- Private operators and fishermen organizations will play an important role in development programs.

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 production 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

DGF is in an administrative situation directly affected by destruction of coastal ecosystems such as mangrove forests, coral reefs, etc.; and therefore, 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.

2.1.2 Fisheries Development Plan in Riau Province

(1) Basic policy and development goals

1) Basic policy

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 the 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.

2) Achievement level of development goals

The annual growth rate in fishery production volume was 2.48 percent during the REPELITA IV period. 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 Strait, the South China Sea, and the inland water area. In the Malacca Strait, the fish catch has recently become stagnant; and its resources exhaustion in 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 in fishing boat operation Fishery Training School in Dumai, etc.

2.2 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 harvest 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 harvest 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, Indonesia conducted research in Aceh, Northern Sumatra and the Riau coast on demersal fish, shrimp and pelagic fish.

The Indonesian territory of the Malacca Straits is largely divided into Aceh and Northern Sumatra/Riau. In this report, the MSY (maximum sustained yield) of the demersal fish including shrimp in the entire Malacca Straits is 85,000 tons per year (8,000 tons/year in Aceh, 77,000 tons/year in Northern Sumatra/Riau). The total harvest in fish between 1973-75 was 82,622.5 - 89,404.8 tons, slightly exceeding the MSY of the area (see Table 2.2). With regard to this situation, the Indonesian government made the following suggestions:

<1> In 1975, the fish harvest 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 harvest 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.

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

The MSY of the pelagic fish in the Malacca Straits is 70,000 tons per year, whereas the fish harvest 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 are 5,000 tons, 20,000 tons and 15,000 tons, respectively.

2) Resource survey in recent years

"Distribution and potential volume of marine fish resources in Indonesian waters (Potensi dan Penyebaran Sumberdaya Ikan Laut di Perairan Indonesia)" reports that the annual harvest volume in the Malacca Straits for demersal fish, pelagic fish and prawn was 116,900 tons, 108,000 tons and 22,900 tons, respectively (see Table 2.3).

And another survey conducted in 1992 by the University of Diponegoro as a part of the coastal villages development project (Proyek Pengembangan Desa Pantai) of the General Office of Fishery Reports that the MSY of the pelagic fish resources was 78,500 tons (Studi Penyusunan dan Penataan Zona Penangkapan Ikan di Perairan Selat Malaka).

(3) Evolution of fish harvest volume and CPUE

The evolution of the pelagic fish harvest volume and CPUE in the Malacca Straits between 1969-90 is shown in Table 2.4. The total fish harvest 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 total fish harvest volume is the result of a substantial rise in the fishing intensity.

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 Fig. 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 harvested through gill-net fishing varies without regard to the change in number of fishing gear (see Fig. 2.2), and the harvest volume per unit is nearly stable (see Fig. 2.3). As for bottom long-line fishing, the harvest volume per unit has shown a significant decline in recent years.

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

(4) Evolution of fishing harvest 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. 2.4).

Riau Province shows a similar tendency to that in the overall area of the Malacca Straits. The volume of the fish harvested through gill-net fishing varies without regard to the change in number of fishing gear (see Fig. 2.5), and the harvest volume per unit is almost stable (see Fig. 2.6). As for bottom long-line fishing, the harvest volume per unit has also shown a significant decline, but the range of its fluctuation was much greater.

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

2.3 Fishing Environment of Riau Province

2.3.1 Weather conditions

(1) Volume of rainfall

In studying the number of rainy days by Kabupaten in Riau Province recorded for the past five years from 1986 to 1990, Kab. Bengkalis has the lowest number of rainy days per year (see Table 2.5). The highest number of rainy days recorded for Kab. Bengkalis in 1990 was during the months of October through November. The highest number of rainy days recorded in Kab. Kepulauan Riau, located on the South China Sea, was during October through December (see Table 2.6). The volume of rainfall shows nearly same seasonal tendency in the case of the number of rainy days (see Table 2.7).

The Panjang channel formulated between the mainland of Sumatra and each of Tebing Tinggi island and Bengkalis island in the study area is greatly affected by the inflow of river water from the mainland during the rainy season. In the tropical rain forest areas, the rivers water contain much amount of rotting organic substances from the soil, creating a dark discoloration of the water. In the aftermath of a heavy rainfall, the area of discolored water in the Panjang channel and in the offshore waters of the river mouth expands.

(2) Wind velocity and direction

During the months of November to March, seasonal winds from the northeast usher and become the rainy season in the study area. The waters become rough in the fishing grounds during this period; and subsequently, the number of fishing trips by

local fishermen drops during these months. From June to September, the southwest seasonal winds are blocked by the mainland of Sumatra, creating calm fishing grounds during this period. Although only the table on wind direction and velocity of Pekanbaru was available during the study, the same conditions in wind direction were observed in the study area (see Table 2.8).

In addition, the fishing grounds do not suffer from the damaging effects of low atmospheric pressure or rainstorms.

2.3.2 Ocean conditions

The average surface temperature of the sea in the study area ranges from 27ø to 29ø throughout the year. The fishing grounds can be divided into the Malacca Strait area and the water channels areas between the islands.

(1) Malacca Strait

The major forms of fishing in the offshore waters of Bengkalis island in the Malacca Strait are drift gill nets and bottom long-lines. The fishing grounds are generally less than 50 meters deep. The ocean current of the Malacca Strait flow in a northwesterly direction throughout the year, but since the fishing ground in the study area is located at the narrowest point of the strait, the ocean current flows faster than in other areas. The waves are calm and moderate and the swells are occasionally of medium height.

(2) Channels between the islands

Numerous islands in the study area lie adjacent to each other and along the mainland of Sumatra, to form channels. The names and length of the major channels are given below.

Panjang channel :	About 140 km
Bengkalis channel :	About 30 km
Padang channel :	About 45 km
Assam channel	About 35 km
Air Hitam channel	About 60 km
Rupat channel	About 70 km

The tidal fluctuation range is two to three meters in the study area, creating periodic tidal currents in the channels. As a result, various types of the bag net fishing has developed in these areas.

2.4 Summary of Fisheries Activities in Riau Province

The basic figures of fisheries in the study area, were to the annual statistical report compiled by the Riau Province and that of Kab. Bengkalis. However, a difference was seen in the figures used in the annual report of Kab. Bengkalis (Laporan Tahunan, Cabang Dinas Perikanan Kab. Bengkalis), and the figures used in the fishery statistics of Riau province (Buku Tahunan Statistik Perikanan Tingkat Propinsi, Pemerintah Propinsi Dati I Riau), regarding fish production volume, the number of fishing boats, etc. Consequently, in this report, the statistical figures of the province were utilized to summarize fisheries conditions of Provincial level; and the figures found in the annual report of Kab. Bengkalis were used to grasp fisheries conditions of kabupaten level in Kab. Bengkalis.

2.4.1 Trend of Fish Catch

(1) Marine fisheries

Marine fishing is conducted in the three kabupaten of Bengkalis, Kepulauan Riau and Indragiri Hilir. According to the provincial fishery statistics, Kab. Kepulauan Riau is divided into two areas (Kepulauan I and II), categorizing Bengkalis, Indragiri Hilir and Kepulauan Riau I into the Malacca Strait area and placing Kepulauan Riau II in the South China Sea area. However, only Kab. Bengkalis has been designated to the Malacca Strait area and the other two kabupaten have been placed in the South China Sea area, according to the provincial fishery development plan mentioned earlier.

Of the fish catch volume of 173,837 tons generated from marine fishing in Riau province in 1991, 85,492 tons or 49 percent of this volume was produced by Kab. Bengkalis, followed by Kab. Kepulauan Riau, and Indragiri Hilir (see Table 2.9).

The volume of fish catch by marine fishing has steadily increased from 157,465.9 tons in 1989 to 173,837.0 tons in 1991, for an average annual growth rate of 2.5 percent for this period. Nonetheless, the fishing grounds of Kab. Bengkalis in the Malacca Strait showed only an annual average growth rate of 0.1 percent, signifying a standstill in fish catch volume. In contrast, the fishing grounds of Kepulauan Riau II in the South China Sea have shown a large growth rate of 4.6 percent (see Table 2.10).

In examining the catch volume of fish, shellfish, and mollusks, the those of shellfish and mollusks have increased at an average growth rate of 2.9 percent annually, although the fish catch volume of Kab. Bengkalis is declining. The greater part of the catch volume for mollusks is produced by Kab. Indragiri Hilir(see Tables 2.11, 2.12, 2.13).

(2) Inland fisheries

Inland fisheries is carried out in all kabupaten, with the exception of Kepulauan Riau. The fish production volume from inland fishing of Riau province in 1991 was

13,437.9 tons. In contrast, the three kabupaten of Bengkalis, Indragiri Hulu, and Kampar each comprises about 25 to 28 percent of the total fish production volume from inland fishing; and the Kab. Indragiri Hilir produces 19 percent.

The production volume increased from 12,015.0 tons in 1987 to 13,437.9 tons in 1991, indicating an average growth rate of 2.7 percent annually for this period. Of the four kabupaten conducting inland fisheries, the kabupaten which had the highest average growth rate per year was Indragiri Hilir at 4.7 percent. This kabupaten has a high production volume of mollusks, mainly freshwater giant prawn and produces 44.1 percent (1,050.5 tons) of the total production volume of 2,384.2 tons of Riau province (see Tables 2.14, 2.15, 2.16).

2.4.2 Trend of Number of Fishing Boats in Marine Fisheries

The number of fishing boats rose from 19,354 boats in 1987 to 22,270 in 1991. Much of this increase is comprised of powered fishing boats of less than five tons. Non-powered fishing boats are on the decline since 1987. Of the 22,270 fishing boats recorded in 1991, 50.5 percent are motorized; and out of this ratio, 79.6 percent are fishing boats of under five tons equipped with inboard engines (see Table 2.17).

In examining the number of fishing boats by kabupaten in 1991, 56.2 percent of non-powered fishing boats were concentrated in Kepulauan Riau I. Of the powered fishing boats, 74.3 percent were based in the two kabupaten of Bengkalis and Kepulauan Riau I. Of this figure, powered fishing boats greater than five tons converged in Kab. Bengkalis.

2.4.3 Major Fish Type of Fish Catch

(1) Marine fisheries

Major products harvested by marine fisheries are fish, mollusks and shellfish; and seaweed is not harvested by marine fisheries.

The largest volume of fish species harvested in 1991 was the bombay duck, at 10.8 percent (13,766.6 tons) of the entire catch volume. This was followed by the giant sea perch at 6.3 percent (7,972.7 tons). Kab. Bengkalis harvested 75.7 percent of the bombay duck and Kepulauan Riau I harvested 90 percent of the giant sea perch.

The composition of the catch are mainly shrimps such as banana type etc. Of the crustacean species, 78.7 percent (31,053.9 tons) of the total catch of 39,447.0tons in Riau province were harvested in Kab. Bengkalis.

Of the mollusk species, 92.8 percent (6.759.5 tons) of the total production volume of 7,282.4 tons were comprised of blood cockles, mainly harvested in Kab. Indragiri Hilir (see Table 2.18).

(2) Inland fisheries

The major species of fish harvested in inland fisheries are Lampan (*Puntius*

spp), catfish, gourami, etc.; and the major species of crustacean are freshwater giant prawn etc.

2.4.4 Major Fishing Methods

Commonly used fishing methods are bag nets, drift gill nets, long-lines, hook and line, etc. Of the total catch volume of 173,837.0 tons in 1991, 46.2 percent (80,242.7 tons) were harvested by bag nets and 78.3 percent (136,180.4 tons) were harvested when include the catch by other two fishing methods. In particular, fish are mainly harvested by bag nets and drift gill nets in Kab. Bengkalis, in comparison to other kabupaten (see Table 2.19).

2.4.5 Population of Fishermen

The population of fishermen in 1991 numbered 23,462 and of this figure, 44.0 percent (10,321 fishermen) were found in the Kepulauan Riau I. If that of Kepulauan Riau II is added, 62.1 percent of the entire fishermen population of Riau province is concentrated in Kab. kabupaten kepulauan Riau.

In Kab. Bengkalis covering this study area, 57.0 percent (3,905 fishermen) of the fishermen possessed powered fishing boats and 25.0 percent (1,716 fishermen) did not own fishing boats. This ratio was high in comparison to other kabupaten (see Table 2.20).

2.5 Outline of Fishing Activities in Kab. Bengkalis

2.5.1 Trend of Fish Production

Marine fisheries is the main of fisheries activities within the kab. Bengkalis. Of the total production volume of 87,926.6 tons in 1991, 96.2 percent (84,576.2 tons) were harvested by marine fishing and 3.7 percent (3,350.4 tons) by inland fishing. Aquaculture production for both sea/brackish water and fresh water totaled only 0.1 percent (88.9 tons) and remains undeveloped (see Table 2.21).

(1) Trend of fish catch by marine fisheries

Of the total catch volume of 84,621.5 tons by marine fisheries in 1991, 57.3 percent (48,448.0 tons) and 26.0 percent (21,964.8 tons) were harvested by the Kec. Kubu and Banko, respectively. These two kecamatan combined, harvested 83.3 percent of the total catch volume. They were followed by the two Kecamatan Tebing Tinggi and Merbau, harvesting 12.8 percent (10,799.9 tons) of the total catch volume.

The catch volume of marine fisheries increased only slightly from 82,256.4 tons in 1987 to 84,567.5 tons in 1991 (average growth rate of 0.7 percent annually). In particular, the catch volume of Kec. Bengkalis, Bukit Batu, Tebing Tinggi, and Merbau show signs of declining (see Table 2.22).

(2) Trend of fish catch by inland fisheries

The centers of inland fisheries in Kab. Bengkalis are Kec. Mandau and Taman

Putih. Of the total catch volume of 3,350.4 tons by inland fisheries in 1991, 93.0 percent (3,115.0 tons) were produced by Kec. Mandau and Taman Putih. For the five year period of 1987 to 1991, the average annual growth rate of the catch volume by inland fisheries showed a steady growth of 13.4 percent. The growth rate for both the aforementioned kecamatan also indicated a stable growth rate of 12.3 percent. In particular, Kec. Siak and Sungai Apit have shown a rapid growth rate, averaging 59.6 percent annually, although their production volume was only 99.6 tons in 1991 (see Table 2.23).

2.5.2 Trend of Number of Fishing Boats in Marine Fisheries

The number of fishing boats engaged in marine fisheries in Kab. Bengkalis in 1991 numbered 3,666, of which 76.9 percent (2,820 boats) were powered fishing boats. Of this figure, 97.3 percent (2,745 boats) were fishing boats with inboard engines, while fishing boats with outboard engines were only observed in Kec. Dumai, Rupat, Bengkalis, and Bukit Batu (see Table 2.24).

In studying the number of fishing boats for the past five year period, the number of non powered boats increased from 543 in 1987 to 846 boats in 1991; and the number of powered fishing boats with both inboard and outboard engines appears to be declining.

The number of fishing boats is decreasing in Kec. Dumai, Rupat, Tebing Tinggi, and Merbau. In contrast, the number of fishing boats has increased in Kec. Kubu, Bengkalis, and Bukit Batu, although the catch volume in marine fisheries is declining. Both catch volume and the number of fishing boats are rising in the Kec. Banko (see Table 2.25).

2.5.3 Major Fishing Methods

The most prevalent fishing gear used in the kab. Bengkalis is the drift gill nets; and they are used in all areas engaged in marine fisheries. In Kec. Kubu and Banko, traps called "bubu" are widely used. In contrast, in the eastern areas from Kec. Dumai and Rupat where the waters are greatly affected by the tidal flow, bag nets such as Ambai, Gombang, Cici, etc. which utilize this tidal flow, are widespread. In addition, shellfish has been harvested since 1989 in the Kec. Kubu and Banko. They are shipped to Kec. Bengkalis and Tebing Tinggi (see Table 2.26).

2.5.4 Population of Fishermen

Of the total population of 9,266 fishermen in Kab. Bengkalis in 1991, 23.1 percent (2,140 fishermen) and 28.6 percent (2,654 fishermen) were found in the Kec. Kubu and Banko. The number of fishermen engaged in inland fisheries was concentrated in the Kec. Merbau/ Tanah Putih, and Siak/ Sungai Apit; and they were not seen in Kec. Banko and Tebing Tinggi/ Merbau. There was a total of 2,071 fishermen in Kec. Dumai/Rupat, Bengkalis/Bukit Batu, and Tebing Tinggi/Merbau in the study area, which comprised 24.2 percent of the total number of fishermen in kab. Bengkalis (see Table 2.27).

2.6 Outline of Fishing Activities in the Study Area

2.6.1 Major Fishing Methods

The major fishing methods found in the study area are gill nets, long-line and traditional bag nets such as Gombang, Ambai, etc.

(1) Gill nets

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

1) Gill nets used by non powered fishing boats

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

2) Gill nets used by powered fishing boats

Gill nets used by powered fishing boats are drift gill net and drift bottom gill nets. Their fishing grounds are not confined to the Malacca Strait and occasionally their fishing operations are carried out in the South China Sea. Period of fishing trip(since departure from the port to return to the port) may last more than one week. Total period of fishing trip per a month are approximately 14 to 20 days by 2 times of fishing trips per a month.

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

The major fishing grounds in the Malacca Strait are located in the northern coastal waters of Bengkalis island. There are two export centers at Bantang Tengah and Muntai in this area which also function as a fishing base for boats operating in the Malacca Strait.

There is a village engaged in a mother boat type gill net fishing in the study area. In this case, both the mother boat and independent fishing boats carry out their fishing operations together.

In fishing of drift gill nets, the fishing boat in 12 to 16 meters long and with a

engine of 6 to 20 horsepower, and fishing is carried out at a depth of 20 to 30 meters. The nets are made of single fiber nylon with a mesh net size of 65 to 75 mm, with a height of 6 to 7 meters. One fishing boat will utilize 40 to 60 rolls of net, each roll 30 to 40 meters long.

The similar size of boat in used for drift bottom gill nets. The water depth of this fishing grounds is about 30 to 45 meters. The fishing nets are made of nylon or twisted polyamide with a mesh net size of 130 to 150 mm, and a height of 5 to 6 meters. One fishing boat will use 30 to 40 rolls of net, each roll 20 to 30 meters long. Although fishing operations are generally carried out at night, throwing and hauling works are continued even in the daytime. Two to three times of the fishing operation in usually done in a day.

(2) Bottom long-line fishing

Bottom long-lines are often carried by drift gill net fishing boats as extra fishing gear and they are used at night. Bottom long-line fishing is operated in the same fishing grounds and at the same water depth as bottom gill nets fishing; and they are used to catch large fish.

The fishing gear is comprised of one main rope with branch ropes and hooks which is wrapped around one square or round shaped cage or box and a hook with a branch rope is attached around the cage. Both the main and branch ropes are dropped into the bottom while the fishing boat is moving. The main rope is made of nylon or twisted polyamide and one cage can part the main rope of 600 to 700 meters long. There are 400 to 500 lines of branch ropes made of single fiber nylon, each 60 to 100 centimeters long with a hook, which are attached to the main. Specialized bottom long-line fishing boats use about 20 to 30 cages and one fishing operation per day is carried out. However, for fishing boats using both drift gill nets and bottom long- lines, each boat will have three to five cages which are used two to three times during a fishing operation.

(3) Traditional fishing methods

1) Gombang, Cici

Gombang and Cici are a stationary form of bag net which utilizes the tidal flow to harvest fish. It is often set about 10 days during in-between period of the tide. Nets are hauled 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 shallow waters (see Fig. 2.1).

2) Ambai

Ambai is also a type of bag net utilizing during the tidal flow, similar to the Gombang. However, unlike the Gombang, Ambai has a bamboo cage attached to the end of nets for catching fish (see Fig. 2.2).

3) Pengerih

Pengerih is also a bag net utilizing the tidal flow to catch mid water fish. Being different from the case of Gombang and Ambai, this bag net is attached to a rope which is tied to the end of a wooden stake. Like Ambai, a bamboo cage is attached to its end of nets .

4) Belat, Togok

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

5) Bubu

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

6) Kiso

Kiso is a triangular shaped scoop net used in the shallow coastal waters to harvest small fishes and shrimps. It is mainly used during the night with lights attached at its head, but they are also known to be used during the day.

2.6.2 Location of Fishing Grounds

Fishing grounds, categorized according to fishing methods in the study area, are given below (see Fig. 2.3).

(1) Kec. Rupat

1) Gill nets

Powered fishing boats engaged in gill net fishing are mainly found in the fishing grounds along the coast of Sinaboi in the mainland of Sumatra area coasted waters of the Malacca strait northeast from Rupat island and north from Bengkalis island. However, they are also known to operate in the fishing grounds of the South China Sea.

In the village of Pangkalan Nyirih, non powered fishing boats are engaged in gill net fishing along the eastern coast of Rupat island.

2) Bottom long-lines

Fishermen using bottom long-lines operate in the fishing grounds along the coast of Sinaboi in the mainland of Sumatra.

(2) Kec. Bengkalis

1) Gill nets

Powered fishing boats engaged in gill net fishing operate along the north coast of Bengkalis island which faces the Malacca Straits. Bantang Tengah is the fishing base for fish landings.

2) Gombang, Ambai

Gombang, Ambai, etc. are used along the coastal waters near the fishing villages (within a five mile range). A major fishing ground for this type of fishing is in the Bengkalis channel and they are not commonly seen in the fishing grounds of the Malacca Strait. However, in the southeastern area of Bengkalis island (the water area lying between Bengkalis and Rangsang island) there is a Gombang fishing ground which is used cooperatively with the fishing village in Kec. Rupat.

(3) Kec. Merbau

1) Gill nets

Motorized fishing boats engaged in gill net fishing share the same fishing grounds with kec. Bengkalis, which are located along the northern coast of Bengkalis island facing the Malacca Strait. The fishing base and fish landing site is Bantang Tengah.

2) Gombang

Gombang fishing is carried out in the waters lying between Bengkalis and Rangsang island. In addition, there are about 100 units of Gombang set up in the waters of Asam channel lying between Padan and Merbau islands.

(4) Kec. Tebing Tinggi

1) Gill nets

Gill net fishing is carried out by powered fishing boats in the fishing grounds located between the northern coast of Rangsang island facing the Malacca Strait and the northern coast of Bengkalis island. In addition, there are fishing boats operating in the kab. Indragiri Hilir.

2) Gombang

Gombang fishing grounds are located more than five miles into the northern offshore waters of Rangsang island facing the Malacca Strait. There are about 280 units of Gombang set up in those fishing grounds.

2.6.3 Trends in Fish Catch by Season, Fishing Method and Fish Species

Interview survey and survey on board were carried out in order to grasp trends in fish catch by season, fishing methods and fish species. Based on the compiled catch data of Kec. Bengkalis/Bukit Batu, Tebing Tinggi/Merbau and Dumai/Rupat collected by the survey and Fishery Department of Kab.Bengkalis, trends in fisheries production are delineated below.

(1) Fish catch volume by fishing method and by season

According to fishermen, the peak fishing season for gill net, longline, Gombang, etc. is during the earlier stage of the year or in the months of January to April; and the lean fishing season is during the latter half of the year or from September to December. In particular, during the start of the rainy season in October and November, the sea becomes rough due to seasonal winds and the number of fishing days and catch volume decline. However, fishing operations are carried out in persuit of high priced fish such as narrow barred king mackerel, wolf herring, etc. during this season.

In contrast, in Tebing Tinggi/Merbau, peaks of seasonal fluctuations in catch volume of bottom longline fishing by non-powered boat and gill net fishing were observed between April and May although the other sites did not show any particular peaks (see Table 2.28 - 2.31). However, the fluctuations in catch volume of Dumai/Rupat regions showed that each catch volume by fishing method, gill net, bottom longline and Gombang, were equal, the catch volume data of the regions were seemed to be distrustful.

(2) Trends in fish catch by fishing method and fish species

1) Fish species composition caught by powered boat gill net fishing

Results of the interview survey found that major species of the catch volume were high commercial valued fish such as wolf herring and narrow- barred king mackerel and the other fish species were rarely caught. Proportions of those high commercial valued fish to the total monthly catch volume by site were, 30 % in Kec.Bengkalis/Bukit Batu, 3% in Tebing Tinggi/Merbau and 65% in Dumai/Rupat. Major fish species of catch volume in Tebing Tinggi/Merbau were low commercial value due to using gill net along small channels between islands. Results of survey on board showed that trends of increasing catch volume of low commercial valued fish in Malacca Straits near the sites and small channels between islands although the major fish species caught off the coast of Malacca Straits was wolf herring.

2) Fish species composition caught by bottom long line fishing

Monthly catch volume of bottom long line fishing by non-powered boat in each site showed that the major species of the catch were low commercial value and

the volume of high commercial valued fish were very little. Results of on board survey indicated that the major species of catch volume of bottom long line fishing by powered boat were rays, conger eels and emperors. The interview survey found that thread fins as high commercial valued fish was a composition of the catch of bottom long line fishing in Malacca Channel.

3) Gombang

Gombang fishing can be divided into two types; mid-water range Gombang targeting anchovies generally caught during daytime and bottom- water range Gombang targeting shrimps and mysids generally caught during nighttime.

On board survey focused on the mid-water range Gombang catching anchovies during daytime. The nets were set on board several times from the morning to the evening. Major components of the catches were anchovies and low commercial valued fish during the daytime and switched to mysids and anchovies were disappeared from the catches in the evening. Particularly in Kec.Bengkalis mysids not caught during daytime were caught 50kg in total weight in the evening although in Bengkalis Channel in Desa Meskom side the catch of mysids by Gombang fishing were not observed even though in the evening. In contrast, monthly catch volume did not record any catches of mysids in Kec.Bengkalis/Bukit Batu. This was largely due to the area being practiced by Gombag fishing (see Table 2.32 - 2.34).

In any sites, shrimps being caught by Gombang were high commercial value and major composition of fish species were anchovies and low commercial valued fish.

2.6.4 Income Distribution Between Fishermen and Boat Owners

The major fishing method by powered boats in the study area is gill net fishing; and in many cases the boat owner hires the fishing crews. Income distribution differed according to each area and the number of employed crew members, and it is outlined below.

(1) Fishing boat owner and skipper are the same

The fishing crew of one fishing boat engaged in gill net fishing is usually composed of one skipper (boat owner) and one to two crew members. A distribution of the revenue generated from the fish landing after deduction of operational costs (fuel, oil, ice, meals, etc.) and tax (usually 5 percent), is given below.

	One crew member	Two crew member
- Cost depreciation of fishing boat/gear	50	40
- Skipper	25	20
- Crew member	25	20x 2
Total	100	100

(2) Fishing boat owner and skipper are different (when the boat owner employs the skipper and the crew members)

The fishing crew is usually composed of one skipper and two to three crew members. The revenue generated from the fish landing is divided into 9 portions and distributed according to the following ratio.

- Maintenance of fishing boat, engine, fishing gear	3/9
- Boat owner	3/9
- Skipper	1/9
- Crew member	1/9x 2
Total	9/9

In many instances the boat owner also works as the skipper, in such cases the distribution of the boat owner is 4/9. Of the maintenance costs for fishing boat, engine is 4/9. Of the maintenance costs for fishing boat, engine and fishing gear, the engine costs are by the boat owner, while the boat and fishing gear costs are covered by the crews. Surplus distributed for maintenance cost is added to the crew members' portion.

In addition, there is a case crew members are paid a fixed salary. In such cases, the daily wage is about 4,000 to 6,000 rupiahs.

2.6.5 Field Survey Findings on Actual Conditions in Fish Production

(1) Survey approach

In order to grasp the actual conditions in fish production in the study area, an interview survey was consigned and implemented by Riau University. The methods of this survey is as follows:

1) Outline of topics interviewed
   - Fishing boat ownership
   - Fishing operations
   - Fish landing sites
   - Method of fish sale
   - Restrictions in fishing
2) Area surveyed

   Eastern coastal areas of Kec. Bengkalis from Rupat island
3) Objective persons interviewed

   Head of fisherman household
4) Sampling method
   a. Selected 60 villages located along the coast in the study area.
   b. Selected and interviewed five to six fishermen (head of fishermen household) in each of selected 60 villages.

(2) Results of Response

There were eight villages out of the selected 60, where the interview survey could not be conducted due to absence of fishermen on lengthy fishing operations. In addition, villages which had conspicuously bad response rates were omitted from the total findings. Based on this factor, there were five villages from Kec. Rupat, nine villages from Kec. Bengkalis, nine villages from Kec. Merbau, 18 villages from Kec. Tebing Tinggi, three villages from Kec. Bukit Kapur, six villages from Kec. Bukit Batu, and two villages from Kec. Sungai Apit, for a total of 52 villages which were included in the analysis. There was a total of 252 participants in the survey.

(3) Fishing boat ownership

Of the 252 participants in the survey, 73 owned non powered boats, 71 owned powered boats, and 4 did not respond, for a total 148 respondents to questions regarding boat ownership (see Table 2.35). In addition, there were three people who each possessed two fishing boats. The number of respondents who did not own a fishing boat was 104 people. Although this figure is large, it coincides with the fact that Kab. Bengkalis has a particularly large number of fishermen who do not possess fishing boats in Riau Province(see Chapter 2.4.5).

(4) Type of fishing operation and average catch volume

The villages selected for the interview survey were categorized and compared according to kecamatan and their geographic location, i.e. the Malacca Strait side or the channel side.

The major fishing methods employed in the study area were largely divided into the three types of gill nets, long-lines, and bag net such as Gombang, pengirih, etc.(see Appendix 1), as supported in the analyzed findings of the collected data (Chapter 2.3.4).

Large differences were observed in the average catch volume of one fishing operation of a powered boat which was 0.3 to 2,550 kg.

Generally, period of a fishing trip for gill nets by powered boats last plural days, ranging from 2 to 12 days. However, average period of a fishing trip for gill net was only one day in Rupat.

Period of fishing trip employing Gombang, Ambai, Pengirih, etc. was usually one day, irrespective of the type of fishing boat used.

There were nine fishermen in the interview survey whose fish catch volume for one fishing trip by motorized boat exceeded one ton. Of the nine, seven fishermen were based in Kec. Merbau and the remaining two were in Kec. Tebing Tinggi. They employed gill nets, lift net, and a variety of bag nets; and one fishing operation lasted 10

to 30 days (see Table 2.36).

The average catch volume of one fishing operation of a non powered boat was 0.3 to 28 kg which was smaller than that of a powered boat in the same area.

The species of fish harvested by non powered boats in the coastal waters were almost the same for all kecamatan and villages; and there were no unique characteristics observed in each area. However, only shrimps and mysids were harvested by Gombang in Tg. Kedabu in Kec. Tebing Tinggi which differed from other areas. This was also confirmed in the field study where tiger prawn and white shrimp were targeted by Gombang in this village (see Appendix 2).

(5) Use of ice to preserve fish catch

Among fishermen with non-powered boats, only 33.1 percent used ice to preserve their fish catch. In contrast, 62.0 percent of the fishermen using powered boats used ice to preserve their fish catch (see Table 2.37). A major reason why fishermen did not use ice was that the catch was for domestic consumption by either the fisherman's family or by the village. A shortage of the ice supply was not given as a reason (see Tables 2.38).

(6) Fish landing sites

There was a strong tendency for both motorized and non powered boats to land their fish catch at their respective villages; and in particular, 67 percent of non powered boats did so. In addition, if the village was located in close proximity to the city, the fish catch was also landed in the city. The ratio of powered boats landing their fish catch in the city was high; and in Kec. Merbau lying between the Kec. Bengkalis and Tebing Tinggi, fish was being landed in both Bengkalis Kota and Selatpanjang (see Table 2.39). Wholesale markets in the study area were found in Dumai, Bengkalis Kota, and Selatpanjang and fish landing facilities were located in Tg. Medang in Rupat island, Dumai, and Bengkalis Kota. During the field study, the wholesale market in Selatpanjang was under construction and had not been opened.

(7) Selection of wholesalers/fish traders

The fish catch is sold either through direct consignment or commissions. Although wholesalers or fish traders are selected by fishermen on the basis of fish price, there are fishermen who have established credit ties with middleman (a Tauke). In many cases, such fishermen are owners of powered boats whose boat construction costs and operating costs for fuel, etc. are much larger than that of fishermen with non powered boats (see Table 2.40).

The fish catch is commonly sold to the local wholesaler or retailer and in many

instances, the boat owner and the middleman are the same. In Bengkalis Kota, Kudap, Sungai Kayu Ara, Teluk Lecah, Tg. Punak and Teluk Makmur the fish catch is sold to the fishermen organizations (see Table 2.41).

(8) Fishing restrictions

Overall, the fishermen's knowledge of fishing restrictions is poor and many are not even aware that such restrictions exist. However, in the five villages of Kec. Bengkalis/Ketam Putih, Kec. Tebing Tinggi/Banglas, Kec. Bukit Batu/Sungai Pakning/Parit I Api-api, and Kec. Rupat/Teluk Lecah, fishing restrictions on fishing methods are being carried out by fishermen organizations. As a result, awareness of resources management is high in comparison to other villages (see Table 2.42).

2.7 Constraints of Existing Fisheries in the Study Area

Villages of the study area can be divided into two groups by their fishing methods ; one mainly practices gill net and bottom long line fishing, and another mainly does the fishing methods utilizing the tidal flow to catch fish, such as Gombang. The following descriptions are constraints of these villages concerning with their existing fisheries.

(1) Constraints of the villages mainly practicing gill net and bottom long line fishing

The villages practicing above fishing methods are aiming to export their catches by targeting high commercial valued fish (e.g. narrow-barred king mackerel and wolf herring). Constraints of the villages' fisheries are as follows ;

- Long term stagnation of their fish catches
- Disadvantaged situation of fishermen controlled by Taukes collecting and exporting the fishery products
- Lack of facilities for fisheries like fishing port

(2) Constraints of the villages mainly practicing the fishing methods utilizing tidal flow such as Gombang.

The villages practicing above fishing methods can be divided into two types ; one is the village mainly catching shrimps of high commercial value, the other mainly catching fishes. The shrimps are exported, anchovies and mysids are processed, and the rest of fish are consumed by local. Constraints of the villages' fisheries are as follows ;

1) Villages catching shrimps
   - Stagnation of shrimps catch
   - Disadvantaged situation of fishermen controlled by Taukes
   - Lack of facilities for fisheries

2) Villages catching fishes
- Stagnation of fish catch
- Low income level, supplementation of income by other jobs such as felling mangrove trees

2.8 Important Factors Regarding Selection of Model Site

Fisheries in the study area are not characterized by any unique features, with the exception of some areas. All the fishing methods employed in the study area are characterized by the same fish species. It is largely divided into the Malacca Strait area and the channels that lie between the islands. The trends in fisheries development in these two areas are summarized below.

(1) Malacca Strait
- Fish catch volume in the Malacca Strait has reached their limit; and an increase in fish production volume above current levels in the Malacca Strait in the study area, is not expected. In addition, the government is withholding new fishing licenses for fishing boats who want to operate in the Malacca Strait. Therefore, a project to promote fish production in these waters has not been considered.
- Some fishing boats from the study area operate in the South China Sea. The South China Sea has abundant fishery resources; and therefore, formulation of a fisheries development plan for these fishing grounds is possible.
- In the Malacca Straits side of Rangsang island in Kec. Tebing Tinggi, Gombang fishing of shrimps is flourishing. Among the fisheries products landed in Kec. Bengkalis, only the harvest of shrimps is increasing. In view of this, and the fact that shrimps are a high priced fishery product, a plan to promote harvests of shrimps in this area may be considered.

(2) Channels between the islands
- Much of the fish harvested by bag net fishing carried out in the channel, are trash fish, small mysid and shrimps. Presently, such by-products (trash fish) are sold at cheap price or used as livestock feed and a segment is utilized as feed for aquaculture. If aquaculture is promoted in the study area, a plan of fish production for aquaculture feed is possible.
- If aquaculture operations are implemented in the study area, it is essential that a stable supply of fish fry is available. In the Kab. Kepulauan Riau, fishing operations specifically for fish fry required in aquaculture, are being carried out. A similar development plan is possible for the study area.
- It is necessary to establish restricted areas in fisheries (mangrove forest areas) which are spawning and nurturing grounds for fish and shellfish, in order to maintain sustainable development of fishery resources.

Based on the aforementioned possibilities in fishery development, it is recommended that villages having the following characteristics are selected as the model area.

(1) Fishing villages mainly composed of fishermen engaged in gill net and long-line fishing by powered boats are;

Fisheries in the South China Sea will be promoted.

(2) Fishing villages with abundant mangrove forests which are spawning and nurturing grounds for fish and shellfish;

Restricted fishing areas can be established in order to protect propagation of fish and shellfish. In conjunction with this, a plan to transfer fishermen currently operating in such areas, to other fishing grounds should be implemented.

(3) Fishing villages that are engaged in bag net fishing either exclusively or partially;

Based on the above, measures to promote fisheries by introducing new fishing methods to harvest fish fry for aquaculture in areas near those restricted for propagation of fish and shellfish will be formulated.

Table 2.1 Outline of Fishery Development Project in Riau Province

Project Type	No. of Project	Total Fund (Rp. 1000,000)	Fund Source
1. Production Increase	17	689.2	APBN
1) Administration	1	85.0	
2) Fishing	7	239.5	
3) Aquaculture	8	293.5	
4) Processing	1	71.7	
2. Batam Station Sea Farming	4	391.0	APBN
1) Administration	1	306.6	
2) Aquaculture	3	84.4	
3. Tarempa Fishery Harbour	3	1,986.0	APBN
1) Administration	1	20.1	
2) Facilities	2	1,965.9	
4. Natua Is. Development	2	135.0	APBN
1) Administration	1	35.0	
2) Fishing	1	100.0	
Sub total	26	3,201.2	APBN
5. Administration	2	32.5	APBD
6. Fishing	3	105.0	APBD
7. Aquaculture	20	66.5	APBD
8. Processing	2	45.0	APBD
9. Marketing	1	7.5	APBD
10. Female	1	18.0	APBD
Sub total	29	674.5	APBD
Grand total	55	3,875.7	

Sources : Evaluasi Perkembangan Riau Pada Repelita V S/D Tahun 1991/1992 dan Usulan Program/Proyek 1

Table 2.2 Annual Landings and CPUE of Demarsal Fish in Malacca Strait (1969~1975)

		1969	1970	1971	1972	1973	1974	1975
Total demarsal landings	(ton)	56,651	63,243	60,259	74,138	88,059	89,405	82,623
Total fishing effort	(days)	307,585	438,240	535,311	581,061	502,044	527,948	562,256
CPUE	(kg/day)	184	144	113	128	175	169	147

Sources : Report of the Workshop on the Fishery Resources of the Malacca Strait, South China Sea Fisheries Development and Coordinating Programme, 1976

Table 2.3 Fishery Resources and Potential in the Malacca Strait

Unit : ton/year

	Resources	Potential
Demarsal fish	235,800	116,900
Pelagic fish*1	216,000	108,000
Coral Fish	13,053	6,526
Penaeid Shrimps	45,800	22,900
Lobster	856	428
Squid	16,500	8,250

Remarks : *1 ; Figure of pelagic fish doesn't include Tuna.
Sources : Potensi dan Penyebaran Sumberdaya Ikan Laut di Perairan Indonesia, DGF 1989

Table 2.4 CPUE of Pelagic Fish in Malacca Strait (1969~1990)

Year	Total catch (ton)	Fishing effort (days)	CPUE (kg/day)
1969 *1	40,102	151,248	265
1970 *1	44,831	163,153	275
1971 *1	49,632	174,001	285
1972 *1	57,473	203,005	283
1973 *1	59,750	213,371	280
1974 *1	66,027	317,804	208
1975 *1	32,597	(285,868)	(114)
1976 *2	47,671	116,000	411
1977 *2	47,758	153,900	310
1978 *2	42,193	166,400	254
1979 *2	41,343	212,700	194
1980 *2	47,277	485,000	98
1981 *2	38,598	585,200	66
1982 *2	45,521	873,400	52
1983 *2	-	-	-
1984 *2	42,466	309,900	137
1985 *2	67,875	407,000	162
1986 *2	79,993	416,900	192
1987 *2	88,668	672,700	132
1988 *2	78,227	932,400	84
1989 *2	87,315	636,000	137
1990 *2	97,274	543,700	179

Remarks : Figures in brackets are estimates

Sources : *1; Report of the Workshop on the Fishery Resources of the Malacca Strait, SCS, 1976

*2; Studi Penyeunan dan Penataan Zona Penangkapan Ikan di Perairan Selat Malaka, DGF, 1993

Table 2.5 Annual Raindays in Riau Province (1986~1990)

Unit : days

Kabupaten	1986	1987	1988	1989	1990
Pekanbaru	114	121	124	137	130
Kampar	143	126	100	102	134
Indragiri Hulu	148	145	105	110	123
Indragiri Hilir	138	123	73	90	106
Bengkalis	98	103	73	83	94
Kepulauan Riau and Batam	124	105	96	96	110

Source : Agriculture Service, Riau Province 1980

Table 2.6 Monthly Raindays in Riau Province (1990)

Unit : Days

	Jan.	Feb.	March	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Pekanbaru	13	13	7	12	10	5	9	6	12	16	16	11	130
Kampar	11	13	10	12	10	5	11	3	11	18	14	16	134
Indragiri Hulu	10	14	10	11	8	7	10	6	8	11	12	16	123
Indragiri Hilir	6	8	7	7	8	7	6	7	11	12	13	14	106
Bengkalis	6	5	4	6	7	6	10	6	10	13	13	8	94
Kepulauan Riau and Batam	9	5	5	8	9	7	7	10	10	13	13	14	110

Source : Agriculture Service, Riau Province 1980

Table 2.7 Amount of Rainfall by Regency (1990)

Unit : Days

	Jan.	Feb.	March	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Pekanbaru	13	13	7	12	10	5	9	6	12	16	16	11	130
Kampar	11	13	10	12	10	5	11	3	11	18	14	16	134
Indragiri Hulu	10	14	10	11	8	7	10	6	8	11	12	16	123
Indragiri Hilir	6	8	7	7	8	7	6	7	11	12	13	14	106
Bengkalis	6	5	4	6	7	6	10	6	10	13	13	8	94
Kepulauan Riau and Batam	9	5	5	8	9	7	7	10	10	13	13	14	110

Source : Agriculture Service, Riau Province 1980

Table 2.8 Prevailing Direction of Wind Velocity in Pakanbaru Municipality, 1990

Month	Prevailing Direction	Wind Velocity (km/hour)
Jan.	Northeast	10
Feb.	Northeast	12
March	Northeast	10
Apr.	Southeast	10
May	Southeast	12
June	South	10
July	Southeast	15
Aug.	South	9
Sept.	Southeast	12
Oct.	Southwest	9
Nov.	Northwest	10
Dec.	Northeast	12

Sources : Meteorology Station Simpang Tiga Pakanbaru

Table 2.9 Fish Production by Regency in Riau Province (1991)

	Fishing		Aquaculture	Total
Kabupaten	Marine	Inland		
Bengkalis	85,493	3,433	167	89,093
Kepulauan Riau I	35,615	-	-	35,615
Indragiri Hilir	31,588	2,595	192	34,374
Kepulauan Riau II	21,142	-	-	21,142
Indragiri Hulu	-	3,562	106	3,668
Kampar	-	3,848	542	4,390
Total	173,837	13,438	1,007	188,282

Sources : Buku Tahunan Statistik Perikanan Tingkat Propinsi Tahun 1991

Table 2.10 Change of Marine Fishery Production in Riau Province (1987~1991)

Unit : ton

	1987	1988	1989	1990	1991	Growth Rate
Bengkalis	84,373	84,456	84,460	85,054	85,493	0.1%
Kepulauan Riau I	31,232	32,105	32,331	34,803	35,615	1.5%
Indragiri Hilir	27,896	28,326	29,040	29,864	31,588	1.3%
Kepulauan Riau II	13,966	14,613	17,695	18,142	21,142	4.6%
Total	157,466	159,499	163,526	167,863	173,837	2.5%

Sources : Buku Tahunan Statistik Perikanan Tingkat Propinsi Tahun 1991

Table 2.11 Change of Marine Fish Production in Riau Province (1987~1991)

Unit : ton

	1987	1988	1989	1990	1991	Growth Rate
Bengkalis	56,589	53,195	53,354	53,745	53,532	-1.0%
Kepulauan Riau I	29,113	30,124	30,956	32,790	33,391	3.7%
Indragiri Hilir	19,059	17,912	18,063	18,469	19,090	0.3%
Kepulauan Riau II	13,955	14,581	17,670	18,120	21,095	11.0%
Total	118,716	115,812	120,042	123,124	127,108	2.0%

Sources : Buku Tahunan Statistik Perikanan Tingkat Propinsi Tahun 1991

Table 2.12 Change of Marine Crustacean Production in Riau Province (1987~1991)

Unit : ton

	1987	1988	1989	1990	1991	Growth Rate
Bengkalis	26,892	30,509	30,352	30,522	31,054	2.9%
Kepulauan Riau I	2,037	1,924	1,294	1,777	1,888	-2.3%
Indragiri Hilir	3,985	5,139	5,746	6,085	6,505	12.2%
Kepulauan Riau II	0	0	0	0	0	
Total	32,914	37,572	37,392	38,384	39,447	3.9%

Sources : Buku Tahunan Statistik Perikanan Tingkat Propinsi Tahun 1991

Table 2.13 Change of Marine Mollusc Production in Riau Province (1987~1991)

Unit : ton

	1987	1988	1989	1990	1991	Growth Rate
Bengkalis	892	751	754	787	907	0.8%
Kepulauan Riau I	82	57	81	235	336	52.7%
Indragiri Hilir	4,852	5,274	5,231	5,310	5,993	4.4%
Kepulauan Riau II	10	32	25	22	47	30.6%
Total	5,836	6,115	6,091	6,354	7,282	4.9%

Sources : Buku Tahunan Statistik Perikanan Tingkat Propinsi Tahun 1991

Table 2.14 Change of Freshwater Fishery Production in Riau Province (1987~1991)

Unit : ton

Kabupaten	1987	1988	1989	1990	1991	Growth ratio
Bengkalis	3,138	3,148	3,328	3,459	3,433	2.8%
Indragiri Hilir	2,103	2,198	2,268	2,281	2,595	4.7%
Indragiri Hulu	3,170	3,171	3,172	3,231	3,562	2.5%
Kampar	3,604	3,605	3,624	3,736	3,848	1.7%
Total	12,015	12,122	12,392	12,706	13,438	2.7%

Sources : Buku Tahunan Statistik Perikanan Tingkat Propinsi tahun 1987 - 1991

Table 2.15 Change of Freshwater Fish Production in Riau Province (1987~1991)

Unit : ton

Kabupaten	1987	1988	1989	1990	1991	Growth ratio
Bengkalis	2,672	2,668	2,868	2,974	2,956	3.2%
Indragiri Hilir	1,039	1,078	1,221	1,215	1,544	9.6%
Indragiri Hulu	2,827	2,767	2,655	2,733	2,824	-0.1%
Kampar	3,501	3,576	3,594	3,727	3,730	1.7%
Total	10,039	10,089	10,338	10,649	11,054	2.5%

Sources : Buku Tahunan Statistik Perikanan Tingkat Propinsi tahun 1987 - 1991

Table 2.16 Change of Freshwater Crustacean Production in Riau Province (1987~1991)

Unit : ton

Kabupaten	1987	1988	1989	1990	1991	Growth ratio
Bengkalis	466	480	459	484	478	0.6%
Indragiri Hilir	1,065	1,120	1,048	1,066	1,051	-0.8%
Indragiri Hulu	343	404	517	498	738	19.0%
Kampar	103	29	30	9	118	-8.3%
Total	1,977	2,033	2,054	2,057	2,384	3.9%

Sources : Buku Tahunan Statistik Perikanan Tingkat Propinsi tahun 1987 - 1991

Table 2.17 Number of Fishing Boat (Non-powered boat) in Riau Province (1/4)

Unit : Number

Kabupaten	1987	1988	1989	1990	1991
Bengkalis	1,222	1,222	1,244	1,216	1,239
Kepulauan Riau I	7,271	6,634	6,093	6,155	6,190
Indragiri Hilir	1,140	1,361	1,377	1,359	683
Kepulauan Riau II	2,636	2,471	2,533	2,548	2,911
Total	12,269	11,688	11,247	11,278	11,023

Sources : Buku Tahunan Statistik Perikanan Tingkat Propinsi Tahun 1987

Table 2.17 Number of Fishing Boat (Out-board) in Riau Province (2/4)

Unit : Number

Kabupaten	1987	1988	1989	1990	1991
Bengkalis	222	223	227	265	365
Kepulauan Riau I	222	297	488	532	560
Indragiri Hilir	94	11	12	12	40
Kepulauan Riau II	24	80	153	163	409
Total	562	611	880	972	1,374

Sources : Buku Tahunan Statistik Perikanan Tingkat Propinsi Tahun 1987

Table 2.17 Number of Fishing Boat (In-boar <5GT) in Riau Province (3/4)

Unit : Number

Kabupaten	1987	1988	1989	1990	1991
Bengkalis	2,215	2,229	2,233	2,424	2,996
Kepulauan Riau I	2,628	3,206	3,566	3,688	3,696
Indragiri Hilir	480	584	590	618	1,131
Kepulauan Riau II	620	759	855	865	1,126
Total	5,943	6,778	7,244	7,595	8,949

Sources : Buku Tahunan Statistik Perikanan Tingkat Propinsi Tahun 1987

Table 2.17 Number of Fishing Boat (In-board >5GT) in Riau Province (4/4)

Unit : Number

Kabupaten	1987	1988	1989	1990	1991
Bengkalis	528	529	539	566	702
Kepulauan Riau I	19	15	27	30	42
Indragiri Hilir	33	42	42	45	156
Kepulauan Riau II					24
Total	580	586	608	641	924

Sources : Buku Tahunan Statistik Perikanan Tingkat Propinsi Tahun 1987

Table 2.18 Production Volume of Marine Fisheries in Riau Province by Speaces by Kabupaten in 1991

Unit : ton

	Bengkalis	Kepulauan Riau I	Indragiri Hilir	Kepulauan Riau II	Total
Fin Fish					
Indian halibuts	52.7	-	13.9	-	66.6
Bombay duck	10,420.9	2,208.6	1,137.1	-	13,766.6
Sea catfishes	24.7	97.6	1,101.7	561.2	1,785.2
Grunters/Sweetlips	46.4	7.1	63.8	212.0	329.3
Red Snappers	-	7,208.4	232.6	531.7	7,972.7
Groupers	35.3	136.8	91.7	1,106.9	1,370.7
Emperors	-	217.2	-	508.3	725.5
Giant sea perch/Baramundi	-	15.8	12.3	868.4	896.5
Threadfin breams	-	5,687.0	380.8	637.1	6,704.9
Yellow tail/Fusiliers	-	2,511.3	-	100.4	2,611.7
Croakers drums	1,108.3	1,520.4	872.0	103.8	3,604.5
Shark	-	149.6	306.5	-	456.1
Rays	577.0	115.4	154.6	9.5	856.5
Black pomfret	228.1	106.5	94.4	41.8	470.9
Silver pomfret	185.3	-	600.7	23.6	809.6
Baracudas	-	241.6	-	-	241.6
Scads	-	29.2	-	-	29.2
Trevallies	126.8	1,360.9	58.0	213.6	1,759.3
Jack crevallies	-	-	-	927.2	927.2
Hardtail scads	15.3	-	608.8	-	624.1
Queen fishes	-	365.3	-	66.4	431.7
Mullets	44.0	28.5	289.0	384.8	746.3
Threadfins	1,100.3	197.0	689.3	485.9	2,472.5
Anchovies	376.4	1,217.0	79.3	565.0	2,237.7
Fringescale sardinella	-	837.7	183.6	144.5	1,165.8
Wolf herrings	1,886.5	800.9	780.1	826.9	4,294.4
Indian mackerels	277.7	674.2	139.5	214.4	1,305.8
Narrow bared king mackerels	643.7	1,012.2	732.4	485.8	2,874.1
Hairhails/Cuttlass fishes	-	380.0	88.8	91.6	560.4
Eastern little tunas	-	112.2	-	6,462.6	6,574.8
Other fishies	36,382.3	6,152.5	10,379.3	5,521.3	58,435.4
Sub total	53,531.8	33,390.9	19,090.2	21,094.7	127,107.6
Crustacean					
Swim crab	11.2	-	-	-	11.2
Mud crab	-	16.0	-	-	16.0
Panulirid spiny lobsters	-	-	173.3	-	173.3
Banana prawn	3,738.7	488.0	1,505.7	-	5,732.4
Other shrimps	27,304.0	1,384.0	4,826.1	-	33,514.1
Sub total	31,053.9	1,888.0	6,505.1	-	39,447.0
Molluscs					
Scalops	-	-	85.1	-	85.1
Blood cockles	906.8	-	5,852.7	-	6,759.5
Common squids	-	260.1	30.6	25.5	316.2
Cuttle fishes	-	75.6	24.1	21.9	121.6
Sub total	906.8	335.7	5,992.5	47.4	7,282.4
Total	85,492.5	35,614.6	31,587.8	21,142.1	173,837.0

Sources : Buku Tahunan Statistik Perikanan Tingkat Propinsi Tahun 1991, Pemerintah Propinsi Dati I Riau

Table 2.19 Marine Fishery Production by Kabupaten by Fishing Gear

Unit : ton

	Bengkalis	Kepulauan Riau I	Indragiri Hilir	Kepulauan Riau II	Total
Beach Seine	446	1,121	602	-	2,168
Purse Seine	864	-	-	-	864
Drift Gill Net	11,291	2,425	5,038	1,617	20,372
Set Gill Net	1,225	2,449	1,814	1,759	7,246
Trammel Net	700	537	1,767	-	3,004
Bagan	-	786	-	702	1,487
Scoop Net	1,021	-	216	165	1,403
Other Lift Nets	2,196	262	449	-	2,907
Drift Long Line	648	-	-	-	648
Set Long Line	-	14,651	1,540	2,542	18,733
Pole and Line	-	7,244	1,629	7,961	16,834
Troll Line	-	-	-	5,425	5,425
Guiding Barrier	346	610	131	805	1,891
Stow Net	65,169	4,038	11,036	-	80,243
Portable Trap	-	336	-	97	433
Other Trap	680	1,155	1,430	71	3,336
Shell Fish Collection	907	-	5,938	-	6,845
Total	85,493	35,615	31,588	21,142	173,837

Sources : Buku Tahunan Statistik Perikanan Tingkat Propinsi Tahun 1991

Table 2.20 Number of Fishermen's Household by Kabupaten by Size of Fishing Boat

Unit : RTP

Kabupaten	Without Boat	Non Powered Boat	Powered Boat				Total
			Out Board	In Board		Sub Total	
				< 5GT	> 5GT		
Bengkalis	1,716	1,225	348	2,974	583	3,905	6,846
Kepulauan Riau I		6,066	546	3,667	42	4,255	10,321
Indragiri Hilir	236	614	38	1,025	145	1,208	2,058
Kepulauan Riau II		2,727	397	1,089	24	1,510	4,237
Total	1,952	10,632	1,329	8,755	794	10,878	23,462

Sources : Buku Tahunan Statistik Perikanan Tingkat Propinsi Tahun 1991

Table 2.21 Fish Production by Kecamatan in Kab. Bengkalis (1991)

Unit : ton

	Marine			Inland Open Water			Total
	Fishing	Aquaculture	Sub Total	Fishing	Aquaculture	Sub Total	
Kubu	48,448	-	48,448	1	4	5	48,453
Bangko	21,965	-	21,965	52	2	53	22,018
Dumai/Rupat	1,715	2	1,717	2	10	12	1,728
Bengkalis / B.Batu	1,528	5	1,533	1	1	2	1,536
T. Tinggi / Merbau	10,796	2	10,798	-	2	2	10,800
Mandau / T. Putih	-	-	-	3,115	46	3,161	3,161
Siak / Sei. Apit	115	-	115	100	16	116	231
Total	84,568	9	84,576	3,270	80	3,350	87,927

Sources : Laporan Tahunan 1991, Cabang Dinas Perikanan, Kabupaten Bengkalis

Table 2.22 Annual Marine Fisheries Production in Kec. Bengkalis (1987~1991)

Unit : Ton

	1987	1988	1989	1990	1991	Growth ratio
Kubu						
Fishing	51,563.6	53,573.4	48,837.0	48,516.0	48,448.0	-2.2%
Aquaculture	-	-	-	-	-	
Bangko						
Fishing	16,630.8	15,192.1	20,766.2	21,242.6	21,964.8	9.3%
Aquaculture	-	-	-	-	-	
Dumai/Rupat						
Fishing	1,558.6	1,164.4	1,772.7	1,825.2	1,715.4	6.6%
Aquaculture	-	0.8	10.0	20.6	1.5	
Bengkalis/B.Batu						
Fishing	1,765.8	1,597.6	1,941.6	1,526.4	1,528.4	-3.3%
Aquaculture	1.4	3.9	5.8	3.5	4.9	27.1%
T.Tinggi/Merbau						
Fishing	10,737.6	11,701.9	11,142.8	11,470.5	10,796.1	-0.1%
Aquaculture	-	0.6	20.0	7.5	2.3	
Mandau/T. Puteh						
Fishing	-	-	-	-	-	
Aquaculture	-	-	-	-	-	
Siak/Sei Apit						
Fishing	-	-	-	-	114.8	
Aquaculture	-	-	-	-	-	
Fishing sub total	82,256.4	83,229.4	84,460.3	84,580.7	84,567.5	0.7%
Aq. sub total	1.4	5.3	35.8	31.6	8.7	72.3%
Total	82,257.8	83,234.7	84,496.1	84,612.3	84,576.2	0.7%

Sources : Laporan Tahunan 1987• 1991, Cabang Dinas Perikanan, Kabupaten Bengkalis

Table 2.23 Annual Inland Fishery Production in Kab. Bengkalis (1987~1991)

Unit : Ton

	1987	1988	1989	1990	1991	Growth rato
Kubu						
Fishing	-	-	-	-	1.3	
Aquaculture	-	-	-	-	4.0	
Bangko						
Fishing	-	-	-	-	51.8	
Aquaculture	-	-	-	0.7	1.5	
Dumai/Rupat						
Fishing	-	-	-	-	1.5	
Aquaculture	11.4	12.8	12.3	5.3	10.0	
Bengkalis/B.Batu						
Fishing	-	-	-	-	1.0	
Aquaculture	-	-	2.4	2.4	1.4	
T.Tinggi/Merbau						
Fishing	-	-	-	-	-	
Aquaculture	-	0.9	1.0	1.0	1.5	
Mandau/T. Puteh						
Fishing	1,837.6	2,740.1	3,102.0	3,040.0	3,115.0	12.3%
Aquaculture	24.6	34.0	25.2	41.6	45.5	15.4%
Siak/Sei Apit						
Fishing	19.1	24.4	25.5	96.5	99.6	59.6%
Aquaculture	5.2	6.7	5.7	15.9	16.3	37.0%
Fishing sub total	1,856.7	2,764.5	3,127.5	3,136.5	3,270.2	13.4%
Aq. sub total	41.2	54.4	46.6	66.9	80.2	16.6%
Total	1,897.9	2,818.9	3,174.1	3,203.4	3,350.4	13.5%

Sources : Laporan Tahunan 1987 - 1991, Cabang Dinas Perikanan, Kabupaten Bengkalis

Table 2.24 Number of Fishing Boat by Kecamatan in Kab. Bengkalis (1991)

Unit : No

	Non Powered Boat	Powered Boat			Total
		Outboard	Inboard	Sub Total	
Kubu	-	-	848	848	848
Bangko	135	-	645	645	780
Dumai/Rupat	231	71	317	388	619
Bengkalis / B.Batu	247	4	361	365	612
T. Tinggi / Merbau	182	-	557	557	739
Mandau/T. Putih	-	-	-	-	-
Siak/Sei. Apit	51.0	-	17.0	17	68
Total	846	75	2,745	2,820	3,666

Sources : Laporan Tahunan 1991, Cabang Dinas Perikanan, Kabupaten Bengkalis

Table 2.25 Change of Number of Fishing Baot by Kecamatang in Kab. Bengkalis (1987~1991)

Unit : No

	1987	1988	1989	1990	1991
Kubu					
Non Powered Boat	-	85	169	-	-
Out Board Motor	-	-	-	-	-
Inboard Motor	669	800	855	850	848
Sub Total	669	885	1,024	850	848
Bangko					
Non Powered Boat	24	113	225	115	135
Out Board Motor	-	-	-	-	-
Inboard Motor	633	487	514	620	645
Sub Total	657	600	739	735	780
Dumai/Rupat					
Non Powered Boat	83	71	173	237	231
Out Board Motor	153	153	157	123	71
Inboard Motor	685	458	486	488	317
Sub Total	921	682	816	848	619
Bengkalis/Bukit Batu					
Non Powered Boat	210	218	275	224	247
Out Board Motor	2	2	-	4	4
Inboard Motor	332	356	366	365	361
Sub Total	544	576	641	593	612
Tebing Tenggi/Merbau					
Non Powered Boat	226	255	308	318	182
Out Board Motor	-	-	-	-	-
Inboard Motor	630	726	715	737	557
Sub Total	856	981	1,023	1,055	739
Mandau/Duri					
Non Powered Boat	-	-	-	-	-
Out Board Motor	10	-	-	-	-
Inboard Motor	-	-	-	-	-
Sub Total	10	-	-	-	-
Siak/Sei. Apit					
Non Powered Boat	-	-	-	-	51
Out Board Motor	2	-	-	-	-
Inboard Motor	-	-	-	-	17
Sub Total	2	-	-	-	68
Total					
Non Powered Boat	543	742	1,150	894	846
Out Board Motor	167	155	157	127	75
Inboard Motor	2,949	2,827	2,936	3,060	2,745
Total	3,659	3,724	4,243	4,081	3,666

Sources : Laporan Tahunan 1987 - 1991, Cabang Dinas Perikanan, Kabupaten Bengkalis

Table 2.26 Change of Number of Fishing Gear by Kecamatang in Kab. Bengkalis (1987~1991) (1/2)

Unit : No

	1987	1988	1989	1990	1991
Kubu					
Beach Seine	95	78	78	25	25
Purse Seine	21	10	4	4	4
Drift Gill Net	294	388	448	443	436
Scoop Net	8	21	51	44	56
Drift Long Line	10	12	7	7	7
Portable Traps	336	359	314	327	298
Stow Net					
Jermal	-	-	-	-	-
Ambai	-	-	-	-	-
Gombang/Cici	-	-	-	-	-
Pengerih	-	-	-	-	-
Shellfish Collection	-	-	1,998	1,998	2,018
Others	-	-	-	-	-
Sub Total	764	868	2,900	2,848	2,844
Bangko					
Beach Seine	-	2	2	4	15
Purse Seine	-	-	-	-	-
Drift Gill Net	305	302	747	436	371
Scoop Net	2	14	11	8	15
Drift Long Line	27	23	29	20	25
Portable Traps	216	207	167	176	213
Stow Net					
Jermal	9	10	8	11	11
Ambai	-	-	-	-	-
Gombang/Cici	26	18	21	31	27
Pengerih	-	-	-	-	-
Shellfish Collection	-	-	499	499	549
Others	13	32	26	24	24
Sub Total	598	608	1,510	1,209	1,250
Dumai/Rupat					
Beach Seine	-	-	-	-	-
Purse Seine	-	-	-	-	-
Drift Gill Net	657	738	714	730	632
Scoop Net	-	-	-	-	-
Drift Long Line	20	16	18	20	16
Portable Traps	-	-	-	-	-
Stow Net					
Jermal	-	-	-	-	-
Ambai	-	-	-	-	-
Gombang/Cici	5	2	1	1	3
Pengerih	45	50	50	80	90
Shellfish Collection	-	-	-	-	-
Others	5	11	6	6	-
Sub Total	732	817	789	837	741

Sources : LaporanTahunan 1987 - 1991, Cabang Dinas Perikanan, Kabupaten Bengkalis

Table 2.26 Change of Number of Fishing Gear by Kecamatang in Kab. Bengkalis (1987~1991) (2/2)

Unit : No

	1987	1988	1989	1990	1991
Bengkalis/Bukit Batu					
Beach Seine	-	-	20	20	20
Purse Seine	-	-	-	-	-
Drift Gill Net	332	358	440	454	455
Scoop Net	-	-	-	-	-
Drift Long Line	-	70	72	72	74
Portable Traps	-	-	-	-	-
Stow Net					
Jermal	-	-	-	-	-
Ambai	26	28	28	28	28
Gombang/Cici	16	21	21	21	23
Pengerih	140	135	51	49	66
Shellfish Collection	-	-	-	-	-
Others	20	34	20	21	22
Sub Total	534	646	652	665	688
Tebing Tenggi/Merbau					
Beach Seine	-	-	-	-	-
Purse Seine	-	-	-	-	-
Drift Gill Net	630	746	652	655	662
Scoop Net	-	-	-	-	-
Drift Long Line	34	75	28	32	20
Portable Traps	-	-	-	-	-
Stow Net					
Jermal	-	-	-	-	-
Ambai	3	3	3	3	3
Gombang/Cici	245	165	156	164	227
Pengerih	90	100	90	12	50
Shellfish Collection	-	-	-	-	-
Others	13	13	14	12	13
Sub Total	1,015	1,102	943	878	975
Total					
Beach Seine	95	80	100	49	60
Purse Seine	21	10	4	4	4
Drift Gill Net	2,218	2,532	3,001	2,718	2,556
Scoop Net	10	35	62	52	71
Drift Long Line	91	196	154	151	142
Portable Traps	552	566	481	503	511
Stow Net					
Jermal	9	10	8	11	11
Ambai	29	31	31	31	31
Gombang/Cici	292	206	199	217	280
Pengerih	275	285	191	141	206
Shellfish Collection	-	-	2,497	2,497	2,567
Others	51	90	66	63	59
Total	3,643	4,041	6,794	6,437	6,498

Sources : LaporanTahunan 1987 - 1991, Cabang Dinas Perikanan, Kabupaten Bengkalis

Table 2.27 Number of Fishermen's Household by Kecamatan in Kab. Bengkalis (1991)

Unit:Household

Kecamatan	Marine	Inland water	Total
Kubu	2,140	15	2,155
Bangko	2,654	-	2,654
Dumai/Rupat	794	17	811
Bengkalis/Bukit Batu	546	10	556
Tebing tenggi/Merbau	704	-	704
Mandau/Tana Putih	-	1,445	1,445
Siak/Sei Apit	80	152	232
Total	6,918	1,639	8,557

Sources : Laporan Tahunan 1991, Cabang Dinas Perikanan Kabupaten Bengkalis

Table 2.28 Average Catch by Gill Net with Powered Boat in 1992

Umit : kg/trip

	Jan.	Feb.	March	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Bengkalis/B.Batu	72	75	83	80	81	83	83	73	81	74	73	76
Tibing Tinggi/Merbau	190	125	125	150	160	150	140	130	135	140	130	125
Dumai/Rupat	150	150	150	150	150	150	150	150	150	150	150	150

Sources : Laporan Table IV, Kec. Bengkalis/B.Batu, Tebing Tinggi/Merbau, Dumai/Merbau in 1992

Table 2.29 Average Catch by Set long line with Non powered Boat in 1992

Umit : kg/trip

	Jan.	Feb.	March	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Bengkalis/B.Batu	28	30	29	30	29	29	29	29	30	30	30	30
Tibing Tinggi/Merbau	16	20	20	30	30	15	12	10	8	9	10	9
Dumai/Rupat	67	67	66.7	67	67	67	67	67	67	67	67	67

Sources : Laporan Table IV, Kec. Bengkalis/B.Batu, Tebing Tinggi/Merbau, Dumai/Merbau in 1992

Table 2.30 Average Catch Volume of First Class Fish by Gill Net in 1992

Umit : kg/trip

	1	2	3	4	5	6	7	8	9	10	11	12
Bengkalis/B.Batu	16	19	18	22	28	27	27	23	21	19	20	21
Tibing Tinggi/Merbau	48	31	31	38	40	38	35	33	34	35	33	31
Dumai/Rupat	132	92	92	92	105	108	114	101	75	75	102	110

Sources : Laporan Table IV, Kec. Bengkalis/B.Batu, Tebing Tinggi/Merbau, Dumai/Merbau in 1992

Table 2.31 Average Catch by Gombang in 1992

Umit : kg/trip

	1	2	3	4	5	6	7	8	9	10	11	12
Bengkalis/B.Batu	30	32	34	30	32	32	34	32	30	25	25	22
Tibing Tinggi/Merbau	20	15	15	20	15	14	12	12	13	15	12	10
Dumai/Rupat	20	20	20	20	20	20	20	20	20	20	20	20

Sources : Laporan Table IV, Kec. Bengkalis/B.Batu, Tebing Tinggi/Merbau, Dumai/Merbau in 1992

Table 2.32 Composition of Gombang Catch in Kec. Bengkalis/B. Batu in 1992

Umit : kg/trip

	1	2	3	4	5	6	7	8	9	10	11	12
White shrimp	2.7	3.2	3.1	4.5	5.4	4.8	2.7	3.2	4.8	3.8	5.0	2.2
Other shrimp	4.2	4.8	6.1	3.0	3.2	7.4	3.4	6.4	3.3	2.5	3.8	3.5
Trash fish	23.1	24.0	24.8	22.5	23.4	19.8	27.9	22.4	21.9	18.8	16.3	16.3

Sources : Laporan Table IV, Kec. Bengkalis/B.Batu, Tebing Tinggi/Merbau, Dumai/Merbau in 1992

Table 2.33 Composition of Gombang Catch in Kec. T. Tinggi/Merbau in 1992

Umit : kg/trip

	1	2	3	4	5	6	7	8	9	10	11	12
Shrimps	4.0	3.0	3.0	4.0	3.0	2.8	2.4	6.6	2.6	3.8	2.4	2.0
Mysid	2.0	1.5	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.0
Anchovy & Others	14.0	10.5	10.5	16.0	12.0	11.2	9.6	5.4	10.4	11.3	8.4	7.0

Sources : Laporan Table IV, Kec. Bengkalis/B.Batu, Tebing Tinggi/Merbau, Dumai/Merbau in 1992

Table 2.34 Composition of Gombang Catch in Kec. Dumai/Rupat in 1992

Umit : kg/trip

	1	2	3	4	5	6	7	8	9	10	11	12
Shrimps	9.0	10.0	12.0	10.0	12.0	14.0	9.0	10.0	14.0	10.0	13.0	10.0
Others	11.0	10.0	8.0	10.0	8.0	6.0	11.0	10.0	6.0	10.0	7.0	10.0

Sources : Laporan Table IV, Kec. Bengkalis/B.Batu, Tebing Tinggi/Merbau, Dumai/Merbau in 1992

Table 2.35 Number of Interviewee by Boat Ownership by Desa

Unit : Person

	Boat owner	Not owner	Total
Bengkalis Kota	6	0	6
Ketam Putih	6	0	6
Sebauk	2	0	2
Bentan Air	6	0	6
Teluk Pambang	6	0	6
Meskom	4	2	6
Slt.Panjang Barat	6	0	6
Kedabu Rapat	0	6	6
Bungur	2	4	6
Tlk.Buntal	0	6	6
Lemang	6	0	6
Lemang	10	2	12
Melai	0	6	6
Tg.Gadai	0	6	6
Alai	5	1	6
Banglas	6	0	6
Topang	0	6	6
Alah Air	0	6	6
Bantar	6	0	6
Tg.Peranap	6	0	6
Tg.Samak	0	6	6
Beting	0	6	6
Tg.Kedabu	1	5	6
Teluk Belitung	3	3	6
Bandul	4	1	5
Kudap	1	5	6
Dedap	3	3	6
Baran Melintang	4	1	5
Centai	4	2	6
Bagan Melibur	3	3	6
Kuala Merbau	6	0	6
Selat Akar	0	0	0
Lubuk Muda	5	1	6
Bukit Batu	3	2	5
Tanjung Belit	0	6	6
Sungai Apit	6	0	6
Sungai Kayu Ara	6	0	6
Teluk Lecah	4	2	6
Tanjung Medang	4	2	6
Pkl.Nyirih	2	2	4
Sungai Cingam	2	3	5
Tanjung Punak	4	0	4
Teluk Makmur	3	3	6
Guntung	3	3	6
Total	148	104	252

Sources : Result of Fishery Interview Survey

Table 2.36 Fishing Style of Interviewee whose Average Catch is More Than 1,000kg/operation

Kecamatan	Desa	Type of Boat	Hp	Fishing Gear	Average Catch /trip	No. of Fishing Gear/Trip	Frequency of Trip /month	Terms of Trip (days)	Fishing day/month
Merbau	Kudap	Outboard	16	Other Lift Net	30,000	2	3	15	10
Merbau	Selat Akar	Inboard	12	Portable Trap	11,000	15	18	1	18
Merbau	Selat Akar	Inboard	16	Portable Trap	10,000	14	18	1	18
Merbau	Selat Akar	Inboard	16	Portable Trap	10,000	15	15	1	15
Merbau	Selat Akar	Inboard	16	Portable Trap	10,000	15	15	1	15
Merbau	Selat Akar	Inboard	16	Portable Trap	10,000	18	15	1	15
Tebing Tenggi	Melai	Inboard	120	Set Long Line	8,000	5	1	30	30
Tebing Tenggi	Bungur	Inboard	45	Drift Gill Net	1,300	50	1	25	25
Merbau	Kudap	Inboard	45	Drift Gill Net	1,000	100	2	15	10

Sources : Result of Fishery Interview Survey

Table 2.37 Condition of Ice for Catches by Fishing Gear (1/2) Non Powered Boat

	Use	Not Use	Total
Beach Seine	2	8	10
Drift Gill Net	6	55	61
Encircling Gill Net	2	6	8
Lift Net	1	2	3
Set Long Line	4	3	7
Portable Trap	1	0	1
Other trap	1	6	7
Gombang	18	16	34
Ambai	0	1	1
Pengerih	21	16	37
Total	56	113	169

Sources : Result of Fishery Interview Survey

Table 2.37 Condition of Ice for Catches by Fishing Gear (2/2) Powered Boat

	Use	Not Use	Total
Drift Gill Net	53	19	72
Encircling Gill Net	1	2	3
Trammel Net	0	1	1
Lift Net	4	1	5
Set Long Line	2	6	8
Portable Trap	2	2	4
Other trap	3	3	6
Gombang	2	7	9
Total	67	41	108

Sources : Result of Fishery Interview Survey

Table 2.38 Reason not to Use Ice (1/2)
Non Powered Boat

	Insufficient Supply of Ice	Not necessary	Total
Bengkalis	-	2	2
Tebing Tenggi	-	52	52
Merbau	-	8	8
Bukit Batu	5	8	13
Sei Apit	-	1	1
Rupat	-	3	3
Dumai	-	4	4
Total	5	78	83

Sources : Result of Fishery Interview Survey

Table 2.38 Reason not to Use Ice (2/2)
Powered Boat

	Insufficient Supply of Ice	Not necessary	Total
Bengkalis	-	9	9
Tebing Tenggi	1	9	10
Merbau	-	4	4
Bukit Batu	-	1	1
Rupat	1	10	11
Dumai	-	1	1
Total	2	34	36

Sources : Result of Fishery Interview Survey

Table 2.39 Unloading Site Selection by Kecamatan (1/2)
Non Powered Boat

Unit : Intrerviewee

	Dumai	Bengkalis	Selatpanjang	Own village	Collecting vessels	Others	Total
1 Bengkalis	-	19	-	33	3	-	73
2 Tebing Tenggi	-	-	21	68	11	14	114
3 Merbau	-	-	-	24	1	3	28
4 Bukit Batu	-	-	-	20	-	-	20
5 Sungai Apit	-	-	-	9	1	-	10
6 Rupat	-	-	-	10	1	2	13
9 Dumai	-	-	-	8	-	-	8
	1	19	43	167	17	19	266

Sources : Result of Fishery Interview Survey

Table 2.39 Unloading Site Selection by Kecamatan (2/2)
Powered Boat

Unit : Intrerviewee

	Dumai	Bengkalis	Selat panjang	Own village	Collecting vessels	Others	Total
1 Bengkalis	-	23	1	24	4	-	52
2 Tebing Tenggi	-	3	10	18	14	9	54
3 Merbau	-	5	4	15	8	-	32
4 Bukit Batu	-	-	-	3	-	-	3
5 Sungai Apit	1	1	1	3	-	-	6
6 Rupat	3	-	1	16	-	5	25
9 Dumai	7	-	-	1	-	-	8
	11	32	17	80	26	14	180

Sources : Result of Fishery Interview Survey

Table 2.40 Selection of Wholesaler (1/2)
Non Powered Boat

Unit : Interviewee

	Fish price	Credit tie	Business tie (without credit)	Others	Total
Bengkalis	19	2	2	11	34
Tebing Tenggi	58	8	2	14	82
Merbau	12	3	1	2	18
Bukit Batu	10	0	0	5	15
Sungai Apit	9	0	0	0	9
Rupat	5	0	0	3	8
Dumai	7	0	0	0	7
Total	120	13	5	35	173

Sources : Result of Fishery Interview Survey

Table 2.40 Selection of Wholesaler (2/2)
Powered Boat

Unit : Interviewee

	Fish price	Credit tie	Business tie (without credit)	Others	Total
Bengkalis	17	16	7	3	43
Tebing Tenggi	28	0	2	1	31
Merbau	5	15	6	2	28
Bukit Batu	1	0	0	0	1
Sungai Apit	4	0	0	0	4
Rupat	3	9	5	1	18
Dumai	3	1	2	1	7
Total	61	41	22	8	132

Sources : Result of Fishery Interview Survey

Table 2.41 Type of Wholesaler by Fishing Gear (1/2)
Non Powered Boat

Unit : Interviewee

Fishing Gear	Type of buyer					Total
	Cooperative	Boat owner	Local wholesaler	Wholesaler (other site)	Retailer	
Beach Seine	-	1	2	-	-	3
Drift Gill Net	1	-	11	4	8	24
Encircling Gill Net	-	2	1	-	1	4
Other Lift Nets	1	-	-	-	1	2
Set Long Line	-	3	3	-	-	6
Portable Trap	-	-	1	-	-	1
Other Trap	1	-	6	-	-	7
Gombang	-	3	16	-	8	27
Ambai	-	-	1	-	-	1
Pengerih	-	1	12	-	10	23
Kiso	-	-	0	-	1	1
Total	3	10	53	4	29	99

Sources : Result of Fishery Interview Survey

Table 2.41 Type of Wholesaler by Fishing Gear (2/2) Powered Boat

Unit : Interviewee

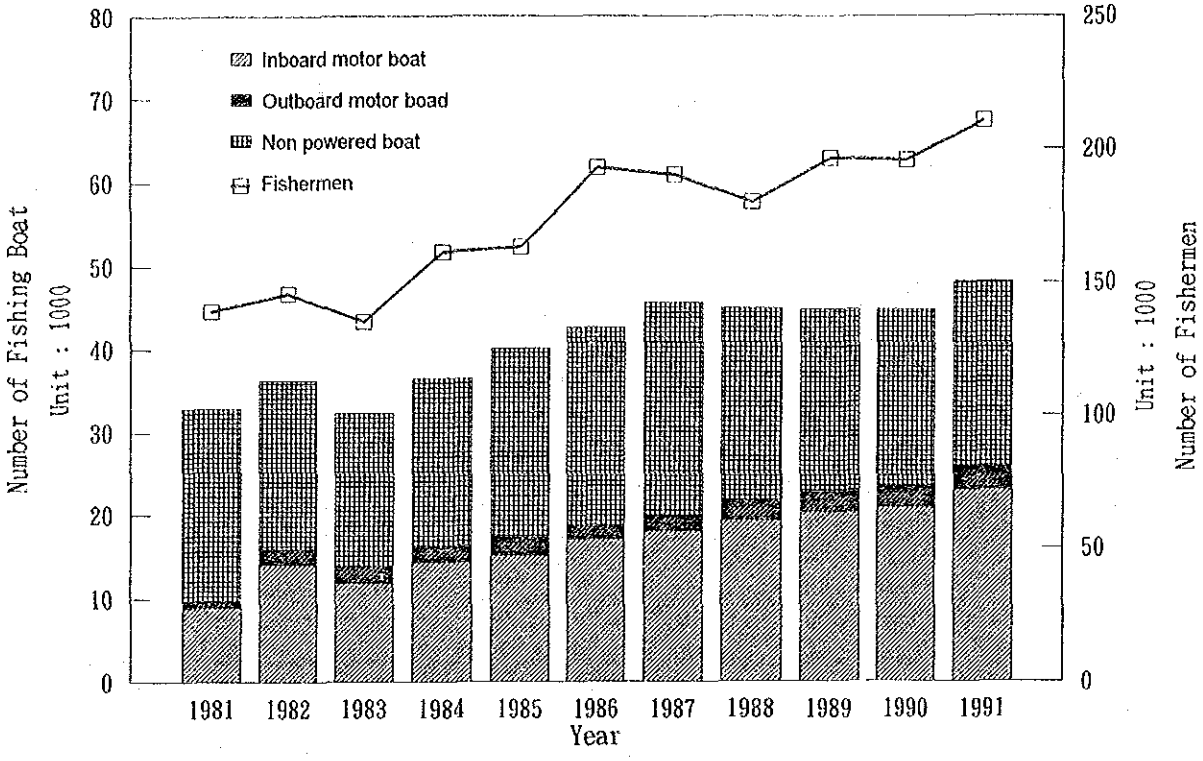
Fishing Gear	Type of buyer					Total
	Cooperative	Boat owner	Local wholesaler	Wholesaler (other site)	Retailer	
Drift Gill Net	10	4	53	1	6	74
Encircling Gill Net	1	1	3	-	-	5
Trammel net	-	-	1	-	-	1
Other Lift Nets	-	-	1	-	2	3
Drift Long Line	1	-	-	-	-	1
Set Long Line	-	1	7	1	-	9
Portable Trap	-	-	4	-	-	4
Other Trap	-	-	3	2	-	5
Gombang	-	-	1	8	4	13
Total	12	6	73	12	12	115

Sources : Result of Fishery Interview Survey

Table 2.42 Recognition of Fishing Lows

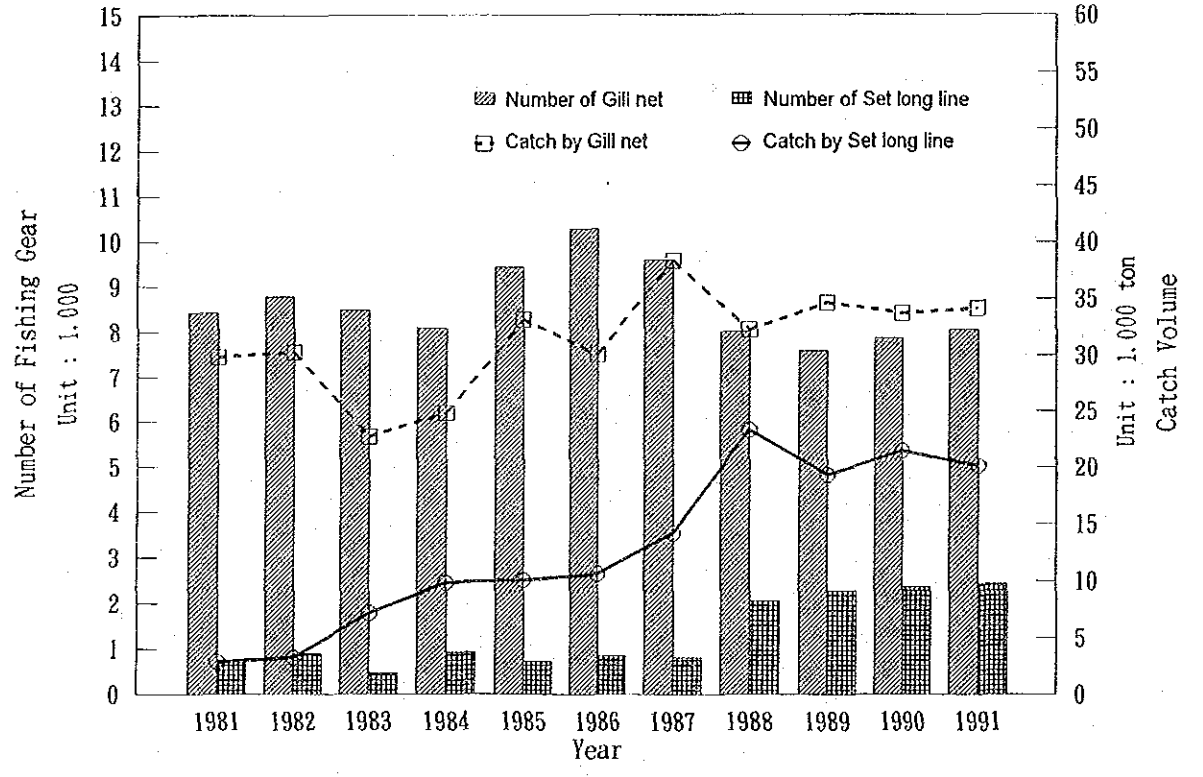
	Fishing method	Fishing season	Fishing ground	Others	Total
Ketam Putih	2	-	2	-	4
Sungai Alam	3	-	-	-	3
Kelemantan	4	-	5	-	9
Sekodi	3	-	3	-	6
Slt.Panjang Barat	0	-	6	4	10
Melai	0	-	1	-	1
Banglas	4	-	2	6	12
Bantar	5	-	1	5	11
Tg.Peranap	2	-	-	2	4
Teluk Belitung	-	1	1	-	2
Kuala Merbau	-	1	-	1	2
Sungai Pakning	-	1	1	-	2
Parit I Api-Api	-	-	2	-	2
Terkul	1	-	1	-	2
Teluk Lecah	1	-	-	1	2
Pkl.Nyirih	-	-	1	-	1
Tanjung Punak	-	-	1	2	3
Total	25	3	27	21	76

Sources : Result of Fishery Interview Survey



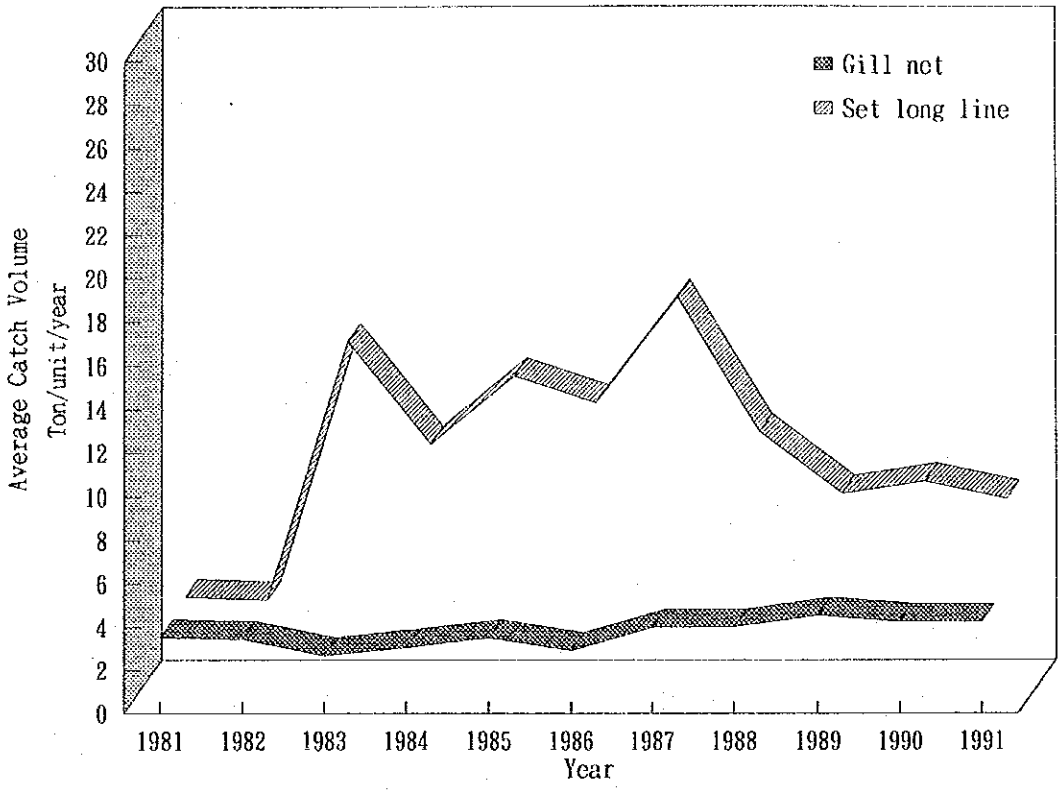
Sources : Fisheries Statistics of Indonesia 1981~1991

Fig. 2.1 Numbers of Fishing Boat and Fishermen in Malacca Strait



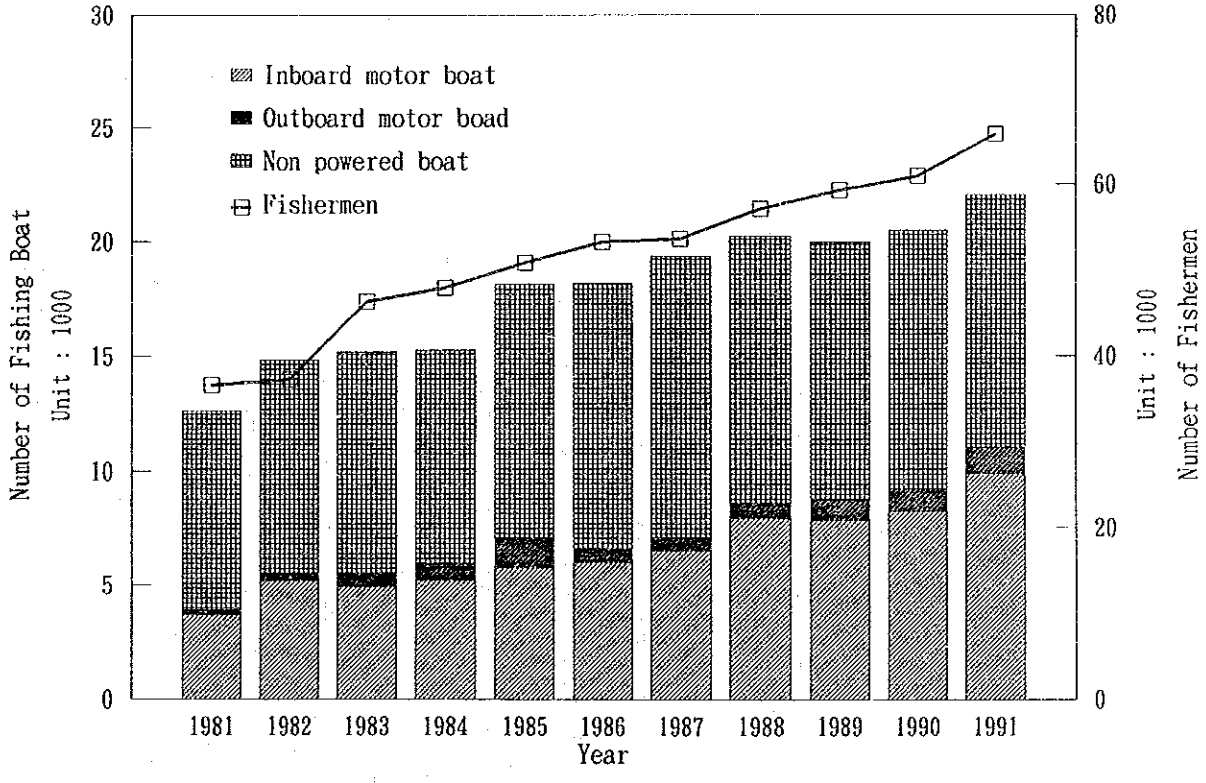
Sources : Fisheries Statistics of Indonesia 1981~1991

Fig. 2.2 Number of Fishing Gear and Fish Catch in Malacca Strait



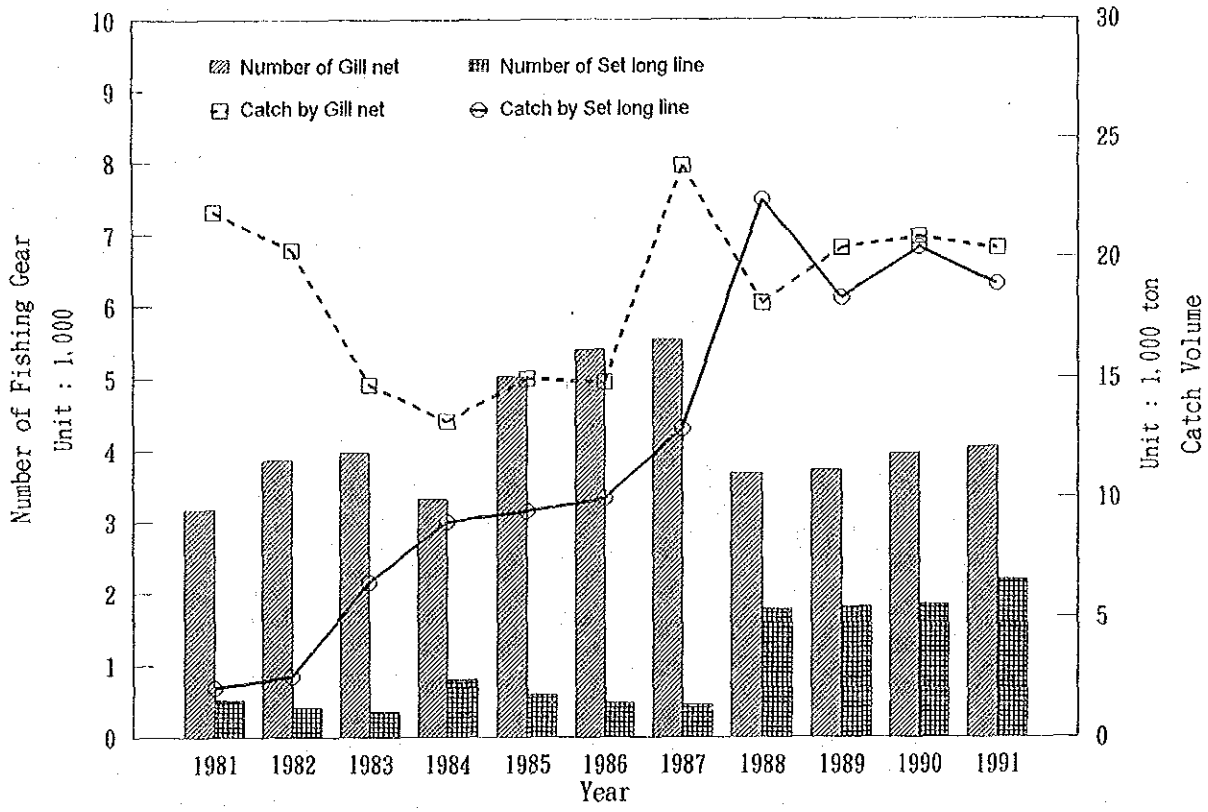
Sources : Fisheries Statistics of Indonesia 1981~1991

Fig. 2.3 Annual Fish Catch per Fishing Unit in Malacca Strait



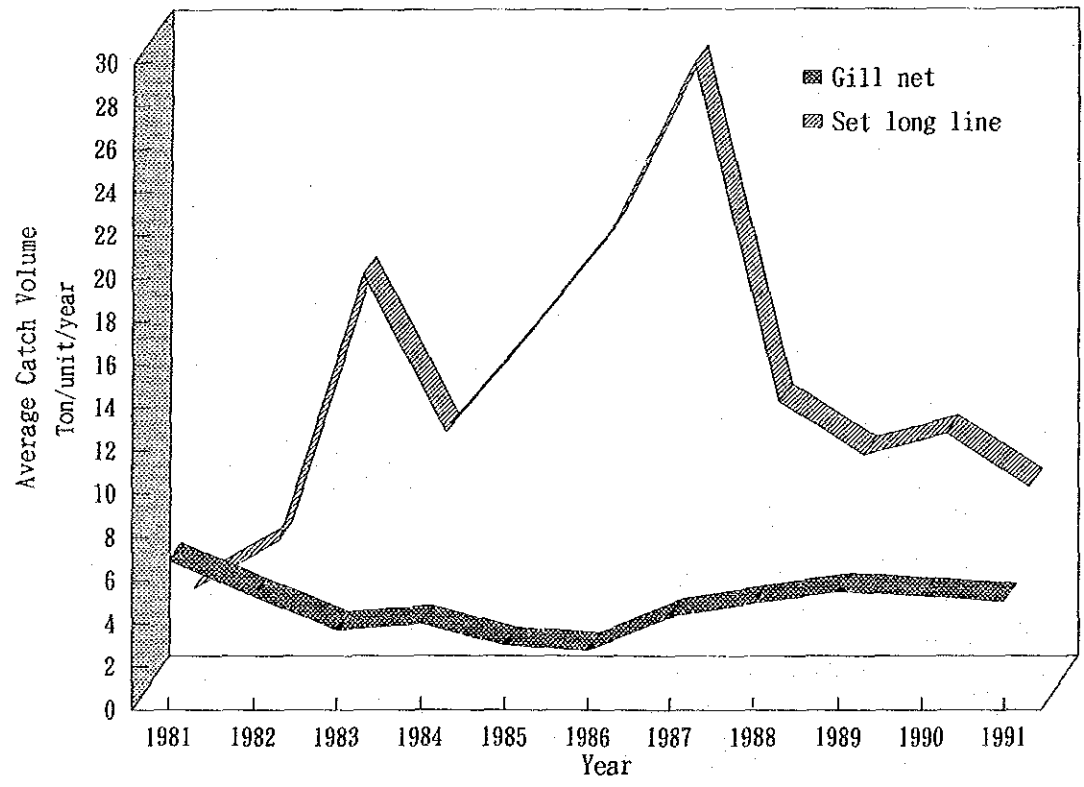
Sources : Fisheries Statistics of Indonesia 1981~1991

Fig. 2.4 Numbers of Fishing Boat and Fishermen of Riau Province in Malacca Strait



Sources : Fisheries Statistics of Indonesia 1981~1991

Fig 2.5 Number of Fishing Gear and Fish Catch of Riau Province in Malacca Strait



Sources : Fisheries Statistics of Indonesia 1981~1991

Fig. 2.6 Annual Fish Catch per Fishing Unit of Riau Province in Malacca Strai

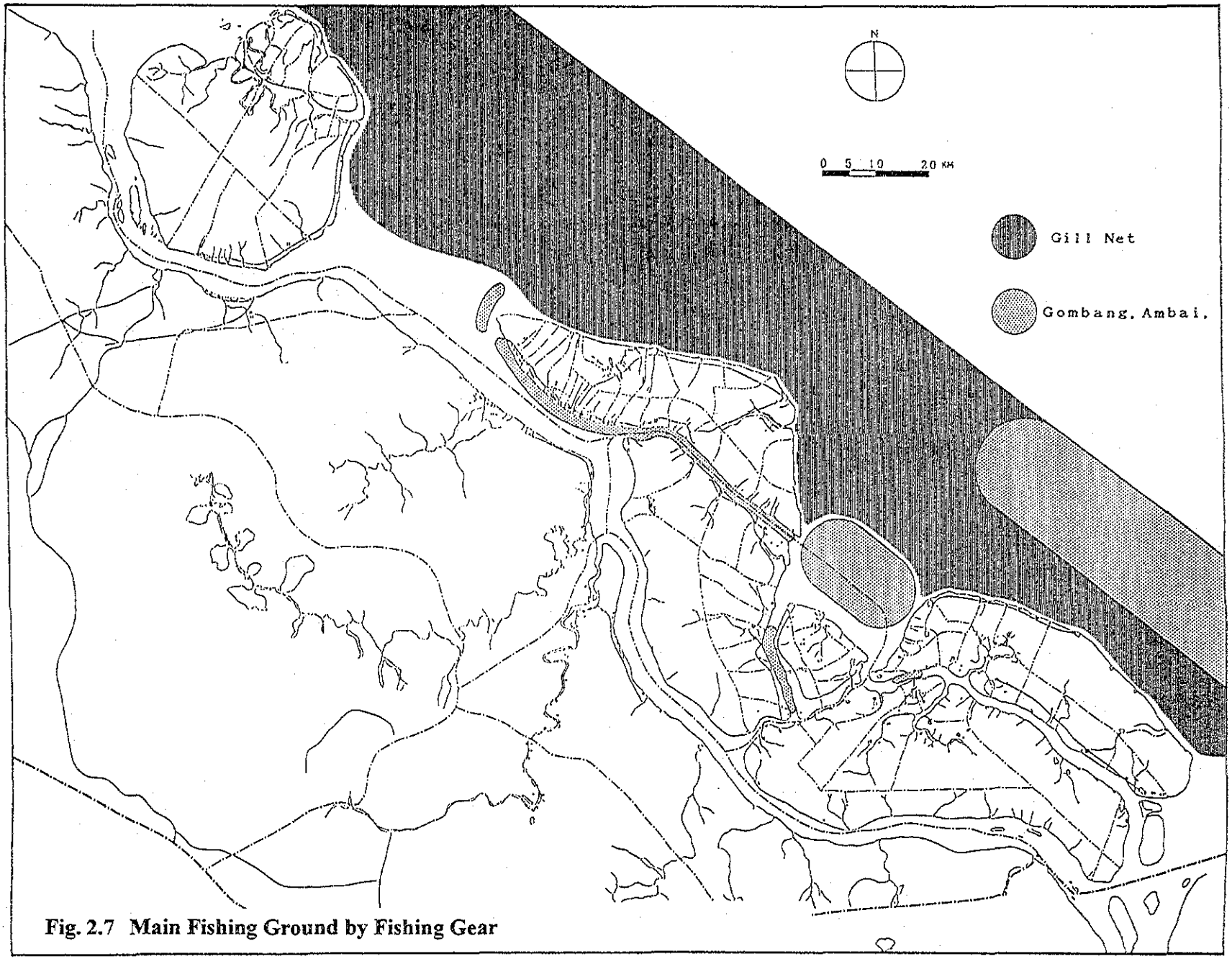


Fig. 2.7 Main Fishing Ground by Fishing Gear

Appendix 1. Average Catch of Powered Boat by Area By Fishing Gear

Kecamatan	Area	Fishing gear	Average catch/trip (Kg)	Trash fish /catch (Kg)	No. of F.G. (Set)	Frequency of fishing trip (/week)	Frequency of fishing trip (/month)	Terms of Trip (days)	Fishing Operation days/mont	Fishing Operation /trip	Catch / operation
Bengkalis	MSS	Drift Gill Net	50.8	2.2	1	1.0	2.0	7.0	14.0	14.0	3.6
Bengkalis	CS	Drift Gill Net	50.3	7.3	40	1.6	5.3	6.7	17.4	12.2	4.1
Tebing Tenggi	CS	Drift Gill Net	60.2	26.6	11	2.0	19.7	3.5	15.5	4.9	12.2
Merbau	CS	Drift Gill Net	240.4	5.6	30	2.8	3.6	8.5	14.9	10.3	23.3
Bukit Batu	CS	Drift Gill Net	22.3	7.0	1	3.7	8.7	2.0	11.3	2.0	11.2
Rupat	MSS	Drift Gill Net	51.1	17.3	1	4.0	12.8	1.9	15.4	3.3	15.7
Rupat	CS	Drift Gill Net	7.5	1.0	1	5.5	12.5	1.0	12.5	1.0	7.5
Dumai	CS	Drift Gill Net	116.9	47.4	9	2.6	7.0	4.4	19.6	9.0	13.0
Bengkalis	CS	Encircling Gill	30.0	5.0	13	6.0	24.0	10.3	24.0	1.0	30.0
Tebing Tenggi	CS	Encircling Gill	100.0	6.0	20	1.0	4.0	7.0	26.0	0.0	-
Rupat	MSS	Encircling Gill	25.0	42.5	1	3.0	8.5	1.5	8.5	5.0	5.0
Rupat	CS	Tramel net	1.0	1.0	40	7.0	14.0	1.0	14.0	3.0	0.3
Merbau	CS	Other Lift Nets	15,002.0	50.0	5	3.0	11.5	8.0	15.0	2.0	7,501.0
Bengkalis	MSS	Set Long Line	7.0	1.0	1	6.0	24.0	1.0	24.0	2.0	3.5
Bengkalis	CS	Set Long Line	41.7	20.0	20	3.5	13.0	6.0	20.0	12.5	3.3
Tebing Tenggi	MSS	Set Long Line	8,000.0	0.0	5	0.0	1.0	30.0	30.0	40.0	200.0
Tebing Tenggi	CS	Set Long Line	15.0	0.0	3	6.0	24.0	1.0	24.0	0.0	-
Merbau	MSS	Set Long Line	200.0	0.0	700	1.0	2.0	8.0	15.0	8.0	25.0
Merbau	CS	Set Long Line	102.5	0.5	351	1.8	7.0	4.0	13.5	7.0	14.6
Merbau	MSS	Portable Trap	10,200.0	0.0	15	0.0	16.2	1.0	16.2	4.0	2,550.0
Tebing Tenggi	MSS	Other Trap	150.0	0.0	20	1.0	4.0	6.0	24.0	12.0	12.5
Merbau	MSS	Other Trap	35.0	5.0	1	16.0	32.0	1.0	15.0	2.0	17.5
Merbau	CS	Other Trap	100.0	0.0	15	1.0	4.0	5.5	22.0	11.0	9.1
Bengkalis	MSS	Gombang	5.0	0.5	1	56.0	112.0	0.3	15.0	1.0	5.0
Tebing Tenggi	MSS	Gombang	17.5	2.5	2	3.0	14.0	1.0	14.0	1.0	17.5
Merbau	MSS	Gombang	35.0	17.5	9	17.0	34.0	1.0	15.0	2.0	17.5

Remarks : MSS ; Malacca Strait Side, CS ; Channel Side.
Sources : Result of Fishery Interview Survey

Appendix 2. Average Catch of Non Powered Boat by Area By Fishing Gear

Kecamatan	Area	Fishing gear	Average catch/trip (Kg)	Trash fish /catch (Kg)	No. of F.G. (Set)	Frequency of fishing trip (/week)	Frequency of fishing trip (/month)	Terms of Trip (days)	Fishing Operation days/mont	Fishing Operation /trip	Catch / operation
Bengkalis	CS	Beach Seine	20.0	5.0	1.0	6.0	24.0	1.0	24.0	1.0	20.0
Tebing Tenggi	MSS	Beach Seine	2.3	0.0	6.0	4.2	16.8	1.0	16.8	9.2	0.3
Tebing Tenggi	CS	Beach Seine	6.0	3.0	3.0	4.0	16.0	1.0	16.0	1.0	6.0
Bukit Batu	CS	Beach Seine	5.7	2.0	1.0	5.7	21.0	1.0	21.7	14.3	0.4
Tebing Tenggi	MSS	Drift Gill Net	5.0	0.0	10.0	4.5	18.0	1.0	18.0	4.3	1.2
Tebing Tenggi	CS	Drift Gill Net	3.9	0.8	1.0	3.7	13.3	1.0	13.3	1.1	3.5
Merbau	CS	Drift Gill Net	6.9	0.7	5.0	4.7	17.0	1.0	16.9	2.0	3.4
Bukit Batu	CS	Drift Gill Net	5.9	1.5	7.0	4.9	12.0	1.0	16.8	2.1	2.9
Rupat	MSS	Drift Gill Net	4.5	1.3	1.0	5.5	19.5	1.0	19.5	6.0	0.8
Rupat	CS	Drift Gill Net	23.3	18.7	1.0	6.3	26.7	1.0	26.7	2.7	8.7
Dumai	CS	Drift Gill Net	4.5	1.3	1.0	5.5	20.7	1.0	21.6	2.8	1.6
Bengkalis	CS	Encircling Gill	4.0	0.0	7.0	4.5	20.0	1.0	20.0	2.0	2.0
Tebing Tenggi	MSS	Encircling Gill	3.0	0.0	4.0	5.0	20.0	1.0	20.0	2.0	1.5
Tebing Tenggi	CS	Encircling Gill	20.0	0.0	3.0	1.0	2.0	1.0	20.0	2.0	10.0
Merbau	CS	Encircling Gill	5.2	1.0	4.0	8.7	34.7	1.0	18.3	2.3	2.2
Merbau	CS	Other Lift Nets	2.0	0.0	18.0	5.0	20.0	1.0	20.0	2.0	1.0
Bengkalis	CS	Set Long Line	12.3	5.0	4.0	4.0	16.0	1.0	16.0	1.0	12.3
Tebing Tenggi	MSS	Set Long Line	5.0	0.0	6.0	5.0	20.0	1.0	20.0	1.5	3.3
Tebing Tenggi	CS	Set Long Line	2.0	0.0	1.0	14.0	120.0	0.5	30.0	0.0	-
Tebing Tenggi	CS	Portable Trap	3.0	0.5	1.0	7.0	28.0	0.5	14.0	2.0	1.5
Merbau	MSS	Portable Trap	20.0	0.0	13.0	0.0	15.0	1.0	15.0	3.0	6.7
Tebing Tenggi	MSS	Other Trap	2.5	0.0	1.0	5.0	20.0	1.0	20.0	2.0	1.3
Bengkalis	CS	Gombang	7.2	3.0	3.0	5.0	20.8	1.0	20.8	2.0	3.6
Tebing Tenggi	MSS	Gombang	11.7	1.8	2.0	4.0	16.0	1.0	16.0	1.0	11.7
Tebing Tenggi	CS	Gombang	7.6	4.4	3.0	7.9	33.9	0.5	17.7	1.4	5.3
Merbau	MSS	Gombang	25.0	15.0	7.0	17.0	34.0	1.0	15.0	2.0	12.5
Merbau	CS	Gombang	42.3	23.8	5.0	15.0	49.8	1.0	26.3	1.5	28.2
Bengkalis	CS	Ambai	20.0	5.0	5.0	5.0	0.0	1.0	24.0	2.0	10.0
Bengkalis	CS	Pengerih	8.0	4.1	9.0	5.6	22.5	1.0	20.0	1.3	6.2
Tebing Tenggi	CS	Pengerih	6.1	2.4	4.0	7.3	29.1	1.0	23.8	1.1	5.4
Merbau	CS	Pengerih	4.8	3.0	5.0	14.0	50.7	1.0	25.3	1.5	3.2
Tebing Tenggi	CS	Kiso	1.0	0.0	1.0	5.0	10.0	0.5	0.0	0.0	-

Remarks : MSS : Malacca Strait Side, CS : Channel Side,
Sources : Result of Fishery Interview Survey

3. Aquaculture

3. Aquaculture

Tables & Figures

3. Aquaculture

3.1 Outline of Aquaculture in Riau Province

3.1.1 Present Conditions of Aquaculture Production in Riau Province

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 188,281.9 tons for the same year. However, production in aquaculture has shown a steady growth rate of 14.7 percent annually from 1980 (see Table 3.1).

According to fishery statistics of the province, the aquaculture industry is mainly divided into fresh water culture and brackish water culture. The production volume of aquaculture in 1991 was 221.3 tons (23.4 percent) for brackish water culture and 723.2 tons (76.6 percent) for fresh water culture. In recent years, cage culture conducted in the sea waters has been carried out in Kab. Kepulauan Riau and Kab. Bengkalis, although this data is not yet recorded in the fishery statistics of the province.

(1) Brackish water culture

Brackish water culture is conducted in the coastal areas of Kab. Indragiri Hilir and Kab. Bengkalis. Many culture ponds were not in operation in the first half of the 1980's and there were no remarkable changes in production volume. However, many began operations from 1987 and production volume rose rapidly from 33.1 tons in 1986 to 221.3 tons in 1991 (see Tables 3.2, 3.3).

In 1991, 65 percent of the production (144 ton) were comprised of milk fish and mullets; and the remaining 35 percent (77.3 ton) were composed of shrimps such as giant tiger prawn, etc. The majority of the shrimps harvested are exported to Singapore, Malaysia, and other countries. In recent years, due to falling prices of prawn, culture of mud crabs has become prevalent; and they are also cultured for the export market. As for marine culture, the cage culture of giant sea perch and grouper family has been initiated.

(2) Freshwater culture

The major species of freshwater culture are carps and tilapias; and although freshwater culture is carried out in all the districts of Riau Province, it is particularly prevalent in the inland area of Sumatra island. The production volume of fresh water culture has steadily increased from 145.1 tons in 1980 to 723.2 tons in 1991. The average annual growth rate was 15.7 percent during this period (see Tables 3.4, 3.5).

The major production area of freshwater culture is Kab. Kampar and its production volume was 66 percent of the total production volume of 1991. It is followed by Kab. Indragiri Hulu which comprises 15 percent of the total production volume. These two kabupaten produce 80 percent of the total production volume of fresh water culture of the entire province.

Recently, the culture of freshwater giant prawn has been being promoted, in addition to carp, tilapia, and other species. As a result, each kabupaten is planning projects in aquaculture or projects to construct hatcheries.

3.1.2 Aquaculture Development Plans in Riau Province

In accordance with development plans formulated in REPELITA V for fisheries at the provincial level, the development goals of the provincial government are "to increase fishery production volume, raise fishermen's incomes, and increase employment opportunities in the coastal areas". The important issues are to resolve the socio-economic inequality of the fishermen communities in the coastal areas and to promote the fishing industry. One of the countermeasures planned in line with these issues, is to promote aquaculture in the coastal areas.

(1) Goal achievement of aquaculture development plans in Riau Province (1989-1990)

1) Extent of goal achievement in brackish/sea water aquaculture development plans

The goal of development plans in brackish/sea water aquaculture by the provincial government of Riau was to expand the area of culture ponds to 597ha in 1990. The area of the culture ponds was 211ha in 1989; and this was equivalent to an annual growth rate of more than 280 percent. In actuality, the area of the culture ponds was expanded to 238ha by 1990, at an annual growth rate of 12.8 percent; and the goal achievement ratio was 3.4 percent.

The production volume of brackish water aquaculture rose from 138.8 tons in 1989 to 188.1 tons in 1990, at an annual growth rate of 35.5 percent; and in 1991 the production volume had increased to 221.3 tons, indicating an annual growth rate of 11.0 percent.

2) Extent of goal achievement in fresh water aquaculture development plans

The development goal in freshwater aquaculture was to expand the area of culture ponds to 629ha in 1990. In fact, however, the pond area increased to only 566ha in 1990 from an area of 506ha in 1989, indicating an annual growth rate of 11.8 percent and a goal achievement rate of 89.9 percent. By 1991 it increased to 660ha signifying an annual growth rate of 16.6 percent.

The production volume of freshwater aquaculture rose from 535.7 tons in 1989 to 687.7 tons in 1990, at an annual growth rate of 28.4 percent; and in 1991 it had risen to 723.2 tons, at an annual growth rate of 5.2 percent.

(2) Aquaculture development plan in Riau Province

The policy which is pursued in aquaculture development plans for the province, is to increase the production of exportable fishery products to Singapore and Malaysia. The provincial government is planning measures to increase production of exportable aquaculture, particularly in brackish/sea water aquaculture, during the period of REPERITA V.

1) Target species of brackish/sea water aquaculture

The policy on brackish/sea water aquaculture is to promote the production of high priced fish and shellfish for export. Target species which are currently planned are shrimps, mud crab, grouper, giant sea perch, seaweeds, etc. In particular, effort has been focused on cage culture of groupers and giant sea perch.

2) Target species of freshwater aquaculture

A variety of development measures to supplement consumption in the villages and settlements in the inland areas have been planned in freshwater aquaculture. Among freshwater species, fresh water giant shrimp, patin and jambai (species of catfish), etc., have been targeted for the high priced market.

3) Areas targeted for aquaculture development

Based on the aforementioned policies to develop and increase aquaculture, the provincial government has formulated various aquaculture projects for valuable species. Each project has been implemented annually and funded by a budget allocated by either the national, provincial, or the kabupaten governments. Areas where aquaculture projects have been carried out are shown bellow (see Appendix 1).

Cultured Species	Kabupaten
Seaweeds(Eucheuma spp):	Kab. kepulauan Riau and Batam
Shrimps :	Kab. Indragiri Hilir, Bengkalis
Mud crabs	Kab. Indragiri Hilir, Kepulauan Riau and Bengkalis
Capture of grouper fry :	Kab. kepulauan Riau
Sea turtles :	Kab. kepulauan Riau
Freshwater giant prawn :	Kab. Kampar, Indragiri Hulu, and Pekanbaru

Brackish/sea water aquaculture is carried out in the three kabupaten of Indragiri Hilir, Bengkalis, and Kepulauan Riau. Kab. Kepulauan Riau is adjacent to Singapore. Bengkalis borders the Malacca Strait and is in the close vicinity of both Malaysia and Singapore. Kab. Indeagiri Hilir is adjacent to these two kabupaten. Among the development projects in aquaculture within the province between 1992 and 1993, Kab. Kepulauan Riau have had the largest number of projects pertaining to brackish/sea water culture. Recently, culture of groupers, mud crab, etc. has developed rapidly in this area; and it has become a base for aquaculture in the province, along with Kab. Indragiri Hilir. In addition, new aquaculture trials are being done such as the cage culture of giant sea perch, release of blood cockles, etc. in Kab. Bengkalis.

3.1.3 Regulation Restrictions Pertaining to Aquaculture

(1) Licenses pertaining to aquaculture development

A license is required from the Fisheries Department of Riau Province, in order to implement aquaculture activities. However, the licensing may be exempted if following conditions are applicable:

- Freshwater pond culture not exceeding 2ha in land area.
- Brackish water pond culture not exceeding 2ha in land area or not handling more than 50,000 pieces of fish.
- Sea water cage culture not exceeding 0.5 ha in cage area

(2) Environmental assessment of new aquaculture operations

If new fish culture operations meet one of the following conditions, they are required to undergo an environmental impact study; and the findings must be submitted to the Fisheries Department, in conjunction with an application for a fish culture license.

1) Aquaculture in general
   - If more than 0.75ha of area is utilized in cage culture or if $50m^2$ of cages exceed 100 units.
   - If more than 5ha of area in utilized in pen culture or if $300m^2$ of fish pens exceed 100 units.
   - If more than 5ha of area is utilized in the seaweeds culture.
2) Marine culture
   - If more than 0.5ha of area is utilized in cage culture or $50m^2$ of cages exceed 50 units.
   - If more than 0.5ha of area is utilized in pen culture or $300m^2$ of fish pens exceed 10 units.

- Culture of new fish species.

3) Aquaculture on land

a. Pond culture

i) When culture operations do not require cutting of mangroves

- If intensive culture operations exceed 5ha of land area.
- If semi-intensive culture operations exceed 5ha of land area.

ii) When culture operations require the cutting of mangroves

- Each building and culture pond

b. Fingerling production facilities for giant tiger prawn

- If facilities have the production capacity of more than 40,000,000 prawns per year.

c. Freshwater culture

- Fish culture of new fish species.
- If the area of the pond exceeds 0.5ha

(3) Import restrictions on live fish

If live fish such as parent fish, fingerlings, etc. used in aquaculture are imported from abroad, a license is required from the Indonesian government. In order to obtain this license, it is necessary to import the live fish via the port of Jakarta.

3.2 Outline of Aquaculture in Kab. Bengkalis

3.2.1 Fish Culture Development Policy in Kab. Bengkalis

The Kab. fishery authority divides Kab. Bengkalis into five areas and sets a different development policy for each area. The development policy for each Kab. is as follows:

Development area	Fish culture development policy
Area I	Coastal pond culture for prawn and mud crab
Kec. Bengkalis	Floating cage culture for giant sea perch
Kec. Bukit Batu	Fresh water pond culture and floating cage culture (Kec.
Kec. Sei Apit	Sei Apit)
Area II	Coastal pond culture for prawn, mud crab and other fin fish
Kec. Tebing Tenggi	Floating cage culture for giant sea perch
Kec. Merbau	
Area III	Fresh water pond and floating cage culture
Kec. Siak	
Kec. Mandau	
Kec. Tanah Putih	
Area IV	Brackish water pond and floating cage culture
Kec. Dumai Barat/Timur	Fresh water pond culture(Kec. Bukit Kapur)
Kec. Bukit Kapur	
Kec. Rupat	
Area V	Mud crab culture
Kec. Bangko	
Kec. Kubu	

Source : Perikanan di Kabupaten Dati II Bengkalis dan Pola Pemgembannya 1993

Kab. Bengkalis, located near SIJORI (Singapore, Johor and Riau), has large consumer markets in the neighborhood and is well situated as an export base of highly commercial fishery products. To be successful in these export markets, it is essential to maintain continuous production, a certain level of product quality and product freshness. These requirements must be satisfied by controlling the kind, size and quality of cultured fishes. At present, fish culture projects to breed giant sea perch are under way in Kec. Bengkalis and Kec Merbau. In the furure, projects will also start in Kec. Tebing Tenggi and Kec. Rupat to breed giant sea perch. The culture of prawn and mud crab is still in an experimental stage.

3.2.2 Present Conditions of Aquaculture in Kab. Bengkalis

(1) Current conditions in brackish/sea water aquaculture

Brackish water aquaculture in Kab. Bengkalis has rapidly increased its production volume since 1988; and the major production comes from shrimp culture (see Table 3.6). The three major areas of aquaculture in Kab. Bengkalis are the Kec. Dumai/Rupat, Bengkalis/Bukit Baru, and Tebing Tinggi/Merbau (see Table 3.7).

In the Kec. Rupat, two privately operated aquaculture farms were forced to close down their operations recently, due to a drop in production volume stemming from fish disease. As a result, aquaculture is nearly nonexistent in this area now.

In the Kec. Bengkalis, cage culture of giant sea perch has been being conducted on a trial basis since 1984/1985. In 1992 the area for cage culture operations of giant sea perch increased to 0.79ha. This activity is anticipated to be continued by the fishermen kelompok with the government assistance currently being planned.

In addition, there is a fishing village which carries out extensive aquaculture of marine fish on a traditional basis. The Fisheries Department of Bengkalis is also providing a mini hatchery of giant tiger prawn, which is expected to begin operations from 1993/94.

In Kec. Tebing Tinggi/Merbau, CDP has been actively promoting aquaculture in this area. Cage culture of giant sea perch, pond culture of mud crab and giant tiger prawn, propagation of blood cockles, etc. have been carried out by the kelompok with the assistance of the government. In addition, extensive and traditional culture of marine fish is carried out on Rangsang island, located on the opposite side of Selat Panjang.

(2) Current conditions in fresh water aquaculture

The two major species of fresh water aquaculture in Kab. Bengkalis are carp and tilapia (see Table 3.8). The major areas of aquaculture are the Kec. Mandau/Tanah Puteh and Siak/Sungai Apit (see Table 3.9).

Fresh water aquaculture is not prevalent in the islands of Kec. Bengkalis such as Rupat, Bengkalis, etc. It is believed that this is due to the limited supply of freshwater on the islands, which has restricted its potential development.

3.2.3 Aquaculture Development Plans in Kab. Bengkalis

The DPK of the Kab. Bengkalis has been implementing assistance measures to develop aquaculture through the fishermen kelompok of each kecamatam (see Appendix 2). Of the 45 fishery projects carried out from 1989/90 to 1991/92, 23 projects have been related to aquaculture. All the projects on brackish/sea water aquaculture have been concentrated in this study area, specifically Kec. Bengkalis, Tebing Tinggi, and Merbau. The government assistance for fisheries activities only through; and therefore the fishermen kelompok.

3.3 Present Conditions of Aquaculture in the Study Area

3.3.1 Outline of Existing Conditions of Aquaculture Farms

(1) Operation of aquaculture facilities

The operational conditions of aquaculture facilities in the study area are as follows.

1) Kec. Bengkalis

a. Desa Penampi: Culture pond of 4ha for giant tiger prawn

Assistance given to the kelompok in 1989 to 1990 by the Riau provincial government included the construction of culture ponds, providing fund for purchasing of fry and the operating budget for culture activities. The cultured shrimps were exported to Malacca, but with the drop in shrimps prices, the facility is presently no longer in operation.

In addition, a private aquaculture farm possessing shrimp culture ponds of 2ha, is also no longer in operation.

b. Desa Teluk Latak: Mud crab and marine fish culture

The fishermen have been carrying out traditional extensive culture of marine fish since 1965. In 1991/1992, the Riau provincial government provided assistance for the culture of mud crabs by furnishing the cost of fry and the operating budget for culture activities. However, this trial was implemented only once (harvested in April 1992). The reason given was that the operating capital required for the second cycle could not be raised from the harvest price of the first cycle.

c. Desa Pangkalan Batang: Mud crab culture

In 1991/1992, the culture of mud crab was carried out with the assistance of the Riau provincial government, which furnished the cost of crab fry and provided the operating budget for culture activities. However, the kelompok was also unable to raise the operating capital for the second cycle, as in the case of Desa Telukl Latak; and culture activities are no longer in operation.

d. Desa Bantang Tengah: Cage culture of giant sea perch

In 1990/1991, a demonstration was carried out by placing one unit of cage culture (two cages) in the river mouth of the Bantang Tengah River as part of an aquaculture project in Kec. Bengkalis. One year later, a middleman (a tauke) and one kelompok began participating in this cage culture; and currently there are more than 150 cages placed in the river mouth. In observations of the aquaculture facilities during the field study, 26 cages of the tauke and 34 cages of the kelompok were jointly operated.

e. Desa Teluk Pambang: Cage culture of giant sea perch

Although aquaculture is not being carried out at the present time, an application to conduct cage culture activities of giant sea perch had been submitted to the Fisheries Department of Kab. Bengkalis by the tauke in Desa Muntai, and has been accepted. According to current plans, 100 cages will be set up.

2) Kec. Merbau

a. Desa Selat Akar: Cage culture of giant sea perch

The test operation of floating cage culture with one unit of cage started by the assistance of DPK of Kab. Bengkalis in 1990/91. And another 60 units of floating cage were supplied by the DPK in 1992/93. These floating cages are operated by the fishermen kelompok. There are 60 units of floating cages also operated by the Tauke of the area.

b. Desa Kuala Merbau: Blood cockles propagation

With government assistance of Kab. Bengkalis in 1991/1992, the village was able to purchase the fry of blood cockles from Rangsang island which were released in nearby coastal waters. Approximately 2,000 kg of fry were released in a 1ha area, which is maintained by the fishermen kelompok. In addition, the kelompok independently constructed about 20 culture ponds, which are no longer in operation due to water leakage and other problems.

3) Kec. Tebing Tinggi

a. Desa Banglas (Sungai Suir): Giant tiger prawn culture

An aquaculture farm has been in operation since 1989 as a demonstration farm supported by the Riau provincial government. Semi-intensive culture of shrimps is being carried out using a water pump, water mill, etc. in an area of 2ha. In addition to this farm, there is a 10ha private aquaculture farm for shrimps also in operation.

b. Desa Sialang Pasung: Mud crab and giant sea perch culture

An aquaculture pond for mud crabs was constructed and operated with the assistance of the Riau provincial government. In addition, the fishermen kelompok is independently carrying out giant sea pearh culture in traditional extensive culture. A private operator is also carrying out traditional extensive culture in the neighboring area.

4) Kec. Rupat

Government assistance for aquaculture activities is nonexistent in Kec. Rupat. There were only two private operators in Desa Tanjung Kapal, who were no longer in operation. One of the operators began shrimp culture in 1988 and produced 3 to 3.5 tons/ha in the first year. However, production levels dropped to 0.8 tons/ha thereafter, and their activity has still reduced. The other operator attempted to culture giant sea perch on a trial basis, but the operation was unprofitable and it was discontinued.

(2) Major culture methods and fish species

1) Traditional extensive aquaculture

This is a culture method that has traditionally been practiced in many areas of Southeast Asia. Major species cultured are giant sea perch, prawn, etc. This method entails guiding the natural fry into the pond along with sea water. As a result, the fry of other species are also mixed in. Fry of giant sea perch, 7 to 8 cm long, are cultured for a period of six to eight months, at which time they are shipped. At the time of this study, giant sea perch, threadfins, grouper, sea catfish, white shrimp, etc. were observed in this mixed batch.

2) Intensive and semi-intensive aquaculture

Much of the fish culture carried out in Kab. Bengkalis is based on traditional culture, and intensive and semi-intensive aquaculture have been introduced only in recent years. Major species of fish used in intensive and semi- intensive aquaculture are giant sea perch, mud crab, giant tiger prawn, etc. However, due to the decline in international prawn price in recent years, many prawn culture operations are no longer economically viable.

Conditions in aquaculture, according to fish species are given below.

a. Giant sea perch

In 1990 cage culture of giant sea perch was started in the area of the river mouth. Cages are fixed to supports which are piled into the sea bottom at a water depth of about five meters. The conditions required for culture are delineated below.

Seedlings	
Length of the fry:	About 7.5 cm
Source of supply :	Thailand, Malaysia (via Malacca)
Cost of fry :	Rp.560 to 1,500/fry
Culture Methods/Duration	
Size of cage :	4 X 4 X 2.5 m
Density :	1,000 fry/cage
Period :	6 to 7 months
Survival rate :	60 to 70%
Feed :	Trash fish (harvested by Gombang)
Shipment of fish	
Size :	0.6 to 1 kg.
Shipment cost :	Rp.5,000 to 9,000/kg.
Destination :	Malaysia

Cage culture of giant sea perch is presently being carried out in two locations within Kab. Bengkalis. The fish fry is imported from abroad in both cases. Great differences have been observed in the purchase cost of fry, due to additional cost such as domestic transportation cost, margin for importers was included in some cases. The fish is mainly destined for Malaysia and are often shipped through the tauke. The fish is iced prior to shipment.

b. Mud crab

Mud crabs are cultured in ponds located in the coastal areas. Although the ponds are simple moats, the walls are surrounded by planks to prevent the crabs from escaping. Water intake and drainage are carried out by using water level fluctuation of the tide. Soil is heaped above the water level in the center of the pond and mangrove trees are planted there to create a nesting ground for the crabs.

The conditions required for mud crab culture are delineated below;

Seedlings	
Size of crab fry:	About 100g/fry (natural fry)
Source of supply :	Desa Teluk Latak : Rupat island and Kec. Kubu, Desa Siarang Pasang : Kab. Indragiri Hilir
Cost of fry :	Rp.150/fry (production site of fry), Rp.250 to Rp.400/fry (including transport cost)
Culture method/Duration	
Size of pond :	10 X 10m (Desa Teluk Latak) 80 X 25m (Desa Siarang Pasun)
Density :	2 to 3 fry/m^2
Period :	4 to 6 months
Feed :	Trash fish (harvested by Gombang)
Shipment of crabs	
Size :	2 to 3 crabs/kg
Shipment cost :	Rp.5,000 to 6,000/kg (local fish market) Rp.14,000/kg (Singapore and Taiwan markets)
Destination :	Bengkalis fish market (Desa Tlk. Latak) Singapore and Taiwan (Desa Siarang Pasung)

Crab fry are naturally harvested; and the only area which can harvest sufficient volumes of crab fry in the study area is Rupat island. Therefore, it will be necessary to purchase fry from Kec. Kubu and Kab. Indragiri Hilir. In that event, transport costs will be added, which contributes to a very high cost.

Desa Siarang Pasung has plans to export their products to the neighboring country such as Singapore. Desa Teluk Latak also would like to participate in the export market, however due to their small production volume, all their products are shipped to the Bengkalis fish market.

c. Giant tiger prawn

A demonstration project of Giant tiger prawn culture by DPP has been implemented since 1989 in Sungai Suir in Kec. Tebing Tinggi. The facilities include four ponds of 1,800 m^2 and one pond of 8,100 m^2. At the time of our field survey, only one pond of 1,800 m^2 was in operation. The pond water was supplied by a pump and a water mill was attached to the pond. The shrimp is iced and exported to Singapore.

Seedlings	
Size of prawn fry :	PL 14 (about 1cm)
Source of supply :	Medan
Cost of fry :	Rp.15/fry (excluding transport cost)
Culture method/duration	
Size of pond :	90 x 20m
Density :	17 fry/m^2
Period :	4 months
Feed :	Artificial diet (made in Thailand)
Shipment of prawns	
Size :	35g/shrimp
Destination :	Singapore

3) Culture of blood cockles

The harvest of blood cockle is presently scarce in the study area, some cockles harvested in the northern area of Kab. Bengkalis are being brought and sold.

Blood cockle propagation is being carried out on a trial basis in Tanjung Merbau in Kec. Merbau (see chapter 3.3.1, section (1), 2)). There was no continued project for blood cockeles in the Study area after this project.

(3) Supply of aquaculture feed

Presently, the feed used in cage and pond culture in Kab. Bengkalis is mainly trash fish harvested by Gombang. Of the fish catch which is harvested by either Gombang or similar methods, comparatively large fish or shrimps are consumed by fishermen families or are shipped to the neighboring market to be sold as either fresh fish or processed into dried/salted products. The remaining trash fish is used as livestock feed. Although the composition of the fish catch harvested by Gombang, etc. differs slightly according to area, mysids are usually abundant in the catch. Some villages dry this mysids and sell them to prawn feed processors in Jakarta.

Generally, aquaculture operators utilize the fish harvested by their personal Gombangs, as feed. However, when the fish catch volume is low, they purchase trash fish from other fishermen, at a price of about Rp.100/kg. Gombangs can be used only during the spring tide. Therefore, they are used for only two weeks within a one month fishing period. In some villages, trash fish is dried during the good harvest time and used during the poor harvested time.

In the culture of fish such as giant sea perch, trash fish is also used as feed. However, in the culture of mud crabs, fish head, chicken entrails, etc. are also used as feed, in addition to trash fish.

3.3.2 Implementation of Existing Aquaculture Projects

Aquaculture projects supported by the Fisheries Department fall into the following three categories.

- Assistance allocating an operating budget to cover the cost of fry, feed, etc. of existing aquaculture facilities.
- General assistance including construction of facilities such as fish ponds, cages, etc.
- Technology transfer to private aquaculture operators.

In kelompoks where aquaculture had been carried out prior to assistance from the Fisheries Department, each member usually possessed their own ponds. The daily work of such farm is carried out individually and the operating budget is completely funded by the individual member. Joint works and operations by members are carried out only during shipping, etc. when extra help is needed.

In contrast, in kelompoks where new aquaculture facilities have been provided, all kelompok members or the entire village will jointly operate the facilities. In this case, feed (trash fish) is supplied by the Gombang possessed by the kelompok or the villagers under a cooperative system. If the aquaculture farm is managed by hired workers, the salaries are paid by the organization. The revenue generated by the farm, excluding the operating fund for the next facility, is distributed by the organization.

3.3.3 Issues of Existing Aquaculture

(1) Inadequate supply system for fish fry

Brackish/sea water aquaculture is still being implemented on a trial basis in Kab. Bengkalis; and therefore, aquaculture activities are not being carried out aggressively. As for fry production facilities, DPK of Kab. Bengkalis has constructed a fry production facility for Giant tiger prawns on a small scale; and it is scheduled to begin operations in 1993. There are no other fry production facilities for brackish/sea water species. The existing aquaculture operators import their fry of giant sea perch from Thailand and Malaysia and depend on capture of natural mud crab fry.

The culture of giant sea perch is widespread in Southeast Asia. As a result, its fry production technology is entrenched and they are produced in large volumes in Thailand and Malaysia. In case of fry import from abroad, they are legally required to pass through the port in Jakarta. However, exposing the fry to long transit hours, lowers their vitality and survival rate; and in reality, importing fry through the port of Jakarta is difficult. As a result, they are directly imported to the site. Subsequently, it is necessary to establish the system of production and supply of fish fry in Riau province.

All naturally caught mud crab fry are harvested within Riau province. In order to establish mud crab culture as an industry, it is necessary to establish a stable supply system of fry. Consequently, it is necessary to preserve and control the mangrove areas which are natural retreats of the mud crabs; and it is also necessary to establish artificial fry production technology.

A stable source of fish fry is a crucial issue in efforts to promote brackish/sea water fish culture in Kab. Bengkalis.

(2) Insufficiency of public assistance

Government assistance, presently provided in the form of projects to develop aquaculture among the kelompok, is comprised of short- term technical guidance and allocation of operating capital for one fiscal year. As a result, kelompoks which are economically limited, are only able to implement operations for the first year in which they have received monetary assistance, after which operations are discontinued due to a lack of operating capital for the following year.

The fishermen are in need of technical and management guidance throughout the year in their aquaculture operations. In this respect, it appears that public assistance measures have been incomplete.

3.4 Aquaculture from the Viewpoint of Coastal Resource Management

Sylvofishery has an objctive of promoting coastal cultivation while planting and managing mangroves. Recently, Indonesia has carried out studies on sylvofishery in Perwakarta, Bogor, under Indramayu in Western Java Province.

Within the framework of sylvofishery, tilapia and shrimp are cultivated in the waterways covering the area afforested with mangroves. The ratio between the platform where mangroves are planted and waterways is about 1:0.8, and the production of sea animals is approx. 1 ton/ha.

The surface area for the mangrove forest and aquaculture waterways is determined so that if mangrove trees stretch into the waterway, they can be removed so that the aquaculture can be operated permanently.

In the study area, omnivorous animals such as tilapia, shrimp, and mud crabs are considered to be appropriate for sylvofishery. The young of milk fish are not available, however, due to the geographic condition.

Sylvofishery is a method in which the protection of the coastal mangrove forests and the guarantee of local residents' profit can be compatible. It may also be necessary to consider the introduction of this method in this plan.

3.5 Important Factors in Model Area Selection and Aquaculture Species

3.5.1 Study on Target Species Based on Natural Conditions for Aquaculture situations

(1) Species targeted for cage culture

Presently, the giant sea perch is the species together for cage culture in Kab. Bengkalis. This species is comparatively easy to culture; and therefore, it is popularly produced in aquaculture operations in Southeast Asia. Fry production technology is well established and a stable supply of fry production is guaranteed, if necessary facilities and equipment are properly provided. Therefore, it is the most suitable species of fish for inexperienced fishermen engaging in aquaculture, to learn while culturing.

The groupers is one of the high priced fish in the markets of Southeast Asia. Currently, fry production technology for the grouper has not been developed; and generally, natural fry are caught and used for culture. In Kab. Kepulauan Riau, private operators culture *Plectropomus* spp. and its marketable size is exported to Singapore. However, this species lives mainly in the coral reefs and it may be difficult to secure a sufficient supply of fry in the mangrove areas near Kab. Bengkalis. During the field survey of this study, it was reported that *Epinephelus* spp were harvested in Kab. Bengklis, however this grouper were not observed at the fish markets.

In order to promote aquaculture in the study area, a fish species with a low cost, stable supply of fry should be selected. The fry production technology of giant sea perch which has been the target of cage culture in recent years, is well established. If fry production facilities are developed, a stable and low priced source of fry supply is possible.

In addition, if natural frys can be easily harvested for fish species such as groupers, siganids, etc. where fry production technology has not yet been developed, or for fish species where there are no fry production facilities yet constructed, these species may also be considered for aquaculture. Presently, fishing activities solely for the purpose of capturing fry for aquaculture is nonexistent in Kab. Bengkalis. However, for the development of aquaculture, it will be necessary to introduce such fry fishing industry.

It has been concluded that the fish species most appropriate for aquaculture in the study area, in terms of helping to facilitate aquaculture technology by the coastal fishermen, is the giant sea perch. In addition to promoting the culture of this fish, assistance should be extended to developing a new fishing industry for capturing natural fry, and to introducing the culture of a new fish such as a groupers.

(2) Pond culture

The traditional culture method utilize the high tides to guide fish fry into the pond along with the sea water. As a result, fry of other fish species are also mixed in. Often the carnivorous species such as marine catfish, grouper, giant sea perch, etc. which are at the top of the food chain, are also found in the pond. Consequently, other fish species are eaten and the production level of the pond become lower. Planned production of a specified fish species is difficult, utilizing this culture method.

By procuring the necessary volume of fry for a specified species by means of artificial fry production or harvest of natural fry, rather than depend on the aforementioned traditional method, pond productivity per square meter is anticipated to increase and contribute to a rise in fishermen incomes.

Initial development programs in aquaculture should target fish species with a well established culture technology which are supported by government assistance measures for aquaculture development such as giant sea perch, mud crab, shrimps, etc.

(3) Propagation of shellfish

Presently, the Kec. Kubu and Banko in Kab. Bengkalis are major production centers for blood cockles to which propagation trial has been started in the study area. Blood cockles are rarely harvested in the study area; and they are imported from other areas. If an appropriate site for blood cockle propagation is selected in the study area, a large production volume is anticipated, due to the fact that fry are readily available in this area and the propagation technology is well established in Southeast Asia.

By implementing measures such as importing fry from other areas and establishing banned fishing areas and fishing seasons, it is anticipated that new fishery resources can be developed within the study area.

(4) Utilize the water area of mangrove forests to supply natural fry

A crucial issue in aquaculture is to secure a stable supply of fish fry. The mangrove forest in the study area contains a large water area which plays an important role as a spawning and nursery ground for a variety of marine species. It is possible to promote effective and sustainable fishery resources by formulating countermeasures on resource management, which include the use of the water body of the mangrove forest only for capturing fish fry in the culture of giant sea perch, grouper, mud crab, etc.

3.5.2 Important Factors in the Selection of the Model Area

(1) Geographical conditions

1) Cage culture

Geographically, the optimum site for aquaculture in this area can be divided into the three areas along the Panjang channel, along the small channels on each island, and parallel to the Malacca Straits.

In the study area, the water flowing into the ocean near the river mouth and into the channel contains much amount of rotting organic substances that often discolor the water to a dark hue. The pH and oxygen levels of this water are often low. Therefore, it is essential that the location of aquaculture facilities is sufficiently removed from the effects of this water.

The Panjang channel is greatly affected by the Siak, Kampar, and numerous other rivers flowing in from Sumatra island. In particular, the volume of water flow from these rivers increases during the rainy season; and a drop in the levels of salinity and pH is seen. Subsequently, it is judged implementing cage culture in water with such changing characteristics is undesirable.

In contrast, although the channel on the Malacca Straits side is not as affected by the river water as Panjang, it is exposed to strong north winds that

creates rough waters during the rainy season. As a result, the coastal areas which are directly affected by strong winds and waves are also unsuitable for aquaculture facilities. However, areas which remain unaffected by either the strong direct winds or the river mouth can be suitable.

Therefore, locations suited for cage culture are areas near the river mouth or in the channels between the islands except the Channel of Panjang, where the effects of land water is limited. However, all areas suited to aquaculture in the study area are affected by changes in the salinity to a greater or lesser extent. Subsequently, euryhaline fish and shellfish are suited to aquaculture under these conditions.

2) Pond culture

The coasted zone of the study area has the tidal fluctuation of 2 to 3 m and many areas covered with clay soil; and therefore, it has suitable conditions for pond culture development.

Following areas shown in the table below, do not have distribution of clay soil, and subsequently are not suitable for pond culture development.

Kec. Bengkalis :	All the coastal area of Meskom, and coastal area of Pangkalan Batang, Sebauk and Tlk. Latak along the Maracca Strait.
Kec. Merbau :	All the coastal area of the Merbau Island.
Kec. Bukit Batu :	All the coastal area.
Kec. Bukit Kapur :	All the coastal area (Only eastern area from Dumai)

On the other hand, it is well known that acid sulphate soil widely distribute in the brackish water area of the Southeast Asian countries.

As almost all of the coastal zone in the study area have potential of acid sulphate soil, it is necessary to conduct a soil survey sufficiently prior to the pond construction. In case the acid soil distributes at the very shallow layer or at the deeper layer than 1.5 m from the surface, the pond construction is possible by removing it or by remaining it untouched.

Among the villages selected by socio-economic criteria, appropriate villages for the pond culture development are shown in the Table 3.10.

3) Propagation

There are mangrove forests containing small and large areas of marshland in the study area, that fulfill an important role as spawning and nursery grounds for a

variety of fish and shellfish. These fishing grounds are a valuable source of natural fry for aquaculture; and therefore, it can be said making an effort to conserve natural ecology of these waters leads to sustainable use of fry resources.

In the study area, trial of cockle farming has been recently started. The coastal shoals with muddy bottom soil is suited for this farming. If aquaculture activities are begun, it is important to locate the culture site away from the effects of the river water.

(2) Important social factors

1) Feed supply

In the study area, by-product of the Gombang fishing, trash fish, is utilized for raw material of fish meal or traditional salted fish. And some fish farmers possess the Gombang net set together with farming facilities, and utilize this trash fish as the feedstuff. However, when its catch is not enough, they are buying from their neighbor fishermen.

In the study area, it will be possible to introduce a price competitive aquaculture system by utilizing this trash fish as the feed for fish, and as a result, by reducing feed cost at the minimum level. Subsequently it is significant to apply an area enabling supply of fish feed by the Gombang fishing to the aquaculture development area as one type of the model area of fishing village development.

The coastal areas of Padan island and Tebing Tinggi island along the Panjang channel, have a low population with few villages; and they are areas where the Gombang fishing is not prevalent. Subsequently, these areas are low priority candidates for aquaculture development.

2) Fishermen organizations

Presently, all government projects promoting aquaculture development have been directed only to fishermen organizations such as kelompok, KUD, etc. The objective of this project is to create a model for coastal resource management with high benefits. Therefore, the agreement and cooperation of the resident fishermen are essential, and it is highly appropriate that the KUD, kelompok, etc. are beneficiaries of the assistance.

The actual conditions of the fishermen organizations in each area should be taken into consideration; and villages with organizational strength should be targeted as potential sites for aquaculture development.

Table 3.1 Annual Fishery Productions in Riau Province (1980~1991)

Unit : Ton

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Fishery Sector	159,119	144,499	128,549	153,032	156,099	160,761	163,114	170,026	172,198	176,592	181,445	188,282
Aquaculture	210	174	213	211	271	385	439	546	577	675	876	945
Brackish Water	64	35	49	64	58	47	33	90	93	139	188	221
Fresh Water	145	139	165	147	213	338	405	456	484	536	688	723

Sources : Buku Tahunan Statisk Oerkanan Tingkat Propinsi (1980 - 1991)

Table 3.2 Annual Brackish Water Aquaculture Productions by Kecamatan in Riau Province (1980~1991)

Unit : Ton

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Bengkalis	-	-	-	-	7.0	2.3	-	0.9	3.5	35.8	82.7	76.4
Kampar	-	-	-	-	-	-	-	-	-	-	-	-
Indragiri Hilir	64.4	35.1	48.6	64.0	38.8	36.9	33.1	89.1	89.8	103.0	105.4	144.9
Indragiri Hulu	-	-	-	-	-	-	-	-	-	-	-	-
Kepulauan Riau	-	-	-	-	12.5	7.6	-	-	-	-	-	-
Total	64.4	35.1	48.6	64.0	58.3	46.8	33.1	90.0	93.3	138.8	188.1	221.3

Sources : Buku Tahunan Statisk Oerkanan Tingkat Propinsi (1980 - 1991)

Table 3.3 Annual Brakish Water Fish Pond Areas by Kecamatan in Riau Province (1980~1991)

Unit : Ha

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Bengkalis	-	4.0	4.0	17.0	28.0	34.0	35.0	41.0	49.0	53.0	80.0	86.0
Kampar	-	-	-	-	-	-	-	-	-	-	-	-
Indragiri Hilir	99.0	54.0	58.0	77.6	79.0	79.0	58.0	81.0	99.0	103.0	103.0	105.0
Indragiri Hulu	-	-	-	-	-	-	-	-	-	-	-	-
Kepulauan Riau	-	-	3.5	50.0	52.0	52.0	53.0	55.0	55.0	55.0	55.0	55.0
Total	99.0	58.0	65.5	144.6	159.0	165.0	146.0	177.0	203.0	211.0	238.0	246.0

Sources : Buku Tahunan Statisk Oerkanan Tingkat Propinsi (1980 - 1991)

Table 3.4 Annual Fresh Water Aquaculture Productions by Kecamatan in Riau Province (1980~1991)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Bengkalis	40	27	30	27	38	41	52	52.3	45.6	46.6	72.8	90.3
Kampar	81	91	103	86	87	47	234	255.3	289.6	356.4	473.7	479.5
Indragiri Hilir	11	13	15	15	46	50	55	53.9	54.3	38.2	44.8	47.1
Indragiri Hulu	13	8	17	20	42	200	65	94	94.3	94.5	96.4	106.3
Kepulauan Riau	-	-	-	-	-	-	-	-	-	-	-	-
Total	145	139	165	147	213	338	405	455.5	483.8	535.7	687.7	723.2

Sources : Buku Tahunan Statistik Perikanan Tingkat Propinsi 1980• 1991

Table 3.5 Fresh Water Aquaculture Pond Areas by Kecamatan in Riau Province (1980-1991)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Bengkalis	36	44	44	49	66	78	78	78	82	94	104	189
Kampar	52	60	62	69	72	144	147	215	215	240	280	289
Indragiri Hilir	16	31	34	38	48	59	59	68	68	68	72	72
Indragiri Hulu	44	44	49	54	61	71	77	98	101	104	110	110
Kepulauan Riau												
Total	148	179	189	210	247	352	361	459	466	506	566	660

Sources : Buku Tahunan Statistik Perikanan Tingkat Propinsi 1980• 1991

Table 3.6 Annual Brackish Water Aquaculture Productions by Species in Kab. Bengkalis (1987-1991)

Unit : Ton

	1987	1988	1989	1990	1991
Milk fish	0.9	1.1	-	1.7	-
Mullets	-	-	-	2.1	6.6
Other fish	-	0.1	-	18.9	15.4
Tiger shrimp	-	1.8	35.8	47.7	23.3
White shrimp	-	0.5	-	12.3	31.1
Total	0.9	3.5	35.8	82.7	76.4

Sources : Buku Tahunan Statistik Perikanan Tingkat Propinsi Tahun 1987• 1991

Table 3.7 Annual Brackish Water Aquaculture Productions by Kecamatan in Kab. Bengkalis (1987-1991)

Unit : Ton

	1987	1988	1989	1990	1991
Dumai/Rupat	-	0.8	10.0	20.6	1.5
Bengkalis/B.Batu	1.4	3.9	5.8	3.5	4.9
T.Tinggi/Merbau	-	0.6	20.0	7.5	2.3
Mandau/T. Puteh	-	-	-	-	-
Siak/Sei Apit	-	-	-	-	-
Total	1.4	5.3	35.8	31.6	8.7

Sources : Buku Tahunan Statistik Perikanan Tingkat Propinsi Tahun 1987• 1991

Table 3.8 Annual Fresh Water Aquaculture Productions by Species

Unit : Ton

	1987	1988	1989	1990	1991
Common carp	17.7	17.4	14.9	27.0	33.8
Java bard	-	-	-	-	-
Tilapia mazambique	13.1	-	6.5	8.5	9.0
Tilapia nile	5.8	16.9	16.8	29.4	27.5
Nilem carp	-	-	-	-	-
Giant Gurami	3.2	2.3	1.4	1.9	6.2
Others	12.5	9.0	7.0	6.0	13.8
Total	52.3	45.6	46.6	72.8	90.3

Sources : Buku Tahunan Statistik Perikanan Tingkat Propinsi Tahun 1987~1991

Table 3.9 Annual Fresh Water Aquaculture by Kecamatan in Kab. Bengkalis (1987~1991)

Unit : Ton

	1987	1988	1989	1990	1991
Kubu	-	-	-	-	4.0
Bangko	-	-	-	0.7	1.5
Dumai/Rupat	11.4	12.8	12.3	5.3	10.0
Bengkalis/B.Batu	-	-	2.4	2.4	1.4
T.Tinggi/Merbau	-	0.9	1.0	1.0	1.5
Mandau/T. Puteh	24.6	25.1	25.2	41.6	45.5
Siak/Sei Apit	5.2	6.7	5.7	15.9	16.3
Total	41.2	45.5	46.6	66.9	80.2

Sources : Buku Tahunan Statistik Perikanan Tingkat Propinsi Tahun 1987~1991

Table 3.10 Selections of Available Areas for Pond Culture by Soil Condition

	Distribution of clay soil	Excavation cost against acid soil
1 Bengkalis		
11 Ketam Putih	○	○
12 Sebauk	○	×
13 Teluk Latak	○	×
14 Penampi	○	○
16 Bentan Air	○	×
18 Jangkang	○	○
19 Teluk Pambang	○	○
20 Muntai	○	×
21 Meskom	×	×
23 Sungari Alam	○	○
26 Selat Baru	○	○
28 Teluk Lancar	○	○
2 Tebing Tinggi		
2 Selat Panjang	○	×
9 Bungur	○	○
15 Tg.Medang	○	○
18 Sonde	○	○
21 Anak Setatah	○	○
24 Kayu Ara	○	○
26 Banglas	○	○
31 Alah Air	○	○
32 Bantar	○	×
34 Tg.Samak	○	○
35 Beting	○	○
36 Tg.Kedabu	○	○
3 Merbau		
1 Teluk Belitung	○	○
2 Mengkirau	○	○
5 Kudap	×	×
10 Centai	×	○
12 Pelantai	○	○
13 Bagan Melibur	○	○
15 Kuala Merbau	×	○
16 Meranti Bunting	○	○
17 Selat Akar	○	○
18 Teluk Ketapang	×	○
4 Bukit Batu		
1 Sungai Pakning	×	×
4 Buruk Bakul	×	○
5 Sungai Apit		
2 Sungai Kayu Ara	○	×
3 Tanjung Kuras	○	○
6 Rupat		
1 Batu Panjang	○	○
3 Terkul	○	○
4 Pergam	○	×
5 Teluk Lecah	○	×
7 Teluk Rhu	○	○
8 Tanjung Medang	○	○
9 Pkl.Nyirih	○	○
10 Sungai Cingam	○	○
11 Makeruh	○	○
12 Tanjung Punak	○	○
13 Kador	○	○
14 Titi Akar	○	○
7 Dumai Barat		
3 Purnama	×	×
8 Dumai Timur		
3 Tanjung Palas	×	×
9 Bukit Kapur		
3 Teluk Makmur	×	×

Appendix 1. Aquaculture Development Plan by Kabupaten in Riau Province (1992/93)

Kal	Budgetary Fund Source		Budget (Rp.1,000)	Activities
Kampar				
	APBN		75,517	Operating BBI and fish rearing tests
	APBN	<1	30,000	Macrobrachium rosernbergii seed production development
	APBD		30,000	Development of people's fish farm for Macrobrachium rosenbergii
	APBD		10,000	Guidance for fish farmers
	APBD		25,000	Stimulant to people's fish pond development in transmigration areas
Batam				
	APBN		30,000	Development/guidance of hatchery for Giant Sea Pearch and Grouper
	APBN		17,250	Rearing exam. of Grouper by froating cage
Bengkalis				
	APBN		50,000	Demonstration of pond culture
	APBN		21,000	Assistance of people's dike pond development
	APBN	<2	15,000	Development of small scale hatchery for P. monodon
	APBD		17,500	Rearing exam. of Giant pearch by floating cage
	APBD		12,000	Rearing exam. of Mud Crab
Kepulauan Riau				
	APBN		10,000	Turtle/tortoise restocking
	APBD		10,000	Development of fish rearing/breeding by floating cage
	APBD		5,000	Assistance of bloodstock rearing
	APBD		85,000	Operation of Hatchery and The Fourth Stage Development
	APBD		25,000	Development/operation of turtle breeding
	APBD		17,000	Stimulant to crab farming business development
	APBD		40,000	Development of crab dempond
Indragiri Hilir				
	ABBN	<2	15,000	Development of small scale hatchery for P. monodon
	APBN		52,000	Construction of crab seeds collecting basin
	APBD		30,000	Rearing exam. of Sembilang
Pakan baru				
	APBN		20,000	Construction of Hatchery for Macrobrachium rosenbergii
	APBD		20,000	Construction of Hatchery for Macrobrachium rosenbergii
	APBD		15,000	Operation of UPBAT hatchery
	APBD	<1	30,000	Development of people's fish farm for Macrobrachium rosenbergii
Indragiri Hulu				
	APBD	<1	30,000	Development of people's fish farm for Macrobrachium rosenbergii
	APBD		40,000	Demonstration of people's fish pond

Remarks : <1 , <2 ; Budgets are total amount of same number's projects
Sources : Perkembangan Perikanan S/D Tahun 1991/1992 dan Rancangan Kegiatan dan Rancangan Kegiatan 1992/1993

Appendix 2. Annual Budget (1989/1990~1991/1992) and Budget Plan (1992/1993) of Fishery Sector in Kab. Bengkalis (1/2)

No	Project Site	Budgetary Fund Source	Budget (1,000Rp)	Activities	Budgetary year
1	Bagansiapiapi	APBN	5,000	Rehabilitation of dormitory	1989/90
2	Kab. Bengkalis	APBD TK I	2,160	Statistics survey in Riau province	1989/90
3	Kec. Bengkalis	APBD TK I	82,752	Stimulant of fish pond development for Kelompok	1989/90
4	Selat Panjang	APBD TK I	33,773	Development of fish pond	1989/90
5	Kec. Bengkalis	APBD TK I	7,696	Assistance for fish farmers in Riau province	1989/90
6	Siak, Mandau Bangko, Bengkalis	APBD TK II	5,000	Stimulant and donation of seed fish	1989/90
7	Bagansiapiapi	APBD TK II	23,000	Rehabilitation of TPI	1989/90
8	Selat Panjang	A P B N	16,180	Demonstration of shrimp farm for P. monodon	1990/91
9	Kec. Bengkalis	A P B N	6,035	Intam survey	1990/91
10	Bagansiapiapi	A P B N	13,400	Survey for processing of fish production	1990/91
11	Dumai	A P B N	27,190	Fishing survey (UPMB Dumai)	1990/91
12	Tg. Medang	APBD TK I	38,350	Development of PPI in Tg. Medang	1990/91
13	Dumai	APBD TK I	20,000	Operation of SUPM boat	1990/91
14	Kab. Bengkalis	APBD TK I	1,390	Assistance/Survey for fishermen and fish farmers	1990/91
15	Kab. Bengkalis	APBD TK I	2,973	Reguration survey for fish auction	1990/91
16	Kec. Bengkalis	APBD TK I	25,845	Establishment of Mini-hatchery	1990/91
17	Kec. Bengkalis	APBD TK II	55,000	Rehabilitation of TPI	1990/91
18	Sungai Rangau	APBD TK II	10,000	Rehabilitation of PPI	1990/91
19	Dumai	APBD TK II	30,000	Rehabilitation of PPI	1990/91
20	Kec. Bengkalis	APBD TK II	12,055	Rearing exam. of Mud Crab	1990/91
21	Sei Apit	APBD TK II	2,030	Guidance of M. rosenbergii culture	1990/91
22	Bantan Tengah	APBD TK II	6,530	Rearing exam. of Giant Sea Perch by floating cage	1990/91
23	Kec. Bengkalis	APBD TK II	7,500	Donation of fishing gear for fishermen	1990/91
24	Balai Pungut	APBD TK II	4,306	Demonstration of fresh water floating cage culture	1990/91
25	Tg. Medang (AB'	APBD TK II	7,500	Establish of PPI	1990/91
26	Kec. Bukit Kapur Kec. Tanah Putih Kec. Merbau	BAPPEDA TK II	9,588	Fish seed (carp) supply for fish farmers Fish seed (carp) supply for fish farmers Rearing exam. of Giant Sea Perch by floating cage	1990/91
27	Kec. Rupat/Kubu	APBN	216,201	Donation of non powered fishing boat and gill net for fishermen by PKT project	1991/92
28	Kab. Bengkalis	APBD TK I	4,380	Statistics survey in Riau province	1991/92
29	Kab. Bengkalis	APBD TK I	1,140	Fishery impact point survey	1991/92
30	Kec. Bengkalis	APBD TK I	17,500	Development of Mud Crab culture	1991/92
31	Kab. Bengkalis	APBD TK I	10,000	Development of fish production processing by fishe	1991/92
32	Tg. Medang	APBD TK I	8,000	Assistance for fishermen	1991/92
33	Kec. Bengkalis Tebing Tinggi	APBD TK I	51,000	Construction of water intake channel for fish farmers	1991/92
34	Kab. Bengkalis	APBD TK I	18,500	Operation of SUPM boat	1991/92
35	Kab. Bengkalis	APBD TK I	14,500	Observation of fishing boat	1991/92
36	Kab. Bengkalis	APBD TK I	36,975	Promotion of fish meal processing	1991/92
37	Kab. Bengkalis	APBD TK I	20,070	Prepatration for facilities of Mini hatchery	1991/92
38	Penampi	APBD TK I	7,000	Establish the water intake system for fish pond	1991/92
39	Kec. Bengkalis	APBD TK I	16,658	Construction and operation of fish breeding pond	1991/92
40	Kec. Bengkalis	APBD TK I	65,000	Rehabilitation of TPI	1991/92
41	Merbau	APBD TK I	5,420	Rearing exam. of Shellfish (Anadara sp)	1991/92
42	Kab. Bengkalis	APBD TK I	4,200	Supply of fresh water fish seed	1991/92
43	Bagansiapiapi	APBD TK I	19,000	Rehabilitation of TPI	1991/92

Sources : Proyek Pada Dinas Perikanan Kabupaten Bengkalis 1989 S/D 1992

Appendix 2. Annual Budget(1989/1990~1991/1992) and Budget Plan (1992/1993) of Fishery Sector in Kab. Bengkalis (2/2)

No	Project Site	Budgetary Fund Source	Budget (1,000Rp)	Activities	Budgetary year
44	Sei. Suir	-	-	Demonstration of shrimp culture	1992/93
45	Selat Panjang	-	-	Technical transfer of pond culture	1992/93
46	Kab. Bengkalis	-	-	Fishing gear survey (Seine)	1992/93
47	Kab. Bengkalis	-	-	Fishing gear survey (Gill net, Tramel net, Trap)	1992/93
48	Kab. Bengkalis	-	-	Post harvest survey	1992/93
49	Bagansiapiapi	-	-	Fishermen survey	1992/93
50	Selat Panjang		90,000	Rehabilitation of TPI	1992/93
51	Kec. Bangko		60,000	Construction of fish pond for Mud Crab	1992/93
	Kec. Kubu			Construction of fish pond for Mud Crab	1992/93
52	Selat Panjang	APBD TK I		Development of Mud Crab culture	1992/93
53	Kec. Bengkalis	APBD TK I	2,605	Fish quality test	1992/93
54	Dumai	APBD TK I	21,440	Operation of SUPM boat	1992/93
55	Tg. Medang	APBD TK I	9,770	Fishermen survey	1992/93
56	Kec. Bengkalis	APBD TK II	69,715	Raring exam. of Giant Sea Perch by floating cage	1992/93
	Kec. Merbau				1992/93
57	Kec. Merbau	APBD TK II	76,340	Assistance of traditional fishermen	1992/93

Sources : Proyek Pada Dinas Perikanan Kabupaten Bengkalis 1989 S/D 1992

4 Fish Marketing/Processing

4 Fish Marketing/Processing

Tables & Figures

4. Fish Marketing/Processing

4.1 Development Policy and Conditions in Fish Marketing

Riau Province is suited for fisheries and extends from the coast on the Malacca Straits bordering east Sumatra island through the Riau islands near Singapore, to the southern area of the South China Sea. Although its fish production volume for 1990 was only about 6 percent of the total national production volume, it has a surplus of fishery products, due to its small population in proportion to its production volume. Its fishery industry supplies fresh fish to northern Sumatra Province and processed fish to west Java (Jakarta, etc.). Riau Province is also geographically near Singapore and Malaysia and fish exports to these countries is large. In 1990 it was the largest exporter of fishery products in the nation.

Based on an interview survey of the Fisheries Department of Riau Province, regional characteristics in marketing are given below.

1) Coast of Malacca Straits

   Excluding the fresh fish which is consumed locally, most of the fish caught are dried as processed fish. The processed fish is shipped to Alan Besal island in the offshore waters of Bagansiapiapi and from there, it is often sent to Mendan; and a portion is also sent to Jakarta and Malacca.

2) Indragiri Hilir

   Due to abundant mangrove forests, shrimp harvests are prevalent. They are shipped to Singapore or Malacca via Tanjung Pinang or Tanjung Barai Karimun.

3) Kepulauan Riau, Lingan

   Fish catch is shipped to Tanjung Pinang, packed in ice and exported to Singapore as fresh fish.

4) Natsuna Straits

   Large demersal fish such as tuna, etc. are caught by long-line fishing and shipped to Jakarta, packed in ice.

Based on the aforementioned, the foremost goal of Riau Province as outlined in the fishery development plan of Replita 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 implemented.

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

Due to an undeveloped road network in Riau Province, export of fishery 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 the Fisheries Department to achieve this goal have not been forthcoming.

4.2 Supply and Demand of Fishery Products

4.2.1 Balance in Fishery Products Supply and Demand in Indonesia

In order to comprehend the supply and demand of fishery pruducts in Riau Province, it is necessary to grasp the overall structural balance of supply and demand of fish products throughout Indonesia and to clarify the relationship between Riau Province and other provinces. If the national balance in supply and demand of fishery products is set at zero, the following formula can be said to represent the balance of supply and demand of fishery products.

If $\Sigma b_k = 0$ i.e. $\Sigma s_k = \Sigma d_k$

Here:

$b_k = s_k - d_k$, $s_k = p_k + i_k$, $d_k = c_k + e_k$

b_k; domestic inflow of fish products in province k
(+ means outflow, - means inflow)

s_k; volume of fishery products supply in province k

d_k; volume of fishery products demand in province k

p_k; production volume of fishery products in province k

i_k; import volume of fishery products in province k

c_k; consumption volume of fishery products in province k

e_k; export volume of fishery products in province k

k; figure representing province k

Past data include production and export volumes of each province given in fishery statistics published by the DGF. In addition, the protein intake ratio from fishery products is given in the "Consumption of Calorie & Protein of Indonesia and Province, 1990", published by the Central Bureau of Statistics. Based on this data, it has been roughly estimated that the protein intake ratio from fishery products was uniform nationwide. Per capita fish consumption volume according to each province was estimated on the basis that per capita protein intake volume was in proportion to fish consumption volume (see Table 4.1). The formula on domestic inflow and outflow of each state is given in Table 4.2.