THE MINISTRY OF AGRICULTURE, FORESTRY,
FISHERIES, AND THE ENVIRONMENT
SAINT LUCIA

NO. 1

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR CONSTRUCTION OF VIEUX FORT FISHERY COMPLEX
IN
SAINT LUCIA

DECEMBER, 1997

JAPAN INTERNATIONAL COOPERATION AGENCY

TETRA Co., Ltd.

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PREFACE

In response to a request from the Government of Saint Lucia the Government of Japan decided to conduct a basic design study on the Project for Construction of Vieux Fort Fishery Complex and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Saint Lucia a study team from August 12 to September 15, 1997.

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

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

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

December, 1997

Kimio Fujita
President
Japan International Cooperation Agency

December, 1997

Letter of Transmittal

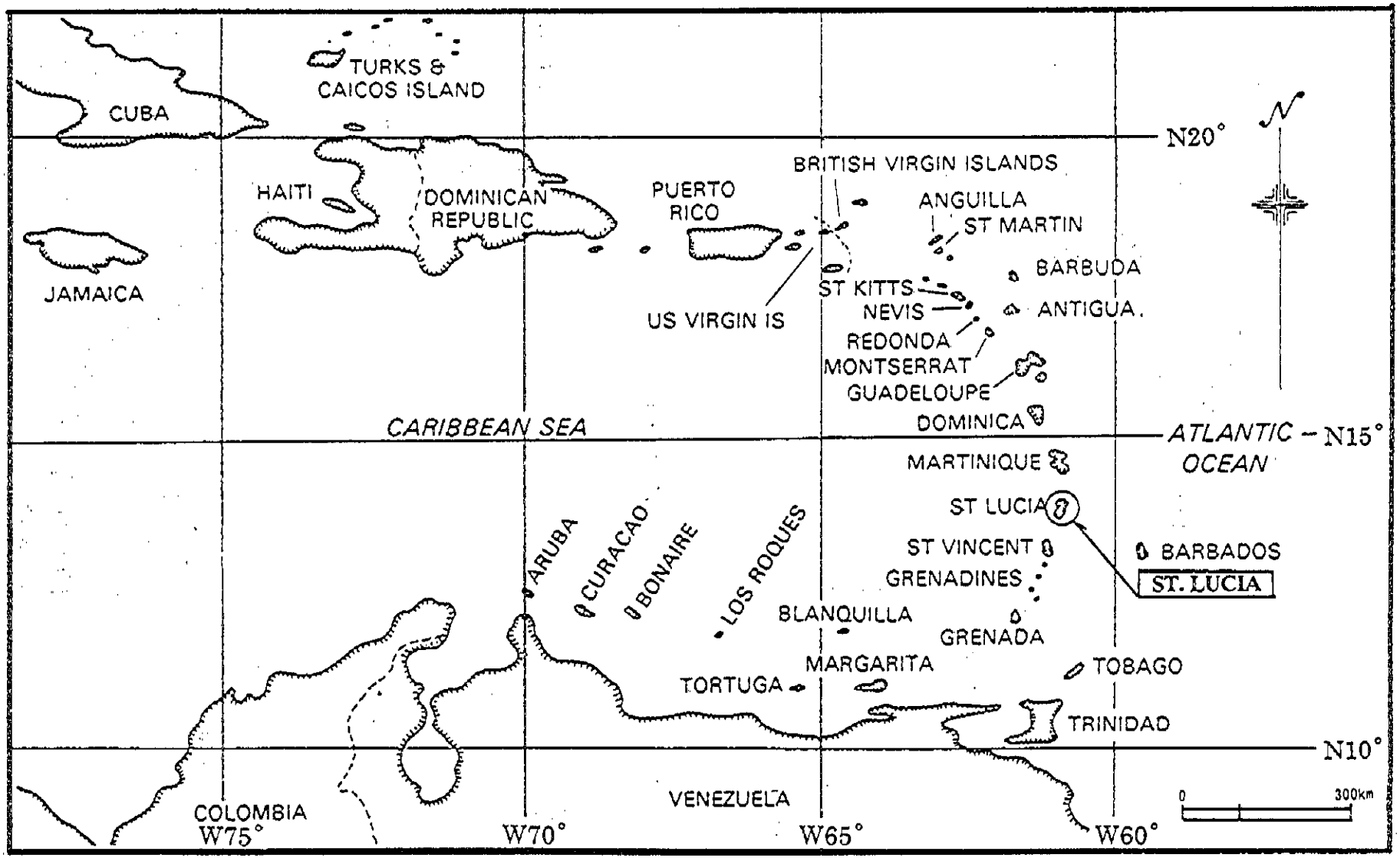
We are pleased to submit to you the basic design study report on the Project for Construction of Vieux Fort Fishery Complex in Saint Lucia.

This study was conducted by TETRA Co., Ltd., under a contract to JICA, during the period from August 8, 1997 to January 28, 1998. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Saint Lucia and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

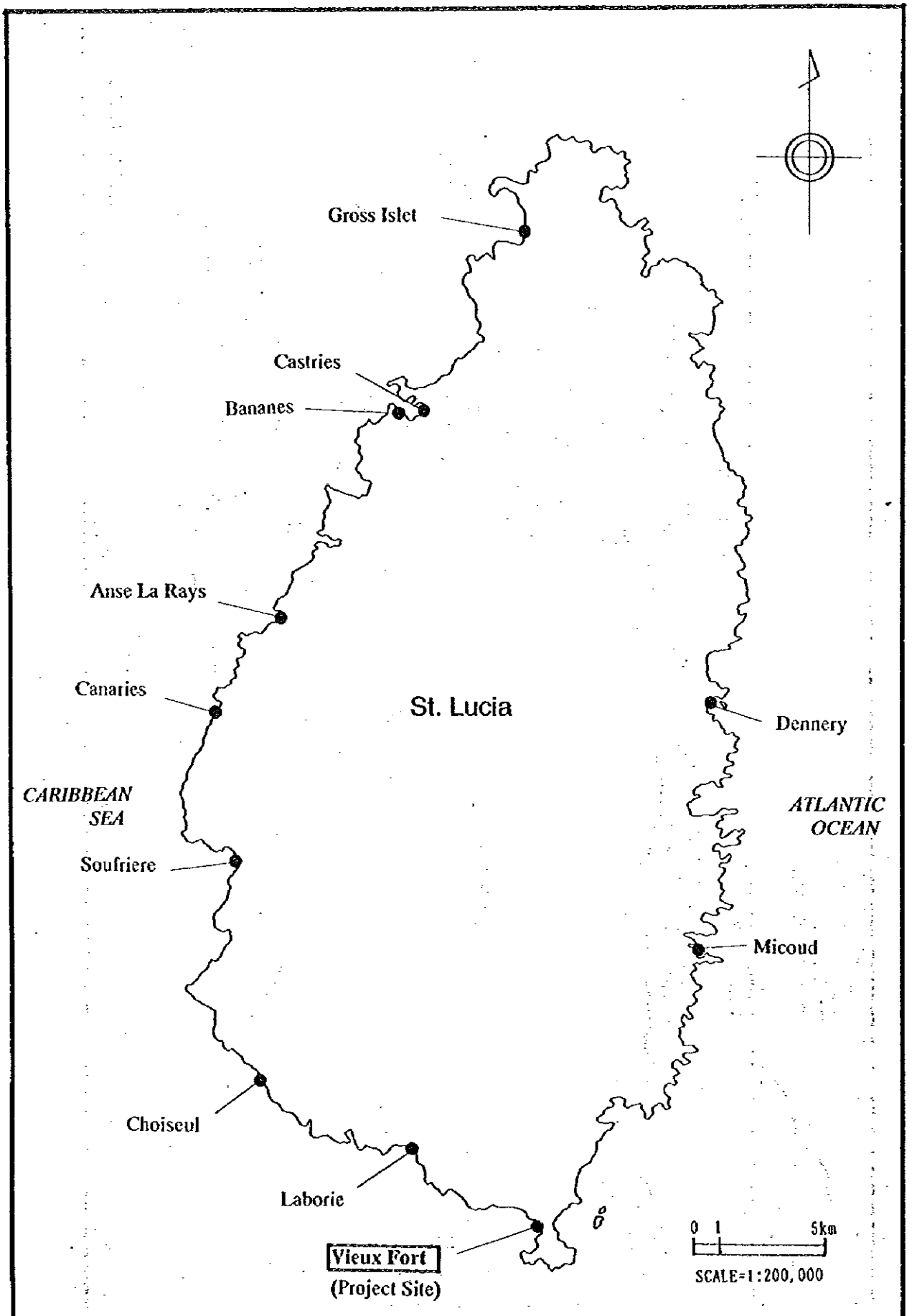
Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

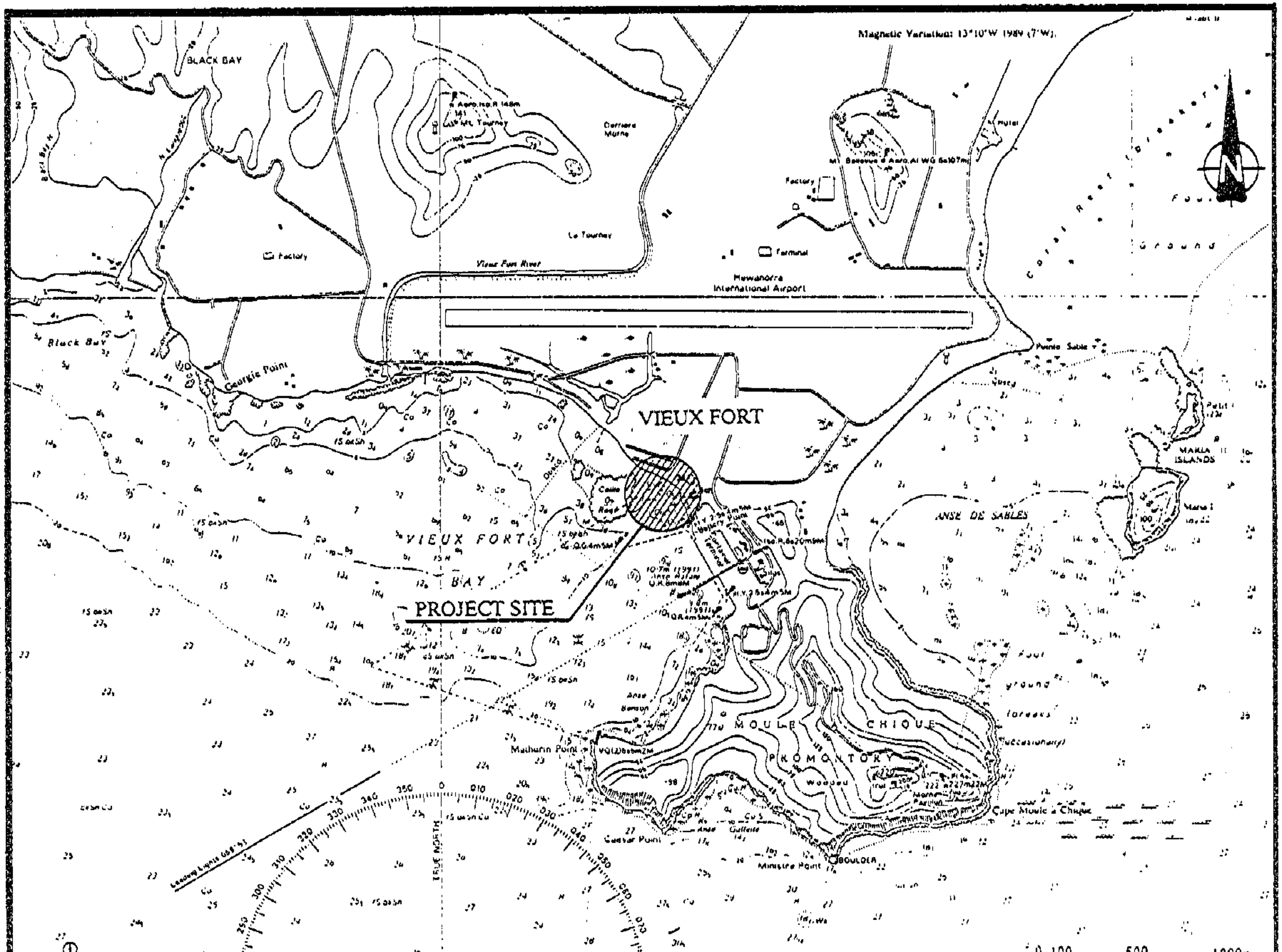
Norio Tanaka
Project manager,
Basic design study team on
the Project for Construction of
Vieux Fort Fishery Complex
TETRA Co., Ltd.



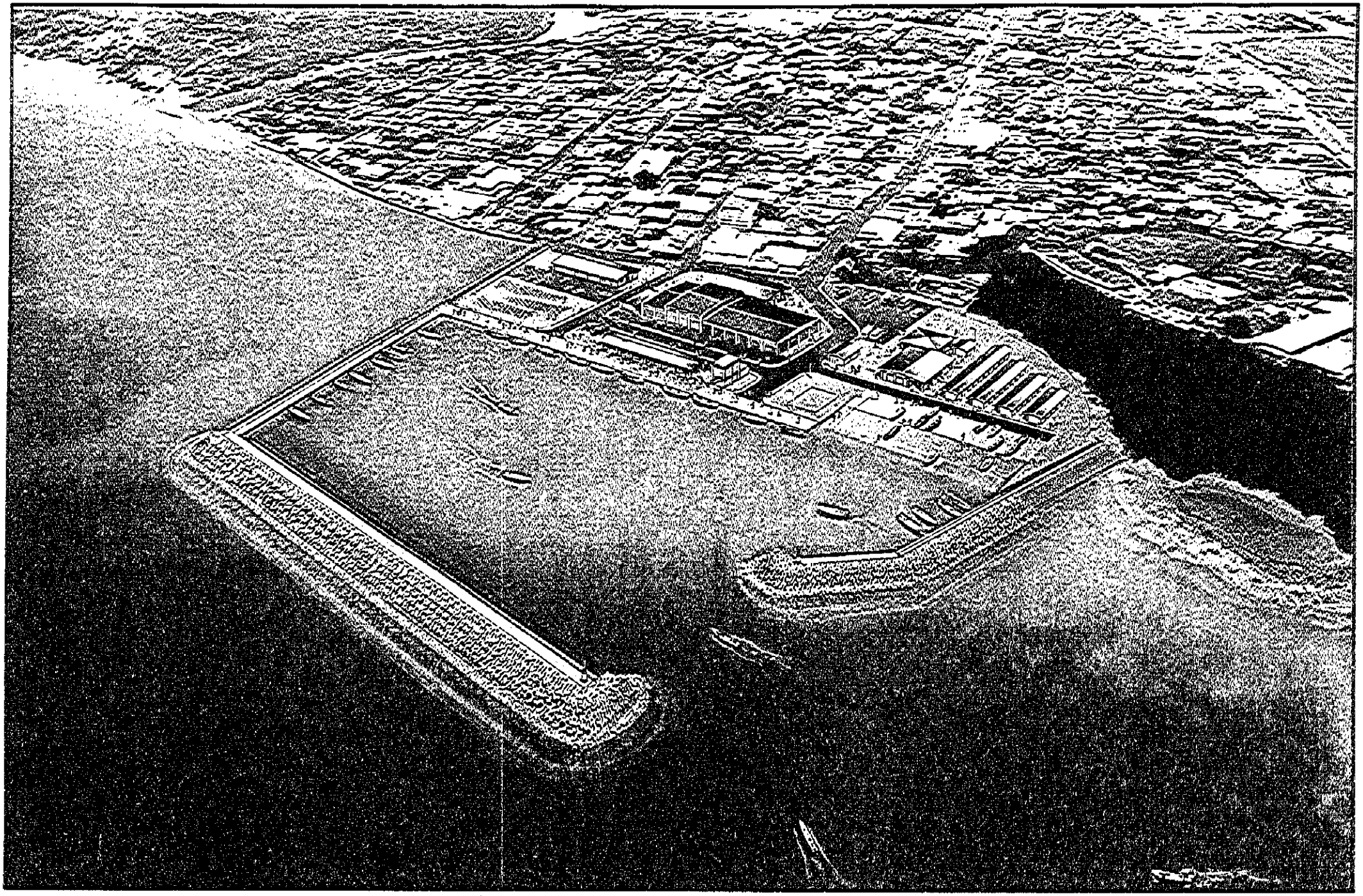
Location of St. Lucia



Location of Vieux Fort



Location of Project Site



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Abbreviations

GDP	Gross Domestic Product
FEZ	Exclusive Economic Zone
FRP	Fiberglass Reinforced Plastic
FMC	St. Lucia Fish Marketing Corporation Ltd.
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
CIDA	Canadian International Development Agency
NGO	Non-Governmental Organization
DOA	Development Control Authority
EIA	Environmental Impact Assessment
PH	Hydrogenion Concentration
DO	Dissolved Oxygen
COD	Chemical Oxygen Demand
CUBIC	Caribbean Uniform Building Code
GT	Gross Tonnage
RC	Reinforced Concrete
DOF	Department of Fisheries
NDC	National Development Corporation
E/N	Exchange of Notes

CHAPTER 1

BACKGROUND OF THE PROJECT

Chapter 1 Background of the Project

1-1 Background of the Project

St. Lucia is an volcanic island located in the eastern part of the Caribbean sea with the distance of 44km from north to south, 22km from east to west, the total area being 616km^2. The central part of the island is steep and mountainous and there are numerous rivers and streams. The climate is of the tropical type; the northeastern trade wind is predominant and there are wet and dry seasons. The country is situated in the hurricane zone with the average annual precipitation of 1,800 mm, while it reaches 3,000-4,000 mm in the mountain areas.

St. Lucia has the population of around 145,000 (1995), of them 56,000 people, representing 38% of the total population, reside in Castries, the capital of the country. The population of Vieux Fort, where the project will be established, is approximately14,000.

The major industry of St. Lucia is agriculture which absorbs around 80% of the work force. Above all, the banana industry is important and in 1996 its production accounted for 53% of the agricultural output in terms of value and 60% of the national exports. However, the banana industry, which supported the national economy for many years, has been on an downward trend during the last several years due to the dwindling international market and natural calamities. The Government of St. Lucia has attempted to develop other sectors of economy, such as tourism, manufacturing, fisheries, as an alternative to the banana industry. Likewise, social infrastructure and human resources development has been accelerated to achieve the national objectives and goals of the Economic Development Plan. Fisheries development is considered to be indispensable from the standpoint of supplying animal protein and reducing foreign exchange spending to import fishery products. The government policy is directed toward the exploitation of offshore fish resources to increase fish production, decrease the import of high-value fish commodities and secure a stable production through the management and conservation of fishery resources in coastal waters.

Fisheries of St. Lucia are characterized by a sharp seasonal fluctuation in fish production which consists largely of surface migratory species. Some 70% of the total annual production is harvested during the high season (January-June) (annual production amounts to some 1,300 tons). The production during the high season exceeds the existing capacity of freezing, storage and market facilities. As a consequence, when the absorption capacity gets saturated, the price of fish declines, resulting in fishermen's withdrawal from fishing and the decline of their income. This vicious cycle is repeated every year.

The project site is located in Vieux Fort, the largest fishing base, where 357 tons of fish were landed in 1996. However, the existing landing and marketing facilities are inadequate and action is needed to reinforce them.

In the light of the above-mentioned situation and problems, the Government of St. Lucia requested the Government of Japan a grant aid for the construction of a fishery complex in Vieux Fort to establish a hub in the south so as to make effective utilization of fish. The details of the requested is shown in Table-1.1.

Table-1.1 Requested items

Requested Items	Facilities, Equipment, Material	
	Component	Remarks
1. Facilities	Dredging	
	Reclamation	
	Breakwater	East, West
	Landing Wharf	
	Slipway	
	Fuel Supply Facility	
	Locker Room	
	Toilet/Shower Room	
	Administration Office	
	Fish Handling Shed	
	Fish Processing Room	
	Fish Market	
	Ice Making Plant/Storage Bin	15 ton
	Cold Storage(-25℃)	400 ton
	Chilled Room(-5℃)	100 ton
	Blast Freezer	10 ton x 2unit
	Coop Retail Shop	
	Salt/Smoking Processing Facility	
	Workshop	
2. Equipment Material	F R P Pirogue	40
	Out-boat Engine	75HP x 40
	Fishing Gear	
	Ocean Survey, Quality Control Equipment	
	Life Vest	
	Cold Storage Vehicle	4ton x 1
	Cold Storage Truck	4ton x 1
	Pick-up Truck	1

1-2 Fisheries in St. Lucia

1-2-1 Present Status of Fisheries

(1) Demand and Supply of Fish

Whilst the fisheries contribution to GDP was less than 1% in 1996, fisheries play an important role in the supply of animal protein and nutrition. There is a high demand for and preference to fish in St. Lucia. FAO estimated that the national fish production amounted to 1,008 tons in 1995 and the entire amounts were destined to domestic consumption. However, the total annual requirements for fish amounted to 2,900 tons in live weight terms and thus there was a shortfall of 1,900 tons. This amount was substituted by the imported fish. Per capita fish consumption reached 20.5 kg per annum in 1996, which was much higher than the world average of 13.5 kg (see Table-1.2.1).

Tuna long line fishing is not yet developed. The Government has a long term plan to increase foreign exchange earnings through the export of frozen tuna, while at this moment only conch and lobster are exported in a negligible amount. The fisheries contribution to the national exports is thus almost zero.

Fish supplies to the domestic market decreases during the low season when fish imports tend to increase. The fish taken during the high season are stored in FMC's cold storage and released in the low season, but the amount does not meet the national demand sufficiently. Therefore the country has to depend on the imported fish, leading to the decline of foreign exchange reserves.

Table-1.2.1 Balance sheet for fishing products

Year	Fish Catch	Imports	Exports	Total Supply	Population	Supply per Capita	Fish Protein	Animal Protein	All Protein	Fish Per Animal Protein Ratio	Fish Per Protein Ratio
Unit	(t)	(t)	(t)	(t)	1000	(kg)	Daily Per Capita Consumption			(%)	(%)
1990	927	1,637	23	2,541	133	19.1	6.0	44.9	76.2	13.3	7.9
1991	941	1,884	15	2,809	135	20.9	6.7	51.0	81.5	13.1	8.2
1992	1,002	1,751	2	2,751	137	20.2	6.0	50.8	80.2	11.8	7.5
1993	1,114	1,885	3	2,996	138	21.7	6.5	52.2	82.3	12.4	7.9
1994	1,092	1,950	3	3,092	140	21.7	6.5	52.2	82.3	12.4	7.9
1995	1,008	1,910	0	2,918	142	20.5	6.2	53.1	82.8	11.7	7.5

(in live weight)

Source : FAO, 1996

(2) Fishery Resources and Management

The Exclusive Economic Zone (EEZ) of St. Lucia extends 11 miles northward to Martinique, 11 miles southward to St. Vincent, 50 miles eastward to Barbados and 50 miles westward. The total area of the EEZ is 8,000km^2 of which the continental shelf covers an area of only 175 km^2, representing 2.2% of the EEZ. The fishery resources consist of:

a) bottom species and reef fish on the continental shelf, which include grouper, red snapper, lobster, conch, etc.

b) offshore pelagic species such as king fish, dolphin, tuna, skipjack, etc.

c) coastal pelagic species such as flying fish, sardine, jack mackerel, etc.

According the CIDA (Canadian International Development Agency), the total allowable catch on the continental shelf ranges from 1,000 to 2,000 tons per annum. However, the DOF (Department of Fisheries) considers that in recent years over-fishing has deteriorated the resources and marine ecosystem in coastal waters and there might be a decrease in fish production unless appropriate measures are taken to rehabilitate the degraded resources. The DOF has implemented a number of management measures in accordance with the Fishery Act (1984), which include control on fishing gear, mesh size limit, restrictions on the size of fish, closed season, closed areas, quota systems, licensing, etc. However, enforcement has not been very effective. For example, capture of undersized lobster and its illegal export to Martinique, destruction of coral reefs and capture of turtles have often been reported.

The Government has been instrumental to increase the awareness of fishermen in fishery management. Positive effects have emerged, though gradually, in Vieux Fort, Laborie, Micoud, on the management of sea urchin. Encroachment of boats from neighboring countries (e.g. Martinique) has posed a serious problem and the Royal Maine Police has tightened its enforcement efforts.

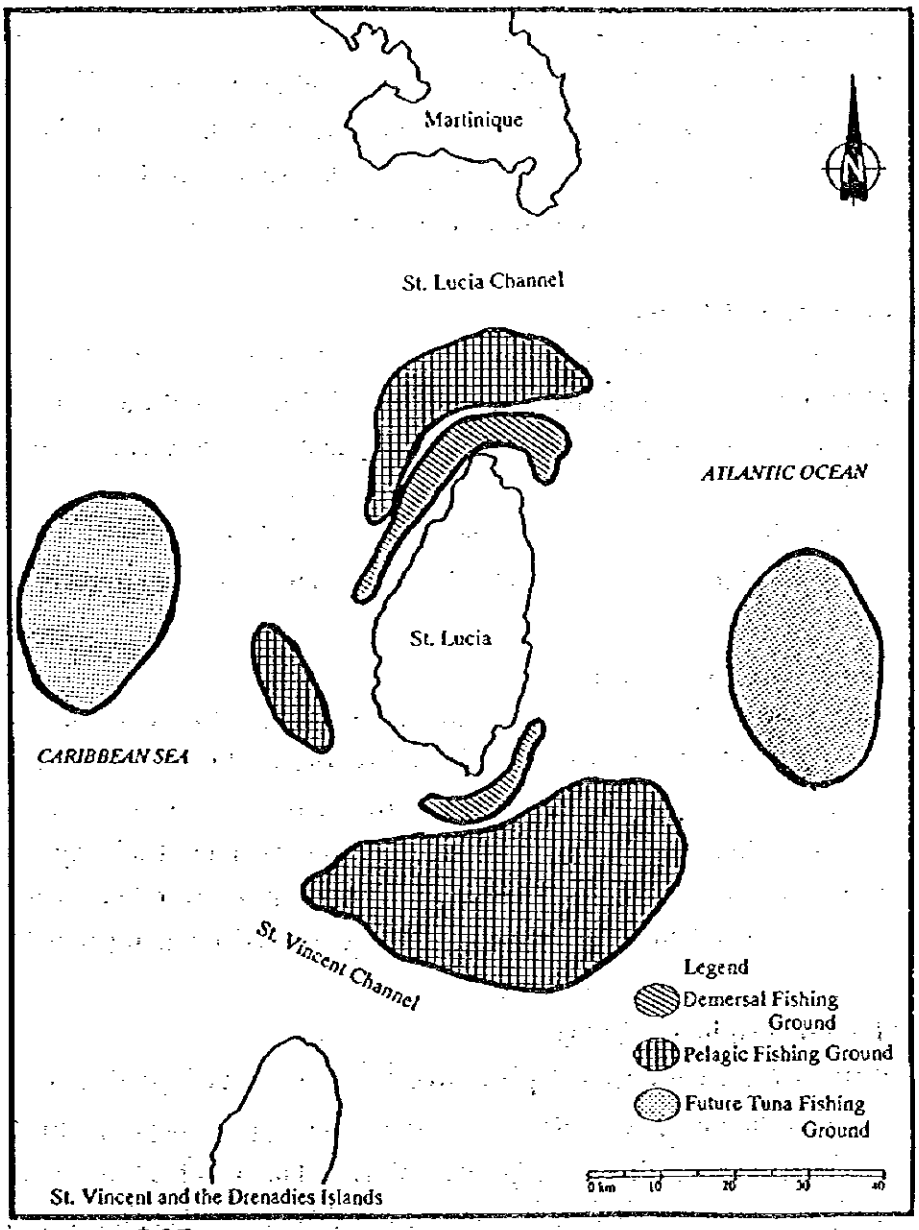
(3) Fishing Grounds and Methods

1) Fishing Ground

The high fishing seasons starts in January when pelagic species (e.g. king fish, tuna, dolphin) approach the coast and last until June. The main gears used during this season are trolling line and surface gill nets. The major fishing grounds for trolling extend from 10 to 75 miles south of from Vieux Fort forming dense fish schools. Fishing areas can be reached in one hour by a boat equipped with the 45 HP engine and in 30 minutes with 75 HP engine. However, fishing operations last from 5:00 AM to 17:00 P.M because it take many hours before fishermen detect the school of fish. The low season is from July to December when fish schools are dispersed and fishing hours

are shorter (6:00 AM to 14:00 PM). During this period fishermen concentrate on inshore fishing and there is a large reduction in catches.

During the low season reef and bottom species are taken in the northern part of the island. However, the fishing grounds are richer in the south where long lines are used to catch fish at the depth of 100-300 m deep. Deep sea tuna fishing grounds are existent at the distance of 60-100 km on the east as well as on the west of the island, but these grounds are still under-exploited. It takes 4-6 hours to reach such areas by a boat with the speed of 14 knots. Traditionally local fishermen have been engaged in one day fishing and do not want to stay overnight at sea. Figure-1.2.1 shows the location of the fishing grounds around St. Lucia.



Source : DOF

Figure-1.2.1 Fishing ground in St. Lucia

2) Fishing Methods

The following methods of fishing are widely employed in St. Lucia.

a) Trolling line to catch large pelagic species;

b) Surface gill nets and beach seines to catch coastal pelagic species;

c) Hand-lines and long lines to catch bottom species;

d) Fish pots to catch rocky and bottom fish;

e) Diving equipment to harvest lobster and conch.

The main gears operated during the high season are trolling line and surface gill nets and the boat is manned by three fishermen. When the boat owner does not go to fishing, a captain is hired to command the boat. In Vieux Fort, there are boat owners who own even 5 boats. The major species caught during the high season are dolphin, king fish and young tuna, while in the low season bottom species such as red snapper, grupper as well as coastal pelagic species like flying fish, jack mackerel, sardines constitute the major species. In recent years the DOF has been conducting an experimental operation of tuna long line in the south-eastern waters.

(4) Fishing Boats and Fishermen

In the country there are 24 fish landing sites, 714 fishing boats (1997) and 1,722 fishermen (1997). Of them, some 60% are full time fishermen and the rest are part time fishermen who are mostly engaged in agricultural activities. Boat owners represent about 20% of the entire fishermen.

Figure-1.2.2 shows the number of fishing boats and fishermen by landing sites. Fishing boats operated in the country can be divided into the following three categories.

a) Wooden canoe of Caribbean type

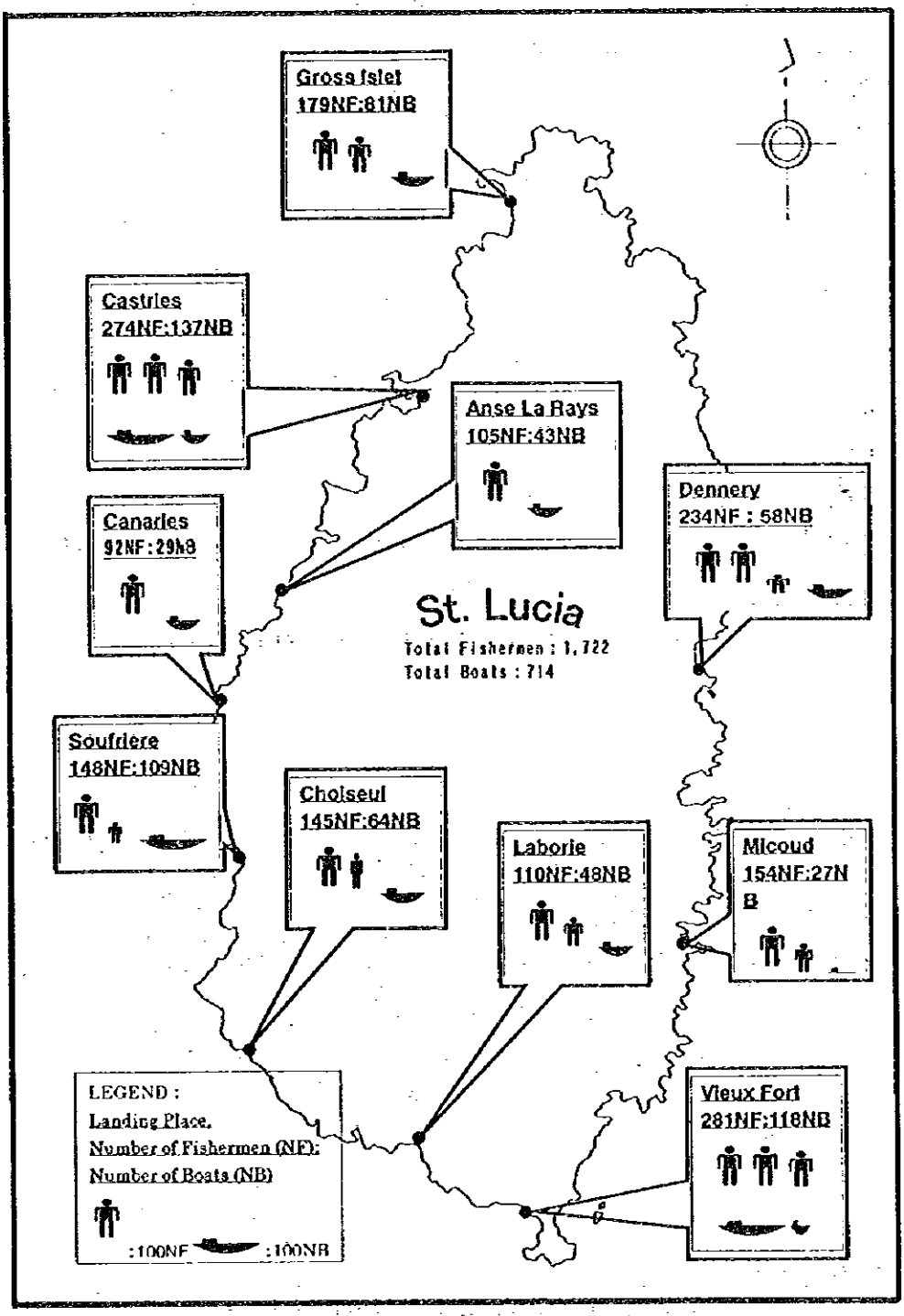
This traditional type of canoe was prevalent until 1991s, while it has been quickly replaced by FRP boats in recent years because FRP is superior to canoe in respect of stability and operational costs, particularly in fuel. Canoes are not suitable for offshore fishing in terms of fishing hours and catching efficiency. Besides, the use of "Gomei" tree for construction of boats was banned several years ago to protect the environment and this has partly contributed to the reduction of canoe boats.

b) FRP boat of Trinidad (T.T) type

FRP boats are considered superior to canoe in respect of speed, stability, loading capacity and durability. Of FRP boats, Martinique type is superior to T.T type in respect of performance, loading capacity, safety and inboard facilities. Since the price of T.T type is lower than that of Martinique type, the former is more widely used.

c) FRP boat of Martinique (M.T.) type

As stated above, M.T. type is considered superior to T.T. type in every respect except for the price. At present FRP boats accounts for some 64% of the total number of boats used in the country.

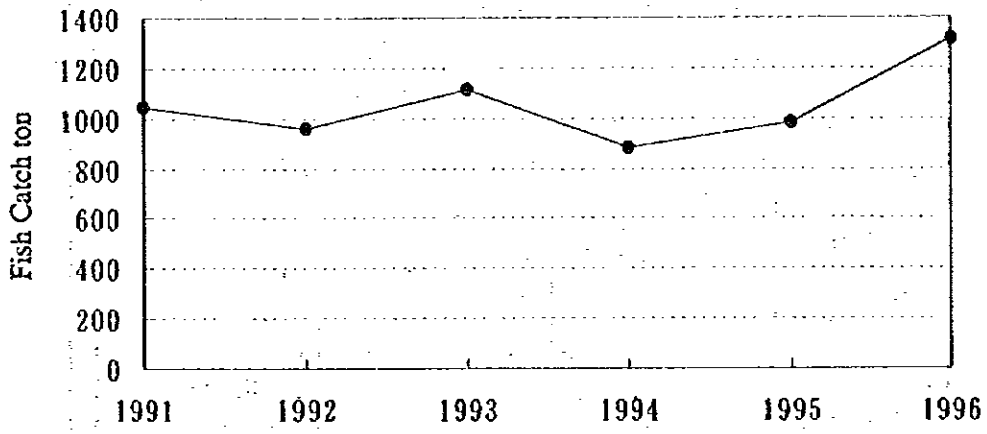


Source : DOF

Figure-1.2.2 Number of fishing boats and fishermen by landing sites

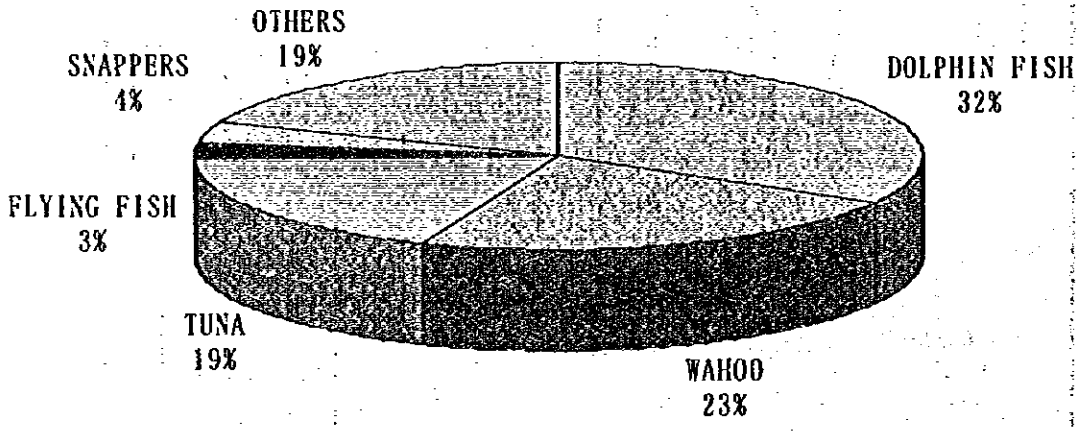
(5) Fish Landings

According to the DOF statistics, the total fish production amounted to some 1,300 tons in 1996, of which some 70% were taken in the high season, and the rest in the low season. In terms of species, large pelagic such as tuna, dolphin and king fish represented about 60% of the total catch. Vieux Fort had the largest landings of 357 tons, accounting for 27% of the total, followed by Dennery (313 tons;24%). (see Fig.-1.2.3, 1.2.4, 1.2.5, and Table-1.2.2).



Source : DOF

Figure-1.2.3 Fish catch in St. Lucia (1991-1996)



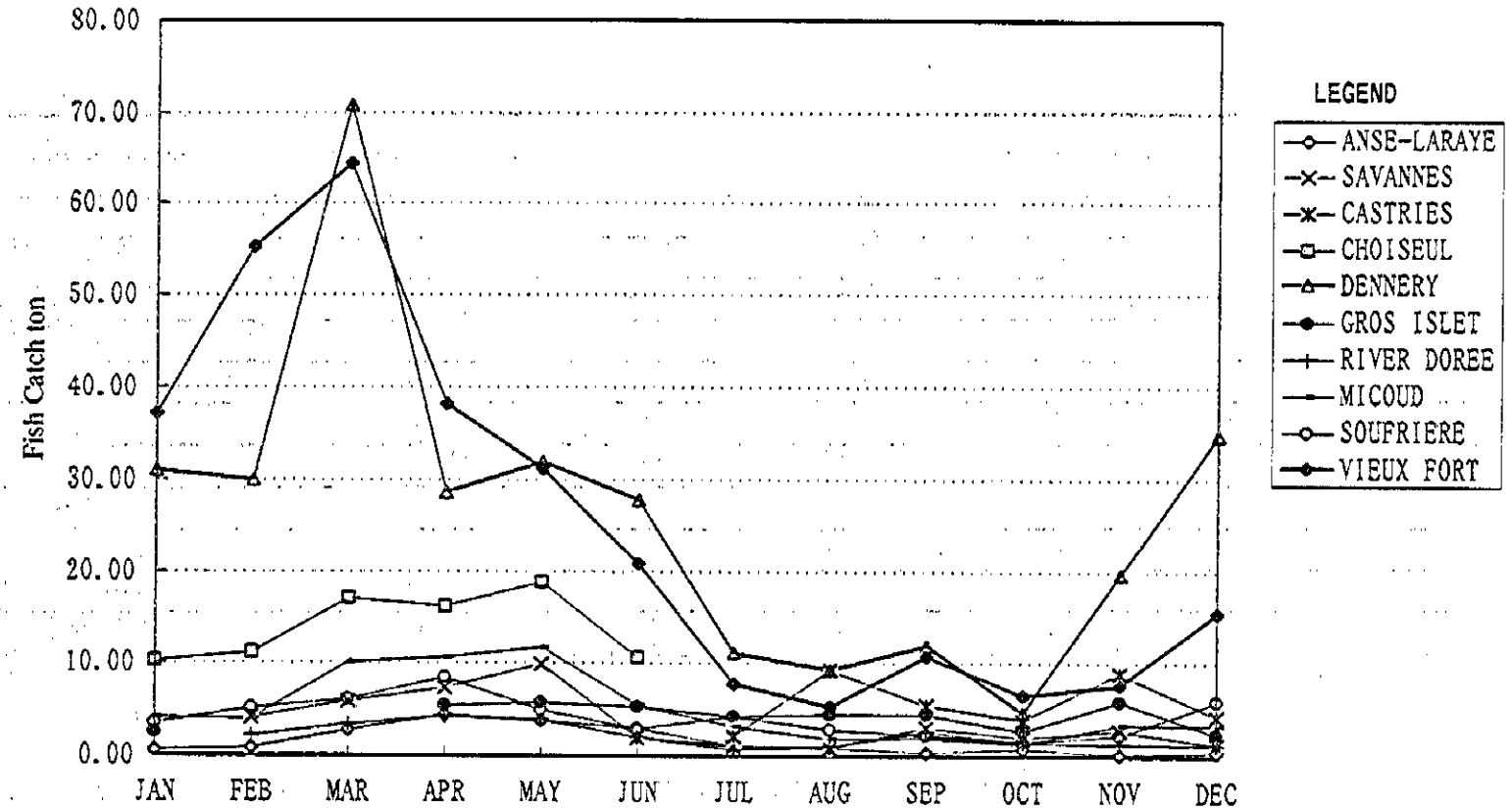
Source : DOF

Figure-1.2.4 Fish catch by species (1996)

Table-1.2.2 Statistical and estimated landing of fish (1996)

SITES	Annual catch by Statistics Report (t)	No of vessels (boats)	Operational rate assuming per VF is 100 (%)	Catch (Jan-Jun) (t)	Catch (July-Dec) (t)	Total (t)
ANSE-LARAYE	19.17	43	14.7	32	10	42
CANARIES	93.02	29	105.8	155	48	203
CASTRIES	100.08	137	24.1	167	51	218
CHOISEUL	159.21	64	82.1	266	82	348
DENNERY	313.17	58	178.2	523	160	684
GROSISLET	109.12	81	44.5	182	56	238
LABORIE	37.54	48	25.8	63	19	82
MICOUD	61.02	27	74.6	102	31	133
SOUFRIERE	52.42	109	15.9	88	27	114
VIEUX FORT	357.62	118	100	597	183	780
OTHER	13.08	0	0.0	0	0	0
TOTAL	1,315.45	714		2,176	667	2,842

Source : DOF



Source : Fisheries Management Unit, Ministry of Agriculture

Figure-1.2.5 Monthly fish catch by landing sites (1996)

There are 24 fish landing sites throughout the country. However, data collection is carried out only at 10 sites by the DOF enumerators. Out of 10 landing sites, 8 sites were designated as the First Category Site (Vieux Fort, Dennery, Micoud, Gros Islet, Soufriere, Canaries, Castries, Choiseul) and 2 sites as the Second Category Site (Savannes, River Doree). In the First Category Site the enumerators collect data for 15 days a month from every other boat which returns to the port, while in the Second Category Site data are collected for 10 days a month from all the incoming boats. This data collection method, however, has some disadvantages. First, data are not collected from the boats which return to the port after DOF's office hours. Secondly, the data from other landing sites (there are 14 sites) are not included. It can, therefore, be considered that the DOF catch statistics could be considerably lower than the actual production of fish. The Study team attempted to estimate the total output of fish using a methodology developed by the team (Table-1.2.2). The methodology is detailed in Appendix-6.

According to Table-1.2.2, total fish output has been estimated to be 2,843 tons in 1996, which is higher than the DOF data by 2.16 times. The discussions that follow will be based on this figure.

(6) Fisheries in Vieux Fort

1) Number of Boat and Fish Catch

There are 5 fish landing sites in Vieux Fort, namely, the Main Pier, Savvanne Bay, Lobster Pot, Market Area, Cocoa Dan and Black Bay. The Main Pier is by far the most important in term of landings with more than 90% of total landings in Vieux Fort.

According to Table-1.2.2 the total catch by boats belonging to Vieux Fort was 780 tons in 1996. The field surveys conducted by the study team revealed that the boats based in Laborie, Choiseul and Soufriere also landed fish at Vieux Fort. Assuming that 30% of these boats landed their catches on Vieux Fort, a total of 860 tons of fish should have been landed by them. In the future, once the new complex is completed, assuming that the rate of boats going to Vieux Fort from Laborie, Choiseul and Soufrier would increase to 50% due to more efficient marketing, the total landings at Vieux Fort might reach of the order of 1,000 tons per annum. This corresponds to 35% of the national production.

Whilst there are variations in the individual catches, it can be estimated that the daily catch per boat might be on average 166 lb. (75kg) in the high season and 50 lb. (25kg) in the low season.

2) Income of Fishermen

There are a number of market outlets, that is, FMC, fish vendors and retail shops. In some cases fishermen themselves sell fish directly to consumers at roadsides. As to the sharing of the profits among boat owners and fishermen, the most commonly used methods in the case of a fishing boat manned by three persons where five shares are established) are as follows.

a) When the boat owner goes to fishing: the boat owner has three shares; each crew one share: in total five shares.
b) When the boat owner does not go to fishing: the boat owner has two shares; the captain has one share and the each crew has one share: in total five shares.

The interviews carried out for fishermen in Vieux Fort and other fishing bases disclosed that FRP boat harvested on an average 172,500EC$ in terms of value, while total expenditures were 88,530EC$, resulting in the gross profit of 88,530EC$. The breakdown of the major expenditure items was as follows: boat and engine maintenance/repair (5,000EC$), fuel (80,000EC$), baits (3,500EC$), registration fees (30EC$). Depreciation was not normally counted. The annual income of a boat owner was estimated to be in the neighborhood of 50,000EC$ with the range between 42,000-62,000EC$, while the income of crew averaged 17,000EC$ per annum.

3) Problems

The following were identified as the major problems confronting fishermen in Vieux Fort and in its neighboring areas.

a) The engine (Yamaha 75 HP) is not strong enough when the boat is fully loaded. Also there have been frequent mechanical breakdowns.
b) When FMC cold storage is full of fish and does not purchase fish, fishermen has to find another market outlets (e.g. vendors, consumers), causing problems particularly late at night.
c) During the high season when fish are plentiful, prices go down. But in the same high season even when fish become scarce, fish prices are still kept low. More flexible arrangements were desired.
d) When boats return to the port late at night from fishing, there is no place to sell fish as the FMC is closed (FMC office hours are from 08:30AM - 16:30 PM).
e) There are few alternative employment opportunities for fishermen during the

low season.

f) Spare parts of engines are not easily available and expensive.

g) Loan schemes for FRP boats offer a high rate of interest, which is currently 11% per year with the repayment period of 6 years.

h) It took takes much time to locate schools of fish as fishermen do not use fish finders.

i) Poaching of fish from fish pots occurs from time to time. Fishermen have appealed to the DOF to tighten the enforcement, but positive effects have not yet been seen.

1-2-2 Present Situation of Fish Marketing

(1) Marketing Structure and System

St. Lucia is characterized by large seasonal fluctuations in fish landings, which brings forth an excessive supply of fish in the high season but the extreme lack of fish during the low season. The pattern of fish marketing can be divided into the following.

a) Direct sale of fish by fishermen and fish vendors to consumers: about 15% of fish landed in Vieux Fort .

b) Purchase by fish vendors: 45% of the total landings:

c) Purchase by FMC: 40% of the total landings.

The marketing channel is shown in Figure-1.2.6.

The FMC headquarters is located in Castries where it has a fishery complex equipped with cold storage, freezing and ice-making facilities. Also FMC is responsible for the operation of ice plants in Dennery, Laborie and Anse La Ray and undertakes to purchase, store, distribute and sell fish. FMC is the sole public organization involved in fish marketing whose major functions include the storage of surplus fish during the high season and release them during the low season when the market is scarce of fish.

Fish supplies become the highest during April and June and FMC's purchase prices from fishermen go down to 2-3 EC$ per lb. which is regarded as the break even point in fishing operations . As a consequence, fishermen suspend fishing during the above season from time to time until fish prices go up. FMC's fish holdings becomes low in November, which corresponds to the high season of fish imports which begin to increase and fill the empty space of the FMC storage.

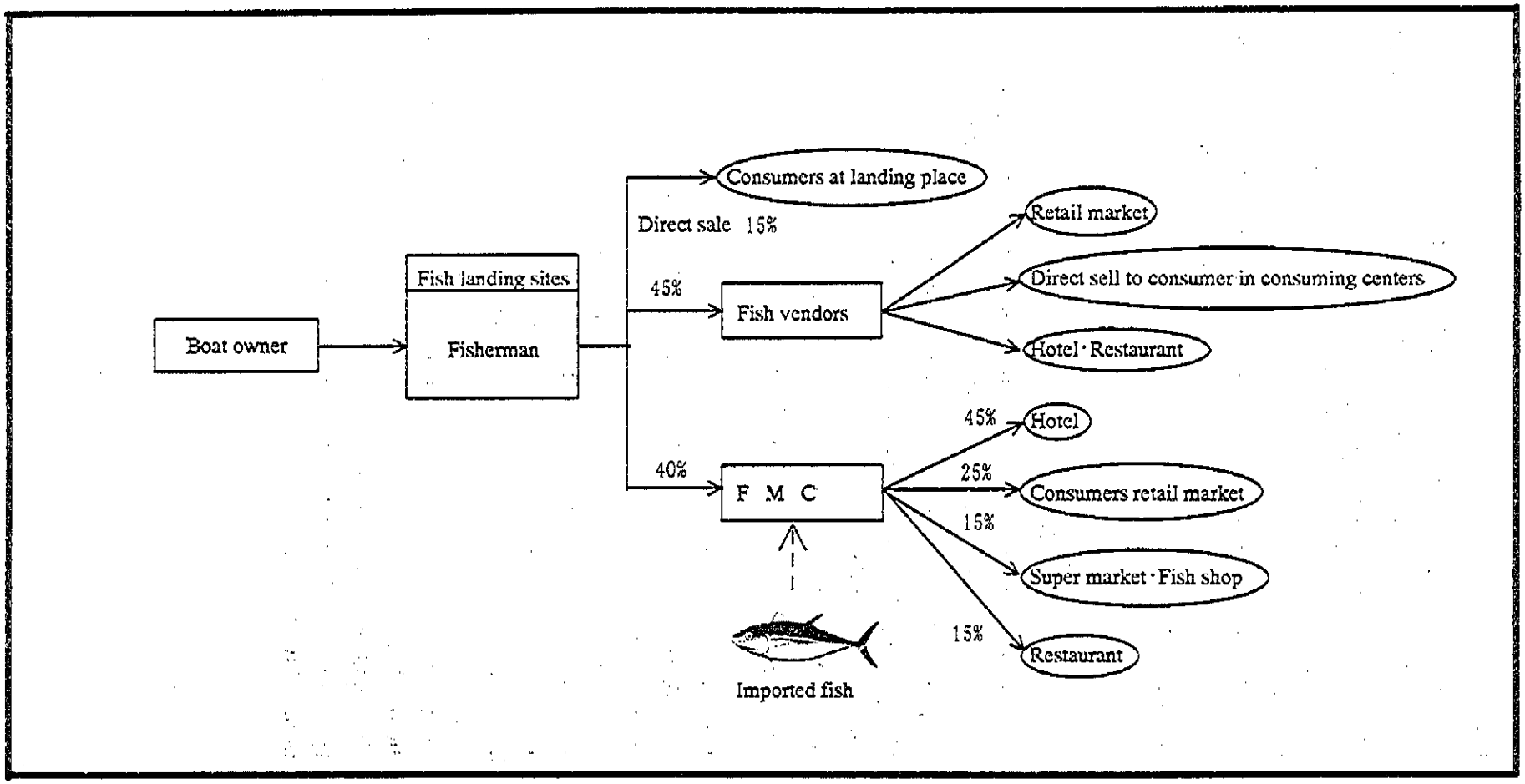


Figure-1.2.6 Marketing channel

(2) Price of Fish

During 1980 and 1994 the Government implemented the fish price control system by determining individual prices for each species. Presently this systems is applied only when FMC purchases fish from fishermen and basically a free market price mechanism is being adopted. Nevertheless, the prices offered by FMC still give a strong influence to the market and provides a sort of yardstick to determine market prices when fish vendors purchase fish. There is a variation in buying prices between the high season and the low season.

Table-1.2.3 Fish prices in high and low seasons

(EC$ per lb.)

Species	High season		Low season	
	Purchase price	Selling price	Purchase price	Selling Price
Dolphin	5	5	6	7
King fish	4.5	5	6	7
Tuna	5.5	6.5	5	6
Red snapper	5.5	6.5	5.5	6.5
Barracuda	5	6	5	6
Shark	2.5	3.5	2.5	3.5
Butter fish	5	6	5.	6
Doctor fish	5	6	5	6
Lobster	15	16-17	15	16-17
Conch	8	9	8	9

Source: FMC

The above table shows that the purchase price of large pelagic species in low seasons was greater than that in the high season by 1EC$ per lb., while there was no variation for bottom species according to seasons. In principle, fish vendors follow the FMC's price table, but during the low season they tend to offer higher prices than those of FMC due to the scarcity of fish. Below is the price list of Castries fish vendors.

Table-1.2.4 Fish vendor's prices in Castries

(EC$ per lb.)

Species	High season		Low season	
	Purchase price	Selling price	Purchase price	Selling price
Dolphin	4-5	6	6	7
King fish	4	6	5	6
Tuna	3	6	5	6

Source: Fish vendors

(3) Fish Vendors

There are 10 fish vendors in Castries, 7 in Viuex Fort and 6 in Dennery. There are no full time fish vendors in Praslin, Micoud, Laborie, Choiseul and Sufriere. Some of fish vendors in Castries go to Dennery and Vieux Fort every day to purchase fish. It takes one hour from Castries to Dennery by car and 20 minutes from Dennery to Viuex Fort. On the other hand, the fish vendors residing in Vieux Fort and Dennery sell fish to local communities, while some of them transport fish to Castries for sale.

There are large variations among the quantities of fish that fish vendors deal with. Those who own a pick-up have a wide range of market outlets, but those who do not have such means confine themselves to local communities. In some cases fish vendors hire transport means to take fish to Castries. The reasons why some fish vendors in Castries travel to Dennery and Vieux Fort are due to the fact that sufficient quantities of fish are not available in Castries.

As to the amount of fish handled by fish vendors, there is a great variation. A large scale fish vendor purchases 300-400 lb. of fish per day during the high season and 60-70 lb. per day in the low season. This makes their annual purchase to reach about 30 tons per year. Small scale fish vendors who do not possess pick-ups purchase around 4-5 tons of fish per year.

Large scale fish vendors normally sell out the entire fish within a day and the transactions are carried out in cash. However, the sale to hotels and restaurants is often on credit terms and the payment is made one month later. It is interesting to note that fish vendors deal with the fish which are not handled by FMC such as skipjack, jack mackerel, flying fish, black fish, robbin fish.

It is rare that fishermen carry ice to fishing, while fish vendors generally use ice when they transport fish in a long distance. However, fish vendors do not make special efforts to use as much ice as possible to maintain the freshness of fish. This is partly because of the lack of awareness of consumers and partly because of fishermen's belief that the freshness of fish can not be deteriorated in 2-3 hours after fish are caught. However, when high-value species such as lobster are caught, banana leaves are used to protect them from the heat.

During the interview some fishermen and fish vendors mentioned that wooden canoe could maintain the quality of fish better than the FRP boat. From time to time FMC offers ice to fishermen free of charge provided that they sell fish to FMC. Some of fish vendors attempt to secure fish from the fishermen to whom vendors have lent money.

(4) Fish Purchased by FMC at Present and after Completion of the Project

Table-1.2.5 shows the monthly purchase of fish by FMC in Vieux Fort and Dennery. The fish were chilled and transported to Castries. In 1996 a total of 408 tons of fish were brought by FMC, namely, 325 tons in Vieux Fort and 83 tons in Dennery respectively. The present cold storage capacity (198 tons) plus the freezing capacity (18 tons) has allowed the FMC to accommodate larger amounts of fish and the problems on the over-supply of fish in the high season has been solved to some extent. Incidentally, in 1995 the Government of Japan provided the cold storage of 100 tons under her grant aid program .

Table-1.2.5 Monthly purchase by FMC in Vieux Fort and Dennery

	VIEUX FORT		DENNERY	
	1996	1997	1996	1997
January	30	25	0	0
February	48	40	17	13
March	102	91	34	30
April	34	68	11	22
May	41	31	14	0
June	20	8	7	0
July	0	---	0	0
August	3	2	---	---
September	12	---	---	---
October	10	---	---	---
November	8	---	---	---
December	17	---	---	---
TOTAL	325	265	83	65

Source: FMC

In order to determine an appropriate level of storage capacity in Vieux Fort, it is necessary to estimate the amount of fish to be landed at Vieux Fort after the completion of the Complex. It is anticipated that a considerable number of boats from Choiseul, Laborie and Sufriere might land fish at Vieux Fort. Table-1.2.6 shows such an estimation.

Table-1.2.6 Estimated landings at Vieux Fort

(unit: tons)

	High season (Jan.-June)	Low season (July-Dec.)	Total
Choiseul	133	41	174
Laborie	31	9	40
Sufriere	44	14	58
Vieux Fort	597	183	780
Total	805	247	1,052

Source: Table-1.2.2

It was assumed that 50% of the landings of Choiseul, Laborie and Sufrier would be landed in Vieux Fort (Table-1.2.2), totaling the entire landings at Vieux Fort at 805 tons. Suppose that 40% of the total landings will go to FMC, 322 tons of fish will be bought by FMC. In addition 8 tons of fish are expected to be transported from Castries to Vieux Fort and thus the total fish to be handled by FMC in Vieux Fort would be of the order of 330 tons. A cold storage with the capacity of 250 tons would be sufficient enough to accommodate this amount of fish.

On the other hand, it can be anticipated that during the low season some 247 tons of fish will be handled by FMC annually and therefore 1,052 tons of fish will be purchased by FMC throughout the year. Presently no fish is transported from Dennery to Vieux Fort, while once the Complex is completed considerable amounts of fish may be transported from Dennery to Vieux Fort in case the Castries FMC is full. Figure-1.2.7 shows the flow of fish at present and after completion of the fishery complex.

(5) Market Outlets

The total sales of FMC in the first half of 1997 (January-July) was about EC$ 5 million, of which fresh fish/frozen fish represented 46% and imported fish 54%. Some 90% of fish purchased were sold in Castries and the remainder in Gros Islet, noted as a touristic area. As to the market outlet, FMC sold 40-45% to hotels, 10% to restaurants, 35-40% to super markets and retail markets. FMC did not sell fish on the road sides.

The FMC's cold storage in Castries becomes almost full in March-April every year, but in June inventories begin to decrease and become some 45% of the total storage capacity. In November and December inventories further declines. However, at that time imported fish starts to be brought in. The profits margin that FMC gains ranges from 20 to 25%.

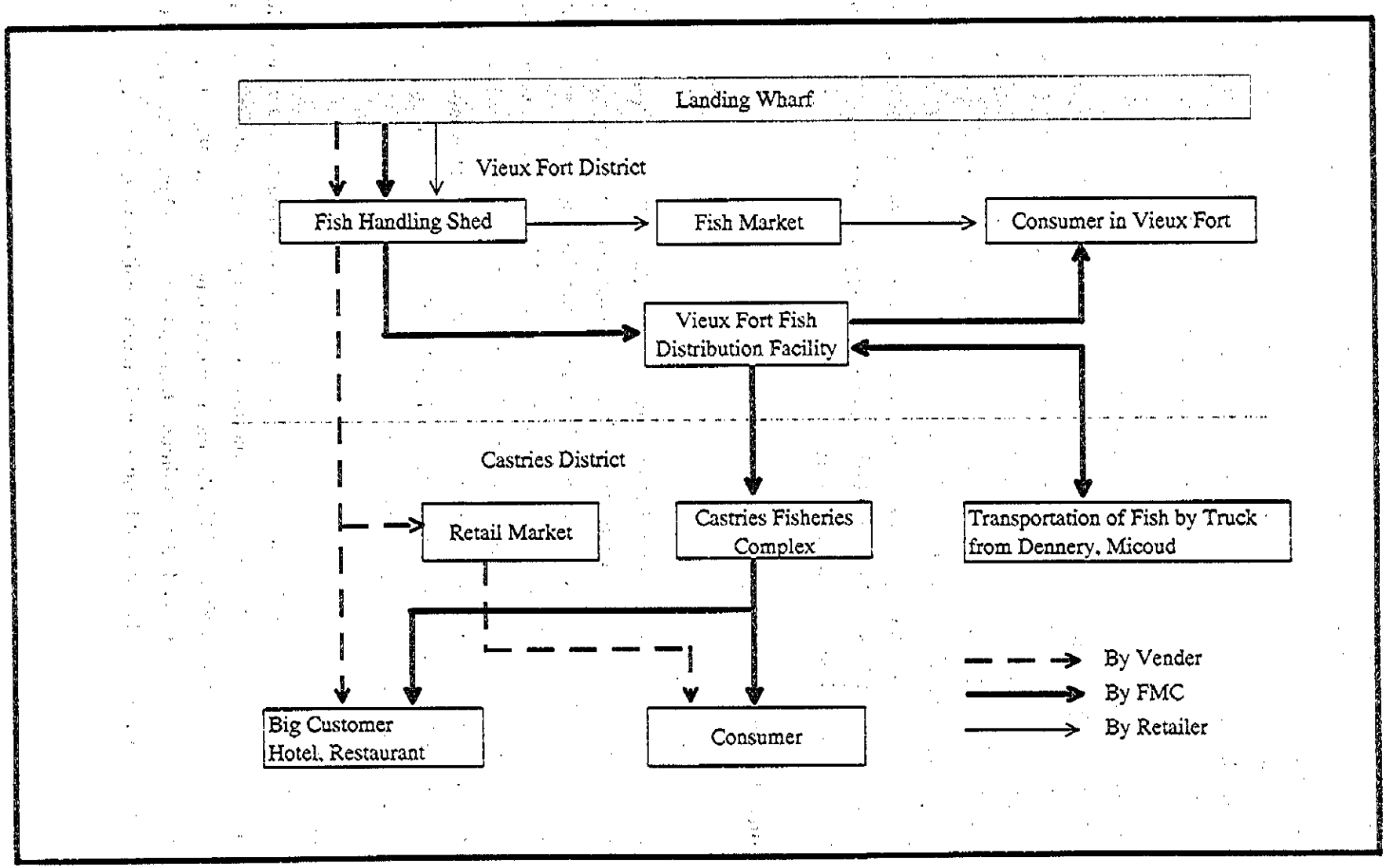


Figure-1.2.7 Estimated flow of fish from Vieux Fort Fisheries complex

(6) Ice Making Machine

Ice making machines in Castries produce flake ice, while those in Dennery and Laborie produce plate ice. The price of ice was 8 lb. per EC$, but ice does not sell well so the operation of the machine is not cost effective. In order to reduce the cost the FMC suspends the operation of the machines in Dennery and Laborie during the low season. Freon is used as refrigerant for the operation of ice machine instead of ammonia.

(7) Import and Export of Fish and Fishery Products

In 1996 FMC imported 235 tons of frozen fish and processed products valued at EC$ 5.8 million (US$ 2.2 million). Imported fish and seafood by FMC is shown in Appendix-6. It accounted for 5-6% of the national imports. The major imports items included frozen shrimp, flying fish, squid, octopus, scallop, lobster, smoked salmon and so on. The major suppliers were the U.S.A and the Caricom countries. FMC exclusively undertakes the import and export of fish and fishery products, and the private sector is not permitted to undertake such business. Fish exports were negligible and only 1 ton of fish equivalent to EC$ 4,000 was exported in 1994.

1-3 Natural Conditions

1-3-1 Climatic Conditions

St. Lucia is located in the tropical trade wind zone and the northeastern trade wind is predominant throughout the year. There are hardly any seasonal changes in temperature, but it has the dry season from January to June and the rainy season from July to December. The rainfall is 3,500 mm to 3,800 mm per year in the mountains and 1,200 mm in the coastal area. Hurricanes attack to St. Lucia during June to November and in some years have given excessive damage to agricultural products. The observation data at Hewanorra Airport Meteorological Observatory, the location of weather observation closest to Vieux Fort, are used as the climatic conditions for the project site.

(1) Temperature

Table-1.3.1 shows monthly average of maximum and minimum temperature during the past 24 years. The table shows that the maximum temperature is about 31℃. The minimum temperature is about 22℃, the mean diurnal range is about 9℃. The annual range for the maximum and the minimum temperatures are about 2℃ and 3℃, respectively. The seasonal change of temperature is rather small throughout the year.

Table-1.3.1 Monthly average of maximum and minimum temperature (℃: 1973 -1996)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Ave.
Max.	29.6	29.6	30.0	30.9	31.4	31.3	31.5	31.5	31.5	31.5	31.0	30.1	30.8
Min.	20.1	19.5	20.5	21.6	22.6	23.0	22.8	22.4	22.5	22.1	22.0	20.7	21.7
Ave.	25.8	25.8	26.3	27.1	27.8	27.8	27.8	27.8	27.7	27.6	27.1	26.4	27.1

Source : Hewanorra Air Port Meteorological Observatory

(2) Rainfall

Table-1.3.2 shows the monthly average of rainfall during the past 24 years. The annual rainfall is about 1,400 mm. The average rainfall of per month in dry season (Jan. to Jun.) is 50 mm to 90 mm and also in rainy season (Jul. to Dec.) 100 mm to 200 mm.

Table-1.3.2 Monthly average of rainfall (mm: 1973-1996)

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
73.4	47.9	57.3	56.9	73.2	94.3	143.1	164.5	193.5	196.7	187.2	105.2	1393.1

Source : Hewanorra Air Port Meteorological Observatory

(3) Relative Humidity

Table 1.3.3 shows the average humidity observed during the past 24 years. The average relative humidity is 70 - 75% during the dry season of January to June and 76 - 79% during the rainy season of July to December.

Table-1.3.3 Monthly average of relative humidity (%: 1973-1996)

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Ave.
74.5	74.3	70.1	70.8	75.5	73.6	77.7	78.0	78.2	78.6	78.4	75.8	75.5

Source : Hewanorra Air Port Meteorological Observatory

(4) Wind Direction and Speed

Table-1.3.4 shows the monthly average of wind speed during the past 24 years. The frequency of wind occurrence by direction and speed and the wind rose (location of observation: Latitude 13° 45'N, Longitude 60° 57'W, Altitude 3 m) are presented in Appendix-7. The predominant wind direction is ENE to ESE and its occurrence ratio is around 86 % through the year. The 60% occurrence ratio of wind speed is almost between

11 and 16 knots.

Table-1.3.4 Monthly average of wind speed (Knots , 1973-1993)

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Ave.
12.5	12.8	12.1	11.8	12.3	13.4	13.7	11.6	10.4	9.7	11.2	12.0	12.0

Source : Hewanorra Air Port Meteorological Observatory

1-3-2 Sea Conditions

(1) Tide

Tide observation was conducted for 15 consecutive days from August 25 to September 9 by installing a pressure type tide gauge at the project site in Vieux Fort Bay. Tides were observed simultaneously in Vieux Fort Bay and Vieux Fort Commercial Port using auxiliary gauge. The results of observation and analysis are presented in Appendix-7.

Chart Datum Level (C.D.L.) is set at the same level as for Vieux Fort Commercial Port which is adjacent to the project site. Figure-1.3.1 shows the tide level chart.

(2) Waves

1) Offshore Wave Characteristics

Since there is no wave observation station near Vieux Fort Bay, no wave observation data are available. We therefore obtained the data for Vieux Fort hindcast offshore waves by taking from U.S. Navy's Global Spectral Ocean Wave Model database. The frequency of occurrence of offshore waves by height and direction, wave rose of offshore waves are shown in Appendix-7.

According to these data, ENE to E waves predominate at about 87 %; the waves 1 m or less in height account for 13%, those between 1 and 2 m 45%, and those 2 and 3 m 35%.

The project site in Vieux Fort Bay is relatively calm as the waves generated by the NE trade wind are shielded by Moule A Chique Promontory. However, since the project site is open to the southwest, hurricane waves from the Caribbean Sea directly hit the area. The wooden pier at the project site was damaged by Hurricane "Allen" in 1980. The revetment at the western end of the container yard of Vieux Fort Commercial Port was damaged by Hurricane "Marilyn" in 1995. Hurricane waves are therefore used as the design waves for the breakwaters of the fishing port.

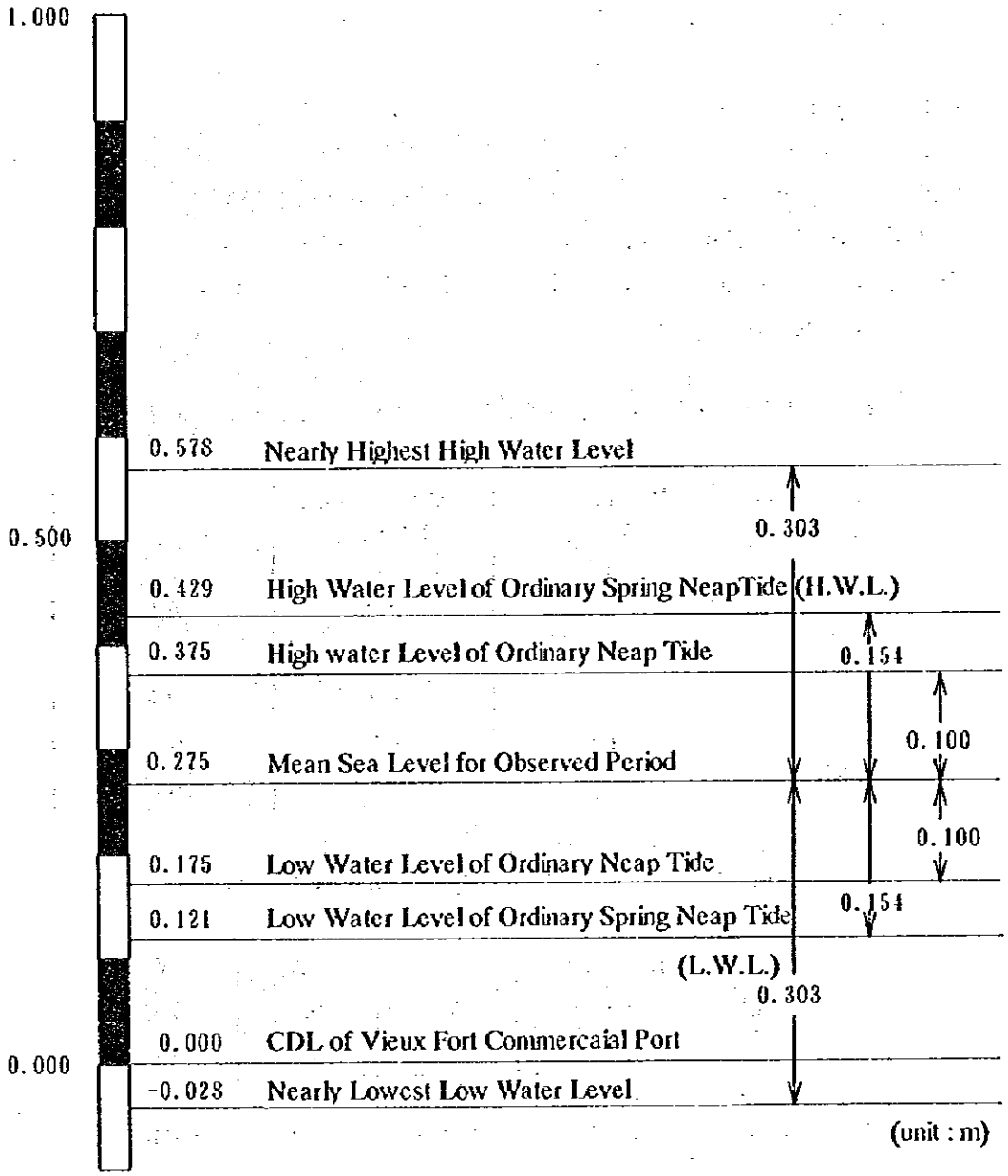


Figure-1.3.1 Tide level chart

2) Design Offshore Waves

By sampling hurricanes of which impacts on Vieux Fort are assumed to have been considerable from their routes and scale, the wave hindcasting was performed. Appendix-7 shows the hurricane tracks and waves sampled off Vieux Fort. By statistically processing the wave data, the wind velocity, wave height and frequency were calculated for each return period. Table-1.3.5 shows the offshore wave dimensions broken down by return periods. The wave with a return period of 30 years was applied in design of the fishing port facilities and dimensions of the design offshore waves are shown in Table-1.3.6. The wave directions S, SW and W, which are considered to affect the project site, were used.

Table-1.3.5 Dimensions of offshore waves by return periods

Return Period (Year)	Wind Speed (knots)	Wave Height H1/3(m)	Period T1/3(sec)
2	17	1.2	4.5
10	47	4.8	8.6
25	57	6.1	9.6
30	59	6.3	9.9
50	63	6.9	10.3
100	69	7.6	10.8

Table-1.3.6 Dimensions of offshore design waves

Offshore Wave Direction		S	SW	W
Wave Height	Ho(m)	6.3	6.3	6.3
Period	To(sec)	10	10	10
Wave Length	Lo(m)	156	156	156
Wave Steepness	Ho/Lo	0.040	0.040	0.040

3) Waves in Vieux Fort Bay

Offshore waves reach the project site after being deformed by refraction due to the sea bottom topography. The significant wave height at the project site was calculated by computing wave deformation using energy balance equation. The results of wave deformation calculation are presented in Appendix-7. Based on the offshore design waves (SW), the wave height at the project site is about 2 m near the damaged wooden pier.

(3) Currents

Current direction and speed were observed for 25 consecutive hours (day and night) in spring tide by installing electromagnetic current meter at three locations (A, B and C) in Vieux Fort Bay. Table-1.3.7 shows the maximum current speed at the time flood and ebb tides. The results of current observation are presented in Appendix-7.

The table shows that the speed of the current is 7.5-15.9 cm/sec during flood tide and 2.4-3.5 cm/sec during ebb tide. At Location A, the current is always heading the west, while at Locations B and C the current heads the east during flood tide and the west during the ebb tide.

Table-1.3.7 Maximum tidal current velocity at spring tide

Tide	Location	Velocity(cm/sec)
Flood	A	7.5
	B	7.7
	C	15.9
Ebb	A	2.6
	B	3.5
	C	2.4

1-3-3 Topography

Topographical and sounding survey was conducted in respect of the land and the sea bottom to understand the topography in the vicinity of the project site. The results are shown in Figure-1.3.2. The Topography of Vieux Fort Bay is outlined as follows.

Vieux Fort is located to the west of Moule A Chique Promontory at the southernmost of St. Lucia Island and faces the Caribbean Sea. Vieux Fort Bay is shaped like a small bow with about 4 km coastline extending from Georgie Point to Mathurin Point. Figure-1.3.3 shows the coastal topography of Vieux Fort.

a) There is a sandy beach at the center of bay and the bottom sediments consist of silty sand.
b) The water depth in the bay is relatively shallow at less than -11 m and the bottom gradient 1/100 up to the depth of -5 m and 1/400 between -5 and -10 m.
c) Commercial Port located in the eastern part of the bay is dredged to -10 m.
d) River-mouth of Vieux Fort River is located at 2 km west of the project site.
e) The coast line of the project site is protected by vertical seawall (crown height + 1.7

m to +1.8 m) on the west and is covered by rough sand and gravel.

f) In the waters west of the project site spreads a reef of - 0.8 m depth.

g) A hard rocky hill stands between the project site and Vieux Fort Commercial Port.

1-3-4 Soil Conditions

The soil investigation was conducted by six marine borings at project site. The boring points, the boring logs and grain size analysis are presented in Appendix-7. Soil conditions at the project site are characterized as follows.

a) The surface layer consists of silty fine sand layer or fine sand layer of N value ≤5, the center layer of relatively dense fine sand layer mixed with gravel of N value = 20 - 50, and the bottom layer hard bedrock or boulder of N value≥100.

b) The depth of three rocky foundations on the offshore side and three on the land side gradually decreases as they head toward the east (approaching the hard rocky hill) (from -19 m to -5 m or -12 m).

Although there exists a relatively soft layer at the depth of -4 m to -8 m from the surface, a fine sandy layer spreads in the center and a bearing layer at -5 m to -19 m, indicating good soil conditions. However, measures against land subsidence must be taken for structures to be constructed on the reclaimed area because a relatively soft sand layer is present in the surface layer.

1-3-5 Littoral Drift

Surveys on the bottom sediments were carried out in Vieux Fort Bay. Appendix-7 shows the sediment locations surveyed and the result of sediment analysis. The characteristics of littoral drift in Vieux Fort Bay are summarized below.

a) The medium grain size of bottom sand is about 0.3 mm at the river-mouth of Vieux Fort River (SP-4,5,6), and tends to become smaller toward the east along the coast. It is about 0.1 mm near the project site and less than 0.1 mm at the jetty of Vieux Fort Commercial Port.

b) The specific gravity shows a similar tendency as the medium grain size, and becomes smaller toward the easterly direction from 2.6 - 2.7 at the river-mouth. It is 2.4 - 2.6 near the project site.

Accordingly, the littoral drift heads along the coast toward the east (Moule A Chique Promontory) from the river-mouth of Vieux Fort River and accumulates in the dredged area in Vieux Fort Commercial Port. Figure-1.3.4 shows the characteristics of littoral drift in Vieux Fort Bay.

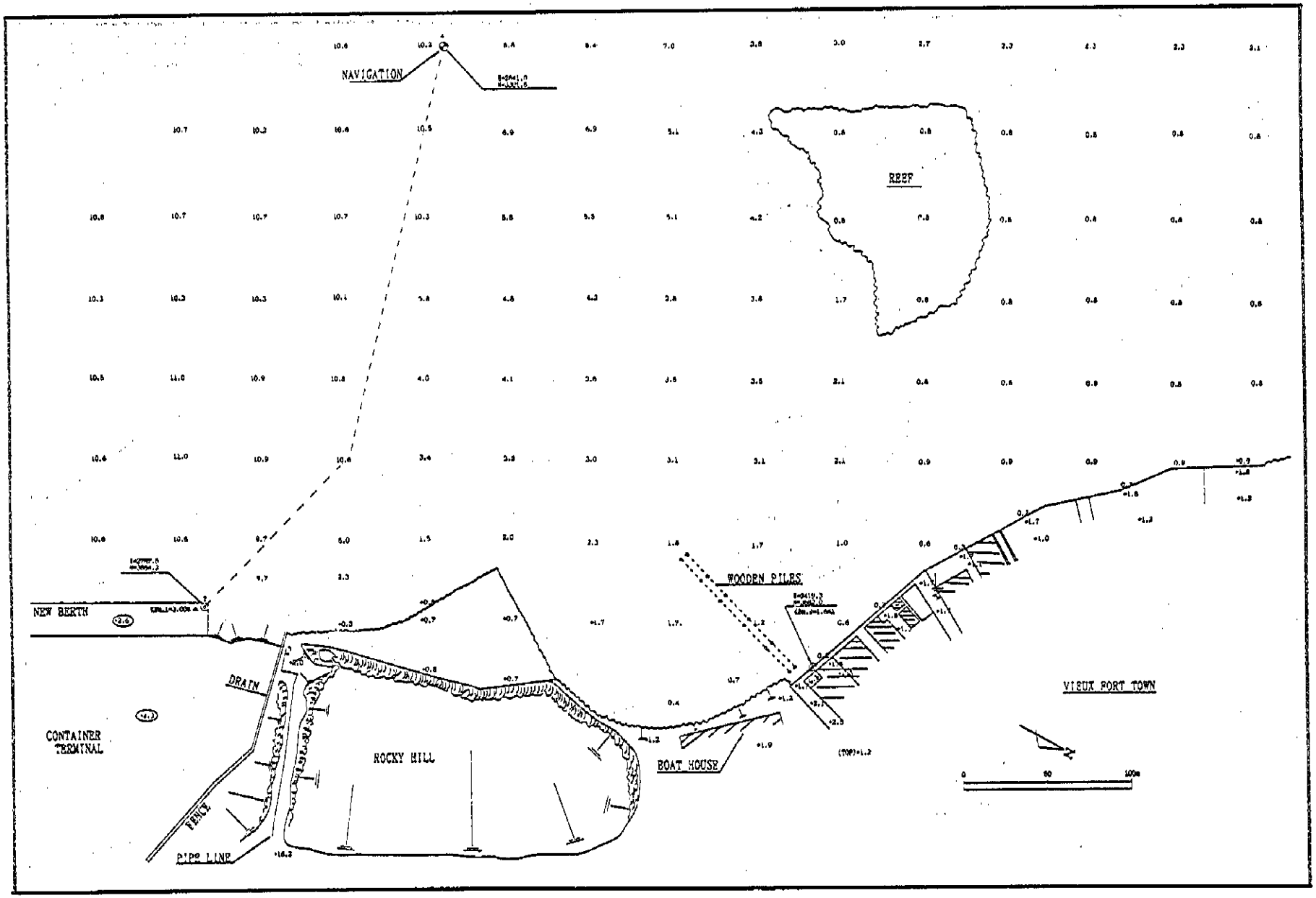


Figure-1.3.2 Topography of Vieux Fort

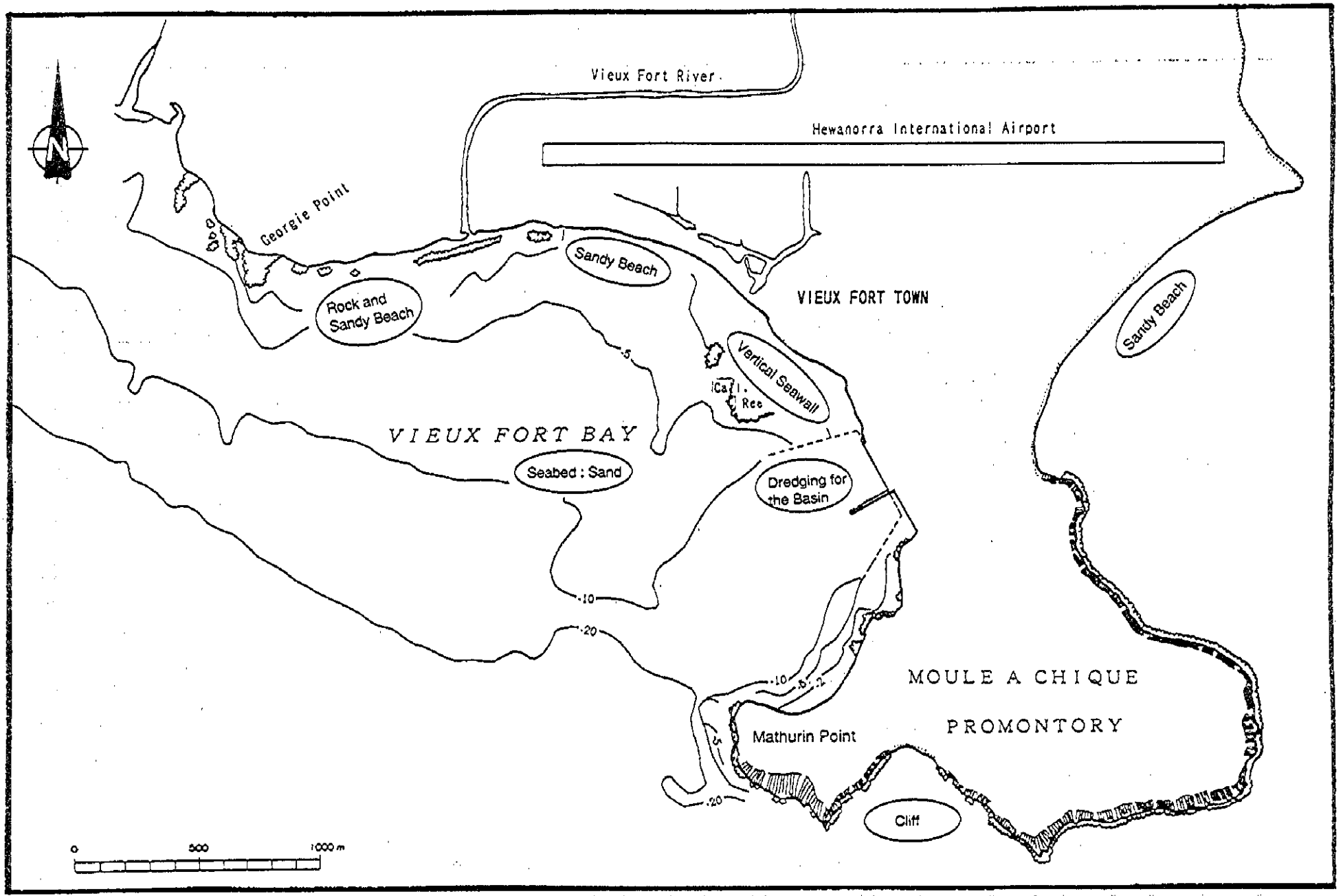


Figure-1.3.3 Coastal characteristics of Vieux Fort

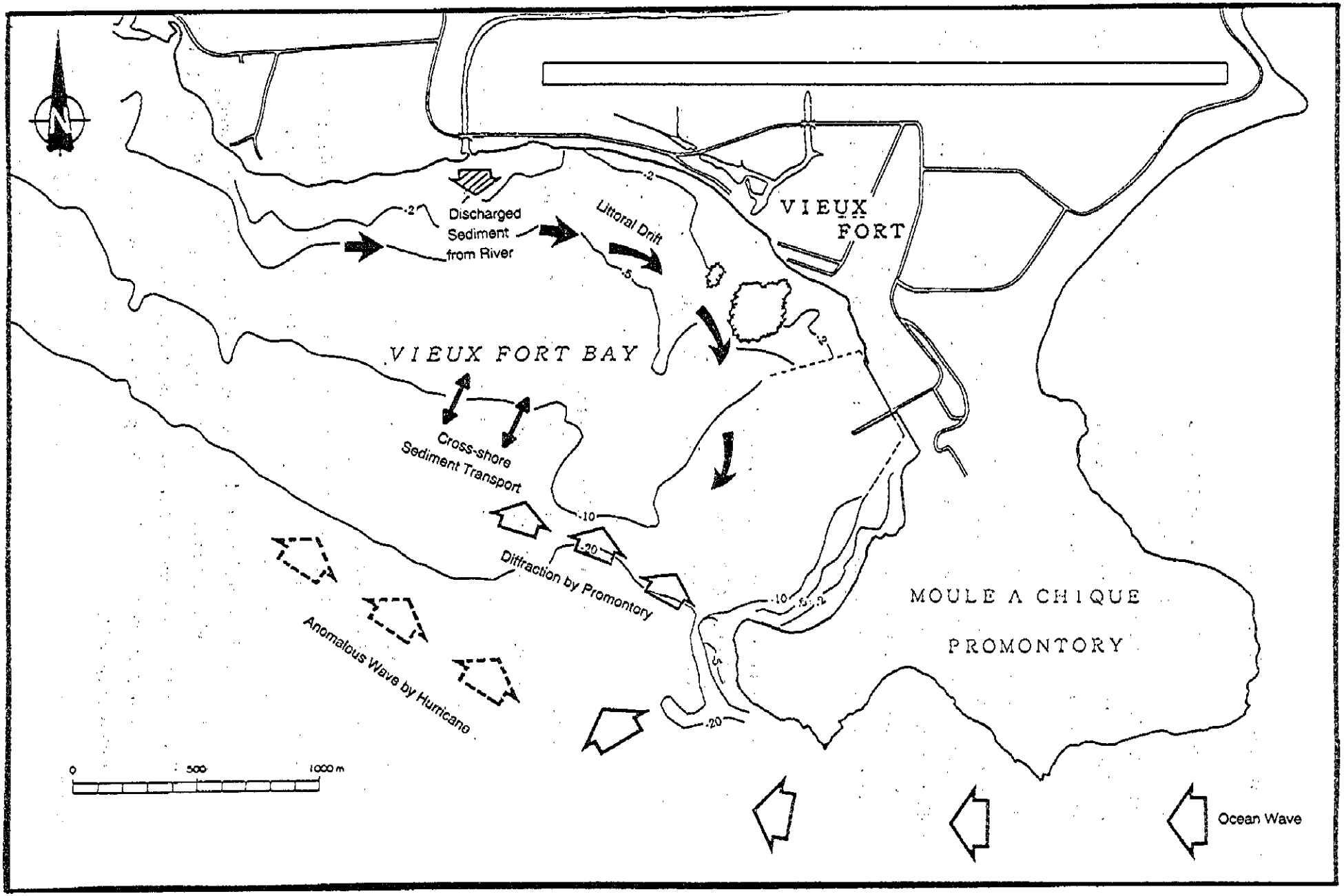


Figure-1.3.4 Characteristics of littoral drift in Vieux Fort Bay

1-4 Environmental Assessment

1-4-1 Background of Environmental Assessment

There are no standards for environmental conservation in St. Lucia, but Development Control Authority (DCA) of the Government is in charge of approving all development plans. According to DCA, the environmental assessment comprises 1) preliminary environmental screening and 2) complete assessment.

1-4-2 Result of Water Quality Surveys

Two surveys were conducted on water quality of Vieux Fort Bay. Appendix-7 shows the location of sampling points, the result of analysis and the environmental standards for sea pollution in the Japanese waters.

At all points, PH was about 8 and DO 6.5 - 7.0, meeting the quality standards. The order of COD assessment was far from the Japanese standards, suggesting the differences in the analytical methods.

1-4-3 Environmental Impact Assessment (EIA)

(1) Environmental Impact Factors

The following three factors are conceivable as the factors for EIA by implementation of the Project.

a) Impacts on scenery by reclamation of the shore in front of the project site
b) Impacts on turbidity by reclamation work and water quality by fishing activities after completion of the Project facilities
c) Impact of littoral drift on topography of the surrounding area by construction of breakwaters.

(2) Forecasting Impact

1) Reclamation of Coastal Area

Reclamation by this project extends for about 200 m in length and about 100 m in width toward offshore. The urban district is located behind the project site and the coast is protected by vertical seawall.

As the reclaimed land will be bordered by a rubble mound type revetment, people will find little impact on the landscape. The reef spreading on the west of the project site will remain intact as the breakwaters are designed to avoid the reef.

The impact on the nearby landscape by reclamation of coastal area is thus considered negligible.

2) Water Quality

Turbidity which may occur by reclamation of coastal area is studied as possible impacts on the water quality by the Project. As sandy gravel with little silt will be used for reclamation, turgidity is hardly expected as the land fill will sediment in a short period of time following placement in the sea. However, a silt protector will be laid around the water area to be reclaimed during the construction work as precautions against spreading of turbidity.

After completion of the facilities, there will be no water pollutant discharged from the facilities themselves, but fishing boats and fishermen who use the facilities are bound to dump wastes and oils. To prevent dumping, control by the port management and cooperation from fishermen who benefit from the facilities are required.

3) Littoral Drift

Impact of littoral drift due to construction of the breakwater on the configuration of nearby beaches is discussed in detail in Section 2-3-8 "Impact of Breakwater Construction on Nearby Beaches". As 3D simulation during stormy weather shows little topographical coastal changes in the sea near the project site, it is judged that the impact on nearby beach due to breakwater construction is negligible.