BASIC DESIGN STUDY
ON
THE PROJECT FOR REHABILITATION
OF THE KIRINDA FISHERIES HARBOUR
IN
DEMOCRATIC SOCIALIST REPUBLIC
OF
SRI LANKA

NOVEMBER, 1991

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to a request from the Government of Democratic Socialist Republic of Sri Lanka, the Government of Japan has decided to conduct a Basic Design Study on the Project for Rehabilitation of Kirinda Fisheries Harbour and entrusted the study to the Japan International Cooperation Agency (JICA).

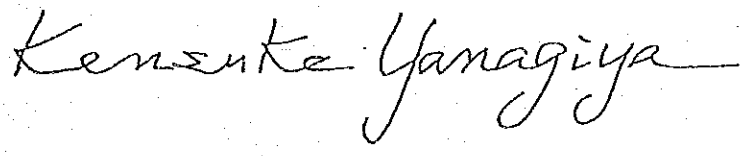
JICA sent to Sri Lanka a study team headed by Mr. Shinya NAKAI, Director of Second Basic Design Study Division, Grant Aid Study and Design Department of JICA, from October 23 to November 12, 1990.

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

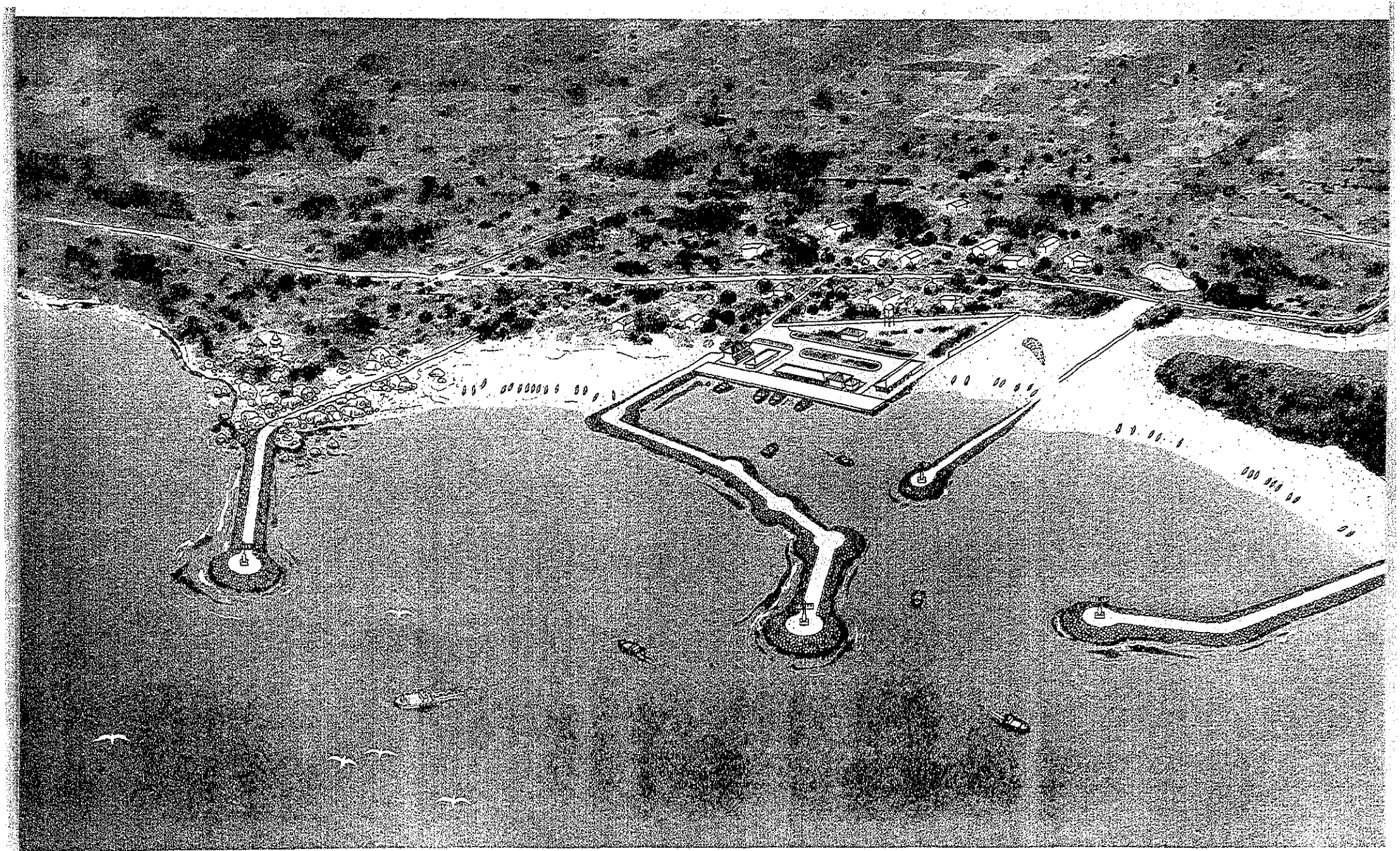
I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

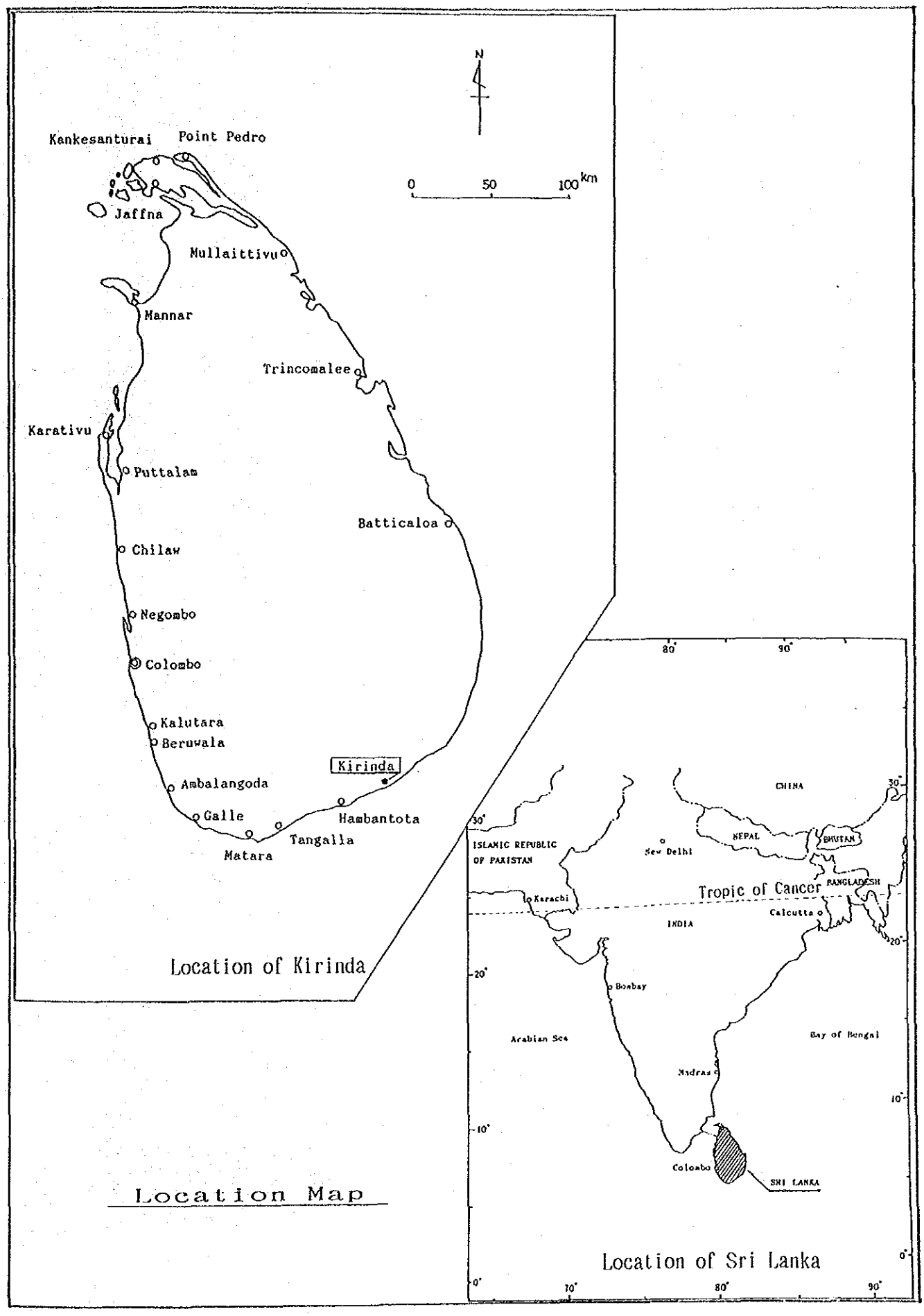
I wish to express my sincere appreciation to the officials concerned of the Government of Democratic Socialist Republic of Sri Lanka for their close cooperation extended to the teams.

November, 1991



Kensuke Yanagiya
President
Japan International Cooperation Agency

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Location of Sri Lanka
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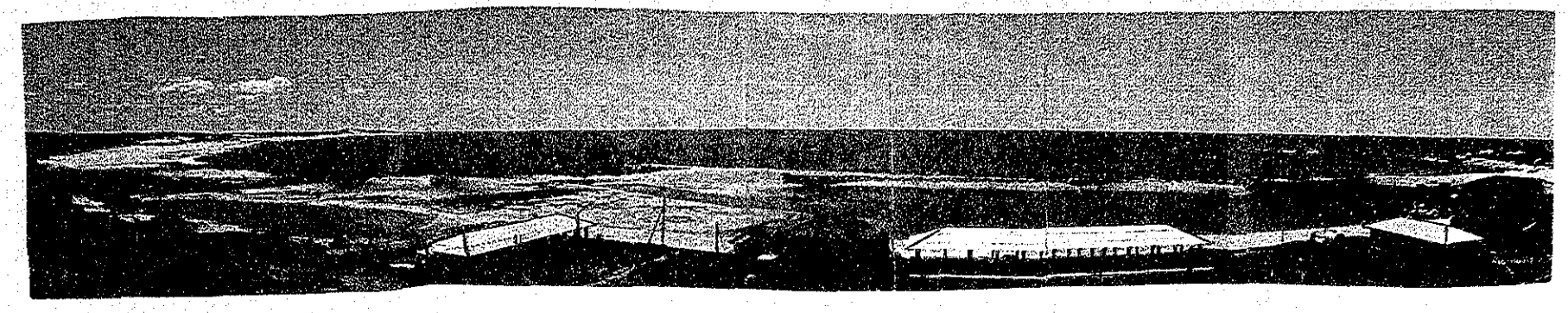

Photo (1) Existing of Kirinda Fisheries Harbour (Mar. 1989)

Photo (2) New Groyne Site (Oct. 1990)

Photo (3) Quarry Site (Oct. 1990)

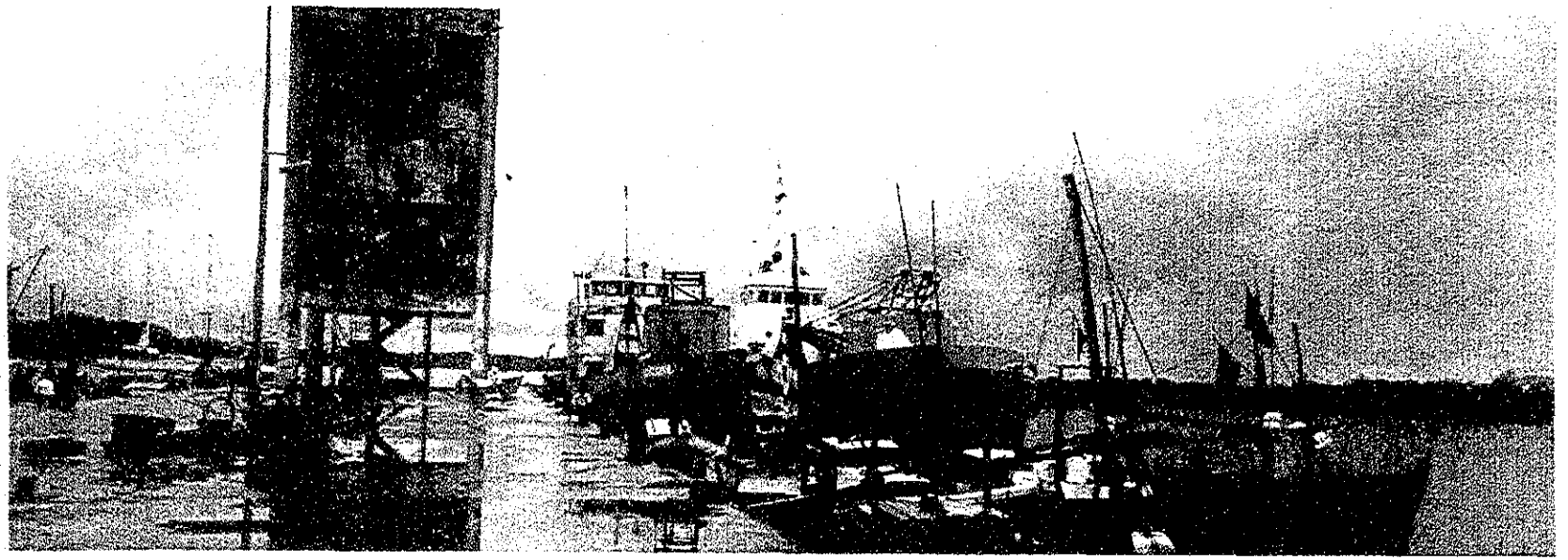

Photo (4) Dredgers Owned by CFHC (Oct. 1990)

SUMMARY

SUMMARY

The Kirinda Fisheries Harbour (hereinafter referred as "the Harbour") which is located on the southeast coast of Sri Lanka was constructed in the period from September 1983 to April 1985 with the grant aid from Japan.

When the Harbour was opened in 1985, it was operating prosperously and more than 150 units of 3.5 GT type fishing boats came for unloading fish. The Kirinda Harbour was looked upon as the important base for fishing in the south where abundant fishery resources remain quite unexploited, and for eventual development of the southern region still lagging behind in terms of social development. However a vast volume of sand drifted into the Harbour just after its completion, causing that in June 1986 the Harbour mouth was closed and hence the Harbour became malfunction.

In May 1987, the Government of Sri Lanka requested the Government of Japan to conduct "the Study on Sand Drift in the Southeastern Coast of Sri Lanka" (hereinafter referred as "the Technical Study") to find measures to solve the problem of the harbour siltation. The Government of Japan carried out a survey on sand drift of the southeastern coast of Sri Lanka from April 1988 through December 1989. Based on the results of the site survey on the natural conditions, hydraulic model tests and numerical model analyses conducted over a year, the suitable countermeasures for siltation of the Harbour were proposed.

In response to a request of the Government of Sri Lanka for rehabilitation of the Harbour, which is based on the above Technical Study, with a grant aid, the Government of Japan decided to perform the basic design study, and the Japan International Cooperation Agency (herein after referred as "JICA") dispatched a basic design study team from October 23 to November 12, 1990.

The population engaged in fishery in Sri Lanka is approximately 110,000 inhabitants and that one living on the fishery industry is approximately 470,000, which represents the 2.7% of the total population, 17.43 million. The northern, eastern and north-eastern districts of Sri Lanka are more densely populated with fishermen, and the population of fishermen in both the western and southern districts accounts for 11% of the entire fishing

population, respectively.

The annual fishery production amounts to approximately 205,000 ton, from which the 76.6% comes from coastal fishery with fishing boats of 3.5 GT type or smaller. The inland waters fishery accounts for 19.4%, while the offshore and deepsea fisheries account for only 4.0%. The annual fishery production in terms of money in 1988 was Rs.4,650 millions and represented 2.13% of the gross national product.

In 1989 approximately 59% of the fishing boats in Sri Lanka were traditional canoes and one fifth of canoes were equipped with outboard engines. FRP fishing boats, most of which have outboard engines and have been increasing in number, accounted for 28% of the total. But the number of fishing boats of 3.5 GT type or larger with inboard engines represented only the 12.5%.

In view of the present situation, the Fisheries Development Project aims to increase the gross catch in quantity to approximately 273,000 ton, and to reach 83% of the total fish demand calculated on the basis of a daily consumption of 60 g per person in 1994. To this end, an increase of 5 to 6% in annual fish catch is demanded. For this purpose, it is planned to increase about 5,000 fishing boats including some 2,000 boats of 3.5 GT type or larger from 1990 to 1994. In addition, organization of fishery cooperatives, the Beach Landing Project (under a grant by U. K.), which is a simple development project for fishery harbours and facilities, and the Southern Area Marine Fisheries Development Project are being planned as important countermeasures.

In the south of Sri Lanka where the Harbour is located, there is a shallow-water area called Hambantota Bank which is situated at about 10 km offshore, and expands eastward for 140 km along the coast, offering excellent fishing grounds such as the shoals of Great Basses Ridge and Little Basses Ridge. The fishing resources (corresponding to MSY : Maximum Sustainable Yield) in this area are assumed to be 35,000 ton (14% of the total resources in Sri Lanka), but the actual catch is only 11,000 ton (7.2% of the total). From this situation it is clear that a high development potential in fishing remains there. Therefore the Southern Area Marine Fisheries Development Project is paying avid attention to this problem.

In the southern Sri Lanka there is no well-equipped fishery harbours

within 200 km east of Tangalla, so that the development of the fishery areas should be behind others. In the Tangalla Harbour with a well-equipped port which is frequented by 3.5 GT type fishing boats, the fish catch is high during the summer corresponding to the occurrence of high wave heights during SW monsoon season. On the other hand, in the Kirinda Harbour with less improved functions where the traditional fishing boats are being mainly used, during this season fishing activities sometimes cease because of the strong agitation generated by breaking waves, and the catch reaches its peak during the winter, corresponding to NE monsoons. To allow all year-round fishing activities and to increase the catches in the Kirinda area, it is essential to restore the Harbour to its full capacity.

The Kirinda Oya Project is currently under way in the Harbour's hinterland to establish irrigation systems and promote permanent settlement. With the increase of population to be brought by the Project, it is estimated that the population will reach about 310,000 inhabitants, whose fresh fish demand will be approximately 2,200 ton/year.

The Harbour is located at 300 m east of the Kirinda Point and extended along the sandy beach for 6 km eastward. The beach is subjected to "swell" from the south throughout the year, and is often attacked by waves overlapped by the wind waves at the time of monsoons. During the SW monsoon season (April to October), the swell and the wind waves come in the same direction, resulting in higher waves compared to the NE monsoon season (December to March). Because of such wave conditions, more than 100,000 m^3 of sand drift comes from the west of the Kirinda Point each year causing the Harbour siltation. During the NE monsoon season, tens of thousands of cubic meters of sand is assumed to come into the Harbour from the east in the opposite direction to that of the SW monsoon season. The sand is assumed to enter the Harbour from the entrance through the rubble stone gaps in the breakwater, and over the crest of the breakwater along with overtopping waves.

The request from the Government of Sri Lanka consists of the following items:

a. To construct a 200 m groyne at the Kirinda Point.
b. To extend the main breakwater for 200 m.
c. To raise the crest elevation of the existing main breakwater

for 100 m, and provide the protective layer.

d. To construct a new sub-breakwater of 230 m length starting from approximately 350 m east of the existing Harbour.

e. To inspect the existing shore facilities such as refrigerators for maintenance and repair if necessary.

Among these, item (a) is essential and effective to deviate the sand drift coming to the Kirinda point, and send it in the offshore direction. Item (b) is an effective measure in preventing the sand drift from flowing into the Harbour from the entrance, maintaining calmness inside the Harbour; and assuring a calm work environment for the maintenance by dredging. Item (c) is effective for preventing the sand entrainment from overtopping the breakwater or passing through the rubble stones. Item (d) is necessary and indispensable to prevent the Harbour siltation due to the sand drift coming from the east coast of the Harbour. The Government's request was thus technically reasonable.

Following effects by the Project of which benefits can be estimated in terms of money are:

1. Increase in fish catch by 3.5 GT type boats
2. Curtailment of fuel consumption of fishing boats
3. Reduction of distribution cost such as transportation

Total benefit due to these effects can be expected to exceed the total cost of the Project including the maintenance and operational costs.

Besides, other benefits are:

4. Preservation of freshness of fish
5. Improvement of safety in navigation
6. Increase in fishermen's income
7. Increase in opportunity of employment
8. Contribution to the region enough supply of protein of better quality

In consideration of these effects and the following situations the implementation of the Project with a grant aid was judged to be justifiable.

1. This Project consists of the rehabilitation of the existing harbour which was constructed with the Japanese grant aid and does not function as it was planned.
2. Some fishermen have already moved to the Kirinda village with their families when the Harbour was opened.
3. Investments by private sectors have been made.

If this rehabilitation plan which follows the proposed plan in the Technical Study is implemented, at most 10,000 m^3 of sediment are supposed to be yearly deposited at the new harbour mouth. Therefore the following measures have to be taken by the Government of Sri Lanka for the proper harbour operation, otherwise the Harbour will become useless again.

a. To ensure an annual budget for dredging.
b. To conduct the topographical surveys at the interval recommended in this Study.
c. To conduct the yearly maintenance dredging

The Ceylon Fisheries Harbour Corporation (CFHC), a substructure of the Ministry of Fisheries and Aquatic Resources, will be responsible for the administration and management of this Project. CFHC has knowhow regarding the harbours construction works and dredging by using dredgers.

CFHC's dredging equipments and machinery include two grab-type dredgers provided by the Government of Japan and one small-size pump type dredger provided by the Government of the Netherlands. One of the grab-type dredgers is obsolete and will be difficult to be used all over the year. However, the other one is new and will be capable to dredge about 60,000 m^3 per year. CFHC is expected to dredge a total volume of 80,000 to 90,000 m^3 per year.

The total maintenance dredging volume in fishery harbours under the CFHC's management is estimated to be 50,000 to 80,000 m^3 per year. Thus, CFHC is considered fully capable to dredge to maintain the Harbour in functional conditions.

CONTENTS

APPENDIX

LIST of TABLES

LIST of FIGURES

CHAPTER 1

Chapter 1 Introduction

1.1 Outline of the Request

The Government of the Democratic Socialist Republic of Sri Lanka (herein after referred to as "the Government of Sri Lanka") is promoting the development of the fishery industry as a part of its national policy to secure supply of inexpensive animal proteins and exploitation of its abundant fishery resources. However, regarding the facilities of the fishery harbours which form the basis for the development and promotion of the fishery industry, there are only eleven harbours in the nation that are fully equipped; but none of them is in the southeastern district. Furthermore, the development of this district was particularly lagging behind others so that the Government of Sri Lanka requested a grant aid from the Government of Japan in May 1982 for the construction of a fishery harbour in Kirinda and promoting the fishery industry in this area.

In response to the request, the Government of Japan decided to assist the construction of the Harbour with grant aid for 1982 and 1983. The construction works were commenced from September 1983 and completed in April 1985. The Harbour was handed over to the Government of Sri Lanka upon its completion and thereafter prospered as the only modern harbour in the area. However, the sand drift phenomenon brought sand into the Harbour completely closing its entrance and significantly damaging its functions in June 1986.

In May 1987, the Government of Sri Lanka requested the Government of Japan to conduct a Technical Study to find out a solution for the harbour siltation problem. From April 1988 to December 1989, the Government of Japan carried out "The Study on Sand Drift in the Southeastern Coast of Sri Lanka" (hereinafter referred as "the Technical Study") and proposed suitable countermeasures for the protection against siltation of the Harbour.

Based on the result of the Technical Study, the Government of Sri Lanka requested to the Government of Japan a grant aid for rehabilitation of the Harbour.

1.2 Dispatch of the Study Team

In response to the above request, the Government of Japan decided to perform this study, and JICA dispatched a study team headed by Mr. Shinya Nakai, Director of Second Basic Design Study Division, Grant Aid Study and Design Department, JICA, from October 23 to November 12, 1990. The study schedule and organization of the team are described in Appendix I.

During the site study, the study team conducted the investigations related to socio-economy, fishery and construction works. The study team also entrusted local consultants to carry out the investigation of the fishery industry and the shoreline topographical survey. After the discussion with the Government of Sri Lanka on October 31, the Minutes of the Meeting were agreed and signed (See Appendix II). The contents of the Draft Final Report was discussed from July 11th to July 18 and both governments confirmed and agreed on the proposal prepared by the study team.

1.3. Objectives of the Study

For the request of Sri Lanka on the basis of the Technical Study, this basic design study is aimed to conduct a socio-economic study and a natural condition survey around the project site, to supplement the results of the Technical Study. Furthermore, considering the results of these studies, the validity of the project for a grant aid is evaluated, and the basic design of the project with appropriate contents and scope is prepared, including the effective utilization of the land facilities of the Harbour.

The Study Team investigated the following items to evaluate the feasibility of the project.

(1) Background of the project and the contents of the request
(2) Contents of the project
(3) Maintenance and management plans
(4) Project site (study on the natural conditions)
(5) Socioeconomic conditions and problems related to the fishery industry
(6) Basic design

(7) Problems related to the construction works

(8) Cost Estimation

(9) Scope of the construction works to be conducted by the Government of Sri Lanka

(10) Implementation Plan

Based on the results of these investigations, the Study Team assessed the validity and feasibility of the project in terms of its contents, scope, layout plans, structure, project costs and plan, and prepared this basic design study report.

CHAPTER 2

Chapter 2 Background of the Project

2.1 Background of the Project

The government of Sri Lanka is promoting the development of the fishery industry for a supply of inexpensive animal proteins for the nation. However, only some fishery harbours in the nation have good fishery facilities and the abundant fishery resources are not fully utilized.

The fisheries of Sri Lanka can be classified into three categories: the coastal fishery, offshore/deepsea fishery and inland fishery.

Administratively, the coastal region of Sri Lanka consists of five Provinces: South, West, Northwest, North and East, and totally 14 District Fisheries Extension Offices (DFEOs) are opened in the said five Provinces. The major fishery bases for each province are as follows:

South Province:	Galle, Matara and Tangalla
West Province:	Kalutara, Negombo and Colombo
Northwest Province:	Puttalam and Chilaw
North Province:	Jaffna, Mannar and Mullativu
East Province:	Trincomalee, Batticaloa and Kalmunai

The fishery industry stands as an important role in the national animal protein production. The statistics of 1988 shows that the people depend on fish protein which accounts for 65% of the animal protein consumed, the remains include meat, poultry, milk and so on.

The outline of the fishery industry in 1989 is indicated in Table 2-1.

The fish production of the coastal fishery in 1989, as shown in Table 2-2, accounts for about 79% of total, manifesting that it is a principal sector in the Sri Lanka fisheries.

The fishing methods in Sri Lanka are by hook and line, pole and line, trap, trolling, beach seine, long-line, gill net and trawling. Gill net is mostly used among these methods. Although most offshore fishery is using gill

net, recently offshore fishing boats using long-line along with gill net are increasing. Besides, in terms of utilization of demersal resources, the introduction of new techniques such as set net, bottom long-line and cuttlefish fishing is being promoted.

Table 2-1 Outline of the Fishery Industry in 1989

Total Population		17,433,200
Fishing Population	Marine	412,200
	Inland	55,909
	Total	468,109
Ratio of Fishing Population		2.68 %
Number of Fishermen	Marine	98,444
	Inland	12,891
	Total	111,335
Number of Fishing Families	Marine	87,808
	Inland	11,451
	Total	99,259
Gross Domestic Production(GDP)		$218,155 \times 10^6$ Rs.
Contribution of Fisheries Sector		2.13 %
Number of Fishing Boats		30,579
Fish Production		205,286 ton

(Source : MOF)

Table 2-2 Fish Production in 1989

Sub-Sector	Fish Production(ton)	Ratio(%)
Coastal Fishing	157,411	76.6
Offshore/Deepsea	8,155	4.0
Inland Fishing	39,720	19.4
Total	205,286	100.0

(Source : MOF)

The fishing fleet in Sri Lanka are mainly traditional canoe type vessels, FRP vessels and 3.5 GT type inboard-engine equipped vessels. The breakdown of the fleet in 1989 is shown in Table 2-3.

From Table 2-3 it is seen that the traditional fishing vessels such as canoes, including those equipped with outboard engine, are 16,437 units, about 59% of the total. These traditional vessels, of which about 21% are outboard

engine equipped vessels, are producing one third of the total production. Therefore from an increase of production standpoint, maintenance, repair and introduction of FRP-made hull or 3.5 GT type vessels are the important themes in the fisheries policy.

Table 2-3 State of Fishing Fleet in 1989

Type of Fishing Boats	Number of Fishing Boat		Ratio(%)	
Traditional Fishing Boats (Oru, Vallam, Teppam, etc.)	12,946		46.6	
Mechanized Traditional Fishing Boat	3,491		12.6	
FRP Fishing Boat with O.B. Engine	7,896	14,860	28.4	53.4
3.5 GT Fishing Boat with I.B. Engine	3,289		11.8	
Over 3.5 GT Fishing Boat	184		0.7	
Total	27,806		100.0	

(Source : MOF)

Sri Lanka has 30 fisheries harbours/landing centers. Among them, only 11 are regular harbours equipped with basic infrastructure including shore facilities or breakwaters or jetties and suchlike. The remains, with no infrastructure, are primitive harbours whose landing is carried out on the foreshore. The location of eleven regular fisheries harbours is indicated in Fig. 2-1. The Kirinda Fisheries Harbour is located at the east of the southeastern region.

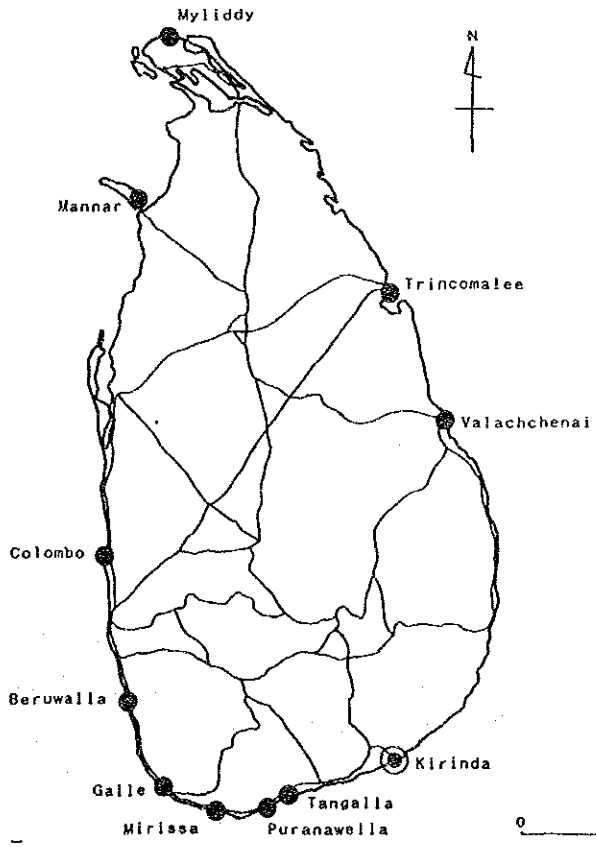

Fig. 2-1 Location of Regular Fisheries Harbours in Sri Lanka

The Ministry of Fisheries launched the 5 year National Fisheries Development Programme 1990-1994. Its objectives are as follows:

(1) Increase in fish consumption per capita for better nutrition through an increase of fish production.
(2) Rational utilization of fishery resources through the introduction of modern fishing techniques.
(3) Improvement of earnings and living standard of fishermen and fishery-related industry workers, and supporting a poverty alleviation plan.
(4) Creation and extension of employment opportunities.
(5) Earnings of foreign currencies through exports of fish products.

Furthermore, in order to achieve the objectives above, the Government identified the following five points to give them serious consideration

(1) Biomass and water/land resources
(2) Minimum requirements of animal protein foodstuff
(3) Current fishing fleet and its capability
(4) Necessary facilities and services for the fishing industry
(5) Real needs of fishermen and fishing communities

Concretely, the basic policy, implementation schedule and finance are to be established for each item below

(1) Marine fisheries
(2) Inland fisheries and culture fisheries
(3) Improvement of socio-economic conditions of fishermen
(4) Development of fishing communities
(5) Fishing equipment and materials
(6) Technical training, diffusion of technology and research management
(7) Fisheries infrastructure
(8) Fish market
(9) Export of fish products

It is needless to say that the principal objective of the Fisheries Development Programme is to increase the fish production. Table 2-4 gives the production target of the 5 year Programme.

Table 2-4 Targets of Fishery Production unit: ton

Sub-Sector	1990	1991	1992	1993	1994	1994/1991
Coastal	147,664	153,570	159,749	166,102	172,746	1.17
Offshore	26,000	27,500	29,000	30,500	32,000	1.23
Deepsea	6,000	9,000	12,000	15,000	18,000	3.00
Inland	39,720	42,130	44,590	47,095	50,000	1.26
Total	219,384	232,200	245,304	258,697	272,746	1.24

(Source : MOF)

The relation between the targets in the above table and the requirements of fish consumption is shown in Table 2-5. According to the Sri Lanka Medical Research Institute (MRI) the requirement of fish per person is 60 g per day. The Government intends to raise it up to 71% of the MRI figure by 1990 and 83% by 1994 according to the Fisheries Development Programme.

Table 2-5 Comparison of Targets between Fish Demand/Production
unit: ton

Items	1990	1991	1992	1993	1994
a.Fish Demand	308,352	313,656	318,864	324,120	329,376
Production					
b.Estimated Production	219,384	232,200	245,304	258,697	272,746
b/a Ratio (%)	71	74	77	80	83
Annual Growth Rate of Production	-	6 %	6 %	5 %	5 %

(Source : MOF)

According to the fishing vessels introduction plan, 100 small fishing boats equipped with inboard engine are to be built each year from 1990; 500 units in total for 1994. These include traditional canoes, which represent one third of the total production. Table 2-6 shows the proposed number of fishing vessels to be introduced each year.

Table 2-6 Targets for Issue of Crafts Unit: Boat

Items	1990	1991	1992	1993	1994	Total
Madel Oru for Beach seine	10	10	5	5	5	35
Non-Mech. Trad. F. Boat	400	400	400	400	400	2,000
Mech. Trad./FRP F. Boat	228	250	290	314	340	1,422
Inboard Engine F. Boat	100	100	100	100	100	500
FRP Boat for Inland Fishing	200	200	200	200	200	1,000

(Source : MOF)

Organization of fishermen by forming cooperatives, aiming at improving their social status and living standard, is emphasized in the Fisheries Development Programme. Its target is to increase the actual membership of 22,000 fishermen up to 74,000 by 1994, which represents an organization rate of about 60%.

Projects related to this Kirinda Project include the Southern Area Marine Fisheries Development Project and Fisheries Harbor Projects, and Refurbishment of Ice Plants and Cold Rooms Projects. The following are the outlines of these projects.

(1) Southern Area Marine Fisheries Development Project

The objectives of the Project are to increase the fish production, thus income of small scale fishermen through supplying fishing boats, fishing gear, fishing materials, etc., and to alleviate poverty. The Project is expected to start between 1991 and 1993 with an estimated cost of Rs.209 millions.

(2) Fisheries Harbour Projects

Although there are 11 fishing harbours with basic infrastructure and 19 primitive fishing ports utilizing foreshore, almost all of them have problems such as harbour siltation, damage of breakwaters, and breakdown of shore facilities. The Project aims at repair and rehabilitate these facilities.

(3) Refurbishment of Ice Plants and Cold Rooms Projects

The ice-making plants and cold storage facilities belonging to the CFC and CFHC have been useful for distribution of fish in the whole country, but recently most of these facilities became superannuated to a degree of requiring urgent renewal or rehabilitation. Most public facilities are placed at remote areas without private business activities, and the Project aims at reactivation of these areas through renewal or rehabilitation of the facilities. The period to realize these projects is from 1991 to 1994, and the cost is estimated at Rs.218 millions.

Kirinda Oya Irrigation and Settlement Project (KOISP), Hambantota Integrated Rural Development Plan (HIRDEP) and other related major infrastructure plan are concerned with this Project among the national development plans in the southern region.

KOISP, which is the biggest irrigation and settlement programme in the southern area, was planned covering some parts of Hambantota AGA (Assistant Government Agent), Tissamaharama AGA and Lunugamvehera AGA, in Hambantota District, and Tanamalwile AGA in Moneragalu District. The project is composed of Phase 1 and Phase 2, which started in 1986 and 1988, respectively.

HIRDEP commenced in 1979 and is receiving substantial support from NORAD (the Royal Norwegian Ministry of Development Co-operation). The Plan is one of the Integrated Rural Development Plans (IRDP) which apply to fifteen districts throughout the country. IRDP aims at improving the life of farmers and peasants through non-centralistic development activities. The objectives of HIRDEP are to increase employment and income, to ensure social welfare, to utilize resources and to activate the market. HIRDEP covers most fields related to regional development and puts serious consideration on improvement of community settlement, water supply and roads. Recently, education has been a matter of great importance. The Kirinda fishermen settlement plan is worked out by HIRDEP. The following concrete measures are included in this settlement plan.

(1) To promote settlement by supplying long term loan for 50 fishermen's family in Kirinda G.S. District

(2) To supply access roads and water

(3) To provide toilets

(4) To provide job training for women to get income (30 women)

The highway construction from Colombo to Wellawaya which is being executed with ADB support, and the railway construction between Matara and Kataragama on which the feasibility study is being carried out, will be considered to be effective to the Kirinda Project as the development projects on infrastructure.

The executing organization for the construction and administration of the Harbour should be CFHC, which is a substructure of the Ministry of Fisheries and Aquatic Resources. The outline of the organization of CFHC at the end of 1990 is shown in Fig. 2-2.

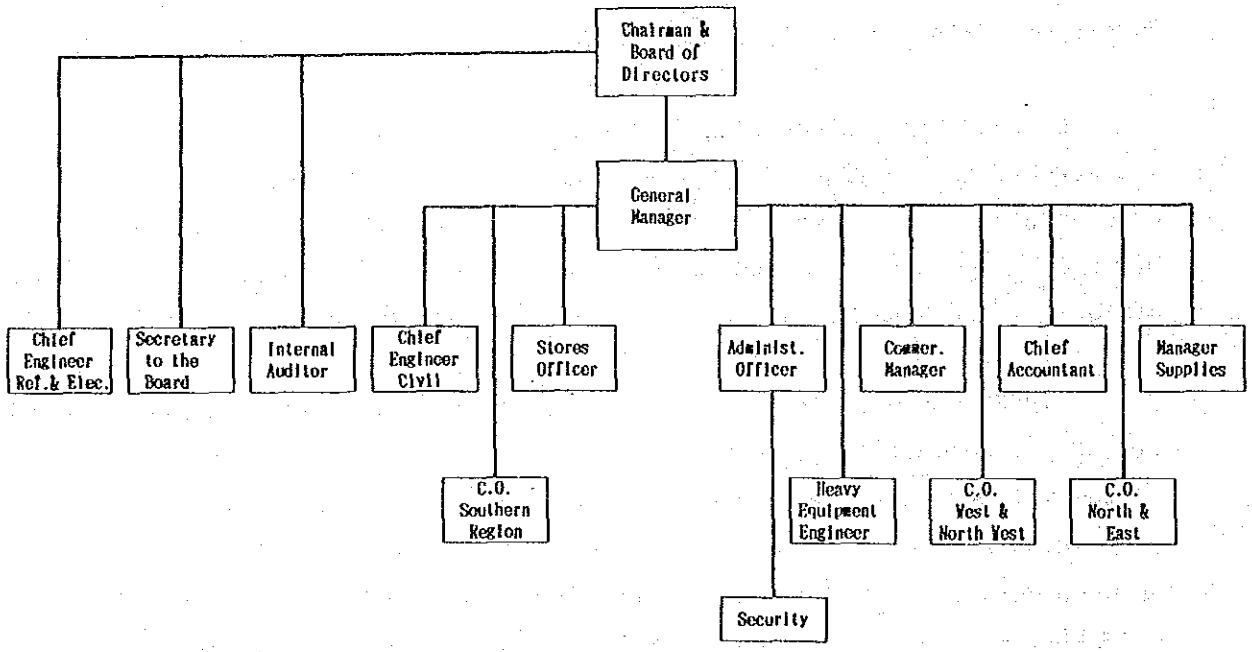

Fig. 2-2 Outline of CFHC Organization

2.2 Outline of the Project Area

Kirinda village is located in southern dry zone of the country. According to the social policy of Sri Lanka, irrigation and settlement in the dry zone has been promoted. KOISP, which is the biggest irrigation and settlement project in the southern area, includes the promotion of this area. Due to the first phase of this project, about 4000 families have settled and in the second phase settlement of about 1800 families is expected. HIRDP is also an effective project in the development of this area as mentioned before. Furthermore, it is considered that the inland area, such as Wellawaya, Badulla and so on, will be developed and becoming the hinterland of the southern fishing villages, such as Kirinda, for fish supply and its population will be also going up to about three hundreds thousands . From these considerations, fish supply from the southern coast, such as Kirinda, shall be significant for the development of the southern area and inland area.

After the rehabilitation of the Harbour, fifty fishing boats will be introduced by the Government for five years and roughly the increase of population will come up to 1,000 inhabitants. As a result, a fishing village with about 2500 inhabitants will be formed. And it is expected to be growing up as a core of commercial area which has the hinterland for fish consumption.

Kirinda fishing village belongs to the administrative area of Hambantota District which consists of eleven AGA Offices. Tissamaharama AGA governs Kirinda village.

The land of Hambantota District is about 2,600 km^2, which is about 4% of all land in Sri Lanka and most of then are plain and within the level of 100 m above sea level.

According to the census of 1981, the population of Hambantota District was 424,344 inhabitants and Tissamaharama Division was 58,383. Population of Hambantota District in 1989 was estimated to be about 505,000 inhabitants, based on the number of the food stamps recipients. The characteristics of changes of population in Hambantota District are as follows:

a. The growth rate of population is higher than the level of the whole country. The birth rate is higher, while mortality is

lower.

b. Urbanization is totally at low level, but the population density of Tangalla is about 6,000 hab/km^2.

c. Distribution of population is centered to the area around Tangalla and Hambantota. The population density of wet zone in the west is higher than in the east, though the rate of increase of population in the east is higher than that of the west.

Since Tissamaharama Division was divided into two divisions, Lunugamvehera and new Tissamaharama, after the last census, the growth rate is not clear between 1981 and 1989. But it is found that the increment of the population due to the irrigation and settlement in Kirinda Oya area is more than 40% of it. The number and rate(%) of food stamps recipients of each Division are reported in the HIRDEP Annual Programme, in 1991. According to these figures, the population of new Tissamaharama Division in 1989 is estimated to be approximately 54,000 inhabitants.

2.3 Particulars and Contents of the Request

2.3.1 Grant Aid Project in 1982

The Sri Lankan Government requested to the Government of Japan in 1982 for the construction of the Kirinda Fisheries Harbour. The Government of Japan dispatched a basic design study team headed by Mr. Akio Saito, Deputy Director of Disaster prevention and Coastal Protection Division, Fishing Port Department of Fisheries Agency at that time, for the project of the construction of the Harbour, to Sri Lanka in 1982 and decided to construct the Harbour from 1982 to 1983 with a grant aid. Based on the results of the study, the construction of the Harbour was commenced in September 1983 and was completed in March 1985, and the following facilities of the Harbour were constructed.

1. Main Breakwater	370 m
2. Groyne	110 m

3. Sub-breakwater	160 m
4. Wharf	150 m
5. Fridge	50 m^2
6. Office	80 m^2
7. Fish Auction House	250 m^2
8. Repair Workshop	200 m^2
9. Store House	100 m^2

The project cost was 1,416 million yen.

2.3.2 Outline of Harbour Siltation

When the Harbour was opened, it was operating prosperously as the only modernized fishery harbour. However a vast volume of sand were drifted into the Harbour just after its completion, causing that the Harbour mouth to be closed in June 1986 and, hence the Harbour became malfunction. The progress of siltation around the Harbour is shown in Fig. 2-3 and 2-4. Fig. 2-3 shows the process of deformation of shoreline from the completion of the Harbour and Fig. 2-4 shows the change of the quantity of the accumulated sand at each area. The pocket beach mentioned in Fig. 2-4 indicates a beach between the Kirinda Point and the Harbour.

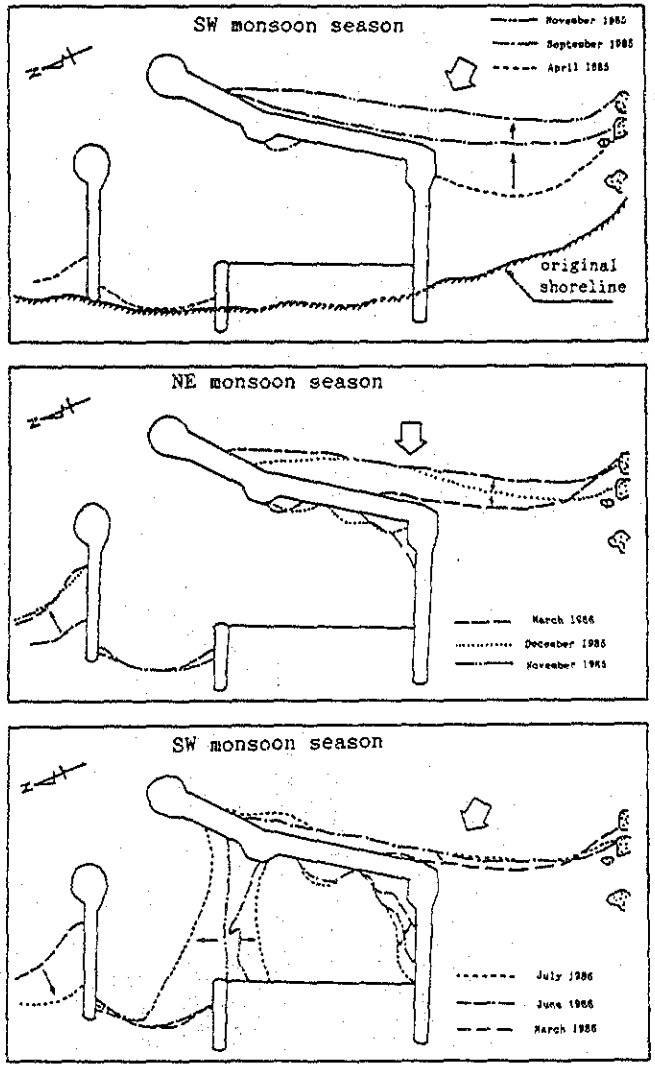

Fig. 2-3 Progress of Shoreline Changes

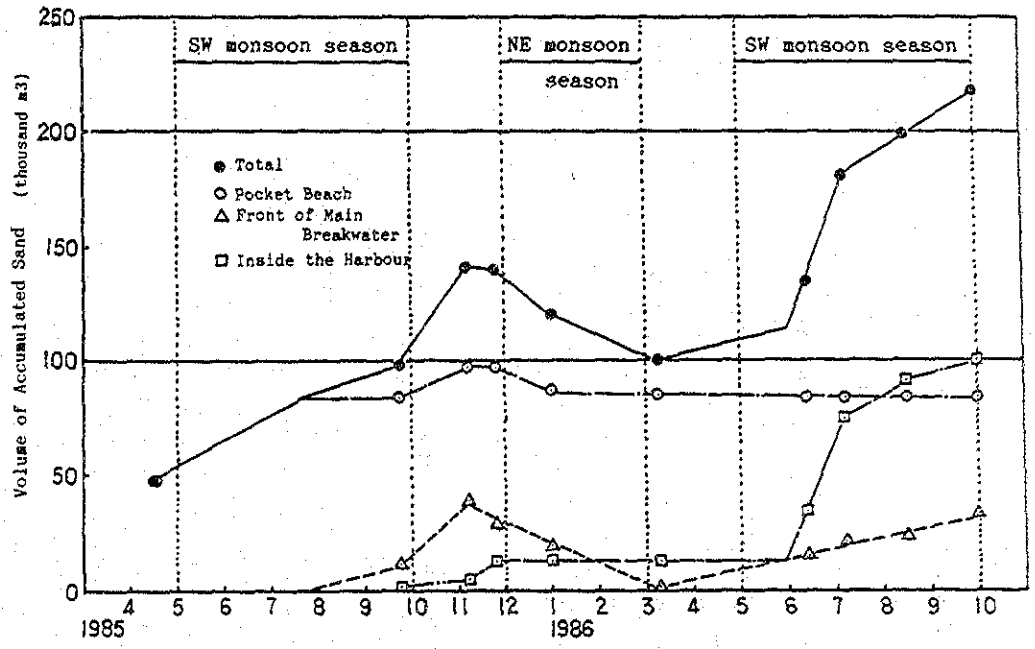

Fig. 2-4 Transition of Sand Accumulation

2.3.3 Technical Study

(1) Outline of Study

Outline

In May 1987, the Government of Sri Lanka requested the Government of Japan to conduct a technical study to find measures to solve the problem of the harbour siltation. In response to the request, the Government of Japan carried out the Technical Study which was a survey on sand drift of the southeastern coast of Sri Lanka from April 1988 through December 1989.

Objectives

The objectives were;

1. To study the sand drift in and out of the Harbour and clarify its mechanism.

2. To prepare a proposal with an appropriate layout for reconstruction of the Harbour to minimize siltation.

3. To formulate a plan for the maintenance and dredging of the Harbour after its reconstruction.

To fulfill these objectives, following works were conducted.

1. Survey for natural conditions for one year to clarify the mechanism of sand drift in the southern coast.

2. Examination on the rehabilitation of the Harbour by hydraulic model tests and numerical simulations.

(2) Field Survey of Natural Conditions and Mechanism of Sand Drift

Contents of Field Survey

Table 2-7 shows the contents of the field survey in the Technical Study.

Table 2-7 Contents of Field Survey

Items	Contents of Survey
Data Collection	Geographical Data in Project Area Meteorological Data(Weather Charts etc.) Charts of Cyclone Course Wind Data in Hambantota Sea Charts Results of Sounding in 1983 and 1986
Sounding	May 1988, March 1989
Shoreline Survey	May, August, November 1988 and March 1989
Wind Observation	From May 1988 to March 1989
Tide Observation	From August 1988 to February 1989 to at Tangalla From August to September 1988 and February to March 1989 at Kirinda
Wave Observation	From May 1988 to March 1989 at 20m depth in front of Kirinda, August to September 1988 and in March 1989 in front of the Harbour
Current Observation	In September 1988 and March 1989
Bed Material Survey	- ditto -
Suspended Sand Survey	- ditto -
Tests	Two dimensional and tree dimensional model tests, and numerical simulation

Summary of Results of the Field Survey and Mechanism of Sand Drift

1. The beach is subjected to "swell" from the south throughout the year and often attacked by waves overlapped by the wind waves at the time of monsoons. During the SW monsoon season (April to October), the swell and the wind waves come in the same direction, resulting higher waves compared to the NE monsoon season (December to March).

2. SW monsoon waves cause the current along the coast from south to north, on the contrary, NE monsoon waves cause the current from north.

3. Because of such wave conditions, more than 100,000 m^3 of sand

drift comes from the west of the Kirinda Point each year causing the Harbour siltation. During the NE monsoon season, tens of thousands of cubic meters of sand is assumed to come into the Harbour from the east in the opposite direction to that of the SW monsoon season.

4. The sand is assumed to enter the Harbour not only from the Harbour mouth, but also through the rubble stone gaps in the breakwater, and over the crest of the breakwater along with overtopping waves.

(3) Examination Method for Protection from Harbour Siltation and Results

Target of Examination

The target of the examination of the protection from harbour siltation was discussed with the Government of Sri Lanka and was set up that the examination aimed at minimizing the quantity of sand deposit in the Harbour to be less than the quantity that C.F.H.C. could handle.

The maximum dredging capacity of the dredgers of C.F.H.C. was estimated to be about 17,000 m^3 per year per harbour with consideration of it's actual dredging works from 1982 to 1986 and the target of dredged quantity by C.F.H.C. for the Kirinda Harbour was set up to be 10,000 m^3 per year.

Examination Method and Results

The examinations were performed to find out countermeasures for the following two different phenomena.

1) Harbour siltation due to sand carried from the Harbour mouth

The Hybrid Model(*) was used to clarify the mechanism of Harbour siltation and to examine countermeasures. Furthermore, for some effective, cases the hydraulic model tests using movable bed(**) were conducted. The cases examined by the Hybrid Model are illustrated in Appendix-12. The tests were carried out along the following steps.

a. Examination for prevention against the sand transport from the south in SW monsoon season

b. Examination of effective layout and size of the Sub-breakwater

c. Adjustment of layout of countermeasures against the sand drift due to NE monsoon waves

From these tests the layout indicated in Fig. 2-6 was presumed to be the most appropriate countermeasure to prevent the harbour siltation. According to the result, the maximum sand deposit volume in the Harbour was estimated to be 10,000 m^3 per year at most.

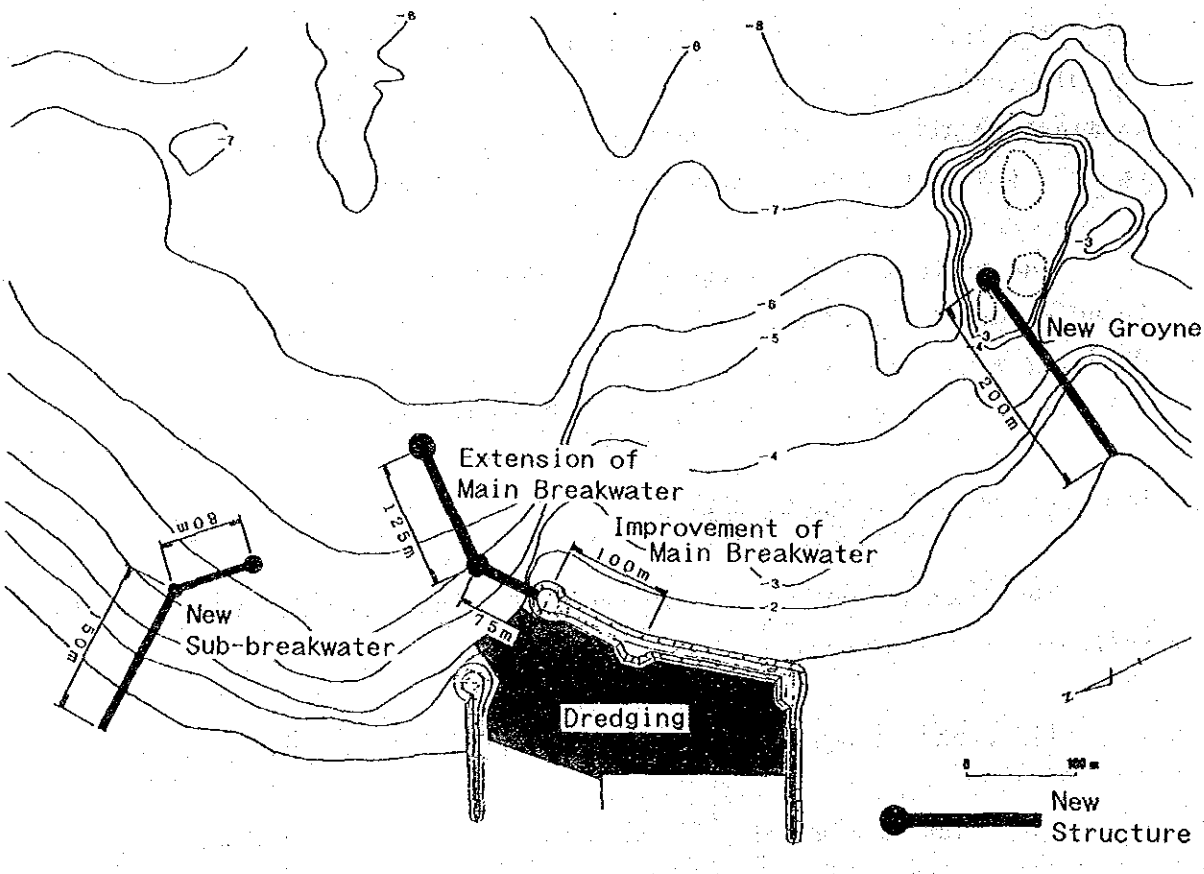

Fig. 2-6 Layout of Recommended Countermeasure

(*) Fig. 2-5 shows the flow of the Hybrid Model. It consists of the physical model tests and the numerical model tests. The physical model tests are conducted to obtain the input data for the numerical tests such as the wave heights, current velocities and wave directions. The numerical tests estimate the distribution of sand deposit. Now this method is considered to be the best method for estimation of sedimentation.

(**) The movable bed means a model bed made by natural fine sand or other fine grains.

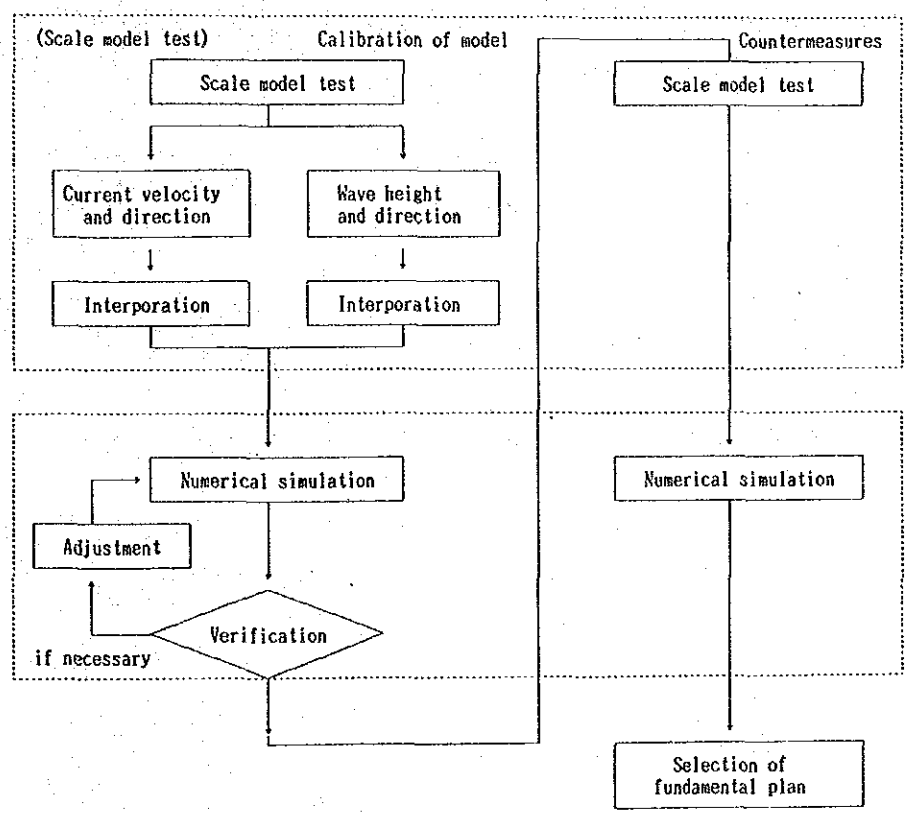

Fig. 2-5 Flow of Hybrid Model

2) Sand overtopping the breakwater

The 2-D hydraulic model tests using movable bed were conducted to prevent sand overtopping and the necessary crest elevations of the breakwaters were made.

By these model tests the crest elevations of the breakwaters

were recommended as below.

* Main Breakwater(existing part) : +4.0 m
* Main Breakwater(extension part) : +4.5 m
* New Sub-breakwater : +3.0 m
* New Groyne : +4.5 m

2.3.4 Contents of the Request

The Government of Sri Lanka requested to the Government of Japan for a grant aid for rehabilitation of the Kirinda Fisheries Harbour based on the results of the Technical Study.

The contents of the request, which correspond to the establishment of the countermeasures for siltation proposed in the Technical Study, are as follows:

a. To construct a 200 m groyne at the Kirinda Point.

b. To extend the main breakwater for 200 m.

c. To raise the crest elevation of the existing main breakwater for 100 m, and provide the protective layer.

d. To construct a new sub-breakwater of 230 m length starting from approximately 350 m east of the existing Harbour.

e. To inspect the existing shore facilities such as refrigerators for maintenance and repair, if necessary.