Project for New Component Development in Fisheries Cooperation

Overseas Fisheries Consultants Association（OFCA）

Project for

New Component Development in Fisheries Cooperation

I. Introduction

The Overseas Fisheries Consultants Association (OFCA) is an association that was established with the aim of contributing to the effective promotion of overseas fisheries development projects. This is done by strengthening the cooperation system for fisheries development projects overseas, as well as improving the quality of overseas fisheries consulting-related engineers.

In the three-year period from FY 2006 to FY 2008, OFCA has implemented the “Project for New Component Development in Fisheries Cooperation” as commissioned by the Fisheries Agency of the Japanese Ministry of Agriculture, Forestry and Fisheries.

For this project, verification and feasibility studies were conducted for three critical issues in international cooperation for fisheries in developing countries. This took place in Africa, Oceania and the Caribbean Region with the aim of developing and introducing new components for international fisheries cooperation from Japan.

This document was created to report the results of this project, as well as to provide the promotion of awareness targeted both domestically and overseas.

II. Project Outline

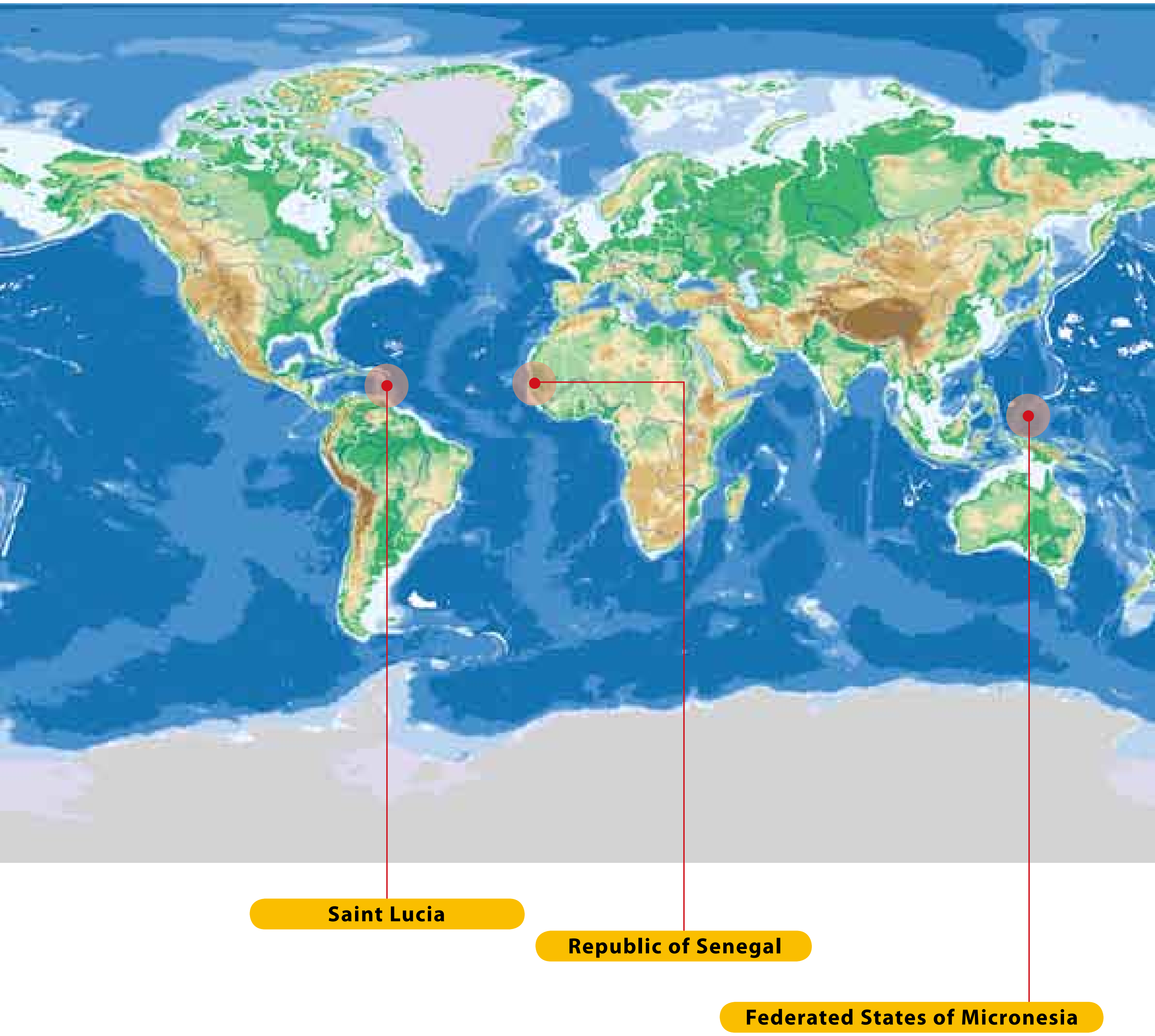
1. Project goals:

With the technical innovation and resource management of recent years in the area of fisheries, as well as the changes in distribution of marine products and consumer spending patterns, the situation surrounding the global fisheries industry is changing. Within this change, the requests from developing countries towards Japan for fisheries cooperation are becoming more diversified and complex. However, as there have not been any actual cases of implementation in developing countries through fisheries cooperation thus far of the components that have been requested, it is difficult to include them in the cooperation. Additionally, as we have seen the difficulty of maintaining and managing the equipment and materials that have been provided in the past, it is therefore necessary to develop cooperation components with emphasis on ease of maintenance and management, as well as durability.

Thus, for this project, the required cooperation components were developed, and practicality was verified through feasibility studies for these challenges faced by the developing countries that are building a close relationship in the fishing industry with Japan. Information is provided not only for fisheries cooperation personnel from Japan, but also for the developing countries. With the aim of contributing to future international cooperation from Japan in the area of fisheries, a project with the following three components was implemented.

2. Contents for feasibility studies

- **Fishing management system:**
  In the Republic of Senegal, a feasibility study using a Vessel Monitoring System (VMS) was conducted and a cooperation component for fishing management systems was developed.
- **Functional maintenance of fishing port:**
  In Saint Lucia, to relieve the problem of sand accumulation in the fishing port, a feasibility study for sand accumulation prediction using observed values gained from weather satellites was conducted.
- **Maintenance of fishing port environment:**
  In the Federated States of Micronesia, a photovoltaic system was introduced with the purpose of reducing existing power usage in fisheries-related facilities, and a feasibility study was conducted.


Saint Lucia
Republic of Senegal
Federated States of Micronesia

III. Results of Feasibility Studies

Fishing management system:

1. Background

For a nation rich in marine fishery resources, it is possible to allow foreign fishing vessels to use their surplus resources. It is also possible to promote the fishing industry in their own country by collecting fishing fees from these foreign fishing vessels. In these countries, the management and supervision of not only domestic commercial fishing vessels, but also of these foreign fishing vessels has become an issue. Presently, many countries have implemented a Vessel Monitoring System (VMS) that uses satellites for the purpose of keeping track of the operational status of fishing vessels.

However, in some countries, fishing management and monitoring activities using VMS and other methods are insufficient. Because of this, their current state is one in which illegal fishing, by vessels from both their own and foreign countries, has become a problem. In addition, even in countries that have implemented VMS, if its usage methods or choice of equipment is inadequate, effective fishing management is not being performed. Also, if foreign fishing vessels that want to fish in that country's waters are forced to make new equipment investments, it will impede that fishing, resulting in ineffective use of resources. Recently, methods have continued to be developed in which VMS is used to collect data on the marine environment and fishing grounds for research. The necessity for the creation of fishing management systems continues to rise for the purpose of the sustainable and effective use of global marine resources. Thus, in order to examine the development of components to answer these issues, feasibility studies were conducted in the Republic of Senegal on a system that keeps track of the operations of fishing vessels using VMS.

2. Feasibility studies

2-1. Activities in the Republic of Senegal

In the Republic of Senegal, the Supervision and Protection Bureau, which oversees the supervision, monitoring and control of fishing vessels, uses an Argos-capable system to display the position of ships. All commercial fishing vessels that operate within Senegal, both domestic and foreign, are required to be equipped with the Argos system.

With this system, problems include the inability to accommodate Inmarsat-equipped fishing vessels, and difficulty in determining illegal operations due to the low degree of accuracy of map information. In addition, there is a potential demand for fishing vessel location information to be used effectively by the Maritime Bureau for fishing management, etc. However, the relevant information was only available for use within the Supervision and Protection Bureau.

In order to answer these issues, it was decided that a system that could accommodate both Argos and Inmarsat, as well as display more detailed map information would be installed at both the Supervision and Protection Bureau and the Maritime Bureau, and the efficient use of fishing vessel location information would be examined.

In the project implementation period spanning over three years, in addition to the dispatching of Japanese engineers four times, Senegalese counterparts were invited to Japan where they received training at the Japan Fisheries Information Service Center, the Fisheries Agency, and the Japan Coast Guard. In the final year of the project, workshops were held for relevant personnel from Senegal, and also in Guinea where a report on the feasibility studies conducted in Senegal was presented.

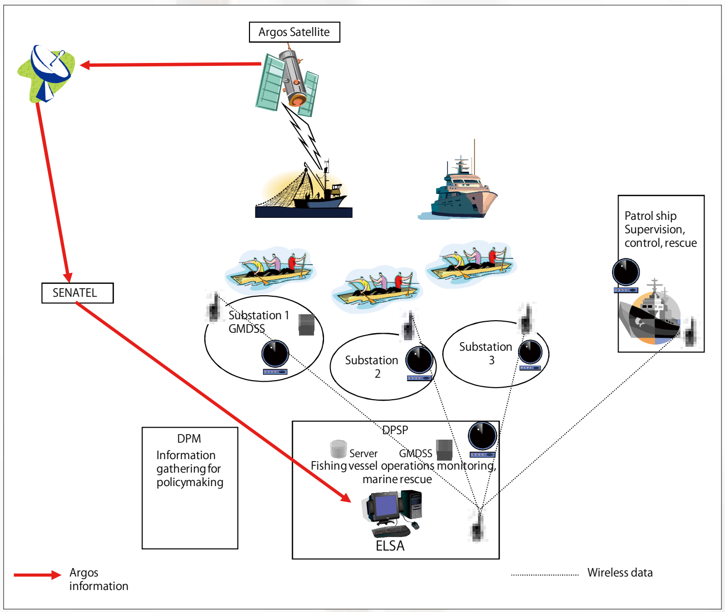


Chart 1. Concept chart of VMS conditions in Senegal

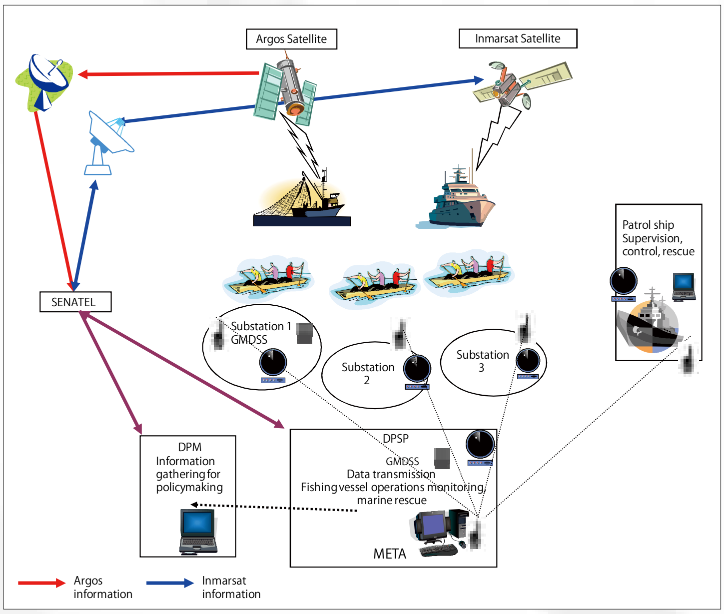


Chart 2. Concept chart after feasibility studies

2-2. Outline of VMS and types of devices

VMS is a system in which the movement and speed of ships can be monitored. The location, speed, direction and other navigational data is transmitted through a device mounted on the ships to an onshore monitor via satellites and landlines, simultaneously displaying information for multiple vessels. By using this system, illegal operations can be monitored, and measures for safe operations are made possible for efficient fishing management. Currently, the Inmarsat system and Argos system, which go through different satellites, are the two main types in operation.

• Inmarsat system

Inmarsat uses four stationary satellites to offer a communications service reporting ship-to-ship distance and ship-to-land distance. Characteristics of this system are that although the installed equipment is costly, it can provide continual communications and data exchange between ships and land stations. In addition, while telecommunications costs are incurred by both the ships and land stations, these costs are relatively low.

Chart 3. Inmarsat VMS terminal installed on ships

• **Argos system**

Argos is a data gathering system that was developed for research purposes, including environmental studies. Its satellite moves around the polar orbit as it collects data transmitted from various types of sending devices. Characteristics of this system are that while equipment and maintenance management costs are low, it cannot provide continual transmission. Additionally, the speed at which information is acquired changes with the position of the satellite.

Chart 4. Argos VMS terminal installed on ship

There are several types of VMS software, which displays information about the position of ships on a computer screen. For small-scale systems, there is software that runs on one computer, and also a type that displays ship information on multiple terminals. One VMS software that runs on a single computer and was used for this feasibility studies is META, from the French company CLS. META has the following functions.

- VMS data from Argos and Inmarsat satellites is received via the internet.
- The position, speed and direction of each ship are displayed on an onscreen map.
- Setting an area on the map, an alarm goes off automatically when registered vessels enter and leave the set area.

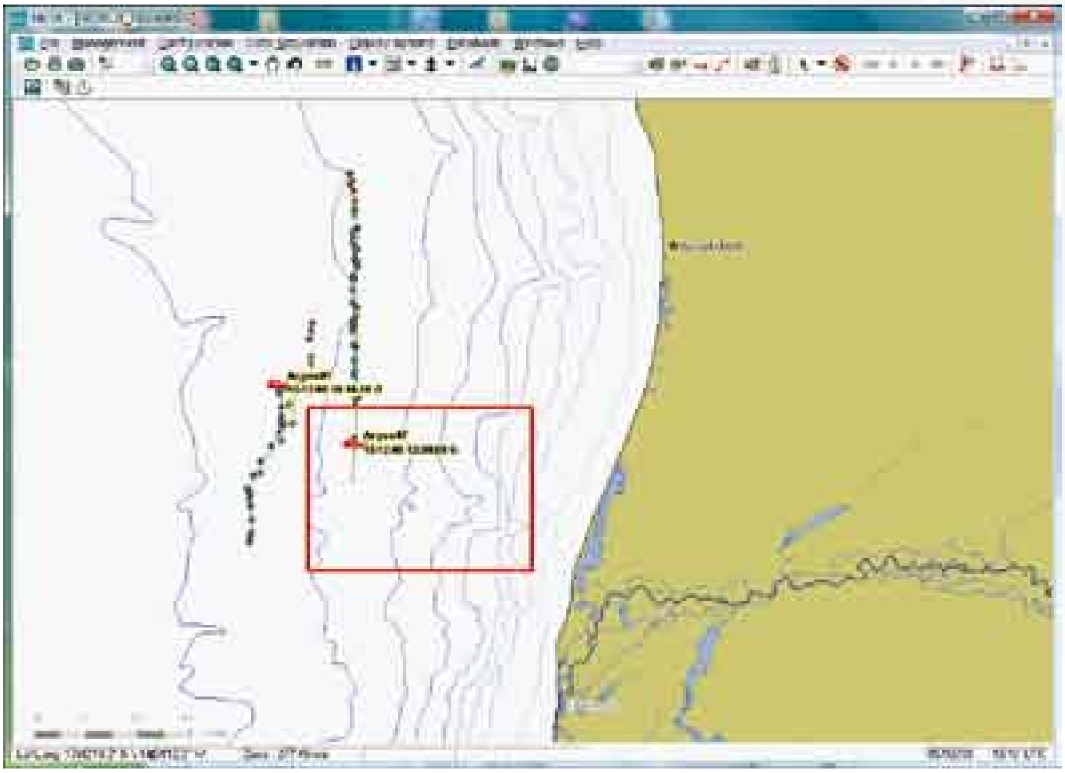


Chart 5. VMS display screen – simulation of setting a prohibited fishing zone as shown by the square marking

2-3. Comments at workshops and effects of this project

The following reports and comments were given at the workshops held in Senegal and Guinea.

- In Senegal, since the change of VMS equipment in the beginning of 2007, a deterrent effect in illegal operations has become apparent. In particular, intrusions into prohibited fishing zones, false reports and illegal operations during closed seasons showed a remarkable decline after the change in VMS equipment. In 1998, illegal operations were over 30%, but declined to 10% by 2007. In 2008, there were no confirmed cases of illegal operations.
- Although VMS is effective against illegally operating fishing vessels, on the other hand, fishing vessels that are not equipped with VMS transmitting devices are not monitored as operating illegally. Therefore, it is necessary to combine VMS with other monitoring methods such as radar, etc.
- VMS is not only useful for monitoring fishing, but by analyzing information on operation locations and catch volumes, knowledge about the state of resources can also be gained.
- For implementing VMS to small scale fishermen, the costs for installing transmitters on their boats (pirogues) and transmission costs are problematic. However, as a part of safety measures, it is advisable to track the location of these small scale fishing boats in particular, especially in the case of an accident.
- This system monitors the fishing activities taking place not only in their own seas, but can also ascertain fishing trends in international waters and the seas of other nations. This can contribute to joint control activities within areas or between neighboring countries.

By the installation of this system, efficient fishing management is made possible. This includes deterring illegal operations, improving fishing vessel monitoring efficiency and protecting small scale fishermen. In the future, by analyzing these information datas on fishing grounds, etc. is expected to contribute to effective resources management measures and regional fishing management.

3. Requirements for installation of the system

3-1. Electrical conditions

If there are frequent power outages, private generator devices or UPS, etc. should also be installed, as a stable electricity supply.

3-2. Network environment

To gather data through a satellite, it is necessary to connect the data processing center and the land station via the internet. For this, a high-speed internet connection (ADSL, etc.) is essential.

Additionally, access to an email server (POP, SMTP, etc.) is also advisable.

In the future, the creation of a network with its own server is also possible.

3-3. VMS software

Since META is a software that does not assume the use of LAN or other network, each configuration must be tested separately for data sharing over a network. In addition, there is also software available for managing multiple fishing vessels on a large-scale network, displaying marine data as a part of resources management, and linking satellite radar images with shore radar information.

3-4. Technical requirements

Use of the software that is expected to be installed is not very difficult. A level of computer skill at which regular Windows applications (Word, Excel, etc.) can be operated is sufficient. However, knowledge of computer systems management will be necessary if the VMS is further developed in the future by building a network or managing multiple fishing vessels.

3-5. Information management, etc.

If fishing management using VMS spans over multiple management organizations, it is necessary to clarify the division of roles among them. Additionally, information gained through VMS may include important items, therefore, the creation of guidelines regarding the handling of information is necessary.

Functional Maintenance of Fishing Port:

1. Background

In general, it is difficult to completely avoid sand accumulation in harbors built on shallow sand beaches, and dredging is necessary to maintain the harbor's functions. If this necessary dredging is not performed, the fishing port will cease to function properly, thus limiting the development of the fishing industry.

Because of this, when building a fishing port on shallow sand beaches, it is critical to consider the effects of sand accumulation. If future sand accumulation conditions can be predicted when designing the fishing port, a design can be devised in which effects of sand accumulation are lessened. Also, by predicting maintenance dredging that may be necessary for the harbor in the future, it can be included in the management plan for the harbor.

However, when predicting the conditions of sand accumulation, the calculations made from actual measurements taken on-site must be relied upon. Therefore, in locations where there is no existing data, it is currently difficult to obtain sufficient information.

As data to supplement the calculations made from actual measurements taken on-site, wave forecasting using meteorological data (Global Spectral Model) and geomorphic change simulations were performed, with the examination of the usability of these results as a goal for this project. Feasibility studies were performed at the Choiseul fishing port in the country of Saint Lucia to compare these simulation results with actual water depth measurements.

2. Feasibility studies

2-1. Understanding wave conditions using Global Spectral Model

We first examined methods of understanding wave conditions at the point of planning, which is the most fundamental external force when considering measures against sand accumulation in fishing ports. Regarding wave conditions, it is important to understand the characteristics of the waves that arrive at the beach under normal circumstances including volume, direction and frequency. Regarding long-term trends in geomorphic change, we have come to understand that they are impacted greatly by wave patterns under normal conditions (waves are low in height, but have a long duration of effect). Meanwhile, it is known that the high waves that come with hurricanes, etc. cause a large geomorphic change in a short period of time. (At the Choiseul fishing port, as an effect of waves from hurricane Ivan in August 2004, a portion of the earth and sand disappeared. After this, over a period of approximately one year, the speed of sand accumulation progression within the harbor slowed.) However, this type of geomorphic change is temporary, and in general, including the case of Choiseul, it returns to its former state gradually.

In order to estimate normal wave patterns, wind data is necessary. Provided by the Japan Meteorological Agency, "Global Spectral Analysis Data" was used for this project. This data is weather (including wind) data that is organized as time-series data for the entire globe, showing various weather elements including wind direction, wind speed, atmospheric pressure, temperature, humidity level, etc. (Ref. Chart 1) By using this data, it basically becomes possible to estimate the wave patterns at any point in the world. Based on this wind data, wave estimation was performed using the "one-point spectrum method." (In the same manner as wave patterns under normal conditions, wave estimation is possible in the case of large-scale hurricanes as well.)

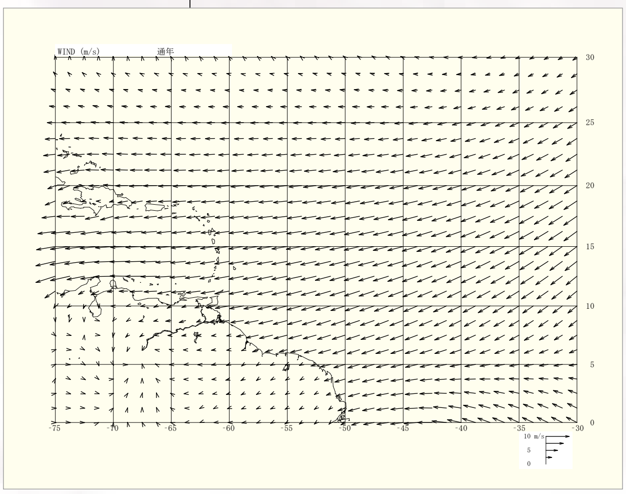


Chart 1. Average wind distribution in the western Atlantic Ocean per global spectral analysis weather data (2002-2006, year-round)

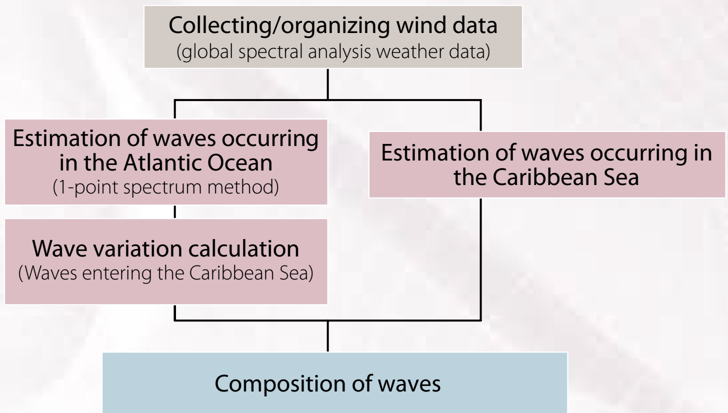


Chart 2. Wave pattern estimation method using global spectral analysis weather data

2-2. Verifying the applicability of geomorphic change simulation methods

Many numerical simulation models for analyzing geomorphic change have been proposed, but the true state of geomorphic change is complex, and a method has not yet been established. Because of this, the geomorphic change simulation model applied here was compared to the results of continuous depth surveys with the goals of understanding local geomorphic change characteristics, improving the accuracy of the geomorphic change simulation model, and evaluating its applicability.

① Understanding local terrain characteristics

a) Understanding arriving wave patterns by surveying surrounding beaches

By investigating the direction of the sand beach portions of surrounding ocean areas, the direction of the waves arriving at the target ocean area can be estimated. Furthermore, in addition to site reconnaissance, it is important to improve reliability by using multiple methods including aerial photographs, written documents, hearing surveys, etc. By comparing these results, the wave estimation values found in Section 2-1 were modified and wave conditions that are closer to reality were set.

b) Understanding the feed source of drift sand

The feed of sediment on the beach consists of the sediment volume that flows down from rivers and the sediment volume fed into the target seashores (or sediment volume runoff to the outer side). For the target seashores, the shore transport rate is estimated based on the rate of shore transport calculated with the longshore sediment transport rate formula and the condition of the beach (ratio of sand beach areas, etc.).

c) Estimating stable conditions for drift sand

At natural beaches, conditions are fundamentally stable. For the coastal shape to change over a long term, there may be a large change in the conditions, including external forces such as the building of structures on the drift sand beach.

However, it is necessary to distinguish between stable conditions and conditions that appear to be stable on the surface. While sometimes there is almost no longshore drift, there is also the case where there is longshore drift, but the income and outgo of feed and runoff sediment is balanced. Especially for the latter, if structures are built within this range, geomorphic change will occur in the surrounding areas. Furthermore, if seasonal geomorphic change is also considered, it is necessary to understand the state of geomorphic change through on-site surveys.

② Implementation of geomorphic change simulation

Based on the above results, a numerical simulation for geomorphic change will be implemented to examine the shape of a fishing port with little geomorphic change, while changing the shape of the harbor. Additionally, this numerical simulation for geomorphic change can contribute to the formulation of countermeasure construction if sand accumulation occurs within the harbor.

a) Applied geomorphic change simulation model

As a computational model for submarine topography change, there is a method called the "power model." This method targets a relatively small area and is suited for predicting the geomorphic change in the vicinity of structures. For this project, several conditions, including environments and periods based on actual waves, were set for this power model as a method of making sequential and continuous calculations for geomorphic change. Furthermore, a continuous calculation model considering the changes in waves and flow accompanying geomorphic change was also created to increase the level of accuracy for the calculations. (Ref. Chart 3.)

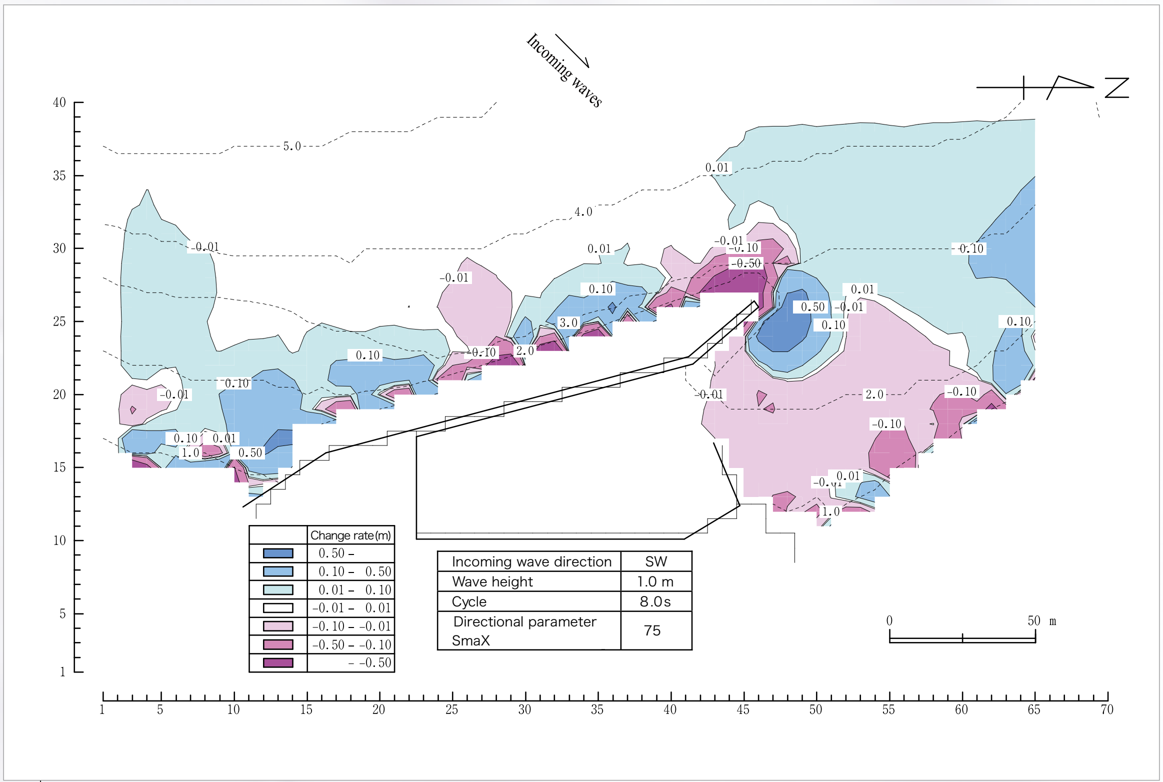


Chart 3. Numerical simulation results (continuous calculation, 1 year later)

b) Implementation of depth survey

Using depth surveys, an understanding was gained regarding the submarine topography change that accompanied sand breakwater extension construction at Choiseul fishing port. The depth surveys for this project were simplified so that they could be performed easily on-site (Ref. Chart 4.), and were performed using local counterparts.

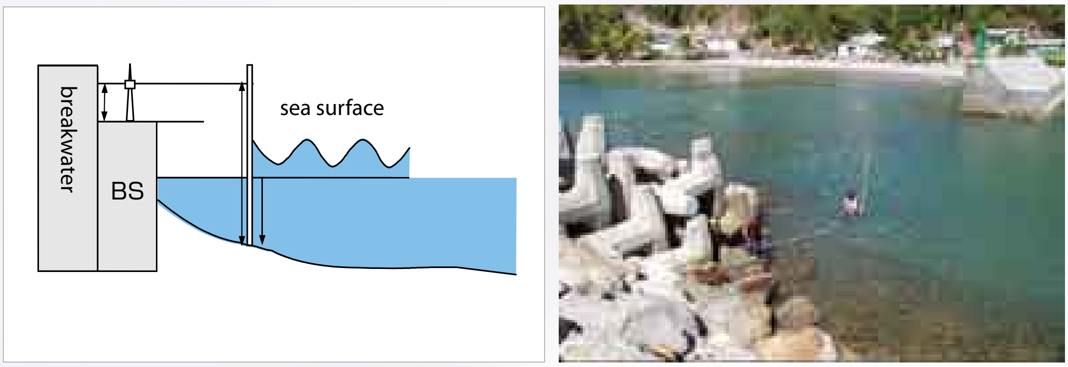


Chart 4. Example of a simplified on-site depth survey

③ Adaptability verification of geomorphic change simulation model and depth survey results

Regarding the applicability of the above geomorphic simulation model, the results of the simulation and depth survey were compared. As a result, it was confirmed that although there is an effect on geomorphic change from hurricanes, the applicability of the above geomorphic change simulation model is high.

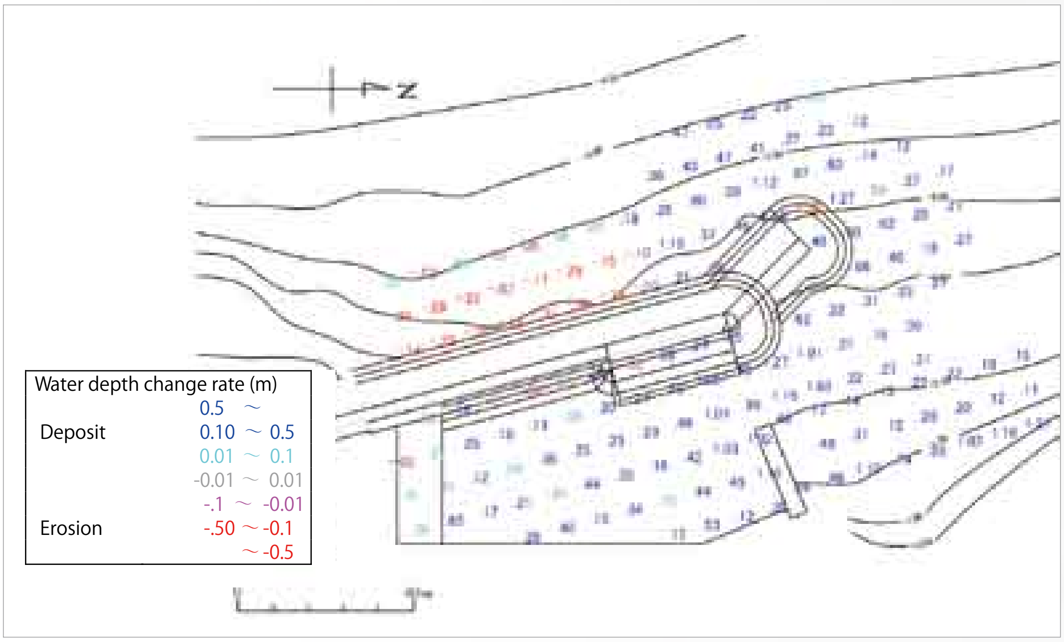


Chart 5. Comparison with depth survey results (approx. 6 months after sand dike placement)

3. Proposals for the implementation of analysis methods using global spectral values and simplified maintenance management methods for fishing port functions

With the wave estimation method using the above observed values and with geomorphic simulation, it has become easier to examine a fishing port shape in which sand accumulation is less likely to occur. In the future, by combining analysis methods that use these observed values with the former methods of analysis that have been used in the past, we can expect an improvement in the level of accuracy for analysis of the sand accumulation mechanism in areas where there is little existing data on natural conditions, etc.

In addition, as a general item, if there is a request for cooperation regarding fishing port construction planning, the requesting country will collect data on wind direction, wind force, and wave height/length, etc. year-round in the vicinity of the planned site in advance. This will contribute to the smooth and speedy implementation of the plan, as well as the further improvement of the system for designing a fishing port in which sand accumulation problems are not likely to occur.

After the design and construction of the fishing port, small to mid-sized harbors in particular will differ in the degree to which sand accumulation in the harbor can be prevented. Therefore, to maintain fishing port functions, a minimum level of dredging is necessary. For fishing ports that have the possibility of sand accumulation, government officials should be made aware of the necessity of fishing port maintenance management.

In accordance with the harbor sand accumulation simulation results, proposals for concrete methods of fishing port function maintenance should be examined in the future. These proposals include a plan to use a wharf or landing facility placed behind the breakwater as a path for maintenance dredging equipment for dredging done at the harbor entrance. Additional, there is a proposal for the installation, from the planning stages, of a seawater exchange system that uses the difference in water levels from inside and outside of the harbor.

Maintenance of fishing port environment:

1. Background

As an environmentally-caused, region specific problem to the South Pacific Islands, maintaining an infrastructure for such things as electrical power and drinking water is difficult. This is one factor impeding the development of the fishing industry, as well as the lifestyles of residents, including fishermen. Therefore, the development of a cooperation component that was durable and cost-effective was required to contribute to the alleviation of this problem.

In this project, and for fishing port facilities that form the foundation of fishing industry development, feasibility studies were conducted for fisheries-related facilities in Yap Island, the Federated States of Micronesia.

2. Feasibility studies

2-1. Goals

On Yap Island in the state of Yap in the Federated States of Micronesia, the soaring price of crude oil has pushed electricity costs higher. In the area of fisheries as well, high fuel costs have limited fishing activities and affect various economic activities on the island, including rising fish and ice prices.

The Yap Fishing Authority (hereinafter called YFA) is mainly active in the areas of selling ice and fresh fish caught by their boats to the islanders. The ice sold is used for a wide variety of purposes including small scale fishing on the island, distribution and food preservation, making YFA’s ice production and sales very important. However, as significantly high electricity costs at YFA have put pressure on operations, is critical to reduce those costs and return YFA to a healthy operating state, as well as make improvements in the effective use of marine products through preservation of freshness.

For this project, feasibility studies were carried out at YFA for the introduction of photovoltaic power not requiring storage batteries, with the goal of reducing YFA’s electricity costs.

2-2. Photovoltaic system (interconnected type) outline

Chart1. About the photovoltaic (interconnected type) system

Characteristics	Although photovoltaic power will be mainly used, existing power sources will be used at night and when there is no sunlight. CO_2 is not emitted during power generation. Storage batteries are not used.
Merits	No storage batteries. Reduction of maintenance management costs and workload. No environmental impact of battery disposal. Since electricity is supplied together with existing power, there is no need to establish an excessively large system. Since there are no CO_2 emissions, it does not contribute to global warming.
Demerits	As there is no storage battery, power is not generated at night. Initial investment in the system is costly.

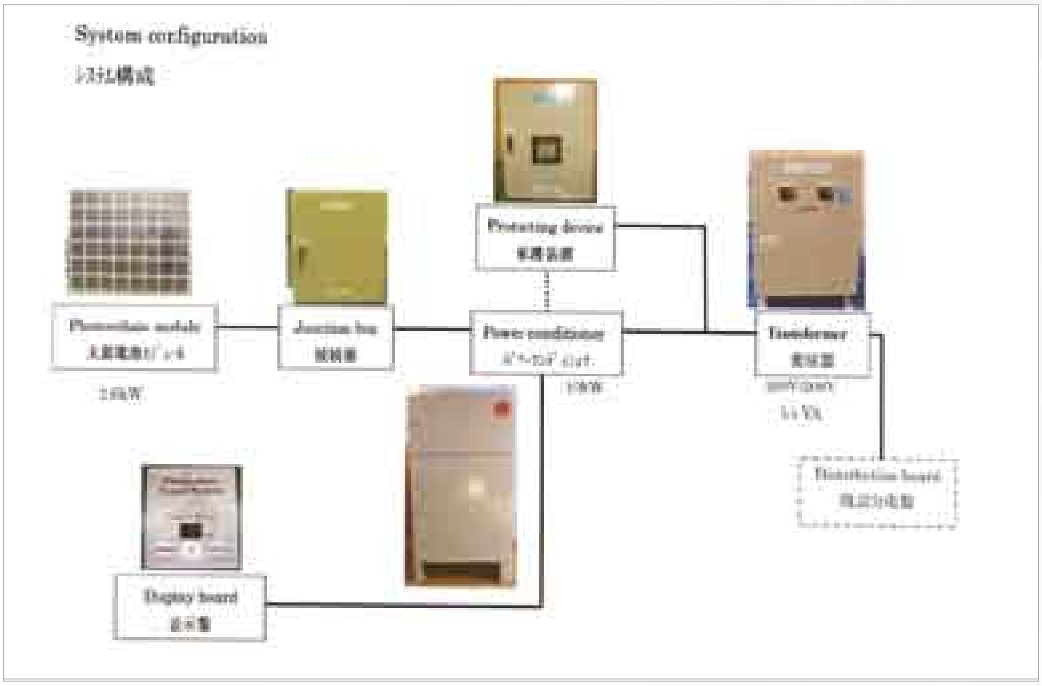


Chart2. Interconnected-type photovoltaic system diagram

2-3. Detail contents of feasibility studies

• At the YFA facility, equipment was installed for an approximately 2.625 kw interconnected-type photovoltaic power generation system. The amount of power generated through solar power and the overall electricity used by the existing facility was monitored.

Photovoltaic panels

Protecting device,
power conditioner, transformer

Junction box

Display board

Chart3. Actual equipment installed

2.4. Results

• The results of a ten-month period of monitoring from mid-February 2008 to mid-December 2008 show that the overall YFA facilities electricity usage was an average of 12,640 kWh per month with an electricity cost of $2,787. Additionally, the amount of photovoltaic power generated was an average of 298 kWh per month.

• Ten months of photovoltaic power generation produced approximately 2.4% of YFA's overall facility electricity usage, resulting in a reduction of electricity costs of about $659 (using YFA electricity cost units).

Chart4. Monitoring results

Period	YFA electricity usage		Photovoltaic power volume (kWh)	Ratio of photovoltaic power in YFA electricity usage (%)
	Electricity volume (kWh)	Electricity cost ($)		
February 2008	12,960	2,858	383	3.0
March	12,720	2,805	363	2.9
April	12,320	2,716	261	2.1
May	14,080	3,107	250	1.8
June	13,360	2,947	237	1.8
July	11,680	2,574	260	2.2
August	12,240	2,698	310	2.5
September	10,800	2,379	263	2.4
October	13,600	3,000	334	2.5
November	12,640	2,787	326	2.6
Total	126,400	27,871	2,987	Average 2.4%

2-5. Optimal scale for this system at YFA

- In this system, not only would power generated in excess be wasteful, but could also produce a negative effect on the electrical system. Therefore, the optimal scale for photovoltaic power for the facility would aim to generate power for daytime electricity consumption at the facility when sunlight is strong and the most energy could be produced. This is thought to be the most effective method.
- In the case of YFA, the equipment consuming the most electricity during the day is the ice storage room and office equipment (computers, air conditioner, lights, etc.). The optimal scale for this power usage is 9.53 kw, and a reduction of approximately 8.7% in electricity consumption for the overall facility is expected.

(*At YFA, the ice-making machine is run at night, therefore, daytime power consumption is low compared to nighttime consumption, reducing the optimal scale of this system, as well as the electricity reduction effects. However, at most ice-making facilities, ice is produced during the day, in which case this system's optimal scale and electricity reduction effects are expected to be greater.)

3. Installation of this system in other regions

3-1. General conditions regarding the installation of this system

☐ Environmental conditions:

The solar panel (hereinafter called "panel") should be facing south in a place that does not become shaded.

The panel should be placed so that is cannot be directly touched, and cannot be damaged by flying objects, etc.

The panel should be placed so that it is not in contact with sea water.

If the panel is installed on a roof, the roof's structure must be able to support the weight of the panel.

The temperature at the place of installation should be less than 90°C.

☐ Electrical conditions:

Low occurrence of frequency fluctuations and electrical power variance.

Ability to draw commercial-use electricity from the power plant.

☐ Optimal scale:

Same scale as peak electric power energy in the daytime.

☐ Precautions and installation conditions:

It is necessary to take precautions against lightening, typhoons (wind and flooding from storm tides), sudden natural disasters and salt damage.

3-2. Possibilities for the installation of photovoltaic power at other fisheries-related facilities and anticipated effects

- Regarding the possibility for the installation of photovoltaic power at other fisheries-related facilities and anticipated effects, installation can be done with the goal of reducing electricity consumption at new and existing fisheries-related facilities.
- The main locations for installation of this system and the anticipated effects are as follows. For ice-making facilities, seedling production and aquaculture facilities, a stable supply of products and lower selling prices can be achieved with the reduction of production costs for ice and seedlings. Also, at fish markets and fish landing centers, a reduction in facilities usage fees can also be anticipated.

3-3. Others

- If installing a photovoltaic power system on outer islands, and this system cannot be directly installed (islands with no power plant, etc.), installation of combined system of private power generators and photovoltaic power can be considered.
- With the installation of a stand-alone photovoltaic power generator, battery maintenance management and disposal are issues. However, since batteries with improved durability and maintenance management have been developed, it is necessary to examine the possibility of their installation.
- Many of the island countries in the Pacific Ocean show strong interest in the prevention of global warming. Implementing projects that reduce oil consumption and CO_2 emissions on the island of Yap, as well as other island nations, hold significant meaning from an environmental perspective. In addition, taking protective measures for global weather and the ocean environment will be of great use in the advancement of the world's fishing industry over the long-term.

Overseas Fisheries Consultants Association

Fisheries Agency
Government of Japan

Overseas Fisheries Consultants
Association（OFCA）

Published by the Overseas Fisheries Consultants Association (OFCA)
Address: Murakoshi Building 6F, 3-21-6 Uchikanda, Chiyoda-ku, Tokyo, Japan 101-0047
Telephone: 03-3254-9001
Facsimile: 03-3254-9003