

No.

**BASIC DESIGN STUDY REPORT  
ON  
THE PROJECT FOR IMPROVEMENT OF  
FISHERY INFRASTRUCTURE IN KAYANGEL STATE  
IN  
THE REPUBLIC OF PALAU**

**JANUARY, 2002**

**JAPAN INTERNATIONAL COOPERATION AGENCY  
ECOH CORPORATION**

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## P R E F A C E

In response to a request from the Government of the Republic of Palau, the Government of Japan decided to conduct a basic design study on the Project for Improvement of Fishery Infrastructure in Kayangel State and entrusted the study to the Japan International Cooperation Agency (JICA).

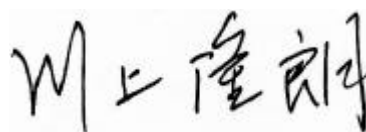
JICA sent to Palau a study team from July 1 to July 29, 2001.

The team held discussions with the officials concerned of the Government of Palau, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Palau in order to discuss a draft basic design, and as this result, the present report was finalized.

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

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

January, 2002



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Takao Kawakami  
President  
Japan International Cooperation Agency

January, 2002

## Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Improvement of Fishery Infrastructure in Kayangel State in the Republic of Palau.

This study was conducted by ECOH CORPORATION, under a contract to JICA, during the period from June, 2001 to January, 2002. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Palau and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

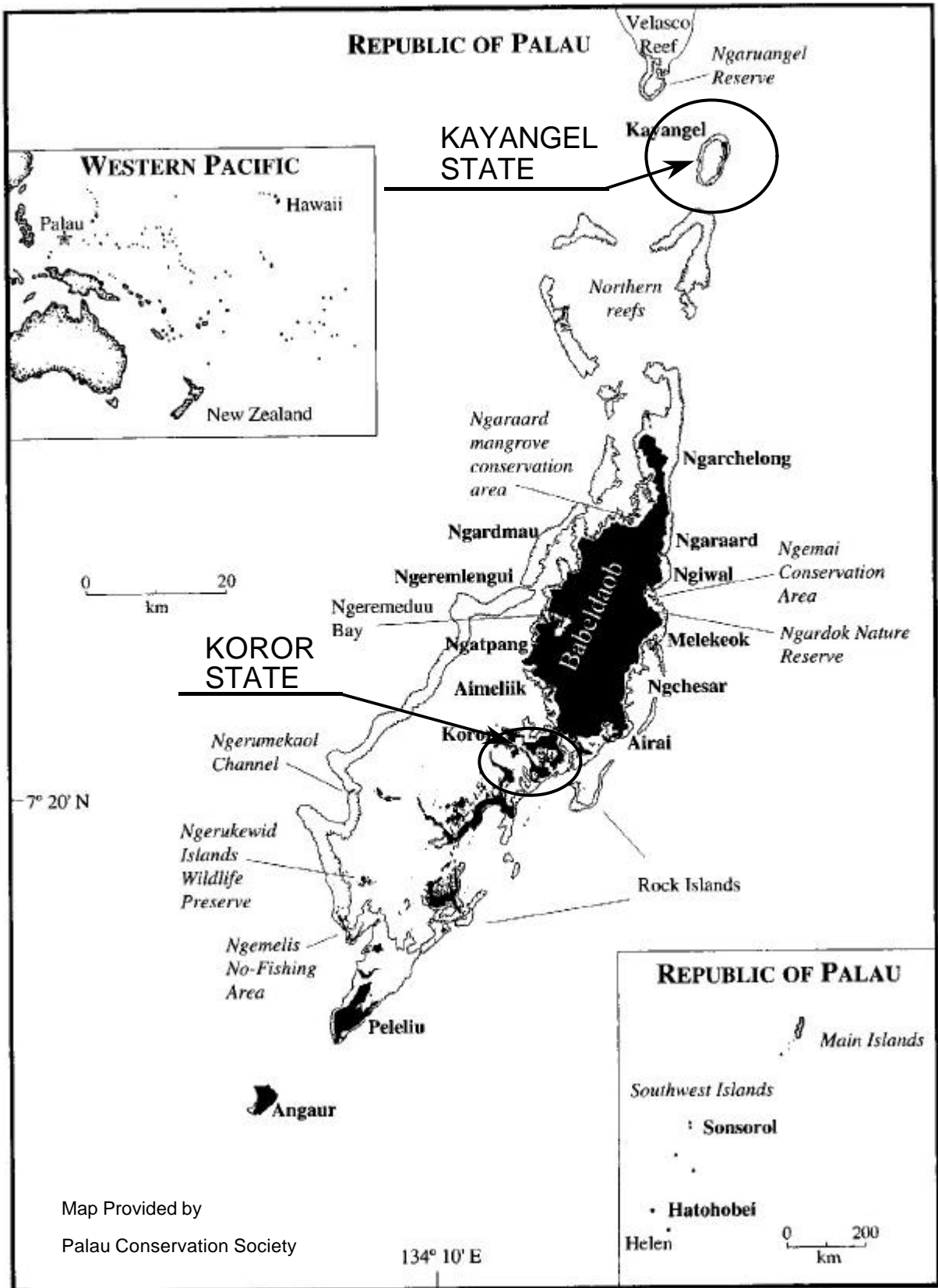
Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,



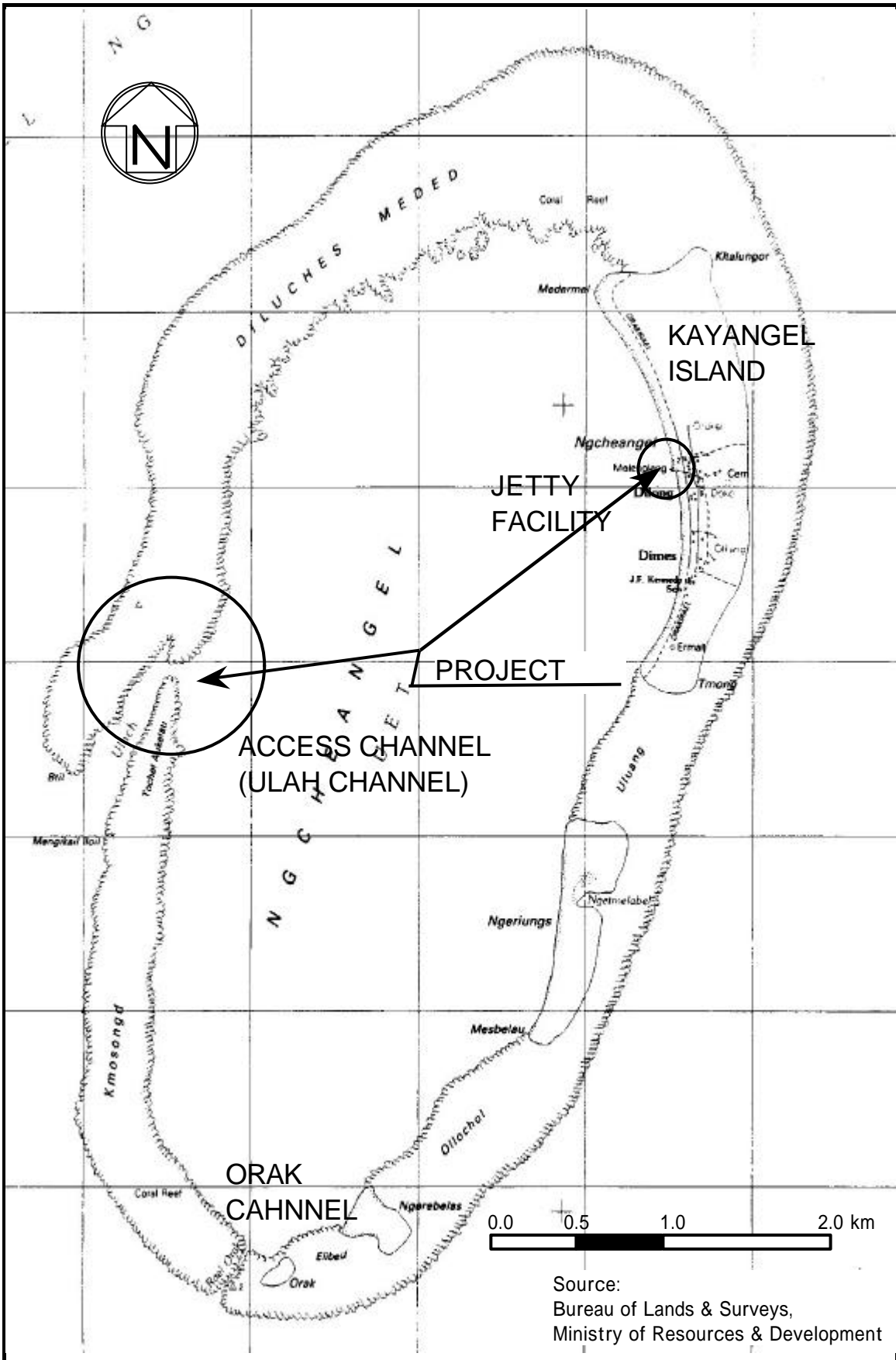
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Yutaka Ochi  
Project Manager,  
Basic Design Study Team on  
the Project for Improvement of  
Fishery Infrastructure in Kayangel State  
ECOH CORPORATION



Location Map of Kayangel State

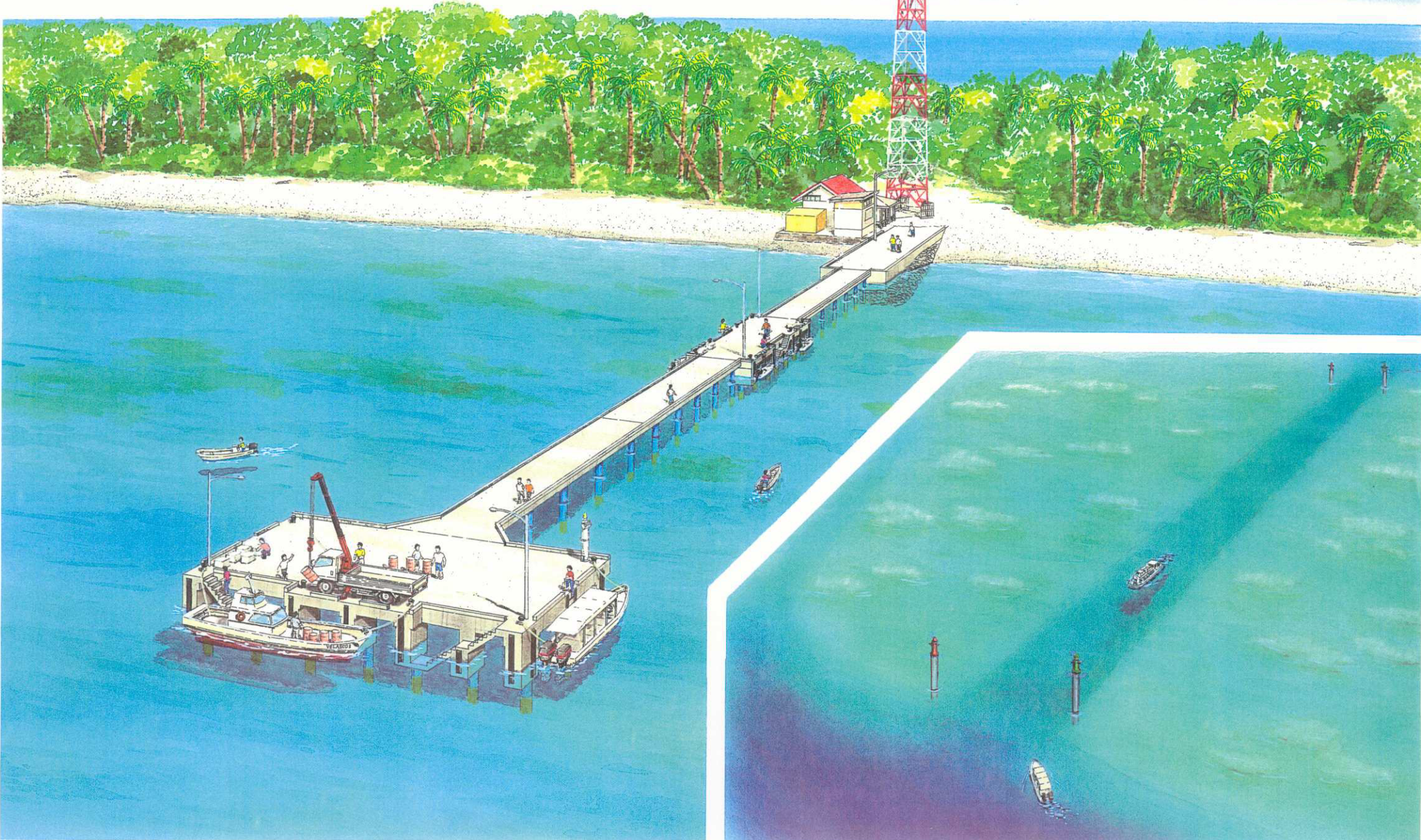




Location Map of Project Site



■ Perspective of The Project for Improvement of Fishery Infrastructure in Kayangel State





## **SUMMARY**

## **SUMMARY**

The Republic of Palau, an island country, consisting of more than 200 islands with a total land area of 487 km<sup>2</sup> is situated at the western most part of the Caroline Islands in the western Micronesia between 3 ° and 9 ° north latitude and 134 ° and 135 ° east longitude. The weather conditions are of the tropical oceanic climate of high temperature and high humidity with a mean temperature of 27.8 °C, a mean humidity of 82% and a mean annual precipitation of 3,620 mm. The climate is divided into two typical seasons, namely the rainy season from June to October and the dry season from November to May.

Palau consists of 16 states with a total population of 19,128 (census 2000), about 70% of which are concentrated to Koror State. Thus, it is important for the outlying states suffering from weak economic foundations to strengthen and vitalize the relationship with Koror State with respect to the supply of fishery products and distribution activities of goods and commodities. In this way, they may be able to get out of a self-sufficiency economic structure and facilitate regional development by enhancing the market economy.

Kayangel State is an isolated island state located 40 km off the north tip of Palau's largest island, Babelthuap, and 83 km from Koror State accommodating the country's capital functions. Kayangel State has the land area of 3 km<sup>2</sup> and consists of the Kayangel Islands (Kayangel, Ngeriungs, Ngerebelas and Orak). These islands form a chain of islands in the eastern side of the Kayangel Atoll that extends 7 km north and south and 4 km east and west. The Ngaruangel Reef is situated in the northern part of Kayangel Islands.

The main industry of Kayangel State is fishing. The fishing activities such as preparation of fishing operation, landing of fish catch and shipping of fishery products are carried out at the sole jetty facility in the state, located in the central part of Kayangel Island. The jetty facility, which plays an important role as well in the function of a physical distribution base, can be considered to be the lifeline of Kayangel.

However, in recent years, a number of problems have been identified.

The water depth of the dock, the basic fishing port facility, is not sufficient for berthing of fishing boats and other boats while the tide level is low, since the jetty does not extend offshore enough. And the structure of the jetty is suffered considerably by super-attenuation and deterioration. The existing jetty fails to undertake normal fishing port functions with regard to preparation works for fishing trips, unloading of fish catches, etc. as well as commercial port functions such as berthing of other boats and handling of cargoes. Furthermore, the access channel located on atoll reef does not have a sufficient water depth, which makes difficult for fishing boats and other boats to navigate through channel and approach the port inside the lagoon particularly during low tide. In addition, safe navigation is threatened since the beacons of navigation aids installed along the access channel are damaged.

It is desirable for Kayangel State to be developed through promotion of the fisheries industry as the mainstream of industry and strengthening the physical distribution of goods and commodities as well as logistics for passenger. Thus, the improvement of the fishing port facilities is urgently needed from the viewpoint of the state development. Considering such a background in Kayangel State, the Government of Palau has requested a grant aid project to the Japanese Government for development of Kayangel State. The project components are concerned with a jetty facility, an access channel facility and navigation aids as well as other relevant facilities and equipment. The requested components are expected the navigation and berthing safety of fishing boats and other calling boats of Kayangel irrespective of tide level, and improve the efficiency of berthing, cargo handling and other related works at the jetty.

In response to the request made by the Government of Palau, the Japanese Government decided to carry out a basic design study for the project. And Japan International Cooperation Agency (JICA) on behalf sent a study team to Palau with the schedule as indicated below.

Basic Design Study Mission	: July 1 to July 30, 2001
Draft Report Mission	: October 21 to November 1, 2001

The study team held discussions with the officials concerned in the Government of Palau and the Kayangel State Government, and carried out a

field survey of the project site. The basic design was accomplished by examining the project components and analyzing the field survey data during home office works in Japan. On this basis, the basic study concluded that the improvement of the requested facilities and the introduction of the equipment as indicated below are justifiable.

- \* Construction of Jetty
- \* Dredging of Access Channel
- \* Installation of Navigation Aids
- \* Introduction of Cargo Handling Equipment

The planning and designing of the requested facilities and equipment are carried out on the basis of the following basic concepts. An adequate consideration is given to the natural environment, including coral reefs and the residential environment of Kayangel. Furthermore, the jetty facility supports not only fishing port activities such as preparations for fishing operation, idle berthing and landing of fish catches but also the other functions of embarkation and disembarkation of passengers and unloading of daily commodities, construction materials, fuel and others.

At the planning and designing stage of the jetty facility, the functions required for commercial port activities are included in addition to the fishing port functions situated as a sole physical distribution base of the isolated island state. In this connection, the following concepts are fully taken into account.

- \* Ensuring the safe navigation of the fishing and other boats for their entry and departure from port
- \* Eliminating the restriction of dock use due to tide level
- \* Improvement of efficiency of cargo handling works at the dock
- \* Environmental aspects

The facilities to be constructed and the equipment to be introduced in the project must be planned as an appropriate scale and according to the grant aid project scheme, taking into account the project background, project objectives, natural conditions, maintenance systems and construction condition. Based on the field survey and the analytical works in Japan, it is ascertained that no new components are not be added to the components

initially requested.

(1) Facilities

- \* Jetty Facility : Total Length: Approx. 116 m  
: Total Area: Approx. 796 m<sup>2</sup>  
: Crown Height: D.L. +3.2 m
- Multipurpose Dock : Water Depth: D.L. -1.7 m  
: Size: 23 m x 10 m (4 Berths)  
: Aux.: 2 Stairways and 2 Traps
- Fishing Boat Dock : Water Depth: D.L. -0.5 m  
: Size: 22 m x 7 m (6 Berths)  
: Aux.: 2 Stairways, 4 Traps
- \* Access Channel Dredging
  - Channel Length : approx. 380 m
  - Channel Width : 20 m
  - Water Depth : D.L. -2.2 m
  - Dredging Volume : approx. 9,800 m<sup>2</sup> w/o Extra Dredging
- \* Navigation Aids
  - Channel Entrance : 1 pair (Lighting Range 5.0 n. miles)
  - Channel Exit : 1 pair (Light Range 2.0 n. miles)
  - Jetty : 1 set (Lighting Range 3.0 n. miles)

(2) Equipment

- \* Cargo Handling Equipment
  - Truck with Crane : 1 set (Crane Capacity 4.0 tm,  
Truck Loading Capacity 3.5 t)

In case of implementation of this project on the basis of the Japanese grant aid scheme, the construction works takes 14 months including detail design and tendering procedures. As for operation and maintenance system, an operator of the crane truck required newly, will be assigned to the existing operator of the State Government. Therefore, no personnel will be newly recruited in this connection.

Implementation of the project will enable the fishing boats and other boats to safely call port and berth at any tide level and improve the efficiency of works at the jetty. The following effects could be expected, so that it is concluded considerably that the project is justified as appropriate and significant on the basis of a grant aid project.

- \* New jetty facility of sufficient water depth for fishing boats including other boats will enable to be utilized at any tide level, where boats currently are

anchored offshore due to insufficient water depth of the dock. This will greatly improve the work efficiency of fishery activities and other port-related activities.

- \* Function of fishing port and commercial port will be improved by implementation of the new jetty. Landing of fish catches and handling of cargo as well as embarkation and disembarkation of passengers, which are currently limited during high tide can take place at any tide level.
- \* The state-owned middle size fishing boat and passenger boat, which currently can berth at the dock not very often through a year, will be able to berth at any time. This will contribute to the effective use of the state owned boats and to the convenience of the users.
- \* Dredging of the access channel will enable fishing boats and other boats including the state-owned boats to pass through the atoll of shallow water area at any tide level without tide waiting and will ensure safety of navigation.
- \* Installation of the navigation aids indicating the alignment and location of the access channel and the jetty will ensure navigation safety of boats in the access channel and inside the atoll.
- \* Introduction of the cargo handling equipment for heavy cargoes and fish catch will make the cargo handling work at the jetty more efficient and safer.

It is recommended that both Central Government and Kayangel State Government will responsible for management and operation of the project facilities. Utmost care should be taken to ensure the effective use of the jetty facility, the access channel facility and other project components.

\* **Appropriate Operation and Management:**

Proper guidance for fishermen and other users of the facilities will be required to ensure appropriate and smooth management and operation of the project facilities. In this context, guideline should be prepared.

\* **Appropriate Maintenance:**

Shoaling of the access channel and bathymetric change in the vicinity of the jetty are likely to occur after completion. Periodical sounding survey will be necessary to observe and examine the siltation phenomena of the access channel and bathymetric change due to littoral drift. When the shoaling of the access channel and bathymetric change adjacent to the jetty are observed, maintenance dredging should be



immediately carried out.

\* **Restriction on the Jetty Use:**

Since the jetty facility has been designed on the basis of the state-owned middle size fishing boat and other larger boats, any boats larger than the design boat size must not use the jetty. Beside, any vehicle larger than the crane truck introduced by the Project must not be allowed to access.

\* **Restriction of Navigation along the Access Channel:**

The access channel is planned and designed on the basis of the state-owned middle size fishing boats and other boats to navigate at any tide level. It should be noted that somewhat larger boats would be possible to navigate through the channel depending on the tide level. In such case, they must pass through at their own responsibility, taking into full account of the channel depth including tide level as well as channel width.

\* **Rough Sea Condition:**

During rough sea condition, fishing boats and other boats mooring along the jetty must hurriedly evacuate to safe areas. Small boats can be pulled up onto the surrounding beach.

\* **Ship Accidents:**

In case of ship accidents in the access channel, the channel should be closed instantly. Therefore urgent recovery works will have to be taken to maintain the lifeline of Kayangel State.

\* **Statistics on Fishery and Other Relevant Activities:**

The number of fishing operations, the amount of fish catches and the volume of fish shipped to Koror State will be recorded to compile fishery activity statistics. In addition, the ship particulars, number of calling boats and the volume of cargoes as well as the number of passengers including tourists will be also collected in order to study situation on physical distribution of goods, tourist visits and other relevant matters.

The Project for Improvement of Fishery Infrastructure in Kayangel State	
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# **CHAPTER 1**

## **BACKGROUND OF THE PROJECT**



# **Chapter 1 Background of the Project**

## **1-1 Background of the Project**

### **(1) Project Background and Sequences**

Palau is an island country consisting of 16 states with a total population of 19,128 (census of 2000), approximately 70% of which is concentrated in Koror State. Because of the national situation, it is important for the outlying states with weak economic foundations to get out of a self-sufficiency economic structure and to promote regional development by strengthening and vitalizing the relation and the connection with Koror State in terms of supply of fishery products and physical distribution activities.

Kayangel State is an isolated island state is situated in the northern most part of the country at a distance of about 3 hours (83 km) by boat from Koror State, accommodating currently the country's capital functions. The main industry of Kayangel State is merely the fishery industry. The fishing activities such as preparation of fishing operation, landing of fish catches and shipping of fishery products are carried out at the state's sole jetty facility, located in the central part of Kayangel Island. Additionally, the jetty facility, which has the function of a physical distribution base, can be considered to be the lifeline of Kayangel State in view of its dependence on maritime transportation.

However, in recent years, a number of problems have been identified. The water depth of the dock, the basic fishing port facility, is not sufficient for berthing of fishing boats and other boats while the tide level is low, since the jetty does not extend offshore enough. And the structure of the jetty is suffered considerably by super-attenuation and deterioration. The existing jetty fails to undertake normal fishing port functions with regard to preparation works for fishing trips, unloading of fish catches, etc. as well as commercial port functions such as berthing of other boats and handling of cargoes. Furthermore, the access channel located on atoll reef does not have a sufficient water depth, which makes difficult for fishing boats and other boats to navigate through channel and approach the port inside the lagoon particularly during low tide. In addition, safe navigation is threatened since the beacons of navigation aids installed along the access channel are damaged.

It is desirable for Kayangel State to be developed through promotion of the fisheries industry as the mainstream of industry and strengthening the physical distribution of goods and commodities as well as logistics for

passenger. Thus, the improvement of the fishing port facilities is urgently needed from the viewpoint of the state development. Considering such a background in Kayangel State, the Government of Palau has requested a grant aid project to the Japanese Government for development of Kayangel State. The project components are concerned with a jetty facility, an access channel facility and navigation aids as well as other relevant facilities and equipment. The requested components are expected to improve the navigation and berthing safety of fishing boats and other calling boats of Kayangel irrespective of tide level, and improve the efficiency of berthing, cargo handling and other related works at the jetty.

## **(2) Outline of the Project**

The following is an outline of the project and a content of the requested components.

### **1) Target**

The development of outlying island fishing villages will be promoted through vitalization of physical distribution between Kayangel State and Koror State.

### **2) Objectives of the Project**

Objectives of the Project is to enable the fishing boats and other calling boats related to Kayangel State to safely enter and leave irrespective of the tide level, which contribute to improve the efficiency of berthing boats, cargo handling works and other activities at the dock.

### **3) Expected Effects**

The Project will improve the jetty facility, the access channel and the related facilities as well as equipment comprising the lifeline of Kayangel State in view of its fully dependence on maritime transportation.

### **4) Indices of the Project Effects**

\* Project Objective (Numerical Index) :

Increase of the number of accessible days for the boats to the port

\* Other Indices :

Improvement of distribution of fishery products to Koror State

Improvement of physical distribution to Kayangel State

## **5) Contents of Requested Components**

- \* Components Requested by Recipient Country
  - Construction of jetty
  - Dredging of access channel
  - Installation of navigation aids
  - Introduction of cargo handling equipment
  
- \* Components Borne by Recipient Country
  - Securing the land related to the Project
  - Obtaining the construction permits for maritime construction works including dredging
  - Implementation of environmental impact assessment
  
- \* Activity plan
  - Securing necessary budget and personnel for management, operation and maintenance

## **6) Project Site**

The project sites for the facility construction in Kayangel State are indicated as following.

- |                                   |                   |
|-----------------------------------|-------------------|
| * Construction of Jetty           | : Kayangel Island |
| * Dredging of access channel      | : Ulach Channel   |
| * Installation of navigation aids | : Ulach Channel   |

## **7) Beneficiaries**

Beneficiaries due to the project implementation are indicated as followings.

- \* Approximately 13,400 residents of Kayangel State and of Koror State
- \* Party engaged in physical distribution in Koror State
- \* Tourists visiting Kayangel State and others

## **8) Project Implementation Organizations**

- \* Responsible Agency :  
Ministry of Resource & Development
- \* Responsible Agency for Project Implementation:  
Ministry of Resource & Development
- \* Management and Operation Entity:  
Kayangel State Government

## **1-2 Socioeconomic and Fishery Condition of Kayangel State**

### **1-2-1 Socioeconomic Condition**

According to the national census in 2000, the population of Kayangel State is 138 persons, comprising 76 males and 62 females. The number of households is 37 in which the average number of persons per household is 3.73. The breakdown by age is 52 persons under age 19, 36 persons in the age from 20 to 39, 28 persons in the age from 40 to 59 and 22 persons over age 60. Focusing on the employment, 118 persons (86% of the population) have some source of income, being employed or engaged in state government employees, service industries, fisheries, forestry and agriculture. The annual income per household is US\$6,100, about 50% of the average income of US\$12,800 for the country's entire population. As for the educational facilities in the state is only a elementary school. Regarding the major religion, 65% of the population are traditional nature worshippers, followed by the 24% of Christians.

### **1-2-2 Fishery Activities**

The present situation concerning fishery activities in Kayangel State is as follows.

#### **(1) Number of Fishermen**

In Kayangel State, there are currently 11 registered fishing boats, of which 7 boats are owned by full time fishermen and the remaining 4 boats belonging to part-time fishermen. The number of full time fishermen, including fishing boat crews, is estimated approximate 20 persons. Presuming the number of part-time fishermen to be about 40, the total number of persons involved in fishery industries is estimated approximate 60. Most of the boat owners have other jobs as well, such as state legislature or state officer, who have non-fisheries income as well.

#### **(2) Fishing Boats**

The fishing boats are of the small type of FRP hull with outboard engine equipped a compass for navigation apparatus. The size and specification of the fishing boats are shown in Table 1.2.2-1. Besides those fishing boats, there are some small fishing boats without outboard engine and wooden canoes, however they are not used for fishing outside the atoll and are not registered.

**Table 1.2.2-1 Fishing Boats Registered in Kayangel State**

Length (ft)	Breadth (ft)	Draft (ft)	Engine (HP)	Crew (psn)
20 ~ 23	5 ~ 6	2.5 ~ 3.0	85 ~ 200	1 ~ 5

### **(3) Fishing Methods and Fishing Grounds**

The most widely practiced fishing methods are trolling line, hand line and spear harpooning by divers without oxygen tank, and the fish species caught by those methods are as followings.

- \* Trolling Line : Tuna, barracuda, Wahoo, Skipjack, Dolphinfish, Large Pelagic Fish
- \* Hand Line : Snapper, Emperor Fish, Bream ,Grouper, Demersal Fish
- \* Harpooning : Grouper, Parrot Fish, Trevally, Red Bream, Rabbit Fish, Reef Fish, Giant Cram, Lobsters and Sea Cucumber

Casting nets and gill nets are allowed only for self-consumption. Harpoon fishing by divers with use of aqualungs is prohibited. For night time fishing, divers use underwater lamps for easier fish catch.

### **(4) Fishing Season**

The main fishing methods used in the vicinity of the coral reef are hand line fishing, harpooning by divers without aqualungs, net casting and gill nets, and a large variety of fishing methods are applied there. The main fishing season there is from January through October.

In fishing ground of outer reef area, the fishing season is about 6 months from March to September and trolling line is adopted for fishing method. During the period from October to March, fishing boats including middle size boat can not carry out fishing operation due to strong seasonal winds.

### **(5) Number of Fishing Operation**

The number of monthly fishing operations depends greatly on the weather and sea conditions. Fishing operations are carried out about 20 days a month, from February to April, which correspond to relatively calm sea condition. From May to June and from December to January, the number of operation days, however, declines to only about 5 to 6 days a month due to

rough sea condition. The total number of annual fishing operation is therefore estimated about 120 to 130days.

#### **(6) Fishing Grounds**

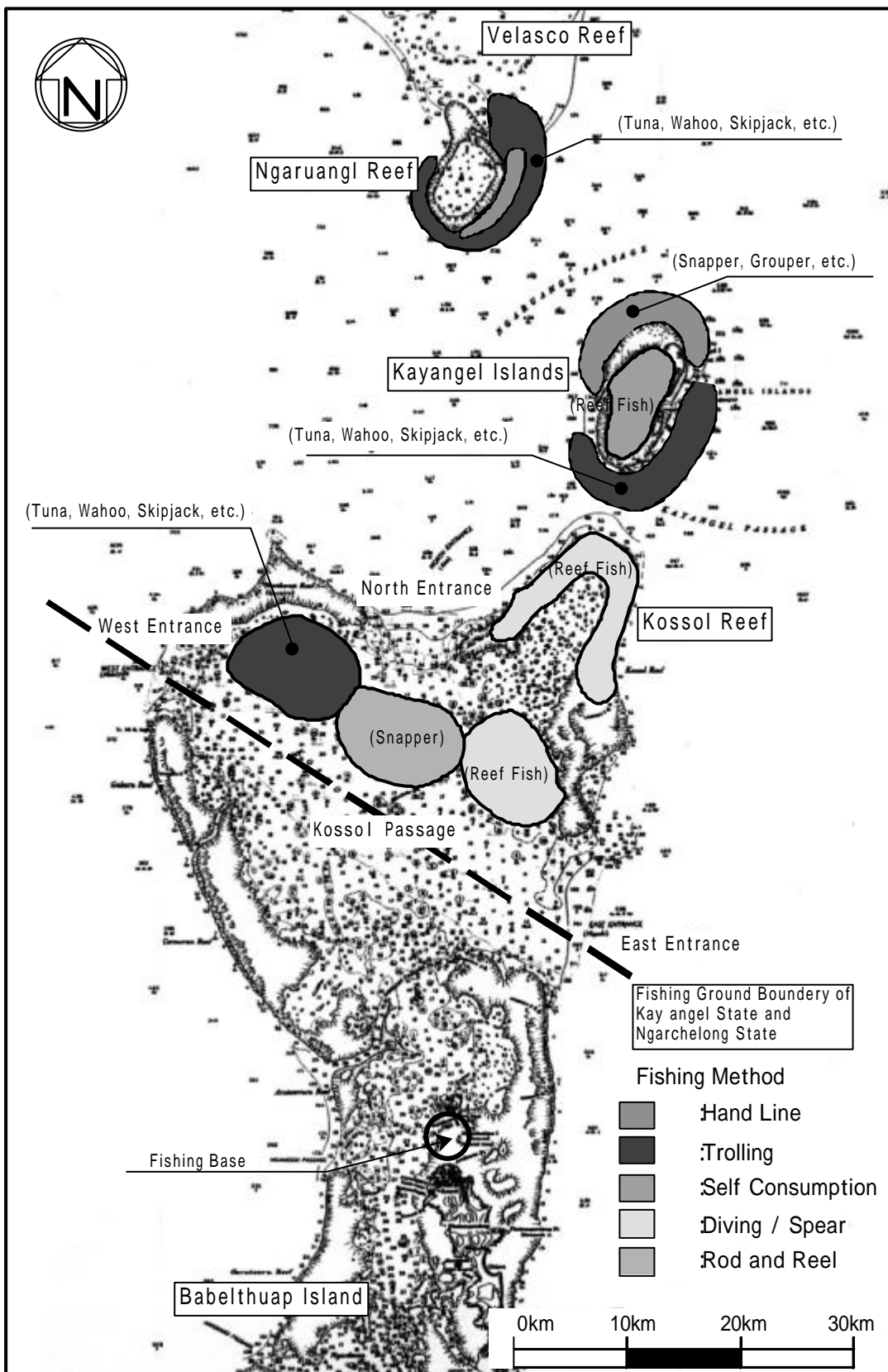
Fishing in the lagoon inside the Kayangel Atoll is allowed only for the self-consumption by the fishermen and their families. Fishery products for marketing is restricted for the fish catch outside the Kayangel Atoll. The fishing grounds are considered to be the area under Kayangel State's exclusive control. The state's law stipulates the zone as indicated in Figure 1.2.2-1. In the north-south direction, the zone extends from the center line of Kossol Channel located between Kayangel State and Ngarchelong State to Velasco Reef. And in the east-west direction the zone extents from 12 n. miles east of Kayangel Island to 12 n. miles west of Ulach Channel.

Fishing boats of trolling line and hand line leave for fishing trip at around 6 or 7 o'clock in the morning and return around 5 or 6 o'clock in the evening. Harpoon fishing by divers is conducted during nighttime, leaving at around 8 o'clock at night and returning the next morning. The fishing grounds are located approx. 1 hour to reach the farthest and less than 30 minutes to get the vicinity of the Kayangel Atoll.

#### **(7) Fish Catch**

There is a traditional custom that some portions of fish catch are consumed by fishermen themselves and their families, and are also distributed to relatives and friends. Division of Marine Resources, the Ministry of Resources & Development presumes that only about 35% of the fish catches is shipped to the market in Koror State and rest of them is allocated to such local consumption.

None of the fishermen has any records of their catches, so that it would be difficult to accurately estimate the total annual fish catches. According to hearing survey, fish catches of about 45 kg (100 pounds) is reported for a single trip in good operation. Based on the annual shipping volume to the different fish markets in Koror, annual average of about 11.33 tons is estimated in the past 5 years. Therefore, the total annual volume of fish catches can be calculated as about 32.4 tons considering the about above-mentioned self-consumption. Assuming that number of fishing boats in Kayangel State is 11 boats and average number of fishing operation is 15 to 20 days a month during 10 months of the year, a daily average fish catch volume is estimated as 15 to 20 kg/boat.



**Figure 1.2.2-1 Fishing Ground of Kayangel State**

### **(8) Fish Marketing**

Fish catches to be sold on the market is collected by the fishing cooperative and transported to Koror State by the medium-size fishing boat, the state-owned speed boat. Regarding reef fish, buying price of the fishing cooperative is US\$1.00 to 1.25 per pound and selling price to the market in Koror State is US\$1.5 per pound. Bottom fishes are dealt somewhat higher price than the reef fish. The fish products are sold mainly to the two fish markets namely Palau Modekngai Company Incorporated (PMCI) and Happy Fish Market and are not sold directly to hotels and restaurants by the fishermen.

### **(9) Fishermen's Income**

Based on the interview to the fishermen, part-time fishermen made US\$520 a month from their main job such as civil servant and about US\$500-600 a year from fishing operation as a sideline occupation. Total income of part time fishermen is estimated as US\$6,800 a year. Although interviews of fulltime fishermen engaged exclusively in fishery industry did not provide enough information to determine their income, it is estimated to be about US\$5,040 to 5,600 a year, assuming annual fishing operation from 180 to 200 days and 10 kg for the markets from the average daily fish catch of 20 kg and an average selling price of US\$2.8/kg.