JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

DIRECTORATE GENERAL OF FISHERIES
MINISTRY OF AGRICULTURE
THE REPUBLIC OF INDONESIA

THE STUDY ON COASTAL RESOURCES INVENTORY MANAGEMENT AND ENHANCEMENT IN THE REPUBLIC OF INDONESIA

MAIN REPORT

MARCH 1994

SYSTEM SCIENCE CONSULTANTS INC.

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PREFACE

In response to a request from the Government of the Republic of Indonesia, the Government of Japan decided to conduct the Study on Coastal Resources Inventory Management and Enhancement in the Republic of Indonesia and entrusted the Study to the Japan International Cooperation Agency (JICA).

JICA sent to the Republic of Indonesia a study team headed by Mr. Tamostu Tomiyama, System Science Consultants Inc. four times between October 1992 and February 1994.

The team held discussions with the officials concerned of the Government of the Republic of Indonesia, and conducted field surveys in the study area. After the team returned to Japan, further studies were made and the present report has been prepared.

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

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Indonesia for their close cooperation extended to the team.

March 1994

Kensuke Yanagiya
President
Japan International Cooperation Agency

March 1994

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

Letter of Transmittal

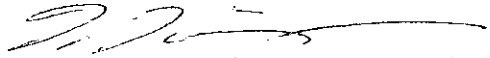
We are pleased to submit to you the report on the Study on Coastal Resources Inventory Management and Enhancement in the Republic of Indonesia. The report contains the advice and suggestions of the relevant authorities of the Government of Japan and Government of Indonesia as well as the fomulation of projects. Also included are the comments made by the National and Regional Steering Committees of the Government of Indonesia during technical discussions on the draft report which were held in Indonesia.

This Study has been conducted by System Science Consultants Inc., based on a contract with JICA, from September 7, 1992 to March 25, 1994. In this Study, we fomulated a regional development plan for each of four model fishing village development areas selected in the Study Area, on the basis of sustainable and rational use of resources, conservation of ecosystems, and promotion of social participation.

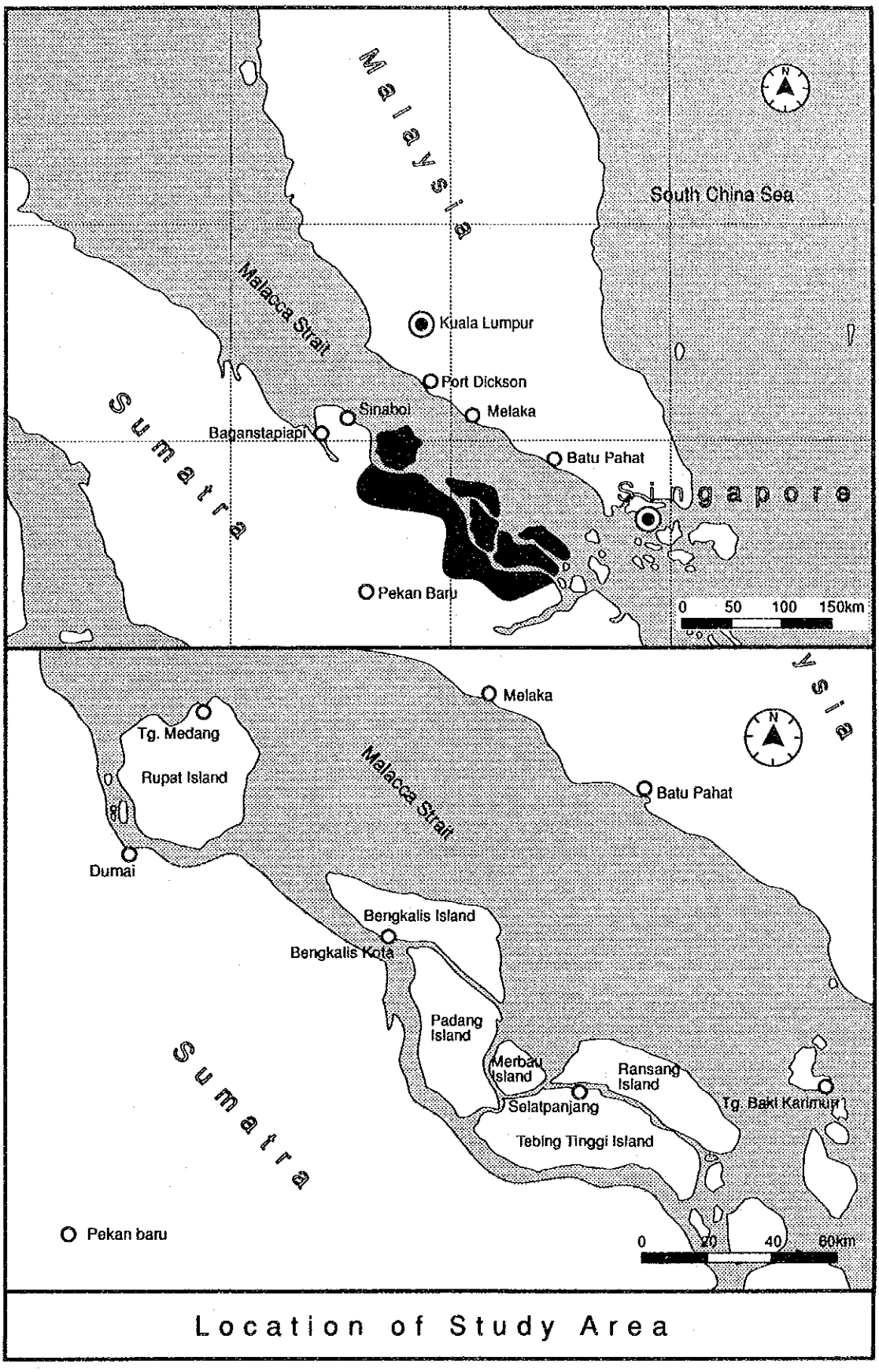
In view of the urgency of developing the coastal resources inventory management and enhancement and of need for socio-economic development of coastal fishing villages, we recommend that the Government of Indonesia will implement this Plan as a top priority.

We wish to take this opportunity to express our sincere gratitude to the relevant officials of JICA, the Ministry of Foreign Affairs and the Ministry of Agriculture, Forestry and Fisheries in Japan. We also wish to express our deep gratitude to the concerned officials of BAPPENAS, DGF and DEPHUT in Indonesia and Embassy of Japan in Indonesia for their close cooperation and assistance extended to the team during the Study.

Very truly yours,



Tamostu Tomiyama, Team Leader,
The Study on Coastal Resources Inventory Management
and Enhancement in the Republic of Indonesia
System Science Consultants Inc.



Location of Study Area

SUMMARY

1. Objective of the Study

The objectives of the study are to formulate coastal community development programes in coastal area of Riau Province based on sustainable and rational resources utilization of ecosystems, and promotion of social participation expecting their contribution to the rural development in Indonesia.

2. Study Area

Eastern coastal areas eastward from the Rupat Island of Kab. Bengkalis in the Riau Province, as shown in attached location map of the Study Area.

3. Current Conditions of the Study Area

3.1 Current Condition of the Fishery Sector

(1) Fishery

The main fishing ground in the Study Area is the Malacca Straits. The fact that the fish catch has shown little change despite the recent increase in the number of fishermen and fishing boats suggests that CPUE has decreased. The fishery resources in the area concerned are presumably used almost up to the limit.

Fishing activities in the Study Area are largely divided into two categories: gill-net/bottom long-line fishings mainly operated in the Malacca Straits, and bag-net fishings using Gombang or Ambai nets mainly operated in the channels between islands. Gill-net/bottom long-line fishings usually use powered boats, and the catch target consists of high-priced fish such as narrow barred king mackerel, wolf herring. These fishes are iced and exported to neighboring countries. The catch target of bag-net fishing consists of anchovies, shrimps, mysids and trash fish. These are mainly caught in the water in front of the villages, using non-powered boats. Harvested anchovies and mysids are consumed within the country, in the form of dried products or salt-pickled guts, meals, etc.

Since all fishing methods using either gill-net, bottom long line or bag-net depend on the tidal current indicated by the special geographic conditions in this water area of the Malacca straits, the operation period is limited to a week before and after the spring tide. Therefore, the operation is possible only about two weeks per month.

(2) Aquaculture

Considering the fish catch of marine fishing in the Malacca straits reaching the upper limit of fishing resources, the Riau provincial government has set up a policy to strengthen an aquaculture development in the fishery sector. The targeted species for the coastal areas concerned are shrimps, giant sea perches, mud crabs, etc., which can be exported. The fruit of the government effort been coming out in the experimental level or in the small-scale private sector level.

There exit wide ranged water areas in the Study Area suitable for aquaculture, and its future development can be much expected.

The main constraints concerned are as follows ;

- Insufficiency of financial, technical and managemental supports by the government, needed by fishermen or their organizations.
- Lack of stable supply system of cheap fry in the Study Area.

(3) Fish marketing

The study area is close to large consumption centers like Malacca and Singapore, just across the Malacca Straits. Most of large size fish caught within the area are exported to these consumption centers. This made Riau Province the largest marine product exporting province in Indonesia in 1990.

There are several export points of marine products along the coast facing the Malacca straits. Since few of them are provided with sufficient service facilities, the quality control of fish catch is not being done well.

The collection and export of marine products are mainly carried out by middlemen of Chinese Indonesians (Tauke). The Tauke lend the money to fishermen to buy fishing boats and equipment, pay the operation expenses, meet living expenses, etc. In return, they buy from fishermen the fish catch at a price cheaper than the market price. Fishermen do not pay interest on the borrowed money, but the system is such that they can only sell the fish to the Tauke who has lent them the money.

(4) Fishermen organization

There are two types of fishermen organizations in Indonesia; KUD and Kelompok. KUD is founded as the place of the local community's activity. Its scope of activities widely extends from agriculture, stock farming and fishes to transportation, electricity, construction and small-scale industry. The Indonesian government created the Ministry of Cooperatives in 1982 to help KUD activities. Kelompok, on the other hand, is a fishermen organization for each field of fishing. The government aim is to organize all fishermen in all the villages into Kelompoks, and to integrate them into the KUD organization. The Kelompok also takes the responsibility of accepting the government's aid to fishermen.

In most of fishing villages in the Study Area, however, the Tauke are in economic control of fishermen, as mentioned above. Therefore it is difficult for fishermen to become free of financial burdens with the Tauke, even after being organized.

3.2 Current Condition and Function of Mangrove Forests

(1) Distribution of Mangrove Forests

It is estimated that some 95,000ha of mangrove forests distributed in the Study Area as of 1976 and some 25,000ha (some 26%) of them have been diminished during some 15 years up to 1991. There are some 70,000ha mangrove forests located in mainly Rupat island, Tebingtinggi island, Bengkalis island and Rangsang island, covering some 26% of mangrove forest in Riau Province.

According to characteristics of secular changes of mangrove coverage, the recent conversion of mangrove forests to other types of land use and the long-standing charcoal production using mangrove trees are the main types of stress on mangrove forests resulting from human activities.

(2) Management and utilization

Mangrove forest management master plan has not yet been prepared in the Indonesia. "Mangrove Forest Greenbelt" is very important regulations for utilization of mangrove forests resources. The mangrove forest greenbelt is defined as protection areas on the coasts around unreserved mangrove forests.

There is currently few official mangrove forest management plan for Riau province. Most mangrove forests in the Study Area belong to designated HPHH[1] areas. Through charcoal manufacturer is mostly a HPHH holder, inhabitants seldom have a direct contract with charcoal manufacturer(s) but freely choose the buyers.

Mangrove charcoal produced in Riau province is mainly exported to either Singapore or Malaysia.

The mean annual volume increment of the *Rhizophora* spp. dominant stand has been estimated to be 1.5 m^3/ha based on the results of observations of this Study (although observations were done in the limited survey period). The minimum mangrove forest area required for producing 1 charcoal kiln is 293 ha.

Therefore, it can be judged that the area of mangrove forests which can allow felling of trees for charcoal production for sustainable utilization is only half of the required area for existing kilns for sustainable utilization after establishment of Mangrove Greenbelts Plan.

1:According to materials given by the Dinas Kehutanan in Riau province. The DEPHUT guides to freeze the issuing of HPHH permit except for yielding of non-wood products since 1989 based on the ministerial decree. Most concession area are likely to have obtained "Minor Forest Products Gathering" permit of HPHH for felling in the Study Area.
In this Study, "HPHH" Stands for the permission to fell mangrove trees in the Study Area.

4. Classification of the Coastal Fishing Villages

Based on the result of field survey in the Study Area, coastal fishing villages are classified into following types, and summarized constraints of each types as follows :

	Type of Fishing Village	Constraints
A :	Fishing village mainly using gill net and/or bottom long line (mainly exporting fresh fish)	
	A1 : A fishing village with funcion of fish marketing center	- Long term stagnation of fish catch - Insufficiency of proper marketing facilities and equipment - Disadvantaged situation of fishermen controlled by middlemen ;Tauke (low income level, lack of economic self-reliance of full-time fishermen) - Lack of fishermen organization with capability of self-reliance
	A2 : A fishing village without of marketing center fishfunction	- Long-term stagnation of fish catch - Lack of marketing facilities and equipment - Low income level ; supplementation of income by other jobs - Lack of marketing system to add more value to fish catch - Lack of fishermen organization with capability of self-reliance
B :	Fishing village mainly using fishing methods utilizing tidal current such as Gombang, etc. (with potentiality enabling development of aquaculture or fish processing using by-product of fish catch)	
	B1 : A fishing village with function of shrimp marketing center	- Long-term stagnation of shrimp catch - Insufficiency of proper marketing facilities and equipment - Disadvantage of fishermen controlled by Tauke - Lack of effective utilization of by-product (trash fish)
	B2 : A fishing village without function of fish marketing center and mainly catching shrimps	- Long term stagnation of shrimp catch - Lack of effective utilization of by-product (trash fish)
	B3 : A fishing village without function of fish marketing center and mainly catching fishes	- Long-term stagnation of fish catch - Low income level ; supplementation of income by other jobs such as mangrove cutting, etc. - Lack of effective utilization of by-product such as; for feed of aquaculture for raw material of value added processed products - Lack of technical, managerial and financial capability for development of aquaculture and processing

5. Selection of Model Areas of Fishing Village Development

5.1 Selection of the Model Areas

The model areas were selected in principle by unit of administrative village and by type of fishing village through the 2 step selection below.

(1) First step selection

Following criteria were applied to all the existing villages in the Study Area:

- The number of fishermen in one village is to be not less than 30.
- The priority is given to the village of which per capita net production value is less than the poverty line of Indonesia (US$160=Rp.320,000) which has been guidlined by UNDP.

(2) Second step selection

In the first step selection, plural candidate villages were selected by each fishing village type. In the second step, following view points have been taken into consideration in order to select one village out of said candidate villages, which can induce maximum development effect.

Fishing Village type	Selection view point
A 1	Present conditions of facilities level as a fish marketing center : To put priority to a village with poor facilities level.
A 2	Accessibility to A 1 type village : To put priority to a village isolated from a fish marketing center but with potentiality of such center function for near-by villages with similar isolated situation.
B 1	The village of this type was not applied as a model area in this Study, because it was judged basic infrastructure for fishing activities of the village has been already provided even though its village level economic condition is below poverty line.
B 2	Villages of this type were not applied as a model area, because these are all above poverty line.
B 3	Possibility of aquaculture development -If yes : To identify as a model area for aquaculture development • To select a village with high availability of land for pond development in the hinterland of mangrove forests -If no : To identify as a model area for fish processing development • To put priority to a village to which public assistance for fish processing is still insufficient • To select a village near to the model area of aquaculture development to minimize the cost for monitoring activity of both model areas

(3) Conclusions of Selection of the Model Areas

Following four(4) villages have been selected as the model areas of fishing village development:

	Type of Model Area	Name of Village
(1)	A1 type village which needs provision of new marketing facilities / equipment and strengthening fishermen organization in order to co-exist with the Tauke	Muntai in Kec. Bengkalis
(2)	A2 type village which needs development of a new marketing system, provision of marketing facilities/equipment and strengthening fishermen organization	Sei Cingam in Kec. Rupat
(3)	B3 type of village which needs development of aquaculture through utilization of by-product(trsash fish) of the Gombang fishing, and transference of part-time fishermen whose main income source is felling mangroves to fish farmer	Pelantai in Kec. Merbau
(4)	B3 type of village which needs development of high value added products through utilization of fish catch of the Gombang fishing	Tlk. Ketapang in Kec. Merbau

5.2 Establishment of Model Mangrove Forest Areas including Model Areas

It is necessary to study the conservation and management improvement plan of mangrove forests from a long-term and wide-ranged point of view. Therefore, decided that an area larger than a model area of fishing village development is established as a "model mangrove areas" with following conditions.

1) The coasts covering the model areas of fishing village development and the neighboring fishing villages
2) The mangrove forests in the model areas of fishing village development; and the coasts where there are the mangrove forests which are adjacent to the mangroves in the model areas
3) The coasts which cover all small-sized concessions (HPHH) set on the coasts of 1) and 2).
4) The coasts which must be managed to establish mangrove areas up to adjacent large scale mangrove forests, of which is considered necessary, for the conservation of coasts and the enhancement of fishery resources.

The agricultural land and the woodland in the hinterland will also be covered in the study because they are expected to be conserved by the management of mangrove forests.

6. Formulation of Policies for Coastal Resource Inventory Management and Enhancement

6.1 Formulation of Policy on Fishery Resources Inventory Management and Enhancement

(1) Policy concerned in the Study Area

a. Policy on management and enhancement of the fishing activities targeted at the fishery resources ranked at the higher position of the food chain system (wolf herring, narrow barred king mackerel, etc.)

1) Enhancement of fishery licensing and monitoring systems

① Enhancement of registration of fishing boats (except non-powered boats) and fishermen based on the existing fishing regulation

② Restrictions on the size and number of fishing gear according to the size of the fishing boat; especially, restriction on the mesh size of the fishing nets

③ Obligation to display the registration sign on the side of the boat in order to enhance the registration of the boats

④ Prevention of operation by unregistered boats, by establishing the fishery supervising system using a small rapid boat (penalties such as removal and confiscation of the fishing gear)

⑤ Ban on specific fishing methods or establishment of the fishing grounds specified by fishing method

2) Establishment of monitoring and analysis systems for the movement of fisheries resources

① Establishment of long-term monitoring and analysis systems for the movement of resources regarding the target species, including their ecology

② Development of an appropriate fishery management method

③ Conduct of an educational activity aimed at fishermen on the importance of management of fishery resources as a part of fishermen organization's activities.

b. Policy on management and enhancement of the fishing activities targeted at the fishery resources ranked in the lower position of the food chain (mysids, shrimps, anchovies, etc.)

1) Establishment, conservation, and management of the coastal green belt areas

2) Restrictions on bag-net fishing : Establishment of appropriate intervals for setting up the Gombang nets

3) Establishment of monitoring and analysis systems for the movement of fishery resources

① Establishment of monitoring and analysis systems for the movement of resources regarding the target species of the bag-net fishing within the channels

② Development of an appropriate fishery management method

③ Conduct of an educational activity aimed at fishermen on the importance of management of fishery resources as a part of fishermen organization's activities

c. Policy on management and enhancement through increasing the income of fishermen by organizing them and the effective and value added use of existing resources

1) Organization of fishermen

① Obligation for recording the volume of the fish catch sold from fishermen to the Tauke

② Establishment and improvement of the fishermen organization to conduct the following activities:

- Setting up of a guideline by the fishermen organizations for the Tauke's purchase prices of the fish catch
- Selling of fish catch by individual fisherman to the Tauke through the fishermen organization and collection of the handling fee
- Handling by the fishermen organization of the administrative procedures for issuing of an export permit
- Employment of the invested funds to each fisherman by the fishermen organization
- Upgrading the fishermen's management capacity and raising their awareness of the resource management through the technical guidance by external personnel

2) Increasing the income of fishermen through an effective use of existing resources

① Upgrading quality of fish catch (raising fish price) through the supply of cheap ice, insulated fish box, etc.

② Increasing fishery-related income by an effective use of existing resources:

- Development of high value added products through utilization of fish catch by the Gombang fishing
- Introduction of aquaculture

③ Study of potential target species other than the existing ones under the current fishing methods, and promotion of their catching methods

- Introduction of trap fishing in the shallow waters

④ Effective use of the undeveloped shallow-water areas:

- Propagation of shellfish

6.2 Formulation of Policies of Mangrove Forest Management and Enhancement

The policies concerned in this Study Area are as follows;

1) To promote the formulation of a regional mangrove forest management plan and the establishment of a plan monitoring system.
2) To prohibit conversion of mangrove forest land in order to either conserve or sustainable utilize the existing mangrove forests to other types of land use.
3) To introduce social forestry to promote local inhabitants' participation for mangrove forest management.
4) To formulate a provisional plan on mangrove greenbelts.
5) To establish field bases for mangrove management and enhancement.

7. Formulation of Regional Development Plan

7.1 Small-Scale Fishery Development Plan

Development policies of the small-scale fisheries of this plan is as follows;

i) Transition from Tauke-dependent fishing activities to independent ones by fishermen themselves
ii) Building up of a basic data-gathering system required for coastal resource management through strengthening fishermen organizations
iii) Establishment of new industries to give additional value to the catch of the bag-net fishing : fish processing and aquaculture

7.1.1 Powered-Boat Fishing Development Project in the Malacca Straits

The model areas for this project are Desa Muntai and Desa Sei Cingam.

The following are the basic strategies of the model area development in this project:

1) Establishment of infrastructural facilities such as landing facilities and ice plant, etc, and operation of these facilities by the fishermen organization
2) Motorization of fishing boats
3) Conversion of the relationship between the individual fishermen and the Tauke into the one between the fishermen organization and the Tauke, on the basis of strengthening the fishermen organization through the establishment of an infrastructure and motorization of fishing boats (establishment of fish catch transactions at the price agreed between the fishermen organization and the Tauke)
4) Prohibition of specific fishing methods and restriction on the mesh size of the fishing nets through the fishermen organization, and prevention of catching the small, low-priced fish, encouraging the selective fishing of large, high-priced fish as the result of said prohibition and restrictions.
5) Fishermen organization acts as an agent for customs clearance procedures for exported fishery products
6) Fishermen organization , records fishing efforts and volumes landed, and gathers basic information required for the resources management of the Malacca Straits

7.1.2 Fisheries Development Project in the Channels between the Islands

(1) Development project in the model areas

The model areas for this project are Desa Pelantai and Desa Tlk. Ketapang.

The following are the basic strategies of the model area development in this project:

1) Use the fish catch by Gombang fishing to feed the cultured giant sea perch and mud crabs, in order to transform the catch to the high-priced product.
2) Produce high-quality dried fish which could be exported by standardizing the drying method of the catch and by providing a processing plant in which the fish can be dried even during the rainy season.
3) Reduce felling pressure of mangroves through transforence of part-time fishermen whose main income source is felling mangrove to full-time ones engaging in above mention.
4) Establish a resources management system, sustainable production system, and marketing system through organizing fishermen.

(2) Fry production center construction project

One of the problems related to the aquaculture activities in the Study Area is that there is no fry production center to ensure a stable supply of low-priced fry. This project will promote the construction of a fry production center for mud crabs and giant sea perch with the capacity to satisfy the demand of the existing aquaculture farms. Since the fry production center has the role of a public facility, it will not be constructed in the model areas, but as a part of the shrimp aquaculture demonstration facility of the Riau province, in Desa Banglas near Selatpanjang.

7.2 Mangrove forest Conservation and Management Improvement Plan

7.2.1 Procedures for Mangrove Forest Resources Management and Enhancement in the Study Area

A mangrove forest management plan and the management system concerned will be established to manage and enhance mangrove forest resources in the Study Area. As establishment of the management system is rather important, it is necessary to establish a system which is capable of promoting appropriate felling practices in accordance with the management plan. Three different management system types are proposed here as the administration-led, the inhabitants' participated and the private business participated system. A close cooperation system or case by case combination among authorities, inhabitants and private business should be established and each responsibility to mangrove forest management should be clearly determined. Required conditions for implementation of these types are as follows :

1) Administration-led management system : It will be necessary to introduce an on-site felling monitoring system by administrative staff.
2) Inhabitants' participated management system : The relevant education and extension system must firstly be established to spread awareness of the need for resources conservation and to stimulate voluntary efforts. It is also desirable to establish a support system whereby a small business loan is provided for local inhabitants for apiculture, soil improvement, etc. in order to consolidate their livelihood.
3) Private business participated management system : Willingness of HPHH concessionaires and charcoal kiln owners to conserve forests shall be inclined by the following incentives:
   - Reduction of or exemption from royalty (IHH) or reforestation fee (DR)
   - Extension of HPHH permit period
   -. Financial assistance

7.2.2 Mangrove Greenbelt Plan

The areas to be conserved in view of the maintenance of the desirable functions of mangrove forests are designated as greenbelts. Greenbelts (mangrove forest greenbelts) are introduced to mangrove forests and marshlands that mangrove forests could be restored.

- Protection measures of greenbelts
  - Coastal Protection Zone (G-I) : No felling will be permitted except for personal consumption by local inhabitants.
  - Mangrove Ecosystem Protection Zone (G-II) : The present level of felling for commercial charcoal production will be permitted in accordance with the standard felling volume. Felling based on the sub-compartment clear felling method (felling area method) will be prohibited.
  - Productive Forest Land (P) : Sub-compartment clear felling will be permitted, according to current measures.
- Width of greenbetls
  - Coastal protection zone:100m towards land from datum tide level along coasts, 50m towards land from datum tide level along river.
  - Mangrove ecosystem protection zone: Mangrove forest area (wide ;130 times the maximum intertidal variation) towards land from datum tide level out of the coastal protection zone.
- Datum tide level : Projection of coastal water line at high tide (as shown on the existing topographical map, scale: 1/50,000) has been adopted as the datum line.
- Maximum intertidal variation : An average maximum tide range of 3m has been adopted based on the tide table for 1993 at Port Bengkalis.
- Rivers : Those with a width of 10m or more are considered to be river, and those with a width of less than 10m are considered to be creeks (tributaries).

7.2.3 Mangrove Forest Management Plan

This Plan provides the foundations for mangrove resources management and enhancement and is a model mangrove forest management plan in the Study Area. The main planning items are as follows.

- Allowable cut of mangrove trees to enable the sustainable use of mangrove forests (yield control by method of annual increment of 1.5m^3/ha)

Whole Study Area :	about 26,000m^3/year in allowable cut, about 60 kilms in allowable number of kilns
Whole model mangrove Areas :	about 2,300m^3/year in allowable cut, about 5 kilns in allowable number of kilns

- Reforestation to restore mangrove stands where their greenbelt function has deteriorated and to increase the resources volume of mangrove forests where the stand conditions have deteriorated (about 330 ha)
- Forest conservation and protection measures required for the management of mangrove forests

7.2.4 Mangrove Forest Management Support Plan

This Plan intends to promote the implementation of the Mangrove Forest Management Plan. A model project of social forestry is planned for inhabitants to participate forest management and in order that excessive felling of mangrove forest against allowable cut can be reduced. The main planning items are as follows.

- Consolidation of inhabitants' participation system (organization and extension)
- Apiculture (beekeeping) mainly in greenbelts and silvofishery in mangrove plantations of brackish marshlands (combined with aquaculture of tilapia and mud crab) and establishment of multipurpose forests (in unused grassland behind mangrove forests aiming at increase in nectar sources, and productivity of cash crop such as rubber, etc.)
- Soil improvement for effective utilization of unmarketable charcoal

7.3 Regional Development Plan by Each Model Area

This regional development plan consists of the small-scale fishery development plan in model areas combined with the improvement plan for conservation and management of mangrove forest, together with road repair works considered necessary for regional economic activities. Regional development plan by each model area and its effort are shown in the next table.

Comparison between Without-case and With-case of Project in Muntai Model Area

	Current situation	With project	Effects
Number of registered fishing boats	Approx. 70	Same as at left	Prevention of the deterioration of resources by limitation of fishing efforts
Number of fishermen	Approx. 150	Same as at left	Same as above
Fishermen organization (Kelompok or KUD)	Kelompok: Insubstantial, inactive	Restructuring the fishermen organization: dynamization of the organization by independent management of fishery-related facilities mentioned below (eventual transition from Kelompok to KUD)	- Financial independence of fishermen households: increase of income, reduction or annulment of financial burdens with Taukes - Increased awareness about fishing through cooperation within the organization: obedience to the law, awareness of resource management, etc - Improvement of quality of fishery-related information for the fishery administration
Fishery-related facilities	None	Installation of landing-related facilities and equipment (mooring, offshore anchoring spot (including access jetty), landing wharf, office, ice machine, insulated room, warehouse, oil and water supply facilities, fishery material store, meeting place, fishing equipment repair yard, boatyard, workshop, equipment (especially refrigeration box, Fish transportation boat, out board engine, etc.)	- Improvement of status as an export base through the enhancement of facility functions - Promotion of separation of the function of fishermen and Taukes: production by fishermen, marketing by Taukes - Establishment of the quality of fish catch - Realization of stable operation
Ice plant facilities	Electricity by generator (private-run) or transport from other areas (Taukes): block ice, high price	Solar power generation + stand-by generator (operated by fishermen organization): cube ice, low-price supply, supply of insulated box	- Establishment of ice supply system with low running cost - Improvement of quality of fish catch through the supply of ice to the organization members -->increase in selling price - Improvement of cooperation with Taukes by selling them the ice cheaper than the market price through the fishermen organization
Sales of fish catch	Export by Taukes (fixing of price by the Tauke only)	Export by Taukes or the fishermen organization by its own cargo boat (fixing of price upon agreement)	- Increase in selling price from fishermen to Taukes - Reduction of the margin obtained by Taukes
Fishery administration	Report to the Fishery Authority by Taukes (partial information on the volume of landed fish)	Fishermen organization serves as the agency for recording and gathering the fishery-related information and for export management operations	- Establishment of trust between the fishery administration and fishermen - Secure tax revenues based on the law
Resource management	Fishery resources: insufficient management for execution of Fisheries Act Mangrove resources: lack of mangrove forest management and utilization plan	- Institution of a monitoring system for actual condition of fishery (record of fishing activities by the fishermen organization) - Limitation of fishing efforts [limitation of the number of fishing boats and equipment, restriction on certain equipment (restriction on the mesh size of gill net, ban on Jaring Kurau, etc.)] - Establishment of mangrove forest management field office - Afforestation of mangroves	- Supply of accurate information to the fishery administration - Increase in the price of fish through realization of sustained use of resources and improvement of the size of fish - Improvement of the residents' awareness regarding the conservation and use of mangrove forests - Expansion of nursery area for fishery resources, prevention of the erosion of coastal area
Road repair work, etc.	During the rainy season: transportation by car between the city of Bengkalis and Muntai is impossible	- Reinforcement of the section with soft ground only	- Realization of smoother commodity transport during the rainy season

Comparison between Without-case and With-case of Project in Sei Cingam Model Area

	Current situation	With project	Effects
Number of registered fishing boats	Approx. 40	Same as at left	Prevention of the exhaustion of resources by limitation of fishing efforts
Number of fishermen	Approx. 80	Same as at left	Same as above
Fishermen organization (Kelompok or KUD)	Kelompok: insubstantial, inactive	Restructuring the fishermen organization: dynamization of the organization by independent management of fishery-related facilities mentioned below (eventual transition from Kelompok to KUD)	- Financial independence of fishermen households: increase of income - Increased awareness about fishing through cooperation within the organization: obedience to the law, awareness of resource management,etc - Improvement of quality of fishery-related information for the fishery administration
Fishery-related facilities	None	Installation of landing-related facilities and equipment (landing jetty, mooring jetty, landing wharf, office, ice machine,insulated room, warehouse, oil and water supply facilities, fishery material store, meeting place, fishing equipment repair yard, boatyard, housing for researchers, equipment(especially refrigeration box, Fish transportation boat,outboard engine,etc.)	- Revitalization of the coastal area through the establishment of a new export base - Promotion of separation of the function of fishermen and Taukes - Improvement of the quality of fish catch - Realization of stable fishing operation
Ice plant facilities	None (only those brought in by Taukes from outside): block ice, high price	Solar power generation + stand-by generator (operated by fishermen organization): cube ice, low-price supply, supply of insulated box	- Improvement of quality of fish catch through the supply of low-priced ice to the organization members - Increase in selling price - Establishment of cooperation with Tauke by selling them the ice cheaper than the market price through the fishermen organization
Sales of fish catch	Export by Taukes (fixing of price by the Tauke only)	Export by Taukes or the fishermen organization by its own cargo boat (fixing of price upon agreement)	- Increase in selling price from fishermen to Taukes - Reduction of the margin obtained by Taukes
Fishery administration	None (the Fishery Authority is unable to control fishing activities)	Fishermen organization serves as the agency for recording and gathering the fishery-related information and for export management operations	- Establishment of trust between the fishery administration and fishermen - Secure tax revenues based on the law
Resource management	Fishery resources: insufficient management for execution of the current Fisheries Act Mangrove resources: lack of mangrove forest management utilization plan	- Institution of a monitoring system for actual condition of fishery (record of fishing activities by the fishermen organization) - Limitation of fishing efforts [limitation of the number of fishing boats and equipment, restriction on certain equipment (restriction on the mesh size of gill nets, ban on Jaring Kurau)] - Promotion of test fishing in the shallow waters southeast of Rupat Island (propagation of blood cockle, introduction of trap fishing,etc.) - Establishment of mangrove forest management field office - Afforestation of mangrove and supplementary planting in low and spare stands	- Supply of accurate information to the fishery administration - Increase in the price of fish through realization of sustained use of resources and improvement of the size of fish - Improvement of the residents' awareness regarding the conservation and use of mangrove forests - Increase in production and income through the effective use of unexploited shallow-water areas - Expansion of nursery area for coastal fishery resources
Road repair work, etc.	- Inconvenience to commodity and passenger transportation due to poor condition of the road within the area - Poor access to the preferred sites for the fishing base	- Upgrade the roads linking the bases within the area and improve the convenience of transport - Preparation of the site for the housing of fishermen moving in	- Smoother distribution within the area - Improvement of access to the new base

Comparison between Without-case and With-case of Project in Pelantai Model Area

	Current situation	With project	Effects
Number of fishermen	Approx. 150 : Dusun Pelantai ; full-time fishermen Dusun KengKam : 14 full-time fishermen Others are mainly engaged in mangrove felling and work as side-business fishermen	Secure a sufficient number of personnel for the project from among the side-business fishermen who are mainly engaged in mangrove felling	Limitation of mangrove felling through the diversion of the fellers to other jobs
Fishermen organization (Kelompok or KUD)	None	Organize new fish-farming Kelompok through the intermediation of the fish-farming facilities	- Improvement of the fishermen's awareness of fishery through cooperation within the organization: obedience to the law, awareness about resource management, etc. - Improvement of quality of fishery-related information for the fishery administration.
Fishery-related facilities	None	- Fishing equipment and boats for Gombang fishing - Aquaculture facilities for crabs and giant sea perch feeding on the trash fish caught by Gombang fishing (fish farm in the pond behind the mangrove forest (crabs), breeding cage with in the Asam channel (giant sea perch), and the incidental facilities (office, warehouse, cold storage, etc.) - Fry production center in Desa Banglas	- Establishment of the fishermen organization through installation of new production facilities - Generate added value by converting the existing low-priced resources (trash fish) into high-priced cultured fish
Sales of cultured fish	Small-scale gill-net fishing and bag-net fishing (fish catch: consumed within the village)	Through Kelompok: - Giant sea perch : Fry fish obtained by nursery culture are sold to private fish farmer - Mud crabs: domestic sales of cultured crabs	- Secure a greater income than through mangrove felling
Fishery administration	None	Kelompok reports on the activities to the fishery administration	- Establishment of trust between the fishery administration and fishermen - Supply of accurate information to the fishing administration - Improvement of management of the fishery resources obtained through bag-net fishing within the channel
Resource management	Fishery resources: insufficient management for execution of the current Fisheries Act Mangrove resources: lack of mangrove forest management utilization plan	- Limitation of mangrove felling by diverting the fellers to fish farmers - Establishment of mangrove forest management field office - Afforestation and management on marshlands with low vegetative cover and the platforms in the crab farming pond	- Improvement of residents' awareness regarding mangrove forest conservation - Limitation of felling in the existing mangrove forest - Expansion of nursery area through afforestation of unexploited land

Comparison between Without-case and With-case of Project in Tlk. Ketapang Model Area

	Current situation	With project	Effects
Number of fishermen	256 (originally living on day work such as mangrove felling, approx. 60 households converted to Gombang fishing through government assistance, and 40 more households through another project)	Intended for the fishermen engaged in the Gombang fishing project under government assistance, approx. 120 households	- Realization of resource management in a limited area within the Asam channel through limitation of fishing efforts
Fishermen organization (Kelompok or KUD)	Kelompok	Enhancement of functions of existing Kelompok through independent operation of processing facilities mentioned below	- Improvement of the fishermen's awareness of fishery through cooperative activities based on the production of dried products under a single standard
Fishery-related facilities	Banliau (drying platform for harvested fish: no processing in case of rain) owned by each Gombang fisherman	Processing facilities for dried anchovies and mysids using a processing method that ensures exportable quality (covered drying ground, cold ware house, office, meeting place, boiler, jetty, marketing hall, etc.)	- Realization of stable processing project by such processing facilities and equipment that enable the production in case of rain - Generate added value by processing the existing low-priced resources (mysids) into high-priced dried products
Sales of processed fish	Domestic sales of dried fish, mainly anchovies (large price fluctuations due to uneven quality of the products because of the weather or difference in processing technology depending on the individual fisherman)	Domestic sales by Kelompok and export through the model fishing village project coordination committee (in the Fishing Authority by Kabupaten level (Prefectural))	- Increase of income through the constant production of high-priced dried products (anchovies) with a single standard regardless of the weather (domestic sales and export)
Fishery administration	Kelompok reports on its activities to the fishery administration	Report on the activities to the fishery administration as an extension of the current government assistance project	- Establishment of trust between the fishery administration and fishermen - Supply of accurate information to the fishery administration
Resource management	- Fishery Resources : Installation of Gombang nets in conformity with the law - Mangrove resources: lack of mangrove forest management utilization plan	- Kelompok monitors whether or not the current Gombang net installation method is appropriate - Establishment of mangrove forest management field office - Installation of green belt and monitoring of felling conditions - Realization of examination projects; apiculture, soil improvement, etc.	- Improvement of residents' awareness regarding greenbelt conservation - Supply of basic information for development of mangrove forest-related project

6.4 Project Cost Estimation

Total project cost is as follows.

Total Project Cost

Unit : Rp. 1,000

Model area	Small-scale fishery development plan	Mangrove forest conservation and management improvement plan	Total
Headquaters	10,940	-	10,940
Muntai	4,192,508	2,247,797	6,440,365
Sei Cingam	2,745,414	1,297,575	4,002,980
Pelantai	2,050,872	552,601	2,603,473
Hatchery	1,115,455	-	1,115,455
Tlk. Ketapang	1,025,535	45,672	1,071,207
Total	11,140,724	4,143,645	15,284,369

7.5 Conditions for Implementation of the Plan and Management and Operation System

7.5.1 Conditions for Implementation of the Plan

(1) Conditions of the implementation system

Prior to implementing this overall plan, it is at least necessary to cooperate with the DGF of the Ministry of Agriculture and Ministry of Forestry. It is also possible that relations with Ministry of Population and Environment, and National Science Institute, etc., will be required. The plan involves issues with which coastal residents are not familiar, such as operation of a fishery base, organization of fishermen, introduction of aquaculture and processing, afforestation, etc. It will be difficult to implement each project without a support system. Therefore, the following conditions are needed to be fulfilled when implementing the plan:

a. It is essential to establish in BAPPEDA a "Project implementation coordination committee" that unifies the projects of each model area, to coordinate the opinions of relevant agency.

b. Effective and continued instruction on organization, technology, management and marketing are necessary when implementing this plan. However, the local administration does not have adequate personnel with the qualifications and fund source to provide such instruction. It will therefore be necessary to call for outside instruction for the first three to five years of the plan.

c. Fishermen or local residents who will be the direct beneficiaries of the plan have not received sufficient education. They need to be reorganized, and the instructors should try to get to know the fishermen and local residents better through the creation of the "Advisory committee for operation and management," which should include not only staff from public sectors but also locally respected educators and religious leaders.

(2) Conditions of the project fund

On the assumption that the catchable fishery resources in this area has almost reached the upper limit, the fishery development plan in the overall plan contents only the improvement of the added value of the fishery products as its benefits. Therefore, no significant increase in the fishermen's income can be expected. Even less direct benefit to the local residents is expected in the mangrove forest conservation and management improvement plan. This leads to the conclusion that the project will not be accomplished unless some portion of the project fund is subsidized by the government. The following methods are required to procure funds:

i) Recoverable investment: low-interest loans
ii) Unrecoverable investment: government subsidiaries or foreign cooperation grants
iii) All or part of technical assistance for management and operation of the projects: technical cooperation grants

7.6 Project Evaluation

As for the small-scale fishery development plan in each model area , its daily operation and facilities renovation will not incur any difficulty since the profit before payment of interest and depreciation is surplus.

Conditions of the capital recovery was evaluated under the assumption that the construction capital would be financed by government credit without interest and long-term government loan by the following low-interest conditions ;

Conditions for financing

- Annual interest: 3%
- Grace period for repayment of the capital: 10 years
- Repayment period: 30 years (including the grace period)

In the above assumption, the overall fishery plan will not stand financially without an subsidy of approx. 30% of the total capital, because all of the projects will not be able to recover the invested capital except the aquaculture project. It is necessary to subsidize some portion of the project fund for each model area mentioned below.

Model area	Subsidy	Reason not to recover the invested capital
Muntai	about 50%	Required amount of construction cost for breakwaters, jetties and solar systems is so large to compare annual landing volume of about 103 tons.
Sei Cingam	About 40%	Required amount of construction cost for jetties and solar system is so large to compare annual landing volume of about 61 tons (in year 2002).
Pelantai/Hatchery	No need	-
Tlk. Ketapang	About 10%	Due to large construction cost for all- weather drying place.

Once the afforestation and experimentation projects are over, maintenance and management fees will not be required in the mangrove forest conservation and management improvement plan. Thereafter, there will be only a little expense for mangrove forest inspection by the officials. Therefore, the operation cost and profit can be considered as nil.

Only in the Pelantai model area, mangrove forest conservation and management improvement project will be integrated in the small-scale fishery development project. Although the small-scale fishery development plan in Pelantai will stand financially without subsidies, there are not enough funds to cover mangrove afforestation. Therefore, when the integrated operation system is launched, subsidies for mangrove afforestation will be still necessary.

The mangrove forest conservation and management improvement plan in the model areas other than Pelantai will also require total subsidy (100%).

As stated above, sufficient revenue which enable the project financially feasible, cannot be expected from the mangrove afforestation project. Most of the expenditure in the afforestation project is the personal expenses. The employment opportunity and income of inhabitants in each model area will be increased as shown below:

Model area	Increased income by the project	Period
Muntai	588 M Rp./year (Yearly Income of about 300 persons)	1995 - 1997
Sei Cingam	544 M Rp./year (Yearly Income of about 270 persons)	1995 - 1996
Pelantai	233 M Rp./year (Yearly Income of about 120 persons)	1995 - 1996

It is expected that apiculture on which the project will implement the experimentation, will bring inhabitants the increase of side income of future, and soil improvement by the use of unmarketable charcoal will also bring the increase of income through improvement of productivity.

Considering indirect benefits with as the nursery function of mangrove forest to fisheries resources and income increase of inhabitants, etc., it is clear that the mangrove conservation and management will lead to the sustainable utilization of coastal resources, even though it requires total subsidy for project cost.

8. Conclusions and Recommendations

8.1 Conclusions

(1) Policies for coastal resources management and enhancement

1) Fishery resources management

- Although the fishing effort in the Malacca Strait has been increasing in recent years, the total catch volume is stagnating, and the CPUE is clearly on the decline. For reasons of resources management, any further increase in fishing effort should be avoided.
- Fishery resources management requires an information-gathering system with high accuracy regarding fishing activities. In order to establish such a system, it is necessary to seek for the financial independence of fishermen and to establish a sound fishermen organization.
- The most effective way to achieve the financial independence of the fishermen in the Study Area should be based on the added value gained by improvement of product quality, and promotion of fish-farming, etc. and not an increase in the fishing effort.

2) Mangrove forest conservation and management

It is necessary to adopt a regional mangrove forest management plan from long-term viewpoints, based on scientific grounds relative to the regeneration and growth volume of the mangrove forests . It is also necessary to institute a monitoring system for related information and data. In this plan, a "mangrove forest management field office "tentative name) will be attached to each fishery development base and projects of afforestation and experimentation will be implemented. For the operation of those projects, cooperation of various relevant agencies led by forestry related institutions such as Cabang Dinas Kuhutanan, is required.

- A green belt should be established in the coastal mangrove forest zone.

- In case a green belt is set up in the model mangrove forest area, the production capacity of the existing charcoal kilns is estimated to be twice the total allowable cut of the mangrove forest outside the green belt. It will be necessary to reduce the number of existing charcoal kilns by half.
- The study area includes the marshlands (with and without low vegetative cover) that have the potential to become mangrove forests through re-afforestation. Afforestation of these lands will contribute to increase in the greenbelt function of the fishery resources and to prevention of one of coastal erosion. However, these results will hardly be visible to the coastal residents and will take more than 15 years until the residents enjoy the returns. Therefore a social forestry method with the participation of fishermen has been adopted for the mangrove re-afforestation in this plan, so that the results will be felt directly by the local people.

(2) Significance of project implementation

The fishery development plan will achieve planned effects if a certain proportion of public subsidy is provided. On the other hand, the mangrove forest conservation and management improvement plan is not expected to give any results that can be evaluated financially. Since sufficient data can not be collected at this stage to make a scientific and quantitative evaluation in this field, we should aim at a qualitative evaluation from long term view points. Results of the existing scientific studies suggest that the vast coastal mangrove forests of Indonesia play an important role in the nursery area of the country's fishery resources.

It is therefore considered significant to implement this overall plan as a model development including the mangrove conservation and management improvement plan from the standpoint of national interest.

8.2 Recommendations

The model areas selected in this plan are put under economically less advantageous conditions in the Study Area. By realizing the plan and by evaluating the results obtained, the fruit can be applied to other regions to contribute to improvement of the standard of living of the coastal population.

The following suggestions are made in relation to the conclusions of this Study.

(1) Fishery development field

1) Government response to the implementation of the model regional development plan : To set up a new fishing regulation to prevent the fish catch smaller than the present size and apply it to the entire Study Area.
2) Assistance to the fishermen organization : Not only to provide the investment fund but also to build an effective support system for fishermen, one that takes into account the "software" - management of fishermen households and their organization (e.g. introduction of long-term instruction system by experts).
3) Improvement of marketing system of fishery product : To build up a marketing system that will increase the fishermen's income (and limit the Tauke' margin).

(2) Mangrove forest management field

1) Formulation of the mangrove forest management plan : To reflect the present condition of Riau province to "natural strategies for mangrove forest management" which is under preparation by the central government. As a temporary solution, Riau province should compile its own mangrove management plan as soon as possible.
2) Mangrove resources management system

Three types of the mangrove management system ; administration-led system, inhabitants' participated system and private business participated system, have been proposed in this plan. Prior to implementing the plan adopting any of these systems, following points are to be examined ;

- A purchased method by charcoal manufacturers that can clearly specify the mangrove felling area.
- A monitoring system of mangrove trees which are not marketed through charcoal manufacturers.

2) Clarification of the distribution price system of charcoal production : To clarify the distribution price structure of charcoal and seek measures to raise the price of lumber.
3) Improvement of production method of mangrove charcoal

The occurrence rate of unmarketable charcoal is very high. The research work on improvement of the structure of charcoal kilns, production

procedure, etc. is to be led by the government.

4) Strengthening technical support to the mangrove forest management

Continuous technical support by the government is required to the following items :

- Growth speed of mangrove trees by region
- Counter measures of illegal felling in a greenbelt zone
- Project evaluation of apiculture, soil improvement using unmarketable charcoal, etc.

(3) Environmental considerations :

To enhance the administrative guidance and restrain the violations such as illegal dumping of waste oil from tankers through the relevant agency.

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ABBREVIATIONS

APBD	:	Anggaran Pendapatan dan Belanja Daerah	Regional Income Budget
APBN	:	Anggaran Pendapatan dan Belanja Negara	Natiional Income Budget
BAPPEDA	:	Badan Perencanaan dan Pembangunan Daerah	District Planning Board
BAPPENAS	:	Badan Perencanaan Pembangunan Nasional	National Development Planning Board
CDK	:	Cabang Dinas Kehutanan	Branch Office of Dinas Kehutanan
DPK	:	Dinas Perikanan Kabupaten	Fishery Department of Kab. Bengkalis
CPUE	:		Catch per Unit of Effort
DEPHUT	:	Departemen Kehutanan	Ministry of Forestry
DGF	:		Director General of Fisheries
DJINTAG	:	Direktorat Jenderal Inventarisasi dan Tata Guna Hutan	Directorate General of Forest Inventory and Land-Use Planning
DPP	:	Dinas Perikanan Propinsi	Fishery Department of Riau Province
HPH	:	Hak Pengusahaan Hutan	Large concession
HPHH	:	Hak Pemungutan Hasil Hutan	Small concession
IHH	:	Iuran Hasil Hutan	Forest Product Royality
Kab.	:	Kabupaten	District, Regency
Kanwil	:	Kantor Wilayah Departemen Kehutanan	Regional Forestry Office
Kec.	:	Kecamatan	Sub-District
KEPRES	:	Keputusan Presiden	Presidential Dicision
KLH	:	Kementerian Lingkungan Hidup	Ministry of Population and Environment
KLN & PM	:	Biro Kerjasama Luar Negeri dan Penanaman Modal	Bureau of Foreign Cooperation and Investment
KUD	:	Koperasi Unit Desa	Multi-purpose Village Cooperative
LIPI	:	Lembaga Ilmu Pengetahuan Indonesian	Indonesian Institute of Science
PKT	:	Pengembangan Kawasan Terpadu	Integrated Area Development
PPI	:	Pusat Pendaratan Ikan	Fish Landing Place
TGHK	:	Tata Guna Hutan Kesepakatan	National Forest Land Use Plan, National Forest Land Use Category
TPI	:	Tempat Pelelangan Ikan	Fish Marcket

1. Introduction

1. Introduction

1.1 Background

In the fifth five years plan (REPELITA V), the government of Indonesia has mentioned the relation between national resources and environmental conditions, and targeted development of its natural resources regarding the sustainable development and consideration for the environment as most important.

On the other hand, since the population of the country is still increasing at the annual rate of 2 percents, many people suffering from unemployment and severance of the living tend to settle in the coastal areas depended on rich productivities of the coastal ecosystem.

As a result, the destruction of the coastal ecosystem has been expanded by over felling of mangrove forests, over fishing, etc. Lives of the coastal people, especially fishermen, who have been traditionally depended upon productivity of the coastal ecosystem, are now threatened by such natural destruction, which may cause social instabilities.

Under such situation the Government of Indonesia requested the Government of Japan to formulate a model development program of coastal fishing community areas on the basis of sustainable and rational use of resources, conservation of ecosystem and promotion of social participation.

The Government of Japan implemented a project formulation study on environmental field in Indonesia in November 1990, and recognized the necessity of implementation of requested study. Based on the results, the preliminary survey mission was dispatched by the Government of Japan in December 1991, and agreed with the Government of Indonesia on the scope of work of conducting the Study on Coastal Resources Inventory Management and Enhancement (hereinafter referred to as "the Study").

1.2 Objective of the Study

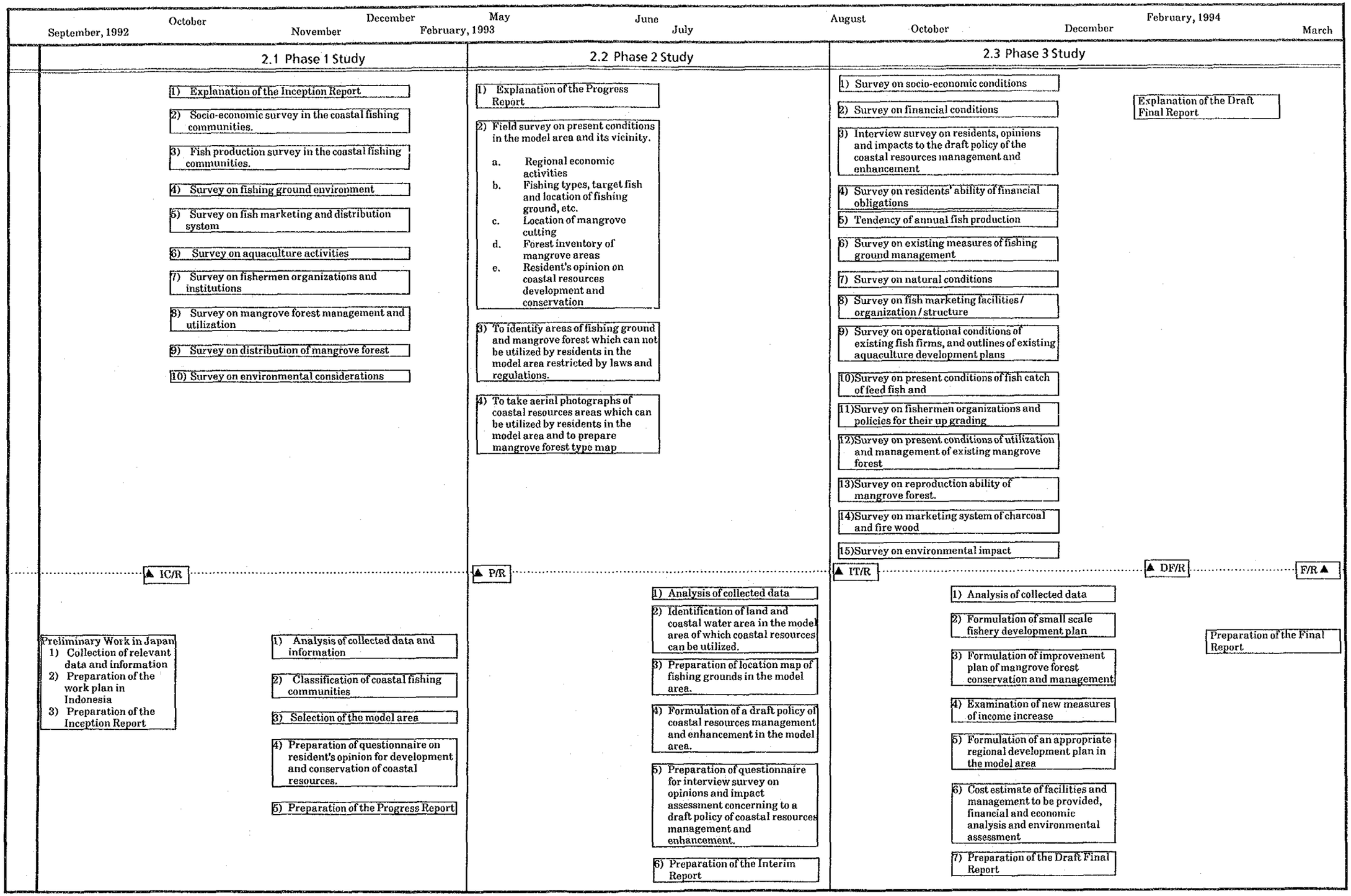
The objectives of the study are to formulate coastal community development programes in coastal area of Riau Province based on sustainable and rational resources utilization of ecosystems, and promotion of social participation expecting their contribution to the rural development in Indonesia.

1.3 Study Area

Eastern coastal areas eastward from the Rupat Island of Kab. Bengkalis in the Riau Province, as shown attached location map of the Study Area.

1.4 Work Flow

The work flow chart of the Study is shown in next page.



Flow Chart of the Study

2. Existing Conditions of the Survey Area

2. Existing Conditions of the Survey Area

2.1 Development Plan of the Study Area

2.1.1 National Development Plan

(1) Outlines of the national development plan and Riau province development plan

Indonesia defines its objectives and strategy for development in the Fifth Five Year Plan (hereinafter referred to as REPELITA V : 1989/90 - 1993/94) which can be explained as follows:

Development objectives

- Maintain a balance between development and the environment from a long-term, sustainable point of view: REPELITA V is the final stage of the nation's twenty-five-year plan that positions natural resources and the environment as a heritage to be handed over to the next generation. It states that the way to achieve important economic growth is to attach great importance to ecology in the management of natural resources, and to manage the resources in such a way that a maximum contribution to the actual development and prosperity will be achieved.
- Contribute to eliminating poverty: The population suffering from poverty is concentrated in the coastal areas and surrounding swamp areas, especially on the east coast of Sumatra island and on the north coast of Java island. In order to tackle the growing population that is the main cause of poverty, promote the enhancement of family planning, efficient management and use of natural resources, and measures against internal migration.

Development strategy

- Investigation and evaluation of natural resources and the environment: Establish a natural resource location and the distribution map, and develop an information and evaluation system.
- Protection of forest, land and water resources: Conserve the fluvial ecosystem, protected forests and genetic resources.
- Improvement of the capacity for management of natural resources and environment: To be based on improving the awareness and participation of local residents.
- Development of the coastal areas: Develop with consideration to the environment of the coastal community and conservation of the coral reef, mangrove forests and marine ecosystem.
- Rehabilitation of the land and forests where destruction continues.

- Internal migration and development of the model for the effective use of resources: There is a plan as a part of the migration policy to move the fishermen of eastern Sumatra and the north coast of Java to eastern Indonesia, where there is a high potential for fishery development. For this purpose, a model will be developed regarding the sustainable and effective use of natural resources in the new land.

(2) Outline of development plan of Riau province

Based on the basic policies endorsed by REPELITA V, the two major objectives of development activities in Riau province are given below.

1) Establish balanced development which will improve the assets and living standards of the inhabitants of Riau province
2) Development activities will be concerned with the moral as well as material well-being of its inhabitants, in accordance with Pancasila.

In addition to the aforementioned, economic development is also targeted and priorities in this area are as follows:

1) Measures which will contribute to development in the agricultural sector, by processing raw materials which are available within the province will be implemented. However, this activity will be carried out within the following framework.
   a. Improve the income of inhabitants and government revenue
   b. Provide greater employment opportunities
   c. Achieve a balanced regional economic structure
2) In addition to measures which target improvements in the economic sector, improvements will also be aimed at the social, cultural, political, defense, etc. sectors as well.

Socio-economic development policies of Riau province will be based on the aforementioned; and the relevant sectors are the agricultural sector which include water resources, the industrial sector which include transportation, and the tourism sector.

Riau province will be divided into six regional zones and the following policies have been formulated for each region.

Region I

Area	: Pekanbaru, eastern Kab. Kampar
Center	: Pekanbaru
Relevant sectors	: Industrial, mining, agriculture (particularly plantations)
	- Pekanbaru will be the center of education, public health, and commerce.
	- Development activities in eastern Kab. Kampar will be implemented at the same level of other regions.

Region II

Area	: Western Kab. Kampar
Center	: Pasir Pangarayan
Relevant sectors	: Agriculture (particularly plantations, production of food grains), industrial, tourism,

- Mining, and energy (particularly improvements in hydraulic power at Kota Panjang)
- Kota Tandun and its neighboring areas will be the center of commerce.
- Pasir Pangarayan will be the center of local government.

Region III

Area	: Bengkalis
Center	: Dumai
Relevant sectors	: Mining, industrial, agriculture, tourism

- Development activities will take environmental conditions into consideration.
- Dumai will not only be the center of development activities, but will also function as the center for industrial and commerce.
- Improvements to Dumai port will allow it to handle not only petroleum, but other export products as well.

Region IV

Area	: Indragiri Hulu, Indragiri Hilir
Center	: Rengat
Relevant sectors	: Agriculture, industrial, mining (particularly Indragiri Hulu)

- Rengat will function as the the center of development activities.
- The road connecting Rengat, Tembilahan, and Kuala Enok will be improved.
- In order to develop the plantations in this region, it is necessary to prepare a development plan promoting the port at Kuala Enok as an export point.

Region V

Area	: Kab. Kepulauan Riau
Center	: Tg. Pinang
Relevant sectors	: Agriculture (particularly plantations and the fisheries), industrial, mining, and tourism

- Development activities will take environmental issues into consideration.
- Tg. Pinang will function not only as the center of development activities, but will become the center for commerce, education, public health, and tourism.

Region VI

Area	: Batam
Center	: Batu Ampar
Relevant sectors	: Industrial, agriculture (particularly the fisheries and livestock industries), and environmental sector - Development of the industrial sector will be emphasized, in accordance with Presidential Decree 41 (1973). - Development activities will take physical, social, and cultural aspects into consideration.

2.1.2 Fishery Development Plan

(1) Goals, policies, and strategy of REPELITA V (1989-1993)

1) Basic policy on natural resources and environmental protection of REPELITA V

REPELITA V is the last stage of the First Long-term Development Plan (25 years) and its goal is economic taking off. Its basic policy is inherited from REPELITA IV and its goals are to improve the life of the populace and to build a strong economic foundation for the next stage of development.

In addition, the condition for economic growth achievement requires natural resources management that insures sustainable development of natural resources, in accordance with the stance that natural resources and the environment are assets to be inherited by the next generation.

Chapter 8 of REPELITA V entitled, "Protection of Natural Resources and the Environment", stipulates that the basic policy of environmental protection measures is rooted in sustainable development and an outline of the basic policy is given below.

- By protecting the abilities and functions of the ecosystem, its sustainability will be improved.
- Technology which will ensure sustainable development of natural resources will be used as much as possible.
- In sectors other than natural resources and environment, sustainable development measures will be adopted, irrespective of duration or region.
- The supply and sustainability of natural resources by the ecosystem will be protected and its functions will be preserved and improved.
- Conservation measures will be based on the functions and abilities of the ecosystem and its processes will be utilized.

2) Development goals, policies, and strategy in fishery sector

An outline of the goals targeted in REPELITA V for fishery sector is given below.

- Fisheries will provide a source of food for the populace, particularly animal protein.

- A source of hard currency will be procured by promoting aquaculture in coastal, brackish water, and fresh water areas.
- A source of hard currency will be provided by strengthening fishing within the EEZ and offshore waters.
- Protection and guidance measures for petty aquaculture operators and fishermen will be strengthened, in order to raise fishermen income levels and to develop the coastal communities.
- Private enterprises and fishermen organizations will play an important role in development measures.

A concrete strategy based on policies emphasizing development of technology, educational training, improvement of facilities and marketing system, incorporating efforts by the private sector, strengthening fishermen organizations, etc. is outlined below.

- Study measures to strengthen, expand, and diversify fishing and aquaculture production and to regenerate resources.
- Increase productivities of fish and shellfish that are competitively viable in the market and high value added.
- Improve fishing ports and surrounding facilities.
- Strengthen fishing ability by motorizing and modernizing fishing boats and fishing gear.
- Develop new fishing grounds and offshore fishing operations.
- Strengthen government support for incorporation with foreign capital and formulation of joint enterprises.
- Increase production and employment opportunities by introducing new technology.

3) Recognition of DGF in coastal environment conservation

Fishery sector is in an administrative situation directly affected by destruction of coastal ecosystems such as mangrove forests, coral reefs, etc.; and therefore, DGF strongly recognizes the importance of conserving the coastal environment. Although the DGF does not have direct jurisdiction over the ecosystems on land, such as the mangrove forests, etc., it has incorporated measures to develop the coexistence of both coastal environmental conservation and coastal fisheries development, since both aspects are essential in implementing measures related to the preservation of the livelihood and production of the inhabitants.

(2) Fisheries Development Plan in Riau Province

1) Basic policy and development goals

In accordance with the development plan for fisheries set forth in REPELITA V, the Riau provincial government formulated the Fisheries Development Plan for the province in 1989/1990- 1992/1993. The goals regarding fishery production given in this plan are to increase and improve fishery productivity to meet consumer demands, and to raise fishermen income by providing raw materials for processing for domestic and export use, in addition, to increase employment opportunities in fishing for the coastal villages.

A high priority has been placed on measures to develop the coastal fishing villages and its surrounding environment, in order to eliminate the socio-economic imbalance via promotion of industry in the villages.

The annual growth rate in fishery production volume was 2.48 percent during the period of REPELITA IV. The average annual growth rate for fishery production volumes targeted during REPELITA V is 2.5 percent. The annual growth rate for 1990 and 1991 surpassed the targeted goal at 2.65 and 6.31 percent, respectively.

2) Development projects

The fishing grounds in Riau province are divided into three areas which are located in the Malacca Straits, the South China Sea, and the inland waters. In the Malacca Straits, the fish catch has recently become stagnant; and its resources exhaustion is being worried. In recent years the production volume of the fishing grounds in the Malacca Strait has peaked and the possibility of resource depletion has become an issue. In view of these circumstances, the provincial government no longer issues fishing licenses for new applicants seeking to begin fishing operations in the Malacca Straits; and it has begun to promote fisheries development in the South China Sea instead.

Fishery development projects formulated and implemented by the provincial government are shown in Table 2.1. Approximately 4,500 million rupiahs (about 11.5 percent of the total budget) has been allocated for 11 projects in fishery production, which range from fishery aid package, assistance in fishing gear, to a practical training course of fishing boat operation at the Fishery Training School in Dumai, etc..

3) Development goals for fish marketing/processing

The foremost goal of Riau province as outlined in the fishery development plan of REPELITA V, is to increase the annual export rate to 15 percent. However, it also fulfills a role as a supply base for fishery products to northern Sumatra and Jakarta. In order to achieve its goal, the following two measures have been raised.

- Education and guidance on quality control of processed products (including frozen fish)
- Marketing and export of fishery products

Due to an undeveloped road network in Riau province, transportation of commodity products is difficult. Large differences in the marketing of fishery products exist between areas. Subsequently, the second development goal of the province is to achieve uniformity in supply and consumption of fishery products within the province. In order to achieve this goal, an improved road network is essential. As a result, concrete measures by DPP to achieve this goal have not been forthcoming.

2.1.3 Forestry Development Project

The main purposes of the forestry development project of REPELITA V are conservation and maintenance of the forests, effective use of the forest land, prevention of diversion of the forest land by farmers, and prevention of forest deterioration. The project has the following objectives:

1. Gather the information and documents on the forest region to study the functions and potentiality of the forests.
2. Develop, conserve and maintain natural resources in and out of the forest land.
3. Maintain the quality and quantity of the water resources in the forest conservation zone to improve the water resource conservative function of the surrounding area.
4. Promote protection and preservation of the forests.
5. Promote the residents' participation in forestry and increase their awareness of the functions and benefits of the forests.
6. Increase the added value of forestry products and increase the nation's annual revenue and exports.
7. Increase the job opportunities and income of the residents in and out of the forest zone.
8. Introduce the knowledge and improvement technology necessary for the forestry development.
9. Acquire human resources for the forestry development.
10. Introduce the equipment and facilities required for the realization of effective forestry, create an efficient organization, and suggest the procedure for realization.

The following policies are suggested with regard to the conservation of the tropical forests.

(1) Afforestation and planting policies

1) Social forestry

a. Objectives

- Afforestation of felled parts of the forest land and desolate unplanted land, as well as recovery of the forest functions
- Increase of job opportunities and income of the farmers living around the forests
- Development of a closer relationship between the forestry corporation and farmers

b. Activities

- Expansion of agroforestry
- Rational pursuit of land production expansion
- Technological development of the processing industry for small-scale agricultural products

2) Industrial afforestation

Afforestation projects of felled land are planned to protect and recover the forests and to maintain the lumber resources. As the financial resource for the project, a felling fee of US$10 /$m^3$ will be collected from the holders of felling rights (HPH) and lumber exploitation permits (IPK). This fund will also be used for the afforestation and recovery of unproductive forest land, especially marshland forest, land covered with shrubs and weeds, unplanted land and alang-alang grassland.

(2) Farmland general development policies (Tree-planting project)

1) Tree-planting project

The objectives of the tree-planting project are the sustained development and conservation of farmland and forestland under the initiative of the Ministry of Agriculture and the Ministry of Forestry, through general measures for agriculture and forestry. The project aims at the planting and conservation of land that is vulnerable to erosion, such as converted forest land. It also aims at improving the functions and potential for use of the land as well as at increasing the possibility of local development. It further seeks for the increase of job opportunities of the local residents through the promotion of their participation in the project. The land area covered by this project is 4.9 million hectors. The details of the project are as follows:

- Construction of a demonstration field for the conservation of natural resources
- Construction of a settlement promotion field for the farmers living through migrative slash-and-burn farming
- Creation of a common forest
- Construction of an adjustment dam

- Construction of a nursery to provide nursery trees to farmers

2) Afforestation project

The objectives of the project are the promotion of afforestation of the forest land, improvement and effective use of unexploited national forest, and increase of job opportunities through the participation of the residents of the surrounding area. The area covered by the project is 1.9 million hectors.

2.2 Socio-economic Conditions

2.2.1 Socio-economic conditions of Riau Province

1) The population density of Riau Province (35 people/km^2) is low. However, since the province receives large numbers of immigrants from other areas of the nation, its population growth rate from 1980 to 1990 was 4.3 percent, higher than the national growth rate of 2.0 percent (see Table 2,3).
2) Approximately 80 percent of the nominal Gross Regional Domestic Product (GRDP) of Riau Province was comprised of petroleum, gas, and petroleum based products. However, due to the declining price of petroleum, the nominal GRDP showed an annual growth rate of 8.9 percent from 1984 to 1989, which was only 70 percent of the national GRDP growth rate (annual rate of 15.1 percent) (see Table 4).
3) The per capita nominal GRDP of Riau Province, excluding gas, petroleum, and petroleum based products, was 834,000 rupiahs; and the difference between this figure and the national statistic of 799,000 rupiahs was not large. In addition, the annual growth rate from 1984 to 1989 was 11.9 percent, which closely approximated the national growth rate (12.7 percent per annum). This indicated that the economic strength and development of Riau Province, excluding the petroleum related sectors, were on par with the national average (see Table 5).
4) In studying the nominal GRDP, excluding petroleum, the ratio of agriculture, commerce, and transport/communications sectors was 26.2 percent, 23.6 percent, and 11.4 percent, respectively; and the main industries of the province were in these sectors. The ratio of government expenditures of the nominal GRDP, excluding petroleum was 9.3 percent and was nearly equal to the ratio of the manufacturing sector (9.5 percent). As a result, the large government role in regional development can be deduced (see Table 6).
5) The major export commodity of Riau Province is petroleum. According to the earnings recorded for 1990, 65 percent of the petroleum exported were shipped to Japan, followed by the United States, Singapore, China, Korea, Taiwan, and Australia, respectively (see Table 7).

2.2.2 Socio-economic conditions of Kab. Bengkalis

1) The annual population growth rate of Kab. Bengkalis from 1980 to 1990 was 4.8 percent, slightly higher than the average growth rate for the province (4.3 percent/year). The population ratio of Kab. Bengkalis was 26.1 percent in 1980 and rose to 27.3 percent by 1990. In addition, the population density of Kab. Bengkalis was 30 people/km^2, which was slightly lower than the entire average density of Riau Province (35 people/km^2). It had the third lowest population density of the other kabupaten in the province (see Table 8).
2) The ratio of Chinese Indonesians in Kab. Bengkalis in 1990 was estimated to be about 20 percent of the entire kabupaten. This was higher than the national ratio (under 10 percent). Kecamatam which contain a ratio of Chinese Indonesians higher than the kabupaten average are Banko (37.5 percent), Kubu (34.0 percent), Rupat (30.6 percent), west Dumai (29.1 percent), and Tebing Tinggi (26.3 percent).
3) The per capita GRDP for the Kab. Bengkalis in 1990 was 565,000 rupiahs, which was higher than the neighboring kabupaten (Kanpar, Indragiri Hulur, Indragiri Hilir) (see Table 9).
4) The industrial distribution ratio of the GRDP in 1989 (1983 constant price) for businesses, hotels, and restaurants in the Kab. Bengkalis was 28.1 percent, followed by agriculture at 25.6 percent. The distribution ratio of manufacturing was 13.3 percent, second only to the special district of Batam, which has been designated for industrial development (34.4 percent). In addition, the distribution ratio for mining was 10.9 percent, succeeding Riau islands (14.3 percent) (see Table 10).
5) The roads in the study area are not paved, with the exception of the road network in Bengkalis island running from Bengkalis to the western tip of Meskom, and from Bengkalis to the northern end of Bantan Air. The unpaved dirt roads pass through the plains and often become impassable during the rainy season. As a result, boats are used as a means of transport not only in inter-island travel, but within an island itself. Hence the relative importance of water transport is high.

2.2.3 Socio-economic Conditions of the Study Area

1) Dumai is the largest city in the study area, followed by Bengkalis and Selatpanjang. The population density surrounding the cities is high (greater than 1000 people/km^2 in residential areas) and it is low in other areas (50-100 people/km^2 in residential areas) (see Table 11).

2) The objective of this study is the management and conservation of coastal resources. Since the coastal areas are major production sites for fisheries, it was considered relevant to select a desa with assertive fishing activities as the model area for the study. It was also surmised that in desa with more than 30 fishermen, an RT comprised of fishermen existed within these desa. In examining the corresponding relationship between the fishing villages and the socio-economic findings on occupational distribution, about 80 percent matched. Consequently, it was decided that the model area would be selected from among desa with more than 30 fishermen.
3) In the study area, industrial activities such as manufacturing, etc. are not extensive. Per capita net production was meager in term of per capita annual income. Desa with a per capita net production lower than the poverty line established by UNDP (per capita annual income of US$160.00 = Rp.320,000), was considered deprived. The final objective of the study was to select a model fishing desa and to formulate a regional development plan, in order to improve the socio- economic conditions of the study area. It was concluded that the surrounding poverty level villages where development has been slow would be a factor in the selection process.
4) There are many desa with a high population ratio of Chinese Indonesians in Kab. Bengkalis. The average income level for the entire desa may be low, but the Chinese residential areas are affluent. In many cases, economic development can be anticipated due to concerted self-help efforts. The selection process for the model area will take this factor and the data collected by the field study team members (standard of living of the inhabitants, self-help efforts in development, etc.), into consideration.
5) Plans on land utilization have been formulated for Kab. Bengkalis, and regional divisions have been made according to the categories listed below. Desa which does not contradict this plan should be selected; and it is necessary to coordinate the study with the development plans of the kabupaten.

- Protected land
- Commerce
- Manufacturing
- Residential land
- Fisheries
- Livestock
- Plantations
- Food crops
- Settlements
- Forests

2.3 Fishery Production and Fishing Grounds

2.3.1 Fishery Resources

(1) Development of fishery in the Malacca Straits

Since the 1960s, expensive marine animals such as shrimp have become export items for Japan and Western countries. For Southeast Asian countries, fishery focusing on such marine animals has become an important means for acquiring foreign currency. For this purpose, the motorization of fishing boats and the introduction of trawling have been promoted, and the catch volume increased sharply.

In Indonesia, the origin of trawling is said to be Bagansiapi-api of Kec. Bengkalis, Riau Province, facing the Malacca Straits. Trawling in the Malacca Straits was diffused from Bagansiapi-api to the special district of Aceh in the coastal area of Sumatra island, Northern Sumatra Province, and Riau Province. But restrictions of trawling have been intensified because of the exhaustion of resources due to the increase in catch intensity and conflicts between trawling boats and coastal fishing boats. This resulted in the complete ban on trawling in 1980. However, shrimp trawling is still permitted only east of the 130 degrees east longitude line on the condition that shrimp nets be used instead of trawl nets.

The history of trawling in Indonesia is as follows:

1965	Beginning of trawling operations in Bagansiapi-api
1976	Restrictions on the number of trawling boats and fishing grounds for trawling
1978	Ban on the construction of trawling boats
1980	Complete ban on trawling

(2) Fishery resources in the Malacca Straits

1) Research on fishery resources in the Malacca Straits in the 1970s

In 1976, a joint seminar[1] was conducted with Indonesia, Thailand, Malaysia and Singapore under the South China Sea Fisheries Development and Coordinating Program of FAO. On this occasion, fishery resources surveys on demersal fish, shrimp and pelagic fish were conducted in Aceh, Northern Sumatra and the Riau coast in Indonesia.

The Indonesian territory of the Malacca Straits is largely divided into Aceh and Northern Sumatra/Riau. In this survey report, the MSY (maximum sustained

1: Report of the Workshop on the Fishery Resources of the Malacca Strait.

yield) of the demersal fish including shrimp in the entire Malacca Straits was estimated at 85,000 tons per year (8,000 tons/year in Aceh, 77,000 tons/year in Northern Sumatra/Riau), while the total fish catch between 1973-75 was 82,622.5 - 89,404.8 tons, slightly exceeding the said MSY of the area (see Table 12). With regard to this situation, the Indonesian government proposed the following undertakings:

① In 1975, the fish catch volume in the area was almost identical to its MSY. Therefore, the number of fishing boats should not be increased. As for new trawling boats, only large-scale ones will be introduced for operation in the new fishing grounds of more than 40 meters deep (potential catch volume: 58,000 tons).

② Trawling in the coastal areas of less than 10 meters deep will be completely banned. These areas have an important role of recovering resources that are already under pressure from the small-scale fisheries.

③ Shift some of the large-scale trawling boats operating in Northern Sumatra and Riau to the South China Sea, the Karimata Straits and the Javanese Sea.

The MSY of the pelagic fish in the Malacca Straits was estimated at 70,000 tons per year, whereas the fish catch volume between 1973-75 was 32,597 - 66,027 tons. Among the pelagic fish resources are mackerel, horse mackerel, sardines, anchovies and tuna. The MSY for tunas, Indian mackerel and horse mackerel was estimated at 5,000 tons, 20,000 tons and 15,000 tons, respectively.

2) *Resources survey in recent years*

"Distribution and potential catch of marine fish resources in Indonesian waters[2] reports that the annual potencial catch volume in the Malacca Straits for demersal fish, pelagic fish and prawn was estimated 116,900 tons, 108,000 tons and 22,900 tons, respectively (see Table 13).

And another survey conducted in 1992 by the University of Diponegoro as a part of the coastal villages development project (Proyek Pengembangan Desa Pantai[3]) of DGF reports that the MSY of the pelagic fish resources was estimated 78,500 tons.

2:Potensi dan Penyebaran Sumberdaya Ikan Laut di Perairan Indonesia
3:Studi Penyusunan dan Penataan Zona Penangkapan Ikan di Perairan Selat Melaka

(3) Trend of fish catch volume and CPUE

The trend of the pelagic fish catch volume and CPUE in the Malacca Straits between 1969-90 is shown in Table 14. The total fish catch volume, which was 40,000 - 60,000 tons in the early 1970s, has almost doubled in 1990 to 97,274 tons. However, the CPUE is on the decline, meaning that the increase in the fish catch volume is the result of a substantial rise in the fishing effort.

The number of fishermen in the Malacca Straits has risen from 139,197 in 1981 to 210,531 in 1991. Accordingly, the number of fishing boats has risen from 32,879 to 48,039 over the same period (see Figure 2.1). Among the fishing boats, outboard-engine boats have shown a significant increase; from 8,909 in 1981 to 22,949 in 1991, or 2.5 times over 11 years.

The volume of the fish catch by gill-net fishing is stagnating after the peak in 1987 (see Fig. 2), and the catch volume per unit shows the similar tendency (see Fig. 3). The catch volume of bottom long-line fishing is also stagnating after the peak in 1988, and the catch volume per unit has shown a significant decline after the same year.

The MSY of the pelagic fish in the Malacca Straits was estimated at 70,000 tons and 108,000 tons in the surveys conducted in 1976 and 1989, respectively. The catch volume in 1990, which was 97,274 tons, was almost equal to the MSY of the pelagic fish in the Malacca Straits. Considering the trend of CPUE, a further increase in the fishing effort should be avoided.

Considering the significant decline of the catch per unit of the bottom long-line as describe above, a further increase in fishing effort to the demersal fish resources should also be avoided.

(4) Evolution of fishing catch volume and CPUE in Riau Province

The number of fishermen of Riau province operating in the Malacca Straits has increased from 36,657 in 1981 to 65,531 in 1991. Accordingly, the number of boats has increased from 12,640 to 22,038. Among fishing boats, powered boats have almost tripled from 3,888 to 11,015 (see Fig. 4).

Riau province shows a similar tendency to that in the overall area of the Malacca Straits. The volume of the fish catch by gill-net fishing is stagnating after the peak in 1987 (see Fig. 5), and the catch volume per unit shows similar tendency (see Fig. 6). The catch volume of the bottom long-line fishing is also stagnating after the peak in 1988, and catch volume per unit has shown a significant decline.

Based on the judgment that fishery resources in the Malacca Straits have almost been utilized to its upper limit, Riau province stopped issuing fishing permits for all new operations in the Malacca Straits to reduce the fishing effort and has put further effort on the development of fishing grounds in the South China Sea.

2.3.2 Fish Production/Fishing Ground Environment

(1) Fishing grounds and fishing methods

1) The study area is located in the coastal area of Kab. Bengkalis, bordering the Malacca Straits; and it includes the islands that lie adjacent to the main island of Sumatra. Numerous long channels have been formed between the islands and their total length is approximately 380 km. These islands are mainly marshland, surrounded by mangrove forests.

2) Marine fisheries is the major form of fisheries carried out in the study area and the level of inland fisheries is very small. The two major fishing grounds are located in the Malacca Straits and in the channels between the islands.

3) The major fishing methods being applied in the offshore waters of the Bengkalis island in the Malacca Straits are drift gill nets and bottom long-lines. Fishing grounds are generally less than 50 meters deep. The sea current flows in a northwesterly direction throughout the year; and in the southeastern coastal waters of the Ransang island, the periodical tidal flow is utilized and Gombang fishing (a kind of bag-net fishing) is prevalent. From November to March, the number of fishing operations decline due to strong north winds.

4) Tidal flow is generated in the channels by tidal changes, and Gombang, Ambai, and other traditional forms of fishing are being applied.

(2) Fish production

1) The production volume of marine fishing for the entire Kab. Bengkalis represents that of Riau province in the Malacca Straits, but for the past several years, it has declined to 80,000 tons. The average annual growth rate from 1987 to 1991 was 0.1 percent. The annual growth rate for fish, shellfish, and mollusks was -1.0 percent, 2.9 percent, and 0.8 percent, respectively. Fish production is declining, but it is supplemented by the rise in prawn production from Gombang fishing, etc (see Figure 15).

2) As shown in the following table, the poorness in fishing efficiency in the Study Area is conspicuous against a comparison of marine fisheries production, number of fishermen and boats in the entire Kab. Bengkalis for 1991.

	Fish Production x10^3ton (%)	Number of Fishermen x10^3person (%)	Number of Boat x 10^3boats (%)	Production/ Fisherman	Production/ Boat
Kab. Bengkalis	85.5 (100.0)	6.8 (100.0)	5.3 (100.0)	12 ton	17 ton
The Study Area	14.0 (16.4)	2.0 (29.9)	2.0 (37.0)	7 ton	7 ton

(3) Fishing operation according to fishing method

1) Gill net fishing

Gill net fishing is employed by both powered and non powered fishing boats.

- Gill net fishing by non powered boats (here after referred as "sampan")

A sampan carrying two fishermen operating in the channel near the fishing village, uses drift gill nets, bottom gill nets (about one to two kilometers long), stationary gill nets, floating gill nets, etc. which are fishing nets are single fiber nylon nets with a mesh size of 65 to 70 mm.

- Gill net fishing by powered boats

Gill net fishing used by powered boats are drift and bottom gill nets. Their fishing grounds are not confined to the Malacca Straits and occasionally their fishing operations are carried out in the South China Sea. In the case of fishing in the Malacca Straits, their operations may last more than one week. Two times fishing operations per month are equivalent to a total of approximately 15 to 20 days out at sea.

Although much of the fishing is carried out at night, occasionally they take place during the day. Fishing operations from throwing to hauling net require five to seven hours of fishing. Generally, fishermen average two fishing operations at night.

The major fishing grounds in the Malacca Straits are located in the northern coastal waters of the Bengkalis island. There are two fish export centers at Bantang Tengah and Muntai in this area.

There are some villages engaged in gill-net fishing using mother boats in the Study Area. In this case, both the mother boats and independent fishing boats carry out their fishing operations together.

Drift gill nets are operated by powered boats of 12 - 16 meters long and with 6 to 20 horsepower; and the fishing is carried out at a depth of 20 to 30 meters.

The size of the boat for bottom gill nets is approximately the same as that of drift gill nets. The water depth of the fishing grounds is about 30 to 45 meters. Fishing operations are generally carried out at night, but sometimes done in the daytime, and throwing net is carried out two to three times a day.

2) Bottom long line

Drift gill net boats often carry bottom long line, while there exist exclusive ones for this methods. outfits. They operate bottom long line fishing at night and aim to catch large fish in almost the same fishing grounds and water depth of the bottom gill net. The main line is rolled and set in a square box or a circular basket as one unit and the branch lines equipped with hooks are hung by such a unit. The main line and the branch lines are thrown and let sink into the sea bottom while cruising the boat. The boats only engaging this fishing equipped with 20 - 30 baskets carry out their operation once a day. In contrast, the boats engaging both drift netting and bottom long lining equipped with 3 - 5 baskets carry out their operation two to three times a day.

3) Traditional fishing methods

- Gombang, Cici

The Gombang and Cici are one kind of stationary bag nets which utilizes the tidal flow to harvest fish. It is often set about 10 days during the period of the spring tide. Hauling nets are done four times a day during the time period when the tide has receded. Although these fishing methods are commonly used throughout the Study Area, they are most prevalent in the southeastern channels and in coastal shallow waters.

- Ambai

The Ambai is also a type of bag net used during the tidal flow, similar to the Gombang. However, unlike the Gombang, the Ambai has a bamboo cage attached to the end as a cod-end.

- Pengerih

The Pengerih is a bag net used during the tidal flow to catch medium layer fishes. This fishing gear differs from the Gombang and Ambai. The bag net is attached to a rope which is tied to the end of a wooden stake. Like the Ambai, a bamboo cage is attached to its end during its operation.

- Belat, Togok

  The Belat is a fishing gear made up several fence nets attached together. During the tidal flow, the fish and shellfish are guided into the nets. The Togok is a fishing method which utilizes wooden sticks beaten to the bottom in stead of fence nets, to guide the fish into the bag net.

- Bubu

  Bubu is a Chinese lantern shaped bamboo cage made of rottan which is widely used in Indonesia and throughout Southeast Asia. In addition to the ordinary bubu, there are Lukar or Bubu Buton which are large bamboo cages.

- Kiso

  The Kiso is a triangular shaped net, a kind of push net, used in the shallow coastal waters to harvest small fish, prawn, etc.. It is mainly used during the night with lights attached at its head, but they are also known to be used during the daytime.

(4) Target fish species

The major species of fish caught by gill nets are narrow-barred king mackerel, thread fin, wolf herring, etc. Thread fin bream, giant sea perch, ray, etc. are caught by long lines; and mysid shrimps, prawn, hairtail, Bombay duck, etc. are by the Gombang (see Table 16).

(5) Relationship between fishermen and Tauke

Many of the fishermen in the Study Area borrow their operating capital from fish traders (Tauke, mainly Chinese Indonesians) and repay their loans with their fish catch. This practice has continued for many years. Although the credit ties between both parties is not clear, this practice has left the fishermen without any surplus earnings for savings.

(6) Fishing regulations

Overall, the fishermen's knowledge of fishing regulations was poor and many were not even aware that such regulations existed according to our interview survey result. The fishermen cooperatives which acknowledged practicing voluntary restrictions, were only five villages out of the 60 surveyed.

(7) Constraints of existing fisheries in the study area

The constraints of existing fisheries by the type of fishing villages are summarized below.

1) Fishing villages mainly using gill-net and/or bottom long-line

These villages are aiming to export their catches by targeting high commercial valued fish (e.g. narrow barred king mackerel and wolf herring). Constraints of their fisheries are as follows ;

- long term stagnation of fish catch
- Disadvantaged situation of fishermen controlled by the Tauke
- Lack of proper marketing facilities and equipment

2) Fishing villages mainly using fishing methods utilizing tidal current such as Gombang, etc..

These villages can be divided into two types ; one is the village mainly catching shrimps of high commercial value in the coastal shallow waters, the other mainly catching fish in the channels between islands. The shrimps are exported, anchovies and mysids are processed, and the rest of fish including trash fish are locally consumed. Constraints of their fisheries are as follows.

Villages which mainly catch shrimps

- Long term stagnation of shrimp catch
- Disadvantaged situation of fishermen controlled by the Tauke
- Need of improvement of existing marketing facilities and equipment

Villages which mainly catch low market value fishes

- Small volume of fish catch and its significant seasonal changes
- Mach amount of trash fish in fish catch
- existence of many part-time fishermen whose main income source is mangrove felling

2.3.3 Aquaculture

(1) Aquaculture production in Riau province

1) The production volume of aquaculture in 1991 was 944.5 tons, which was only 0.5 percent of the total production volume of fishery products of 188.282 tons for the same year (see Table 18).
2) According to provincial fishery statistics, the aquaculture industry is mainly divided into fresh water culture and brackish water culture. Recently, ocean cage culture of giant sea perch in river mouth and propagation of blood cockle frys has started.
3) The production volume in 1991 for brackish water culture was 221 tons and 723 tons for fresh water culture. The Riau provincial government has earmarked brackish water culture products for exportation and fresh water culture products for the local consumption in the inland areas. The study area in Kab. Bengkalis is targeted for brackish water culture.

(2) Aquaculture development plan in Kab. Bengkalis

The government of Kab. Bengkalis has concentrated its efforts on developing aquaculture. Of the fishery development projects implemented in the kabupaten from 1989/1990 to 1991/1992, 23 projects were related to aquaculture. These government assistance projects are channeled to the fishermen through KUD (multipurpose village cooperative) and the fishermen Kelompok (fishermen cooperative based on fishing method).

(3) Present conditions of aquaculture within the Study Area

1) Although shrimps, mud crabs, giant sea perch, etc. are cultured in brackish water, there are still in the experimental stage, and technological and operational problems have hindered efforts to achieve stable operations. Meanwhile, cage culture of giant sea perch in the vicinity of the river mouth has started and shipments have commenced in the Bengkalis island. However, in view of being depended on supply of imported fry at a high price and significant fluctuations of the exported price, achieving a stable base of operations is an issue.

   As for propagation of brood cockles, efforts to transplant its fry have done in the north coast of the Marbau island, but precautions are required in selecting fishing grounds, due to floods during the rainy season and siltation from the rivers.

2) DPP and/or DPK provides assistance to aquaculture by providing the initial investment and technological and operational guidance. However, in many cases the first operation ends in failure due to an inadequate budget and guidance period, despite deficient technological and operational capabilities of the fishermen; and subsequently, the project is discontinued.

(4) Prospects for aquaculture

Several large scale areas of mangrove forests are found along the banks of the rivers in the Study Area, which have potential of supply source of giant sea perch, mud crabs, etc. In addition, trash fish harvested by Gombang nets set up along the channel, are able to provide feed for aquaculture operations. In view of these factors, it has been concluded that aquaculture development in this area is prospective. However, fry production within this area should be aimed in further in stead of being depended on supply of imported fry.

2.4 Fish Marketing/Processing

2.4.1 Balanced Supply and Demand of Fish in Indonesia

1) According to island groupings, fishery products are in great shortage in Java, in slight shortage in Sumatra, and the remaining islands are all surplus areas. It is surmised that the fish surplus of Kalimantan fills the shortage in Sumatra and Java (see Table 18).
2) Fishery products are abundant in the areas east of Java and the flow of fishery products in central Indonesia moves from east to west. In addition, North Sumatra province is a fish shortage area and surplus fish products from Riau province are shipped there.
3) It is surmised that a major marketing route exists, which ships fish products from the Kab. Kepulauan Riau geographically near Java, to Jakarta and Singapore. As a result, fresh fish (particularly high priced fish) tend to be in short supply on the island of Sumatra; and the major fish product consumed in the provinces of Riau and North Sumatra is the relatively inexpensive processed fish.

2.4.2 Fish Marketing/Processing in the Study Area

1) The export volume of Riau province rose from 9,400 tons in 1986 to 51,000 tons in 1991, indicating a growth of 5.4 times. Export earnings were 4.2 million rupiahs in 1986, and reached 43.5 million rupiahs in 1990, showing a growth of 10.4 times (see Table 19, 20). The growth in earnings was particularly remarkable from 1989; and it is surmised that exports of high value added fishery products have been increasing since that time.
2) Much of the fish exported from Riau province are from Kab. Kepulauan Riau located to east of the Study Area, and from the kec. Kubu and Banko in the Kab. Bengkalis, located west of the Study Area. In 1991 the fish export, converted into raw fish, was equivalent to 11,640 tons or an earnings of 2.2 million US dollars (see Table 21, 22). Of this export, the export volume from the Study Area was only 453 tons or an earnings of 844,000 US dollars.
3) Much of the fish volume exported from Riau province is fresh fish (85 percent), followed by processed prawns (4.2 percent, see Table 23). Nearly all of the fish products exported from Kab. Bengkalis were fresh fish and some dried and salted fish.
4) Since fish inflow and outflow volume is unknown, it was difficult to project the fish consumption volume of the Study Area. Based on the result of the socio-economic interview survey, per capita fish consumption in this coastal area was estimated at 42.4 kg/year, while that of the entire province of Riau was estimated at 28.0 kg/year based on the balance in fish supply and demand in Indonesia. Accordingly per capita fish consumption in the coastal area is likely to be larger.

5) The Study Area is located near Singapore and Malacca in Malaysia; and the large fish production centers of Bagansiapiapi and Cinaboi in Kec. Banko are to the west. Although the influence of these two areas cannot be ignored, the core of the Study Area, in terms of population, commerce, government, etc., is Dumai, Bengkalis, and Selatpanjang. This core forms three separate marketing zones, specifically the Dumai marketing zone in the west and the Bengkalis and Selatpanjang marketing zones (see Fig. 9).

6) The Dumai marketing zone has two centers, namely Tg. Medang (Rupat island) which is the fish export center for Malacca, and Dumai, the local consumption center. The center of the Bengkalis marketing zone is Bengkalis, but Bantan Tengah and Muntai facing the Malacca Straits are also the fish export point for Malacca. The northeastern part of Bengkalis island is located closer to Selatpanjang and its ties are stronger with this distribution zone. Fish is exported to Singapore via Selatpanjang. Among the three distribution zones, Selatpanjang is the largest in terms of area, production, and consumption volumes. Tanjung Kubu is the export center of Rangsang island and fish is transported from there to Tanjung Barai.

7) The exported fresh fish from the Study Area has problems in terms of freshness and size, and therefore its price is comparatively cheaper in the markets of Malacca and Singapore. In the Malacca market, the price of fish greatly depends on its quality and size. In case of wolf herring and narrow-barred king mackerel from Indonesia, wholesale price of fresh and large size ones (Rp. 7,200/kg) is more than 1.5 times higher than average wholesale price of the same fishes (Rp. 4,600/kg). Also in case of Jurong market in Singapore, qualified fish is more appreciated. The prices of these fishes in very fresh conditions even from Indonesia are Rp. 10,800/kg in large size and Rp. 8,400 /kg in smaller size, respectively (see Table 24).

8) Due to the undeveloped road network on land, with the exception of certain areas in Bengkalis island, the fish catch is transported by either fishermen's boats or fish carries owned by the Tauke to marketing center (Dumai, Bengkalis, Selatpanjang, etc.).

9) In studying the production volume of marine fisheries which were processed in 1991, the ratio of fresh fish, dried and salted fish, and for terasi was 35.8 percent, 39.3 percent, and 24 percent, respectively (see Fig. 25).