JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

ST. VINCENT & THE GRENADINES
MINISTRY OF AGRICULTURE,
INDUSTRY AND LABOUR

BASIC DESIGN STUDY REPORT ON THE COASTAL FISHERIES DEVELOPMENT PROJECT IN ST. VINCENT & THE GRENADINES

MAY 1993

OVERSEAS AGROFISHERIES CONSULTANTS CO., LTD.

JICA BASIC DESIGN STUDY REPORT ON THE COASTAL FISHERIES DEVELOPMENT PROJECT IN ST. VINCENT & THE GRENADINES MAY 1993

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

ST. VINCENT & THE GRENADINES
MINISTRY OF AGRICULTURE,
INDUSTRY AND LABOUR

BASIC DESIGN STUDY REPORT
ON
THE COASTAL FISHERIES DEVELOPMENT PROJECT
IN
ST. VINCENT & THE GRENADINES

MAY 1993

OVERSEAS AGROFISHERIES CONSULTANTS CO., LTD.

PREFACE

In response to a request from the Government of St. Vincent and the Grenadines, the Government of Japan decided to conduct a basic design study on the Coastal Fisheries Development Project in St. Vincent and the Grenadines and entrusted the study to the Japan International Cooperation Agency (JICA).

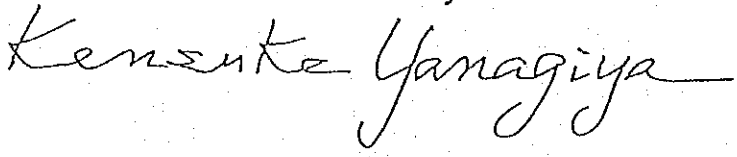
JICA sent to St. Vincent and the Grenadines a study team headed by Mr. Kanji Kitazawa, Assistant Director, Ministry of Foreign Affairs, Department of Economic Cooperation, Grant Aid Division, and constituted by members of Overseas Agro-Fisheries Consultants Co., Ltd., from 10 January to 18 February, 1993.

The team held discussions with the officials concerned of the Government of St. Vincent and the Grenadines, and conducted a study at the field study area. After the team returned to Japan, further studies were made. Then, a mission was sent to St. Vincent and the Grenadines in order to discuss a draft report and the present report was prepared.

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 St. Vincent and the Grenadines for their close cooperation extended to the teams.

May 1993



Kensuke Yanagiya
President
Japan International Cooperation Agency

31 May, 1993

Mr. Kensuke Yanagiya,
President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

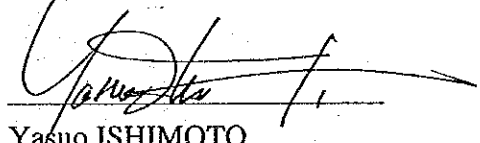
We are pleased to submit to you the basic design study report on the Coastal Fisheries Development Project in St. Vincent and the Grenadines.

This study was conducted by Overseas Agro-Fisheries Consultants Co., Ltd., under a contract to JICA, during the period of 8 December, 1992 to 31 May, 1993. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of St. Vincent and the Grenadines and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, the Ministry of Foreign Affairs, and the Ministry of Agriculture, Forestry and Fisheries, Fisheries Agency. We would also like to express our gratitude to the officials concerned of Ministry of Agriculture, Industry and Labour, the Embassy of Japan in Trinidad & Tobago for their cooperation and assistance throughout our field survey.

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

Very truly yours,



Yasuo ISHIMOTO
Project manager,
Basic design study team on
the Coastal Fisheries Development Project
in St. Vincent & the Grenadines
Overseas Agro-Fisheries Consultants Co., Ltd.

SUMMARY

St. Vincent & the Grenadines is a volcanic archipelago in the East Caribbean sea. It gained independence from United Kingdom in 1979. The country is surrounded by rich fishing grounds having pelagic fish resources such as skip jack, tuna, etc. and demersal fish on the continental shelf. However, the fishing industry on the island is small scale, therefore, productivity is limited. The economy of the country has developed based on a mono-cultural formed agriculture industry revolving mainly around the export of bananas. However, because of the emergence of a unified European market, the banana export business has been looking gloomy. For this reason, the Government decided to institute a national development Five year project (1991 - 1995) with the intention of restructuring the economic structure through diversification of the primary industry, based on the slogan "Balanced Growth and Sustainable Development". Concerning the fishing industry, especially, because of abundant unused resources and demand for fish both the market in domestically and internationally and also in that the people of the country are accustomed to a sea life traditionally, the fishing industry is positioned as a prominent field which can be expected to develop in the future. Unfortunately, establishment of facilities and systems to support fishing industry is delayed because of lack of funds and the current situation in regard to fishing is not active.

Reflecting on this background, the Government of St. Vincent & the Grenadines government decided on a coastal fishery development plan primarily for establishing fisheries supporting facilities in the Grenadines because it is an urgent matter to develop the coastal fishery and effectively use marine products. To implement this project, the government made a request to the Japanese government for Grant Aid assistance. Based on the request, the Government of Japan decided to conduct survey the basic design of the project, and the Japan International Cooperation Agency (JICA) dispatched the basic design study team to St. Vincent & the Grenadines from 8 January to 18 February in 1993. The team confirmed the contents of the request, had discussions about the details of the project, and carried out survey of the soil and the condition of the sea. After that, the JICA again dispatched a draft report explanation study team from 17 April to 26 April to discuss the results of the basic design planning. The results of the survey determined the project to be necessary and reasonable for St. Vincent & the Grenadines. It has been decided to build Fisheries Centers at two sites, Paget Farm in Bequia Island and Clifton in Union Island, and to provide equipment such as an ice-making machine, refrigerator and other equipment in the Kingstown fish market.

This project is to build Fisheries Centers at two places of remote islands in order to support safe and efficient coastal fishing operation. With the establishing of the centers, fishermen will always be able to receive extension service from the government, thus, their fishing technique may be improved, the fish distribution channel may be secured and fishing can be established as a viable business. Furthermore, the fishery cooperative may be systematized and activated, consequently, the level of fishermen's life may be improved. In addition to this, it has been confirmed that the ice-making machine and refrigerator to be installed in Kingstown will permit stable fish distribution throughout the year and the consumer price of fish can be stabilized.

The team have reached the conclusion that in order to achieve the goal, preparation of the following facilities and equipment is most effective and efficient.

1. Paget Farm (Bequia Island)

1) Port engineering facilities
   a. Breakwater : 20m long, rubble mound slanted embankment
   b. Mooring quay : 24m for small and 35m for medium sized boats
   c. Landing place : 35m slipway, 7m x 35m landing place
   d. Reclaimed revetment : 50m wave break revetment, 90m perpendicular revetment
   e. Access road : Road 6m x 70m, road bridge 6m x 4m

2) Building
   a. Center building : 2 storied (385m^2), shippng packing space, office, ice making machine, chilling room
   b. Locker building : Accommodates 20 lockers for fishermen
   c. Toilet and shower building: Rest room, shower
   d. Fish processing area : Sea water supplied sink

3) Facilities
   a. Water supply system : Rainwater tank (150 tons), elevated tank
   b. Ice making machine : 2 tons/day, flake ice
   c. Fuel supply : Gasoline tank (2kl)
   d. Cylinder filling up : Compressor for Cylinder charging
   e. Drainage system : Treatment tank
   f. Emergency power supply : Diesel engine generator 20KVA

4) Equipment and materials
   a. Extension equipment : a 4WD pick-up truck, boat (with outboard engine) 7m long
   b. Marketing material : 58 insulated boxes, 1 platform scale

2. Clifton (Union Island)

1) Civil engineering facilities
   a. Pier: 10m, Pile type 5m x 30m (+1.5m)
   b. Landing place : Slipway 30m, landing area 7m x 30m

2) Building
   a. Center building : 1 story building A (176m^2), building B (100m^2) shipping, packing area, office, ice making machine
   b. Locker building : Accommodates 16 lockers for fishermen.
   c. Toilet and shower building : Rest room, shower
   d. Fish processing area : Sea water supplied sink

3) Facilities
   a. Water supply system : Rainwater tank (120 tons), elevated tank
   b. Ice making machine : 1 ton/day, flake ice
   c. Fuel supply : Gasoline tank (3kl)
   d. Cylinder filling up : Compressor to charge cylinder
   e. Drainage system : Treatment tank
   f. Emergency power supply : Diesel engine generator 20KVA

4) Equipment and materials
   a. Extension equipment : 1 pick-up truck, boat (with outboard engine) 7m long.
   b. Marketing material : 43 insulated boxes, 1 platform scale

3. Kingstown fish market

1) Ice making, refrigeration equipment
   a. 2 tons/day, flake ice, ice storage 6 tons
   b. 2 rooms (-5 °C and -20 °C), total 30m^2

2) Fish quality inspecting instrument
Quality inspection instrument such as K value measurement, Conway unit

3) Fish processing equipment
Belt saw, vacuum sealing machine, fish meat separator

The implementation body of the project is the Fisheries Division of the Ministry of Agriculture Industry and Labor, and the Government will take the leading role of operating the center at the initial stage, then in 5 years, actual operation of the facilities will be transferred to the Fishery cooperative of each island. Taking account of natural conditions of the project site and staff position plan, budget operation plan, etc. of the implementation organization, the team have conducted on the basic design of facilities and equipment, etc. required for implementation of projects which can be smoothly operated by current technological level and people.

The project cost responsible for St. Vincent & the Grenadines government is already allocated and the land reclamation can be started any time when the two governments commitment become effective. Detail design takes 4.0 months and construction takes 12.0 months, for the completion of the project.

Implementation of the project can be expected to improve the working environment of the fishermen in the Grenadines drastically and fishery productivity can be greatly improved. The following effects can be obtained in detail.

a. Fishery productivity is improved and the income of fishermen is increased.
b. Fishing technique is improved and the available fishing ground is expanded, thus use of unexploited resources becomes possible.
c. Improvements in marketing and distribution enable expansion of fresh fish distribution and small scale fishermen's net income is improved.
d. Safety of fishing operation is secured and employment becomes stable.
e. Accurate fisheries statistics collection permits the fisheries industry to transfer to a resources based management type fishery.
f. The quality of fish to be distributed is improved, and hygienically safe fish can be supplied.
g. Development of new fish products processing is promoted.

As explained above, implementation of the project can be expected to be useful for both small scale fishermen and people in general. Also, it is supposed that it will greatly contribute to the structure of country's economy in terms of diversification of the primary industry, which is the Government's aim. Therefore, it can be judged to be so meaningful that the project will be implemented by Japan's Grant Aid System. In addition, to ensure the success of the project by effectively using facilities and equipment to be provided, it is desired to promote well-balanced production and protection of marine resources and management and control type fishery which gives consideration to preservation of the environment.

Accompanying with implementation of the project, that technical assistance to develop a small-scale coastal fishery (including marketing of fish), and provide technical guidance for the development of Fishery cooperative by the experts shall be more effective and efficient for the successful achievement of the project.

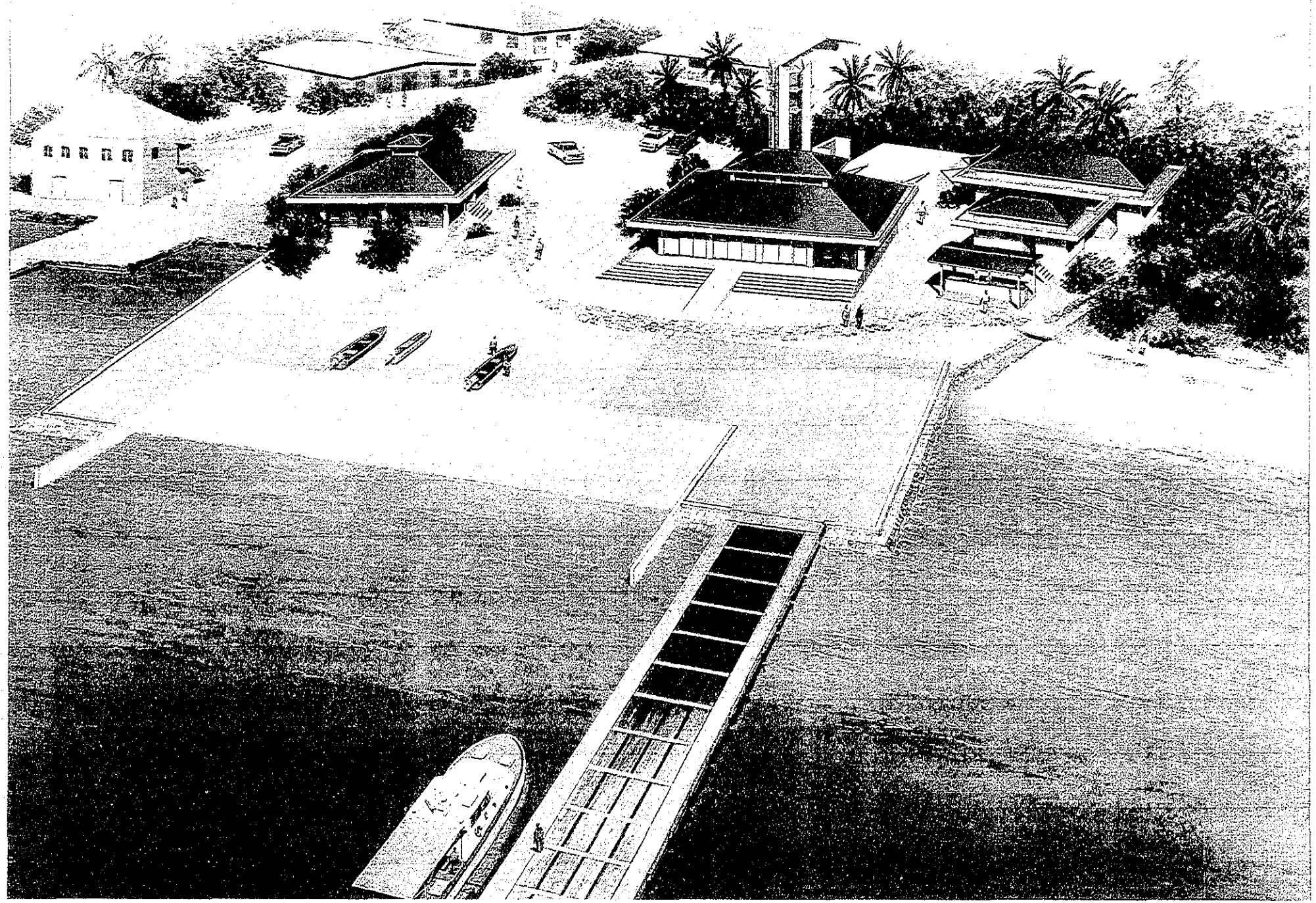


TABLE OF CONTENT

CHAPTER 1 INTRODUCTION

St. Vincent & the Grenadines has been endeavoring to break away from extreme dependence on their primary industry, the mono-cultural banana production industry, so that they can diversify their industry in order to be able to better navigate the unpredictable currents of the international economy. With the national 5-year project (1991 to 1995), they are trying to diversify their agriculture under the slogan "Balanced growth and sustainable development". Fishing industry in particular is positioned as a prominent field for economic development and contribution to the national economy. This is because the sea surrounding the country has abundant marine resources not currently being exploited and markets for fish exist domestically and in neighboring countries. In addition, many of the indigenous population are familiar with traditional sea life. In St. Vincent & the Grenadines, however, the establishment and construction of facilities and systems to support fishing has been delayed because of lacking of financial supports.

Based on this background, the government of St. Vincent & the Grenadines decided to implement on a coastal fisheries development project primarily intended for the establishment of facilities to promote development of fisheries in the southern part of the Grenadines, providing or upgrading machinery and equipment used in the New Kingstown Fish Market. The government of St. Vincent & the Grenadines has requested to Japanese government to provide Grant Aid assistance in order to implement this project.

In response to this request, the Government of Japan decided to conduct the basic design of this project and commissioned the Japan International Cooperation Agency (hereinafter referred to as JICA) to dispatch the basic design study team, led by Mr. Kanji Kitazawa, Assistant director of the Grant Aid Division of the Ministry of Foreign Affairs, to St. Vincent & the Grenadines from 10 January to 18 February in 1993. The team had discussions with the government and confirmed the content of the request, details of the Project, conducted survey of the natural condition of the project site, and the project management system.

Upon the return of the basic design study team, a Draft Final Report was prepared based on analysis of the results of the above survey. From April 17 to April 26, 1993, JICA dispatched the draft final explanatory team, led by Mr.Hitoshi. Fujita, chief fisheries officer of the International Affairs Division of Oceanic Fisheries Department, Ministry of Agriculture, Forestry and

Fisheries, to explain the Draft Final Report and conduct final discussions confirming the content of the basic design of the Project.

Based on the above research, this report summarizes the basic design, implementation system, project evaluation and suggestions for appropriate construction and project facilities. The members list of the study teams, the survey schedule, discussion records, and a list of major interviewees are attached in the appendix.

CHAPTER 2 BACKGROUND OF THE PROJECT

2-1 Outline of St. Vincent & the Grenadines

2-1-1 General information

St. Vincent & the Grenadines was discovered by Christopher Columbus in 1498. England ruled the country since 1763. On July 1979, the St. Vincent Independence Bill passed Parliament and the country became an independent state on October 27, 1979. The government is a constitutional monarchy holding Queen Elizabeth II as the titular head of the nation, with an elected Prime Minister as the political leader.

The country is a volcanic archipelago belonging to the Windward Islands chain of the lesser Antilles in the Eastern Caribbean Sea and is situated at 13° 15' N latitude and 61° 10' W. The archipelago is in total about 18 km east to west and about 50 km south to north, with a land area of 389 km^2.

The whole St. Vincent island is volcanic and the terrain of the entire northern and central area is high mountains. This steep geography makes it impossible to build a road circulate around the island. Mt. Soufriere (1,230m) last erupted in 1979.

The Grenadines consists of around 100 small and large islands. Bequia (17.9 km^2), Union (8.4 km^2) and Canouan (7.4 km^2) are relatively large islands and are situated within about 35 nautical miles of St. Vincent.

Though the country locates in the tropics, because of the constant northeasterly trade winds the climate is a relatively cool and the temperature ranged 18° to 32°. The dry season extends from December to April with little rain and the rainy season from May to November, accounting for 70% of the total yearly precipitation. Few hurricanes strike but there have been several occasions when the country experienced extensive damage.

The total population is about 108,000 (1991) and the racial structure of the population consists of African Black 66.5%, mixed blood (black and white, etc.) 19%, Caucasian 3.5%, Indian 5.5%, Caribbean 2%, and other 3.5%. Located in St. Vincent, Kingstown, the capital has

a population of about 23,000. The population density is 279/km^2, making this country one of the most congested in the Caribbean.

The major industries are bananas and spice cultivation. Following bananas, the tourist industry contributes foreign exchange, as many tourists visit the country from North America and Europe to escape from winter cold. Also, foreigners have villa and cottages scattered about here and there and it is said that many retirees love the country.

Caribbean sightseeing cruisers call on the country frequently. The government places importance on the growing tourist industry and supports hotel construction, cottage construction, developing islands for villa and training for such supporting staff.

The country has been greatly influenced by United Kingdom in terms of life and culture. For example, cricket and soccer are both popular sports. The national language is English, and Christianity (Anglican, Methodist, etc.) is the dominant religion. In St. Vincent and Bequia island, small scale coastal whaling is still conducted.

2-1-2 Current political and economical situation

GNP in 1988 was US$1,100/person. Agriculture is the major industry and there is about 2,500ha of cultivating land. Agricultural products occupy about 65% of total exports. The economy suffered damage in 1979 with the eruption of Mt. Soufriere and in 1980 with a hurricane; however, no aftereffects remain and recently, construction, manufacturing and tourist businesses have been growing steadily. Economic growth in 1991 was 4.57%.

The major exports are bananas, arrowroot starch, and coconut. Banana cultivation was introduced in 1953 and has become the top exporting item surpassing arrowroot starch which is a special product of this country. Nowadays, in the US, the major market of arrowroot starch, but nowadays the US herself producing corn starch and it has been increasing, and moreover, Brazil becomes a competitor as well in this starch market. Therefore, the country is obliged to develop new markets.

The country suffers from a chronic trade imbalance. Exports of bananas and arrowroot starch are mainly to England, the US and other Caribbean countries. While imports of consumer goods, fuel, and machines are primarily from Caribbean countries and United Kingdom. The trade record from 1983 to 1991 is as follows.

trade record from 1983 to 1991 is as shown Table 2-1.

Table 2-1 Import/export record (unit: US$1,000,000)

Item	1983	1984	1988	1991
Export	110.8	144.6	85.2	68.0
Import	190.0	206.8	233.3	137.6
Balance	-79.1	-62.2	-37.0	-69.6

1992 : St. Vincent government statistics

On St. Vincent, the main island, a coastal road runs both east and west from Kingstown, the capital. The total length of the road is 438 miles. Of that, 243 miles (55%) is paved. Currently, a road extension project is underway to enhance future connections with farming and fishing villages and smooth physical distribution of agricultural and fishery products. Kingstown has a natural harbor, however, the harbor is not well equipped since there are no land-based cranes. Therefore, the cargo unloading devices on ships are used to load and unload.

The country is serviced by two airlines, BIWTA and LIAT. There are many flights and access to neighboring countries by small airplanes. However, there is no direct flight to the US main land. The access to the US. is via Barbados or Antigua.

2-2 Fishery Background

2-2-1 Fish Resources of Caribbean sea

1) Bottom fish resources

According to a report by the FAO, the fishery resource environment in the area around the lesser Antilles, to which St. Vincent & the Grenadines belong, has rapidly suffered due to fisheries and tourism development, which has led to over fishing of reef fish, lobsters, conch, etc. in many areas. Despite the fact that the fishing technology in this area is not advanced, utilization of reef fish resource in shallow areas has been exploited to certain extent. In many cases, large fish or large fish species cannot be found in a haul. The degree of development differs by island, however, in particular in regard to resources in fishing grounds near densely populated areas. Resources in deep water and continental shelf slope areas are thought to not yet have been exploited to the degree the reef fish resources in shallow sea areas. However,

the total amount of this resource is relatively small. Therefore, if people try to increase their catch, there is some danger that the resources may decrease rapidly. It has been reported that the body size in schools of snapper and grouper has become smaller in certain areas because of the effects of over fishing.

Productivity per unit area differs considerably in different areas among; however, it is supposed to be generally in the range of 0.5 to 5.0 ton/km²/year in the Caribbean sea. When this estimation is applied to total continental shelf area and the shallow reefs of the lesser Antilles, production is estimated at between 11,000 to 110,000 tons/year.
According to a 1987 survey in Martinique, near St. Vincent, the demersal fish resource was 0.24 to 8.45/tons/km²/year, demonstrating that production differs greatly depending on location.

2) Pelagic fish resources

Large sized pelagic fish resources (skipjack, swordfish, tuna, dolphin, Spanish mackerel, shark, etc.) are thought to be worth developing. That is, the estimated amount of pelagic fish resources is 55,000 tons/year for all types of yellowfin and skipjack and 30,000 tons/year for others, however, the catch currently totals around 42,000 tons/year and these catches are concentrated off the Venezuelan coast. Despite the fact that resources around the lesser Antilles are estimated at 25,000 tons/year, the catch is currently just 5,000 tons/year. According to the ICCAT resource estimation, the yellowfin resource has been exploited to a considerable degree but there is still room to develop bigeye and skipjack resources.

2-2-2 Outline of marine fishery

St. Vincent & the Grenadines consists of 100 small and large islands and has the 4th largest continental shelf area (about 27,500 km) among countries in the East Caribbean sea.
Concerning fishing resources of the area around the country, lobsters and conch are being over fished in some part of the country. On the other hand, stocks of pelagic fish and demersal fish around offshore areas are almost intact. This offshore area has an important and valuable resource for a country therefore development of fisheries is an important issue.

Most fishing conducted in this country is traditional small scale, and in coastal areas people employ hand lining, haul nets, drag nets, and skin diving fishing. Many fishermen target bottom fish around the Grenadines during the off season for pelagic fish. For this reason, the stocks of deep sea resources such as sea bream, grouper, lobster, conch, mollusks, seaweed and black

coral, etc. tend to be decreasing. However, below 200 meters, there seem to be still abundant resources. Therefore, to control resources, the Fishery Division has designated the 3 month period from May to August as a fishing prohibition period for large sized lobsters and sea turtles. Seasonal migrating fish species (flying fish, skipjack, tuna) in surrounding sea areas have not been fully exploited yet and there is sufficient possibilities in that area to justify future development. There is no sign of over fishing of pelagic fish and migrating fish by neighboring countries such as Trinidad, Barbados and Saint Lucia and the production is always high.

The country's fishery is operated by fishermen in 22 villages in St. Vincent and 16 in the Grenadines. In 1991, fisheries production is recorded a total of 1,810 tons, and the yield has been increasing in the last several years.

1) Fish catch

Comprehensive statistics on the country's fisheries have just recently been summarized with the help of Canadian government. The survey method was generalized and the estimation method was standardized in 1992. Since the new fish market has opened in Kingstown, the flow of all fish in St. Vincent is concentrated into one place; thus, it has become easy to accurately calculate the catches and catch estimations are generally speaking accurate. However, statistics for the Grenadines are still unclear because of the sampling method and delays in assigning fishery staff persons. Recent fish haul statistics are as follows.

Year	1988	1989	1990	1991	1992	
Fish catch	546	520	1,464	1,303	1,279	(tons)

Compiled by the Fisheries Division : 1993

Pelagic fish accounts for 70 % and demersal fish for 30% of the total.

The figures before the opening of the New Kingstown fish market in 1990 are rough estimations and are not so reliable. It is true that the opening of the New Kingstown market stimulated fishermen's' enthusiasm and the haul of fish has increased remarkably. The numbers shows that establishment of a reliable distribution channel has an effect on increases in production.

2) Fishermen and the fishing method

In 1988 the population of the country was 122,000, with 5,000 to 6,000 of these being fishermen. 3,000 of these are full-time fishermen (about 1,000 are ship owners, 2,000 are

hired fishermen and 50 are full-time divers). The others are fishermen with other jobs. In addition to the above, about 2,500 people are working in fishing-related fields (fish vendors, boat repair, building, and servicing, etc.) and, if their families are included, there are on the whole a total of about 30,000 people related in various ways to fishing. In the Grenadines, 85 to 95% of the adult men have fishing or fishing-related jobs. Many of the fishermen go to sea in the morning and come back in the late afternoon or evening.

The major fishing methods are as follows.

Gathering and collecting

With this type of fishing, gaffs or spears are used to collect seaweed coral, sea urchin and mollusk during low tide or by diving.

Dropline

Using a hand line and longline fishing gears, bait is used to fish mainly grouper, snapper, wrasse, sea bream, horse mackerel, filefish, lizard fish, moray, shark, etc.

Hauls net are used to fish primarily for tuna and barracuda.

Traps

A pound cage is a kind of fish trap having a mechanism by which once fish are lured in at high or low tide or using bait they cannot get out.

Gillnet

Gillnets are used to catch fish by tangling them in a mesh net eyes. With this method, different mesh sizes enable to catch different kind of fish. Usually, one panel of gillnet is used. In the trinal net method 2 to 3 panels of nets are overlapped, but this method is now prohibited.

Seine net

There are beach seine and boat seine in surrounding net. They are used to mainly catch horse mackerel types of pelagic fish. Usually 2 ships with about 10 to 12 people are engaged in boat seine fishing.

Other fishing methods

Other methods include casting nets, hydrogun spears and brush weirs.

3) Fishing boats

Most fishing boats are wood or FRP boats of 5 to 8 meters long. Except for five 12m, 105 hp longliners provided by Japanese grant aid and three commercial small Florida-type

longliners, the local fishing boats are equipped with an outboard engine which uses mixed gas. Because of the constant easterly trade winds and attendant high waves, many boats are equipped with large horsepower outboard motors. However, there is some imbalance in matching that some 6m long boats have 75 hp engines. Also, generally speaking, people tend to prefer equip with large engines that allow them to travel at higher speeds.

Since most of the boats are small and have no deck, there is no space for ice box or a fish cooler. Also, the small fuel tank does not allow them operate over a wide range of sea; thus, operation efficiency is low. The continental shelf extends east of St. Vincent, windward. The waves in the windward area are rough and approach to fishing ground is difficult, therefore, few resources have been developed in that area. Most of the boats do not have fishing equipment such as large hand reels, etc. and their fishing tools and fishing methods lag behind neighboring countries such as Grenada.

Wooden boats are built around Kingstown and Bequia Island. When boat repair is required, fishermen pull up boat to beach and painting and take preventive waterproof corking measures is conducted by themselves in each village vicinity. The durable life of wooden ships is about 10 to 15 years. Recently, because of the difficulty in obtaining good materials, the construction of wooden boats has been decreasing and instead, FRP boats built in Trinidad and Tobago or Canada have become popular.

In addition to these kind of fishing boats, fish collecting boats called schooners have been used in the area. These are also called trader boats and are combination sailboat/motor boats 18m long and 4.5m width equipped with a 60 hp engine. They anchor offshore of fishing villages of the Grenadines and collect fish, lobster, conch, etc., then export them to Martinique. This type of vessel has a freezer of about $30m^3$, taking on ice in Martinique and traveling to villages about 1 day's journey. They stay in the area for about 5 days to collect the catch and then head back to Martinique.

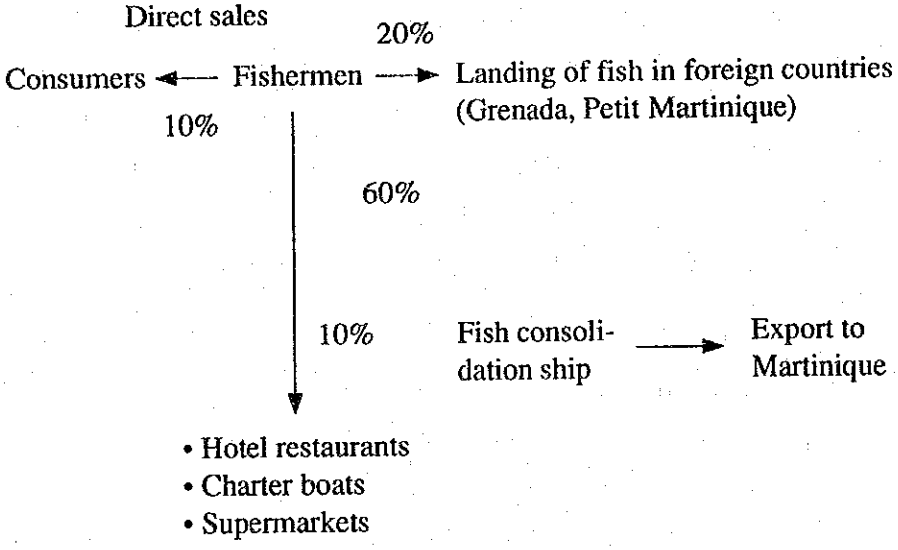
Registration of fishing boat has not been implemented and the actual number of boats is unknown, but about 600 boats are thought to be operating in the whole of the country. The Fishery Division is working on initiating implementation of a fishing vessel registration system by 1993 to 1994.

4) Fish marketing and distribution

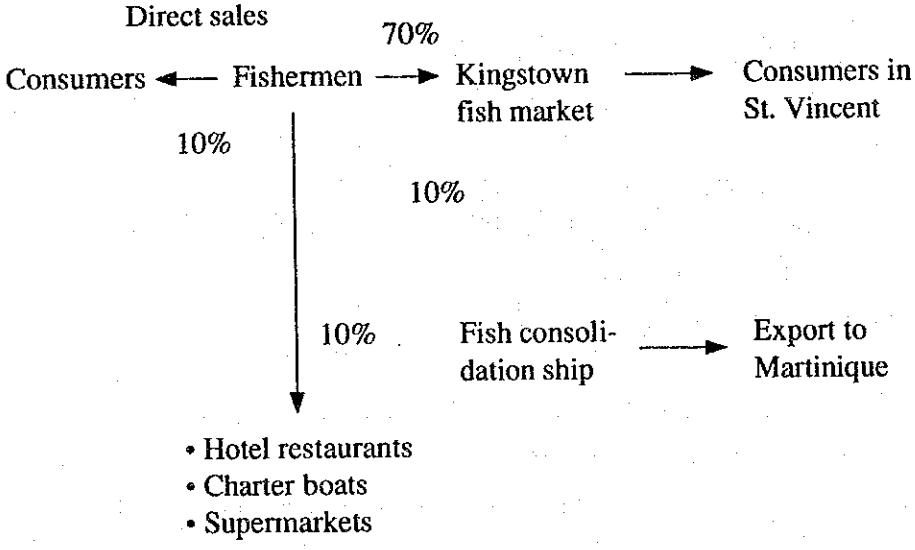
The Fisheries Division has estimated the fish marketing and distribution condition as follows.

Fish marketing channel

a. Route of distribution of demersal fish



a. route of distribution of pelagic fish



Since demersal fish are more high price in this country, only a part of the catch is distributed to general consumers, while the bulk of this sort of fish is exported by fish collecting boats. In particular, most fresh fish are exported to Martinique, an overseas province of France situated 160 km north of St. Vincent.

On the other hand, pelagic fish are inexpensive and are consumed by ordinary people. 70% of the fish go to consumers directly through the New Kingstown fish market.(NKFM) There are almost no middleman and the NKFM, an affiliated public corporation of the government under the Marketing Corporation, is consigned the fishermen's catch. In this way, the NKFM takes a broker-like role. On Carriacou Island, the suburb of Kingstown, unloaded fish are sold by fishermen and their families directly to consumers. The only people who are engaged in broker-type jobs are those who collect export-bound fish on Bequia Island. This is because the amount of fish handled is small and the margin or commission obtained from this trade cannot support a fish brokerage business.
The volume and value of export of fisheries are as follows.

Year	1988	1989	1990
Export volume (ton)	163	166	117
Export value EC$ (1000s)	915	973	925

(1992 export statistics)

Fresh fish account for 98% of the export volume and conch and lobster occupy the remainder. These exported fish are almost all bottom fish and are sent to Martinique. Some of the large pelagic fish are exported to Saint Lucia and Grenada but do not show up in the statistics.

Around Kingstown, abundant quantities of fish are available because of the fish market; however, it is still difficult for people on the east coast (the sea is rough and they cannot travel by boat) and inland areas of the island to obtain fish. For this reason, the Fisheries Division and NKFM are planning to establish a fish market in local cities such as Mesopotamia and Georgetown, transporting fish for sale using cold insulated vans. According to trials results, sales are relatively good so the demand for fish in the country is expected to increase.

The country imports salt-dried codfish (from the North Atlantic) used in traditional meals as well as canned sardine, mackerel and herring. 146 tons of codfish were imported in 1990

worth about EC$1,280,000. The government is making an effort to develop substitute import products; trials of salt-dried shark has received a favorable response from consumers.
The retail price of fish per pound is EC$5.00 for bottom fish and EC$3.00 to 3.50 for horse mackerel and mackerel. Usually the price of fish is cheaper than beef and pork (EC$4.00 to 5.00/lb.) but more expensive than chicken (EC$2.61). (From market research conducted in January 1992.)

5) Fishery cooperative

The Fishery Cooperative movement is under the auspices of the Cooperative Bureau of the Ministry of Cooperative and Housing. Establishment of a cooperative was recommended from the late 1950s to 1960s by the government and many agriculture and fishery cooperatives were registered. Fishery cooperatives were established in Barrouallie (1956), North Grenadines (Bequia in 1959), Union Island (1960) and Cannouan (1960). However, those cooperatives have disappeared or been dismissed from 1970 to 1980 because of operations deadlocks.

The S.V.G. Goodwill cooperative was established and start operation in Kingstown in 1987. Currently the registered cooperatives are as follows.

S.V.G. Goodwill Fishery	Registered in Sep. 1976
Bequia Fishery Cooperative	Registered in May 1990
Union Island Fishery Cooperative	Registered in Dec. 1990
Fancy Canada Cooperative	Registered in Oct. 1990

Among these, the S.V.G Goodwill cooperative has a fuel station dedicated for fishermen and performs cooperative purchases of gasoline. The main function of other cooperative is also cooperative purchases of fuel. No cooperatives have fishery supportive facilities or equipment and their cooperative activities have not been active so far.

2-2-3 Fishery of the project area

1) General

The Grenadines has a small in population and consumption by local residents is quite limited. Therefore, most of the fish is caught for export purpose. As in St. Vincent, the scale of fishing is artisanal level. Fishing activity depends on the visits of fish collecting boats engaged in export. This means that when the boat is staying in the vicinity, fishermen go out for fish each day, deliver their catch to the boat and are paid. The fish collecting boat stays in

the same place for about 5 to 7 days and when the fish hold becomes full, it heads for Martinique. About 10 tons can be loaded in each ship. Most of the fish are demersal fish, and there are few pelagic fish because the price is low in pelagic fish.

The Fisheries Division conducts organoleptic tests for export inspection and issues permission to export. Since fishing is on a one-day operation basis, fishermen cannot go sea far from the base village. Therefore, their custom is to go to an island near the fishing area and camp there for many days during the fishing season. Some fish collecting boats anchor near such 'campgrounds' to collect fish. Offshore of Mustique and Cannouan islands are such places. The fish collecting boat has ice hold by which fish can be preserved on ice for about 10 days.

Fishermen continuously for about 2 to 3 weeks staying in the camp as a fishing base and go home for about a week to spend time with their families while the fish collecting boat is gone. The major fishing methods employed are hand lining on the continental shelf at depths of between 50 to 100m, diving on reefs, and using beach seines or small round haul nets. While the fish collecting boat is away, people gut the fish and remove the organs and head, then process them as salt-dried products for delivery to St. Vincent market.

2) Paget Farm, Bequia Island

Bequia Island is situated about 9 miles from St. Vincent. The island locates on the northernmost of the Grenadines island, has about 5,000 population. The tourism development of this island is advanced and there are always 100 or more yachts anchor in Port Elizabeth, a quiet inlet on the west coast. Resort areas have been developed along with the coast and many bungalows, hotels and restaurants are open for business. A ferry boat runs 3 times a day between Kingstown and people and goods come and go frequently. Port Elizabeth has a harbor, post office, bank, library, hospital and two junior high schools and is the center of politics and business on the island. The island has villages such as Hamilton, Mount Present Spring, Belmont, Lower Bay, Friendship Bay, La Pump, Paget Farm, each connected by paved roads.

The island became a colony of France in 1720, then became a colony of United Kingdom in 1762. The geography of the island is steep and there is little precipitation (1,200mm/year), thus the island is not suitable for agriculture. During the colonization era, cotton and sugarcane were tried but did not meet with success. Because of this, people started developing an abundance of fisheries. Since 1880, shipbuilding, whale hunting and seaborne trade have

been active and the island is famous for the building of wooden boat for Caribbean countries and has given birth to many sailors. In the 1940s, fish trading boats began to visit from Martinique so the fishermen who quit whale hunting started to catch demersal fish for sale.

Paget Farm (population : 1,450) the site for construction of the planned fisherman's center, is situated about 4.5 km from Port Elizabeth, on the south shore of Bequia Island and houses are scattered along the steep slope facing the south. Other villages have tourist facilities such as hotels, bungalows cottages, restaurant and souvenir shops but this village does not have any of them. However, in October 1992 an airport opened in the eastern part of the village with the support of the EC and a public pier was built. Furthermore, there is a plan to develop land for cottages on the slope of the south side of Paget Farm and sell land in lots.

According to the results of interview-based survey conducted by Canada in 1991, there are 270 families in the village and about 37% of adults are engaged in fishing. Adult females are working as maids or waitresses for tourist facilities in Port Elizabeth and Friendship Bay. 95% of the families own a house and more than half of the families have a refrigerator and TV set. The educational background of adults is low, with only about 48% having finished the lower grade of elementary school and about 25% having graduated from junior high school. The breakdown of fishing equipment each family owns is as follows.

Boat	37%
Out board engine	38%
Beach seine	4%
Handline fishing tool	28%
Seine net	13%
Diving equipment	7%
Other fishing tool	2%

CIDA survey data (1991)

Ordinary people strongly want to take adult education and vocational education classes. The subjects they want to take are small business management, reading & writing, nutrition and cooking, sea safety, etc. Many people want to have better jobs.

On the other hand, 90% of fishermen want to take classes such as sea safety, fishing methods, fishing gear repair, etc. Furthermore, 60% of them want to study navigation,

reading/writing and outboard motor repair techniques. The income of about 40% of the families is derived primarily from fishing.

There are 76 boat owners in the village and all of them are engaged in fishing. Their ships are traditional double enders (both the bow and stern can cut water) or modern speed boats. The double enders are made of wood, 4.5 to 5.3m long and are equipped with a 6 to 10 hp outboard motor. The speed boats are made of plywood with an FRP coating, 5.3 to 6.5m long and is equipped with 40 to 65 hp outboard motors. Most of those boats are built in boat building factories in the village. The boats are very well maintained and the engines last a long time. Bank loans are used to purchase boats and engines.

Fishing method used in Paget Farm fishing boats

Bottom longline (demersal fish)	57%
Diving fishing (lobster, conch)	18%
Beach seine/round haul net (small pelagic fish)	14%
Diving	11%

The bottom longline boat owners have double ender boats and sometimes join beach seines. Catch small fish for bait for bottom longline fishing with casting net. Demersal fish such as grouper, snapper and butter fish are caught near the shore. Expensive large size snapper and grouper live in deeper water or along the slope of the continental shelf; however, it is difficult to go that far because of the time required for travel to and from the fishing ground by small boat. The catch per person per day is about 15 to 30 kg.

Diving fishing is usually conducted by 3 people from a boat. One person dives, one person observes the diver from the surface, and the other person controls the boat. They catch about 10 lobsters or 100 to 200 conch a day.

Beach seine/round haul net fishing has been a cooperative venture for a long time. There are 10 units of fishermen group for seining. Each unit has 2 to 6 boats under their control. This fishing method requires 15 to 20 fishermen in one time. The presence of fish is unsure and cannot be predicted; however, when in season, they are always ready to go fishing. One fishing trip brings about 2 to 5 tons of horse mackerel or mackerel. The ship owner takes the half the catch for boat, equipment and requisites investment and remaining fish is evenly divided between the 15 to 20 people working on the venture.

Many fishermen establish camp on other Grenadines islands close to fishing ground during the fishing season. Specifically, about 30% of the fishermen go to Mustique Island. For this reason, a private developing company in Mustique built lodgings and water supply facilities on Britannia bay in 1993 with the intention of establishing better relationships with the fishermen who come there. After this, hotels and restaurants became able to obtain fish, lobster and conch. Also, the fishermen of Bequia island camp on Canouan, Petit Vincent and Petit Martinique islands.

Most fishermen work according to the schedule of the fish transport boats. While the boat is there, they will work for 6 days straight in a week. Most of the fish is exported to Martinique and not sold in the village. Usually, 2 collecting boats anchor near Bequia island and purchase fish there. One of the boat is underwritten by France and the other by Bequia island. Transaction are in cash and the purchase price is fixed. Snapper and grouper are EC$8.00/lb. and butter fish and red grouper are EC$7.00/lb. When the transport boat is away, the fishermen go to St. Vincent; however, since they have to bear the transportation costs themselves, it is not worth it even if the fish can be sold at higher price.

Most of the small pelagic fish is sold in Kingstown fish market. The catch is transported to Kingstown by speedboat without keeping it in ice. This is not good business because of the high risk across in all the way in rough seas by a small boat.

Lobsters are sold in hotels and restaurants. Yachts customers often come to buy it. Conch is sold to buyers whose base is Petit Martinique. The price of lobster is EC$10.00/lb. and conch is EC$5.00/lb.

The fishermen do not book keep their income, thus, they don't know how much they make from their operation. About the half of the fishermen's income is thought to be EC$250 to 500/month. However, in fact, it is estimated to be EC$750 to 1,000 or much more. Generally, fishermen are better of than other people in the village who have different jobs. Fishermen feel aggrieved that there is government offers almost no support for fishing. Also, they believe that the resource has been decreasing because everybody operates in the same fishing ground. They want to use large fishing boats so as to have much more capability to travel far from their base of operations. Many of them think the fishery and tourism industry can coexist and that they are benefiting from sales of the catch, especially in that lobster and conch are popular among tourists.

On Bequia Island, a fishing cooperative was established in 1959 and operated a fishing gears store in Port Elizabeth. However, it was closed in 1964 because it was unprofitable and the cooperative was dissolved. After that, a new fishery cooperative was registered in May 1990; however, at this time no business is being conducted due to personnel problems within cooperative. The cooperative is planning to engage in cooperative purchase and resale of fuel, introduction of an insurance system for boat owners and refrigeration and preservation of fish on Paget Farm. However, in fact the purpose of the cooperative establishment seems to be to operate the facility when the Canadian cooperation project is implemented.

3) Clifton, Union Island

Union island is situated 30 miles south of St. Vincent and is the 3rd largest island among the Grenadines. The island is just 6 miles from Grenada's Carriacou Island. The island consists of two villages, Ashton and Clifton. Ashton is a fishermen's village and is very quiet. Clifton is a village surrounded by a lagoon and the tourist industry is being developed. The ferry boat runs 3 times a week between Union and the Kingstown, taking about 4 hours to complete the journey. From the airport completed in 1992, it takes about 25 minutes to get to the main island. Clifton has bank, hotels, supermarket, government offices, etc. and is the center of the island. Also, there is a yacht club and there always about 80 yachts at anchor in the Clifton Bay and this village is a support and supply base for large yachts.

With the completion of the new airport, the island is now conveniently located as a relay station between other countries and many tourists travel to other areas such as the Tobago Keys or Palm Island via Union Island.

The populations of Ashton and Clifton are 1,700 and 1,070, respectively. The island receives about 1,000mm precipitation annually and the climate is dry. Plants such as cactuses and agave, etc. grow well. According to interview survey conducted by Canada in 1992, 62% of adults graduated from junior high school. This is a relatively high ratio nationally. About 35 to 40 % of the people have tourism-related jobs. Since many people work in foreign countries, one characteristic of the island is that many families rely on remittances from abroad. 76% of the people own a house and 60% of them have a refrigerator and TV set. About 10% of the whole families have boats.

There are 33 ship owners on Union island. As the same as with the fishermen on Bequia Island. Their fishing boats are double enders or speedboats with flat bottoms. Double ender boats run about EC$4,000.

The fishing methods used are mostly the same as at Bequia Paget farm; however, many of the fishermen from Union Island dive and use traps and spear guns to catch bottom fish. They catch about 15 to 25 kg of bottom fish a day. Beach seine is used 5 to 6 times a year when fish shoals are found.

Fishing method ratio on Union Island

Fishing method	Main method	Sub-method
Trap	39	—
Spear	36	
Hand lining	11	85
Beach seine	—	14
Long line	—	18
Conch diving	—	14
Lobster diving	—	46
Gillnet	11	—
Trolling	—	75

(CIDA : 1992)

According to interviews with fishermen, they choose their personal fishing methods depending on availability of bait and the tide, and do not operate using just a single method. Concerning trolling, since most fishermen drift 1 or 2 lines while traveling to and from the fishing ground, the number indicated in the survey is large.

50% of boat owners operate within 1 mile of the island, not go any further than 3 miles out. They only go fishing when a fish transport boat anchors nearby; otherwise, they take the day off. Fishing is conducted by 2 or 3 fishermen and bottom fish caught are sold directly to the transport boat and exported to Martinique.

Fish are also sold on St. Vincent, the main island, and to Grenada; however, this happens only when the transport boat is not in the vicinity and such case is very rare. Fish are landed at the village only when hotels or yacht people make an order and it is also rare. The fishermen also go to Petit Martinique (about 4 miles) by themselves to sell fish when the transport boat is not in the inshore area.

Large amounts of pelagic fish landed caught by beach seines or seine nets are sold to Martinique and Grenada because there is no market on Union Island. However, they don't have ice so if they cannot transport the fish quickly, their value drops. How to transport the fish is an important issue. Lobster and conch are consumed by hotels and restaurants on the island. Also, they are often sold to yacht people. The amount of fish landing per year in Union is estimated at about 200 tons. Fisherman's income is estimated to be EC$500 to 750/month.

Equipment and fuel for fishing have to be bought from outside. They order fishing tools from the transport boat and the transport boat delivers them. There is no gas station on Union Island, therefore, each person has to import a drum of gasoline from St. Vincent. Purchasing a drum of gasoline (200 liters) costs a lot of money for each person. A fishing cooperative has been established to improve this situation.

The fishermen complain that government support for fishing industry is insufficient. They want the government to quickly implement the extension of technology and other guidance. The fisheries resources around the island is said to have been decreasing in the past 5 years. May be because, the fishermen have only ability to fish in the same narrow range of fishing ground. For this reason, many boat owners want to introduce large-sized fishing boat. However, the current situation is that the lack of capital seems to make it difficult.
As the tourism industry has been expanded, many fishermen have changed their jobs. But remaining fishermen strongly want to continue fishing in the future.

Members of the cooperative are hoping for the construction of a fishermen's center because there is no support facility now. The people, especially, expect the installation of the fish preservation facility, ice and workshop because they may dramatically change the current fishing form and create a better environment.

2-3 Outline of related projects

2-3-1 Nation development plan

With the 5-year national development project (1991 to 1995), the government has endorsed the slogan "Balanced Growth and Sustainable Development" and is planning economic development. Three fields, agriculture, education and tourism, have been selected as highlighted as priority sectors. Specifically, the following have been targeted: product diversification,

development of fields other than farm products, such as the livestock industry and marine fishery industry, improvement of educational levels, and tourism industry development. And implement and construct the economic production base as important target.

For development of the agriculture sector, the government is intending to break sole reliance on banana production and diversify farm products because of government worries about influence of the abolishment of favorable United Kingdom tariff of due to EC integration planned for 1993. Especially significant is that fisheries development is positioned as an industry with considerable potential and it is believed that diversification of the primary industry will be implemented because there are abundant unexploited resources in the sea surrounding the country.

2-3-2 Fisheries development project

Concerning the fisheries sector in the country's 5-year national development plan, the objectives are to increase the supply of animal protein to the population, and develop resources which can substitute for imported products.

The following are future development objectives.

1) increasing the output of seafood, consistent with sustainable development;
2) raising the productivity and income of fishermen;
3) raising export earnings and increasing the supply of fish to the domestic market;
4) establishing five community fishing centers to provide the infrastructure necessary for increased productivity;
5) training of fishermen in boat handling, engine maintenance, navigation and fish handling;
6) modernizing the industry through improved boat design, equipment and use of improved techniques;
7) establishing a Management Plan for the Country's seafood resources to ensure that development is sustainable; and
8) expanding and strengthening the Fisheries Division to enable it to adequately manage the country's industry.

2-4 Description of requested project

2-4-1 Progress of request

Previously the Government of Japan has extended two fisheries Grant Aid assistance projects for St. Vincent & the Grenadines, one the construction of New Kingstown Fish Market

(delivered in February 1989) and the other the supply of fishing boat and fishing equipment (delivered in March 1992).

Because of the opening of the New Kingstown Fish Market, there has been an remarkable increase in the amount of fish and supplied to St. Vincent island, where more than 90% of the population of the country live. Ice is now being used and sanitation level of marketed fish has significantly improved.

As distribution has increased, the demand for ice has increased and the current ice production capability has become insufficient. Also, because the export of fish is going well, further improvements in international quality control and sanitation have been requested. In addition, because of the introduction of modern small boats and effective use of various fishing equipment, improvement in fishing technique, development of unused resources and increased catches are expected.

However, the fisheries resources in the area around the Grenadines have still not been fully developed. This is mainly due to an inadequate fishery infrastructure in the region. For example, it is limited for fishermen to sell their catch and it takes long time to repair their fishery equipment, thus, they cannot smoothly engage in fishing activities. Also, their fishing technique is not modernized. In addition to the above, they have socio-economic problems such as education, welfare programs, etc.

With the above background, the government has been making an effort to develop the fisheries of the Grenadines, with the intention of increasing the supply of animal protein to their people as well as increasing the volume of export of high valued fish. For the past 9 years, the promotion of fisheries industry on remote islands has relied on the support of the Canadian International Development Agency (CIDA).

The achievement plan was merely a bureaucratic achievement based on many survey and investigations, and the implementation of specifics of the project has not implemented forward. Equipment and materials were given only on a small scale and there has been no progress toward the construction of a fisheries support facility.

For this reason, on February 1992, the government formally asked CIDA to terminate the Project, and in turn requested Grant Aid assistance from the Government of Japan for the construction of the fisheries centers, the main component of the Project.

According to the original plan prepared by CIDA, building facilities in the capital, Kingstown (St. Vincent) and Ashton (Union Island) are included in addition to Paget Farm on Bequia Island and in Clifton on Union Island. However, they have been excluded from the current request because for Kingstown, Japan had already supplied the cooperative workshop in the project for equipment and material supply (the 2nd fisheries Grant Aid assistance). And for Ashton, it is geographically very close to Clifton so that it has been excluded as well.

2-4-2 Requested project component

The project component requested by St. Vincent & Grenadines are as follows;

1) Establishment of Fisheries Centers
   A. Building of Fisheries Center in North Grenadines (Bequia Island, Paget Farm)
   B. Building of Fisheries Center in North Grenadines (Union Island, Clifton)

Request items	Bequia Island Paget Farm	Union Island Clifton
Wharf	Yes	Yes
Breakwater	Yes	No
Slipway	Yes	Yes
Ice-making refrigerator	Yes	Yes
Workshop	Yes	Yes
Water supply facility	Yes	Yes
Toilet and shower	Yes	Yes
Fishermen's locker	Yes	Yes
Fish retail space	Yes	Yes
Co-op office	Yes	Yes
Division office	Yes	Yes
Meeting room	Yes	Yes
Work boat	Yes	Yes
Pick-up van	Yes	Yes
Fish box	Yes	Yes

2) Expansion of New Kingstown Fish Market facilities
   A. Expansion of ice making capacity
      Ice-making equipment (plate ice, 2 tons/day) : 1
      Refrigerator (-20°C, 25m^2 x 2.2m, 12.5 tons) : 1

Refrigerator (0°C, 15m^2 x 2.2m, 5 tons) : 1

B. Equipment for fish quality control

High-speed chromatography device, K value meter, clean bench, autoclave, incubator, chromatography, colony counter, etc.

2-5 Fisheries cooperation projects

2-5-1 Support by the Government of Japan

1) New Kingstown Fish Market construction project

To improve the fisheries distribution system in St. Vincent & the Grenadines, Japan implemented the successful New Kingstown Fish Market construction project in 1987. The major principals of this market are as follows.

Land area	:	11,000m^2
Building area	:	1,440m^2
Fish handling volume	:	Ave. 3.6 tons/day
		Max. 5.0 tons/day
Ice making capacity	:	3.5 tons/day
Ice storage capacity	:	17.5 tons
Refrigerator	:	10 tons (2 rooms)
Freezer	:	25 tons (2 rooms)
Refrigerator	:	1.8 tons

The New Kingstown Fish Market (NKFM) has become prominent because of its good location (next to the government central office), unique appearance and convenient location next to the bus terminal attached to the market. Many people come and go throughout the day.

NKFM is operated by the Marketing Corporation. This corporation is the government founded and mediates the distribution of mainly agricultural products, fertilizer, agricultural chemicals, etc. In the old fish market, about 100 tons of fresh fish was marketed each year. The new market handled 455 tons in 1991, accounting for about 1/3 of the total national catch. They handle many pelagic fish such as dolphin, skip jack, bonito, horse mackerel, etc. Less

than 10% of the total volume handled is the bottom fish because they are mainly marketed for export.

Fish are landed on the pier attached to the fish market. Because fishing trip is a one-day operation, many boats return to port in evening, so a large volume of fish are brought in after 4 o'clock in the afternoon. Fish transactions take place through NKFM with retailers and fishermen. The fish are gutted and the heads are cut off and they are preserved in the refrigerator until next day. The deal procedure is a face to face negotiation and there is no auction. There are 30 tables for vendor and fish are sold to ordinary customers.
Currently, 20 staff are working for the fish market. The detail breakdown are as follows.

Manager	:	1
Refrigeration	:	1
Refrigeration assistant	:	1
Facility manager	:	1
Accounting	:	1
Cashier	:	2
Fish transport	:	4
In charge of ice	:	3
In charge of the pier	:	3
Miscellaneous tasks	:	1
Cleaning	:	2
Total	:	20

A –20°C refrigerator and blast freezer are used for long-term preservation of large amounts of fish landed during the prime fishing season (during migration of large-sized fish from February to August).

Because fishing boats are not equipped to use ice (open deck type boats with no fish hold) ice is not used except in certain medium size longline boats and in the fish transport boat. However, retailers have an obligation to use ice; therefore, the necessary amounts of ice are supplied to the retailers free, usually twice a day. Because of this, the freshness of the fish has improved dramatically and the number of flies inside the market has been reduced, with the result that the sanitary conditions of the fish has improved sharply.

The market is open 7:00 am to 5:00 pm and transactions take place throughout the day. According to the financial report for 1992, the financial report showed a negative balance of EC$11,850. This is because personnel expenses account for 48% of total expenses and furthermore, since use of ice is recommended in the policy the retailers are given ice free of charge. At present about half of ice production is distributed free. If it stop this free service of ice the financial standing of the market would be improve.

2) Fisheries development project

In March 1992, the Government of Japan implemented grant assistance to supply equipment and materials required for the fishery development project, aiming at improvement of fishing technique, improvement of living standard of fish folks and increase of supply of fish to consumers. The following is the list of supplied materials and the location.

	St. Vincent		The Grenadines		
Item/place	Kingstown	Barrouallie	Bequia	Canouan	Union
Fishing training boat	1				
Fishing boat (13.9m)			1	1	
Fishing boat (12.7m)		1			1
Fishing gears	1	1	1	1	1
Insulated van	2				
Prefab house	1				
Machine tool	1				
Communication equipment	Kingstown base	1			
	Fishing training ship	1			
	Fishing boat	4			

Use and operation of boats and equipment has just begun. The fishing training boat is used by the Fisheries Division to extend longline fishing techniques to fishermen. The fishing boats have adopted the same fishing method and the bottom longline method can also be used. Preparation at the distributed side has been delayed but they are supposed to begin operating soon. Among the various fishing gears, FAD (Fish Aggregating Device) has already been installed and its effectiveness in attracting pelagic fish has been verified. The insulated vans are under the control of the NKFM and is used to transport fresh fish inland on the main island to promote fish consumption of the people living there. The prefab house was planned to be used as a workshop; being used by the fishermen of the Goodwill fishery cooperative of

Kingstown. However, the foundation of the house was lost due to excessive rainfall in November 1992. The house is under consideration of the transfer to other location.

2-5-2 Other assistance from foreign countries and international organizations

1) FAO

FAO conducted research in September 1982 and concluded "an assessment of the possibilities, necessity and economics of fishing", "a decision on a appropriate fishing development plan" and "creation of a reference plan for organizations wishing to invest". After that, the FAO began the TCP (Technical Cooperation Paper) project in order to create a fishing development plan in which the necessity for development of the country's fisheries is fully reflected and to create related references for the plan. The FAO created "The 1984 to 1991 Fisheries Development Plan" in which "development of offshore fishing resources", "ensuring a stable fish supply to inland areas" and "structuring of the distribution system" have been raised as priority projects.

2) CIDA

To support the country's fisheries, CIDA conducted research and prepared a report in 1986. In this report, "organization of the system relating to the fishing industry and education of people", "structuring of the fishing industry infrastructure in fishing villages" and "structuring of the domestic distribution and export systems" were emphasized and "The Grenadines Fisheries Resources Development Plan" was supposed to be implemented within 4 years from 1990. However, extremely slow progress finally caused the Project to be formally terminated in February 1992.

3) OECS

The Fisheries Unit of the Organization of East Caribbean States (OECS) was established in November 1985 with the support of the International Ocean Development Center (ICOD) with the intention of developing and controlling fishery resources around the East Caribbean countries. Countries joining the organization are Antigua & Berbuda, the British Virgin Islands, Dominica, Grenada, Montserrat, St. Kitts, Nevis, and St. Vincent & the Grenadines, a total of 8 countries. The main office is located in Kingstown, St. Vincent. Its main activities are the drafting of a fisheries development plan, education and training, and the financing of small products (projects on a scale of EC$5,000 to $15,000).

4) Bequia development company

On Mustique island, south of Bequia, facilities such as fishermen's lockers, fish market, kitchen, and lodgings for fishermen were built by Mustique's development company and a small ice maker (flake ice) was installed in June 1992 by CIDA.

CHAPTER 3 DESCRIPTION OF THE PROJECT

3-1 Objectives of the project

In the Grenadines, which locates in the south of the country, fishing has been carried out on for ages, mainly in near the island coastal areas, and the existence of an abundance of fish resources has been confirmed. However, as there are no facilities to support the fishery activities on each island, fishing operations are limited to a small sea area near those islands. Therefore, if there is no change in the current situation, it cannot be expected that the volume of both the catch and distribution of fish will increase. The subsistence fishermen in the country use traditional, premitive fishing gears and methods in the areas of the sea just in front of their fishing village or in coastal fishing grounds that are very close to the village. Furthermore, since they can sell their catch only when the fish collecting boat visits, the overall fishing environment is unstable and uncertain.

The objectives of this project is to improve the situation by establishing fisheries centers which have the ability to support the landing and preservation of fish, and provide a technical assistance in order to support the development of unexploited fishing grounds, promote marketing of catch and improve the lives of fishermen community. In addition, three years have passed since the New Kingstown Fish Market (NKFM) on St. Vincent was opened and now the demand by fishermen and retailers for ice has increased beyond production and refrigeration capabilities; thus, a request was submitted to expand the facility. Furthermore, the request has been received for the up grading of a quality inspection system for fishery products because of enthusiasm for fishing activities and an increased production which results in increased exporting of fish to foreign markets.

The short-term targets of the project are:

1) Structure a supporting system for subsistence fishermen so that their catch grows and thus income increases.
2) Reinforce fishermen's groups such as the fishery cooperative under the guidance of the Fisheries Division in order to improve the fishermen's standard of living.

The long-term targets are:

1) Put together fishing-related facilities and heighten the efficiency and safety of the fishing in order to establish the base of the stable fishery industry.
2) Increase the supply of fish from the Grenadines to St. Vincent to respond to domestic demand, promote the development of products which can substitute for imported products, and promote exports.
3) To effectively use the Grenadines' fish resources, develop marine products processing technology to improve the quality of the catch and promote the use of un-utilized fish.

3-2 Examination of the project component

The contents of the request made from St. Vincent & the Grenadines concerning this project are described in item 2-4-2 in this report. The results of the study in the contents is as follows.

3-2-1 Suitability and necessity of the project

The Grenadines consists of many small islands and has few natural resources; only the tourism and fishery industries can be only industry to support island's economy. Since the start of the national 5-year plan in 1991, the government has expressed its intent to diversify the industrial base because there is a cloud hanging over banana export, the country's main industry; because of this development of fisheries is a prominent target. The Grenadines, the focus of the project, has had a traditional fishing industry for a long time and the people are used to working in the sea. Furthermore, the marine resources in coastal areas have been exploited but the demersal fish on the continental shelf and its slope far from the islands are virtually untouched. Since there are no preservation facilities (refrigerators, ice making facilities) and the fish collecting boat coming from Martinique (an overseas province of France) is the only destination to sell fish, product marketing and distribution is extremely unstable and uncertain. There are many factors that prevent obstacles to the activation of the shore fishery. For example, the freshness of fish can be maintained for only one day because of the lack of ice and fishermen cannot fish in distant areas because fish rot easily due to the high temperature. Also, fishing efficiency is low because the fishermen in the region go fishing upon the arrival of the fish collecting boat and the price of fish is under the collector's thumb, thus fishing is not profitable.

Despite the fact that fish distribution has increased steadily over the past 3 years along with the opening of the NKFM (about 100 tons/year in 1987 vs. 455 tons/year in 1991), the fish comes almost exclusively from the fishing villages on the main island of St. Vincent and the amount of fish supplied from the Grenadines is limited. This is because there are no supporting facilities for collection and distribution of fish on the islands in the south, and no distribution channel has been established.

The fish currently being sold in the NKFM is generally consumed by the 30,000 people living in the capital and surrounding areas. That means people in the city consume about 15kg/person per year. On the other hand, about 20,000 - 30,000 people living in the east and inland do not have a channel to get fresh fish and instead obtain imported canned fish or imported salted fish. It is estimated that the people in these areas currently eat only about 5kg of fresh fish a year. Working from this perspective, the Fisheries Division and NKFM are jointly promoting a plan to establish a outlets for inland fish sales (retail stores) and on the east coast. Test marketing and distribution of fresh fish began in 1992 using a small cold insulated truck provided by the Government of Japan.

If this marketing of fresh fish continues smoothly, it is certain that consumption of about 200 - 300 tons of fish per year will be promoted and fresh fish can be expected to replace imported salted fish. Furthermore, much of the fish caught around the Grenadines is bottom fish and they are different from pelagic fish, which are the primary product found in the NKFM. Therefore, a new demand for fish may be generated in the city. For this reason, even if the supply of fresh fish from the Grenadines increases, it is greatly expected that there will be expansion of the market in St. Vincent.

The Government of St. Vincent and the Grenadines intends to change type of fishing to management and control-type fishing based on the viewpoint of environment preservation and effective utilization of the fisheries resources. For example, the size and season for lobsters and conchs are regulated, and an export tax is levied on them. However, while placing such regulations on fishermen, the Government has provided fishermen with no financial and technological support. That is partly because structuring of the Fisheries Division is relatively new and there is a lack of personnel and the organization system is not equipped to handle it. Furthermore, appropriate facilities which can be the hub of extension activities do not exist on any of the islands and an administrative system has not been properly established. For the above reasons, the implementation of this project is very reasonable and the need for it is very convincing because the project is useful in improving the life of subsistence fishermen and

contributes to the promotion of the rural economy, as well as promoting appropriate use of unexploited resources.

3-2-2 Implementation and operation plan

The Fisheries Centers to be built in two locations (Paget Farm on Bequia Island and Clifton on Union Island) will be operated by the fishery cooperatives in each area in the future. For the time being, the centers should be operated by the NKFM, fishery cooperatives, under the auspices of the Fisheries Division through cooperation and role sharing. The related organizations should provide support for 5 years so that the fishery cooperatives in both districts can obtain sufficient operating ability; when the cooperatives are determined after 5 years to be fully capable of operating the center, the whole project should be transferred to the fishery cooperatives.

The Fisheries Division unifies the entire operation of the facilities, encompassing various fields such as extension of technique, control, and guidance to fishermen. Though the workshops are equipped with basic machines for outboard engines, they should be leased to private parties and persons who have excellent machine repairing skills. In Clifton, the fish retail space should be leased to a sales person in the village to sell fresh fish to residents or yacht community.

Management of fishermen's lockers will be the responsibility of the cooperatives. The NKFM will be responsible for maintaining the refrigeration facilities, and wholesale fish transactions. The NKFM will manage the ice-making machines and refrigerators, as well as related facilities and equipment.

The Fisheries Division will manage and control fish quality control equipment and materials and marine products processing machines.

For operation of the centers, an agreement based on the following points will be established between the government and the contractor overseeing operation, i.e. the fishery cooperatives so that the Fisheries Centers will be able to be utilized for development of the fishing industry in future.

1) The government shall transfer the management and operation of the facilities to the contractor. The contractor shall be responsible for the management and operation of the

facilities and will bear operating expenses by generating income from the operation of the facilities.

2) The contractor shall periodically report to the government on the current circumstances regarding operation of the facilities and will bear operating expenses by generating income from the operation of the facilities.

3) The contractor shall operate the facilities, with the purpose being the promotion of the fishing industry, regional development in the area, etc.

4) The government and contractor shall establish organization committees for the purposes of discussing operation of the facilities and shall decide details for execution of work. Also, both sides shall hold periodic meetings to solve various operation problems through consensus of the concerned people.

5) The government shall constantly conduct extension activities necessary to bolster the fishery cooperative's use of the facilities.

3-2-3 Relation to similar projects.

As part of the structuring of the Grenadines fishing villages, installation of a fisheries center in each fish landing place has been planned but due to financial difficulties such construction has not commenced. The following projects have been undertaken:

1) Installation of fishermen's lockers with the aid of OECS (Caribbean countries organization) (1990 ~ 1993). Lockers for fishermen were installed at Kingstown and at the Friendship Bay of Bequia Island using an OECS EC$15,000 grant and government funds. This facility is supposed to increase efficiency and safety of fishing activity.

2) A fishermen's support facility (1992, about US$1 million) was built for fishermen visiting Mustique Island through the joint cooperation of a real estate company developing Mustique Island and the Government of Canada. The facility is similar to a campgrounds, with a lodging, bathroom, shower, kitchen, fish processing space and vendor stall. Because of this, it is now possible for tourists visiting Mustique to obtain fresh fish from fishermen and, in the process, a friendly relationship between tourism and the fishing industry has been established.

3-2-4 Study on project component

The functions of the facilities and equipment and included in the project are mainly divided into a. landing of fish, b. preservation of landed fish, c. distribution and marketing of landed fish, d. extension of fishing techniques, e. support for fishing activities, and f. improvements in the quality of marine products. These functions are all essential to promote coastal and artisanal fisheries and, by full play of these functions the fishing industry can be comprehensively developed. For this reason, the comprising elements of the project are judged to be sufficient.

3-2-5 Study on facilities, equipment and materials

1) Fish landing facility

At Paget Farm on Bequia Island, all boats are always pulled up on the beach as the waves are always high. A public pier was built in 1992 near the project site. However, this pier is designed for medium-sized cargo ships and the height of the pier is not appropriate for small fishing boats. With the constant northeasterly wind at the site, it is necessary to secure a quiet area for the landing of fish. For this reason, it is necessary to build a breakwater at the east side of the site. Also, it is necessary for there to be a fish unloading facility available for landing of fish from FRP longline fishing boats (12m long,. 2.5m deep) provided by the Government of Japan and loading of fish onto the fish transport boat (16m long).

Since the sea area around Ashton village on Union Island, where many fishermen live, is surrounded by a shallow atoll, boats with a deep draft have never been able to enter the port. On the other hand, in Clifton, a watercourse leading to the open sea has been provided on a part of the atoll so FRP long-liners and fish transport boats can both enter the port. Since there is no facility for landing fish, it is necessary to build a dedicated unloading pier for fishing boats with the intention of promoting work efficiency and reducing the time required to handle fish in high temperatures.

Also, it is necessary for Paget Farm and Clifton to secure a slipway in order to pull up small fishing boats to the ground so that maintenance and repair can be facilitated.

2) Preservation facility for catch and landed fish

Currently, neither island has ice-making facilities and fish cannot be preserved in this situation. Only the fish transport boat has ice and takes a role as a floating refrigerator. Since all the project area are influenced by the visits of the transport boat, their fishery is very

unstable and uncertain. For this reason, ice will be made at the fishery center to maintain freshness of fish in the distribution route. Fish will be preserved in a refrigerator after landing and cooled on ice when shipped.

By introducing this facility, the fishing activity will become independent and not influenced by the fish transport boat, and also increases in the freshness of fish, diversification of sales destinations and a rise in the price of fish may become possible.

3) Distribution facilities for landed fish

As explained above, the marketing of fish is influenced by the visit by the fish transport boat. For though large volumes of fish such as mackerel and halfbeak are caught because they come near the shore, the fish cannot be sold if the transport boat is not there. Together with installation of the preservation facility, it makes possible to select a transportation method among various channels such as using a ferry boat to send fish to the main island, by air for fresh fish for export (at both sites, which are located just about 500m from the airport, it is convenient to use air transportation for fresh fish marketing), or mass transportation by chartered transport ship. Also, by providing a small scale retail location, it will be possible to sell fish to people, hotel, cottages, and yacht people.

Fish caught in the Grenadines are bottom fish. Very few such fish species are caught in St. Vincent. Since the demand for bottom fish is generally high, good sales can be expected when those fish are brought to the main island. The difference in the beach price of fish between remote islands and the main island is only EC$0.50~0.75/Kg (based on the results of a 1993 survey). Even though under the plan fish are preserved with ice and are transported by a ferry boat, the cost per kilogram has been estimated at EC$0.20/Kg. Therefore, it is profitable enough even after adding the distribution cost (EC$0.10~0.20/Kg) of NKFM or Fishery cooperative.

4) Extension of fishing technique

So far, the government has dispatched a fisheries extension officer to teach fishing technique to the Grenadines for short period of time but has not conducted systematic training and guidance of fishermen. The extension officer's job is just to put his signature on the export permission certificate and doesn't have the ability to actively teach technique, and also there is no equipment nor facility to do such extension work. This is partly because fishermen live here and there, therefore, it has been difficult to assemble them to conduct training. Through fishermen want to master techniques such as safe navigation techniques, new fishing

techniques and engine repair techniques, there is no chance or facility by which they can fulfill their desire.

The implementation of this project will establish an activity base for fishermen and make possible classes and instruction in actual technique by providing a study room. Thus, improved fishing safety, productivity and quality of life are supposed to be realized.

5) Support to fishing activities

To support the fishery industry as a profitable industry and ensure that fishermen can lead stable lives, it is necessary to prepare a place where fishermen can cooperate with each other. So far, the fishermen in Paget Farm and Clifton place their boats here and there within about 1 to 1.5 km along the beach and only exchange information about fish with the next boat or neighboring 2 to 3 groups. Therefore, they cannot exchange large amounts of information or opinions each other.

The project includes providing fishermen's lockers and this may facilitate management and storage of fishing equipment and materials, and also, by functioning as a regional gathering place for fishermen, promotes information exchange before and after fishing. In addition, space for fish processing table and sink will be installed where gutting of fish can be done under sanitary conditions. By providing such a "place", systematization of the fishery cooperative can be promoted.

Concerning repair of outboard engines which is always problem for fishermen because of insufficient follow-up servicing by the manufacturer or dealers, a small repair shop will be installed in both centers. It will eliminate the trouble of requesting for repairing by sending defective engines to St. Vincent. (So far, while the engine is being fixed, the fisherman have to give up fishing.) Fishermen on isolated islands are not privileged socially. Their incomes are lower than people working for tourism industry, merchants and clerical workers and their standard of living is not so good. According to hearings held in local areas, the profitability of a fishermen's family and the effect of implementation of the project can be estimated as follows.

Study of profitability of fishermen (the Grenadines)

Case 1 *Current situation*

Income			
Amount of catch =2,700Kg/year	15Kg/day x 180 days/year		
Sales amount =EC$20,790	2,700Kg x 2.2 x EC$3.5/Lb		
Expenses			
Fuel (gasoline) =EC$7,200	20L/day x 180day x EC$2.0		
Fishing tool	EC$300/set x 5/year	= EC	$1,500
Engine depreciation	EC$4,000/4years	= EC	$1,000
Fishing boat depreciation	EC$8,000/10years	= EC	$800
	Total expenses	= EC	$10,500
	Net income	= EC	$10,290
	Monthly income	= EC	$857

Case 2 *After establishment of Fisheries center (22% increase in catch)*

Income			
Amount of catch =3,300Kg/year	15Kg/day x 220 days/year		
Sales amount =EC$25,410	3,300Kg x 2.2 x EC$3.5/Lb		
Expenses			
Fuel (gasoline) =EC$8,800	20L/day x 220day x EC$2.0		
Fishing tool	EC$300/set x 6/year	= EC	$1,800
Engine depreciation	EC$4,000/4years	= EC	$1,000
Fishing boat depreciation	EC$8,000/10years	= EC$800	
Charge for use of facilities (Landing place)			EC$50/year
	Total expenses	= EC	$12,450
	Net income	= EC	$12,960
	Monthly income	= EC	$1,080

Notes. Assuming boat owner prepares fuel, the boat and fishing gears for 3 fishermen and takes half of the catch.

a. The price of fish is the beach price survey in January 1993.
b. The fuel price is one surveyed in January 1993.
c. The boat is 7m long with 3 fishermen, 25 hp equipped outboard engine and the purchasing fund is a bank loan.

As shown in the above, introduction of the center will increase the income of boat owners. At the same time, fishermen who help boat owners can expect to increase their income by about 20%.

6) Improvement of quality of marine products

Currently, quality inspection of marine products is only done using organoleptic test and no scientific check is taken place. Incidents cause by cigatera poisoning of reef fish has been reported often from neighboring countries of Caribbean sea. Fortunately, St. Vincent has only one incidence several years ago but it cannot be said with certainty that it won't happen again sometime in the future. Many allergy cases have been reported from eating degraded fish, etc. Recently, neighboring Grenada has been actively exporting tuna to the US by air. Canadian fish importers have been inquiring about the same thing in St. Vincent and fresh fish export is supposed to be realized soon from this country. In that case, the US standard requires attachment of a quality inspection certificate.

Mercury testing of exported tuna is recommended in order to monitor contamination. For the above reasons, it is necessary to install a quality inspection analyzer in the Fisheries Division to respond to future international requests.

The country imports 146 tons/year of salted codfish caught in the North Atlantic Ocean and foreign currency of this payment is EC $1.28 million. On the other hand, since a lot of sharks are caught around the country as a by-product of longline fishing, the Fisheries Division has been promoting with research and development for the use of salt dried shark as a substitute for imported fish products. According to a trial taste questionnaire conducted with ordinary people in 1992, such products was favorably received and further study is necessary to improve the quality in the future development. For this reason,the processing machine such as a vacuum packaging machines are required to promote research and development of fish products. It is very important for the country's economy from the viewpoint of saving foreign currency by means of products which substitute for imported products.

3-2-6 Necessity for technical cooperation

It will be the first time for the country to establish and operate a Fisheries Center and now it is in the stage of study concerning what kind of management and operation should be utilized for the most effective operation; however, its structure, staff and finance are still under consideration process. The cooperative which has been operating some time but their activity has been merely joint purchasing fuel for the out-board engine so far. Therefore, when the facility is completed and delivered, it is essential to have advisors who support the technical side of fishing activities. In particular, guidance by a specialist who knows about fresh fish marketing and distribution is necessary in the field of small coastal fisheries and another specialist is required for bolstering the functioning of the Fishery cooperative.

In Paget Farm, for example, about 60% of the people only have education levels equivalent to lower elementary school, and, in fact, many of them cannot do simple calculations. For this reason, guidance by the technical advisor of the Fisheries Division is essential for accounting, bookkeeping and drafting of the operation plan.

Regarding the maintenance of refrigeration machines, it would be most effective if the refrigeration engineer of the Kingstown fish market does routine guidance and servicing to the two centers. However, it is preferable that the refrigeration operators at both facilities take training for a short period of time in Japan for technological transfer, then they can implement safe operation back home.

3-2-7 Principal of implementation of cooperation

According to the above study and examination of the project, since the effects, feasibility and implementation capability of the government were confirmed and the effect of the project conforms to the scheme of the Japanese Grant Aid assistance, it is determined that the project is appropriate to be implemented by the Government of Japan's Grant Aid program. Therefore, with the precondition that the project would be financed by Japanese grant aid, the project will be further studied in detail and the basic design of the project will be prosecuted.

3-3 Outline of project

3-3-1 Executing Agency and Operational System

1) Executing agency

The Fisheries Division is under the Ministry of Agriculture, Industry & Labor and currently has 16 staff persons led by the Chief Fisheries Officer. There are 23 positions including lower-grade staff; however, the policy is to fill the people gradually and not fill the positions immediately in order to obtain qualified staff possessing enough ability. When the project is implemented, the plan is to hire staff persons to work for Paget Farm from among people who are from this island. Selection of these persons is now in process.
The budget of the Fisheries Division in 1993 is as follows. (These figures are for the 1993 Fisheries Division budget. Unit of measurement: EC$.)

1. Personal Emoluments	293,240	
2. Other Charge		
Travel and Subsistence	5,000	
Transport Allowances	15,000	
Materials and Supplies	5,000	
Operating and Maintenance Costs	32,000	
Office Expenses	2,000	
Public Utility Charge	5,000	
Contribution to Fishermen's Week Canouan Regatta	18,000	(Marine festival at Cannouan Island)
3. Reserved Expenditure		
Surveillance of EEZ	10,000	(200-mile patrols)
Installation of FADS	10,000	
Total	395,240	* Source : 1993 Budget Paper

The main tasks of the Fisheries Division are fishing statistics, technical extension, management and control of resources, research and development and international fishery relation and small number of staff cover a variety of those tasks.

The government of St. Vincent & the Grenadines has prepared the budget (EC$500,000) for reclaiming work required for the project to the 1993 budget estimation and is ready to start the construction work which is responsible to the St. Vincent side immediately after the commitment of cooperation from the Government of Japan.

3-3-2 Location and condition of the project

1) Bequia Island Paget Farm

(1) Location

As shown in the map at the beginning of this report, the project site is situated at latitude 13° 00' N, longitude 61° 15' W, the northernmost end of the Grenadines. This island is situated 8 miles south of St. Vincent about 1 hour by ferry boat. The site is located in the southwest part of Bequia Island, about 4km from Port Elizabeth, the center of the island. Paget Farm is an old fishing village and is situated near the fishing ground around the Grenadines. In 1992, a coral reef to the west of Paget Farm was reclaimed and an airport was built with the support of the EC. The project site is located about 500m east side of this airport, almost the right under the flight path. (See Fig. 3-1)

(2) Topography

The area around the site is shallow, and there is a gently inclined shore with water 1 - 3m deep. The bottom of the shore is comprised of rocks and sand, and coral reef. The hinterland of the shore is a steep slope based on volcanic rocks and the surface of the earth has been weathered and is covered with shrub. Houses are distributed here and there on the steep slope along the shore. At the Site, two ditches to drain surface water from the hinterland slope have been provided. Usually water is not drained except during heavy rainfall. Since rain water flows all at once from the watershed, about a 2m x 1m crosssectional area of flow has been secured. The coastline is a rock beach with many rocks around 1m in diameter and there is almost no sand. There is a public pier (50m long) 80m west side from the site. Petit Nevis Island, offshore about 1 km to the southeast, has a whale hunting base, and Isle a Quatre and Pigeon Island is 2km south. The Government of St. Vincent has agreed that they will start reclamation of the subject area (about 50m by 70m) of the project concurrent with implementation of the project.

(3) Weather and sea condition

There is a constant easterly wind at the site and wild waves are deflected along the coast line from the east side and break on the shore. Winds from the southeast blow only

about 10 days a year. Rain falls about 200 days each year and precipitation is only about 1,654mm a year. Since Bequia Island does not have fresh water sources, people rely completely on rainfall for freshwater.

(4) Condition around project site

The site is situated 80m east side of the public pier and adjacent to the trunk road connecting the airport and Port Elizabeth, and is right under a slope adjacent to an Anglican church and two private houses. The east and west side of the site have ditches and torrents flow into the sea during heavy rains. 60% of the people around here are fishermen. They keep their fishing boats pulled up on the beach. They have shabby lockers near the boats and store fishing tools in it.

Electric line has been installed on the road on the slope, thus a power line can easily be installed. As explained above, the island does not have a water supply system and the people gather rainfall and use it as freshwater. Microbuses run between the site and Port Elizabeth, the center of the island, frequently and it takes about 15 minutes to get to the port. Since the airport was built at Paget Farm in 1992, connection by air with the main island has improved. The government is planning to develop housing and tourism around the airport and sale of land in lots and building of hotels have been planned in the village.

2) Union Island Clifton

(1) Location

The project site is situated on the south coast of Clifton of Union Island which is located in the south part of the Grenadines at longitude 61° 26'W. This island is 54km from St. Vincent and it takes about 4 hours by ferry boat. It is just 6.5km to Carriacou Island to adjacent Grenada. Clifton, where the site is located, is one of the two villages on the south coast of Union Island and its major industries are tourism and fishery. The population of the island is 1,750. There is an airport 500m east from the site. This airport was opened in 1992 with the support from Taiwan and is connected to places such as the main island of St. Vincent, Martinique Island and Grenada. (See Fig. 3-2)

(2) Topography

The site is located at the most rear part of Clifton Bay. This place is in a closed reef and is not influenced by waves or currents from the open sea at all. The bottom of the sea is sand originated from coral reef and the seaweed is lush there. The proposed land is comprised of sand and is flat and vacant. The bottom gently offshore and leads to the waterway of bay at about 5m deep. Coral reef of 50cm in thickness spreads in strips around 4m long at the shore.

(3) Weather and sea condition

Though there is a constant easterly/northeasterly wind, the wind does not directly hit the site because there are hotel(s) and related houses at the windward side. There is very little precipitation and is estimated at 1,000mm/year, 70% of that of St. Vincent. Plants growth on the island is characterized by aroe, cactus and other plants with many thorns which grow in arid land. The rainy season is from June to December.

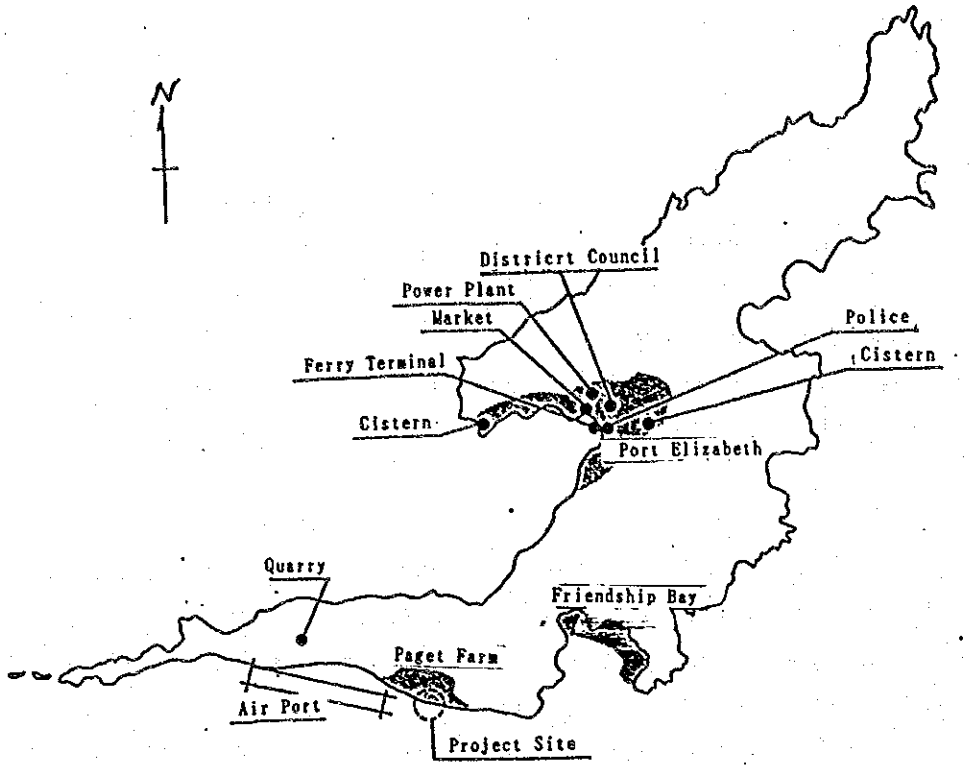
Because the site locates inside the reef, it is virtually unaffected by waves and current. The difference of high and low tide is less than 1m and is very small. Tidal change merely moves sea water a little. The bottom material hardly moves and mud is deposited. The degree of water transparency is very low and contamination by drain water from people is fairly profound.

(4) Condition around project site

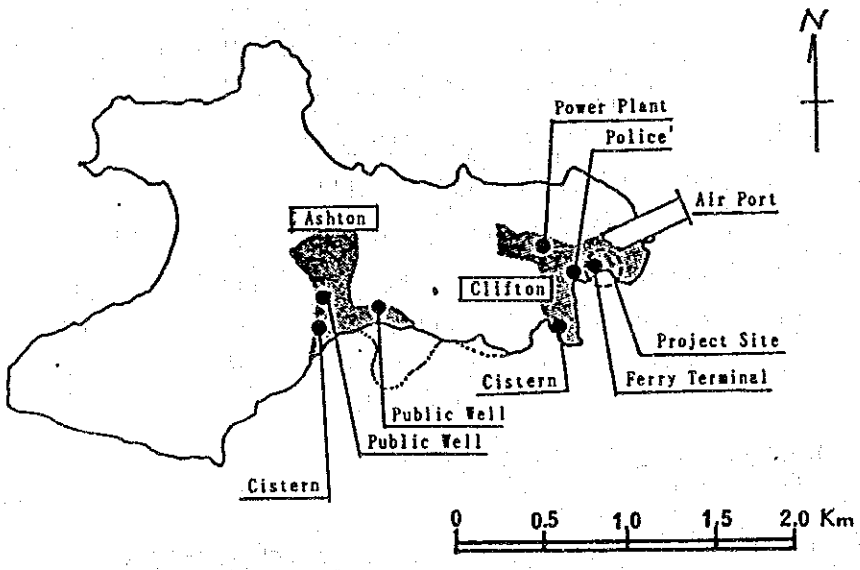
The site is situated at the center of the tourist industry facility which is the middle of Anchorage hotel and Clifton beach hotel. The site is the central area of the Clifton village because there is a supermarket, bank, government branch office, etc. near the site. At the reef, there are always around 100 large yachts at anchor and the place is one of the most eminent yacht harbors. There is a public pier 20m west side from the site and ferry boats arrive and leave from there. The west and pier sides of the site face the road and there are vacant houses in the site. Those houses will be demolished by the St. Vincent side upon implementation of the project. A power line supplies the site with electricity. A water supply system has not been provided because there is no source of freshwater and each family has a tank to store rainfall. Site area is around 3,400 square meter.

3-3-3 Facilities and Equipment

Facilities and equipment necessary for the project are as follows.



BEQUIA ISLAND



UNION ISLAND

Table 3-1 Bequia Island Paget Farm

	Facilities & equipment	Description	Specifications and size
Fishing port facilities	Breakwater	Rubble-mound inclined embankment	20m long
	Shore protection	Wave return type	60m long
	Quay	Perpendicular block	52m long, -2.5m front deep
	Slipway	Concrete	35m long, for beaching fishing gboats
	Road pavement	Stone pitching	70m long
	Access road bridge		
Buildings	Fisheries center building	RC structure	Floor area 385m^2
	Fishermen's' lockers	Block structure	20 lockers
	Toilet and shower	RC structure	20m^2
Attached system	Water supply system	Ice making used inside building	150 tons, water tank, rain/sea water intake
	Gas station	For fishing boats	Gasoline
	Electricity system	Refrigerator only	Emergency power supply
	Drainage system	For living drain	Purification tank
	Environmental system	Leftover	Garbage incinerator
refrigeration/ equipment	Ice making machine	Flake ice	Ice making ability : 2 tons/day, R-22
	Refrigerator	For fish preservation	-5˚C, 10m^3
	Cylinder fill up facility	For diving cylinder	2hp compressor
Equipment	Work boat	1 boat	7m FRP for propagation of technology
	Outboard engine	1 engine	25hp for technology spread
	Pick-up track	1 vehicle	4WD for transportation of fresh fish

Table 3-2 Union Island Clifton

	Facilities & equipment	Description	Specifications and size
Fishing port outer facilities	Small sized pier Slipway	Pile structure Concrete	40m long, -1.0m - -3.5m deep 30m long for beaching fishing boats
Buildings	Fisheries center building Fishermen lockers Toilet building	RC structure Block structure RC structure	Floor area 276m² 16 lockers 20m² toilet/shower
Attached systems	Water supply system Gas station Stand-by generator system Drainage system Environmental systems	Ice making used For fishing boats Refrigerator only For living drain Leftover	120 tons, water tank, rain/sea water intake Gasoline Emergency power supply Purification tank Garbage incinerator
Refrigeration equipment	Ice making machine Refrigerator Cylinder fill up facility	Flake ice For fish preservation For diving cyliner	Ice making ability : 1 ton/day, R-22 -5°C, 10m³ 2hp compressor
Equipment	Work boat Outboard engine Pick-up track	1 boat 1 engine 1 vehicle	7m FRP for propagation of technolocy 25hp for propagation of technology 4WD for transportation of fresh fish

3-3-4 Operation and Management plan

Basic policy

The Fisheries Division will take the initiative in the operation of the fisheries centers for a duration of five years during which time it implements an on going broad based extension programme to up-grade all related activities of the fisheries centers in an effort to bolster the cooperatives' independence both technically and financially. After this period of time the cooperatives should be able to independently manage the centers as main constituents of their operations.

An immediate increase in the number of fishermen is not anticipated but it is expected that there would be an increase in the number of fishing day/year because of the fish holding and processing facilities at the centers, and secured markets. The development of new fishing

techniques, the expansion to new fishing grounds both within the territorial sea and the EEZ (Exclusine Ecomical Zone), and the introduction of new fishing gear and methods, would result in an increase in the price of fish. Improved post harvest handling practices would produce a fresher product, and the income of fishermen would be increased.

At both sites, little or no ice is being used at present. But when the project is implemented, ice will be used in order to maintain good quality for stable distribution. Fishermen would leave the centers with ice packed in an insulated box in which they would store their catch until their return, when the fish would then be transferred to a -5°C refrigereator. Presently, the catch is put into a "pool" of sea water at the bottom of the fish is therefore degraded by the time the fishermen return to port in the afternoon. The use of ice permits fishermen to go much further away and allows for the harvesting of the deep slope demersal resources on the continental shelf which have hitherto been underexploited.

In the new fisheries centers, fish markeing will be the responsibility of the NKFM. Fish would be landed, gutted, (according to species and market requirements) and processed, then weighed and put into ice and kept under refrigeration. When fish is to be shipped, it will be placed into an appropriate size insulated box, with ice and carried to the ferry terminal by the facility truck. (Ferry boats run three times/day between Bequia Island and Kingstown, and three times/week between Union Island and Kingstown). Since it takes one hour to get from Bequia and about four hours to get from Union Island, the freshness can be quite easily maintained. The amount of fish NKFM handles should be the increased catch derived from the implementation of the project. The fish collected by the fish transport boats should be exported to Martinique using the same distribution channel as of now. Export of fish by airplane to Miami, US has been going on now for just about one year. However, since each fisheries center is located about 500m from each airport, it is ideal for exporting high quality fish and shellfish to the wider Caribbean and beyond. The Fisheries Division would encourage private entrepreneurs to join this area of activity. This means that the Fisheries Division should promote the use of the center's facilities by private traders, the issuance of fishery products export permission certificates, and provide traders with market intelligence.

Estimated amount of fish marketing and distribution is as follows.

(tons)

	Record in 1992			Completion + 5 years		
	Consumption on island	Vincent main island	Export	Consumption on island (including customers on yachts)	Vincent main island	Export
Paget Farm	10	10	200	20	100	350
Clifton	6	0	120	15	100	300

On Paget Farm, fish caught around Mustique Island and the central Grenadines is taken to the fish transport boat anchored off of Paget Farm by speedboats. This is because there are no ice or refrigeration facilities available in that area. With this project, one can expect an increase in fish landings from those surrounding islands. In Clifton, the situation is very much the same as it is at Paget Farm, and increased landings from adjacent islands can also be expected.

With respect to the development of pelagic fish resources, since the pier and quay will be built to accommodate the 12m type FRP long liners provided by the Government of Japan, development of off-shore pelagic fish resources such as yellow fin tuna, sword fish, marlin, barracuda, etc. in the EEZ around the Grenadines would become possible. Concerning the resources in this area, the Fisheries Division has already been conducting longline trial operations with the JICA fisheries training vessel, showing the results to the local fishermen and giving guidance in the use of new fishing methods to the fishermen who want to adopt such fishing methods.

3-3-5 Staff plan

Facility operation staff of each fishery center is planned as follows.

The Fisheries Division should assign a staff person to each center as a branch resident staff who is in charge of collecting fishery products statistics, issuing the exported fishery products inspection certificate and observation of resources preservation. For the first 5 years, this person should assume responsibility for managing the facility and does adusting work with the fishery cooperative, NKFM, local government and residence group.

Furthermore, the Fisheries Division should dispatch technical advisors to extend technologies periodically or as required. This activity should not be limited only to fishery but also should cover a wide range of fields from how to keep accounts to general life such as nutrition and raising children, etc. Also, this technical advisor section should act as a counterpart when foreign technical expert cpmdict rpitome giodamce.

The fishery cooperative should assign a manager, a person in charge of machines and accounting staff, a total of 3 staff persons, as full-time staff. The manager is responsible for management work including general affairs and accounting and is in charge of sales of ice and fuel. The person in charge of machines is responsible for operation and maintenance of machines such as the refrigeration, air compressor and stand-by generator. Two workers should be assigned as part-time staff for receiving and delivering fishery products.

Though the workshop is equipped with basic machines for outboard engines, it should be leased by a private concern and persons who have excellent machine repairing ability should provide service.

In Clifton, the fish retail space should be leased by a sales person in the village to sell fresh fish to resident people or yacht people.

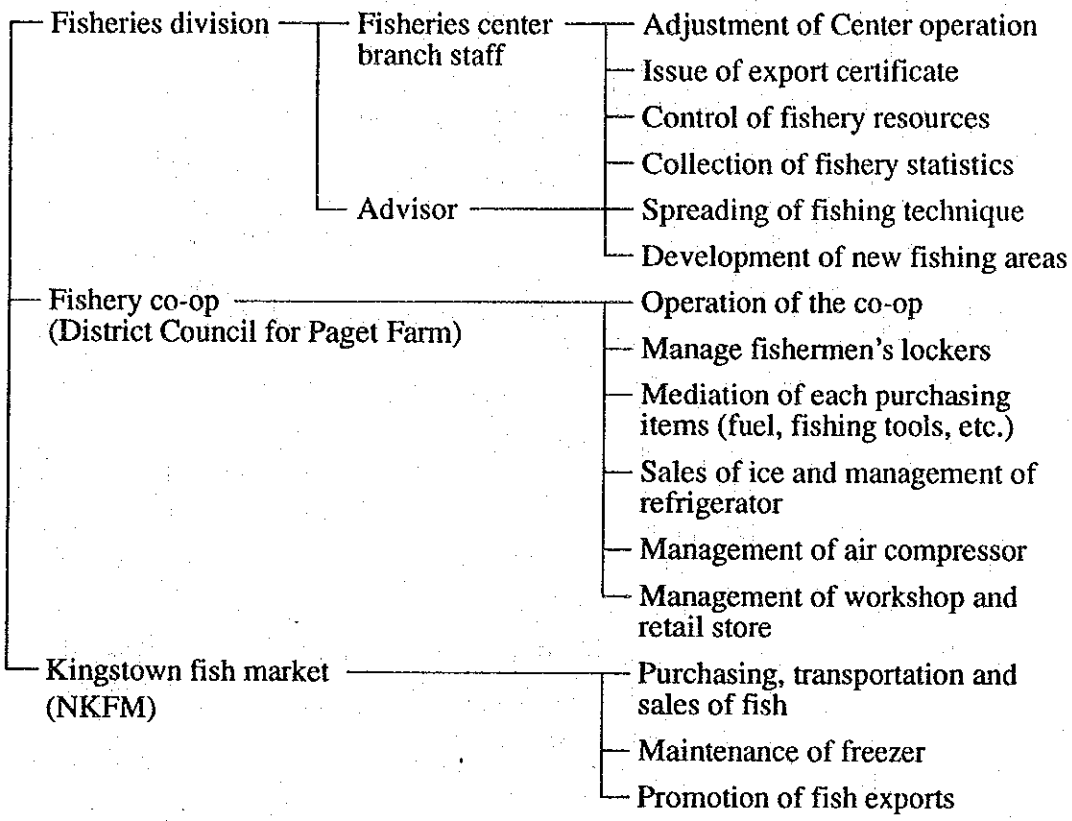
NKFM should dispatch staff for the first 6 months at least, maight be extended if necessary, and this person should check, sort, pack and ship the landed fish. This person should also transfer technique to members of the cooperative and maintain the ice making machine, refrigerator, compressor, etc. by making frequent inspections.

The following table is a summary of staff assignments.

( ) : part-time staff

	Staff	No. of positions
Fisheries Division	Branch staff Full-time advisor Expatriate expert	1 1 (1)
Fishery cooperative	Full-time manager Machine staff Clerk staff Laborer	1 1 1 (2)
Wholesale section	NKFM staff Full-time for 6 months then local staff will take over	1
	Sub total	6 + (3)
Retail sale section (Clifton) (leasing of retail place) Workshop (leasing of space)	Retailer Mechanics	1 1
	Sub total	2
	Total	(2)

Fisheries center operating structure and duties



3-3-6 Financial plan

Though the center's operation is not for profit oriented, it must be operated at least to cover the operation expenses and maintenance cost. For each organization related to the operation, i.e. the St. Vincent Government Fisheries Division, the Fishery cooperatives and NKFM it has to be operated with care not to shoulder any financialdifficulties. Especially important in that the Fishery Cooperatives has full-time workers, it must produce their salaries and allowances from business activities. However, if the prices of sales items are raised the production costs or wholesale price of fish would consequently be raised and this may result in decrease competitiveness. Therefore, it is necessary to do this operation by suppressing the cost as much as possible.

1) Paget Farm

Item	Estimated Sale (EC$)
Sale of Ice	Ice production per day x Day of Sale x Effectiveness of Sale x Unit price of Ice 2,000 kg/day x 200 day/years x 1/2 x 0.77 EC/kg = 154,000 Day of Sale : Fishing day per year 200 day Effectiveness of Sale : Considering promotion of use of ice one half of production is chargeable Unit price of ice : The same as NKFM 0.77 EC/kg
Sale of Fuel (Gasoline)	No. of Boat x Average Quantity x Fishing Trip per year x Sale commission 39 boat x 30 l/day x 200 day/year x 0.03 EC/l = 7,020 Boat Number : Half of fishing boat of Paget Farm Average Quantity : For out board engine 30 l/day Sale Commission : 0.03 EC/l
Refrigerator Tariff	Storing Quantity x Holding day per year x Store charge 350 kg/day x 365 day/year x 0.2 EC/kg =25,550 Storing Quantity : One third of Total Catch of the area 450 ton x 0.3 ÷ 365 day = 350 kg/day Store charge : 0.20 EC/kg
Air cylinder charging	Air charging fee per bottle x No. of Bottle per day x Operation day 5 EC x 40 bottle/day x 200 day = 40,000 Bottle No : Diving Fisherman x 2 Fishing day : 200 day per year Fee : 7 - 9 EC by Diving shop
Locker Tariff	Free
Work shop rental Fee	100 EC/month x 12 month = 1,200
Slipway charge	Slipway charge : 50 EC/year x 19 boat = 950
Wharf charge	Fishing boat mooring : Free Fish Transport boat : 50 EC/day x 70 = 3,500
Fish handling charge	Domestic Transport Quantity x charge 100 t/year x 100 EC/t = 10,000 Quantity of Fish : 100 t/year Charge of Handling : 0.2 % of average fish price
	Total Sale of Paget Farm 242,220 EC$

1) Clifton

Item	Estimated Sale (EC$)
Sale of Ice	Ice production per day x Day of Sale x Effectiveness of Sale x Unit price of Ice 1,000 kg/day x 200 day/year x 1/2 x 0.77 EC/kg = 77,000 Day of Sale : Fishing day per year 200 day Effectiveness of Sale : Considering promotion of use of ice one half of production is chargeable Unit price of ice : The same as NKFM 0.77 EC/kg
Sale of Fuel (Gasoline)	No. of Boat x Average Quantity x Fishing Trip per year x Sale commission 16 boat x 30 l/day x 200 day/year x 0.03 EC/l = 2,880 Boat Number : Half of fishing boat of Clifton Average Quantity : For out board engine 30 l/day Sale Commission : 0.03 EC/l
Refrigerator Tariff	Storing Quantity x Holding day per year x Store charge 300 kg/day x 365 day/year x 0.2 EC/kg =21,900 Storing Quantity : One third of Total Catch of the area 400 ton x 0.3 ÷ 365 day = 300 kg/day Store charge : 0.20 EC/kg
Air cylinder charging	Air charging fee per bottle x No. of Bottle per day x Operation day 5 EC x 30 bottle/day x 200 day = 30,000 Bottle No : Diving Fisherman x 2 Fishing day : 200 day per year Fee : 7 - 9 EC by Diving shop
Vendor's stall	100 EC/month x 12 month = 1,200
Locker tariff	Free
Work shop rental Fee	100 EC/month x 12 month = 1,200
Wharf and slipway charge	Slipway charge : 50 EC/year x 16 boat = 800 Fishing boat mooring : Free Fish Transport boat : 50 EC/day x 70 = 3,500
Fish handling charge	Domestic Transport Quantity x Charge 100 t/year x 100 EC/t = 10,000 Quantity of Fish : 100 t/year Charge of Handling : 0.2 % if average fish price
	Total Sale of Clifton 148,480 EC$

The yearly sales of the above business is EC$242,130 for Paget Farm and EC$148,480 for Clifton.

Center operation expenses

Among operation expenses of the center, salaries for Fisheries Division staff and NKFM staff should be borne by the government or marketing corporation. The amount borne by the corporation can be collected by means of charges for transportation and consignment sales businesses.

Personnel expenses

Full-time manager	1	1,300/month	EC$	15,600/year
Machine staff	1	1,000/mon.	EC$	12,000/year
Clerical staff	1	800/mon.	EC$	9,600/year
Worker (part-time)	2	500/mon.x 2	EC$	12,000/year
		Total EC$		49,200/yearEC$

Electricity and heating expenses

Ice-making refrigerator related	15KW x 0.7 x 200days/24hr	=	50,400KWh
Lighting, etc.	21.4KW x 0.3 x 200days x 6hr	=	7,704Kwh
	58,104 kw x EC$ 0.45/kwh	=	26,147EC$
	Total		26,147EC$

Maintenance expenses

Telephone	300EC$ x 12	=	3,600
Stationery	200EC$ x 12	=	2,400
Consumable	500EC$ x 12	=	6,000
Fuel	60gal/month x 6.2EC$ x 12	=	4,464
	Total		16,464EC$

In addition, money for purchasing fuel and payment of electricity will be necessary as a starting fund of the center and it is possible to borrow this money from the Development Corporation of St. Vincent. This corporation is the 3rd sector of the government and administers loans of development funds. In the case of this project, on the condition that Ministry of Agriculture, Industry & Labor underwrite the loan, the corporation can execute loans to the fishery cooperative.

The following is the summary of direct expenses concerning operation of the project facilities.

		(EC$)	
a)	Personnel expenses	49,200	
b)	Electricity and heating expenses	26,147	(Clifton : 14,050)
c)	Maintenance expenses	16,464	
d)	General management expenses	10,000	
Total of yearly expenses		101,811	(Clifton : 89,714)

According to the above estimation, a profit of EC$140,409 (year) for Paget Farm and EC$58,766 (year) for Clifton would be expected from the center's operation.

CHAPTER 4 BASIC DESIGN

4-1 Design Policy

4-1-1 Basic Policy

The basic design shall be executed based on the present state of the country, and in order to appropriately select the scale of the facilities within the limits of the grant aid system provided by the Japanese government, the Basic design shall be carried out in consideration of the following factors ;

1) An appropriate scale of facilities design

   a. Based on an investigation of the present state, future of requirements shall be suitably estimated, and then, each facility scale shall be selected.

   b. The scale and type of the facility and its contents shall be selected conform with the frame of the grant aid system.

   c. Consider that maintenance and operation cost of the facilities shall be minimal.

2) A design taking into sufficient consideration on the natural conditions

   a. The design shall meet satisfactory of the weather, topography, geology, sea and wave conditions of the project site.

   b. Consideration shall be given so that detrimental effects on the surrounding environment during and after construction will not occur.

3) The structure and the construction methods shall be appropriate to various local conditions

   a. The structure and construction methods shall be simple, and made easy to maintain and manage.

   b. Preference shall be given to materials obtainable from within the country or from the neighbor countries.

4) Consideration shall be given to preserve existing landscape.

4-1-2 Natural conditions

At the time of establishing the basic design of the present project, various following natural conditions were taken into consideration. The factors be taken into consideration, Each factors are arranged in accordance with the different conditions for each site.

Table 4-1 Projected conditions for Paget Farm, Bequia Island

Item			Projected value	Notes
Natural conditions	Max. wind velocity (significant)		60m/sec.	Approach of a hurricane
	Max. wave height		2.2m/SE~SW	One occurrence of offing waves every 20 years, wave height = 3.8m
	Water level	Tide level (flood tide)	CD+0.12~0.73m	Max. tide level difference = 60cm, ave. + 0.24~0.64 (tide level difference = 40cm)
		Suction height	+0.5m	+0.5m
	Max. current velocity		2 knots	One hurricane approach/20 yrs.
	Seismic intensity		0.14 (0.052)	Short period T = 0.3 sec, 0.05 when T > 1 sec
	Bottom sediment		Coral crushed sand/gravel w/ a particle diameter of 50cm, 80% w/ a particle diameter of 0.15~2.4mm	
	Precipitation		Annual ave. = 1,665mm; one hour max. = 20mm (max. rainfall over six hours was converted into one hour)	
	Temp.	Yearly fluctuation	High = 33.5°C (September), Low = 18°C (January)	
		Comparative difference	Ave. = 5.5°C, Annual ave. temperature = 27.3°C	
	Humidity		Average = 78% (Kingstown)	
Nature of the soil			Surface layer	Foundation
	Moisture density		1.82 ton/m³	2.10 ton/m³
	Percentage of water content		40~49% by weight	19% by weight
	Nature of soil/particle size		One portion (BH/2) silt-blend clay, and a large portion of coral sand/w gravel	Solid sandstone, silt-blend clay/gravel
	N value		5~15	60~100
	Single axis compression strength		——	——
	Layer thickness		3.5m (BH/4) ~ 14.5m (BH-1)	Water depth 6m (BH/2.4) ~ 9m(BH/3), 15(BH-/1)

Meteorological data are obtained from Observed values at the Kingstown weather station

Table 4-2 Projected conditions for Clifton, Union Island

Item			Projected value	Notes
Natural conditions	Max. wind velocity (significant)		60m/sec.	Approach of a hurricane
	Max. wave height		1.0m/SE	One occurrence of offing waves every 20 years, wave height = 3.8m
	Water level	Tide level (flood tide)	CD+0.12~0.73m	Maximum tide level difference = 60cm, average + 0.24~0.64 (tide level difference = 40cm)
		Suction height	+0.5m	One hurricane approach / 20 yrs.
	Max. current velocity		2 knots	
	Seismic intensity		0.14 (0.052)	Short period T = 0.34 sec, 0.05 when T > 1 sec
	Bottom sediment			
	Precipitation		Annual ave. = 999mm; one hour max.= 20mm (max. rainfall over six hours was converted into one hour)	
	Temp.	Yearly fluctuation	High = 33.5°C (September), Low = 18°C (January)	
		Comparative difference	Ave. = 5.5°C, annual ave. temperature = 27.3°C	
	Humidity		Ave. = 78% (Kingstown)	
Nature of the soil			Surface layer	Foundation
	Moisture density		1.83 ton/m³	2.10 ton/m³
	Percentage of water content		23 ~ 37% by weight	—
	Nature of soil/particle size		Coral sand, one portion clay, concrete sand, stone mixture, silt mixture	
	N value		3 ~ 10	33 ~ 100
	Single axis compression strength		5.5 ~ 21.6 ton/m³	
	Layer thickness		15m (BH3) ~ 18m (BH-2)	Water depth = 17.5m~18.5m or less

Meteorological data are obtained from Observed values at the Kingstown weather station

Soil condition obtained from the survey of January 1993.

1) Wind

During normal times, the direction of the prevailing wind at St. Vincent is 70° - 120° (NE~SE), the annual average velocity is 12 knots, and the maximum velocity is 35 knots (18m/sec) (MET).

2) Typhoon

The surrounding area of St. Vincent is 15 times per 100 years (US Naval Weather service). Within the country of St. Vincent, the only one occurrence of a hurricane was recorded in 1895, while tropical storms have occurred three times in 1955, 1979 and 1981. The record of these times estimates a maximum wind velocity of 45 knots and a gust (instantaneous wind velocity) of 65 knots (33.4m/sec). In recent years, the largest hurricane occurring in the surrounding area was ALLEN in 1980, which attacked on Jamaica with a central atmospheric pressure of 930mb and a maximum wind velocity of 150 knots (77.1m/sec).

As described above, a hurricane has not occurred within the country of St. Vincent in over 20 years, and additionally, the country lies outside the sphere of influence of hurricanes striking surrounding area (50~550km sphere), thus in regards to the facilities of the present project, it is decided that a maximum wind speed of 60m/sec would be sufficient for the designing.

3) Current velocity

[Bequia Island]

The maximum tide velocity in off shore of Paget Farm is 2 knots.

[Union Island]

The tide velocity changes in a northward water channel between 1.7 knots (116°)/2.0 knots (300°) and in a southward water channel between 1.3 knots (88°)/1.2 knots (288°) following the ebb and flood of the tide. The current velocity at low tide is approximately one-half of the aforementioned.

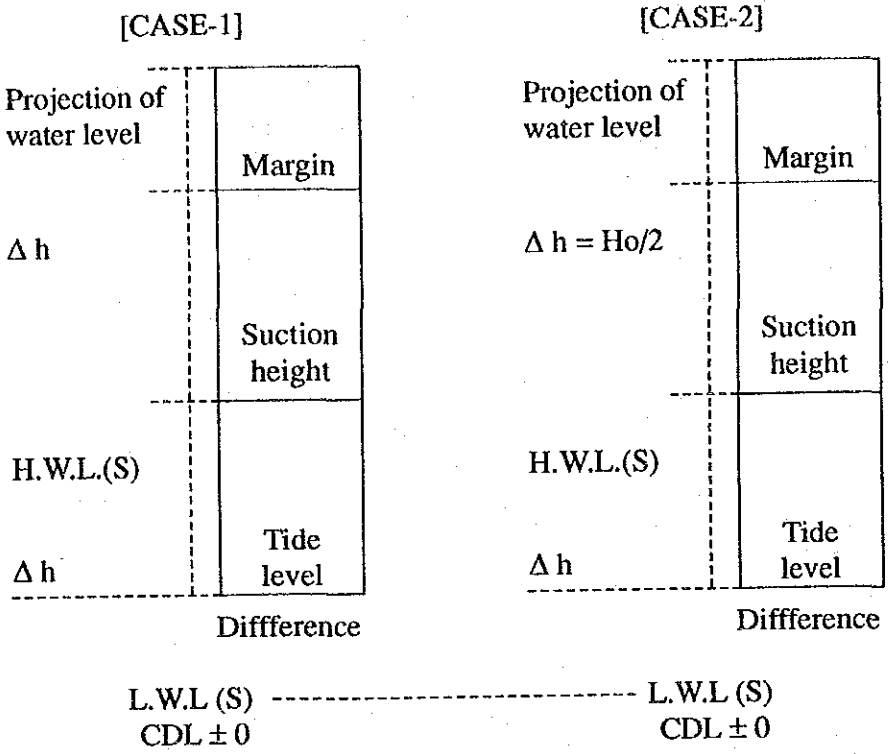
4) Variation in sea water levels

The average annual variation of the water level in accordance with the astronomical tide is 2.1 feet - 0.8 feet = 1.3 feet (approx. 40cm), and even at the time of spring tides this variation is small at 60cm. Besides the static suction height (Δhs) of the deep water regions, the kinetic

suction height (Δhd) of the other shallow water regions are added to obtain the water surface rise which accompanies atmospheric pressure decrease at the time of a hurricane approach. For the new airport on Bequia Island and for the expansion of the airport on Union Island, based on Holland's research (R-11), the static suction height (Δhs) is estimated in the following.

Distance from center of hurricane	Static suction height (Δhs)
0' Nautical mile	0.71m
30' Nautical mile	0.28m
50' Nautical mile	0.18m
100' Nautical mile	0.10m

Based on the above estimated results, the total suction height (Δh = Δhs + Δhd) 0.5m at Union Island, and at Bequia Island Δh = 1.0 m is being used as the standard for the airport design. However, in this project, significance of the fishing port facilities was considered to be less when compared with the airport, and thus a height (Δh) = 0.5m was selected for both Bequia Island and Union Island.



Furthermore, in estimating the highest water level of the design, the probability of a rise in water level and simultaneously occurrence of maximum wave height due to the approach of a hurricane is remarkably small, thus it is not necessary to add these two events together.

CASE-1: The water rise due to approach of a hurricane once every 20 years is added to the high tide level at the time of spring tides.

CASE-2: The wave crest of the maximum waves occurring once every 20 years is added to the high tide level at the time of spring tides.
Choosing the higher value among the above two examples was judged to be sufficient.

5) Wave height

Normal circumstances

From 18,678 cases (wave direction, wave height and period/See Wetteramt Hamburg) of wave observation data taken during normal times by ships, over 21 years in the surrounding sea region (10 - 14°N, 60 - 56 °W) which includes St. Vincent, the wave heights generated at a frequency of once every X years is estimated below based on statistical calculation (Kocks

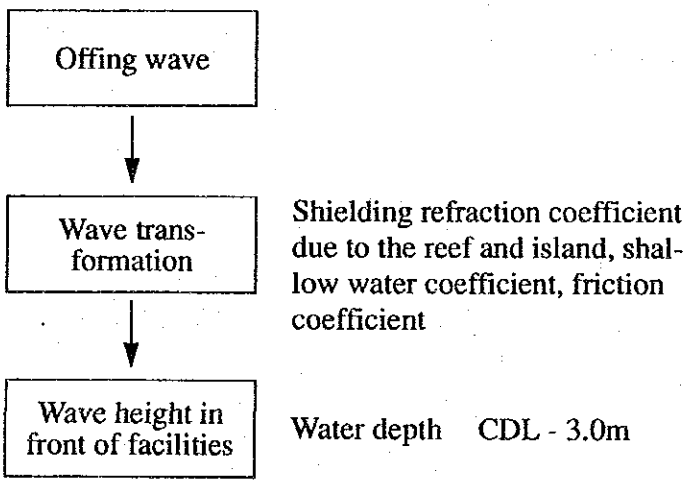
Consult GmbH). In 93% of the observed cases, the wave direction was eastward (NE, E, SE), and the prevailing wave cycle period was 7 seconds.

The above-mentioned estimated results (offshore waves) are being used in the design for the airport on both in Bequia Island and in Union Island, thus same results be also used as the offshore waves (significant waves) in the design for the facilities of the present project because both sites are near the airports.

Probability of recurrence	NE	E	SE	S	SW	W	NW	N
1 year	3.8	4.1	2.8	1.6	0.8	0.7	1.0	2.4
10 years	4.9	5.2	3.5	2.8	3.3	1.8	2.6	3.8
20 years	5.2	5.5	3.8	3.2	3.8	2.2	3.1	4.2
50 years	5.6	6.0	4.0	3.8	4.5	2.5	3.7	4.8

offshore wave height Ho (m)

The projected value for the maximum wave height in front of each site is estimated in the order below.



[Bequia Island/Paget Farm]

Diffraction & refraction / Effect of water depth

			Offshore wave after diffraction			
Wave direction	Wave height (Ho)	Period T (Sec)	Ho' (m)	Wave direction	Water depth (h)	Wave height
E	5.5m	7.0	1.6	SE		
S	3.2m	7.0	2.2	S		
SW	3.8m	7.0	3.2	SW	4.5m of less	h/2 = 2.25m

In the project area of Paget Farm, the peninsula side of island lies in the eastward direction, and in the southward direction exists an island, but no obstacles exist in the southwest direction and thus this portion is laid open. As a result, even when considering the effects of the diffraction or shielding by objects and the refraction due to sea bottom topography, the offshore wave is not significantly affected, with the exception of the E/S direction. However, in considering the water depth (h) of the wave breaking zone, it was determined that there should be no fear of wave exceeding the height area h/2 = 2.25m coming from the SE direction into the site.

[Clifton, Union Island]

The Clifton site, excluding the navigation channel which goes around in front of site the reef, is surrounded by an island, as well as, a reef with a water depth of 1 fathom (1.8m) or less. As a result, when considering the breaking effect of the shallow reef, there should be no fear of the attacking by waves barring a height greater than Hs = h/2 < 0.9m (h = water depth). In the case when a submerged reef does not exist, the maximum wave height after the diffraction due to the periphery island, is estimated based on "the energy distribution analysis as shown the fishing port standard", be value which is close to the value estimated by the airport expansion project, Ho = 3.6m(E), ~ 2.6m(SE).

However, in both Bequia Island and Union Island, in regards to invading waves from the western side of the project area, the wave height is greatly reduced before reaching the project area and is thus not anticipated to exceed the wave height created by rough seas during normal

times because the present island disperses the majority of their energy. Therefore, further research was deemed unnecessary.

Abnormal circumstances

A hurricane of maximum magnitude, such as Allen (1980), was assumed to approach near in the new airport on Bequia Island. (Kocks Consult GmbH)

Maximum wave height ; Hs = 9.6m (significant offshore wave)
Period of the waves ; Ts = 12.0 sec
Radius of the region of maximum wind velocity ; R = 27.8km (= 15nmi)
Direction of progress = 280° (- W)

In the present project, Based on the low probability of a hurricane directly advancing onto St. Vincent (the frequency of one passing the surrounding sea region of a width of 5° is 0.15, as stated above), the probability of a hurricane approaching up to 100nmi (= 1.67°) from the north and south of Bequia Island/Union Island was determined as 0.15 X 1.67°/ 5° = 0.15 X 1/3 = 0.05.

From henceforth, in accordance with the reports (R-6), the offshore waves due to approach of a hurricane will be estimated as shown below. However, in viewing the passage routes of past hurricanes, it was determined that an offshore wave height Hs of 4.0m (significant) shall be sufficient in regards to the westward direction, since in most of the past cases the hurricanes passed on the northern side of St. Vincent.

Approach distance	Maximum wave height
100 (Nauticalmile)	4.7m/EW, 6.6m/S (F)
50 (Nauticalmile)	4m or less (westward direction)

6) Earthquake

CUBIC (Caribbean Unified Building Code) PART 2/SEC. 3" earthquake load" is a standard for buildings with the exception of civil structures such as piers, wharves and the like; however, the concept of the earthquake load is applicable to civil facilities and was thus adopted in the present project. (e.g.. Recommendations for the design of concrete sea structures/FIP 1, Oct. 1973, the UBC in USA is used as the standard upon which CUBIC is based.)

This standard is a method for calculating the seismic intensity taking into consideration the characteristic period of the structure. The horizontal earthquake load (V) is provided by the following formula in relation to the dead weight (W) of the structure:

Corrected seismic intensity = K' = ZCISK'V = K'(W),

where

a.= Regional coefficient; maximum of 0.75 (north of St. Lucia) minimum of 0~0.25/within Guyana, and 0.5 at St. Vincent,

b.= Significance coefficient; hospitals/1.5, meeting places/1.2, others/1.0; 1.0 shall be USED for CIVIL structures which do not involve human lives

c.= Reduction coefficient taking into consideration the characteristic period (T) of the structure; maximum of 0.12

d.= Foundation coefficient which relates to C; maximum CS < 0.14.

e.= Seismic intensity ; maximum of 2.0 FOR gravity-type structures range ; generally in the 0.8 - 2.0 range

Based on the above results, the corrected seismic intensity in relation to the characteristic period (T) of a structure will be as follows:

T (Characteristic period)	K' (Corrected seismic intensity)	Notes
0.3 gee sec	0.14	k = 2.0
1.0	0.07	
5.0	0.035	

In the present project, large-scale, ductile structures (e.g.. steel products) with long periods are not being considered, thus use of a maximum K' = 0.14, as the projected seismic intensity, was deemed appropriate.

7) Movement of the bottom sediment

At both Paget Farm and Clifton, the coral crushed sand have the uniform particle diameters of 0.15~2.4mm, and when there is a strong unidirectional flow in the wave-breaking zone, the bottom sediment moves easily.

In the present project, the tide current at both Paget Farm and Clifton is a weak current of approximately 2 knots accompanying the ebb and flood of the tide, which shifts directions by