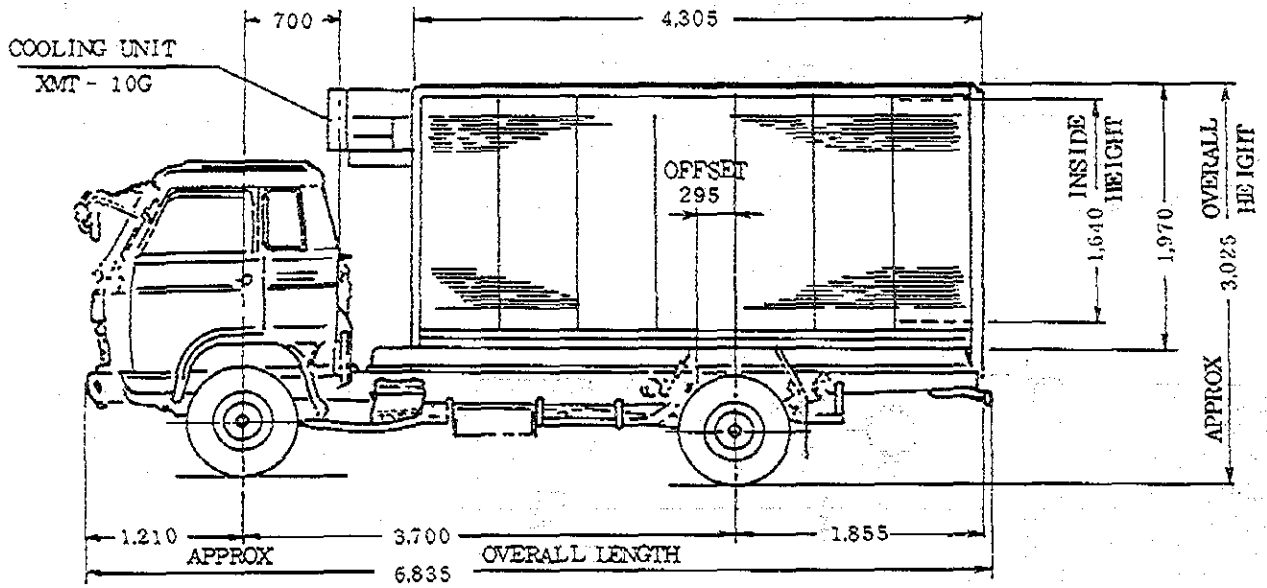


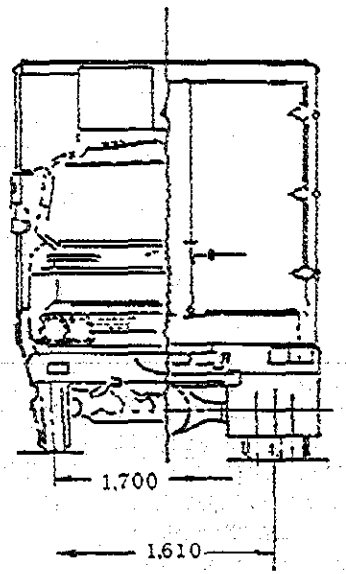
DRY WEIGHT APPROX. 570 kg

Refrigerated Van

(Unit: mm)







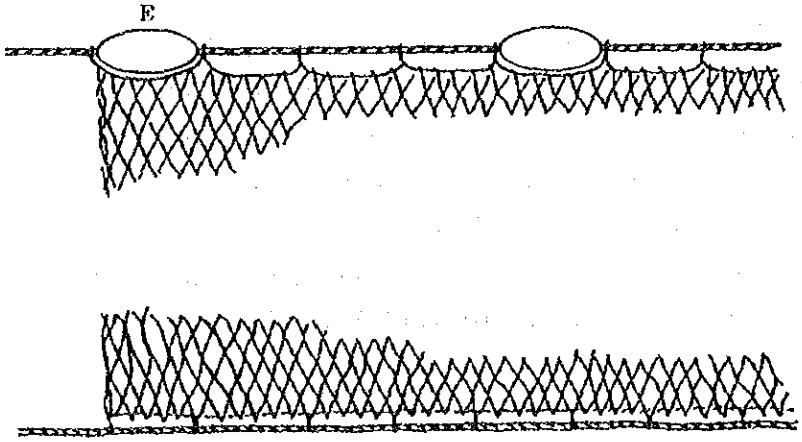
An example of a surround net

B : Float Line

C : Sub-Float Line

A : 2'str . 62MD x 985MW

D : sinker Line



	Description	Q'ty.
A	Netting showed above	
B	Nylon Braided Rope 8m/m dia. each end 1Mtr. flying	27 meters
C	Vinylon Twine 5's/30	
D	Nylon Braided Rope lead core 8m/m dia., 200gr/Mtr.	27 meters
E	Float 61mmL x 35mmD x 10mmH.D Buoyancy 35gr/pce	51 pieces

5.4 Implementation

5.4.1 Fishing Boat

To meet increase of fish catch and improve distribution, it is noted that most of boats used are inadequate for fishing and transportation and that the boats are insufficient in number. To acquire modern boats with adequate equipments is very difficult because of short financing. Our recommendations, therefore, will be extremely effective and proper to provide small size fishing boats under this program.

The following two factors are most important for effective operation of the boats we will provide.

(1) Operating costs

The main operating costs are fuel costs and repair costs. If any of the state government cannot bear the whole operating costs, the central government must provide financial support to the state.

Standard costs for fuel and repairs per annum are shown in Table 8. The working hours per day and working days per year are estimated by results of the site survey, and prices of fuel are based on the average local prices as of December 1981.

Table 8 Yearly Operation Costs of Boats to be Provided

(Unit: dollar)

Item	Small fishing boat, FRP, with inboard diesel	Skiff, FRP, with outboard motor
Working hours per day ... (1)	3 hours	2 hours
Working days per year ... (2)	200 days	200 days
Fuel consumption rate ... (3)	(Diesel oil) 11 liters per hour	(Gasoline) 11 liters per hour
Fuel price ... (4)	$0.48 per liter	$0.42 per liter
Fuel expenses per year (= (1)·(2)·(3)·(4))	3,170	1,850
Repair expenses per year	2,000	500
Total	5,170	2,350

(2) Maintenance and administration

Spare parts and materials for the boats to be provided should be administered only by the central government. It is desirable that repair work be conducted by Public Works or Micronesia Boatbuilding & Drydocking Corp., which are administered by the government, and that the engine should be overhauled once a year, if possible.

5.4.2 PFFA

(1) Ice making facilities

PFFA does not have ice making facilities. They are selling ice, made by Yoshida Enterprise, their neighbor.

The selling price of ice is 3 dollar per 45 kg and PFFA earns a 15% commission on the sales amount.

Ice must be used more than 3 to 1 ratio to fish in order to cool and store fish well, based on conditions such as temperature in Palau, distance to the fishing ground and storage conditions of the ice and fish. As the lowest price PFFA pays for fish is 88 cents per kilogram, fishermen are paying 20 percent of their fish sales for ice.

A stable supply of low priced ice to the fishermen is necessary to promote fishery and to improve distribution system. Therefore appropriate ice making plant should be included in this plan.

The more ice made per year, the lower the unit cost of ice making becomes as shown in Table 10. It is necessary to increase the annual sales of ice to provide fishermen with low priced ice. It is suggested to expand the supply of ice to foreign fishing boats, both purse seine and pole and line fishing for skipjack and tuna.

Table 9 Rough Estimate of Annual Cost for Block Ice Making Plant

(Unit: dollar)

Item	Calculation formula	Amount
Power fee	Power capacity$_{80\ Kw}$ x Load rate$_{0.7}$ x 24^{hr} x 250^{day} x 7^{cents}	23,520
Water fee	$1.5/month x 12 month	18
Depreciation expense	$45,000^{thousand\ yen}$ ÷ 15^{years} ÷ 220	13,636
Repair fee and others	About 600,000 thousand yen annually	2,826
	Total	40,000

These calculations are based on 250 days as annual working days considering seasonal lay off.

Table 10 Unit Cost for Making a Piece of Block Ice (45 kg)

(Unit: dollar)

Annual production quantity	Production cost
1,000 tons	40,000 ÷ 1,000,000 × 45 = $1.80
1,500 tons	40,000 ÷ 1,500,000 × 45 = $1.20
2,000 tons	40,000 ÷ 2,000,000 × 45 = $0.90

(2) Prefabricated cold storage

Storage conditions and utilization of cold storage facilities were not regarded good from the point of preserving quality and rate of utilization.

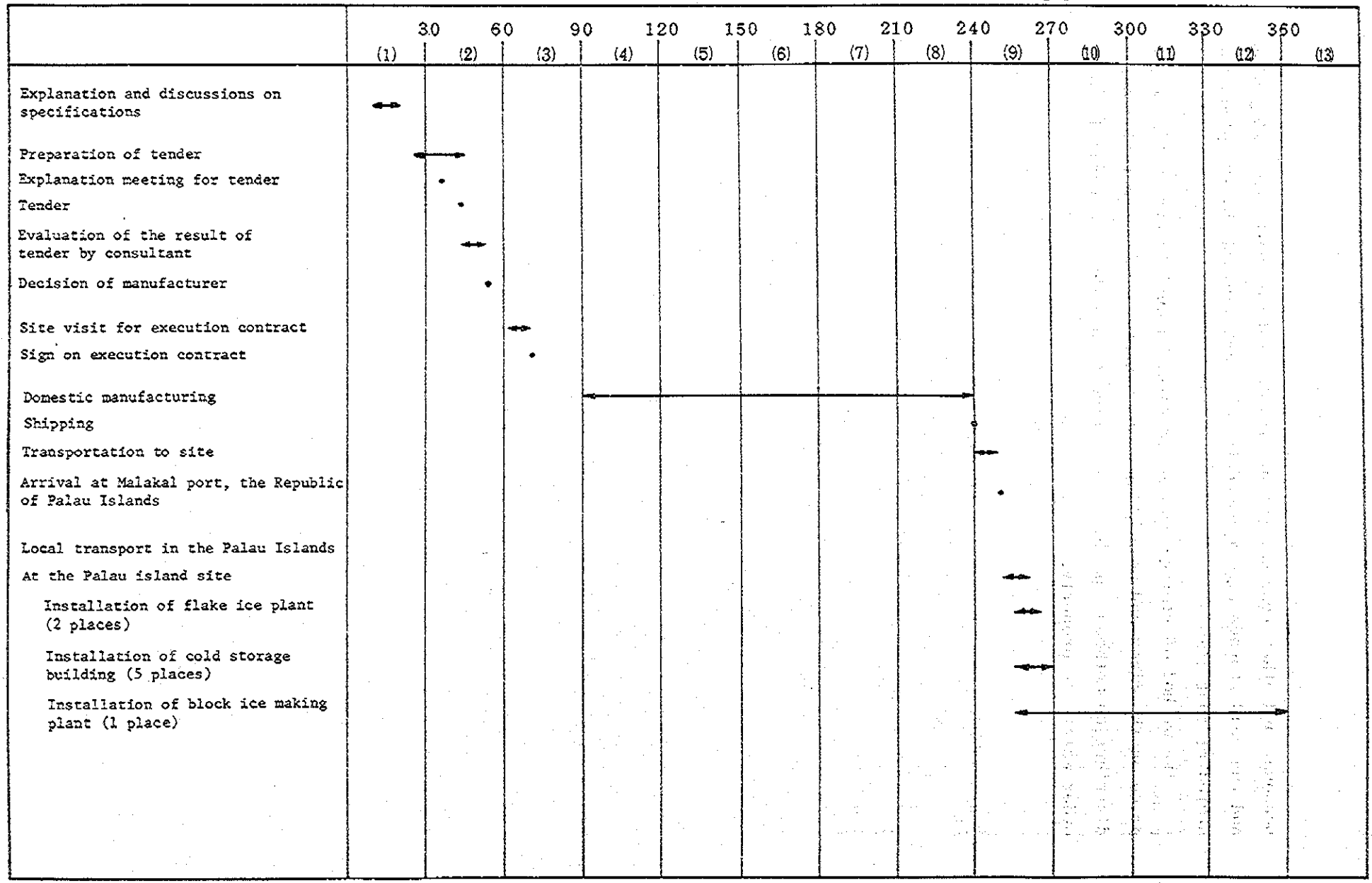
The operating cost of a cold storage facility is largely influenced by size of surface of cold storage and heat penetration ratio of the outside air rather than the factors of the quantity of cargo stored in the storage area. If utilization rate of a cold storage facility is improved by increased cargo, the operating cost per unit of stored cargo weight will be decreased. During the period when the utilization rate of cold storage is low because of

seasonal and other reasons, the utilization rate of both ice making plant and the cold storage are improved if the block ice made by the plant is stored at that time.

The method of storage must be improved in quality and cost by laying grids on the floor and by storing fish in baskets. Transportation and distribution methods must be also studied to use the refrigerated van and other materials properly.

5.5 Implementation Schedule

(Note): The date of signing the official exchange letter will be the starting point of this schedule.



5.6 Recommendations for Maintenance and Control

For a better use of the machines and materials to be provided consideration must be given to the personnel, the equipment and the natural marine resources. Systematic control is required for coordination in use of the equipments to be provided.

The National Resources Ministry will be responsible for this project and the state governments and fishermen's union will undertake the execution of the project. It is desirable to control the personnel affairs, equipments, and the natural marine resources through an overall coordination of the three organizations.

Immediate planning should be set up to arrange a list of all personnel involved in the project. Personnel required for the operation of the fishing boats and facilities should be designated before the arrival of the equipments in Palau. It is recommended that studies be started as soon as possible concerning the duties of the managers and engineers. This also includes the budgeting of personnel.

For the equipments, maintenance measures should be taken by sending specialists, once a year, to check the block ice making plant and prefabricated cold storage buildings. The specialists should be selected from Public Works or PFFA. The same preventive measures apply to the fishing boats. Small fishing boats, FRP, with inboard diesel should be taken to MICRONESIA BOAT BUILDING & DRYDOCKING CORPORATION and skiffs, FRP, with outboard motor to PUBLIC WORKS annually for repairs, that include cleaning the bottom and overhauling the engine,

The preferred method for control of materials is for the central government organization to supervise the storage of fishing gear and spares by keeping records in respective ledgers. The budget should be considered by the central government based on para 6.5 to assist in the expenses required for the dispatch of engineers and the operation of the project.

Fishing grounds and natural marine resources are not unlimited and the control of resources must be done with extreme care to prevent destruction and overfishing.

CHAPTER 6: JUSTIFIABILITY AND BENEFITS OF INTRODUCING THE MACHINES AND MATERIALS

6.1 Justifiability

The main industries in the Palau islands are agriculture and fishing. The government of the country has tried to effectively use skipjack and tuna resources and to promote small scale fishing.

The introduction of the machines and materials to the fishery is considered to be indispensable for the promotion of small scale fishery as it is clear that fishing boats and fishing gear are required and cold storage facilities for the catch of fishery are lacking.

Two engineers to operate the block ice making plants are already enrolled, and engineers to operate flake ice making plants have been secured. There are no manpower difficulties. Manpower for the prefabricated cold storage building and for operating the diesel engine generators is available because high technology is not required. Drivers for the refrigerated van also require no special technical training. The present technical level of the fishermen is sufficient for operating fishing boats and the fishing gear is also advanced enough for their fishery.

The parliament of Palau has already decided, by vote, that each of the state governments should be responsible for the operation and administration of the equipment and the central government should administer and support them.

Our counterparts of the Republic of Palau Islands are almost ready to accept the conditions. This program is considered to be adequate to provide a stable supply of animal protein to the people of the Palau Islands, to contribute to the advancement of their living standard and to increase job opportunities.

6.2 Benefits

The Palauan Government is concerned about improving their small scale fishery to raise the income standard of the people, increase their job opportunities and decrease the import of processed marine products from abroad.

The studies on small scale fishing boats, ice making plants, cold storage facilities and fishing gear conducted by our study team will contribute to increasing the quantity of the catch of fish and for adjusting the flow of the distribution of the catch. The Palauan government has already acquired the approval of the parliament for handling the machines and materials. This means that the central government will provide the state governments with the machines and materials after acknowledgement of the justifiability of the requirements from the state governments and insure their operation programs through intensive inspections.

The benefits of introducing small scale fishing boats, ice making plants, cold storage facilities and a series of machines and materials are expected to be as follows:

Fishing boats and fishing gear

The number of fishing boats to be provided and the type of the boats were decided after taking into account local conditions such as the quantity of maximum continuous production from the fishery resources of each state, the quantity of consumption and the geographic conditions were carefully considered. The fishing boats will directly contribute to increase the quantity of the catch of fish and to improve the distribution systems throughout the country, as well as each state. The fishing boats will indirectly contribute to improve the living standard of the people and to increase their job opportunities.

Our site survey and the explanation made by the officials of the fishery authorities disclosed that the fishing boats in use were inadequate in quantity and were poor in quality. The fishing gear in this program will enable increases in the quantity of the catch, contributing to an improvement in the efficiency of fishing labor.

Prefabricated cold storage building (about 4 tons)

The quantity and the locations were decided after factors such as the estimated quantity of fish to be transported to Koror city and the distance from the site to the city were taken into consideration. The decision is also supported by the results of our site survey. The provisions for cold storage in this program will contribute to improve the distribution system of fishery products, not only through supplementing the capacity of the present cold storage facilities, but also through enabling the country to improve the quantity of the catch of fishery in the fiture.

Insulated fish box

Light and convenient insulated fish boxes used for preserving ice and fish are advantageous for small scale fishery because they require no electrical power and can be used at any location. This will contribute to improve the distribution system because they are free from technical difficulties.

Block ice plant

It is difficult to meet the demands of fishermen with the ice sold by PFFA because they have the capacity to produce only about 5 tons per day. It is necessary to establish another ice making plant with a capacity of 15 tons per day if we take the increase of the quantity of the catch of fishery and the improvement of distribution systems into consideration.

Accordingly, establishing an ice making plant at Koror City is indispensable for the small scale fishery promotion program, which will contribute to the effective utilization of fishery products.

Flake ice plant

To keep the fish caught fresh, plants will be established at the two places between the east coast and west coast of Barberudaob island, where water and engineers are available.

Diesel engine generator

They are required as a power source for prefabricated cold storage buildings and flake ice plants.

Refrigerator van

The van is used in the Koror city to improve the distribution systems in the consumption areas and it can be used with the present road conditions. It will contribute to the improvement of the distribution system in the Republic of Palau Islands.

Others

Platform scales, ice crushing machines and fish baskets are to be used for supplementing the function of the ice machines and materials to be provided. They will contribute to the improvement of the distribution system.

6.3 Recommendations

Regarding the provision of small scale fishing boats, ice making plants and cold storage facilities, fishing gear and the like, we would like make our recommendations to the government of the Republic of Palau Islands as follows:

(1) Supporting steps necessary for each state government should be carried out soon, to make arrangements for skilled personnel for the maintenance, administration and operation of the machines and materials.

(2) Regarding effective utilization of the machines and materials to be provided to the central government, each state government and the fishermen's union should endeavor to keep continuous and close contact.

(3) The results of the effective utilization of the machines and materials to be provided should be reported to the Japanese government within a specified time after the grant.

APPENDIXES

APPENDIX 1. ITINERARY

No.	Date	Activity
1	Dec. 11, Fri.	Left Tokyo for Guam. Arrived at Guam. Paid a courtesy call at the Consulate General of Japan.
2	Dec. 12, Sat.	Left Guam for Palau. Arrived at Koror.
3	Dec. 13, Sun.	Discussed with Vice President, Minister of National Resources and other government officials over the purposes and objectives of study, sites to be surveyed, time schedule, grant aid cooperation system, etc.
4	Dec. 14, Mon.	Discussed with the Palauan counterparts with respect to the background and details of their request and a letter of inquiry.
5	Dec. 15, Tue.	Studies Ngiwal, Melekeok and Ngchesar on the east coast of Baberudaob.
6	Dec. 16, Wed.	Visited the Palau Federation of Fishing Associations, shipyard, repairing shop, power plant, etc.
7	Dec. 17, Thu.	Studied Ngeremlengui, Ngatpang and Aimeliik on the west coast of Baberudaob.
8	Dec. 18, Fri.	Studied Peleliu.
9	Dec. 19, Sat.	Discussed among the study team members, and preparation of a draft estimate.
10	Dec. 20, Sun.	Organizing collected data.
11	Dec. 21, Mon.	Submission of draft minutes of questions and answers, and discussions.
12	Dec. 22, Tue.	Discussions about the draft minutes, and signing of the minutes.
13	Dec. 23, Wed.	Left Koror for Guam. Arrived at Guam, and gave a summary of the study to the Consulate General of Japan.
14	Dec. 24, Thu.	Left Guam for Tokyo. Arrived at Tokyo.

APPENDIX 2. LIST OF PALAUAN GOVERNMENT OFFICIALS CONCERNED

Mr. Alfonso R. Oiterong	Vice President (Minister of State)
Mr. Koichi Wong	Minister of National Resources
Mr. Victorion Uherbelau	President's Special Representative to Political Status Negotiation
Mr. Yoichi K. Rengiil	Special Assistant to Vice President
Mr. Juan Polloi	Physical Planner
Mr. John Sugiyama	Chairman, Palau Maritime Authority
Mr. Marhence Madranchar	Vice-chairman, Palau Maritime Authority
Mr. Toshiro Paulis	Director of Marine Resources Office
Mr. Salvador Ongrang	Director of Economic Development Office
Mr. Yoichi Suzuki	Economic Planning Advisor (United Nations Development Program)

APPENDIX 4. MINUTES

MINUTES OF DISCUSSIONS
FOR SMALL SCALE FISHERIES DEVELOPMENT
AND MARKETING PROJECT - PALAU - 1981

In response to the request made by the Government of the Republic of Palau for the Project of Small Scale Fisheries Development and Marketing (hereinafter refered to as " the Project"), the Government of Japan has sent, through the Japan International Co-operation Agency (hereinafter refered to as "JICA"), a team headed by Dr. Kyoshiro Ohi to conduct a basic design study for 12 days from December 12th,1981. The team had a series of discussions and exchanged of views with the authorities concerned.

As the result of the study and discussions both parties have agreed to recommend to their respective Governments to examine the results of the study attached herewith towards the realization of the Project.

大井恭四郎

Dr. Kyoshiro Ohi
The Japanese Survey Team

Honorable Alfonso Oiterong
Vice President
Republic of Palau

December 22,1981

M I N U T E S

1. The proposed site of the Project will be Koror and other fifteen States (hereinafter refered to as "the Project Site").

2. The object of the Project is to provide necessary fishing vessel, facilities and equipment for improvement of small scale fisheries at the Project Site.

3. The Japanese Survey Team will convey to the Government of Japan the desire of the Government of the Republic of Palau that the former takes necessary measures to cooperate in implementing the Project and provides the vessel and other itmes listed in Annex I within the scope of Japanese economic co-operation in grant form.

4. The Government of the Republic ofPalau will take 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 of the project.

   b) To secure lands necessary for the installation of the facilities.

   c) To clear and level the Project Site before the start of the installation.

   d) To provide the other items listed in Annex II.

   e) To ensure prompt unloading and customs clearance in the Republic of Palau of imported materials and equipment for the construction, and to facilitate their internal transport.

f) To exempt the Japanese Nationals concerned from customs, duties internal taxes and other fiscal levies imposed in the Republic of Palau for the supply of goods and services for construction.

g) To provide and accord necessary permissions, licenses and other authorization deemed advisable for carrying out the Project.

ANNEX I

Items requested by the Government of the Republic of Palau, the cost of which will be borne by the Government of Japan --

1. Inboard Diesel Fishing Vessel
2. Outboard powered fishing skiff
3. Insulated storage room
4. Insulated fish box
5. Block Ice plant
6. Flake Ice plant
7. Diesel Electric Generator
8. Delivery van
9. Fishing gear
10. Miscellaneous
    a) Fish wighing scale
    b) Block Ice crusher
    c) Plastic Fish Handling box

A N N E X II

Items the cost of which will be borne by the Government of the Republic of Palau --

1) Water supply mains to the Project Site.
2) Extternal drainage and sewage line to the Project site.
3) Electrical power main line to the Project Site.
4) Telephone lines and equipment.
5) Installation of the facilities.
6) Construction of shed for the facilities.
7) Exterior facilities like access roads, fencing, parking and landscaping.
8) Provision of space necessary for such constructions as temporary offices, working area, stock yard, and others.

9) Items (1),(3), and (6) shall be completed prior to the start of Site works.

APPENDIX 4. CURRENT FLOW IN THE SOUTHWEST PACIFIC

Fig. 1 Current flow, January to February

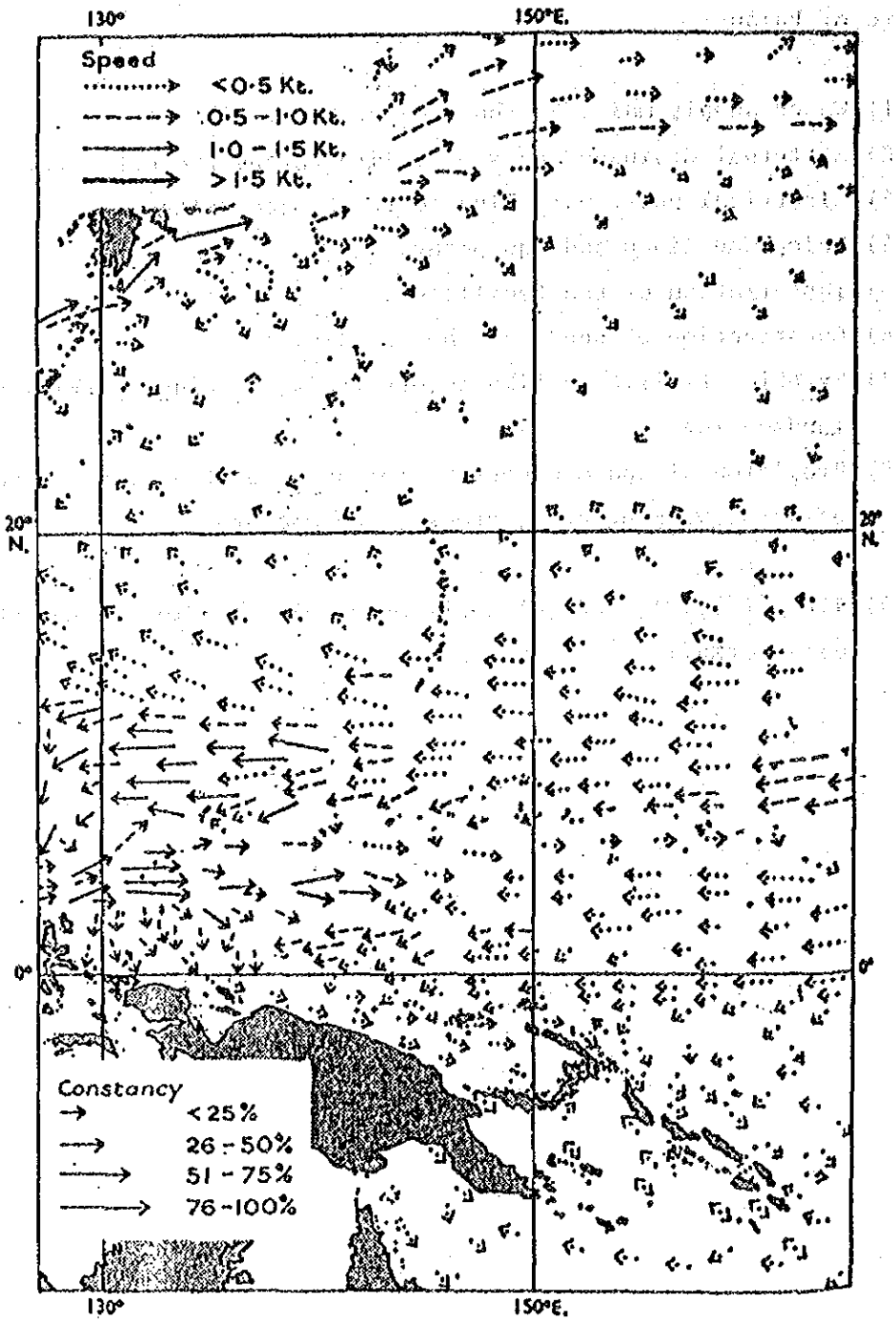


Diagram 7. Current flow January/February.

Source: Pilot book (English Edition)

Fig. 2 Current Flow, July to August

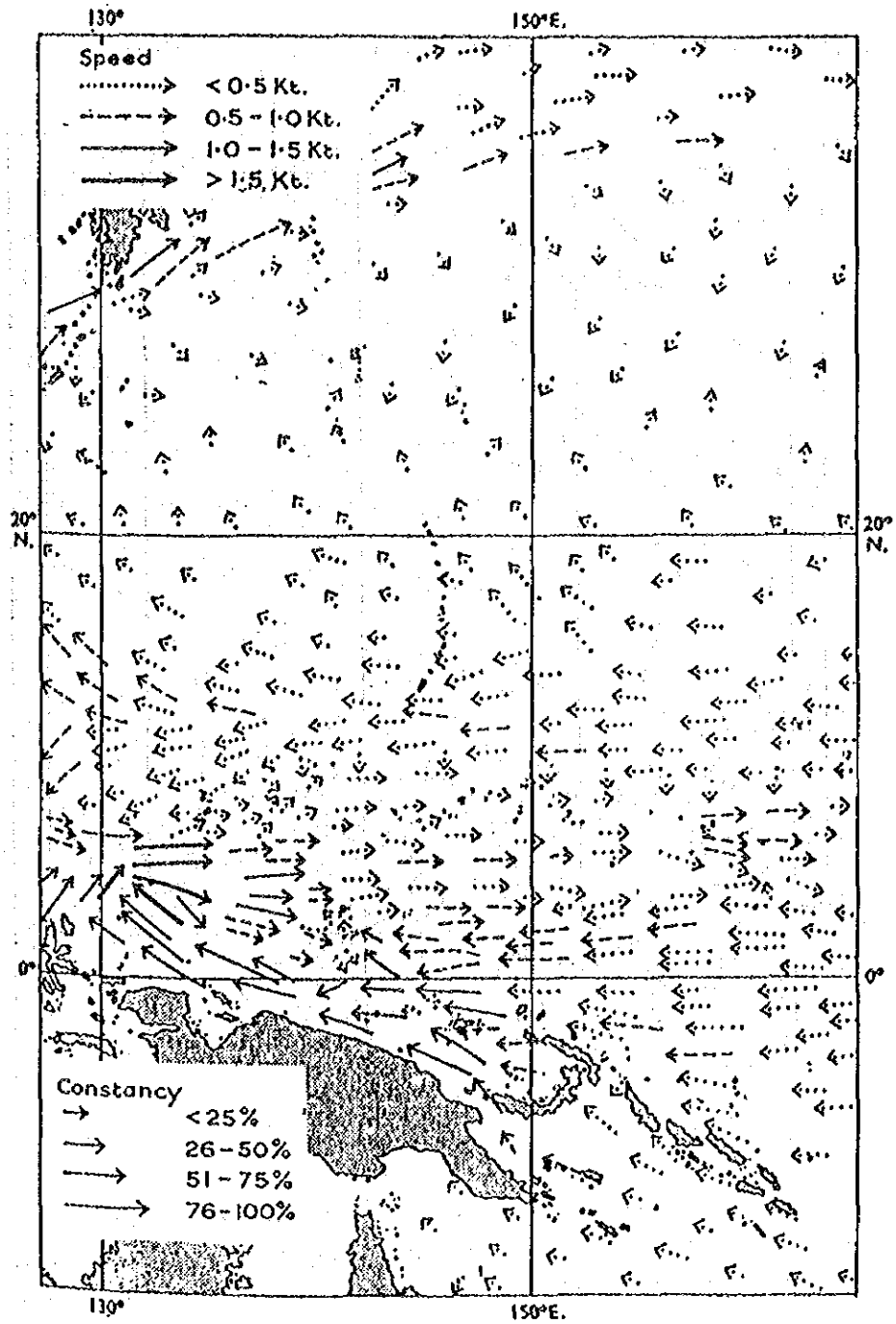
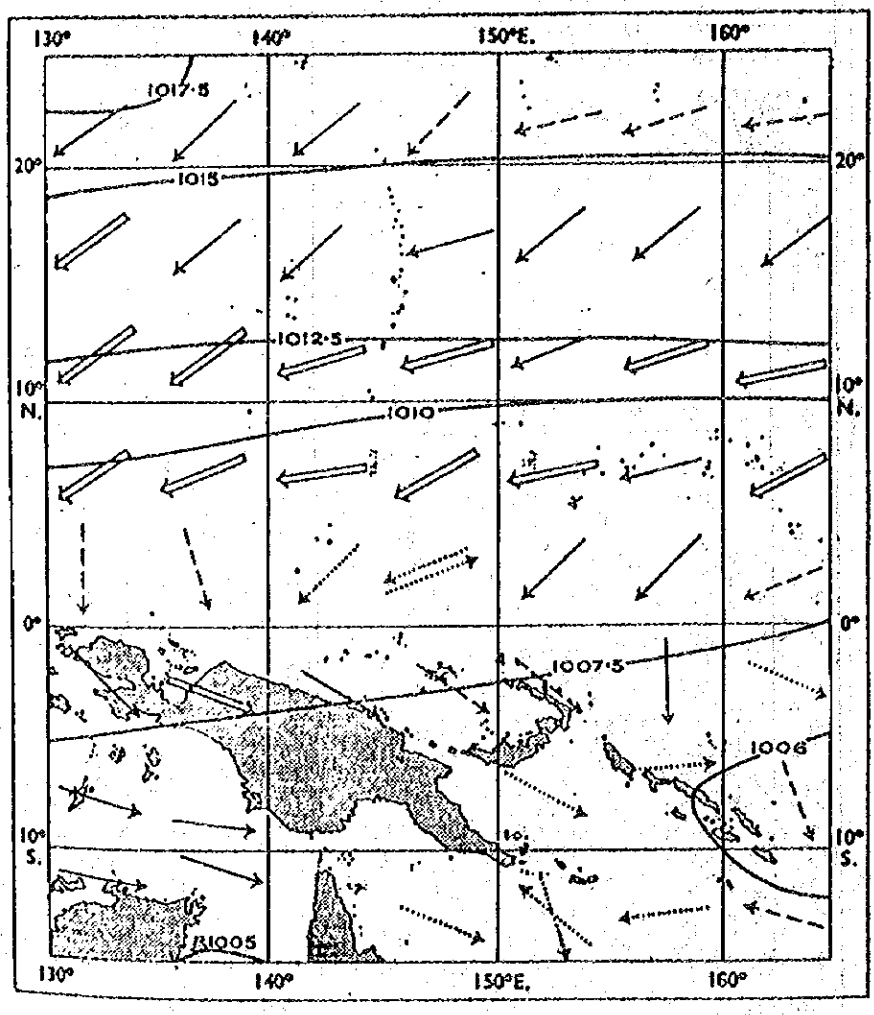


Diagram 6. Current flow July/August.

Source: Pilot book (English Edition)

APPENDIX 5. BAROMETRIC PRESSURE AND PREDOMINANT WINDS IN SOUTHWEST PACIFIC

Fig. 1 Mean Barometric Pressure and Predominant Winds, January



Arrow Key:—

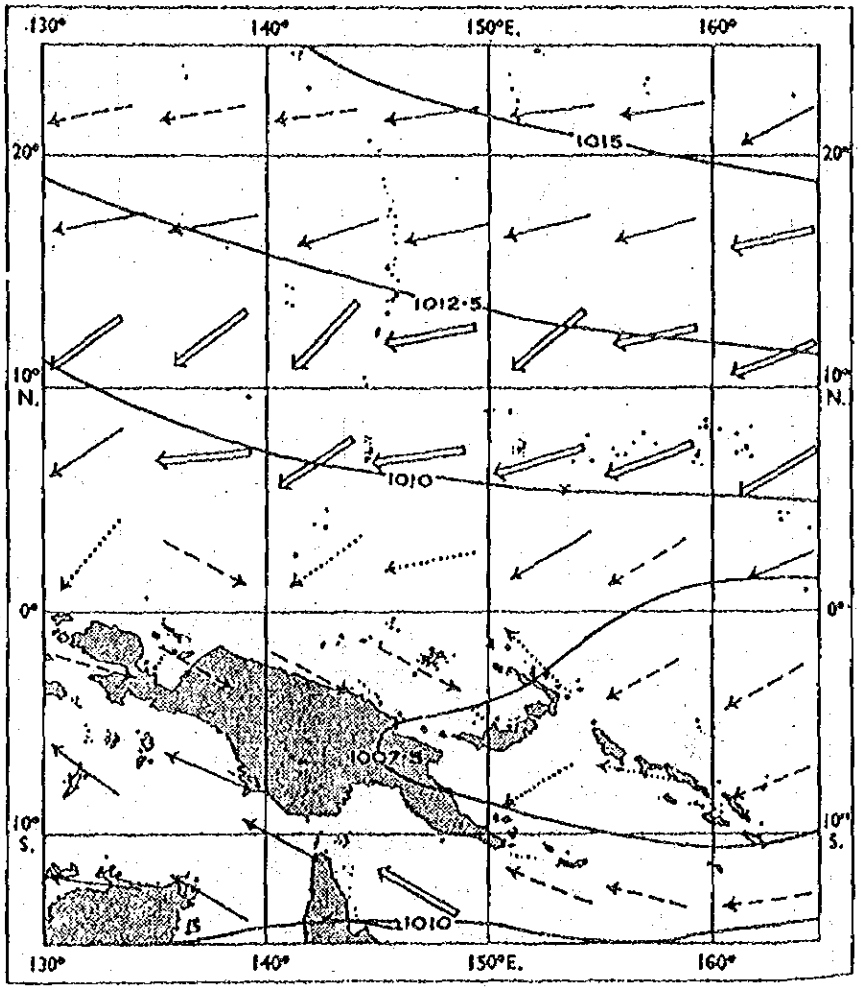
21 - 40% 41 - 60% 61 - 80% 81 - 100%

Arrows show the direction of the Predominant wind and its constancy

Diagram 8. Mean barometric pressure and predominant winds — January.

Source: Pilot Book (English Edition)

Fig. 2 Mean Barometric Pressure and Predominant Wind, April



Arrow Key:—

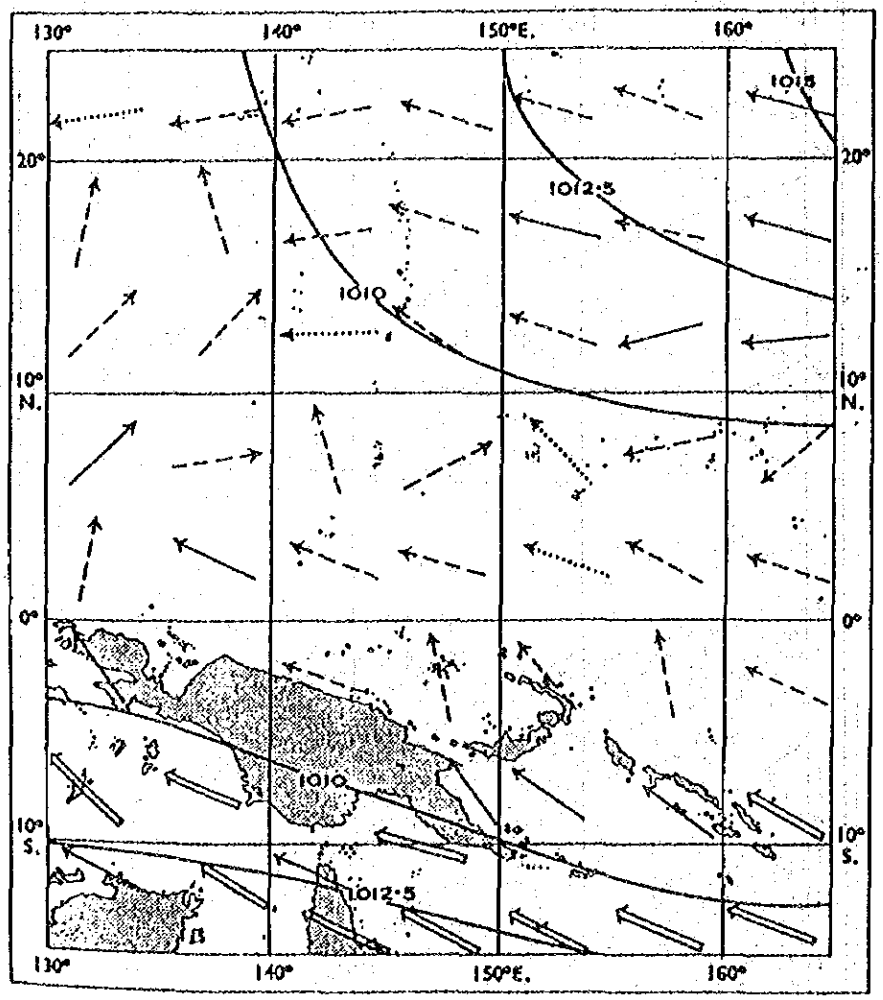
21 - 40 % 41 - 60 % 61 - 80 % 81 - 100 %

Arrows show the direction of the predominant wind and its constancy.

Diagram 9. Mean barometric pressure and predominant winds — April.

Source: Pilot Book (English Edition)

Fig. 3 Mean Barometric Pressure and Predominant Winds, July



Arrow Key:—

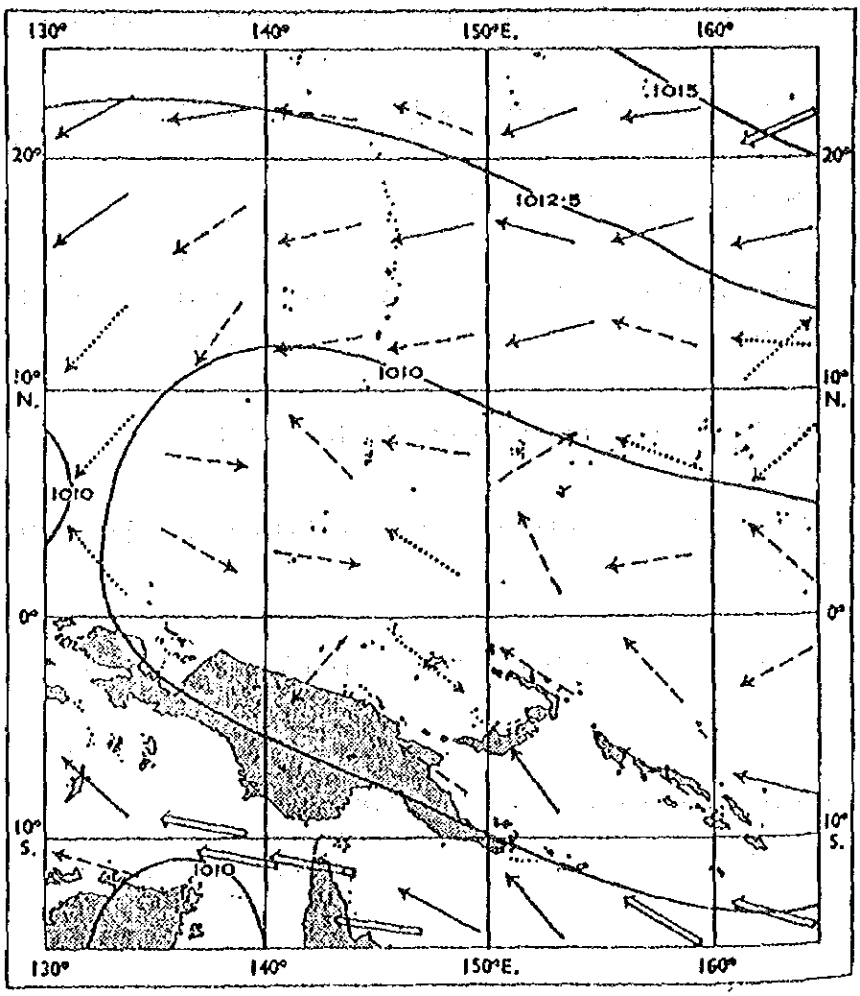
←·····21-40%←— — —41-60%←————61-80%⟸81-100%

Arrows show the direction of the predominant wind and its constancy.

Diagram 10. Mean barometric pressure and predominant winds — July.

Source: Pilot Book (English Edition)

Fig. 4 Mean Barometric Pressure and Predominant Winds, October



Arrow Key:—

21 - 40% 41 - 60% 61 - 80% 81 - 100%

Arrows show the direction of the predominant wind and its constancy.

Diagram 11. Mean barometric pressure and predominant winds — October.

Source: Pilot Book (English Edition)

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