JAPAN INTERNATIONAL COOPERATION AGENCY

DEPARTMENT OF FISHERIES
MINISTRY OF AGRICULTURE AND COOPERATIVES
KINGDOM OF THAILAND

THE STUDY ON FISHERY COMPLEX ON THE ANDAMAN SEA COAST

FINAL REPORT (SUMMARY)

July 1997

TETRA CO.,LTD.
SYSTEM SCIENCE CONSULTANTS INC.

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PREFACE

In response to the request from the Government of the Kingdom of Thailand, the Government of Japan decided to conduct the Study on Fishery Complex on Andaman Sea Coast and entrusted the study to Japan International Cooperation Agency (JICA).

JICA sent to the Kingdom of Thailand a study team headed by Dr. Taiji Endo, TETRA Co., Ltd., four times during the period from December 1995 to July 1997.

The team held discussions with the officials concerned of the Government of the Kingdom of Thailand, and conducted field studies at the study area. After the team returned to Japan, further studies were made 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 two countries.

I wish to express my sincere appreciation to the officials concerned of the Kingdom of Thailand for their close cooperation extended to the team.

July, 1997

Kimio Fujita
President
Japan International Cooperation Agency

July,1997

Mr. Kimio Fujita
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Mr. Fujita

Letter of Transmittal

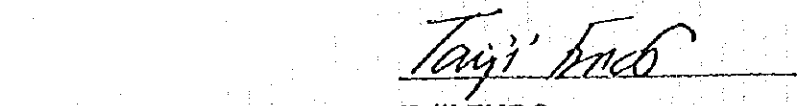
We are pleased to submit the report on the Study on Fishery Complex on the Andaman Sea Coast in Thailand. The report contains the advice and suggestions of the relevant authorities of the Government of Japan and the Government of the Kingdom of Thailand as well as the formulation of the above mentioned project.

This study was conducted by TETRA Co., Ltd. and System Science Consultants Inc., based on a contract with JICA, during December 1995 and July 1997. In this study, we formulated the master plan for development of Phuket Fishing Port up to the year 2012 and the short-term plan with examination of the feasibility for the period up to the year 2007.

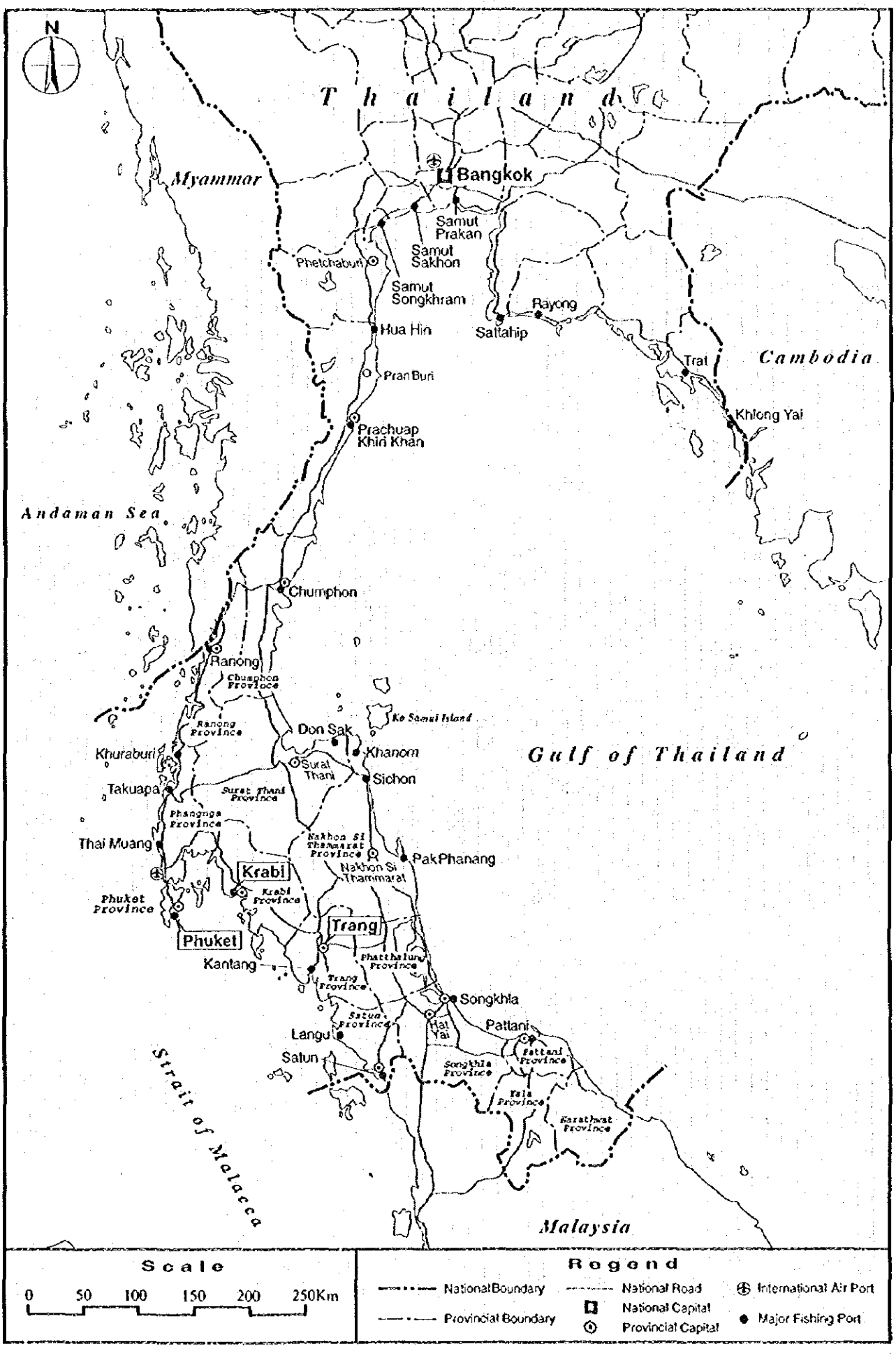
In view of the urgency of promoting Thai tuna fishery in Andaman Sea and Indian Ocean, we recommend that the Government of the Kingdom of Thailand will implement this Project as a top priority.

We would like to take this opportunity to express our gratitude to the relevant officials of JICA, the Ministry of Foreign Affairs, and the Ministry of Agriculture, Forestry and Fisheries in Japan. We are also greatly indebted to the concerned officials of the Department of Fisheries and Fish Marketing Organization, and the Embassy of Japan in Thailand for their close cooperation and assistance extended to the team during the preparation of the report.

Yours faithfully,



Taiji ENDO
Team Leader
The Study on Fishery Complex
on the Andaman Sea Coast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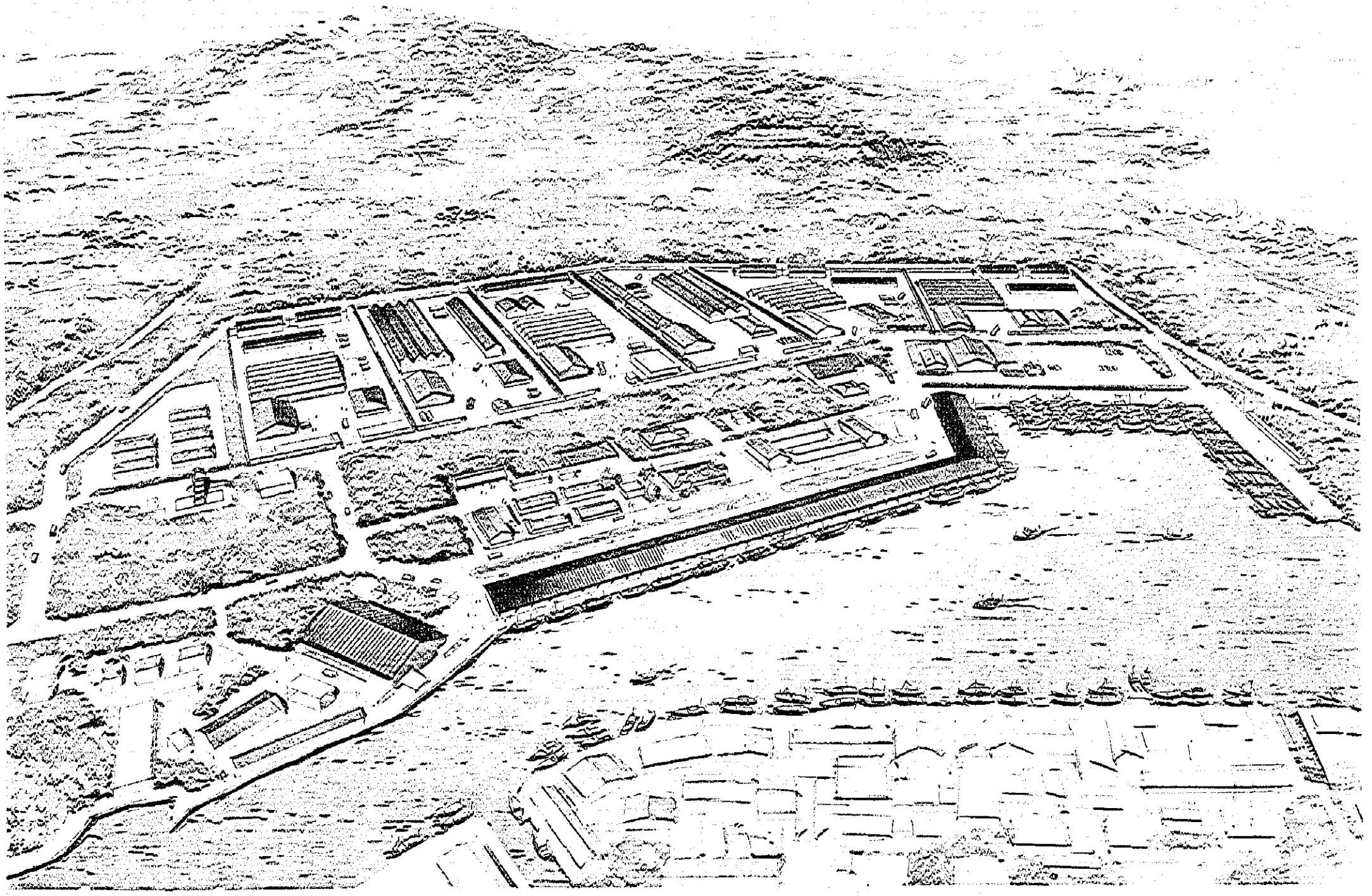

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1. INTRODUCTION

1.1. Background of the Study

Thailand has a coastline of 2,614 km with an excellent fisheries environment in the Gulf of Thailand and the Andaman Sea. The fishery sector is a major industry and source of national income. With the establishment of EEZ by the countries neighbouring Thailand, the fishing grounds of Thailand have greatly decreased by 30 % since 1991, especially in the Gulf of Thailand. Since bilateral agreements with Malaysia and Myanmar have not been reached, fishing operations by Thai boats are restricted to Thai and Bangladeshi waters. As a result, the fishing effort of fishing boats from the Gulf of Thailand and from the Andaman seacoast has increased, but a rise in fish catch volume has not been recorded from the fishing grounds in the Andaman Sea. Under these circumstances, the fishing operations in the Andaman Sea should be controlled to maintain and nourish the stock.

Considering decrease of fish catch as mentioned above, a cooperative established in a city on the Andaman Sea coast has started preparation of purchasing a large purse seiner to develop tuna fishing. Long line fishing for catching tuna is operated by Taiwanese and Chinese fishing boats. As a result, Thai fishermen are very eager to establish joint-venture companies with Taiwanese firms in long line fishing operations.

Large tuna processing and canning plants around Bangkok which are export oriented are under consideration for relocation to the southern part of Thailand where the labour cost is comparatively lower than plants around Bangkok.

In view of the above situation, the Government of Thailand is planning to construct a fishing port complex along the Andaman seacoast, incorporating an area exclusively for export fish processing, in order to improve the fish marketing system and to enhance the fisheries industry.

In conjunction with this plan, the Government of Thailand requested technical cooperation from the Government of Japan to formulate a master plan and a short-term development plan on the Fishery Complex on Andaman seacoast. On receiving the request, the Government of Japan conducted a preliminary study in July 1995 and the scope of work (S/W) was agreed on between both governments. Based on this agreement, JICA dispatched a study team and commenced the study in January 1996.

1.2. Objectives

The objectives of the study are to formulate a master plan to develop a complete Fishery Complex on the Andaman seacoast to meet the urgent needs of current fishing activities, and to conduct a feasibility study for a project to be implemented immediately.

1.3. Study Area

The study area will be the Andaman seacoast in Thailand and it will cover relevant areas such as the Gulf of Thailand and the surrounding area of Bangkok.

1.4. Study Schedule

The study was carried out in two phases. In the first phase of the study, an assessment of the fishery sector in Thailand was undertaken based on existing data and a field survey. A survey on natural conditions and a preliminary environmental survey will be carried out at five proposed sites of the Project. The project site was selected according to natural conditions, construction cost, and the social and natural environment of the five proposed sites. In the second phase, a master plan for the Fishery Complex was formulated and a feasibility study for a short-term plan was conducted.

2. OUTLINE OF FISHERIES SECTOR

2.1. Government Policies

2.1.1. Government Policies of the National Economic and Social Development Plan

The Seventh National Social and Economic Development Plan (1992-96) aimed to strengthen the fisheries and fish processing industry by enacting the following policy measures.

- Promote coastal aquaculture for exports and freshwater aquaculture for domestic consumption.
- Protect the environment and limit the destruction of mangrove forests by restricting the shrimp culture area to a maximum of 80,000 hectares.
- Regulate the number of fishing vessels in order to reduce the overexploitation of resources.
- Restrict the mesh size of fishing nets and ban the use of light attraction fishing methods.
- Fishing agreements with resource rich nations such as Bangladesh, Myanmar, India, Indonesia, Malaysia, etc.

2.1.2. National Fisheries Development Plan (1995-2001)

The major policies and targets of the National Fisheries Development Plan (1995-2001) are as follows.

(1)Improved living standards of fishermen and achievement of sustainable development through efficient resource management are targeted in the development of fisheries in Thai territorial waters. A sustained production of 1.7 million tons is targeted.

(2)In the production and development of the fisheries outside Thai territorial waters, joint fishing ventures with other countries will be promoted in compliance with international laws, targeting an annual catch of 1.8 million tons.

(3)In fisheries related industries, improving the quality of fish after catching or harvesting and raising the quality standards of processed fishery products will be promoted in both exported and domestically consumed fishery products. The production target for exported fish is not less than one million tons per year (750 million baht) and fisheries production will be distributed in rural areas in order to keep domestic fish consumption at more than per capita 30kg.

(4)Sustainable development in aquaculture will be achieved. The targets are to increase production of coastal aquaculture for export by five % annually and to attain a total production of 555,000 tons in 1996, consisting of 250,000 tons from inland aquaculture and 305,000 tons from coastal aquaculture.

2.2. Socioeconomy and Fisheries Sector

2.2.1. National Economy

(1) Industrial Structure

Gross Domestic Products (GDP) share of the manufacturing sector was 28.2%, followed by commercial, services, agriculture, transportation, communications, and other sectors, which accounted for 16.4, 12.6, 10.2, 7.4 and 25.2 %, respectively.

(2) Labour Market and Policy on Alien Workers

It is estimated that Thai industries suffered from an overall labour shortage of 1.36 million workers in 1996. Approximately 700,000 foreign labourers are estimated to be working in Thailand, under Article 12 of the 1978 Work Act for Foreign Immigrants, in the agriculture, construction, manufacturing and service industries.

Following a modification of the Act mentioned above, existing alien labourers were registered with the Ministry of Labour as legal alien labourers in June 1996. This modification will further enable the registration of new immigrants.

(3) Income Distribution and Poverty Alleviation

Although Thailand has achieved economic growth in recent years, it is estimated that income disparities have increased. The ratio of the population in poverty in 1992 was estimated at 13 % for the entire country, 3.0 % in Greater Bangkok, 6.0 % in the central, 11.6 % in the southern, 19.5 % in the northeastern, and 15.5 % in the northern regions. The population ratio in poverty in the southern region was the median for the whole country.

In the Eighth National Economic and Social Development Plan (1997-2001), a national policy targeting a poverty ratio of 10 % was established and reduction of the regional defferentials through industrial decentralisation has been planned.

2.2.2. Role of Fisheries in the National Economy

(1) Gross Domestic Product

Gross Domestic Product (GDP) in 1993 at the current market price was 3,161 billion baht, of which 1.5 % or 47 billion baht was produced by the fisheries sector.

(2) Foreign Trade

1) Role of Fisheries Products in Foreign Trade

In 1993 the total import value was 1,171 billion baht and the total export value was 951 billion baht; and the trade balance deficit was 219 billion baht. However, the foreign trade balance of fishery products was favorable, with an excess of 69 billion baht, with an exported fishery product turnover of 91 billion baht or 9.6 % of the total export earnings.

2) Canned Tuna

In 1993 the tuna canning industry in Thailand produced 230,000 tons, which accounted for 20 % of the total world production, and made Thailand the second largest producer after the United States in 1993. Most of this production has been exported, and Thailand has been the largest exporter of canned tuna since 1985. In 1993 Thailand exported 230,000 tons or 46 % of the total world market in canned tuna; and its major market was the US and the EU countries.

However, the tuna canning industry faced a domestic production shortage of raw materials; and it imported 402,000 tons of frozen tunas or 33 % of the world market, which was the largest volume in the world.

In the face of increasing competition in the world market, the unit price of canned tuna decreased. The unit price was 65 baht/kg in 1988 and 57 baht/kg in 1993. But it recovered to 62 baht/kg in 1995 and to 64 baht/kg in 1996.

3) New Markets for Exported Tuna

The Japanese fish market pays a higher price for high quality tuna for sashimi, which are a different species from the raw materials used in canning in Thailand. The fishery industry in Thailand has paid closer attention to the importance of the Japanese market and it has exported this tuna to Japan in recent years.

(3) Tuna Canning Industry

Benefiting from lower labour costs and the low priced materials, the tuna canning industry in Thailand developed during the 1980s. From 1989 to 1994, the average annual growth rate for canned tuna export registered 4.8 % in volume and 2.6 % in FOB value. The total export value of all canned food was about US$1.5 billion of which canned tuna formed about 50 %, or US$700 million.

Due to insufficient research and government policy papers, it was difficult to clearly estimate the prospects of Thai canning and other food processing industries, where tuna processing is dominant. However, the following is recommended for policy implementation based on the result of a comparative analysis of manufacturing systems of Thai tuna canning factories. Firstly, large-scale canning factories using imported tuna should be promoted and supported. Secondly, the government should help these factories to improve their efficiency and rationality and to promote the industrial conversion of inferior factories.

(4) Food Supply

Fishery products are an important source of nutrition for the people of Thailand. The fishery industry provided a per capita consumption of 26.3kg of fish in 1994 and the Thai government set a per capita consumption target of 30kg of fish.

2.2.3. Socio-economic Conditions in the Andaman Area

(1) Southern Region

1) Socioeconomic Conditions in the Southern Region

Among the 76 provinces in Thailand, the southern region is composed of 14 provinces encompassing a total land area of 1,673 square kilometres with 7.6 million inhabitants as of 1995. The production infrastructure and national wealth are extremely concentrated in the capital region. The nominal Gross Regional Product (GRP) of Bangkok and its vicinity was 50.9 % of the national aggregate in 1994, while the southern region was 8.5 % or 307.5 billion baht. This figure is the average ratio of other regions, excluding the area in and around the capital. In terms of industrial structure, the agricultural sector remains predominantly the largest segment of the region's economic activities, with a 36.0 % share. In the agricultural sector, the main sub-sectors are crops and fisheries which have the greatest share of the sector, each accounting for 47.5 %, and 32.5 %, respectively.

2) Development Strategy of the Southern Region

The main inputs supporting the future economic growth of Thailand are large-scale developments in infrastructure, human development and a steady market supply. The government commissioned a study on the Southern Seaboard Development Plan (SSDP). The overall strategic objectives of the plan were set forth as: (i) Provide additional maritime gateways to the country and establish an active maritime and fishery presence in the Andaman Sea, (ii) Create competitive industrial locations and trade and business centres together with new or upgraded towns to attract foreign investment and create job opportunities, (iii) Promote the development of infrastructure as part of the globalization of Thailand, etc.

(2) Gross Regional Product in the Andaman Area

1) Regional Differences in GRP

The GRP in 1993 was 259 billion baht or 8.2 % of Thailand's total GDP. Per capita GRP in the southern region was 32,000 baht or 60 % of the national average.

The GRP of market prices in 1993 in the Andaman area was 74,857 million baht or 29 % of the southern region. Per capita GRP was 1.4 times greater than the average in the southern region.

2) Role of Fisheries Industry in the Regional Economy

The fishery industry plays an important role in the regional economy of the Andaman area. The fisheries sector comprised 13.1 % of the province's GRP in 1993, in contrast to 1.5 % of the national GRP average and 11.3 % of the GRP for the entire southern area.

(3) Labour Conditions

1) Unemployment Rate

According to 1995 labour and employment statistics of the Department of Labour Protection and Welfare, the unemployment rate was 1.4 % in the southern region, lower than the national average of 3.1 %.

2) Labour Demand

The major source of employment in the Andaman area is the rubber, oil palm and fishery industries. Due to a shortage of Thai labour, many Myanmar people are employed illegally.

(4) Fish Consumption

1) Local Demand in Fish Consumption

The total population of the six provinces in the Andaman area was 1,748,000 in 1993. It is estimated that the fish consumption volume was 44,000 tons annually.

In contrast, the 1993 annual fish production volume was 820,000 tons. The production volume greatly exceeds local demand, excluding fish earmarked for fish meal; and the Andaman area is an important source of fish supply in Thailand.

2) Fish Consumption Demand in the Tourism Industry

Tourism is highly prevalent in the Andaman area; and the number of tourists in 1994 was 262,000 in Trang Province, 659,000 in Krabi and 2.1 million in Phuket Province. Fish consumption by tourists has contributed to the local economy.

2.3. Conditions in Fisheries

2.3.1. Condition of Fisheries in Thailand

(1) Fishing Grounds and Production

Fisheries in Thailand consist of marine fisheries, inland fisheries, and aquaculture. Major Thai fishing grounds are located in and out of Thai territorial waters. Territorial waters of neighbouring countries such as the Arafura Sea in Indonesia, Myanmar territorial waters, etc. are main fishing grounds for Thai fisheries, where fishing is carried out with trawls and purse seines.

The fishing grounds in Thai territorial waters are located in the Gulf of Thailand (304,000 km^2) and the Andaman Sea (116,280 km^2).

Marine capture fisheries are mainly carried out in the Gulf of Thailand. Of the total fish landing volume of 2.752 million tons in 1993, 70 % or 1.93 million tons were landed from the Gulf of Thailand and 30 % or 0.82 million tons were landed from the Andaman Sea.

(2) Fishing Gear

Fisheries in Thailand consist of commercial and small-scale fisheries. Commercial fisheries employ powerful fishing gear such as trawls and purse seines while small-scale fisheries use small traditional fishing gear and methods and operate on a subsistence level. The production volume of small-scale fisheries is about 13 % of the total fish landing volume.

(3) Fishing Season

There are two monsoon seasons in Thailand, the southwest monsoon season between May and October, and the northeast monsoon season between November and April. During the northeast monsoon, the waters of the Gulf of Thailand become rough. In addition, the Nakhon Si Thammarat coastal region located in the centre of the Gulf of Thailand, is closed to fishing due to fish spawning activities and nurseries. Therefore, many commercial fishing boats that are based along the Gulf of Thailand move their fishing grounds to the Andaman Sea during this period.

2.3.2. Fishery Resources

There is still opportunity for future development of some pelagic fish such as spanish mackerel, haretail scads, etc. in the Gulf of Thailand; and it is also possible to increase the yield of pelagic fishery in the Andaman Sea. However, DOF has reported that demersal fish in both the Gulf of Thailand and the Andaman Sea has been overexploited

In contrast, the total landing volume in both the Gulf of Thailand and the Andaman Sea has increased gradually since 1985. These figures reflect the catch from both Thai and outside territorial waters.

Due to a drop in the fish catch from the Gulf of Thailand, many fishing boats have moved their fishing grounds out of Thai territorial waters.

2.3.3. Issues in the Fisheries Sector

The major problems confronting the Thai fisheries sector are (1) fishing agreements with neighbouring countries, (2) insufficient number of crew members, and (3) high price of fuel.

2.3.4. Deep-sea Fishing in the Indian Ocean

(1) Tuna Resources in the Indian Ocean

The production of tuna and tuna-like species in the Western Indian Ocean is nearly three times the catch of the Eastern Indian Ocean, due to a concentration of purse seiners in the west.

According to the Indo-Pacific Tuna Programme (IPTP), resources of small tropical oceanic tunas, skipjack and juvenile yellowfin and bigeye are underexploited in the Eastern Indian Ocean.

IPTP has also commented on the sudden increase of long line fish catches in the Western Indian Ocean suggesting that this fishery could produce more, if fishing effort were to rise. Whether this increased catch is sustainable, however, will presumably be seen in the future, as Indian Ocean coastal countries are becoming increasingly interested in long line fishing.

(2) Tuna Purse Seine Survey by DOF

DOF has carried out tuna fishing surveys in the Andaman Sea and the eastern and western part of the Indian Ocean using the survey vessels, Chulaphorn and Mahidol.

(3) Thai Tuna Oceanic Fishery Cooperatives (TOTFIC)

Under the DOF policy to promote deep-sea fishing, fishermen interested in deep-sea fishing organised a fishermen's group to engage in tuna fishing in the Indian Ocean, known as the Thai Tuna Oceanic Fishery Cooperatives (TOTFIC) in May 1996.

(4) Tuna Fishing in the Indian Ocean by Taiwanese Fishing Boats

The number of Taiwanese tuna fishing boats in the Indian Ocean increased from 185 in 1985 and peaked at 393 in 1990. These fishing boats consisted of mainly large-scale boats of more than 500 tons.

In addition to these large-scale fishing boats, small-scale Taiwanese long liners have operated in the southwestern area of the Java Sea, Sumatra Sea, and the Andaman Sea since 1991. Most of these small boats were based in Singapore or Penang in Malaysia during the initial stages, but some of them have moved their mother port to Phuket. In 1996, 100 long liners were based in Phuket.

(5) Tuna Purse Seine by Japanese Fishing Boats

Japanese purse seiners operate in the eastern area of the Indian Ocean. Japan has the right to operate 11 fishing boats in the Indian Ocean. However, a segment of the purse seiners has moved their fishing grounds to the Pacific Ocean, following an expanded limit on the number of purse seiners in 1996. Therefore, there were only three Japanese purse seiners, including one research vessel, operating in the Indian Ocean in 1996.

2.3.5. Summary of Fishing Activities in the Andaman Sea

(1) Existing Fishing Conditions in the Andaman Sea

1) Main Fishing Grounds in the Andaman Sea

Fishery resources in the Andaman Sea have also been overexploited. As a result, major fishing grounds in the Andaman Sea have expanded to the territories of neighbouring countries such as Myanmar, Malaysia and Indonesia. Some fishing boats also operate in the Indian Ocean.

2) Major Fishing Gear and Fish Production

Otter board trawl and purse seines are the major fishing gear employed in commercial fisheries in the Andaman Sea. Total landings by purse seines increased from 96,525 tons in 1988 to 205,531 tons in 1993 in the Andaman Sea.

The landing volume of otter board trawlers also increased from 175,022 tons in 1988 to 449,475 tons in 1993.

(2) Fish Landing Sites

There are eight main landing sites and only three fishing ports which are managed by FMO along the Andaman seacoast. These fishing ports are located in Ranong, Phuket and Satun.

2.3.6. Condition of Fisheries in Each Province of the Andaman Seacoast

Muang in Ranong Province is the landing site for the largest fish catch volume, with an annual landing volume of more than 150,000 tons. Phuket Fishing Port and Muang in Satung Province are the second largest landing sites with a landing volume of about 60,000 tons annually. These are the three largest fish landing sites along the Andaman seacoast.

The number of fishing boats registered in provinces along the Andaman seacoast has increased. Nearly 3,005 boats or 16.5 % of the total number of boats in Thailand were registered in this area in 1993. However, many fishing boats migrate from the Gulf of Thailand during the northeast monsoon season.

2.3.7. Factors to be Investigated in Selecting a Project Site from a Fishery Standpoint

(1) Influence of Fish Agents and Processing Factories on Fishing Boat Owners

Many fish agents and fish processing factories along the Andaman seacoast own their own fishing boats. In addition, they supply the operation expense, ice, and fuel for more than 50 % of individual fishing boat owners. Fishing boats which are supported by fish agents must land their fish at the fish landing facilities owned by fish agents and use these facilities as their base of operations.

Only few fishing boats are expected to transfer to the new fishing complex independently. Therefore, the number of fish agents and processing factories transferring to the new complex will greatly influence the number of fishing boats which will transfer to the complex.

(2) Possibility of Moving the Fish Landing Site to Other Provinces

The majority of the fish agents along the Andaman seacoast are also engaged in car sales, hotel businesses, livestock farms, etc., in addition to the fishery business. Due to the complexity of their business dealings, it will be difficult for fish agents to transfer only their fishing activities to another province, despite the favourable location of the new fishing complex.

The fishing grounds of boats are located near their mother port. Hence relocating the mother port signifies a change in fishing grounds as well. If only the location of the mother port were to be moved, the distance to their fishing grounds would increase, in addition to operating costs. As a result, relocating the mother port to another province would place fishermen under difficult circumstances.

(3) Fishing Boats That Will Be Attracted to the New Fishery Complex

The type of fishing boat which will be attracted to the new fishery complex is as follows.

- Existing fishing boats within the province of the project site
- Fishing boats which move and operate from the Gulf of Thailand to the Andaman Sea
- Fishing boats which operate in the Indian Ocean

2.4. Fish Marketing and Processing

2.4.1. Summary of the Fish Marketing System in Thailand

There are two types of fish marketing channels in Thailand. One is through fishing ports and fish markets managed by the Fish Marketing Organisation (FMO), a public agency, and the other is through fish agents and processing factories.

(1) Fish Marketing at FMO Fishing Ports and Markets

There are eight fishing ports and three fish markets managed by the FMO in Thailand. The total volume of landed fish in the entire country was 3,400,000 tons (including inland fishery and aquaculture) in 1993. Of this figure, 314,000 tons or about 10 % of the total were unloaded at FMO fishing ports and transported to local retail markets/processing factories, consumption areas, and processing factories outside the local area. Three fish markets are located in Bangkok, and in Samut Prakan and Samut Sakhon in the surrounding areas of Bangkok. The total marketing volume of those markets was 499,000 tons.

Major transactions of fish at FMO fishing ports and markets are carried out through direct consignments and there are few auctions. Transactions at the Bangkok fish market is mainly through auctions and 74 % of the total handling volume at this market was sold through auctions in 1995.

(2) Fish Marketing Through Fish Agents and Processing Factories

Many small and large-scale private jetties exist along the seaboard. Fish unloaded at these private jetties is transported through traders who are also jetty owners, to the local retail markets and processing factories, consumption areas, and processing factories outside the local area.

All transactions at private jetties are direct consignments and there are no auctions.

2.4.2. Summary of Fish Marketing and Fish Processing Industry on the Andaman Seaboard

(1) Fish Marketing

About one half of the volume of landed fresh fish are locally consumed or processed for surimi, or frozen and semidried in local factories at the major fish landing sites, excluding Phuket. The rest is transported to processing factories and fish markets in Songkhla, Hat Yai, Samut Sakhon and Bangkok. A small quantity is transported to processing factories in other provinces on the Andaman seaboard and is also exported overland to Malaysia and Singapore.

Frozen fish processing factories import mackerel from Norway and shrimp from Vietnam and Indonesia through the Songkhla commercial port. They also export their product through Songkhla. Frozen skipjack/tuna unloaded at the Phuket commercial port by Japanese purse seiners are transported overland to processing factories in Songkhla.

In addition, fresh tuna unloaded at the Phuket fishing port by Taiwanese long liners is transported by air to Japan through Phuket International Airport.

(2) Infrastructure Related to Transportation

The major national road network is well developed in southern Thailand. Therefore, fresh fish and processed fish products are transported by insulated and refrigerated trucks in the country.

There are also two commercial ports which serve as international trade bases in Songkhla and Phuket in southern Thailand.

(3) Fish Marketing Facilities

The FMO fishing ports have the concrete wharves/jetties. In contrast, most of the private fish landing facilities have wooden wharves/jetties.

There are many private ice plants at the eight major fish landing sites on the Andaman seaboard and there is only one public plant in Phuket. Ice is sufficient in provinces along the Andaman seaboard, except in Krabi.

All the processing factories, except the fish meal plant, own their own cold storage facility. There is only one public cold storage facility in Phuket which is owned by Cold Storage Organisation (CSO).

There are seven private shipyards on the Andaman seaboard with slipways and workshops for repairing and constructing wooden fishing boats.

(4) Fish Processing Factories

There are more than ten modern fish processing factories, consisting of two canning, two surimi, and six frozen and semidried factories, located around the fish landing sites on the Andaman seacoast. These factories export most of their products and only a small quantity is earmarked for domestic consumption. In contrast, traditional processing factories produce dried fish, fish ball/cracker, fish sauce, etc.

Most of the modern processing factories currently located on the Andaman seacoast face such problems as a shortage of raw materials and labour, similar to factories in Zone 1. As a result, their operational ratio is low (37 to 68 %).

3. INITIAL ENVIRONMENTAL EXAMINATION (IEE) AND SITE SCREENING

Initial environmental evaluation wad conducted with the main objective being to identify the preferred site for the Fisheries Complex, based on biophysical and socio-economic environmental criteria and to set out, in broad terms, the scope of the EIA.

3.1. Description of the Proposed Project

This project, to plan, design and construct a 'Fisheries Complex' (FC), was conceived to meet that objective. It would have to handle the full volume of both the Thai nearshore fleet and foreign (Taiwanese, Korean, Chinese and Japanese) deep sea fishing fleets wanting to process their Andaman Sea and Indian Ocean catches.

Some key operating features of the FC which could have significant impacts on the environment would be:

- fish processing facility for cleaning, freezing and shipping
- shrimp processing (cooking)
- fish processing waste treatment
- ship waste (including bilge and sewage) collection
- ship refuelling
- ship servicing
- access road construction and operation

3.2. Proposed Port Sites and Existing Environmental Conditions

In 1995, the Government of Thailand identified five possible sites for a fisheries complex on the Andaman Sea coast. Brief description of each site follows; focusing on the biophysical and social environmental settings.

(1) Ban Bang Raet (Palian River), Trang Province (Site No.1)

The Palien River site is located at the mouth of the Palien River as is empties into the highly productive. The site is situated in a mangrove forest, within a mangrove conservation area. The bio-physical environment has a good biodiversity including a very productive, estuarine area, as well as a healthy mangrove forest with a full complement of wildlife, primarily birds, herptiles and invertebrates. Water quality in the estuary and near the site is excellent, with very minimal anthropogenic impact.

The estuary has rich seagrass beds, dugong colonies as well as dolphins. This estuary is a highly productive nursery area for many of the fish important to the regional Thai inshore fishery.

(2) **Ban Klua Tai, Trang Province (Site No. 2)**

This site is located in the small village of Ban Klua Tai, on the West shore of the Trang river about 4km downstream of Kantang Town. Various commercial and industrial operations, such as charcoal, rubber and fishmeal production are located from 1.5 - 2.0 km upstream of the village. Generally, the land-side bio-physical environment is highly disturbed with only a few remnants of the natural ecosystem remaining; consisting of small nipa palm stands and tropical rain forest, as well as small mangrove stands. The river, at that location is somewhat contaminated, with sewage and processing waste.

If the complex is located at this site, involuntary resettlement will be necessary causing major changes in traditional lifestyle which may completely reshape this small village's economy and social fabric.

(3) **Pak Meng, Trang Province (Site No.3)**

This site is located in a newly designated national park, Pak Meng village is surrounded to the North and East by second growth mangrove forest and to the South by cleared agricultural lands, including shrimp ponds and rice. This site has a rich bio-diversity, including seagrass beds located South of the village. It is highly likely that dugong colonies exist in the area associated with the seagrass. Water quality in the area appears to be very good and indicates an optimal environment for seagrass production and general marine fertility. Infrastructure at this site is minimal in that power, water and waste management services do not exist. The proposed site is located in a subsistence agricultural and small-scale tourism land use area, with no industrial or commercial enterprises in the vicinity.

(4) **Ban Khao Thong Tai, Krabi Province (Site No. 4)**

The site is located directly on Phang Nga Bay, a sparsely populated shallow bay. The land use in the area is essential agriculture and fishing with about 10 semi-permanent trap nets being operated just off shore by several local families living in Ban Khao Thong Tai, 1.5 km inland. The bio-physical environment, aside from the intrusion by the fishing operations, is pristine, with a small stand of first growth mangrove trees. Visually this area is spectacular, with the skyline being broken up only by the limestone karst islands scattered around the offshore area. Broadly, this area has a rich coastal bio-diversity, ranging from unspoiled coastal tidal flats, to seagrass beds and coral formations in the deeper waters. The proposed site has no services, (aside from a low voltage power line that passes by along the road) or an adequate road system to a transportation gateway. While the immediate site around Ban Khao Thong Tai is not tourist(yet), the general area is a highly valuable tourism zone.

(5) **Phuket Fishing Port (Site No. 5)**

This site is located immediately adjoining the existing Phuket commercial fishing pier in an industrial land use area. The actual site for the facility has been cleared of buildings and vegetation, thus is ready for construction. The cleared land plus the surrounding second growth mangrove stand, is under the control of the Fish Market Organisation. On the West side of the channel are a large number of actively used private fishing jetties. Combined with the government pier's operations, the activity in much of this 'harbour area' is related to fishing.

Such high density of fishing activity, and a total lack of waste management facilities, has lead to a high level of water pollution in the harbour and out into the nearshore area of Phuket Bay. A number of significant biophysical feature exist in the study area. First is a mangrove stand which fringes the East and South sides of the site and, secondly, remnant fringing coral reefs along the small islands in Phuket Bay.In terms of the social and human environment, the only sensitive feature is the sea gypsy village on Cape Tukkae. Given that the site already has heavy truck traffic and must have good power supplies, the infrastructure, in relation to other areas, is quite advanced.

3.3. Probable Environmental Effects

Based on a principally qualitative field survey, the impact of the proposed facility on 37 environmental factors was assessed and a probable impact profile of each site was prepared in Figure 3.1. These two broad groups were further subdivided into the following areas:

Natural Environment -

- ecosystems degradation, soil and erosion, hydrology and water quality, air, noise and odor

Social Environment -

- socio-economics, institutional and local customs, culture and landscape,

3.4. Summary of the IEE/ Site Screening Process

The IEE focused on the analysis and tabulation of results focusing exclusively on the selection of a preferred site, rather then the determination of the need for an EIA.

The assessment of the 37 environmental criteria used in the selection of a preferred site is summarized below for the fisheries complex on environmental grounds.

(1) Ban Bang Raet (Palian River), Trang Province (Site No.1)

This site was ranked as in 5th place as a fishery complex site. This ranking a candidate site for the following environmental reasons:

- This site is located in a coastal mangrove forest classified as a 'conservation' area, and as such the site is deemed to be very significant and totally protected .
- The need to dredge a 3km+ access channel would lead to serious and potentially chronic environmental losses.
- The need to construct a new access road would require involuntary resettlement of people and would inflict permanent changes to the local villages in terms of very significantly increased traffic, noise and air pollution.

(2) Ban Klua Tai, Trang Province (Site No. 2)

The site is ranked 3rd and this ranking was based on the following key environmental reasons.

- 300-400 citizens would have to be resettled and in the process losing the community social structure and their historical identity in Trang Province.
- A major and costly road construction work would require taking of agricultural lands and the likely displacement of people.

(3) **Pak Meng, Trang Province (Site No.3)**

This site was ranked 2nd as a fishery complex site. This ranking was based on the following key environmental reasons:

- This site is in a national park and as such, park policies do not allow development other then that designed to improve the park's function.
- The construction and maintenance of a long and deep access channel and/or causeway could have drastic effects on nearshore fish distribution and production.
- Pak Meng beach area would be in real danger of being fouled by accidental spills.
- The access channel and/or causeway would cut across seagrass beds as well as known dugong travel routes, interfering with these two nationally protected environmental features.
- Pak Meng would be in serious jeopardy of being completely destabilized by the influence of this large fishing complex.

(4) **Ban Khao Thong Tai, Krabi Province (Site No. 4)**

This site was ranked in 5th place as a fishery complex site. This ranking was based on the following key environmental reasons.

- The massive dredging and/or causeway construction would irreparably degrade this area
- Both seagrass bed and dugong are present in this area and any permanent disturbance, such as from a fishing port, would most certainly extirpate the dugong.
- Accidents are bound to happen and thus the risk of severe degradation of the exceptionally clean natural ecosystem and the economically robust, and growing, tourism industry from oil spills, bilge discharges and sewage/garbage dumping.

(5) **Phuket Fishing Port (Site No. 5)**

Phuket is considered the best location for the fishery complex for both bio-physical and socio-economic reasons.

- The area has been extensively disturbed and dredged. The development of a fishery complex would only help to clean up the area, providing waste treatment and proper handling of catch, reducing the spoilage rate and increasing profits to the fishermen.
- The mangrove forest is under the control of the Phuket fishing Port and is such, clearing of this area is not restricted.
- There appear to be no significant negative socio-economic impacts other then from the access road construction.

3.5. Conclusions

Based on the evaluation of 37 environmental criteria at five possible sites for the fishery complex, Phuket is clearly the first choice on environmental grounds. A distant second choice would be Pak Meng, Trang Province, followed by Ban Klua Tai, Bab Bang Raet and finally the Ban Khao Thong Tai in Krabi Province.

4. SELECTION OF PROJECT SITE

4.1. Proposed Project Site

On the basis of Scope of Work on August 10th, 1995, the Study Team made visits to the five locations of (1) Right bank of Palian River (Ban Don Khiam) in Trang, (2) Right bank of Mae Nam Trang (Ban Na Klua Tai) in Trang, (3) Pak Meng in Trang, (4) Ban Khao Thong in Krabi and (5) Fishing Port in Phuket. In addition to the proposed locations, the team was recommended, for the team's understanding on the fishery activities on the Andaman Sea coast, to visit (6) Ranong, (7) Kuraburi, (8) Takua Pa, (9) Tapu Lamu, (10) Thai Muang, (11) Langu and (12) Satun.

The Team made reconnaissance of the twelve locations as above and reviewed the situation at each location from viewpoints of fishery, social economy, and engineering.

Through discussion with DOF on the basis of results of the reconnaissance, the study focuses on the five locations from (1) to (5) for selection of the project site.

4.2. Criteria for its Selection

The fundamental concept of the fishery complex is conceived to be promotion of the fishing activities by:

- Thai nearshore boats in the Andaman Sea, and
- Deep-sea fishing vessels from Thailand to be newly purchased plus foreign countries in the Andaman Sea and Indian Ocean.

The concept is expected to cover the ideal scale of facilities for fisheries industry such as fish processing and annexed facilities.

In examining the locations on the basis of criteria, the project concept mentioned as above will be employed. The criteria for selecting the project site are proposed on the basis of the aspects from planning and engineering, and the aspects from fishery and environment at each location.

(1) Planning Aspects

- Area for flexible layout of necessary facilities
- Safe Manoeuvring of Fishing Vessels
- Functional layout of the facilities
- Utilities (Electricity, Water Supply, Sewerage)
- Easy to Supplying Water for Processing and Cleaning Fish Landing lace.
- Completed or Available to Supply of Electricity.

(2) Engineering Aspects

- Soil characteristics and topographic features for land reclamation
- Marine conditions (Waves)
- Sedimentaion in channels and baisns

(3) Fishery Aspects

- Number of existing fishing boats and fish agents

- Distance to fishing grounds
- Conditions of transportation.
- Available Human Resources for Processing Plants and Related Facilities.

(4) **Environmental Aspects**

- Ecosystem degradation
- Hydrology and Water Quality
- Air, Noise and Odor
- Socio- Economic Destabilization
- Changes to Institutional and Local Customs
- Changes to Culture and Landscape

4.3. Evaluation of Proposed Locations

For identification of the project site, the proposed locations in the three provinces are evaluated on the assumption of landing fish catch as 100,000 ton. The five proposed locations are ranked with giving marks of three grades of 1, 2 and 3 which presents "most desirable", "desirable" and "least desirable" respectively. They are evaluated relatively on each criterion among the said locations.

Examining the results, the locations of No.1, No.2 and No.4 are ranked low. Pak Meng and Phuket mark competitive scores. Key criteria which leads to the evaluation result are land area for the FC and environment. In Phuket, insufficient area in the proposed site might impede proper layout of the FC but there might exist few serious impacts to the environment. In Pak Meng, sufficient area might be available for ideal layout of the FC but impacts to ecosystem might be concerned in operation of the FC.

Conservation of natural resources and enviornment is one of the most important issues, which should be considered regionally and internationally with top priority. In spite of advantage of Pak Meng in planning, the above comprehensive consideration leads the conclusion that Phuket Fishing Port, with expanding project area to the outside of the canal, is identified as the project site.

5. MASTER PLAN FOR FISHERY COMPLEX

5.1. Present Conditions and Future Projections

5.1.1. Socioeconomic Conditions in the Phuket and Phang-nga Provinces

Phuket has made steady and substantial economic progress during the period of 1990 to 1994. The nominal GRP in 1994 was Bt. 20.1 billion with an average annual growth rate of 7.7 %, and a per capita GRP of Bt. 108,652. The service industry, which is made up mainly tourism, was the largest industry and it comprised 24.6 % of the Gross Provincial Products (GPP). The agricultural sector was the second largest sector and formed 17.3 % of the GPP. The fishery sector comprised 69.9 % of the primary industry, and formed 11.9 % of the GPP.

5.1.2. Fisheries Sector

(1) Fisheries Sector in Phuket Province

1) Fish Landing Sites in Phuket

There are three landing sites for commercial fisheries in Phuket Province. The largest landing site is Phuket Fishing Port located between Phuket Island and Siri Island, and the other are small-scale landing sites. The Phuket Fishing Port is composed of the FMO Fishing Port located on the Sire Island side; and the private landing facilities are located along Phuket Island. Fishing boats from other provinces sell their fish catch mainly to fish agents at the FMO Fishing Port. In order to resolve the congestion, the wharf and mooring space at the FMO Fishing Port were expanded in 1996.

Japanese purse seiners which operate in the eastern area of the Indian Ocean, unload their catch at the Phuket Commercial Port located in the southern part of Phuket.

2) Fishing Grounds and Fish Production

The major fishing grounds at Phuket are off the coast of Phuket to Ranong (border of Myanmar) and Myanmar waters. In addition, some fish agents dispatch their own boats to the Indian Ocean, Malaka Straits, etc.

The landing volume at Phuket decreased from 81,379 tons in 1988 to 63,832 tons in 1993. This was caused by a decrease in trash fish from 49,490 tons to 19,760 tons. In contrast, the landing volume of commercial fish increased from 29,869 tons to 37,187 tons.

3) Main Fishing Methods

Commercial fisheries employ trawls, purse seines, and long lines.

4) Number of Fishermen and Fishing Boats

There were 1,986 fishermen and employees in Phuket province in 1995. There were 431 boats registered in 1994, of which 104 were otter board trawlers and 45 were purse seiners.

As mentioned above, the main fishing grounds are off the coast of Phuket and Myanmar territorial waters for boats based in Phuket. However, the number of boats has decreased in recent years due to the closure of Myanmar territorial waters, damages incurred from the typhoon in Bangladesh, the transfer of fishing boats to Ranong following infrastructural improvements of the Ranong FMO Port, etc.

(2) Phuket FMO Fishing Port

1) Landing Volume

The annual landing volume at the FMO Fishing Port decreased from a peak of 39,343 tons in 1989 to 24,558 tons in 1994. This is mainly attributed to a decrease in the landing volume of trash fish. The landing volume of commercial fish fluctuated between 25,000 to 30,000 tons in 1988 to 1994.

(3) Number and Capacity of Fishing Boats

1) Number Fishing Boats According to Fishing Methods

According to the result of the field survey, there were 93 trawlers, 35 purse seiners, and 71 long liners (53 Taiwanese and 18 Chinese boats) utilising the FMO Fishing Port in June 1996.

The largest number of fishing boats using the FMO Fishing Port in one day was 38 boats in 1994, 43 boats in 1995, and 48 boats from January to May in 1996. Most of these boats were purse seiners.

2) Capacity of Fishing Boats

The capacity of Thai fishing boats which use Phuket FMO Port are mainly 46 to 60 tons. Nearly one half of the long liners were Taiwanese boats in the 30 to 40 ton class, but six 70 ton class fishing boats were also registered. In contrast, Chinese long line boats were in the 170 ton class and larger than Taiwanese vessels.

5.1.3. Projected Landing Volume and Number of Boats

(1) Development Potential in the Indian Ocean

Purse seine fishing will target skipjack and yellowfin, and long line fishing will target yellowfin and bigeye in the Project. Fishery resources should not be exploited higher than the MSY level for sustainable development. Existing studies have indicated the possibility of developing skipjack and yellowfin stock in the Indian Ocean.

(2) Development Potential in the Andaman Sea

Fishery experts have indicated that developing fisheries on the continental shelf without a knowledge of its resource conditions would cause an overexploitation of whole resources in the Andaman Sea. As a result, production volume will be kept at existing levels in view of resource conditions and development plan.

(3) Projection of Fisheries in Phuket

1) Introduction of Stock Management for Offshore Fishing

Fishery resources have been overexploited, and CPUE (per hour) has decreased both in the Gulf of Thailand and the Andaman Sea. Although development of offshore fisheries in Phuket also has ended, the introduction of fisheries based on resource management is under consideration. FMO and DOF must manage the fishery industry to foster and conserve fishery resources, and to introduce resource management for sustainable development in order to maintain present levels.

2) Conversion of Present Fishing Methods to Tuna fishing in the Open Sea

The objectives of the Project are to develop not only coastal fisheries in the Andaman Sea, but also tuna fishing in the Indian Ocean. In order to achieve development of the latter, TOTFIC was established to investigate the potential for tuna and skipjack purse seine fishing outside Thai territorial waters.

Thai fishermen have become interested in tuna long line fishing in recent years, with the intention of operating the joint ventures with Taiwanese fish agents. Taiwanese and Chinese fish agents have begun technical transfers of tuna long line fishing and started test operations by Thai fishermen since the end of 1996. Tuna fishing is expected to play an important role in the prospective development of Thai fishing based at the Phuket Fishing Port.

(4) Projection of Fishing Boats in Phuket

1) Fishing Boats in Offshore Fisheries

In view of the existing circumstances, it is not likely that there will be an increased number of fishing boats from other provinces or new investments in fisheries which will increase the number of fishing boats in Phuket Province. It was concluded that the number of trawlers and purse seiners at the FMO Fishing Port was currently at maximum and that any new boats in future would simply be the replacement of depreciated boats.

2) Number of Long Liners

Taiwanese long liners have shifted their base port from Singapore to Penang in Malaysia, and then to Phuket in pursuit of convenient short cuts to fishing grounds in the Indian Ocean. Of these three ports, the FMO Fishing Port in Phuket is the nearest to the fishing grounds, and there are daily direct flights to Japan, the consumer site, from Phuket international airport. Therefore, long liners that are based in other ports would be attracted to the FMO Fishing Port in Phuket, if it is developed and expanded.

With the introduction of Chinese long liners in 1996, there has been a shift from Taiwanese to Chinese boats. There were 100 long liners, composed of 75 Chinese boats and 25 Taiwanese boats at the end of 1996. Local fish agents are presently planning to double the number of contracted boats in 1997.

However, local fish agents constructed the private jetty along Phuket Island for 70 long liners at the end of 1996, due to the small-scale and the congested conditions at the FMO Fishing Port . Based on these circumstances, it is estimated that about 200 long line vessels will be utilising Phuket port as a base by the short-term target year of 2002. Of this figure, 130 fishing boats are anticipated to use the FMO Fishing Port and the remaining 70 will use the private jetty on the opposite bank.

It is estimated that the number of long liners will increase to about 300 in 2012 since there is a high possibility that Taiwanese boats will transfer their base port from Penang to Phuket following improvements to the FMO Port.

Conversely, many Thai fishermen have become interested in tuna long line fishing due to the success of Taiwanese and Chinese long liners. A Thai long liner has carried out test operations since the end of 1996.

3) Number of Tuna Purse Seines

Currently, TOTFIC is promoting tuna purse seine fisheries in the Indian Ocean, and it has drawn up a plan to purchase three purse seiners. Rapid development of tuna purse seine fisheries in Thailand is viewed as difficult, due to the high initial investment cost. TOTFIC's plan is to purchase one purse seiner by 2002. It also will be able to purchase another two boats by 2012, if the operation of first boat is successful.

There are presently two Japanese purse seiners operating in the Indian Ocean which are expected to continue their activities.

(5) Projection of Fish Landing Volume in Phuket

1) Landing Volume of Offshore Fisheries

The landing volume of offshore fisheries is not anticipated to increase rapidly since the industry has been adequately modernised and motorised, and fishery resources have been overexploited. The fish landing volume of trawlers and purse seiners at the FMO Port will be limited to the existing volume (62,000 tons) for the next ten years, despite the introduction of fisheries based on resource management.

2) Landing Volume of Tuna Long Line Fishing in the Indian Ocean

The annual landing volume of a tuna long liner is estimated at 133 tons per boat, of which 80 tons are exported.

Approximately 200 fishing boats are expected to be in operation in 2002, and the annual fish landing volume of tuna long liners is estimated at 26,600 tons, of which 15,960 tons will be exported.

3) Landing Volume of Tuna Purse Seiners in the Indian Ocean

The annual fish landing volume of one Thai purse seiner is estimated at 2,880 tons, based on the results of the trial operation of the DOF research vessel.

In contrast, the current annual fishing landing volume of a Japanese purse seiner was 4,950 tons.

4) Projected Total Fish Landing Volume in 2002 and 2012

Based on the projections described above, the number of fishing boats and their landing volume was estimated. The estimations are shown below.

a. Number of fishing boats

- The number of existing fishing boats is not expected to increase.
- About 70 foreign tuna long line fishing vessels are anticipated to use the new private jetty on the bank opposite to the FMO Fishing Port that was under construction at the end of 1996. These boats are expected to continue using this jetty in future and they will not use the FMO Fishing Port.

b. Landing volume on the FMO Fishing Port and Private Facilities

The estimated landing volume at the Phuket FMO Fishing Port is 92,070 tons in 2002, 95,660 tons in 2005, and 111,130 tons in 2012. Conversely, the estimated landing volumes of the private facilities are 9,310 tons for each year.

The estimated total landing volume for Phuket Fishing Port is 101,380 tons in 2002 and 120,440 tons in 2012.

The estimated landing volume for the Phuket FMO Fishing Port is 92,070 tons in 2002 and 111,130 tons in 2012.

The estimated landing volume for the FMO Fishing Port and private facilities are shown in the table below.

Table 5.1.3 (1) Number of Fishing Boats Unloading Fish at Phuket (2002,2005,2012)

Type of Fishing Boats	FLV (ton/year/boat)	2002		2005		2012	
		N (Boat)	V (ton/year)	N (Boat)	V (ton/year)	N (Boat)	V (ton/year)
Off Shore Fishing	1,348	46	62,000	46	62,000	46	62,000
Tuna Long Line							
China Taiwan	133	80	10,640	95	12,640	130	17,290
Thai	133	50	6,650	62	8,240	100	13,300
Tuna Purse Seine							
Japan	4,950	2	9,900	2	9,900	2	9,900
Thai	2,880	1	2,880	1	2,880	3	8,640
Total		179	92,070	206	95,660	281	111,130

Remark FLV ; Fish landing volume(ton/year/boat)
N ; Number of fishing boat
V ; Total fish landing volume(ton/year)

Table 5.1.3 (2) Fish Landing Volume at FMO Fishing Port in Phuket (2002,2005,2012)

Type of Fishing Boats	FLV (ton/year/boat)	2002		2005		2012	
		N (Boat)	V (ton/year)	N (Boat)	V (ton/year)	N (Boat)	V (ton/year)
Off Shore Fishing	1,348	0	0	0	0	0	0
Tuna Long Line							
China Taiwan	133	70	9,310	70	9,310	70	9,310
Thai	133	0	0	0	0	0	0
Tuna Purse Seine							
Japan	4,950	0	0	0	0	0	0
Thai	2,880	0	0	0	0	0	0
Total		70	9,310	70	9,310	70	9,310

Remark FLV ; Fish landing volume(ton/year/boat)
N ; Number of fishing boat
V ; Total fish landing volume(ton/year)

5.1.4. Fish Marketing and Processing

(1) Present Condition of Fish Marketing and Processing at the Project Site

1) Fish Agent

There are eighteen fish agents in Phuket and ten of them are engaged in business at the FMO Fishing Port. The remaining agents operate on the opposite side of the FMO Fishing Port.

2) Fish Transaction System

All fish landed on Phuket Fishing Port are transacted through fish agents. Transactions at private jetties are all carried out through direct consignments. Transactions at the FMO market are conducted through direct consignments and auctions. However, the number of transactions carried out through direct consignments is higher than transactions made through auctions.

3) Fish Marketing Volume and Destination of Fish

In 1994, 24,000 tons of fresh fish were unloaded at the FMO Fishing Port. Of this volume, 16 % were consumed locally and the remainder was transported out of the province. Major destinations outside the province were the FMO market and processing factories in Samut Sakhon and Bangkok. Their share was 27 % to Samut Sakhon and 26 % to Bangkok. The remaining 19 % was transported to Hat Yai / Songkhla and 12 % was sent to Phang-nga, Krabi and Trang. Some fresh fish was exported to Malaysia and Singapore, but the volume was quite small.

In addition to this fresh fish, frozen skipjack/tuna which was unloaded at the commercial port were transported to processing factories in Songkhla. This volume was 14,000 tons in 1995.

Fresh tuna which was also landed at the Phuket Commercial Port by Taiwanese and Chinese long liners, was transported by air from Phuket International Airport to Japan through fish agents. This volume was about 500 tons in 1995 which rose to about 1,300 tons in 1996.

4) Fish Transport System

Fish is transported by air or land from Phuket. Fresh tuna is transported by air from Phuket International Air Port to the Japanese market. Most of the fish agents own their insulated/refrigerated trucks. There are several transporters in Phuket, but their operations are limited.

5.2. NATURAL CONDITIONS AT PROJECT SITE

5.2.1. Meteorology

Southern Thailand is situated in the torrid zone and affected by the two tropical monsoon seasons as south-west (SW) monsoon and north-east (NE) monsoon season.

(1) Temperature

Mean temperature is 28.1 Celsius, mean maximum temperature is 31.8 Celsius, and mean minimum temperature is 24.1 Celsius.

(2) **Relative Humidity**

Mean maximum relative humidity is constantly from 85 % to 93 %,

(3) **Rainfall**

At Phuket, mean rainfall records have been little in the NE monsoon season as between 20 mm and 60 mm. However, mean rainfall in the SW monsoon season was in the range from 200 mm to 400 mm.

(4) **Wind**

Significant winds blow in the direction of west in the SW monsoon season and NE or E in the NW monsoon season. Frequency passing southern Thailand is low as 4 typhoons per year as average.

5.2.2. Marine Conditions

(1) **Tides**

The area on the Andaman Sea coast has high tidal range up to 2.44 m during a spring tide. Highest High Water Level is 4.0 m above the chart datum.

(2) **Wave**

According the continuous wave measurement for 5 months from June in 1996, 80 % of measured waves is less than 0.3 m and wave periods between 7 and 10 seconds are predominant. The record shows that mean values of $H_{1/3}$ varies from 0.14 to 0.26 m and swells are recorded as mean values of $T_{1/3}$ from 8.12 to 13.85 seconds.

Wave hindcasting was conducted to obtain statistical wave data for the design. The following table indicates the wave data.

Table 5.2.2 Offshore Wave Height for Return Period

	10-year return period	30-year return period
Waves from SW monsoon	3.8 m	4.0 m
Waves from NE monsoon	0.7 m	0.9 m

(3) **Sampling and Analysis of Seabed Material**

Seabed material is of fine sandy silt and movement direction of seabed material is mainly from south to north.

5.2.3. Earthquakes

(1) **Outline of Earthquakes in Thailand**

The epicentres of tremors felt in Thailand are concentrated in regions of active faults in the northern Thailand. It also be concerned that the epicentres are not identified in the southern Thailand. Phuket in southern Thailand is categorised in Zone 1.

(2) **Seismic Coefficient**

Horizontal seismic coefficient (Kh) in this project is determined to be 0.05.

5.3. Relocation of Fish Processing Factories

5.3.1. National Policy on Relocation of Factories

(1) Government Incentives for Factories to Relocate

The Seventh National Economic and Social Development Plan was prepared by the Government of Thailand with several major objectives, one of which was to redistribute income and regional development. Based on this objective, the Government of Thailand initiated a policy to relocate processing factories from the surrounding area of Bangkok to other regions, in order to promote environmental conservation around Bangkok and to resolve the regional disparities between urban and rural areas.

A Board of Investment (BOI) Notification on investment incentives were announced in 1993. BOI divided the country into three zones and enacted a policy of tax exemption privileges for firms investing in that zone. An outline of the three zones are given below.

Zone 1	Bangkok, Samut Pracan, Samut Sakhon, Pathum Thani, Nonthaburi, Nakhon Pathom.
Zone 2	Ten provinces around Zone 1 such as Samut Songkhram, Kanchanaburi, Ang thong, Saraburi, etc.
Zone 3	Southern, northern, northeastern, eastern parts of Thailand and Laem Chabang Industrial Estate, excluding Zone 1 and 2.

(2) Present Status of Industrial Zone Development

Industrial zones in Thailand have developed rapidly due to energetic investments since 1987. At present, there are 52 industrial zones, including those under construction.

There are two types of industrial zone developers. One is the Industrial Estate of Thailand (IEAT) under the Ministry of Industry and the other is private firms.

On the other hand, there are also two categories of industrial zone use. One is the General Industrial Zone (GIZ) and the other is the Export Processing Zone (EPZ). General industry firms are found in the GIZ and firms which export more than 80 percent of their products are placed in the EPZ.

In actuality, the majority of the industrial zones are either GIZ or a combined form of GIZ/EPZ and there are few zones that are exclusively EPZ. The industrial zones are operated and managed by IEAT or a private firm.

Most of the private industrial zones developed recently are joint projects with IEAT in the planning, construction and operation of these zones.

Industries operating in an IEAT industrial estate receive various privileges such as the one-station service (one central point for submitting and receiving notifications and approvals).

In addition, firms operating in an export processing area (EPZ) are granted various exemptions.

Industrial zones in the southern part of Thailand were developed and constructed as part of the Southern Sea Board Development Project. But there is only one industrial zone with an EPZ in Songkhla. Fish processors are an export industry. Therefore, industrial zones with an EPZ for factories relocating from Zone 1 need to be developed and constructed.

5.3.2. Outline of Fish Processing Industry

(1) Processing Industry and Raw Material Demand

The fish processing industry in Thailand is comprised of the modern canning and frozen food processing industry which aim at exportation and the traditional processing industry manufacturing fish sauce and salted/dried fish.

The number of salted/dried fish processing factories has maintained an overwhelming majority from 1985 to 1993, but their numbers have been decreasing annually. In contrast, the number of frozen, canned, and fish meal factories have gradually increased.

The raw materials for processing are mainly used for domestic fishery products. However, processing and re-exporting imported raw materials have been the recent trend, due to an increment in raw material demand in the aftermath of rapid development in the modern processing industry.

There were 1,370,000 tons or 42 percent of the total processing materials of 3,280,000 tons which was used by fish meal factories in 1993. Canning and frozen fish industries processed 30 percent and 25 percent of the total raw materials, respectively.

(2) Present Status of Frozen Fish Industry

The frozen fish industry is representative of the processing industries targeting exportation, and its major source of raw materials are shrimp, squid and white meat fish.

The production volume of frozen shrimp increased from 127,877 tons in 1989 to 243,858 tons in 1993, due to the development of black tiger (*penaeusu monodon*) culture. In contrast, raw materials of other frozen products have to be imported due to difficulty in securing local materials as a result of decreased fishery resources.

There were 129 frozen fish factories registered in Thailand in 1993; and 834,000 tons of raw materials were consumed by these factories. Frozen fish factories in Thailand are concentrated in Samut Prakan, Samut Sakhon in the suburbs of Bangkok, and Songkhla. More than 60 percent of the total volume of raw materials were processed in these three provinces in 1993.

(3) Present Status of Canned Fish Industry

The production of the canned fish has continued to increase steadily, and it has more or less maintained a production volume of 400,000 tons since 1990. The export volume of canned fish increased from 140,000 tons in 1985 to 410,000 tons in 1993. Export value also increased from US$285 million in 1985 to US$1,205 million in 1993. About 60 percent of this value was comprised of canned tuna or skipjack.

There are 52 canning factories in Thailand and their total production volume is 580,000 tons/year. However, their operational ratio is low because of a shortage of raw materials.

Nearly 80 to 90 percent of the raw material supply for canned tuna factories is imported.

The world production volume of canned skip jack/tuna steadily increased from 800,000 tons in 1985 to 1,100,000 tons in 1989 and stabilised at 1,100,000 to 1,200,000 tons since 1989. Canned skip jack/tuna produced in Thailand are mostly exported to foreign countries such as the USA and EU. The production volume in Thailand increased from 90,000 tons in 1985 to 230,000 tons in 1989. Exported canned tuna remained stable at about 230,000 tons from 1989 to 1995, with the exception of the two year period from 1991 to 1994 (270,000 tons to 280,000 tons).

(4) Present Status of Fish Processing Factories in Zone 1

1) Number of Factories According to Type of Processing

In 1996, there were 115 fish processing factories that were members of the Thai Food Processor's Association (TFPA) and the Thai Frozen Food Association (TFFA) in Zone 1. They consisted of 43 canneries and 72 frozen food processing factories. Few factories processed only one single species.

These 43 canneries were composed of 19 skipjack/tuna canneries and 24 marine product factories.

2) Problems in Fish Processing Industry

The fish processing industry developed under a system of inexpensive and stable supply of raw materials, low labour costs, and a sufficient supply of manpower. However, it has become difficult to secure low priced domestic materials in recent years because of deteriorating fishery resources. Moreover, the fish processing industry in Thailand is facing a turning point because of the high cost of labour brought on by the development of industries.

Fish processing factories in Zone 1 presently face many problems. The major problems are as follows.

- Shortage of raw materials
- Shortage of manpower and a shift of human resources to other industries such as electronics
- High labour cost
- Low international market price
- Low quality of raw materials
- Traffic congestion of the surrounding area
- Unloading and loading port congestion

5.3.3. Estimated Fish Processing Factories Attracted to New Fishery Complex

(1) Selection of Processing Industry Targeted in the Project

One of the objectives of the Project is to construct a export processing zone as a part of the fishery complex in order to resolve the issues of high labour cost, securing manpower, environmental problems, and to give firms a competitive edge by developing an efficient operational system.

The processing industries targeted by the Project are frozen and canning factories.

The raw material used in the frozen food industry are mainly fish/shellfish landed domestically, whereas the canned skipjack/tuna industry imports 70 to 80 percent of its raw materials.

Major raw materials of the frozen food industry are shrimp and squid. The supply and demand of these materials in the coastal zones is balanced. Therefore, if frozen food processing factories located in the surrounding area of Bangkok move to southern Thailand, the balance in the supply and demand will be destroyed and additional expenses will be necessary to procure raw materials and transportation. Therefore, frozen food companies are not considered suitable targets for the Project.

In contrast, the canned skipjack/tuna industry relies on imported raw material. Therefore, they are able to relocate more easily than frozen food industries if a fishing port is constructed as a landing base for raw materials from the Indian Ocean.

The canned skipjack/tuna industries are able to decrease transport costs for raw materials and easier to secure labour than Bangkok by the relocation to Phuket Fishing Port. The minimum daily labour wage is B145 in Phuket as same as Bangkok, even Phuket is categorised Zone 3. However, daily labour cost which is composed of minimum daily labour wage and allowance such as transportation fee, accommodation, etc., is decreased from B230 in Bangkok to B200 in Phuket, due to the allowance is cheaper than it in Bangkok. These decrease of costs are in accord with the objective of fostering a competitive edge in the international market.

Therefore, the canned skipjack/tuna factories located in metropolitan Bangkok and its surrounding area should be targeted for relocation to the fishery complex.

(2) Incentives for Canning Factories in Zone 1 to Relocate to Phuket

Processing factories will receive the following benefits by relocating from Zone 1 to the Project site in Phuket.

Table 5.3.3 Expected Benefits in Relocating Processing Factories

Items	No Relocation	Relocation
Supply of raw materials from Indian Ocean	Far from fishing ground to fish landing site.	Near fishing grounds and fish landing site. Therefore, purchase price of raw material is cheaper because of lower transport cost.
Cost of land transport	Far from fish landing site to factory, and from factory to shipping port	Near fish landing site to factory and from factory to shipping port, resulting in lower transport costs.
Labour cost	B230 person/day	B200 person/day
Securing labour	Difficult.	Easy in comparison to Zone 1.
Infrastructure	There is little to choose between both.	
Incentives by the Government		
BOI Privileges	End of tax exemption benefits	Will receive tax exemption benefits
IFCT Privileges	–	Will be funded for relocation at an interest lower than that of commercial banks
Area to be located	Some factories do not locate to EPZ.	Will be authorised as EPZ.

(3) Tuna Canning Factories Attracted to the Fishery Complex

1) Import Volume of Skipjack/Tuna by Canning Factories According to Production Area and Fishing Grounds

The raw materials of canned skipjack/tuna factories are imported through importers from the western Pacific Ocean and the Indian Ocean to Bangkok and Songkhla by refrigerated carrier vessels. The total import volume was 407,000 tons in 1993. Approximately 290,000 tons or 71 percent of the total import volume were imported from the western Pacific Ocean and 101,000 tons or 25 percent were imported from the Indian Ocean. The remaining 70,300 tons or 4 percent were imported from other areas such as the Atlantic Ocean.

2) Processing Volume of Potential and Relocated Canning Factories

When the fishery complex is constructed in Phuket, skipjack/tuna from the Indian Ocean will be transported by reefer and unloaded at Phuket. Therefore, processing factories relocating from Zone 1 to Phuket will be close to the fishing grounds and given priority to use 101,000 tons of skipjack/tuna from the Indian Ocean. Therefore, it is assumed that the total capacity of processing factories relocating to the fishery complex will be the entire 101,000 tons.

(4) Number of Processing Factories to be Relocated

The total volume of raw material which will be processed by relocated factories is estimated at 101,000 tons of skip jack/tuna from the Indian Ocean. If the relocated factory processes 40 tons/day of raw material, operating 300 days per year, the production capacity will be 12,000 tons annually. Therefore, eight factories will relocate due to the incentive of a readily available supply of raw material.

5.4. Master Plan for Fishery Complex

5.4.1. Planning Concept

(1) Concept for Fishery Complex Development

Fishery Complex Project (FC) aims at achieving objectives to develop Thai fishery in the Andaman Sea and Indian Ocean, and to promote fish processing industry, principal industry in Thailand.

1) Development of Fishing Port

The yields of fish catch in the Thai waters have been decreasing in spite of increase of fishing efforts. The tendency leads Thai fishery to necessity of stock control and development of new fishing grounds for sustainable fishing in the Thai waters of Andaman Sea and Indian Ocean. Fishery Complex Project will be to develop Phuket Fishing Port as a pilot fishing port for future fishery development. The Fishery Complex is expected to supply raw material to fish processing plants in Phuket and other provinces and to export fresh tuna by long line fishing to the international market(mainly in Japan) by air.

The development plan will be established with the following concept.

a. Introduction of Stock Management

The project will provide facilities and system to manage fishery operation with acquiring accurate information on fish catch volume, species, fishing ground, etc.

b. Development of Tuna Long Line Fishing

Phuket Fishing Port under the Project is expected to play a role of not only a home port for long liners but a pilot fishing port which will promote tuna long line fishing for Thai fishing boats.

c. Promotion of Purse Seine Fishing

The Fishery Complex Project will provide a landing station, the most convenient fishing port in Indian Ocean, for not only Thai purse seiners but foreign fishing and carrier vessels.

2) Promotion of Fishery Processing Industry

The Fishery Complex Project will help promotion of the policies to transfer fishery processing plants neighbouring Bangkok to southern Thailand. Implementation of the project will enable to supply reasonable raw material to the plants. The products will be distributed in the local market and exported to the international market.

3) Encouragement to Tourism Industry

Fishery industry plays a role of supporting tourism industry in Phuket and implementing the Project will be an opportunity for the fishing port to be a tourism spot.

(2) Strategies for the Master Plan

The strategies for development of Fishery Complex will be considered as below, for reflecting the basic concept for the Project as mentioned in the previous sub-section.

1) **Expansion of Development Room and Efficient Utilization of Land**

The berth for large purse seiners will be constructed outside the canal because of its narrow waters against ship's sizes. Layout of facilities should be planned with utilizing the limited area designated as an industrial zone.

2) **Cetralization of Fishing Port Management for Stock Control**

In introducing stock control system for the existing fishing, fishing port management to control all activities in the port is required for sustainable fishing development. The FC aims at preparing necessary facilities for the said function.

3) **Provision of Exclusive Berths and Separation of Berth Functions**

For improving handling efficiency and keeping freshness of fish, exclusive berths will be provided to meet the ways for handling fish. The FC will provide exclusive landing wharves being expected to improve landing efficiency and exclusive wharves for lay-by and preparation.

4) **Provision of Landing Facility for Tuna Purse Seine Operated by a Cooperative**

The FC is expected to support the purse seine fishing and to make provision of a landing facility for larger purse seiners. The facility is also expected to play a role to accommodate reefer carrier vessels

5) **Provision of Facilities for Keeping Fish Freshness Corresponding Landing Volume**

The necessary capacity of cold rooms and ice making facilities will be provided to keep freshness of fish in the scope of the Project.

6) **Redevelopment of Project Site and Improvement of Environment**

The Project will promote redevelopment of the zone to efficiently use the shore lines and land where fish meal plants exist. Implementation of the Project is expected to improve and/or preserve environment of the Industrial Zone.

7) **Cooperative Promotion with City Planning**

The mutual activation by the coexistence for fishery and tourism industry will be considered with utilizing the room for development.

(3) Optimization of Investment Size and Timing

Appropriate phasing for investment will be planned without investment centralization to a phase and excessive advance investment.

5.4.2. Scope and Size of Project Facilities

(1) Basic Facilities of the Fishery Complex

1) **Mooring Facilities**

Fishing operated in Phuket Fishing Port is classified in the three categories: 1) Existing Thai style fishing , 2) Tuna long line fishing and 3) Tuna purse seine fishing with large purse seiners.

Scale of the facilities is listed below:

Table 5.4.2(1) Scale of Berthing Facilites

	Landing Wharf	Lay-by Wharf
Wharf for Existing Boats	155 m	320 m
Wharf for Long Liners	180 m	
Deep-sea Wharf	210 m	-

2) **Channels and Basins**

a. **Design ship**

The same ships, as stated in the above, as Mahidol and the reefer carrier vessel of 5000GRT are applied for design the channel and basin.

b. **Approach channel**

. Layout of the approach channel

The existing channel will be utilized as much as possible to reduce dredging costs. Two layout plans are proposed along the existing. Appropriate layout will be proposed with examining the siltation volume in the sub-section 6.3.3.

. Width of the channel

Width of the channel is determined to be 100 m, equivalent with about 6 times of breadth of the design carrier vessel.

c. **Depth**

Considering tide difference, the channel depth is planned to be 5.5 m from the chart datum.

3) **Turning basin**

a. **Depth**

Design depth of the turning basin is - 7 m below the chart datum.

b. **Area for turning**

The turning basin is planned to keep 230 m as a circle diameter of 2 times of LOA for manoeuvring a carrier with a tug's assistance.

4) **In-port road system**

The new road is planned with 2 lanes of 3.5 m in width, namely, a 7 m wide road will be provided.

(2) Functional Facilities of Fishing Port

1) **Policies**

The type, structure, specifications, and layout of each functional facility will considered natural conditions surrounding the proposed site. Construction methods and materials predominantly used in the project area will be utilised as much as possible. Moreover, the objective of the layout plan is to effectively use the limited area of the port, while maintaining a balance between its surrounding environment. Therefore, the area for functional facilities will be divided into zones according to function, in order to ensure easier and more efficient use of the facilities.

2) **Project Site**

The planned site in Phuket is divided into two areas by a narrow canal, i.e. one area is on Phuket Island and the other is on Si Rae Island. The Phuket city government designated this area as an industrial park. The total area required for the planned site is approximately 83.9 hectares (524.4 rais), of which 65.4 hectares (408.8 rais) on Si Rae Island have already been acquired by FMO, but approximately 18.5 hectares (115.6 rais) on Phuket Island is privately owned.

3) **Zoning**

The functional facilities and processing plant facilities were divided into four (4) zones shown in below;

Table 5.4.2(2) Zoning for Functional Facilities in Project Site

Zone A	It is located west side of internal road (R) in Si Rae Island. It contains an open space for a fish landing, a mooring wharf, a trucking berth, a parking and lot and internal roads. The fishing related facilities have been located in the zone created by above mentioned open spaces and the (R).
Zone B-1	It is located east side of (R) in Si Rae Island. It contains the entire industrial estate.
Zone B-2	It is located west side of (R) in Si Rae Island. It is a part of the industrial estate.
Zone B-3	The entire project site on Phuket Island was allocated as an industrial
Zone C	The west side of (R) in Si Rae Island includes existing fishing related facilities.
Zone D	A service road has been planned around the Zone B-2 and a green belt has been left along the adjacent boundary of this industrial estate.

4) **Infrastructure**

a. **.City Water**

- City water will be supplied to two (2) city water reservoir tanks in Si Rae Island (for the FMO's facilities and processing plant facilities) and one (1) city water reservoir tank in Phuket Island .
- Capacities of the city water reservoirs in each target year is shown as follows.

Table 5.4.2(3) Capacity of City Reservoirs

Unit : m^3

Target year	Phuket Island site		Si Rae Island site	
	Underground	Elevated	Underground	Elevated
2002 year	0	0	500	100
2005 year	0	0	1,750 (500 & 1,250)	300 (100 & 200)
2012 year	500	100	1,750 (500 & 1,250)	300 (100 & 200)

"Underground" means underground reservoir tank and "}Elevated"} means elevated water tank.

b. Electricity

- High voltage electricity (33,000V/50Hz) from a main line running parallel to the neighboring main road will be used. High voltage electricity will be supplied to one (1) electrical sub-station in Si Rae Island and one (1) electrical incoming station in Phuket Island.
- Capacities of the incoming stations in each target year is shown as follows:

Table 5.4.2(4) Capacity of Incoming Station

Incoming station name	2002 year	2005 year	2012 year
Incoming station on Phuket Island	0 KVA	0 KVA	6,000 KVA
Incoming station on Si Rae Island	3,000 KVA	9,000 KVA	9,000 KVA

c. Telephone

The main telephone line running along the neighboring main road will be connected to each facilities on the project site using the electrical wiring post.

d. Water Treatment Facilities

- A total of two waste water treatment facilities will be constructed, i.e. one on Phuket Island and the other on Si Rae Island. Waste water drainage lines from related facilities will be connected to these water treatment facilities.
- The source and volume of waste water are given below.

* Si Rae Island 3,410 m^3/day
* Phuket Island 1,055 m^3/day

5) Marketing Hall

The existing marketing hall will be enlarged 324m to the south.

6) **Office and Others**

a. **FMO Office, Wharf Watchman Box and Auction Watchman Box**

The FMO office will be located in the center of the project site, and in front of the marketing hall. Moreover, the Wharf Watchman Box at three (3) points within the project site and an Auction Watchman Box which will be planned.

b. **DOF Office**

DOF office for fisheries resource control and quality control of export processed fish products will be planned.

c. **Radio Communication System**

The supplementary equipment to the DOF's radio station and FMO office will be equipped.

d. **Custom and Immigration Office**

The custom and immigration office for the immigration control for foreign crews and the custom service for frozen tuna in this fishery complex is planed in FMO office.

e. **Fish Agent Office**

Existing offices will be leased by FMO to fish agents in future.

7) **Ice Plant and Ice Storage**

An ice plant with a production capacity of 180MT/day and a ice storage facility with a one day production capacity will be constructed and ice will be provided to long liners by an ice crusher tower on the wharf.

8) **Cold Storage**

A cold storage facility with a capacity of 600 tons and a temperature setting of up to -25°C, will be installed to temporarily stock the frozen tunas landed by carrier vessels.

9) **Fuel Oil Supply Facilities**

A supply facility for fuel oil has not been included among the functional facilities in this project in accordance with frequency of ulilization, but land space will be allocated for a fuel oil supply facility that may be constructed in future.

10) **Supply Facility for Sea Water**

Sea water for washing the market floor will be treated by filters and chlorine disinfection system (capacity of the water pump: 500 litres/minute, 30 ton/hours).

11) **Garbage**

The garbage from the new fishery complex will be treated by public system.. On the other hand one, rubbish disposal area (approx. 50m^2) will be prepared for the large garbage.

12) **Workshop**

One workshop building for the tentative repairing works for pumps and engines will be constructed in the fishery complex.

13) **Ship Yard**

The land space for the private shipyard company will be provided for the extension of shipyard in future.

14) **Fishing gear repairing area**

Area of 600 m² for fishing gear repairing for local purse seiners will be provided.

15) **Fishing gear storage**

The agents are mainly fishing boat owners, possessing several fishing boats who are in need of storage facilities for their fishing gear. There are 20 agents, therefore, storage facilities in 20 different lots are required.

16) **Fish Box Storing Area**

In present, the open space (40 x 40 m) near the existing FMO office is utilized for fishing box storing from local fishing boats of FMO fishing port.

The area size of fish box storing area will be considered with fish boxes of local boats landed on FMO side and Phuket island side. Therefore, the fish box storing area sized 40 x 80 m will be allocated behind the mooring jetty.

17) **Service Building for Wharf Workers**

Service building for fishermen and truck drivers will be allocated behind FMO fishing port and center of the project site. Service building is composed with canteen, restaurant, kiosk and other service facilities.

(3) Fish Processing Factories

1) **Long and Short-term Development Targets of the Master Plan**

The industrial zone including the east and west banks of the canal will be redeveloped under the Master Plan. The FMO site located on the west bank of the canal is owned by FMO and is currently vacant. However, fishery related facilities such as fish meal factories are located on the east bank of the canal. These private firms will be relocated during the implementing stage of the redevelopment project. It is difficult to coordinate and resolve issues pertaining to negotiations, budget allocation, and location planning in a short period of time.

Therefore, factories that will be accommodated on the west bank will be relocated in 2005 which has been set as a short-term target year. The east bank area will be developed by 2012, the long-term target year of the Master Plan; and the remaining factories will be relocated.

2) **Number of Processing Factories to Be Relocated**

There are a total of eight factories which will be relocated due to raw material supply. One factory will require an area of about 28 Rais. When the available land area of the new site is divided by the number of factories which will be relocated, six factories will be relocated to Phuket by the short-term target year and two factories will relocate every year until the long-term target year, i.e. from 2005 to 2007. The six factories that are anticipated to move to Phuket by the short-term target year will not make the move for one year.

5.4.3. Outline of Project Site

(1) Land use of Project Site

1) City Plan of Phuket City

Phuket City Plan shows that the project site is designated as "Industrial Zone", and the site reserves a right of its deforestation for development of fishing port.

2) Land use of the project site

The Project Site is divided in 6 zones from a viewpoint of land use and each land use is outlined as below.

3) Private land adjacent to the Project Site

The land in the project site is privately owned by private people.

(2) Existing Infrastructure around the Project Site

1) Road System

Phuket, Bangkok and Songkhla are linked with the well-paved road. Present road system serves easy access to the Phuket International Airport.

2) Water

Water supply by both authorities is not enough, however, water supply to the new Fishery Complex will be sufficient after completion of dams and deep wells.

3) Electricity

Capacity of electricity supply is sufficient and a plan to provide a new power station in Phuket will allow sufficient electricity supply to the new Fishery Complex.

4) Garbage

A new garbage furnace (250 ton/day) provided near the existing ground will help efficient collection of garbage under the city collection services.

5) Fishing port facilities

There exist a few permanent facilities in Phuket Fishing Port as the FMO wharf and related facilities, which are shown in Figure 5.4.6.

a. Landing facility

The181 m long wharf is of concrete sheet piles. It is highly occupied with fishing boats since functions for landing and mooring are not separated. On the opposite side, private firms reserve own wooden jetties or concrete seawalls for landing or mooring in the 600 m range along the canal.

b. Approach channel and basin

The existing approach channel to Phuket Fishing Port are of 60 m wide and 3 m deep.

6) **Fish Marketing Facilities**

a. **FMO Market**

This capacity is inadequate to handle the present fish landing volume. Sea water is utilized for washing the floor.Water for fishing boats is supplied by lorry due to an insufficient water supply.

Block ice is supplied to fishing boats after crushed with nine ice crushers.

b. **Ice Plant**

Total production capacity of these ice plant is 777 tons/day, but the actual production capacity is 555 tons/day. The ice supply for the fishery sector is roughly in balance with demand.

c. **Cold Storage**

There is only one (1) cold storage facility with a capacity of 500 tons which is owned by CSO at the FMO site in Phuket.

7) **Fish Processing Factories**

There processing factories, excluding the fish meal factories, are small-scale traditional factories. The total production volume of fish meal factories in 1993 was 9,313 tons of products.

(3) **Related plan around the Project Site**

A project preparard by the Phuket Provincial Governmentis is conducted to provide a tourist pier on the west bank of the canal.

5.4.4. Master Plan for Fishery Complex Development

(1) **Preparation of Alternative Plans**

1) **Basic conditions for preparing alternatives**

a. **Extent of possible development and size of facilities**

It is premised that all the facilities should be located in the designated area as the industrial zone. In the east district separated by the canal, there exist FMO facilities and mangrove forest owned by FMO which reserves a licence to fell it. The facilities of the Fishery Complex will be planned to be located in the area. In order to improve the environmental situation, redevelopment of the west district is being examined.

b. **Utilization of existing facilities**

The existing concrete wharf and other solid facilities will be efficiently utilized for minimizing investment to the project. The fishing port facilities prepared as a master plan are proposed with improvement and expansion of the existing FMO facilities and the function of fishing port management will be basically centred on the east district occupied by FMO.

c. **Environment and governmental regulations**

Environment Impact Assessment (EIA) has been conducted for feasibility study on the project to preserve the environment of the site. Some modification of a proposed plan might be required in the implentation stage, since the several issues to be settled will remain in a plan.

2) Alternative master plans

There remains little flexibility in planning alternatives for the master plan. Three alternative plans are prepared, considering a function of unified management in the fishing port and locations of a deep-sea wharf.

As a result of evaluation of the three layout plans, the plan illustrated in Figure 5.4.1 is selected as a more desirable layout from viewpoints of convenience and economy criteria.

5.4.5. Construction Plan

Construction schedule for the master plan are shown in Table 5.4.1 and preliminary construction cost is shown in Tables from 5.4.2 and 5.4.3.

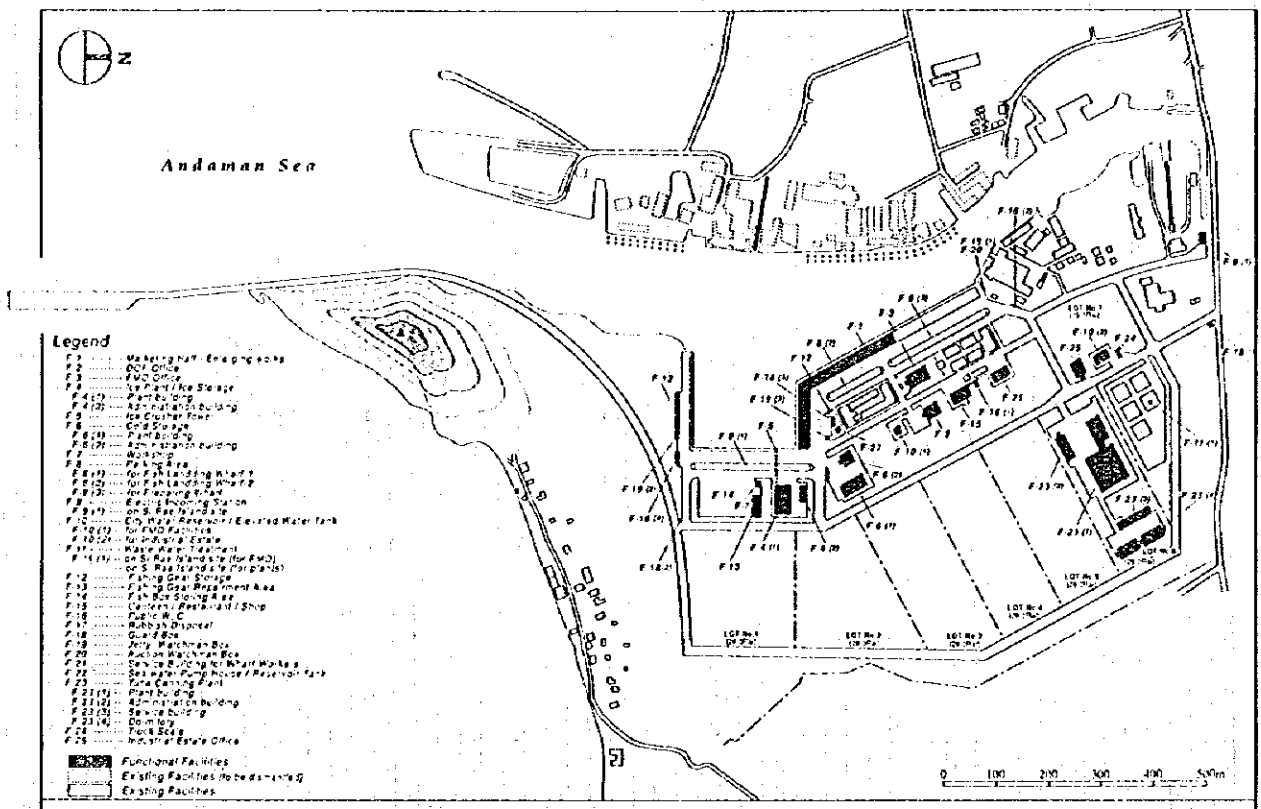

Figure 5.4.1 Detailed Layout Plan of Phuket Port

Table 5.4.1 Implementation Schedule

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Loan to engage design consultants																
Recruite design consultants																
Mobilization																
Design/Prequals/Tendering																
Construction loan agreement																
Construction contract award																
Mobilization/Demobilization																
Landing wharves																
Lay by wharves																
Deep-sea wharf																
Dredging & land filling																
Access trestle																
In-port road																
Bridge to main road																
Temporary work																
Land preparation																
Buildings in FMO zone																
Utilities in FMO zone																
Utilities in Industrial Estate																
Construction of plants																

Table 5.4.2 Construction Cost (Master Plan)

	Item	Quantity	Total Cost	Foreign Currency	(Unit: ,000 Baht) Local Currency
1	Landing Wharf for Existing Fishing Boats and Long liners	335 m	83,750	40,200	43,550
2	Lay-by Wharf	380 m	91,240	42,418	48,823
3	Deep-sea Wharf	210 m	111,563	78,094	33,469
4	Access Trestle	700 m	113,750	45,500	68,250
5	Dredging	1,800,000 m^3	450,000	360,000	90,000
6	In-port Road	1,600 m	27,000	0	27,000
7	Bridge to City Road	15 m	3,375	0	3,375
8	Aids to Navigation	Lump sum	20,740	18,715	2,025
9	Temorary Jetty	Lump sum	4,800	0	4,800
10	Mobilization/Demobilization	Lump sum	31,250	29,688	1,562
	Total		937,468	614,614	322,854
11	Detailed Design and Engineering Investigation		93,648	60,871	32,777
12	Contengency		84,064	48,932	35,132
	GRAND TOTAL (excluing VAT)		1,115,181	724,417	390,763
	VAT 7%		78,063	50,709	27,353

Table 5.4.3 Construction Cost of Fishing Port Facilities (Master Plan)

I. Fishing Port Functional Facilities and External Infrastructure unit : 1,000Baht

	Item	Unit	Qty	Total floor area of 1 lot (sqm)	Total floor area (sqm)	Total Cost	Foreign Currency	Local Currency
Public 1. Fishing Port Functional Facilities								
1	Marketing Hall / Enlarging works	Lot	1	6,243.00	6,243.00	37,985	0	37,985
2	DOF Office	Lot	1	414.00	414.00	23,941	16,560	7,381
3	FMO Office	Lot	1	558.00	558.00	11,637	2,530	9,107
4	Ice Plant / Ice Storage / Ice Crusher Tower	Lot	1	2,258.00	2,258.00	123,004	75,739	47,265
5	Cold Storage	Lot	1	1,704.00	1,704.00	45,014	19,550	25,464
6	Workshop	Lot	1	156.00	156.00	10,838	8,947	1,891
7	Electric Power Station	Lot	1	252.00	252.00	2,217	0	2,217
8	City Water Reservoir / Elevated Water Tank	Lot	1	-	-	8,863	0	8,863
9	Waste Water Treatment	Lot	1	-	-	11,995	0	11,995
10	Fishing Gear Storage	Lot	1	400.00	400.00	2,706	0	2,706
11	Fishing Gear Repairment Area	Lot	1	600.00	600.00	4,600	0	4,600
12	Canteen / Restaurant / Shop	Lot	1	1,008.00	1,008.00	12,076	0	12,076
13	Others	-	-	-	-	13,690	368	13,322
	Sub-total					308,566	123,694	184,872
14	Detailed Design and Engineering Service					13,416		
15	Overhead and Profit					18,782		
	Total - 1					340,764		
Public 2. External Works and Infrastructure								
1	External Works and Infrastructure					145,098	0	145,098
	Sub-Total					145,098	0	145,098
2	Detailed Design and Engineering Service					6,309		
3	Overhead and Profit					8,832		
	Total - 2					160,240		
Total - I						501,003		

II. Industrial Estate in Si Rae Island unit : 1,000Baht

	Item	Unit	Qty	Total floor area of 1 lot (sqm)	Total floor area (sqm)	Total Cost	Foreign Currency	Local Currency
Public 1. Facilities								
1	City Water Reservoir / Elevated Water Tank	Lot	1	-	-	16,057	0	16,057
2	Waste Water Treatment	Lot	1	-	-	70,380	0	70,380
3	Estate Office	Lot	1	414.00	414.00	6,403	0	6,403
	Sub-Total					92,840	0	92,840
4	Detailed Design and Engineering Service					4,006		
5	Overhead and Profit					5,651		
	Total - 1					102,527		
Public 2. External Works and Infrastructure								
1	External Works and Infrastructure					180,835	0	180,835
2	Detailed Design and Engineering Service					7,862		
3	Overhead and Profit					11,007		
	Total - 2					199,704		
Total - II						210,231		

III. Industrial Estate in Phuket Island unit : 1,000Baht

	Item	Unit	Qty	Total floor area of 1 lot (sqm)	Total floor area (sqm)	Total Cost	Foreign Currency	Local Currency
Public 1. Facilities								
1	Electric Power Station	Lot	1	252.00	252.00	2,217	0	2,217
2	City Water Reservoir / Elevated Water Tank	Lot	1	-	-	11,680	0	11,680
3	Waste Water Treatment	Lot	1	-	-	36,513	0	36,513
	Sub-Total					50,410	0	50,410
4	Detailed Design and Engineering Service					2,192		
5	Overhead and Profit					3,068		
	Total - 1					55,670		
Public 2. External Works and Infrastructure								
1	External Works and Infrastructure					85,649	0	85,649
2	Demolish Work of Existing Building and Site Clearance					25,300	0	25,300
	Sub-Total					110,949	0	110,949
3	Detailed Design and Engineering Service					4,804		
4	Overhead and Profit					6,753		
	Total - 2					122,526		
Total - III						178,196		

IV. Processing Plants unit : 1,000Baht

	Item	Unit	Qty	Total floor area of 1 lot (sqm)	Total floor area (sqm)	Total Cost	Foreign Currency	Local Currency
Private Processing Factory								
1	Tuna Canning Plants and related facilities	Lot	8	14,606.00	117,568.00	1,334,475	42,228	1,292,247
	Sub-Total					1,334,475	42,228	1,292,247
2	Detailed Design and Engineering Service					58,021		
3	Overhead and Profit					81,229		
Total - IV						1,473,725		
Grand Total						2,363,155		

6. SHORT-TERM DEVELOPMENT PLAN FOR FISHERY COMPLEX

6.1. Planning Concept

The Fishery Complex (FC) will be formulated with the concept of (1) Development of Fishing Port, (2) Promotion of Fishery Processing Industry with Using Tuna as Raw Material, and (3) Contribution to Tourism Industry. The FC will provide fishing port facilities for introducing fish resources management and for long liners and larger purse seiners, and will develop the estates for fish processing plants.

Policies for provision of the necessary facilities for FC are determined to be: (1) minimization of investment to the existing fishing, (2) provision of a deep-sea wharf in requirement of raw material for operation of processing plants, and (3) improvement of comprehensive fishing port management and operation system with efficient services of berth usage, improvement of environment in the fishing port, enhancement of quality control and provision of a whole sale market. Considering the above for feasible implementation of the Project, and a term for provision of necessary facilites for the estate and for relocation of factories, the year 2007 is most appropriate for the target year for the short term plan.

6.2. Planning of Fishing Port Facilities

6.2.1. Basic Facilities

(1) Projection of number of fishing boats

1) Number of fishing boats for the existing fishing

Number of fishing boats using the fishing port daily for the short-term development plan is estimated at:

Table 6.2.1 Number of Fishing Boats Using Fising Port

Number of boats using FMO facilities:	20
Number of boats using private jetties :	26
Total	46

2) Number of Long liners

The number of boats in year 2007 is estimated at 175.

3) Larger purse seiner

Introduction of a larger purse seiner is planned, considering the progress of raising fund for purchasing the boat.

6.2.2. Scale of wharf

Berth length in the plan is tabulated below:

Table 6.2.2 Proposed Length of Berths

		Landing	Lay-by
Thai offshore fishing boats	:	155 m	320 m
Long liners	:	137 m	
Deep-sea purse seiners	:	210 m	

6.2.3. Approach channel and basin

(1) Approach channel

The channel is planned to be 100 m wide and 5.5 m deep.

(2) Turning basin

The basin is planned to keep circle area of 230 m in diameter and to be 7 m deep.

6.2.4. Preliminary Design of Functional Facilities

(1) Project Site

The site for functional facilities in the short term development plan will use Si Rae Island side located existing FMO facilities. The area for the project site is approximate 65.4 hectares (408.8 rais) owned by FMO.

(2) Infrastructure

1) City Water

City water will be supplied	500 m^3
Elevated water tank	100 m^3

2) Electricity

High voltage electricity (33,000V/50Hz) from a main line running parallel to the neighboring main road will be used. High voltage electricity will be supplied only to the electrical sub-station (3,000 KVA) for the FMO's facilities through the electrical incoming station on Si Rae Island site.

3) Water Treatment Facilities

One waste water treatment facility (750 m^3/day) will be constructed only for the FMO related facilities on Si Rae Island. Waste water and drainage lines from related facilities will connected to this facility.

(3) Marketing Hall

The existing marketing hall will be enlarged 324m to the south.

(4) Office and Others

1) FMO Office

The FMO office will be located in the center of the project site, and in front of the marketing hall. Moreover, Wharf Watchman Box at 3 points within the project site and an Auction Watchman Box which be planed.

2) DOF Office

DOF Office for fisheries resource control and quality control of export processed fish products will be planned.

3) Radio Communication System

The supplementary equipment to the DOF's radio station and FMO office will be equipped.

4) Custom and Immigration Office

Custom and immigration office will be planed in the FMO office.

(5) **Ice Plant and Ice Storage**

An ice plant with a production capacity of 180MT/day and ice storage facility with a one day production capacity will be constructed.

(6) **Cold Storage**

A cold storage facility with a capacity of 600 tons and a temperature setting of up to -25°C will be installed.

(7) **Supply Facility for Sea Water**

Sea water for washing the market floor will be treated by filters and chlorine disinfection system (Capacity of system: 500 liters/minute, 30 ton/hours).

(8) **Rubbish Disposal Area**

The garbage from new fishery complex will be treated by public garbage collection system. On the other hand, one rubbish disposal area (approx. $50m^2$) will be prepared for the large garbage.

(9) **Workshop**

One workshop building for the tentative repairing works of pumps and engines will be constructed in the fishery complex.

(10) **Fishing gear repairing area**

Area of 600 m^2 for fishing gear repairing for local purse seiners will be provided.

(11) **Fishing gear storage**

There are 20 agents, therefore, storage facilities in 20 different lots are required.

(12) **Fish Box Storing Area**

Fish box storing area sized 40 x 80 m will be allocated behind the mooring jetty.

(13) **Service Building for Wharf Workers**

Service building for fishermen and truck drivers will be allocated behind FMO fishing port and center of the project site. Service building is composed with canteen, restaurant, kiosk and other service facilities.

6.2.5. Layout Plan of Fishing Port

Layout of the planned fishing port facilities is illustrated in Figures 6.2.1, 6.2.2 and 6.2.3.

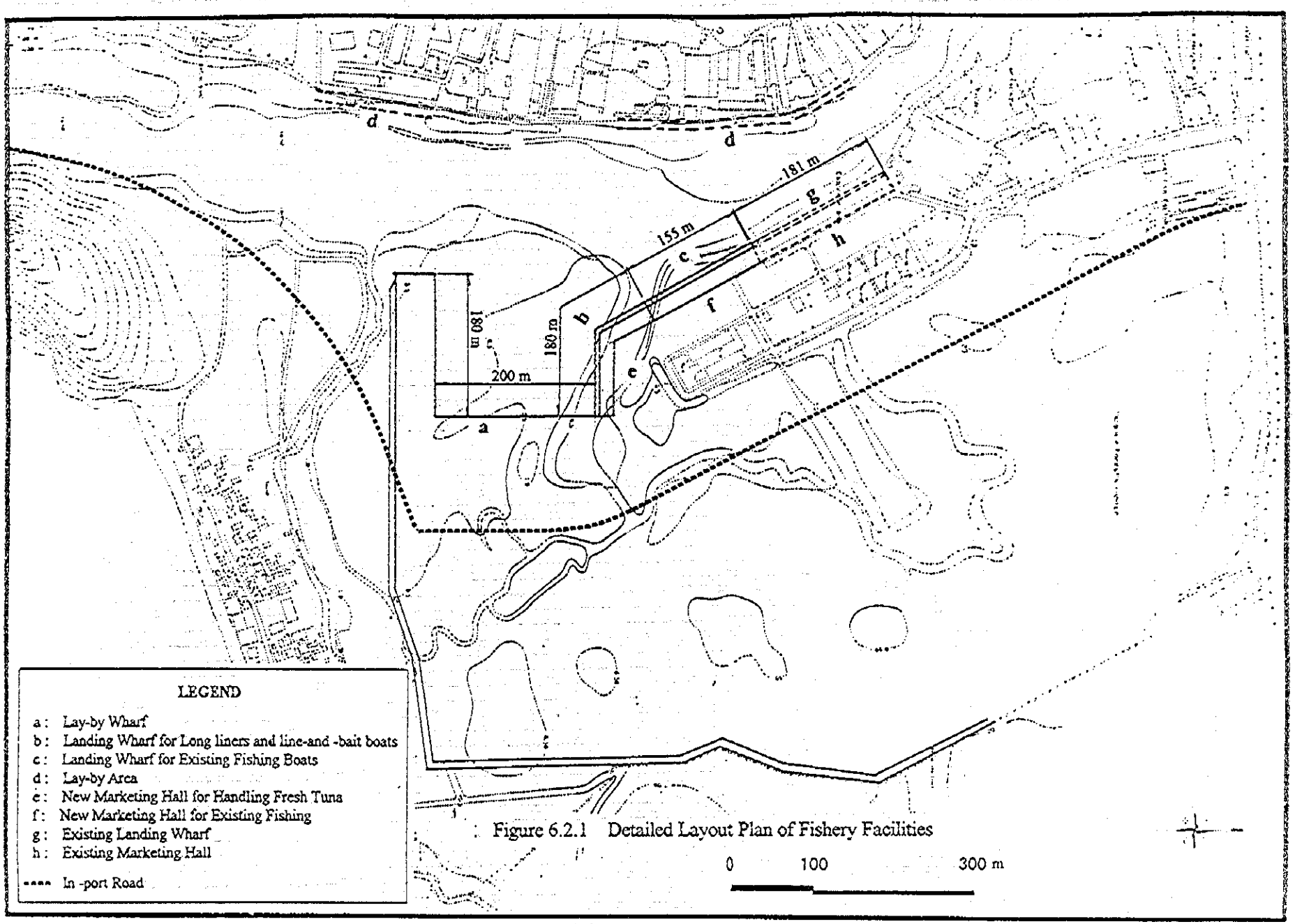

Figure 6.2.1 Detailed Layout Plan of Fishery Facilities

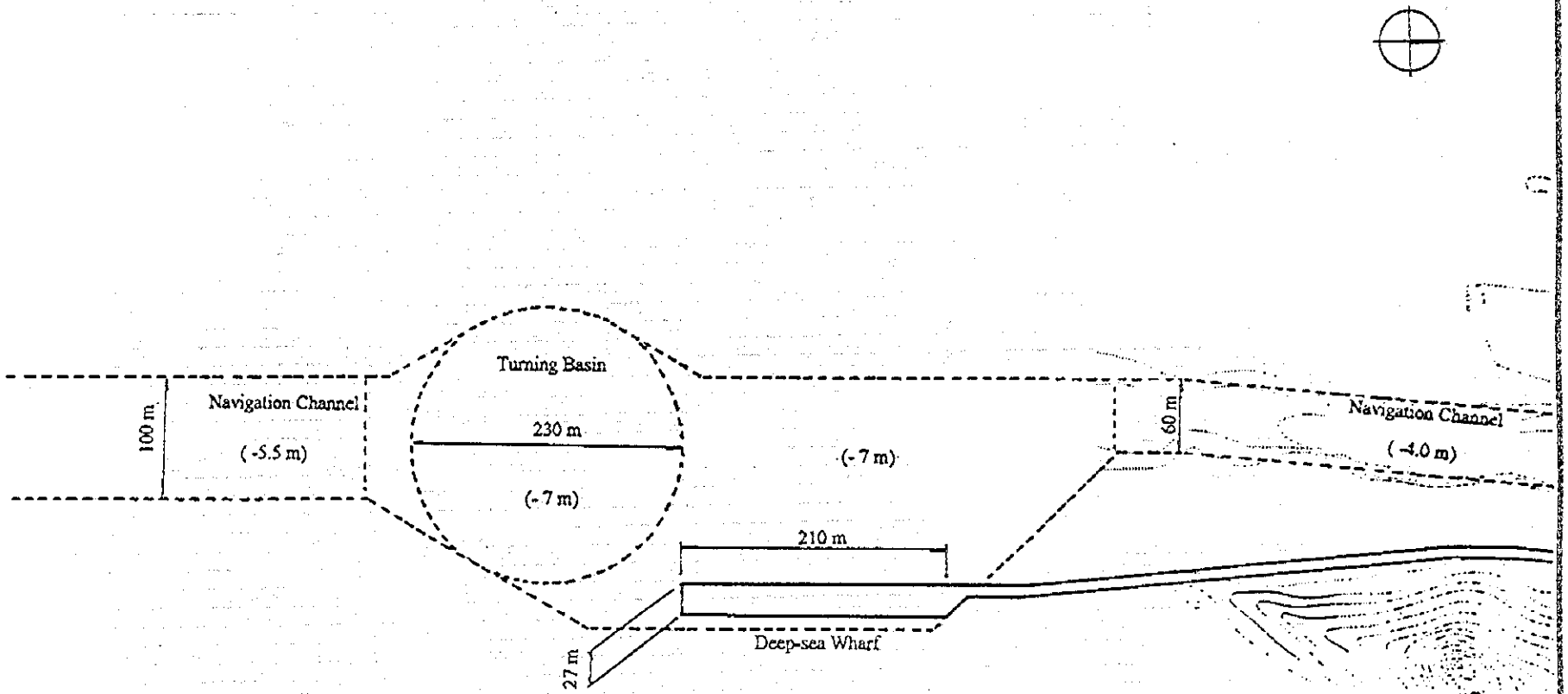

Figure 6.2.2 Detailed Layout Plan of Deep Sea Wharf

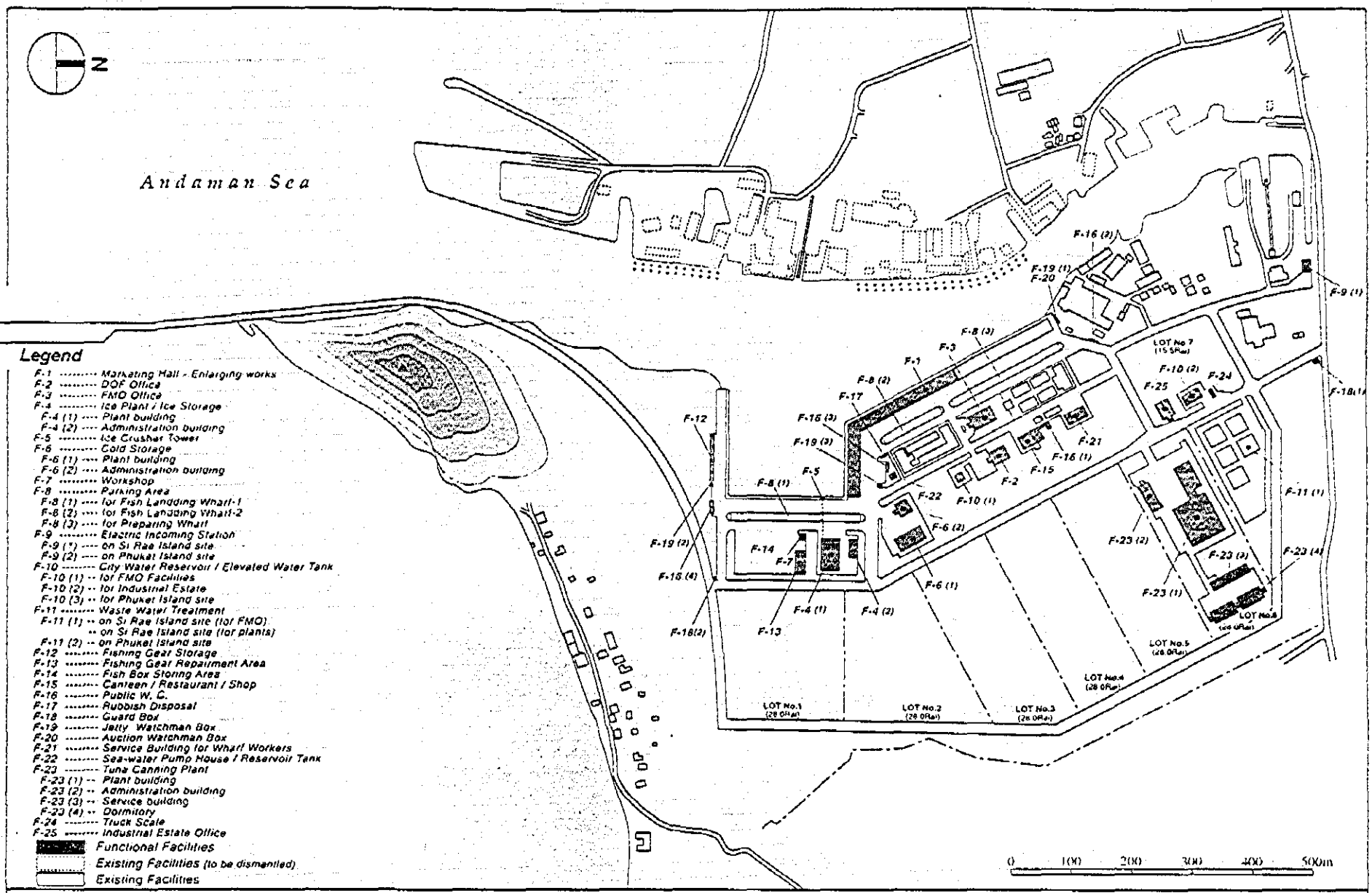

Figure 6.2.3 Detailed Layout Plan of Phuket Port

6.3. Development of Industrial Estate for Fish Processing Factories

6.3.1. Relocation of Fish Processing Factories and Need to Develop the Industrial Zone

The Seventh National Economic and Social Development Plan was prepared by the Government of Thailand with the major objectives of redistributing income and regional development. Based on these objectives, the Thai government initiated a policy to relocate processing factories from the surrounding area of Bangkok to other regions, in order to promote environmental conservation around Bangkok and to resolve the regional disparities between urban and rural areas. In addition, the government has provided tax privileges for relocated firms under the investment promotion law.

This Project includes relocating existing fish processing factories from the urban area of Bangkok (Zone 1) to Phuket (Zone 3) and supports the national policy of industrial decentralization. As there is no industrial estate in Phuket, developing one is essential in order to relocate the firms there. Therefore, developing such an estate should be implemented in the Project.

6.3.2. Scenario For Developing an Industrial Zone for Fish Processing Factories

(1) Type of Industrial Zone

The industrial estate proposed in this Project should be categorized as an EPZ, since the factories are mainly involved in export activities. As a result, it is essential that IEAT participates in the development of an industrial estate.

(2) Industrial Estate Developer

The industrial estate in the short-term project will be located behind the fishing port; and it will be a part of the fishery complex owned by FMO. Despite the fact that the implementing agency of this complex will be the FMO, it is recommended that the industrial estate is developed jointly by both FMO and IEAT, due to IEAT's technical expertise in this area. FMO which has no experience in developing an industrial estate needs the cooperation of IEAT to draw up and implement a development plan. The expertise involved in developing an industrial estate will differ according to the type of development.

(3) Organizing a "Phuket Industrial Estate Developing and Coordination Committee" (PIEDCC)

The industrial estate which is proposed in this project differs from other industrial estates because the processing industry which is targeted is limited. Moreover, the incentives to attract the processing factories do not only include tax privileges, but also low interest financing for relocating, securing manpower, and a lower purchase price of raw material. Therefore, a Phuket Industrial Estate Developing and Coordination Committee should be organized, in order to ensure smooth implementation of the industrial estate and recruitment of factories. The members of the committee and their functions are outlined as follows.

Table 6.3.2 Organization, Functions and Duties of Coordination Committee

Member	Function and Duty
Public	
1. DOF	- Promote and adjust project formulation of the project for developing an industrial estate
2. FMO	- Formulate and implement the project for developing an industrial estate
3. IEAT 4. IFCT	- Formulate and implement the project for developing an industrial estate
5. Phuket Provincial Government	- Financing private investment capital for factories relocating to Phuket
6. Phuket City Government	- Indirectly support and cooperate with the project for developing an industrial estate
7. Phuket Labor Office	- Indirectly support and cooperate with the project for developing an industrial estate
Private	- Indirectly support and cooperate with the project for developing an industrial estate
8. Thai Food Processor's Association (TFPA)	- Convey the objectives and contents of the project to develop an industrial estate to its members and feedback their opinions to the Committee
9. Thai Frozen Food Association (TFFA)	
10. Representative of the importers of raw material	- Convey the objectives and content of the project to develop an industrial estate to its members and feedback their opinions to the Committee
11. Phuket Chamber of Commerce	- Convey the objectives and content of the project to develop an industrial estate to others in the same trade and to cooperate with the project
	- Indirectly support and cooperate with the project to develop an industrial estate

6.3.3. Industrial Estate and Scale of Processing Factories

(1) Project Site

The project site for the estate will use the area on Si Rae Island where existing FMO facilities are located. The area of the estate is approximately 29.4 hectares (183.5 rais) owned by FMO.

(2) Infrastructure

1) City Water

City water will be supplied to the city water reservoir only for the estate on Si Rae Island from an existing 8 inches main pipe running parallel to the neighboring paved main road. This reservoir water will be supplied to processing factories from through the main pipe running parallel to the neighboring main estate road.

Capacities of the city water reservoirs for each target year is shown as follows.

Underground reservoir tank	1,250 m^3
Elevated water tank	200 m^3

2) Electricity

One electric incoming facility for estate will be installed at the sub power station on Si Rae Island. High voltage electricity (33,000V/50Hz) from a main line parallel to the neighboring main road will be used. Each factory will be provided with its own transformer. High voltage electricity from the substation will be supplied to each factory through the parallel to the neighboring main estate road.

Total capacity of electric power station is 6,000 KVA.

3) Telephone

The main telephone line running along the neighboring main road will be connected to each facilities on the project site using the electrical wiring post.

4) Water Treatment Facilities

One waste water treatment facility will be constructed for the fish processing factories estate on Si Rae Island (capacity : 2,700 m3/day).

(3) Processing Factory Facilities

The components of one fish processing factory are as follows.

1) Area of the site: 4.5ha (28 Rai)

2) Production Factory (one storied building) One Building

Production capacity: 40 tons/day of raw material

3) Cold Storage (one building)

Scale: Rated capacity 1,000 tons (actual capacity 600 tons), room Temperature: -25°C

4) Service Building (two one-storied buildings)

Locker room for workers, shower room, toilet and washing area, canteen and kitchen

5) **Dormitory (two buildings each two storied)**

The dormitories will accommodate 75 % of the total number of employees (500) or 368 people.

6.3.4. Financial Analysis of Canned Skipjack/Tuna Factory Relocated from Zone 1 to Phuket

All the existing canned skipjack/tuna factories have different production capacities, location, and financial conditions (fixed assets, liabilities, depreciation, etc). This study aims at analysis to determine whether the investments made by factories to move to Phuket are profitable or not, by comparing the profitability of a tuna processing factory as demonstration in the event of relocation under the project, with its profitability under the existing conditions (without project implementation). As a result, relocation of a demonstration factory will produce more profits than a case without relocation.

6.4. Design of Channel and Basin

(1) Planning of the facilities

Considering the soil characteristics of the channel location as silty soil, both slopes of the facilities are planned to be 1:10, which is the same as the facilities with similar soil conditions.

(2) Estimate of sedimentation volume

For appropriate layout of the channel, numerical simulation for estimating sdimentation volume was conducted for two layout options. The estimated volume of sedimentation is tabulated below:

Table 6.4.1 Estimated Annual Sedimentation Rate in the Channel

	Annual volume	Remarks
The existing (- 3m)	110,000 m3	Records: 3 - 190,000 m3
The renovated (- 4m)	210,000 m3	
Option 1	400,000 m3	
Option 2	490,000 m3	

(3) Selection of a layout plan and estimation of annual dredging volume

Option 1 is selected from a viewpoint of minimization of maintenance dredging cost, but the channel might give some impacts to live coral around the two islands located southward the channel. Considering the environment and the project practicability, the Study Team believes that Option 2 should be selected in order to minimize the affection the biological environment. The Figure 6.4.1 shows the layout of the selected layout. The annual maintenance dredging volume is estimated at 500,000 m3.

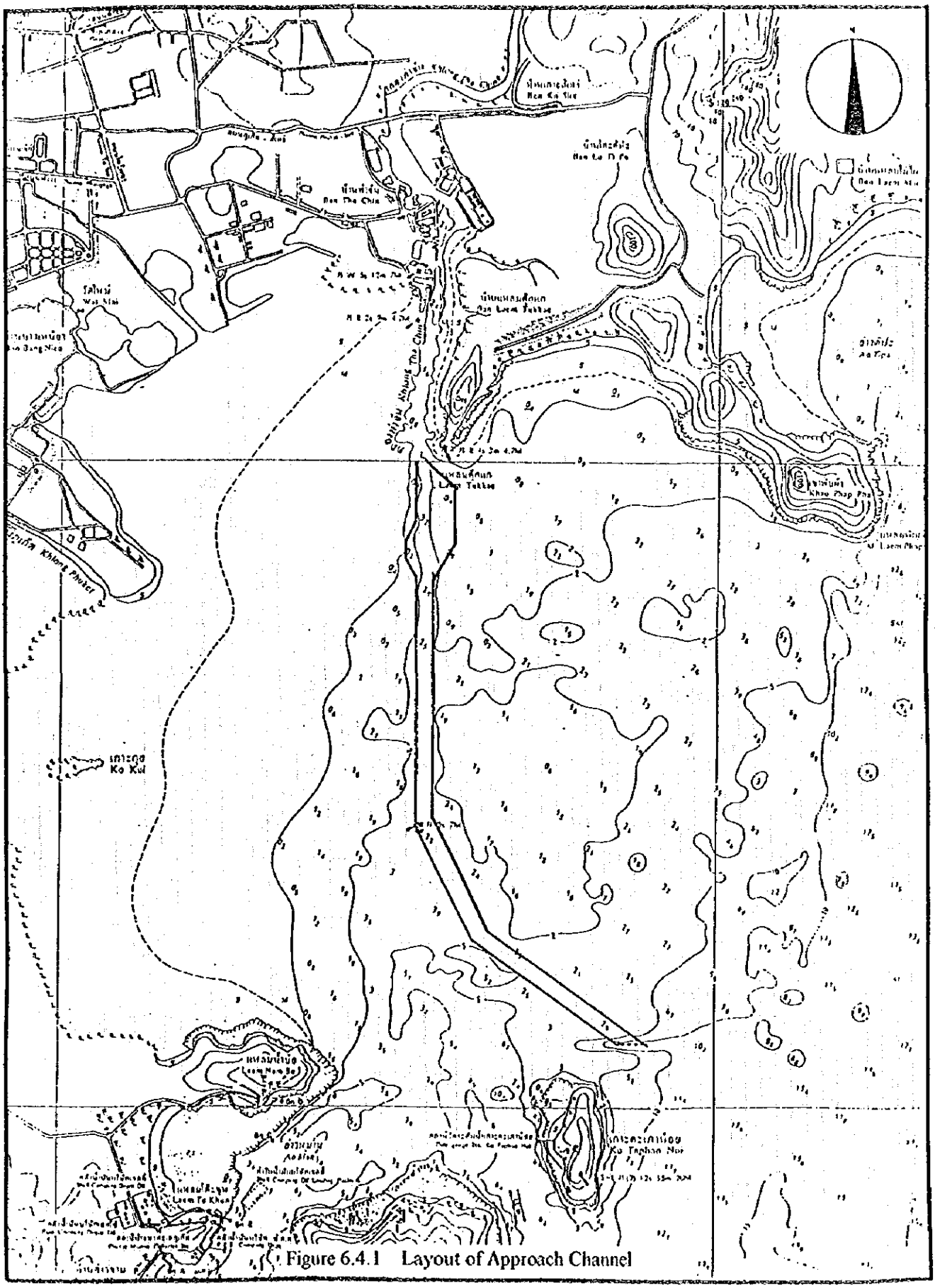

Figure 6.4.1 Layout of Approach Channel

6.5. Construction plan

Overall implementation schedule is shown in Table 6.5.1 and the cost is tabulated in Tables 6.5.2 and 6.5.3.

Table 6.5.1 Implementation Schedule

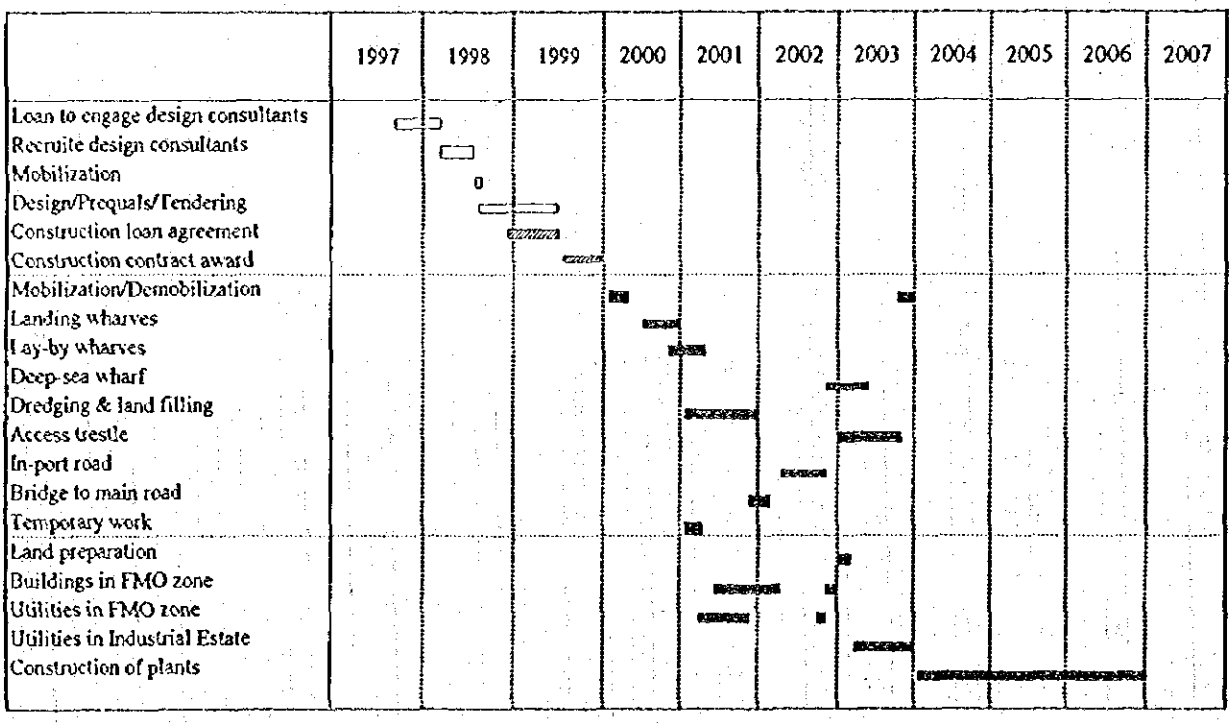

Table 6.5.2 Construction Cost (Short Term Plan)

	Item	Quantity	Total Cost	Foreign Currency	(Unit: ,000 Baht) Local Currency
1	Landing Wharf for Existing Fishing Boats and Long liners	335 m	83,750	40,200	43,550
2	Lay-by Wharf	380 m	90,250	42,418	47,833
3	Deep-sea Wharf	210 m	111,563	78,094	33,469
4	Access Trestle	700 m	113,750	45,500	68,250
5	Dredging	1,800,000 m^3	450,000	360,000	90,000
6	In-port Road	1,600 m	27,000	0	27,000
7	Bridge to City Road	15 m	3,375	0	3,375
8	Aids to Navigation	Lump sum	20,740	18,715	2,025
9	Temorary Jetty	Lump sum	4,800	0	4,800
10	Mobilization/Demobilization	Lump sum	31,250	29,688	1,562
	Total		936,478	614,614	321,864
11	Detailed Design and Engineering Investigation		93,648	60,871	32,777
12	Contengency		83,916	48,932	34,984
	GRAND TOTAL (exeluing VAT)		1,114,042	724,417	389,625
	VAT 7%		77,983	50,709	27,274

Table 6.5.3 Construction Cost of Fishing Port Facilities (Short Term Plan)

I. Fishing Port Functional Facilities and External/Infrastructure — unit : 1,000Baht

	Item	Unit	Qty	Total floor area of 1 lot (sqm)	Total floor area (sqm)	Total Cost	Foreign Currency	Local Currency
Public 1. Fishing Port Functional Facilities								
1	Marketing Hall - Enlarging works	Lot	1	6,240.00	6,240.00	37,985	0	37,985
2	DOF Office	Lot	1	414.00	414.00	23,941	16,560	7,381
3	FMO Office	Lot	1	558.00	558.00	11,637	2,530	9,107
4	Ice Plant / Ice Storage / Ice Crusher Tower	Lot	1	2,258.00	2,258.00	123,004	75,739	47,265
5	Cold Storage	Lot	1	1,704.00	1,704.00	45,018	19,550	25,464
6	Workshop	Lot	1	158.00	158.00	10,838	8,947	1,891
7	Electric Power Station	Lot	1	252.00	252.00	2,217	0	2,217
8	City Water Reservoir / Elevated Water Tank	Lot	1	-	-	8,863	0	8,863
9	Waste Water Treatment	Lot	1	-	-	11,995	0	11,995
10	Fishing Gear Storage	Lot	1	400.00	400.00	2,706	0	2,706
11	Fishing Gear Repairment Area	Lot	1	600.00	600.00	4,600	0	4,600
12	Canteen / Restaurant / Shop	Lot	1	1,008.00	1,008.00	12,076	0	12,076
13	Others					13,690	368	13,322
	Sub-total					308,586	123,694	184,892
14	Detailed Design and Engineering Service					13,416		
15	Overhead and Profit					18,782		
	Total - 1					340,784		
Public 2. External Works and Infrastructure								
1	External Works and Infrastructure					145,098	0	145,098
	Sub-Total					145,098	0	145,098
2	Detailed Design and Engineering Service					6,309		
3	Overhead and Profit					8,832		
	Total - 2					160,240		
Total - I						501,003		

II. Industrial Estate in Si Rae Island — unit : 1,000Baht

	Item	Unit	Qty	Total floor area of 1 lot (sqm)	Total floor area (sqm)	Total Cost	Foreign Currency	Local Currency
Public 1. Facilities								
1	City Water Reservoir / Elevated Water Tank	Lot	1	-	-	15,057	0	15,057
2	Waste Water Treatment	Lot	1	-	-	70,380	0	70,380
3	Estate Office	Lot	1	414.00	414.00	6,403	0	6,403
	Sub-Total					92,840	0	92,840
4	Detailed Design and Engineering Service					4,036		
5	Overhead and Profit					5,651		
	Total - 1					102,527		
Public 2. External Works and Infrastructure								
1	External Works and Infrastructure					180,835	0	180,835
2	Detailed Design and Engineering Service					7,062		
3	Overhead and Profit					11,007		
	Total - 2					199,704		
Private, Processing Factory								
1	Tuna Canning Plants and related facilities	Lot	6	14,696.00	88,176.00	1,000,856	31,671	969,185
	Sub-Total					1,000,856	31,671	969,185
2	Detailed Design and Engineering Service					43,515		
3	Overhead and Profit					60,922		
	Total - 3					1,105,293		
Total - II						1,407,525		
Grand Total						1,908,528		

7. MANAGEMENT AND OPERATION PLAN (MO)

The new Fishery Complex holds major two functions of the fishing port facilities and the industrial estate, and the organization for the MO for the Fishery Complex is recommended to be a body with two divisions for MO of two functions.

7.1. Management and Operation Plan of Fishing Port Facilities

7.1.1. Operation of Existing Fishing Port.

(1) Management and Operation of facilities of Phuket Fishing Port.

Accurate information on landing volume is not available since the activities are made at both FMO and private facilities. Proper management of Phuket Fishing Port is not conducted by FMO in terms of overall management of the fishing port.

Existing staff organization for 16 persons is tabulated below:

(2) Constraints on Management and Operation of the Fishing Port.

1) Insufficient management organization

Phuket Fishing Port has been managed continuously by FMO and private sector for their own facilities, therefore, unification for management of fishing port has not been available. This situation causes the difficulties of obtaining correct information on landing volume and of collecting various charges from fishing boats and fish agents on utilization of the fishing port on the basis of each landing volume.

2) Undeveloped System of Auction and Bidding

Direct transaction is conducted without auction or bid, and fish products are distributed to marketing channels through fish agents. They are sometimes not fairly settled from the market requirements and fishermen often receive disadvantage in selling fish.

3) Insufficient consideration to environment.

The bilge-water and oil thrown in the port from fishing boats, waste water used for washing wharf and trash fish, and waste water draining without purification from fish meal plants are sources of water pollution in the Phuket Fishing Port. Odor from these fish meal plants contaminates the environment.

4) Unsanitary handling of fish

Most fish landed on the fishing port are handled unhygienically.

7.1.2. Improvement of system for management and operation of the fishing port.

(1) Policy for improvement of management and operation system

It is concluded that improvement of the system for management and operation of fishing port be required at the opportunity to improve the fishing port under establishment of the new Fishery Complex.

1) **Unification of fishing port management for stock management**

To be effective for stock management at the fishing port, the same system should be applied to all fishing ports. It is essential to obtain correct data on the fish species, landing volume and the system of collecting data is proposed to be established for the purpose. Therefore, unification of fishing port management will be required with giving strong authorities to the manger.

The system exercised for Phuket Fishing Port is expected as a pilot port on the occasion of implementing the project for Fisheries Complex. The necessary measures should be taken by the government in introducing the system.

2) **Examination on tariff of fishing port charges**

It is desirable to modify the tariff with decreasing each fee. The tariff will be determined in examining balance between revenues and expenditures for the new fishing port.

3) **Establishment of Wholesale Market.**

For maintaining fairness of prices on fishery products, it is necessary to introduce system of auction and bidding for fish marketing in the fishing port.

4) **Complete management of traffic and mooring of fishing boats.**

The management will give entry permission to fishing boats and assign their landing and mooring positions on the basis of their obligate reports on entry to the management office before entering. The manager and management office will have authority to control all the activities in the fishing port.

5) **Improvement of the Fishing Port Environment.**

For improvement of quality of water and exoneration of odor in the port, it is necessary to give an authority to the manager for banning disposal of waste water, bilge water and oil, and forbidding emission of odor in the Fishing Port. Establishment of monitoring system around the port area is essential. for the purpose.

6) **Hygienic handling of fish and its quality control.**

Instruction to the fishing boats' owners and fish agents should be given to handle fish hygienically.

7.2. Maintenance Dredging

7.2.1. Present activities of maintenance dredging

(1) Maintenance dredging at fishing ports on the coast of Andaman Sea

The maintenance dredging is carried out almost annually at each port on the coast and the volume less than 300,000 m^3 are recorded.

(2) Organization for maintenance dredging

Harbour Department (HD) under the Ministry of Transport and Communications is responsible for maintaining the channels and basins in the ports with provision of the annual budget for operating and maintaining dredgers for the purpose. Phuket Fishing Port is maintained in the Coastal Dredging and Management Centre I.

(3) Maitenance dredging at Phuket Fishing Port

The approach channel in the Phuket Fishing Port is maintained annually with dredging about 100,000 m3 by a dredger from Dredging Centre I.

7.2.2. Maintenance and operation plan for the new approach channel

(1) Volume of maintenance dredging and capacity of the existing dredgers

Annual dredging volume for maintaining the new channel is estimated at about 500,000 m^3. It is confirmed by Harbour Department that a new dredger will be stationed in the Centre and that a dredger to continuously cover the said volume might be easily provided if necessary.

(2) Cost for maintenance dredging and its operation

Dredging cost for the maintenance will be 27.5 million Baht. In implementing the project, it is recommended for HD to maintain the channel and navigations aids as the present maintenance system.

7.3. Management and Operation Plan of the Industrial Estate

(1) Operation and Management Plan of the Industrial Estate in the Project

It is recommended that the industrial estate proposed in the Project is jointly managed and operated by FMO and IEAT

1) Industrial Estate as an EPZ

An industrial estate under IEAT management and operations will be designated as an EPZ. The tenants will be provided with a "one station service" which will allow them to submit and receive all relevant notifications and approvals from one location. In addition, since the perspective tenants are in the export processing industry, they would like the estate to be recognized as an EPZ.

2) Maintenance of the Infrastructure

The personnel in charge of the estate's management and operations will be responsible for providing the tenants with a high level of infrastructural service. In this respect, IEAT has managed and operated many industrial estates. It has a budget and technical expertise to cope with any sudden emergencies.

In contrast, the industrial estate proposed in this Project will be the first such estate managed by the FMO and it will be difficult to organize a system to cope with sudden emergencies.

7.4. Organization of Management and Operation for Fishery Complex

7.4.1. Division for Fishing Port Facilities

(1) Management body and its organization.

1) Management body

It is understood desirably that improvement of FMO will be made to accommodate expansion of fishing port facilities under conditions that maintenance dredging be conducted by Harbour Department with its budget and that operation costs except dredging be borne by FMO as same as the present management system.

2) Organization

In order to embody the above mentioned system of the management, it is proposed an organization of management of the Fishing Port composed of 38 officers.

(2) Wholesale Company.

For realizing smooth operation of production and marketing system on fair transaction and for securing stable supply of food stuffs for the nation, establishment and promotion of wholesale market in the Fishing Port are essential and important.

Necessary measures with revision of the Act or related regulations are expected to be considered through clarification of issues at each step in the channels.

For modernizing the marketing channels with establishment of wholesale market system, a master plan for the nationwide marketing system will be required.

(3) Legislation of authorities for management and operation

Legislation for efficient management and operation of fishing ports will be required, and the legislation should cover the followings:

- The whole fishing boats involved in trawl and purse seine fishing shall land their fish catch at the FMO facilities, for resources management in Andaman Sea.
- Service charges for using FMO facilities and fish handling charges from fish agents shall be listed one by one.
- The whole sale market shall be established. (Detailed description on the establishment with modifying the present Act or Strict enforcement of the Act)

The fishing port manager shall be appointed with authorities for controlling the activities in the fishing port for management and operation:

7.4.2. Division for Industrial Estate

(1) Management body and its organization.

a. Management body

It is recommended that te industrial estate proposed in the project is jointly managed and operated by FMO and IEAT,

b. Organization

Eight staff members will be allocated.

7.4.3. Fishery Complex Management Committee

It is recommended to establish the Fishery Complex management Committee for its smooth operation and future development of this complex. This committee will be organized by representatives from FMO, DOF, IEAT, provincial and municipal government, fish agents, fishermen, the Chamber of Commerce, and fish processing companies. The function of this committee is to provide smooth operation of the complex

8. THE ENVIRONMENTAL IMPACT ASSESSMENT

8.1. The Need for an EIA

These environmental impact assessment (EIA) guidelines indicate that potential changes in the environmental resources/values require assessment:

8.2. Alternative Designs

8.2.1. Alternative Fisheries Complex Designs

The two basic design options were considered as shown in the master plan and short-term plan stated in the previous chapter.

8.2.2. Alternative Vessel Approach Channel Options

The two layout options were examined as mentioned in the master plan and short-term plan.

8.3. Methodology

The methodology for all components consisted of many steps. The four major steps were:

- Reviewing the Literature and Interviewing DOF and local officials.
- Conducting a Field Program
- Analyzing Alternatives
- Public Involvement

8.4. Existing Conditions

8.4.1. Natural Environment

(1) Physical Oceanography

Of the area's physical oceanographic conditions only tidal currents and waves were examined.

1) Tides and tidal currents-

Tidal currents are strongly north south oriented.

2) Waves -

Waves are quite small and there is no major shore swell.

(2) Hydrology and Flooding

The drainage area of Klong Tha Chin is about 8 km^2 which is very small. The discharge of the Klong Tha Chin (Q) is quite small.

(3) Water Resource

Fresh water requirements for the project will be met by Phuket Municipal and regional sources to be developed in the near future.

(4) Groundwater

Underground water in this area (if there is any) could be contaminated by salt water intrusion. Most of these water samples could be classified as Ca-Mg Type

(5) Seawater and Sediment Quality

1) Seawater Quality -

Only grease and oil measurements seemed to exceed Thai standards.

2) Sediment Quality -

All metals, except tin (10-17ug/g), which is found in abundance in Phuket, were at very low levels and within Thai standards for heavy metals in soils.

(6) Air Quality, Noise, Vibration and Odor

1) Air Quality

TSP for the other three stations was within the standards set by the GOT. Nitrogen Dioxide (NO2) were well within the standards. Sulfur Dioxide (SO2) were well within the GOT standards. Carbon Monoxide (CO) were well within the GOT's standards.

2) Noise

Noise level around the Centre for Pre-School Child Development and the Phuket Community Authority was nearly the same as whole day due to the buses and trucks running to the tourist pier.

3) Vibration

Lower level was measured.

4) Odor sources

Odorous gases concentration in the area persists sometimes for quit long during the day period but the concentration are within the tolerable range.

(7) Mangrove, Wildlife and Coastal Marine Ecosystems

1) Mangrove Forest-

The density of sapling and seedling in mangrove forest of Klong Tha Chin is high, indicating extensive natural regeneration, however, a narrow healthy band of trees remains along the forest's southern border.

2) Wildlife and Wildlife Habitats-

The tidal mudflat supports a great diversity and abundance of resident and migratory bird species, including some very rare species. This area supports a healthy diversity of mammals, birds, reptiles and amphibians.

3) Marine ecology and fisheries

a. Plankton -

The inner section of Phuket Bay (from northwest to southwest), about 5 km^2 area, is very shallow and rich in plankton and seagrass The benthic community is also found in these shallow waters.

b. Coral -

The distribution and abundance of corals in Phuket Bay can be summarized as very poor at all sites.

4) **Fishing Activity-**

In the project area, there were 2 small fishing villages namely, Ban Tha Chin and Ban Tukkae.

5) **Fish -**

The overall species collected was 32 for the inner section and 20 outer section of the bay respectively.

(8) Solid Waste and Wastewater

1) **Solid Waste Management - Phuket Province:**

Existing solid waste generation in Phuket province is 125 - 160 tons/day and the collective handling capacity of sanitary land fill and incinerator will be 400 tons/day. The existing waste generation rate within the FMO port area is 1.6 tons/day. Solid waste generation on private jetties is approximately 2.0 tons/day. The collection bin and pick up system for solid waste is not adequate.

2) **Wastewater -**

At present the FMO site has not provision for the management of its liquid waste. T

8.4.2. Social and Human Environment

(1) Land Use

The existing landuse along west side of Klong Tha Chi is for private tourism piers, fishery piers and fishery industries. The mangrove forest area, slated to be cleared and filled in, is a part of the national forest reserve, but has been leased to the DOF for use in fishery industry development.

(2) Socio-Economic Condition

1) **Population -**

By the end of 1995, total population of Phuket Province was 207,287 and the average density of population in Phuket was 382 persons/km2, which was about 3 times higher than that of the Nation (120 persons/km2).

2) **Land Ownership -**

Only 26.5 % of the residents legally own the land they occupy.

3) **Physical Environment -**

In summary the existing socio-economic conditions for most people in the study area are substandard, with key deficiencies being: insufficient infrastructure, especially the water supply, access road, telephone and refuse collection.

4) **Economic Conditions -**

About 27%of the villagers derive their living from fishery related while 4 % of them work in the fishery on a part-time basis.

5) **Social Conditions-**

In the study area, there are only one primary school and one pre schooling child center. Health services consist of a Koh Si Rae health center , mostly for minor routine requirements and the hospitals in Phuket town.

(3) **Tourism and Visual Environment Conditions**

Tourism plays a minor role in and around the immediate study area.

(4) **Public Health**

Most parts of the communities in the Municipal areas and in the sea-gypsy village have poor sanitation.

8.5. The Selected Option

The option for the short-term plan, which was predicted to have the least significant impact on the bio-physical and social environment of the study area, was examined for EIA

8.6. Identified Impacts and Mitigation Measures

(1) **Physical Oceanography -**

No significant physical impact is expected in provision of a jetty and a channel. Localized sediment plumes will be controlled by silt curtains, using a geo-textile material, and all dredge waste will be pumped onto the shore and disposed of in the lands cleared of Mangrove trees. Drainage of the dredge water back into the sea will be controlled, permitting all fine grained silt materials to settle out. given the large quantities of dredge waste being dumped, a continuous monitoring program is proposed. With such safeguards in place and a continuous monitoring program, the impact of the dredging operation during the construction and as a maintenance activity should be minimal.

(2) **Water Supply -**

Resources have been found to be sufficient in fully operational Fisheries Complex. With the construction of a new water treatment plant by the Phuket Municipal Government, the supply of potable water should not be an issue.

(3) **Air Quality -**

No significant impacts from road traffic or vessel traffic on the existing area of potential impacts.

(4) **Noise-**

Noise during the construction period is unavoidable. The best control measures will be to establish an construction operation timetable that avoids the quiet night time periods

(5) **Vibration -**

While possibly noticeable during the construction period, or coming from the pile driving activity and the movement of heavy equipment, vibration is not expected to be at a level which would cause any health-related or structure damage in the study area.

(6) **Odor -**

Odor problems during the construction period will be negligible. A well organized waste management scheme is planned as well as the establishment of the installation odor control technology, and training in its operation and maintenance.

(7) **Marine Environment-**

An environmental construction guideline, addressing issues such as fuel and equipment management over water will provide a measure of protection. The local siltation from construction dredging will be controlled by silt curtains. In terms of marine organisms, including invertebrates and fish, elimination of any possible impacts or minimal and acceptable impacts, such as small amounts of habitat disruption, small moralities of organisms caught in the dredging operation and some changes in the local-offshore sedimentation deposition rates , are expected .

(8) **Terrestrial Ecosystem -**

To mitigate loss of the existing mangrove, existing mature and healthy trees along the southern shore and and around the eastern perimeter of the facility should be retained, thus providing some habitat for the many bird and invertebrate species identified. A further mangrove replanting program, to replace the trees remove is also proposed.

(9) **Wastewater -**

The project will include a fully functional sewage treatment plant. Furthermore, it is recognized that such a plant needs to be operated by skilled technicians and, to that end, staffing of the plant and training of staff is proposed. To prevent oil spills and to have in place an action plan, in the event of a spill, a detailed oil spill contingency plan was prepared with recommendation to becoming a part of the operating procedures for Harbor Department, and/or FMO

(10) **Fuel and Oil Spills -**

A detailed oil spill contingency action plan was prepared to prevent oil spills and also the clean up actions needed and contacts to be made in the event of a fuel spill.

(11) **Solid Waste-**

Proposed mitigation measures during construction is a) to initiate a recycling and reuse program and b) to provide an ample supply of waste bins, and to assure that waste sorting is organized and pick up and removal is regular and on time., and that disposal is according to Thai regulations. During operations, a similar program is planned with the addition of much larger disposal bins, an educational campaign to use the disposal bins, reuse and recycle waste, and to provide daily waste pick up for disposal at the municipal landfill site.

(12) **Landuse -**

The impacts are expected to be negligible.

(13) **Socio-economic -**

The EIA did not find any evidence that the FC would attract new fishers to the fishery in-shore fishery, thus further increasing the pressure on already over-exploited fish stocks. Overall, the project is expected to improve the overall socio-economic conditions in the study area.

(14) **Tourism -**

The new FC, is expected to dramatically improve this situation since, one objective of the FC management is to convert the FC into a tourism attraction. Even with a fully functional FC, traffic volume will still be within the acceptable limits for congestion-free traffic movement.

(15) **Visual Landscape -**

Assuming that careful architectural treatment is given all elements of the facility, with consideration for visual context of the structures, impacts should be negligible.

(16) **Archaeology -**

Based on a review of historical records and discussions with local historians, no features needing protection were found, this no impacts are predicted.

(17) **Public Health-**

The EIA recommends augmenting the health services with a local health unit and increasing the number of beds in the Phuket City hospital. Details are provided in the EIA document.

(18) **Institutional Capacity -**

In order to competently manage the new facility, particulary the proposed Sewage treatment facility and to monitor FC operations, a number of trained operators and inspectors should be retained. It is suggested that the team of three to four people needs to be established to operate the sewage treatment system plant.

(19) **Environmental Management Plan -**

The implementation sequence of all mitigation measures, responsibility and special measures, were specified in the EMP. The EMP, would become a part of contractual agreements with contractors as well as operators of the FC and associated industries such as the tuna processing factories.

8.7. Summary

The Impacts identified are relatively easily managed, provided that commitments to implement mitigation measures are kept. The net benefits to the local area will outweigh the negative effects. No resettlement or taking of occupied or agricultural lands will be necessary. Only the mangrove will be affected and the dredge materials will be disposed on land. The EIA concluded that with the appropriate mitigation and monitoring measures in place, impact would be easily managed and the project would be environmentally acceptable.