In 1992/93, the government implemented two financial aid projects for this village. One project was made under the APBD II program and furnished two Gombang net sets for each fishing family, totaling of 60 sets for 30 families. These Gombang nets were intended to fish for anchovies. The other aid project was made by PKT for 40 fishing families, who were given 40 Gombang net sets in total (i.e., one set for each family), 20 sampans and 20 drying yards (i.e., one sampan and one drying yard for every two families), to fish mysids. At the time of our survey, the PKT aid was in the stage of delivering the materials and was not put into operation yet. Aside from the above aid projects, 9 fishermen were engaged in Gombang fishing. It was estimated all in all 87 Gombang sets (not counting the nets supplied under the PKT aid) were being used at the time of this survey.

In addition, gill-net fishing and Pengeirih fishing are practiced by 2 powered fishing boats.

(2) Condition of fisheries infrastructure

As stated above, Desa Tlk. Ketapang is one of the major channel traffic bases in this area, and fuels for such traffic boats are sold here. There are two jetties in Dusun Terus, the center of the village. In addition, small makeshift jetties are attached to fish drying yards (locally named Banliau scattered along the coast of Asam channel to dry anchovies caught by the Gombang fishing.

Fishing equipment and tools such as gill nets can be purchased at Selatpanjang.

(3) Felling of mangroves by fishermen

Many fishermen in Desa Tlk. Ketapang are engaged in the felling of mangroves for a living. Mangroves are used as fuel to boil Gombang catches before drying them in the sun. In some cases, besides used as fuel, mangroves are sold to the charcoal manufacturer in Terus.

2.4.2 Main Fishing Methods and Fishing Grounds

(1) Fishing seasons

The Gombang fishing seasons in the Asam channel in front of Desa Tlk. Ketapang are as follows:

Fishing seasons		Direction of the wind	
Lean fishing season	:	April - July	Eastery and southerly
Mid season	:	Jan. - March and August	Northerly and easterly (Southerly in August)
Prime fishing season	:	Sep. - Dec.	Westerly and northerly

The above seasons apply to the day-time Gombang fishing of anchovies.

(2) Fishing methods and fishing grounds

1) Main fishing methods and the types of fishing operation

The main fishing method employed in this village is the Gombang fishing method. Most of the Gombang fishermen are newcomers who moved from other occupations under government supports (APBD II and PKT); they have little experience with a fishing career of one year or so. The fishermen who turned to Gombang fishing under the government supports operate on a small scale with one or two fishing sets. Like gill net fishing and other fishing methods, Gombang fishing is operated during the spring tide. The nets are removed during the neap tide and again installed at the next spring tide.

There are two types of Gombang netting, i.e., the intermediate level netting and the bottom level netting. The Gombang method employed by this village is the intermediate level netting designed to catch anchovies.

Besides Gombang, gill net fishing and bottom long line fishing are practiced. Although the Pengeirih method belongs to the same type of bag net fishing as Gombang, the target fish of Pengeirih is different from that of Gombang because the Pengeirih fishing nets are placed on the bottom level of the sea (to catch shrimps and small fish). Because of this, a recent increase in Gombang fishing operations under the government support has not affected the catch of Pengeirih fishing at all.

Gill net fishing and bottom long line fishing are all carried out on a one-day operation basis because these fishing methods are undertaken by non-powered fishing boats. The fishing scale is rather small, with the gill net fishing utilizing 5 to 30 units and the bottom long line fishing utilizing 100 to 200 hooks. Consequently, fishing boats have no ice, and all the catch is brought back to the village without ice preservation.

All the fishes except those caught by Gombang are consumed by the villagers.

2) Fishing grounds and the targeted fish

The fishing grounds for all the fishing methods is an area in the Asam channel in the shore frontage of the village. The target of gill-net fishing is wolf herring and narrow-barred king mackerel as in the case of Desa Pelantai located on the opposite side of the Asam channel.

In the Gombang fishing carried out in nearby villages on the Asam channel, the target of day fishing is anchovies and that of night fishing is mainly mysids with shrimps and small fishes occupying a smaller portion. These villages use mysids to feed livestock. In contrast, the fishermen in Desa Tlk. Ketapang do not operate the

night Gombang fishing because mysids have no value other than the raw materials of terasi and are priced as low as Rp. 100/kg if sold unprocessed.

Therefore, the fish catch is mainly anchovies caught in the daytime with a small catch of mysids.

The Pengeirih fishing method, characterized by netting in the bottom of the channel, has a fish target different from that of Gombang. Its target is shrimps and small fish but not anchovies.

Gill net fishing and bottom long line fishing in this village target fishes mainly comprising small fishes as in the case of Desa Pelantai. Wolf herring and narrow-barred king mackerel are also fished, but they are mostly small in size.

Targeted fishes by the types of fishing are as follows:

Gombang fishing	:	Anchovies, mysids, small (biang biang, lomek, etc.)
Pengeirih fishing	:	Shrimps, small fish (biang biang, lomek, etc.)
Gill net and Bottom: long line fishing		Small fishes (biang biang, lomek, etc.), Wolf herring, Narrow-barred king mackerel

(3) Sale of the catches and profit sharing

Fishery in Desa Tlk. Ketapang is primarily family operations with scarcely any hired fishermen. Some lend Gombang fishing equipments to others. In such a case, a borrower will withhold one half of his fish catch and give the remainder to the lender. The maintenance cost of floats and sampans is borne by the lenders. In fact, almost all Gombang fishermen use their equipments for their own operation; those lending their equipments to others are only a few.

All the anchovies hauled by Gombang are boiled and dried, and then shipped to Selatpanjang for sale. Fish caught by gill net fishing are sold to grocers handling fresh fish in Dusun Terus or directly marketed to consumers.

Although someone own rubber or coconut palm plantations and get money from sources other than fishery, most of the fishermen earn cash as wage workers working for the felling of sago or mangroves, or for rubber plantations, etc.

(4) Use of ice

Sampan fishermen in this village do not use ice as in Desa Pelantai because their fishing grounds are in the Asam channel. Since fish caught by Gombang are boiled immediately after hauling, it is not necessary to use ice. This means that practically no ice is used for fishery in this village.

2.4.3 Estimation of Fish Catch

According to the on-site interview, there was no difference between the lean and prime fishing seasons in the Gombang fishing activity, with fishermen operating 14.5 days per month all year round. Calculated from the average daily fish catch per net of Gombang fishing, the average daily fish catch of all the 87 Gombang fishing sets will total about 1,600 kg/day (see Table 2.13).

At the time of the field survey, the 40 Gombang sets supplied under the PKT aid were not operating. A test operation by this survey resulted in a catch of 5.2 kg of mysids per night. Based on this result, the total catch of all the 40 Gombang sets is estimated at 208 kg.

2.4.4 Problems of the Fishery in This Village

Two problems are encountered by the fishermen of this village:

(1) Catches by gill net fishing are mostly small fish

As in the case of Desa Pelantai, the village's gill net fishing in the Asam channel cannot expect a large catch of such high commercial valued fish as wolf herring or narrow barred king mackerel. The catch is limited to small fishes of those of lower commercial valued. Thus, the present gill net fishing cannot earn much money.

(2) Unexploited Gombang fishing grounds

In this village, the shore on the north of RW 03 is not inhabited by fishermen. The fishermen in RW 01 and RW 02 have no access to the RW 03 because they are all sampan fishermen and their sampans are not fit to cover such a distance.

Thus, the good Gombang fishing grounds in RW 03 are left unexploited.

2.4.5 Key Points for Managing Coastal Fishery Resources

Desa Tlk.Ketapang is located the opposite side of Desa Pelantai crossing the Asam Strait so that the fishing condition closely resembles to the Desa Pelantai's. Therefore, key points plans for managing coastal fishery resources to schime the development plan are as the same as its of Desa Pelantai.

Table 2.1 Numbers of Fishermen and Fishing Boats in Desa Muntai

Dusun	Number of Fishermen	Number of Fishing Boat			Jetty
		Non-powered	Out-board	In-board	
Kelapa Sari	27	0	1	13	0
Pusaka	193	20	4	31	0
Total	220	20	5	44	0

Sources : Result of field survey

Table 2.2 Fishing Effort of Gill Net Fishing by by Boat Type in Desa Muntai

	Fishing Season/Middle season	Lean season
Powered boat		
Trips/month	16.1	-
Days/trip	1.1	-
Non powered boat		
Trips/month	17.5	-
Days/trip	1.0	-

Sources : Result of field survey

Table 2.3 Daily Average Catch by Gill Net Fishing

Unit : kg/day/boat

	Fishing season	Middle season	Lean season
Powered boat	13.1	6.0	-
Non powered boat	5.0	3.3	-

Sources : Result of field survey

Table 2.4 Daily Average Fish Landing in Desa Muntai

Unit : kg/day

	Fishing season	Middle season	Lean season
Powered boat	641.9	294.0	0.0
Non powered boat	100.0	66.0	-
Total	741.9	360.0	0.0

Sources : Result of field survey

Table 2.5 Numbers of Fishermen and Fishing Boats in Desa Sei Cingam

Dusun	Number of Fishermen	Number of Fishing Boat			Jetty
		Non-powered	Out-board	In-board	
Serimenanti	15	9	0	1	0
Serimakmur	39	10	3	7	1
Pangkalah Buah	22	1	0	8	1
Total	76	20	3	16	2

Sources : Result of field survey

Table 2.6 Fishing Effort of Gill Net Fishing by Boat Type in Desa Sei Cingam

	Fishing Season/Mid season	Lean season
Powered boat		
Trips/month	10.2	15.8
Days/trip	1.5	1.0
Non powered boat		
Trips/month	17.0	14.0
Days/trip	1.0	1.0

Sources : Result of field survey

Table 2.7 Daily Average Catch by Gill Net Fishing in Desa Sei Cingam

Unit : kg/day/boat

	Fishing season	Mid season	Lean season
Powered boat	16.3	7.0	4.1
Non powered boat	9.6	5.8	3.0

Sources : Result of field survey

Table 2.8 Daily Average Fish Landing in Desa Sei Cingam

Unit : kg/day

	Fishing season	Middle season	Lean season
Powered boat	309.7	133.0	77.9
Non powered boat	192.0	116.0	60.0
Total	501.7	249.0	137.9

Sources : Result of field survey

Table 2.9 Number of Fishermen and Fishing Boats in Desa Pelantai

Dusun	Number of Fishermen	Number of Fishing Boat			Jetty
		Non-powered	Out-board	In-board	
Pelantai	87	86	0	0	1
S. Kamal	0	0	0	0	0
Wonosari	0	0	0	0	0
Kengkam	62	62	0	2	1
Total	149	148	0	2	2

Sources : Result of field survey

Table 2.10 Fishing Effort of Gill Net by Non Powered Boat in Desa Pelantai

	Fishing Season/Mid season
Trips/month	14.1
Days/trip	1.0

Sources : Result of Field Survey

Table 2.11 Daily Average Catch by Gill Net Fishing in Desa Pelantai

Unit : kg/day/boat

	Fishing season	Mid season
Non powered boat	9.3	4.4

Sources : Result of Field Survey

Table 2.12 Numbers of Fishermen and Fishing Boats in Desa Tlk. Ketapang

Dusun	Number of Fishermen	Number of Fishing Boat			Jetty
		Non-powerd	Out-board	In-board	
Terus	57	57	1	2	2
Ketapang Hulu	80	80	0	0	0
Ketapang Hilir	104	104	0	0	1
Piskul	15	15	0	0	0
Total	256	256	1	2	3

Sources : Result of field survey

Table 2.13 Daily Average Catch by Gombang Fishing in Desa Tlk. Ketapang

	Fishing season	Mid season	Lean season
Daily average catch (kg/unit/day)			
Anchovies	16.8	8.0	2.8
Mysids	6.0	3.6	3.2
Others	0.4	0.4	-
Number of Fishing gear	87	87	87
Daily average catch (kg/day)			
Anchovies	1,461.6	696.0	243.6
Mysids	522.0	313.2	278.4
Others	34.8	34.8	-

Sources : Result of field survey

3. Aquaculture

3. Aquaculture

Tables & Figures

3. Aquaculture

3.1 Aquaculture Potential by Model Area

The four model areas selected based on the findings of the Phase 1 survey were studied with regard to their aquaculture potential from the aspects of coastal soil properties, coastal wave conditions and the possibility of supplying feed stuff. The results suggest that the environment of Desa Pelantai is most suitable for aquaculture. Although Desa Sei Cingam has lots of areas suitable for aquaculture along the Marong channel, the catch of trash fish for feed stuff use is so small that aquaculture for the purpose of supplying feed stuff is not feasible in the village. Other villages are unfit for aquaculture because of a number of negative factors.

	Soil properties	Wave conditions	Possibility of feed stuff
(1) Muntai	×	×	×
(2) Sei Cingam	=	=	
-The Malacca Straits side	×	×	×
- The Marong channel side	○	○	×
(3) Pelantai	○	○	○
(4) Tlk. Ketapang	○	○	×

Note: ○= Fit; × = Unfit

As a result, Desa Pelantai has been clarified as an appropriate village, as contemplated in the selection in the stage of Phase 1 survey, where an aquaculture development project can be implemented. Also, some areas along the shore of the Marong channel in Desa Sei Cingam may have the potential of extensive aquaculture by fertilization.

A major problem that could bar the promotion of aquaculture in the Study Area is the lack of a fry supply system. Therefore, in addition to the target of promoting aquaculture in the model area, this plan should envisions the establishment of fry supply system to fulfill the need of the Study Area.

3.2 Aquaculture Potential in Desa Pelantai

Desa Pelantai is a village located on the shore of the Asam channel; the coastal area is covered by a narrow belt of mangrove forests. At present, no aquaculture is practiced in this village. Fishery is limited to small scale gill-net fishing, etc. solely for the self-consumption of villagers. Fishermen engage in the felling of mangroves as their main source of income.

3.2.1 Potential of Feed Supply for Aquaculture

In general, aquatic animals are mostly a carnivorous, and feed stuff occupies a large percentage in the operating cost of aquaculture. Accordingly, the first challenge in aquaculture is to secure steady protein supply at low cost. In this project, one of the basic policies is to produce and supply as much feed stuff as possible within the village itself without resorting to outside supply sources.

(1) Present fishery condition in the Asam channel

The Asam channel runs between Padan island and Merbau island. Bag-net fishing for mysids and anchovies and gill-net fishing for small fishes like biang biang and lomek are in operation.

Gombang fishing is popular in the Asam channel in front of Desa Tlk. Belitung, a village adjoining Desa Pelantai in the north. Fishermen catch small fishes and mysids to feed livestock. Also, in Desa Tlk. Ketapang on the opposite shore across the channel, anchovies are boiled and dried for sale.

(2) Examination of feed stuff supply sources for aquaculture

In existing aquaculture farms in the Study Area, mysids and trash fish obtained by Gombang fishing are fed as feed stuff. Mud crabs culturing farms in Kab. Tg. pinang outside the Study Area uses the refuse of fish and chickens as feed for the crabs.

In Desa Pelantai and neighboring villages, however, fish are in short supply and demand is mostly filled by the supply from outside, so practically no fish refuse is available to feed culture farms. It is also difficult to obtain chicken refuse in a sufficient quantity to fill the need of feed stuff because chickens are sold alive in the market.

Thus, aquaculture feed stuff available in Desa Pelantai is limited to the Gombang fish catch.

(3) Estimation of Gombang fish catch

It was reported the Gombang fish catch in Kec. Tebing Tenggi/Kec. Merbau is at a level of 10 to 20 kg/net/day all the year around. Our site survey observed a fish catch of 15 to 24 kg/net/day (daytime operation) in November in the Air Hiram channel (running between Rangsang island and Tebing Tenggi island). The fish catch was composed mainly of anchovies from daytime fishing and mysids from evening fishing.

In the Asam channel, Gombang fishing is operated in Desa Tlk. Ketapang, at a level of 6 to 23 kg/net/day (daytime operation). The catch is mainly anchovies. Night Gombang fishing is done in Desa Tlk. Belitung in order to obtain livestock feed stuff. The fish catch is relatively constant all the year around, at a level of 10 kg/net/night. A night test-fishing conducted in the site survey at Desa Tlk. Ketapang yielded a 12.6 kg/net/night catch on the average, mainly composed of mysids. Because 0.5 kg of the catch was shrimps of high commercial value, fish suitable for feed stuff use yielded 12 kg (including 10 kg of mysids) (see Table 3.2).

As stated above, the Gombang fish catch in the Asam channel excluded shrimps is estimated that both night and day operation will yield an average feed stuff catch of 17 kg/net/day throughout the year. If anchovies boiled and dried for sale are included in feed stuff use, the yield will reach an average of 26 kg/net/day throughout the year.

(4) Possible water area for Gombang net installation and the possible number of net installations

Possible Gombang fishing grounds in Desa Pelantai are an area offshore about 4 km to the south of the mouth of the Kengkam river in the north of the village and an area offshore extending about 0.8 km at the mouth of Pelantai river in the south of the village.

Usually, Gombang nets are installed in the water about 15 to 25 m deep. Since the Asam channel off the mouth of the Kengkam river is less than 23 m deep, even in the middle of the channel, the waters fit for Gombang fishing will be the area from the point 60 m offshore to the middle of the channel. The breadth of the Asam channel is about 1,800 m in front of Dusun Kengkam. About one-third of the river breadth, i.e., an area covering 600 m from the shore of Dusun Kengkam, can be allocated as a Gombang fishing ground and the 600 m area in the middle of the river retained for ship traffic. Thus, the possible water area for Gombang net installation in the village will be a 2.2 km^2 area to the south of the mouth of the Kengkam river and a 0.4 km^2 area offshore near the mouth of the Pelantai river.

The laws of Riau Province stipulate that Gombang nets must be separated from each other by 1,500 m in the front and rear and 100 m to the right and left. The fishery authority of Kec. Bengkalis recommends a front and rear separation distance of 500 m between nets in an ordinary water area. The authority, however, permits a shorter separation distance if allowed by the local situation in a channel like the Asam channel. In a government-supported Gombang fishing development project now under way in Desa Teluk Ketapang, on the opposite shore of Desa Pelantai, the front and rear separation distance between Gombang nets is set at about 50 m.

In our project, the separation distance between Gombang nets will be 80 m lengthwise and 60 m crosswise, about the same size with the fishing equipment itself. Accordingly, a water area of about 0.02 km^2 will be necessary for installing one set of nets.

In consequence, about 110 Gombang fishing nets can be installed in the 2.2 km^2 area in the south of the mouth of the Kengkam river, and about 25 Gombang fishing nets in the 0.5 km^2 area off the mouth of the Pelantai river.

3.2.2 Suitability in Terms of Water Quality

Suitable species to aquaculture in the Study Area will include giant sea perch, giant tiger prawn and mud crab. These fishes were also selected for a brackish water fish culture development study by the local fishery authority. Table 3.3 shows both the breeding conditions of these three species and the findings from a study on the natural conditions of the Asam channel.

The study of installing a floating cage culture farm in the Asam channel indicated no particular problems except for a rapid tidal current. Although a current flow of 0.5 m/sec. or less is generally considered desirable for a fish farm to breed giant sea perch, the study of the natural conditions of the Asam channel measured a maximum tidal current speed of 0.77m/sec. Consequently, some means must be devised to moderate the speed of the tidal current when a floating cage farm is installed.

In the floating cage culture, leftover feed stuff or feces from cultured fishes can accumulate on the bottom of the culture area. This can aggravate the living conditions of cultured fish. In this channel, however, we anticipate no such problems because the tidal current runs so smoothly that the accumulation of such leftovers and feces can be prevented.

The culture of giant tiger prawn and mud crabs is not a subject to a tidal current because they are grown in earth ponds. However, the water condition in this area was determined to be appropriate for aquaculture although the salinity concentration was found somewhat high (30 ppt).

3.2.3 Land Availability for Earth Pond Development

From the nature of this study, earth fish ponds should be constructed in unexploited areas not covered by mangrove forests. The shore of this village along the channel is mostly covered by mangroves. Thus, marsh lands with low vegetation cover in the background of mangrove forests will be utilized as the site for earth ponds relatively easy to get water from the water supply system construction.

The area of such marsh lands which can be suited for aquacultural land is about 46 hectors in this village.

3.3 Aquaculture Potential of Desa Sei Cingam

3.3.1 Conditions of Aquaculture

As stated in section 3.1 above, Desa Sei Cingam is not a place where feeding-type aquaculture is feasible, because hardly any feed stuff is available in the village. However, it may be possible for fertilized aquaculture, utilizing marsh lands with low vegetation cover in the hinterland of mangrove forests.

3.3.2 Land Availability for Earth Pond Development

In the north of Desa Sei Cingam, there are marsh lands with low vegetation cover extending over an area of 600 hectares. Most of these marsh lands are located on the shore of the Malacca Straits. The shore on the Malacca Straits consists of sandy beach, and drifting sand often blocks the mouths of streams in the area. This makes the area unsuitable for the location of culture ponds because of the risk that water inlet channels can be blocked by drifting sand.

On the other hand, marshlands along the shoreline of the Marong channel are located in the hinterland of mangrove forests and are suitable sites for fish pond construction. The area of these marshlands totals about 120 hectors.

In addition, there are about 150 hectares of marshlands in the north of the village in which can be possible for fertilized aquaculture.

3.3.3 Selection of Fish Species for Aquaculture

The species of fish must be selected to suit the type of aquaculture, which will be the fertilized culture type in this village.

The species for selection must meet the following conditions:

1) To grow in brackish water.
2) To be omnivorous.
3) To be highly reproductive and capable of reproducing within a pond.
4) Fish fry to be easily available.

The species that meets all of the above conditions and is presently being bred in Indonesia is tilapia. In Indonesia, the average yield of tilapia by the fertilized culture-type is 350 kg per hector.

3.4 Establishment of Fry Supply System

3.4.1 Selection of Target Fry Species

The target marine species to be cultured in Kab. Bengkalis are shrimps, giant sea perch and mud crabs. Of these, shrimps have a fry production facility, though small in scale, already constructed by the Kec. Bengkalis fishery authority and due to be commissioned in 1993/94. Accordingly, our project will concentrate on giant sea perch and mud crabs in our effort to establish the supply system. Tilapia, a species now planned to be introduced in Desa Sei Cingam, will be excluded because its fry are now being produced in Kec. Bengkalis. Once the fry are introduced, it will not be difficult to reproduce them in aquaculture ponds, making it unnecessary to introduce additional fry.

3.4.2 Selection of Site for Possible Fry Production Facility

For a fry production facility, sites were proposed in Kec. Bengkalis, where culture ponds already exists, as well as in Kec. Merbau and Kec. Tebing Tenggi. Of the three districts, Kec. Bengkalis already has a small-scale giant tiger prawn fry production facility. This project would select the site of a new fry production facility from among the proposed sites in Kec. Merbau and Kec. Tebing Tenggi, where the production of fry has not yet started.

Conditions for site selection are as follows:

1) Public power service that is capable of driving sea-water pumps and other equipment to be available.
2) Unpolluted sea-water to be available.
3) To allow easy access to equipment repair service and materials purchase.
4) Not to have any fry transportation problems up to existing culture ponds.

The fishery authority of Kec. Tebing Tenggi, which administrates both Kec. Merbau and Kec. Tebing Tenggi, was selecting a possible site for the construction of a fry production facility from its own point of view.

Its proposed sites were as follows:

1) Siarang Pasung, Desa Lemang
2) Sungai Suir, Desa Banglas
3) Sungai Sodor, Desa Bokor

Of these proposed sites, Desa Bokor and Desa Lemang lack availability of public power service and are isolated from Slatpanjang across the channel. On the other hand, the site in Desa Banglas is located only about 5 km to the south of the town of Slatpanjang and has power service already available within 2 km. It is certain that the power service can be made available to the site quite easily. In addition, it was judged that other said conditions would be also fulfilled in general.

For the above reasons, it is considered Desa Banglas is the first priority as the site of a new fry production facility.

The new facility in Desa Banglas will be constructed inside the existing shrimps aquaculture demonstration facility located along the Suwir river and now managed by the Riau Province fishery authority.

The water quality of the Desa Banglas demonstration facility is as follows:

- Salinity :18 - 28 ppt
- pH :6 - 7
- DO :6 ppm
- WT :20 - 23℃

3.5 Key Points for the Promotion of Aquaculture

3.5.1 Desa Pelantai

(1) Target species for aquaculture

Two types of aquaculture are considered in this village; floating cage culture and earth pond culture. A species suitable for floating cage culture is giant sea perch. Species suitable for earth pond culture are, giant sea perch, giant tiger prawn and mud crab.

At present, all the floating cage culture in the Study Area is located in the river mouths. Though the area is suitable for fish farming, it has a limit of space for the further development of the cage culture. On the other hand, total length of the channel is over 300km, and the channel has a large potential for the development. Thus, it is desirable to innovate the cage culture technology required in this Model Area.

The aquaculture of giant tiger prawn is technically established now and can be developed at the initiative of the private sector. In contrast, the aquaculture of mud crab is a technology that is quite new and still in an initial experimental stage. The fishery authority is trying hard to make their attempt successful. With growing markets like Singapore at hand, this area has a promise of good business in aquaculture of mud crabs and shipping them alive. Further support and assistance are needed to make its development successful.

All in all, the species most suitable for aquaculture in this project are judged to be giant sea perch for floating cage culture and mud crabs for earth pond culture.

(2) Introduction of cold storage for feed stuff preservation

Because Gombang fishing in the area is limited to the period of spring tide, feed stuff becomes insufficient for the period of neap tide. To deal with this problem, the existing breeding farms dry and preserve fishes taken in the period of spring tide. This situation, however, causes the deficiency of vitamins and essential fatty acids

In our project, it is essential to provide a cold storage facility capable of preserving enough foodstuff against the period of neap tide.

(3) Introduction of sylvofishery

In the earth pond for mud crab, earth platforms will be provided in the pond to serve as nests. Mangroves could be planted in the low-vegetation marshlands where aquaculture ponds would be also developed. Accordingly, it may be necessary to study the introduction of sylvofishery, in which mangroves are planted on platforms.

3.5.2 Desa Sei Cingam

(1) Introduction of sylvofishery

In Desa Sei Cingam, fertilized culture is a prerequisite for aquaculture development because there are no sources of cheap feed stuff in this village. The yield of aquaculture in this case is dependent on the inflow of organic substances and nutrient salts into the culturing water areas. Consequently, it is necessary to examine the possibility of a sustained supply of organic substances by means of the introduction of sylvofishery.

(2) Clarification of the purpose and role of fertilized culture

Fertilized culture requires less money to operate, but it produces less yield per unit area. In addition, the price of tilapia, a species applicable to this culture method, is relatively low (Rp. 1,500/kg).

It should be mentioned here, however, that the purpose of this project is not to sell its products to outside markets. Rather the purpose is to fill the need of villagers and replace inshore fish catch now consumed by the villagers.

3.5.3 Fry Production Facility in Desa Banglas

(1) Objectives of activity

One of the objectives of this facility is to provide a stable supply of fry at low prices to the fish farms now existing in the Study Area. Accordingly, the species chosen for production will be giant sea perch and mud crabs, which are presently being cultured in the fish farms but the supply system of which is still inadequate.

On the other hand, large quantities of giant sea perch are being produced in neighboring countries, such as Thailand and Malaysia. In view of this, it will be necessary in the future to introduce new species for aquaculture. This facility will be responsible for the research and development of new species for aquaculture in addition to the production of fry of the above two species.

(2) Determination of production scale

Fry produced in this facility will be supplied only to the existing fish farms in the Study Area. Therefore, the scale of this facility will be set at a level to match the demand of this Area.

Table 3.1 Aquaculture Potencial of Each Model Areas

Model Fishing Village	Soil	Sea condition	Potencial of feed supp
Desa Muntai	The coastal soil generally consists of gambut, which has low water-holding capacity and is not suitable for the construction of earth fish ponds.	In the season of northerly wind, the coast is exposed to rough sea waves. This makes it difficult to install floating cage along the coastline.	Gill-net fishing, a main fishing method in Desa Muntai, is intended to catc large fishes of high commercial value rather tha small fishes suitable for fish culture feedstuff. Thus, feedstuff supply is scarce.
Desa Sei Cingam Coastal area of Malacca Strait	The area on the coast of the Malacca Straits is a sandy beach surrounded by marshlands with low vegetative cover in the background. Because of frequent sand sedimentation in the nearby rivers, the construction of waterways to earth ponds seems difficult.	In the season of northerly wind, the coast is exposed to rough sea waves. This makes it difficult to install floating cage near the coastline.	Gill-net fishing, a main fishing method in Desa Sei Cingam, is intended to catc large fishes of high commercial value rather tha small fishes suitable for fish culture feedstuff. Thu feedstuff supply is scarce.
Coastal area of Marong Channel	Mangrove forests grow on the coast of the Marong channel. In the background are unexploited marshlands with low vegetative cover. These marshlands can be utilized as earth ponds.	The channel is calm and sheltered from rough sea waves produced by the seasonal wind. This area is suitable for installing floating cage	Gill-net fishing, a main fishing method in Desa Sei Cingam, is intended to catc large fishes of high commercial value rather tha small fishes suitable for fish culture feedstuff. Thu feedstuff supply is scarce.
Desa Pelantai	Mangrove forests grow on the coast of the Asam channel. In the background are unexploited marshlands with low vegetative cover. These marshlands can be utilized as earth ponds.	The channel is calm and sheltered from rough sea waves produced by the seasonal wind. This area is suitable for installing floating cage	Gombang fishing is popular the Asam channel, and small fishes suitable for fish culture feedstuff are available in great quantity
Desa Tlk. Ketapang	Mangrove forests grow on the coast of the Asam channel. In the background are unexploited marshlands with low vegetative cover. These marshlands can be utilized as earth ponds.	The channel is calm and sheltered from rough sea waves produced by the seasonal wind. This area is suitable for installing floating cage	In Desa Tlk. Ketapang, the kelompok activity to proces and ship gombang fishing catches for sale is thrivin among fishermen. In view of this, the utilization of gombang fishing catches for fish culture feedstuff seem inappropriate because it would compete with the current fishermen's activit

Table 3.2 Productivity of Gombang in Asam Channel

Unit : kg/set/day

	Fishing seazon	Middle seazon	Lean seazon	Average
Day time *1				
Anchovies	16.8	8.0	2.8	9.2
Mysids	6.0	3.6	3.2	4.3
Others	0.4	0.4	-	0.3
	23.2	12.0	6.0	13.7
Night time(Estimate) *2				
Mysids	10.3	10.3	10.3	10.3
Shrimps	0.5	0.5	0.5	0.5
Others	1.9	1.9	1.9	1.9
Sub total	12.8	12.8	12.8	12.8
Total (kg/unit/day)				
Anchovies	16.8	8.0	2.8	9.2
Mysids	16.3	13.9	13.5	14.6
Shrimps	0.5	0.5	0.5	0.5
Others	1.9	1.9	1.9	1.9
Total	35.6	24.4	18.8	26.2

Sources *1 ; Result of field survey
*2 ; Estimated based on the result of test operation in Sep. 1993

Table 3.3 Water Condition of Asam Channel

	Water condition of Asam Channel		Optimum condition for Giant Sea Perch		Optimum condition for Mud Crab		Optimum condition for Giant tiger prawn
Salinity	31 ppt	*1	0 ～ 35 ppt	*2	10 ～ 25 ppt	*3	5～ 34 ppt
DO	3.5 ml/l	*1	> 3 ml/l	*2	> 4 ppm	*3	> 5 ppm
Tidal range	2.6 m	*1	1 ～ 2 m	*2	-	*3	
Tidal current	Max 0.77 m/sec	*1	< 0.5 m/sec	*2	-	*3	

Sources *1 ; Result of Natural Condition Survey
*2 ; Jothy, 1968; Ho, MS; Lai and Chua, MS
*3 ; Status of Mud Crab (Scylla spp) Fishery and culture in Indonesia

4. Fish Marketing/Processing

4. Fish Marketing/Processing

Tables & Figures

4. Fish Marketing/Processing

4.1 Desa Muntai

4.1.1 The Present State of Fish Marketing and Processing

In Bengkalis Island, the majority of fish harvested by powered fishing boats in the Malacca Straits are for export. Desa Muntai is regarded as one of the export bases on this island for fish catch to Malaysia. All exported goods are iced fish. The fish catch are not processed, except for dried fish for home consumption.

(1) Condition of fisheries infrastructure

Facing the Malacca Straits, the village has advantageous location for fish catch collection and its export, but the fisheries basic infrastructure is not yet sufficiently developed.

1) Landing facilities

Currently, 49 powered fishing boats and 20 sampans are in service in the village. There are also powered fishing boats from outside the village that unload their harvested fish in the village. Despite its role as a fish collection base, the village has no landing facilities such as jetties.

Fishing boats are moored along the stream of the Muntai River (4 - 5 m wide) which passes through the village and joins the Malacca Straits. At low tide, the river becomes too shallow for the boats to sail and fishing boats have to wait for the tide to rise high enough to pass because at that time, the coastal water also retreats for several hundred meters. The fish are sold to the fish collection boats that are moored at the seashore.

2) Ice plant facilities

The village has an ice plant run by KUD Putra Karya; capacity is two tons per day. The plant takes in water from wells. The acidity of the water (less than pH 5) affects the quality of the ice, making it inappropriate for preserving harvested fish. The selling price of the ice is 150 Rp/kg, 3 times higher than 50 - 60 Rp/kg in Slatpanjang.

The neighboring village of Desa Tlk. Pambang also has an ice plant with a capacity of two tons per day; its operation is now suspended, however. Its ice producing facilities have the same financial backing as the aforementioned KUD Putra Karya ice plant, and by the wish of financiers it will be integrated with the plant of this village.

3) Roads

The village is linked by road with Kota Bengkalis, the center of Kab. Bengkalis. However, the road between the two villages is sealed only between Kota Bengkalis and Desa Bayoneting Tengah; it is not sealed between Desa Bantang

Tengah and Desa Muntai. The unsealed part of the road becomes partly inaccessible to automobiles and motorcycles on rainy days because the soft ground becomes extremely muddy. Therefore, it is difficult to depend on the road to transfer the catch landed at Desa Muntai to other regions.

4) Application for export permit

The official procedure of export is to transfer the collected fish to the PPI of Kota Bengkalis and to obtain an export permit (certification of origin). At this stage, the traders pay an export charge, including port dues, equivalent to 5 percent of the price at which they bought the products from the fishermen. It usually takes 8 to 12 hours to transfer the fish from the village to Kota Bengkalis by boat. Since the price of fresh fish is largely dependent upon their quality, in a majority of cases the fish are directly exported from the village without passing through the Fisheries Department of Kota Bengkalis. Application for export is made separately by the Tauke or the broker, and the traders pay the fee accordingly.

(2) Marketing structure

The marketing channels for fish catch in this village are divided into two major categories: export to Malaysia and local consumption. Export is carried out by several Taukes and KUD Putra Karya.

The main purchasers of fish in the village are the two Taukes (the old Tauke and the new Tauke) and KUD Putra Karya. However, KUD Putra Karya entrusts the sales and export entirely to a Tauke who lives in the neighboring village. Therefore, only Taukes substantially handle the sole export of fish.

Powered boat fishermen, whose target is fish for export with high commercial value, such as narrow-barred king mackerel and wolf herring, sell their entire harvest to the Taukes or KUD Putra Karya. The reason is that many powered boat fishermen have borrowed money from the Taukes to pay for their boats and operation fees, and they must sell the fish to the Tauke in return. Other fishermen who are free from such obligations can choose their own customer among the Taukes. Some of the free fishermen in the village sell to the Tauke in Desa Bantang Tengah 20km away from the village, because the purchase prices of the Tauke here is too cheap (see Figure 4.1). The fish collected by the Taukes are exported mainly to Malaysia, but some of them may be exported to Singapore via Tg. Balai Karimun.

The fish caught by sampan boats are smaller than those caught by powered boats and include many tiny insignificant fish. Sampan fishermen also sell their catch to the Tauke. The fish are classified into those that can be exported and smaller ones for local consumption.

(3) Price of the fish

KUD Bengkalis consists of fishery-related people within the Kec., including the Tauke, who constantly establish purchase price guidelines for fish per species for when Taukes buy fish from the fishermen. However, the results of a local study show that each Tauke sets up a different purchase price.

In general, the purchase price of the Tauke is established on the assumption that the Tauke lend money to the fishermen. The Taukes do not impose any interest on their loans to fishermen, but they fix the purchase price much lower than when they sell directly to the market. For example, the new Tauke of the village purchases harvested fish at a price that is 22 - 60 percent lower than the purchase price guidelines established by KUD Bengkalis (see Table 4.1).

There are Taukes who fix a price higher than this purchase price when they buy from obligation-free fishermen.

Three Taukes are currently engaging in collecting harvested fish in the village: the new Tauke who has been engaged in fish collection for three years, the old Tauke who had done it in the past and has started again in recent years, and the Tauke in a neighboring village who collects harvested fish through KUD Putra Karya. The old and the neighboring Taukes fix their purchase price at Rp.500 - 1,000 higher than the new Tauke, in an attempt to expand their shares, as they are the latecomers in fish collection business. The purchase price of the Tauke in Bantang Tengah is also fixed at a higher level than the new Tauke in the village.

The price of small fish for local consumption, such as biang biang and lomek, is around Rp.1,000/kg.

(4)Supply and demand for ice

As the majority of the fish caught by powered boat fishing are exported, so ice is used to keep them fresh. The fish collected by Taukes and KUD Putra Karya are also stored in ice until they reach a certain quantity. Since the freshness of the fish is ensured entirely by ice, demand for ice is high. If the fish/ice ratio is fixed at 1:1, the quantity of ice required to preserve the total of the catch by the 49 power boats of the village during the peak season will be about 642 kg (average catch: 13.1 kg/day/boat). As the same amount of ice is required for the storage of the fish after landing, a total of 1,284 kg of ice per day will be necessary for the entire village during the peak season. The fish catch by sampans do not require ice for storage, as they are consumed within the village in a short period of time.

There is an ice plant with a capacity of two tons per day, but there are problems involving price and quality, so the quantity of ice used to preserve the fish is limited. The new Tauke buys ice from Slatpanjang and supplies it to his subordinate fishermen free of charge.

However, a local survey shows that the actual fish/ice ratio used to preserve them was 1:0.8, meaning that there is a shortage of supply in ice compared to the ideal ratio of 1:1.

4.1.2 Problems of Marketing and Processing

(1) Absence of the export permit office

There is no export permit office on the Malacca Straits side, the main fishing ground of Kec. Bengkalis. In order to obtain an export permit, one has to transport the fish to Kota Bengkalis, located in the opposite direction of the destination of the products. This means that more than 16 hours will be lost just to make a return trip to Kota Bengkalis. In most cases, therefore, the fresh fish are actually exported through temporary measures, and the export permit is obtained by the Tauke afterwards in Kota Bengkalis.

It is extremely difficult to obtain accurate figures regarding the export quantity, as the fresh fish are exported without undergoing inspection by the Fishery Department. Such a situation interferes the establishment of accurate data on the fish catch in the Malacca Straits and makes it difficult to control the fishery resources.

(2) Lower purchase price proposed by Taukes

Although KUD Bengkalis has established guidelines for the purchase price, the Taukes set their own prices that are often lower than the guidelines. Obligation-free fishermen who own their powered boats can choose their customers by comparing the different purchase prices proposed by the Taukes from neighboring villages, but the sampan fishermen who do not have means of transportation cannot choose among the Taukes. Therefore they end up selling their fish at a lower price than the guidelines, even if they are not in debt to Taukes.

(3) Ice with low quality and high price

Ice produced in the ice plant of the village is sold at 150 Rp/kg. This price is three times that of Slatpanjang, which is 50 - 60 Rp/kg. Also, the acidity of the water makes the quality of the ice produced in the plant inappropriate for the preservation of fish. Considering the necessity of high quality ice at a low price for the improvement of the quality of fish, the current situation regarding the supply of ice is hindering the development of the local fishing industry.

4.2 Desa Sei Cingam

4.2.1 Present State of Fish Marketing and Processing

(1) Conditions of fisheries infrastructure

The village used to be a part of the official registered region of KUD Rupat, but it is now excluded from the region because of its remoteness. However, some fishermen in the village continue to work directly under KUD Rupat, and they use the base of KUD Rupat (outside the village of Sei Cingam) including its fisheries infrastructure.

The village centers upon the export of iced fresh fish, as in the case of Desa Muntai, and does not process the fish.

1) Landing facilities

There are three jetties along the Marong Channel which divides the village into the northern and southern parts, but they are not used for fish landing of powered boats. However, powered boat fishermen moor their boats at the jetty during the off season. Such fishermen in the village are largely classified into those who sell for the Tauke, the only one in the village and those who sell for KUD Rupat.

The Tauke of the village uses Alohong of Dusun Srimakmur as his base. Since Alohong is a sandy beach, powered boats cannot come alongside the quay. Therefore, the boats moored near the shore, and the fish are reloaded onto sampans for landing.

Fishermen working directly under KUD Rupat have their fishing base outside the village. Therefore, they do not bring the fish to the village.

2) Ice plant facilities

An ice plant with a capacity of two tons per day was operating from 1975 - 80, but it closed down after having been beaten in the price competition with the newly-built large-scale ice plant in Tg. Medang, which has a capacity of 40 tons per day. The village no longer has its own ice producing facilities.

(2) Marketing structure

The export channels of the village are classified into the following two: through KUD Rupat and through the Tauke of the village (see Figure 4.2).

KUD Rupat collects fish from the fishermen in its zone of activities, including the four villages in the north of Rupat Island, and ships them to its main base of Tg. Medang towards Malacca. Some of the powered boats of the village use Tg. Medang and Desa Kuala Simpang, where KUD's fish collecting site is located, as their fishing bases. KUD Rupat is a legal form of fishermen's organization, but there are a number of Taukes among its members. The export of fish catch is financially controlled by one Tauke living in Malacca.

The Tauke of the village collects the fish at Alohong and exports them to Malacca by himself. He also buys fish from the sampan fishermen of the village, but handles only the exportable fish. Sampan fishermen sell other small fish within the village.

There is no fish market in the village, so consumers buy fish directly from the fishermen.

(3) Price of the fish

The fish catch of the village with high commercial value are usually exported to Malaysia, and commercial transactions are settled in Ringgit (the Malaysian currency unit).

According to our interview survey, the purchase prices of KUD Rupat and the Tauke of the village were almost identical(see Table 4.2). The price of the small fish for local consumption, such as biang biang and lomek, was around 1,000 Rp/kg.

(4) Supply and demand for ice

In the village, the freshness of fish catch is ensured entirely by ice; thus, the demand is high. If the fish/ice ratio was 1:1, the quantity of ice required for the preservation of the catch by the 19 powered boats of the village during the peak season will be about 310 kg (average catch: 16.3 kg/day/boat). As the same amount of ice is required to store the fish after landing, a total of 620 kg of ice per day will be necessary for the entire village during the peak season.

At present, fishermen under the control of KUD Rupat are supplied with ice produced in the ice plant in Tg. Medang. The price of the ice is 75 Rp/kg. The Tauke in the village also buys ice at Tg. Medang and supplies it to fishermen at the cost price (75 Rp/kg). The Tauke in the village buys the ice produced in Malacca at 100 Rp/kg when he exports fresh fish there and sells the ice within the village. This ice costs 25 Rp/kg more than the locally produced ice, but it is of better quality and can be used for a longer period of time.

According to our interview survey, the fish/ice ratio used in powered boats was 1:1.25, showing that a sufficient quantity of ice was used. However, as the quality of the ice is poor and therefore not appropriate for the preservation of fish for a longer period of time, it is unknown how much ice is actually used in an effective way.

4.2.2 Problems of Marketing and Processing

The village faces the following three main problems.

(1) Absence of an export permit office

There is no export permit office on Rupat Island except for Tg. Medang. In case of development of the fisheries infrastructure in Desa Sei Cingam, it will be necessary to establish another export permit office or its agency at this place to be able to accurately record the quantity of exported fish.

(2) Absence of landing facilities

Currently, there are no landing facilities in the village. Therefore, sampans are used to land the fish catch from powered fishing boats and to transport the ice to the boats. It is necessary to provide landing facilities alongside which the powered boats can be stationed in order to improve the efficiency of those processes.

(3) Absence of an ice plant

Many fishermen purchase a sufficient amount of ice when going fishing. But they are entirely dependent on sources outside of the village for the supply of ice. It is indispensable for the development of the local fishing industry to establish a stable ice supply system within the village. Therefore it is necessary to either provide the ice plant facilities or ice storage facilities when transporting ice from outside.

4.3 Desa Pelantai

4.3.1 Present State of Fish Marketing and Processing

(1) Condition of fisheries infrastructure

Fishermen in the village mainly work with sampans, and most of them catch fish for home consumption and are also involved in another job. The number of fishermen who sell the fish catch is extremely limited. All fish are consumed fresh within the village, but they are not sufficient quantity to meet the demand. Processing of the fish does not take place in the village.

1) Landing facilities

There are two jetties at Dusun Pelantai and Dusun Kengkam. At Desun Kengkam, the existing jetty is wearing out and a new jetty is being constructed by

the Gotong Loyong in this Dusun.

2) Ice plant facilities

There are no ice plant facilities in the village.

Sampan fishing, which is the main fishery activity of the village, is operated on a day-trip basis. The fish catch are either consumed at home or sold immediately after landing, so ice is not used for preservation. There are two powered boats, and they buy ice at 45 Rp/kg at Slatpanjang when going fishing.

They are dependent on sources outside of the village for the supply of ice, but the demand for ice for fisheries is so low that there is no particular requirement of a ice plant.

(2) Marketing structure

Fishery in the village is mainly focused on small-scale fishing for home consumption; the fish are not landed outside the village. The fish supply by the current fishing does not even cover the demand of the village, so the village is dependent of the fish supply in from outside.

The sources of fish supply are peddlers from Slatpanjang and grocers in Desa Tlk. Ketapang, on the opposite bank of the Asam channel.

(3) Price of the fish

Fish are sold directly to consumers in the village. Therefore, the prices indicated here are the consumer prices (see Table 4.3). Fish coming in from outside are small in size or low quality fish that are not for sale in the markets of Slatpanjang.

4.3.2 Problems of Marketing and Processing

Fish supply by current fishing is low; they are entirely sold and consumed as soon as they are landed, thus creating no particular problem regarding the condition of fish marketing within the village. The problems for the village are on the supply side. Currently the village depends on the fish coming in from outside to complement the inadequate supply of fish to be consumed within the village. The first step to be taken to improve the situation will be to increase the local production and to facilitate the acquisition of fish.

4.4 Desa Tlk. Ketapang

4.4.1 Present State of Fish Marketing and Processing

(1) Condition of fisheries infrastructure

The village benefits from aid by APBD II and PKT for the year 1992-93. A fish processing project is being carried out using the fish catch by Gombang fishing.

1) Landing jetties

There are two jetties at Dusun Trus and one at Dusun Ketapang Hilir in the village. These jetties are used not only for landing fish catch but also for landing general daily supplies. The jetties at Dusun Terus in particular are landing spots for ferryboats; in other words, there are the gateways to Desa Tlk. Ketapang.

Other than public jetties, there are many drying-yards for anchovies along the Asam channel. Anchovies are the products from Gombang fishing. The drying-yards serve as landing spots for sampans. Drying-yards for twenty fishing households are under construction with the aid of PKT.

2) Ice plant facilities

There are no ice plant facilities in the village.

Fisheries in the village in the Asam channel focus on Gombang fishing and gill net fishing by sampans. With either method, the products are immediately consumed or processed so that ice is hardly used.

(2) Marketing structure

The village has two powered boats, and gill net fishing is carried out at the base located in Slatpanjang. All operations, from the supply of ice and fuel to the landing of the fish catch, take place in Slatpanjang.

The fishery in the village is centered on Gombang fishing. That for anchovies is now operated, and the catch are shipped to Slatpanjang in the dried form.

Gombang fishermen of the village form a kelompok (groups). The kelompok is divided into three sub-kelompoks according to the district. Dried anchovies are shipped through sub-kelompoks. The catches of Gombang are boiled and dried. Then they are collected at sub-kelompoks and shipped to the wholesale Taukes.

Mysids are harvested as by-products of Gombang fishing, and are also boiled and dried to be shipped as the dried product.

(3) Price of the fish

The price at which dried anchovies are sold to the wholesale Taukes of Slatpanjang varies according to the quality of the products and the seasons; it is generally between 1,700 and 3,500 Rp/kg. Since the fresh fish yields about 25 percent product, the cost of the fish including processing fee will be 425 - 875 Rp/kg.

Dried mysids are sold at 300 - 1,000 Rp/kg. The size of the market in Slatpanjang is small, however, and some shops refuse to buy them.

4.4.2 Problems of Marketing and Processing

(1) Lack of means of drying anchovies during the rainy season

Boiled anchovies are spread onto the drying-yard to be dried in the sun. However, the peak season for anchovies is between September and November and falls into the rainy season. Sometimes the fish cannot be dried and become spoiled.

(2) Lack of dried anchovy processing technology and quality control

Dried anchovies as products vary in their water contents and sizes of fish or chipped ones. Other small fish or mysids are often found. These elements affect the quality and eventually the selling price of the products.

It is necessary to raise the quality of the dried anchovies by improving the production process.

Table 4.1 Producer's Price of Fish in Desa Muntai

Unit : Rp./kg

	Present Taul*1	Bantang Tenga*1	KUD Bengkalis*1	Statiscal Da*2
Narrow barred king mackerel				
Big size	2,500	3,600	3,200	3,500
Small size	1,500	-	2,500	-
Wolf herrings				
Big size		3,600	3,200	2,500
Small size	1,000	-	2,500	1,750

Sources :*1: Result of field survey on August 1993.
*2 : Laporan Informasi Harga dan Kebutuhan Pokok Nelayan. Juli, 1993

Table 4.2 Producer's Price of Fish in Desa Sei Cingam

Unit : Rp./kg

	Tauke*1	KUD Rupat*1	Statiscal Da*2
Narrow barred king mackerel			
Big size	3,200	3,200	3,300
Small size		2,000	
Wolf herrings			
Big size	3,200	3,200	3,300
Small size		2,000	

Sources :*1: Result of field survey on August 1993.
*2 : Laporan Informasi Harga BAP Dumai/Rupat Mai 1993

Table 4.3 Consumer's Price of Fish in Desa Pelantai and Tlk.Ketapang

Unit : Rp./kg

	Pelantai	Tlk.Ketapang
Black pomfret	2,000	-
Sea catfish	2,000	2,200
Shrimps (Small size)	1,500	1,500
Rays	1,500	-
Biang biang	1,500	1,500
Bombay duck	500	400

Sources : Result of field survey on August 1993.

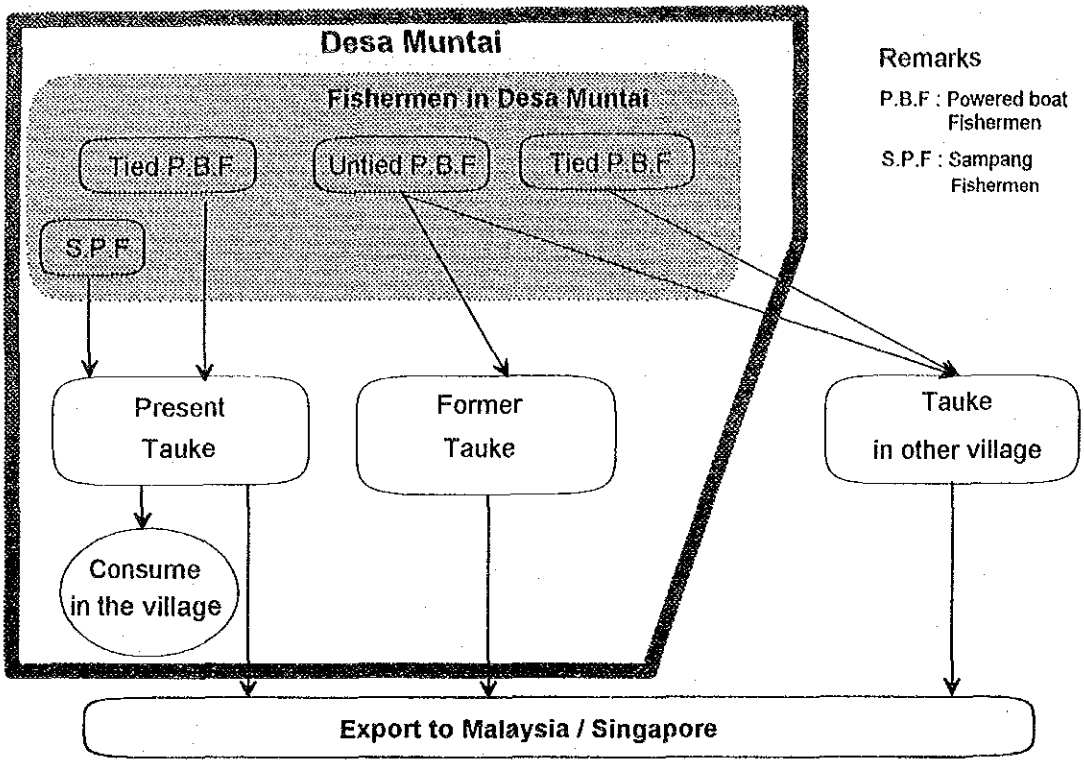

Fig. 4.1 Fish Marketing Structure in Desa Muntai

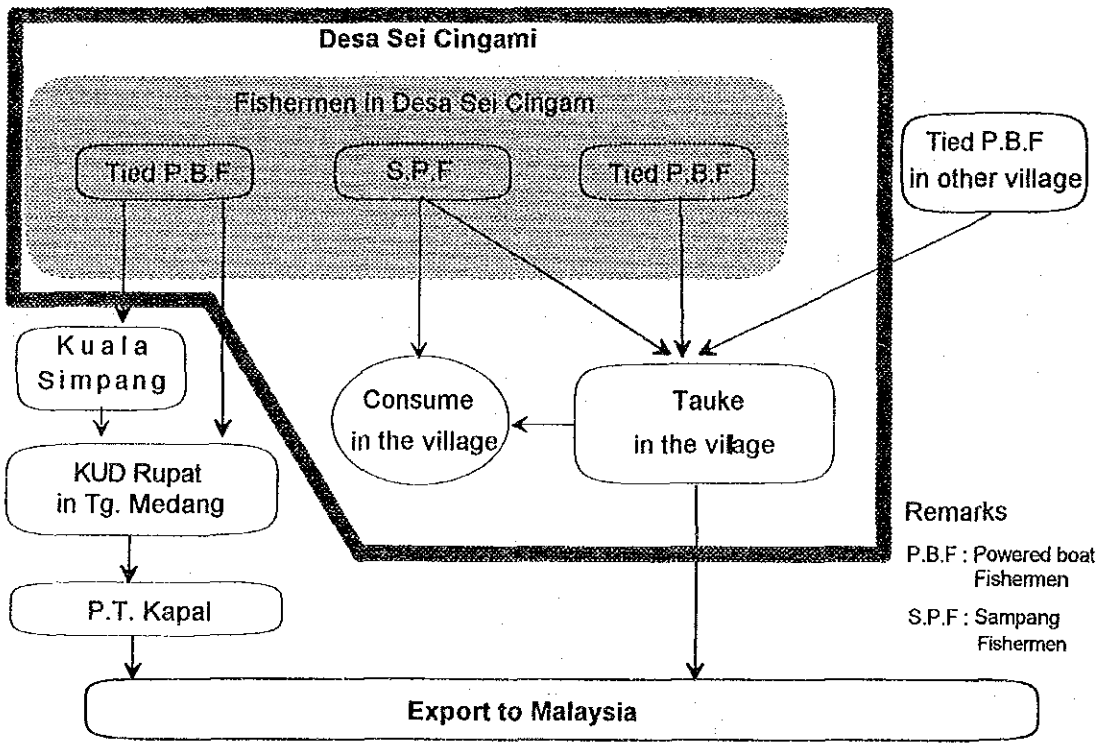

Fig. 4.2 Fish Marketing Structure in Desa Sei Cingam

5. Fishermen Organizations/Institution

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5.1 Desa Muntai

5.1.1 The Current State of the Fishermen Organizations

The KUD and the kelompok are the two types of organizations that can be given as fishing organizations in the pertinent villages.

(1) KUD Putra Karya

The KUD Putra Karya started up in December of 1991, encompassing the entire Desa Muntai. The number of members has increased from 22 when it started up to 81 as of August, 1993. KUD Putra Karya has plans to increase membership further in the future.

1) Business organization and activities

This cooperative is run by five officers, consisting of a president, a vice president, a secretary, a deputy secretary and a treasurer. The current president also serves as the head of Desa Muntai village. The officers serve for a period of three years. At a general meeting of the cooperative that is held once a year in December, there is an evaluation and summarization of the activities that took place during the year and a determination of the activities for the coming year.

In the KUD Putra Karya articles of association, the following five items are given as the business operations of the cooperative:

① Financing by the cooperative.

② Sales of the items required for the livelihood of members of the cooperative at low cost.

③ The processing and sales of products produced by members of the cooperative.

④ Agriculture, forestry, livestock, fishing and handicrafts, such as industrial handicrafts.

⑤ The education, guidance and betterment of members of the cooperative.

2) Activities of the cooperative

Upon joining the cooperative, members are obligated to have a deposit of 10,000 Rupia and add 200 Rupia to that each month. This will become the source of finance for the cooperative.

An activity of the cooperative that is currently taking place is the joint purchase of fertilizer for members that are rice producers. In implementing such joint purchasing activities, the cooperative receives no assistance from the government finance system. When purchasing fertilizer, the funds are procured from the members of the cooperative.

3) Member fishermen and fishing activities

Among the 81 current members, 16 are listed in the cooperative's register as fishermen. However, as a result of an interview with the cooperative's vice president, it was discovered that there are actually about 30 members engaged in fishing. These 30 members break down into 10 that operate from powered fishing boats, 15 that operate from sampans and 5 that hire out their services.

The KUD buys the catch of these members. Although the cooperative has plans to participate in the fish shipping business, it has yet to attained that goal. At present, none of the activities of the cooperative are geared toward the fishermen. Thus, for the fishermen, there are no benefits in participating in the cooperative.

One activity that can be given as a fishing related activity of the cooperative is an ice manufacturing plant that started up in November of 1992 with joint financing from the cooperative and a Tauke. However, the Tauke manages the ice plant. Management by the KUD cannot be ascertained.

(2) The Kelompok

1) Business organization and activities

The kelompok was established at the same time that the KUD Putra Karya was established. The kelompok is run by four officers, the kelompok head, a deputy head, a treasurer and a director. The activities of the kelompok are to provide two meetings for the members each year, where things such as the current state of the fishing business and the future of fishing organizations are considered. However, due to inadequate funding, there are no real activities. Neither are there any signs of administrative guidance by the government.

2) Kelompok membership

The kelompok is formed of about 60 RW04 and RW05 fishermen. These fishermen are mainly sampan fishermen, with only a few members using powered fishing boats. Among them, some are members of the KUD mentioned above, while others are not.

Different from the KUD, to become a member of the kelompok does not require providing a deposit, and there are no articles of association.

5.1.2 The Relationship Between the Tauke and the Fishermen

Because the pertinent village is an export base for fish bound for Malaysia, there are several Taukes' activities within the village and among the neighboring villages. The fishermen are restricted by the financing from the Tauke. Moreover, the fisherman's catch is solely sold to the Tauke, because individually they have no sales routes for export fish.

The following three people can be given as representative Tauke in the villages concerned:

① An old Tauke who was active until four years ago. Recently, this Tauke has begun booking fish catch again in Desa Muntai.

② A new Tauke that is operating in place of the old Tauke. This Tauke receives financial support from a Tauke in Malacca.

③ A Tauke in a neighboring village called Desa Teluk Pambang. This Tauke started booking fish catch two years earlier. This is the only Tauke who is not of Chinese ancestry.

Many of the fishermen receive financing support from the Tauke for the purchase of things such as fishing boats and for operating expenses. They then sell their catch to the Tauke in order to pay back the financing. After repayment of the debt, they receive financing from the Tauke for operating expenses. However, in general, such fishermen are free to operate as they please, having little dependency on the Tauke. But there are fishermen who are continually being refinanced by the Tauke and are not able to repay their entire debt, thus, remaining under the control of the Tauke.

In the country of Indonesia, it is extremely difficult for fishermen whose income is dependent upon the fish catch and is unstable, to get financing from the banks. However, in the pertinent village, there are fishermen who receive regular financing from the banks. To get the financing, they have to provide their houses and palm gardens as collateral. These fishermen apply this financing to their operating expenses and have absolutely no restrictions. However, to purchase a powered fishing boat, they cannot manage with the financing from the bank alone. Thus, they receive additional financing from a Tauke.

In Desa Muntai, the current purchase price for fish catch by the new Tauke is the same for fishermen indebted to the Tauke (controlled fishermen) and for freely-operating fishermen who are not indebted to this Tauke. However, the purchase price by the old Tauke who is booking fish catch and that of the Tauke in the neighboring village is higher than that of the new Tauke currently in Desa Muntai. As a result, about thirty of the free- operating fishermen will not sell their catch to the new Tauke in the village. They sell for a higher price to the old Tauke or to the Tauke in Desa Tlk. Pambang and Bantang Tengah.

The sampan fishermen in Desa Muntai sell to the lower priced new Tauke in the village because they lack the mobility to go and sell their catch to the Tauke in neighboring villages. The fishing boats under the control of these Taukes are as follows:

① Old Tauke: None. Purchases the catch of some of the free-operating fishermen.

② New Tauke: 26 powered boats (17 boats in Muntai and 9 in Tlk Pambang) and some sampans under his control.

③ Tlk Pambang Tauke: Owns five boats, controls 110 (20 in Muntai and 90 in Tlk Pambang) and uses some free-operating fishermen.

5.1.3 Problems in the Village

(1) Low level of fishing organization activities

There are two fishing organizations in the village concerned, but both are organizations in name only. In actuality, neither conducts any activities for the fishermen. One reason for this is that funds are inadequate for conducting activities.

In particular, in the case of the kelompok, which is chiefly for the sampan fishermen, since it has no means of transporting the catch to the locations of other Tauke, it sells its catch for a low price to the new Tauke in the village. If the fishing organization could put a group together that could combine the catch of the fishermen and sell it the Tauke of another village or sell it directly to Malaysia, an equal relationship probably could be created between the Tauke and the fishing organization. Under the current circumstances, this cannot occur because the fishermen do not have the initial financing to purchase a transport vessel.

(2) The Vertical Relationship Between the Tauke and the Fishermen

In general, the relationship between the Tauke and the fishermen is that a number of fishermen enter into a one-to-one relationship with the Tauke through debt. For the fishermen who have received financing from the Tauke, many are dependent on the Tauke for a significant part of their livelihood, from their fishing expenses to their living expenses. This puts them totally under the control of the Tauke. Therefore, in order to organize the fishermen anew will require the establishment of a financing system that replaces the Tauke and provides the same type of financing that exists now.

5.2 Desa Sei Cingam

5.2.1 Current State of the Fishermen Organizations

Desa Sei Cingam is located in the center of the eastern part of Rupat island. The KUD Rupat has been organized in Desa Tg. Medang, which is located in the northern part of this island. It covers four villages in the northern part of the island. Until 1991, KUD Rupat handled eight villages on Rupat island, including Desa Sei Cingam. From the time it was no longer part of KUD Rupat until the present, no KUD has been organized in Desa Sei Cingam. However, there are some fishermen who continue to operate under the influence of KUD Rupat as before.

There is one fishing organization in this village, a kelompok. However, currently, it is inactive.

(1) The kelompok

1) Business organizations and activities

This kelompok was organized in November of 1991 as the receiving organization for implementing a comprehensive regional development project sponsored by the government (Proyek Pengembangan Kawasan Terpadu: PKT).

The executive group of this kelompok is composed of three individuals, a kelompok head, a deputy kelompok head and a treasurer. Under the PKT project, for the 38 fishing families within the village, one sampan and 20 gill-net units were provided to each two families. Under the PKT programme, the fishermen are obligated to set aside a portion of their fishing profits. Even under the programme, the profits were set aside for the first six months that the project was implemented. However, there were accidents at sea in the PKT-provided sampans and some fishermen have subsequently abandoned these government-supplied sampans. As a result, the kelompok is currently inactive and the repayment of the debt has been forgiven as a form of reparation for the accidents.

The activities of the kelompok at the time that fishing took place using the sampans are as indicated below:

① A meeting of the kelompok members took place once a month. There, they did things such as exchange fish catch information and solicit donations for fishermen who lost equipment or whose equipment was destroyed.

② Fishermen with powered boats would tow sampans to the Marong channel estuary. Since there was no remuneration for the towing, for the powered boat owners it was purely service free of charge.

2) Kelompok membership

This kelompok is composed of 38 members who all received benefit from the PKT financial support. They are scattered throughout the village. The members of each Dusun are as follows:

Dusun Srimunanti :	24
Dusun Srimakmur :	10
Dusun Pangkalan Buah :	4
Total	38

Among the kelompok members, there are two types of members, those who were engaged in fishing before the PKT financial support and those who became engaged in fishing due to the PKT financial support. Of the fishermen who abandoned the sampans provided by the government as described above many became engaged in fishing after the PKT support. Those who had been involved in

fishing before the PKT support currently still engage in fishing.

(2) Fishermen under the umbrella of KUD Rupat

As described above, Desa Sei Cingam was once within the activity sphere of KUD Rupat. At the present time, there are some fishermen in this village who purchased powered boats and equipment through financing by the KUD and still continue to repay the debt. These KUD umbrella fishermen use Desa Tg. Medang, the base of the KUD Rupat, as a base and use Desa Kuala Simpang, which is where the catch of the KUD fishermen is gathered, as a base. They are supported by subsidies, such as those for fishing equipment, ice and fuel. In the KUD Rupat, many members are Taukes. The fishermen often receive financing from these Taukes. The condition of the fishermen under this KUD in actuality is the same as if they were under the control of the Tauke.

The number of fishermen by Dusun are as shown below. The number of fishermen under the KUD umbrella are concentrated in Dusun Pangkalan Buah.

Dusun Srimunanti :	3
Dusun Srimakmur :	3
Dusun Pangkalan Buah :	13
Total	19

5.2.2 The Relationship Between the Tauke and the Fishermen

The Tauke that is active in the village concerned amounts to one Tauke who lives in Alohong, which is along the coast of Dusun Srimakmur. This person has been operating as a Tauke since 1990. At present, he owns six powered fishing boats (2 in Desa Sei Cingam and 4 in other villages). Under his control are 10 to 16 powered fishing boats and about 10 sampans (some of them have outboard engines). However, the fishermen are only financed operating expenses. Thus, there are only a few cases of them being heavily in debt to the Tauke.

The Tauke of this village was the treasurer for the kelompok mentioned earlier. In addition, his relationship with the fishermen is a smooth one.

Villages on Rupat island that have a lot of fishermen are mostly under the KUD umbrella. Most of the Tauke also are KUD members. There is only one other Tauke in private business on Rupat island, an individual Tauke such as the one in the village concerned.

5.2.3 Problems of the Village

(1) Repayment of debts to the KUD Rupat

Currently, for the fishermen under the KUD Rupat umbrella, there are many cases in which all of the profit from their catch goes toward repaying their debt. In such cases, when the fishermen need cash, including living expenses, they receive lump-sum financing from the KUD Tauke once again. The result is that they are continually in debt to the KUD, which makes it difficult for them to become economically independent.

(2) Cease of the kelompok activities

The kelompok was organized at the same time as the PKT financing. However, after the sampan accident at sea, not many fisherman have used the sampans to go fishing. With this, the activities of the kelompok have ceased. Offing of in the Marong channel, which is the fishing ground for this village, is some distance from the village, which makes it difficult to make round trips in a sampan. Additional reasons are that when the seasonal winds blow from the north, the waves are strong. This makes fishing in a sampan dangerous and creates the fear that there will be another accident.

During the time when fishing took place using sampans, the types of activities previously mentioned also took place. Since the groundwork has been sufficiently laid for the activities of a fishing organization, the reestablishment of such an organization is desirable.

5.3 Desa Pelantai

5.3.1 Current State of the Fishermen's Organizations

In Desa Pelantai, there has been no financial support from the government to date, and neither have there been any attempts to organize a KUD or a kelompok by the fishermen. Fishing activities are limited to those of individual family units, with virtually no horizontal connections among the fishermen.

The fishermen are mostly those who fish as a side business, with many of them dependent on things other than fishing for cash income. The fishing is mainly for the personal consumption of the family. The number of fishing days are limited compared to other villages. The reason that fishing activities do not lead to cash income is that most of the fishermen in Desa Pelantai are sampan fishermen. They operate in the Asam channel in front of the village. However, the catch in the Asam channel amounts to a lot of small fish and small trash fish. Fish that have a high probability of conversion into cash are mostly not caught.

As for the number of full-time fishermen, it is small. Four are in Dusun Pelantai and just under 14 are in Dusun Kengkam. Under the current circumstances, it is difficult for the fishermen to organize.

As a means of fishermen gaining cash income mainly, there are works such as felling of sago palm or mangroves, and wage labor on the rubber plantations.

5.3.2 Relationship Between the Tauke and the Fishermen

In Desa Pelantai, there is neither a Tauke whose occupation is fishing nor the control of fishermen by a Tauke. In the village, there are two fishermen who operate powered boats, but these fishermen are not indebted to any Tauke, including those of other villages. They operate from their own funds.

Moreover, in the cases of the fish catch of both the powered boats and sampans, throughout the entire village, there is no relationship with a Tauke for fish collection and sales to facilitate selling or consuming the catch.

5.3.3 Problems in the Village

(1) Unorganized part-time fishermen

As discussed above, much of the fishing is for the purpose of personal consumption. Although statistically they are classified as fishermen, as a means of gaining cash, most of the villagers are engaged in wage labor, such as felling work of sagos and mangroves. For this reason, there are no connections among fishermen and, under the current circumstances, organizing them would be very difficult.

In Dusun Pelantai, about 70 percent of the adult male population is engaged in felling work of mangroves, gaining an income of about 5,000 Rupia per day. In addition, there are many villagers who seek work outside of the village. Many are on the powered fishing boats of other villages as hired fishermen.

In this village, which has few sources of cash income, it is necessary to organize the fishermen who are statistically considered fishermen but are currently engaged in wage labor. This will increase their opportunities for employment through the promotion of a new fishery industry such as aquaculture by these fishermen.

(2) Lack of means of procuring financing for fishing

Because their is no Tauke in the village, it is not possible to receive the financing to purchase fishing boats and equipment and for operations from a Tauke. Although the fishermen are not restrained by a Tauke through debt, it is difficult to carry out the fishing that requires some initial investment, such as for a Gombang nets. Therefore, the fishing of this village will take place through gill- netting. For Pengeirih, it will take place through small sampans, which require only a small initial investment. Yet, because the fishing will be for a variety of trash fish, this will not lead to cash income.

(3) Necessity for market development

Currently, in the village there is no fish catch that has a high cash conversion characteristic, just as there is no Tauke involved in fish collection operations. In order to establish a new fishery industry such as aquaculture, its marketing routes and customers must be developed. However, since there has been almost no contact with a Tauke, a sufficient amount of caution will be required in the relationship with the Tauke when developing its new markets.

5.4 Desa Tlk. Ketapang

5.4.1 Current State of the Fishermen's Organizations

In 1992/93 in Desa Tlk. Ketapang, there were two government projects, the APBD II and the PKT. Kelompoks were formed along with these projects.

(1) The APBD II kelompok

1) Business organizations and activities

This kelompok was formed in February of 1993 as an organization to receive the two Gombang nets for each family, for a total of 60 when they were provided.

The executive committee of the kelompok is composed of three persons, the head of the kelompok, the deputy head of the kelompok and a treasurer. Their terms are for two years.

This kelompok has a large number of members, 30. Since the members live in all of the Dusuns within the village, they are divided into three sub-kelompoks.

The kelompok is involved in the following activities:

① Sponsorship of an annual general meeting.

② Joint shipment of dried anchovy products in sub-kelompok units.

③ Coordinating the talks between those involved when the location of the Gombang net installations change.

④ Joint handling of operations that are impossible for one individual, such as the work of driving stakes for the Gombang nets.

⑤ Assistance in purchasing new equipment when a member's equipment is stolen or washed away by the water.

The members are obligated to donate 5,000 Rupia each month. This money is used to purchase fishing equipment for the members mentioned above.

2) Kelompok membership

When selecting the kelompok members who will benefit from the financial support of the APBD II project, the member must satisfy the following conditions:

① To be able to read and write.

② To be physically and mentally in good health.

③ To be a fisherman on the statistics basis.

④ Not to have participated in the same type of project in the past.

⑤ To be able to participate in the project until it ends.

⑥ To be less than 45 years of age.

Among the 30 members, 16 were engaged with Gombang fishing before this project began. Among the others, many were involved in wage labor, such as felling work of the mangroves.

(2) PKT

This project involves providing Gombang nets to villagers in June of 1993 and providing sampans to them in September of 1993 using financial assistance from the PKT. When we surveyed this area, the materials that were being provided had just arrived and had not actually been put into operation. The kelompok had not even been formed yet. However, a decision already had been made to organize the 20 fishing families who would benefit from the project and organize a kelompok by the end of September. The plan was to have the operating unit conform to the APBD II kelompok described above.

The product of this project (various types of mysid) is scheduled to be processed for terasi. The construction of a processing facility also is part of the project. The plan is for the 20 villagers who will participate in the terasi processing factory to form a new kelompok.

5.4.2 Relationship Between the Tauke and the Fishermen

As in Desa Pelantai, there is no Tauke in this village whose occupation is fishing. Most of the fishermen are engaged in Gombang fishing. Since most of the fishermen obtained their fishing equipment through the financial support of the APBD II and the PKT projects, almost none of them are in debt to a Tauke for the purchase of fishing equipment. Exceptions are some fishermen who received financing assistance to repair fishing equipment from a Tauke in Slatpanjang, to whom the dried anchovies are sold. The amount of the debts are small. They appear to be financing based on custom, which strengthens the relationship between the Tauke and the fishermen.

In Dusun Terus, there are two gill-net fishermen who use powered boats. They fish to the Malacca Straits. These fishermen received financing assistance to purchase their boats and equipment from the Tauke in Slatpanjang. They also sell their catch to this Tauke.

5.4.3 The Problems of the Village

(1) Unorganized part-time fishermen

As in Desa Pelantai, there are villagers who in the statistics are classified as fishermen, but in reality many of them are part-time fishermen who are engaged in the other work such as wage labor.

However, in this village, these people have already been receiving the benefits of the APBD II and PKT projects, which have promoted organizing the fishermen. The part-time fishermen who are involved in wage labor desire to put the emphasis on fishing and have a permanent job. However, they cannot provide the initial investment for fishing boats and equipment, and there is no Tauke to provide the financing. Thus, the situation is that they are resigned to the current state of affairs. It is necessary to promote the organization of these part-time fishermen and establish a new industry that promotes a fishing business by these fishermen and increase their chances of employment.

(2) The inadequacy of financial institutions engaged in financing for activities

As previously stated, the members of the kelompok are obligated to make a 5,000 Rupia donation each month. On Merbau island where the village is located, there is no bank. The closest bank is in Desa Tlk. Belitung (the capital of Kec. Merbau) on Padan island across from this island. However, the problems are that using the public transportation to Desa Tlk. Belitung, it is impossible to go there and return the same day. Moreover, the bank's operation is limited to one day a week on Friday. Thus, depositing and withdrawing money is very inconvenient. The result is that the money collected from the members each month is kept by the treasurer in his office. It appears that it is necessary to take effective measures for handling the cooperatives money.

(3) The inadequacy of means of funds procurement for fishing

As with Desa Pelantai, there is no Tauke in this village and, therefore, no means of obtaining funds to finance fishing. Most of the fishermen who have benefited by being provided with Gombang nets because of the financial support of the APBD II and the PKT projects, had been gill-net fishing using sampans until then or had been engaged in felling work of mangroves. They are typical examples of people who would convert to fishing, which brings in cash, if only they could obtain the initial investment required to purchase fishing equipment.

6. Current Condition and Management and Utilization of Model Mangrove Area

6. Current Condition and Management and Utilization of Model Mangrove Area

Tables & Figures

6. Current Condition and Management and Utilization of Model Mangrove Area

6.1 Current Condition of the Model Mangrove Area

The forest type maps(scale 1:10,000), showing types of mangrove forests classified by dominant species and the tree height were prepared by using air photos taken in 1993 (sacle 1:25,000), and forest conditions were grasped through forest survey. Also the productivity and litter production of mangrove forests were presumed by the results of the follow up survey using permanent plots and litter traps installed in 1992.

Table 6.1 shows summary of forest inventory plots.

6.1.1 Distribution of Mangrove Forests and Land Use in Coastal Area

The type classification of mangrove forests and the land use and vegetation classification in each model mangrove area, are indicated in Table 6.2.

The four model mangrove areas covering some 12,000ha, mainly comprise some 3,100ha of mangrove forests, some 420ha of lands with no forest cover where were covered with mangrove forests in the past. The major part is covered with some 4,300ha of tree crops lands consisting of rubber, coconut palm, etc.

(1) Classification of forest types

The forest types indicating the conditions of mangrove forests and the site conditions have been established and a mangrove forest type map has been prepared. The Watson's tide level classes showing the degree of flooding have mainly been used for the site conditions and these tide level classes are outlined in Table 6.3. Table 6.4 shows the characteristics of tree species found in model mangrove areas. The general conditions of each forest type are summarized in Table 6.5.

1) *Avicennia* spp. dominant forests (Av)

(Av: These letters indicate the above forests on the Mangrove Forest Type Map. The letters in brackets below are used in the same way.)

These forests are composed of tree species of pioneer species type in the seaward zone and range mainly in the Muntai Model Mangrove Area. The inundation class is where flooded by medium high tides (Watson's inundation class: 2) *Avicennia* spp. of about 10m height grow in the forests. These are sparse stands and are distributed in the water area detached from the shore line. In other model mangrove areas, *Avicennia* spp. of about 3m height is distributed in small areas in these forests. Generally no mound was observed on the ground.

2) *Rhizophora* spp. dominant forests (Rh)

In most of these forests, *Rhizophora apiculata* and *Xylocarpus* spp. are mixed which are composed of tree species of mesa-type zone. These forests are distributed in all model mangrove areas.

Near the shore line, *Rhizophora mucronata* which is a tree species of pioneer type in the seaward zone is dominant, but *Rhizophora apiculata* is dominant in the inland area, about 5m from the shore line. In this type of forests, *Xylocarpus* spp. is usually mixed. Along creeks and where *Rhizophora apiculata* is fewer, *Xylocarpus* spp. is rather dominant. The subject site is generally flooded by normal high tides (Watson's inundation class: 3).

In this type of forests, *Bruguiera parviflora* is dominant along small creeks, except for the Muntai Model Mangrove Area. From the inland area about 200m from the shore line, *Bruguiera gymnorrhiza* and *Lumnitzera* spp. (a species of land ward species zone) start to be found, and low trees such as *Ceriops tagal* and *Scyphiphora hydrophyllacea* (species of land ward species zone) start to be mixed. *Bruguiera cylindrica* which is a tree species of meso-type zone is found where there is much *Lumnitzera* spp. The subject site has relatively high ground level and is flooded by spring high tides (Watson's inundation class: 4).

In this type of forests, trees are on the average 10m high. These forests are classified into 3 types depending on the remaining conditions of high and medium trees and on their average height.

- Low forests (LRh)

  In this type of forests, there is hardly any trees higher than 10m. Most forests are classified as this type. Some forests with the trees of around 10m height are classified sparse low stands (LRh-S) when the crown density of the high tress is less than 15%.

  Most forests of LRh-S type are distributed mainly in the Sei Cingam model mangrove area of Kac.Rupat. These forests compose of trees with the bent stems.The bent stems with many prop roots result in bad regeneration. Compare with the other model areas, more mounds on the ground are observed. In the case of the other model mangrove areas, these forests formed by intensive selective cutting.

- Medium forests (MRh)

  In these forests medium sized trees of 10 - 20m height remain. These forests usually range adjacent to low forests, farther form the shore line.

- High forests (HRh)

  In these forests, trees of more than 20m height remain. These forests usually range in the inland area of Kec. Merbau.

3) Marsh lands in brackish water range (M)

Marsh lands are mangrove forest land with almost no trees. Marsh lands are classified into the following two types.

- Marsh lands with no low vegetation cover (M1)

  In these marshes, there are hardly any *Acrostichum aureum* or herbs, or if there are, they are not grown well, lower than 50cm. This type of marsh lands range mainly in the Muntai Model Mangrove Area. Generally, these marshes range where the ground level is low and is flooded by normal high tides (Watson's inundation class: 2). Almost of the areas are considered to be cutover areas. It is probably possible to plant mangrove tree species, especially those of pioneer species type in the seaward zone in these marsh lands. Because the subject site is flooded by medium high tides.

- Marsh lands with low vegetation cover (M2)

  In these marshes, *Acrostichum aureum* and herbs grow to the height of 1m and more. *Nypa fruticans* (a species of pioneer species-type in the brackish-water zone) grow gregariously in spots, and low and medium trees of *Lumnitzera* spp.are found here and there. Young trees of *Bruguiera cylindrica* (a species of meso- type zone) as well as low trees of *Scyphiphora hydrophyllacea* (a species of landward species zone) are also found.

  These marsh lands are distributed in all model mangrove areas. It is, however, estimated that they generally range where the ground level is high and the sites are sometimes flooded and have inflow of seawater in a year. These marsh lands are formed because of advancement and/or felling of mangrove forests. The subject sites have high ground level and are flooded by spring high tides and abnormal tides mainly. It is probably suitable to plant mangrove forest tree species, especially species of landward species zone and rear mangrove tree species, in these marsh lands.

(2) Land-use of hinterlands of mangrove forests

1) Non-mangrove forests (NM)

The Study Area has a wide distribution of peat soils called Gambut. Inland non-mangrove forests are considered to be freshwater swamp forests and are widely distributed in the Pelantai and Ketapang Model Mangrove Areas. The tree height of such swamp forests is some 20m on average.

Those HPHs (large-scale concessions) found inland are believed to aim at felling useful species in these swamp forests. The aerial photography conducted for the Study clearly identified large cut-over areas both in the Pelantai and Tlk. Ketapang Model Mangrove Areas. No large-scale logging and shipment of timber of species in these swamp forests along the coasts of the model mangrove areas were observed during the survey period. However, the felling of these trees by local inhabitants and subsequent transportation by sampans or other means were

observed.

2) Grassland (G)

This is freshwater wet grassland which is in the process of conversion from wet land created by the felling of a terrestrial forest or the advancement of a mangrove forest to a terrestrial forest. The grassland type can be identified based on the dominance of *Gramineae* grass or herbaceous plants called Pecubelantas and Kekai.

The former is mainly distributed in the Muntai Model Mangrove Area and is usually found on the inland side with an elevation of at least 1m above the flood tide shoreline and with a relatively low ground water level.

The latter is mainly distributed in the S. Cingam Model Mangrove Area and is relative height from the flood tide shoreline is relatively low. It usually borders a mangrove forest(NM) or marsh lands with low vegetation (M2). This type of grassland is also observed in the Pelantai Model Mangrove Area.

3) Tree crops (R, C, S)

Tree crops is mainly distributed around settlements. Rubber, coconut and sago trees are the dominant species but are not managed in an intensive manner like plantations.

a. Rubber

Rubber trees are widely distributed in the S. Cingam, Pelantai and Tlk. Ketapang Model Mangrove Areas. In most cases, the rubber trees are mixed with swamp forest species and fruit trees. In general, the tree height is around 15m and many trees are said to be more than 15 years old. Such crops as dry field rice are cultivated under the rubber trees in some areas.

Rubber trees usually commence producing gum in the 5th year. The peak yield is reached between the 10th - 15th year with the yield declining in subsequent years.

b. Coconut

Coconut trees are widely distributed in the Muntai Model Mangrove Area and are mainly planted in home gardens (Pekarangan). An industrial crops are planted under coconut trees in the eastern part of the Muntai Model Mangrove Area to obtain fiber for the manufacture of mats. It is said that a coconut tree requires 8 or 9 years for the full-scale production of coconuts.

c. Sago palm

Sago palm trees are widely distributed in the Pelantai and TK. Ketapang Model Mangrove Areas. They are generally found between a mangrove forest and a swamp forest. As they are weak against salt, they are said to be planted in clayey soils inundated with the fresh waters in the cut-over areas of swamp forests. They also grow on Gambut. It is said that a sago palm tree requires 8 - 12 years before it can be harvested.

4) Agricultural land (A)

Agricultural land is seen around settlements and also found in home gardens and grassland. The main crop is rice. Agricultural land is mainly distributed in the Muntai and S. Cingam Model Mangrove Areas.

5) Settlements

Settlements tend to be found in the inland between 500m and 1,000m from the shoreline.

(3) Characteristics of model mangrove areas

1) Muntai Model Mangrove Area

Facing the Strait of Malacca on the north, this area is directly affected by the waves of the open sea. The coast is about 30km long and the seashore is 400 - 500m wide where a large tidal flat appear at low tide. Mud (mainly sandy silt) accumulates along coasts while limitedly there are some sites where Gambut (woody humus in peat) tends to accumulate at river mouths. In the water about 100m seaward from the shore line, some 90ha of mangrove sparce stands are distributed. *Avicennia* spp. are dominant there (Open-sea type mangrove forests). There are found a lot of stumps between the shore line and the stands and in themselves. It is, therefore, presumed that there used to be a wide range of mangrove forests. Brackish-water marsh, where considered to be such deteriorated area of mangrove forests, cover some 120ha. The hinterland is considered to have been terrestrial forests. At present, however, the land is dotted with houses and there are coconut (some 1,100ha) and rubber trees (some 400ha). Most other part of the hinterland is grassland (some 900ha) with low trees here and there. Some part is used as agricultural land.

In this forest area, there is no *Rhizophora* spp. dominant forest, except for the areas along the Sei. Bantan Tengah river and the Sei. Kembung river. There are, however, some small areas a long small rivers where the *Rhizophora* spp. may grow.

2) Sungai Cingam Model Mangrove Area

This area is located in the northeast part of the Rupat Island.

It is at the east end of the S. Morong Channel flowing in northwest. The *Rhizophora* spp. dominant mangrove forests grow along the Channel (some 1,100ha).

There are mangrove forests along the open sea to the south coast around the end of the Channel, extending about 1km inland from the shore line (Open-sea type mangrove forests). Near the landward side, there range forests with mangroves of about 20m height. Most of the mangrove forests on both coasts of the Channel are lower than 15m in tree height (Inland sea type mangrove forests). There are sparse stand areas (some 130ha) on the north coast of the channel. Four HPHHs exist in this area and some part of this model mangrove area is included designated as HPH.

Near the end of the S. Morong Channel in the northeast part of this area faces the Strait of Malacca, there exist small forests where the *Rhizophora* spp. and the *Avicennia* spp. are dominant. In most other part, marsh lands with low vegetation cover touches the shore line. There are about 10 private houses at the north end of the area, namely Alohong village. Only grass lands(some 690ha) and terrestrial high forests are found there.

In the hinterland of the mangrove forests on both coasts of the Channel, a residential area lies in parallel with the channel. Adjacent to the residential area, there are rubber tpreels (some 670ha). Terrestrial forests (some 250ha) range behind the trees.

3) Pelantai Model Mangrove Area

This area is located at the southeastern end of the Padang Island. The area faces the Merbau Island beyond the Asam Channel. There range *Rhizophora* spp. dominant mangrove forests along the Asam Channel (Inland-sea type mangrove forest). Most part, except for the area near Tg. Merantibunting, is low forest. The range of forests is narrow in width (about 300m) except along rivers.

Two HPHHs are set in this area. Many coconut, sago palm, and rubber trees are distributed in the hinterland of mangrove forests observed, where secular changes of mangrove coverage are recognized. In the north end, there are petroleum related facilities such as wells, and petroleum development is under way.

4) Teluk Ketapang Model Mangrove Area

This area is located in the southwest part of the Merbau Island. The area faces the Pelantai forest area beyond the Asam Channel. *Rhizophora* spp. dominant mangrove forests range along the Channel (Inland-sea type mangrove forests). There are large mangrove forests along the rivers in the north inland part. The range of the mangrove forests to the south of Teluk Ketapang is narrow in width (about

200m). There range mangrove forests where partially high and medium *Rhizophora* spp. is dominant, from the Terus village in the south to the coast of the S. Rengit Channel.

There is one HPHH on the north coast of the S. Asam Channel, and 2 along the S. Rengit Channel. There are also 3 sites of charcoal kilns.

Near the residential area in the hinterland, there range coconut trees and rubber trees. Between mangrove forests and inland high forests, the development of sago palm trees in under way. Land conversion to coconuts, rubbers and sagos is considered to be one of the reasons of secular changes of mangrove coverage (especially rear mangrove).

Fig. 6.1 illustrates forms of coasts of open sea and inland sea type and tidal level. Fig. 6.2 illustrates typical profile of mangrove forests each model mangrove area.

6.1.2 Stand Condition on Mangrove Forests

(1) Volume of mangrove forest biomass

The utilizable volume for charcoal production and above ground biomass (oven-dried weight) were estimated in the case of standing trees (minimum stem diameter of 4cm). The subject species for estimation of the utilizable volume were *Rhizophora* spp., *Bruguiera* spp. and *Ceriops* spp. Using the existing volume table[1], the standing tree volume was firstly estimated and converted to the volume per ha.

Estimation of the existing above ground biomass oven-dried weight was conducted for all species. The existing estimation formula[2] was used to estimate the biomass for each standing tree and converted to the biomass per ha.

The mangrove forest biomass per ha is shown in Table 6.6.

The standard sample plot method was used for the present study in view of the short field survey period. It will be necessary to increase the number of sample plots to improve the accuracy of the volume estimation for a survey aiming at formulating such a mangrove forest management plan as one toward the entire Study Area.

1) Utilizable volume

The utilizable volume for charcoal production per ha is approximately 7 - 27 m^3 for all standing trees and approximately 3 - 19 m^3 for trees with a allowable diameter (10cm and above). In the case of LRh, the volume on Rupat Island was estimated to be approximately half the volume of other islands.

1: C. Kusmana, S. Sabiham, K. Abe, H. Watanabe (1992) An Estimation of AboveGround Tree Biomass of Mangrove Forest in East Sumatra, Indonesia

2: K. Soemarha, (1974) Table Volume Bakau-bakau (*Rhizophora* spp) di Daerah Bengkalis, Riau

2) Above ground biomass (oven-dried weight)

The above ground biomass per ha is approximately 9 - 60 tons for all standing trees and 5 - 54 tons for trees with a allowable diameter (10cm and above).

(2) Mangrove forest productivity and litter production Volume

For the present Study, fixed plots and litter traps were introduced for continuous observation to determine individual tree growth (in about 9 months) and the litter production volume (in about 1 year). With the introduction of larger plots and long term observation, the growth estimation will be much more reliable. It will also be necessary to determine the levels of growth based on different diameter classes as well as site conditions to achieve the high productivity of mangrove forests through their proper management for charcoal production purposes, in turn establishing mangrove forests as stable sources of cash income for local inhabitants. The continuous observation of longer duration in more litter traps installed in a mangrove forests located in a small watershed will be needed. Because casual relation between litter production, aquatic production and fish catch must be clarified.

1) Mangrove forest production

a. Growth of diameter and height of individual trees

Fig. 6.3 and 6.4 show the individual tree diameter growth and individual height growth respectively (R. apiculata) based on the initial diameter. While the actual observation values widely differ, the average values are estimated to be a tree diameter growth of 0.5 - 1.0cm in 9 months and tree height growth of 0.5 - 1.0m in the same period regardless of the plot or initial tree diameter.

While clear correlation between the tree density and average tree growth was not observed, the growth of both the diameter and height tended to become smaller in accordance with a higher elevation.

b. Individual tree growth

- Utilizable volume

While growth of the utilizable volume also differs from tree to tree as shown in Fig. 6.5 (*R. apiculata* all standing trees) , the average value is estimated to be 0.003 - 0.005 m3/tree in the 9 month period regardless of the tree diameter. The actual utilized log volume of *Rhizophora* spp. for charcoal production was found to be approximately 0.01 m3/tree for trees with a diameter of some 7cm and 0.05 m3/tree for trees with a diameter of some 14cm. The actual utilized log volume of *Xylocarpus* spp. for fuel was found to be approximately 0.02 m3/tree for trees with a diameter of some 10cm.

- Above ground biomass over-dried weight

For estimation of the stand growth, the increment of all sections on an individual tree and that of the stem are assumed to be 6.7 kgs/ha and 4 kg/ha, respectively.

The increment of the above ground biomass (*R. apiculata*, all standing trees) largely varies from one stand to another as shown in Fig. 6.6. This variation becomes smaller when only the stem volume is considered. The leaf weight is approximately 1kg/tree regardless of the stem diameter (Fig. 6.7 and Fig. 6.8).

In the case of standing trees (*Rhizophora* spp.) with a diameter of some 6cm, no predominant tendency was observed in regard to the relationship between the stem section and root section, the approximate stem and leaf weight of which were 12 kg/tree and 3 kg/tree respectively. In the case of standing trees (*Xylocarpus* spp.) with 2 branches of some 8cm in diameter and 3 branches of some 5cm in diameter, the total stem weight was some 46kg while the branch weight and leaf weight were some 25kg and some 5kg respectively, all of which were lower than prior estimates.

c.Stand growth estimate

Table 6.7 shows the estimated annual increment of mangrove forest biomass. The annual growth of the utilizable volume per ha is approximately 2 - 7 m^3 for all standing trees and approximately 0.2 - 0.6 m^3 for standing trees with a allowable diameter.

The annual growth of the above ground biomass per ha (oven-dried weight)is 5 - 15 tons for all sections of standing trees and approximately 2 - 7 tons for stems only. In the case of standing trees with a allowable diameter, the annual growth for all sections is 1 - 2 tons/ha while the annual growth for stems only is approximately 0.5 tons/ha.

Fig. 6.9 shows the frequency distribution of diameter and it's change.

2) Volume of litter production

a. Litter production

Fig. 6.10 shows the oven-dried litter production per ha by forest conditions.

The monthly total volume of litter production is approximately 0.5 - 1.0 tons/ha except in January when the litter production hits a peak. Stands along the shoreline produce the most litter at a rate of some 15 tons/ha/year, followed by (mixed stands of *R. apiculata* and *Xylocarpus* spp. (some 13 tons/ha/year) and dense stands of *R. apiculata* (some 11 tons/ha/year). Sparce stands in cut-over areas produce some 9 tons/ha/year.

The litter production volume at stands along the shoreline which produce a high annual litter volume temporarily drops in July while the litter production volume of stands dominated by *Xylocarpus* spp. sharply increases in the same month. The litter production in sparce stands shows a marked increase in April and July. All types of forests begin to increase their litter production in October. The litter predominantly consists of leaves (90% of the total litter volume), followed by others (mainly petioles), seeds and branches in this order. Leaf- based litter is produced all year round. While the volume declines in June, it is compensated for by the increased production of other types of litter. Litter production in terms of seeds or branches is low throughout the year.

There is no annual fluctuation in the branch-based litter production while seed-based litter production has 2 seasons, i.e. from January to February and from July to October with a peak in September.

b.Litter ingredients

The average volumes of the ingredients of leaf-based litter in the 6 samplings collected between February and May are given in Table 6.8. There is little fluctuation of the Na, P and ash at approximately 10 mg/g, 23 mg/g and 10 m/g respectively. However, large fluctuations occur in the case of K and N with respective ranges of 6 - 12 mg/g and 0.6 - 7.0%.

There found no tendency on decomposition of litters preserved at room temperature. The observation with the litter bag method will give information on litter decomposition and vanishing process.

6.1.3 Hinterland Problems

In the model mangrove areas, the width of the mangrove forest belt is generally narrower than that of mangrove forests in rivermouth areas. The brakish water area is also narrow. The hinterland of these mangrove forests is used for tree crops' lands of rubber, coconut palm and sago palm, farmland and grassland, without a belt of brackish pioneertype nipa palm and others. Land use as grassland (G) or one of land uses described above at sites where forests other than mangrove forests are indicated on the forest type map indicates that these sites were formerly covered by nipa palm or non-mangrove forests.

The hinterland of mangrove forests in the model mangrove areas has 2 types of problems, i.e. those originating from the potential sulfuric acid soil and those originating from the tropical peat swamps. It is desirable to concentrate efforts on improving the productivity of the existing land use rather than trying to develop not only mangrove forests but also their hinterland due to the following reasons.

(1) Problems originating from potential sulfuric acid soil

The land currently covered by non-mangrove vegetation near the shoreline often contains deposits from the previous mangrove forest period, having pyrite (a sulfide). When this pyrite is oxidated, it becomes sulfuric acid soil with strong acidity.

The possibility of pyrite in hinterland soil is low in the case of inland sea-type coasts due to the slow sedimentation speed but high in the case of mangrove forests. In contrast, it is likely that the coasts of the open sea type S. Cingam and Muntai Model Mangrove Areas were once covered by mangrove forests and, therefore, the presence of pyrite is possible if only in small amounts.

In the case of sparce low mangrove forests (LRh-s) in the S. Cingam Model Mangrove Area, the high mounds suggest the possibility that such organism asc crabs push sulfide upwards from the lower layers even though the ground surface deposits contain no sulfide.

When pyrite is turned into sulfuric acid soil due to agitation of the ground surface or cultivation, such problems as salt damage, low pH and Al damage tend to occur. One report suggests that the preservation of mangrove forests to produce charcoal gives better land productivity than the conversion to paddy fields in Thailand.

(2) Problems originating from tropical peat swamps

Tropical peat mainly consists of the remains of woody plants. It is necessary to drain this water before developing peat land to maintain the plant bearing power, causing a lowering of the ground. From a chemical point of view, most ash is contained in the remains. The burning or decomposition of peat easily leads to leaching, resulting in a deterioration of fertility within 2 to 3 years. Moreover, the clay deposits between the peat layers may contain pyrite accumulated in mangrove forests.

The development of swamp forests to agriculture lands should, therefore, be avoided except for selective felling until paddy rice cultivation techniques for peat land have been firmly established.

Most local land is unsuitable for agriculture due to the soil conditions described earlier. Altough the land is developed for agricultural purposes, the productivitry remains low. Industrial plantation at peat swamps is difficult because of the obvious soil conditions. Even if the plantation is found to be possible, the long felling cycle makes it difficult for a newly established forest to continously provide cash income oppotunities to reduce the excessive pressure for felling by local inhabitants. The remaining option is the felling of useful trees by means of the selective felling method. The productive activities at HPHs in the Study Area appear to be of little importance at the present.

6.2 Functions of Mangrove Forests

The realities of the forest functions of the model mangrove areas and the causes of their deterioration are summarized below.

(1) Muntai Model Mangrove Area

The area is subject to strong sedimentation and erosion as it faces the ocean. Once mangrove forests were formed a narrow zone, these have mostly been felled. The coastal area is affected by strong winds and waves in the rainy season. Erosion on the eastern part of Bengkalis Island with coconut stands may have resulted in retreating several tens of metres every year according to the interviewed local inhabitants. As many marsh lands have deteriorated in terms of their land creation and erosion prevention functions, the urgent creation of mangrove belts is required.

(2) Sei Cingam Model Mangrove Area

The seaward eastern coast has a narrow mangrove belt because of open sea type and is probably subject to sedimentation and erosion as well as wind and waves in the rainy season. Those mangrove forests along the Morong Channel are used for charcoal production but their resources have been seriously depleted due to felling over a long period of time.

The creation of mangrove belts along the eastern coast is required for the same reason as the Muntai Model Mangrove Area. As the degree of dependence on mangrove timber for the livelihood of local inhabitants is relatively low in Desa S. Cingam, the improvement of the forest function of providing nursery for fishery resources is strongly hoped for.

(3) Pelantai Model Mangrove Area

The mangrove forests in this area are inland sea-type forests. With the supply of fresh water from inland peat swamps, the brackish area is rather small. Tall mangrove trees are still observed in the south as the felling intensity is low. However, the stand conditions have deteriorated in the north except in areas along rivers. The local inhabitants of Desa Pelantai largely depend on the sale of mangrove timber for cash income, making the maintenance of mangrove trees as forestry resources necessary.

(4) Tlk. Ketapang Model Mangrove Area

The general conditions are the same as those of the Pelantai model mangrove area and the use of mangrove forests as forestry resources is hoped for. The maritime traffic through the Rengit Channel has been increased in recent years. The large and frequent waves caused by speedboats has been eroding the substratum of the edges of mangrove forests there. Restrictions on the navigation speed appears necessary to prevent such erosion. The increased maritime traffic in this area has also made it desirable for mangrove forests to provide a pleasant landscape as well as sites for health resort and ecoturism.

6.3 Realities of Mangrove Forest Utilization and Management

(1) Impacts of Forestry Policies

1) Muntai Model Mangrove Area

At present, there is no mangrove stand capable of producing mangrove timber in this model area. The impact of current forestry policies is not clear.

2) S.Cingam Model Mangrove Area and Pelantai/Tlk. Ketapang Model mangrove Area

While some positive effects of the regulative measures are observed along the coastal belt, Stand conditions may have become worse. Tightening the control appears necessary to improve the situation.

(2) Mangrove Forest Management

As implied by the situation described in 6.3.1, there appears to be a shortage of manpower to effectively control or manage the mangrove forests in the model areas. One feasible improvement measures for all the model areas is an increase of the staff level (CDK staff members) to tighten control and to provide proper guidance for local inhabitants.

(3) Reforestation of Mangrove Forests

1) Muntai Model Mangrove Area

A mangrove forest belt must have once been seen along the coastline in this model area as many stumps can still be found. While it is conceivable that any effort to rehabilitate mangrove forests may be hampered by strong waves due to the location which directly faces the Malacca Straits, current reforestation techniques should be able to overcome the problems. Reforestation efforts should be conducted by the selecting suitable species.

2) Sei Cingam Model Mangrove Area

Although dwarf sparse stands are seen in some parts of this model area, the existing commercial species should be able to maintain proper growth with reasonable care. Reforestation using those species should to produce charcoal is feasible by firstly land preparation.

3) Pelantai/Tlk. Ketapang Model Mangrove Area

Compared to the above two model areas, mangrove forest areas have been best sustained in this model area. There are some dwarf sparse stands and marsh lands with low vegetation cover. Reforestation should be conducted using the same method to be employed for the S. Cingam Model Mangrove Area.

(4) Utilization of Mangrove Forests

1) Mangrove Wood for Charcoal Production (commercial charcoal)

The dominant species currently used for charcoal production is *Rhizophora apiculata*. Other species include *Rhizophora mucronata, Ceriops tagal, Bruguiera gymnorriza* and *Bruguiera parviflora*. While the best species for charcoal production are *Rhizophora mucronata* and *Ceriops tagal* due to their high species gravity, these are only sparcely observed at present.

Xylocarpus spp. is mainly used as fuel wood for charcoal production and the size of most logs are a diameter of 5cm and a height of 8m.

2) Mangrove Wood for Miscellaneous Use

The foremost use of mangrove wood in daily life is as fuel but it is also used as a material for housing construction, boats and fishing gear.

(5) Felling of Mangrove Forests

The currently observed sparse low *Rhizophora* species stands (LRh-s) and marsh lands with no low vegetation cover are assumed to be the result of intensive felling. The felling intensity of the most mangrove forests intends to decline in case of mangrove forests located further inland because of the dependence on sampans to transport the wood. The interview survey revealed the existence of people who engage in felling around the time of spring tide and paid labor on neighboring farmland for the rest of the time. One respondent put the daily felling volume at around 60 trees.

The distribution of HPHH in the model mangrove area is shown in Fig. 6.11.

1) Muntai Model Mangrove Area

Apart from areas around Parit Cape, a cut-over area of more than 100m in width is observed along almost the entire coastline. There are some remaining stands, but the crown closure is sparse.

2) Sei Cingam Model Mangrove Area

Grasslands, and dwarf sparse stands are observed at the back of the current mangrove forest zone. As no stamps are found in these grasslands, it can be caused by factors except felling.

3) Pelantai/Tlk. Ketapang Model Mangrove Area

These model areas have the least number of cut-over areas compared to the other two model mangrove areas.

(6) Production and Distribution of Mangrove Charcoal

The realities of the production and distribution of mangrove charcoal are almost the same for all the model mangrove areas.

1) Production Sequence of Mangrove Charcoal

	Process	Time Required for Completion
1.	Purchase of Raw Wood	Each manufacturer purchases the raw wood from unspecified local residents at any time and then stores it
2.	Landing and Stocking woods into a kiln	2 days
3.	Burning/Carbonization	30 days
4.	Cooling	15 days
5.	Unloading Charcol from a Kiln	2 days
	Total	49 days

It appears that an average of 4 operations are conducted annually.

(2) Charcoal Production Cost for One Operation at One Kiln

	Cost Item	Amount (Rp*)	Remarks
1.	Raw Wood	863,854	
2.	Kiln Depreciation	125,000	10 year depreciation
3.	Contribution to Reforestation Found	85,860	
4.	Royalities	14,018	
5.	Tax	8,761	
6.	Miscellaneous	103,382	
	Total	1,563,589	

* Based on the values as of August 1993 (exchange rate 2086 Rp/US$)

Table 6.1 Summary of Forest Inventory Plots

Sampling	Sample plot	Regeneration Sub plot 3)	Forest type	Forest description	Site description	Island	Remarks
B-1-1 (100m)1)	100 m²	100 m²	LRh	R.apiculata including Xylocarpus spp. stand. (About 5 years after) felling.	Some 175m landward from S.Bantantengah (near a chacoal kiln)	Bengkalis	L,A
B-1-2	100 m²	100 m²	LRh-S	Strongly cutted stand R.apiculata About 3 months after felling	Some 150m landward from S.Bantantengah (near a chacoal kiln)	〃	L,A
B-1-3	100 m²	50 m²	LRh	R.apiculata stand	Some 100m landward from S.Bantantengah (near a chacoal kiln)	〃	L,A
B-2-4 (18m)	25 m²	25 m²	LRh	Along the river (Greenbelts)	Along S.Bantantengah (near a chacoal kiln)	〃	L,A
B-3-5 (61m)	100 m²	50 m²	LRh-S	Near the boundary to another vegetation (Near settlements)	Some 1 km landward from S.Bantantengah(Some 30 minutes by boat from the nearest chacoal kiln)		
T-4-1 (100m)	100 m²	25 m²	LRh	Sparce of higher B.parviflora	Some 100m landward from S.Suir (Some 15 minutes by boat from the nearest chacoal kiln)	Tebing tenggi	
T-4-2	100 m²	a. 13 m² b. 13 m²	LRh	Dense of higher B.parviflora	Some 150m landward from S.Suir (Some 15 minutes by boat from the nearest chacoal kiln)	〃	
T-5-1 (0m)	100 m²	-	HRh	Conserved(tended) (natural regenerated R.apiculata)	Some 10m landward from S.Suir(around a chacoal kiln)	〃	A
T-6-1 (0m)	25 m²	25 m²	LRh-S	Along the Morong Strait(Greenbelts)	In front of a chacoal kiln	Rupat	
T-7-1 (240m)	A:4,800 m² B: 2,400 m²	a: 600 m² b: 20 m²	MRh (60m) LRh (170m) HRh (10m)	Midium-high Rhizophora spp, dominant stands Low Rhizophora spp, dominant stands High Rhizophora spp, dominant stands	Along Sei Bagiharus which flows into Rengit Channel, about 20 minutes by pompon fromthe nearest site of kilns	Tebing tinggi	
T-8-1 (50m)	A:1,000 m² B: 1,000 m²	a: 125 m² b: 20 m²	LRh-S	Low Rhizophora spp, dominant stands	Near S.Cingam River about 10 minutes by pompon fromthe nearest site of kilns	Rupat	
T-9-1 (50m)	A:1,000 m² B: 1,000 m²	a: 125 m² b: 20 m²	LRh	Low Rhizophora spp, dominant stands	Near Pelabuhan Sei Cingam about 5 minutes by pompon fromthe nearest site of kilns	Rupat	
T-10-1 (0m)	B: 225 m²	b: 4 m²	Av	Avicennia spp, dominant stands	10km westword from the central village of Desa Muntai about 30 minutes on foot	Bengkalis	

Remarks:1) Length of sampling line
2) Size of plot
3) Size of plot
4) L:Litter trap(0.785m²x5traps/plot)
A:Additinal surveyed
A:Sample plot for trees (D≧10cm)
B:Sample plot for trees (² cm)
a:Regeneration sub-plot for saplings (D< 4cm, H≧1.3m)
b:Regeneration sub-plot for seedlings (D< 4cm, H< 1.3m)

Table 6.2 Area by Forest Type and Landuse-vegetation Type in Model Mangrove Areas

Forest type and landuse Vegetation type				Simbo	Area			
					Muntai	Sei Cingam	Pelantai/ Tlk.Ketapan	Total
Mangrove	Mangrove forests	Avicennia spp.dominant forest		Av	93.5	5.7	0.4	99.6
		Rhizophora spp. dominant forest	High Rhizopora spp. stands	HRh	0.0	7.3	28.7	36.0
			Medium-high Rhizophora spp. stands	MRh	0.0	123.0	355.6	478.6
			Low Rhizophora spp. stands	LRh	0.0	877.7	1,493.6	2,371.3
			Sparse low Rhizophora spp. stands	LRh-S	0.0	134.8	17.5	152.3
			Subtotal (Rhizophora spp.)		0.0	1,142.8	1,895.4	3,038.2
		Total (Mangrove forests)			93.5	1,148.5	1,895.8	3,137.8
	Marshlan	Marshlands (Non-low vegetation cover)		M1	120.1	6.4	0.0	126.5
		Marshlands with low vegetation cover		M2	95.9	133.7	62.5	292.1
		Subtotal (Marshlands)			216.0	140.1	62.5	418.6
		Total (Mangrove forests)			309.5	1,288.6	1,958.3	3,556.4
Non-mangrove	Fore	Non-mangrove forests		NM	72.8	250.5	724.0	1,047.3
		Total (Foersts)			166.3	1,399.0	2,619.8	4,185.1
	Tree crpos	Rubber trees		R	437.8	665.1	758.9	1,861.8
		Coconut trees		C	1,133.9	215.6	512.7	1,862.2
		Sago trees		S	0.0	0.0	597.0	597.0
		Subtotal (Tree crops)			1,571.7	880.7	1,868.6	4,321.0
	Others	Agricultural lands		A	475.6	341.8	189.3	1,006.7
		Grasslands		G	911.4	689.6	507.7	2,108.7
		Site of chacoal kilns		K	0.0	2.6	2.6	5.2
		Settlements and facilities			55.3	20.8	72.3	148.4
Ground total					3,396.3	3,474.6	5,322.8	12,193.7

Table 6.3 Summary of Watson's Inundation Classes

	Inundation class [1]	Dominant species	
Class 1	Inundated by all tides.	Rhizophora	(exceptionally)
Class 2	Inundated by medium-high tides.	Sonneratia alba	
		Avicennia alba	
		A. marina	
		Rhizophora mucronata	
Class 3	Inundated by normal high tides.	Rhizophora spp.	(often dominant)
		Ceriops tagal	
		Xylocarpus granatum	
		Sonneratia alba	
		Bruguiera parviflora	
Class 4	Inundated by spring tides only.	Rhizophora spp.	(little)
		Bruguiera spp.	
		Xylocarpus spp.	
		Lumnitzera littorea	
		Excoecaria agallocha	
Class 5	Inundated by equinoctial of other exceptional tides only.	Bruguiera gymnorrhiza	(dominant)
		Rhizophora apiculata	(little)
		Xylocarpus granatum	(little)
		Intsia bijuga	
		Nypa fruticans	
		Heritiera littoralis	
		Excoecaria agallocha	

Remark 1

Inundation class	Height above datum line(fect)		Times flooded per month	
	From	To	From	To
1	0	8	56	62
2	8	11	45	59
3	11	13	20	45
4	13	15	2	20
5	15	-	-	2

(Port Swettenham = Port Klang)

Sources: Mangrove Management in Thailand, Malaysia and Indonesia, FAO,
Mangrove forests of the Malay Peninsula, 1928, J.G.Watson

Table 6.4 Charactaristics of Tree Species Found in Model Mangrove Area (1/2)

Botanical name	Local name	Lifeform [1]	Root [2]	Seed [3]	Main uses [4]
Verbanaceae					
Avicennia spp.	Api-api	T	P	C	
A.officinalis / A.alba					
Sonneratiaceae					
Sonneratia spp.	Perapat laut	T	P	S	
S.alba	Kerabu				
S.obata	Berenbang				
Rhizophoraceae					
Rhizophora spp.	Bakau	T	S	V	C
R.conjugata/R.apiculata	Bakau biasa				
R.mucronata	Bakau hitam Belukap				
Bruguiera spp.	Bakau	T	R	V	C,H,T
B.parviflora	Lenggadai Ngarai				
B.gymnorrhiza	Tumu				
B.cylindrica	Temoshi				
Ceriops spp.	Tegar	T	R	V	C
C.tagal					
Maiaceae					
Xylocarpus spp.	Nyirih	T	R	S	F
X.granatum	Nyirih bunga		(PR)		
X.molaccensis	Nyirih batu				
Combretaceae					
Lumnitzera littorea	Sesok	S/T	R	S	P,Fs
L.rasemosa					
Euphorbiaceae					
Excoecaria agallocha	Pebuta	T	-	S	T
Acanthaceae					
Acanthas ilicifolius / A. ebracteatus		S	-	S	

Remarks
S: Shrub T: Tree F: Fern
2) P: Pneummatuphores(erect root), S: Stilt-root, R: Root knees
PR: Plank root
3) V: Vivipary, C: Cryptovivipary, S: Seed
4) Based on interviewed results
C: Charcoal, F: Firewood, T: Timber, Fs: Fishing stake, P: Poal
Toxic poison, H: Housing, A: Agricultural use, Fo: Food

Table 6.4 Charactaristics of Tree Species Found in Model Mangrove Area (2/2)

Botanical name	Local name	Lifeform[1]	Root[2]	Seed[3]	Main uses[4]
Palmae					
Nypa fruticans	Nipah			C	H,Fo
Polypidiaceae					
Acrostichum aureum		F			
Rubiacear					
Scyphiphoar hydrophyllacease	Cingam	S		S	P,A
Sapindaceae					
Allophylus cobbe	Keneras	S/T			
Vetaceae					
Cissus adnata	Seketan	S			
?	Kelap				

Remarks S: Shrub T: Tree F: Fern
2) P: Pneummatuphores(erect root), S: Stilt-root, R: Root knees
PR: Plank root
3) V: Vivipary, C: Cryptovivipary, S: Seed
4) Based on interviewed results
C: Charcoal, F: Firewood, T: Timber, Fs: Fishing stake, P: Poal
Toxic poison, H: Housing, A: Agricultural use, Fo: Food

Table 6.5 Summary of Quantative Characteristics (by the result of inventory plots)

	Forest types						
				LRH		LRH-S	
	Av	HRh	MRh	P.Rupat	Except P.Rupat	P.Rupat	Except P.Rupat
Ind./ha[1]							
D < 4cm[2]	55,000	3,680	43,294	11,320	89,460	11,320	9,800
	(0)	(3,580)	(33,127)	(6,080)	(46,840)	(6,080)	(8,800)
4≦D<10cm	0	1,000	2,017	690	1,318	720	700
		(800)	(1,700)	(500)	(1,053)	(440)	(600)
10≦D	400	350	212	110	177	160	100
	(0)	(150)	(81)	(80)	(77)	(50)	(100)
Total (4≦D	400	1,350	2,229	800	1,495	880	900
	(0)	(950)	(1,781)	(580)	(1,130)	(490)	(700)
Average							
D (cm) 4≦	16	9	7	7	7	7	7
	(0)	(8.3)	(5.7)	(7.5)	(6.6)	(6.5)	(6.4)
H (m) 4≦D	6	10	10	6	9	6	5
	(0)	(11.8)	(10.1)	(5.7)	(9.0)	(5.6)	(5.0)

Remarks 1) Tree species for charcoal in parentheses.
2) Numbers of actual seedlings are expected to be less than the values because seedlings exist on g of tree crowns.

Table 6.6 Amount on Mangrove Forest Resources per ha (Estimated)

	Forest types						
				LRh		LRh-S	
	Av	HRh	MRh	Rupat	Except Rupat	Rupat	Except Rupat
Effective volume for charcoal (m3/ha) [1]							
4 ≦ D < 10cm	0.00	7.40	11.42	4.73	8.41	3.36	4.30
10 ≦ D	0.00	19.25	7.43	6.30	10.88	3.53	3.80
Total (4 ≦ D)	0.00	26.65	18.85	10.92	19.29	6.89	8.10
Above ground biomass (t/ha) 4 ≦ D < 10cm [2]							
Ws	0.00	8.65	14.39	3.47	10.21	2.88	2.32
	(0.00)	(7.02)	(10.88)	(3.38)	(7.64)	(1.91)	(2.15)
Wl	0.00	1.19	1.79	0.56	1.44	0.47	0.44
	(0.00)	(1.01)	(1.43)	(0.47)	(1.17)	(0.34)	(0.41)
Wb	0.00	3.64	6.36	1.51	4.29	1.30	1.04
	(0.00)	(2.90)	(4.85)	(1.13)	(3.17)	(0.81)	(0.94)
Wr	0.00						
	(0.00)	(1.33)	(1.06)	(0.56)	(1.46)	(0.40)	(0.43)
Wt	0.00	14.81	23.59	6.11	17.39	5.04	4.23
	(0.00)	(12.26)	(18.2)	(4.86)	(13.43)	(3.46)	(3.93)
10 ≦ D							
Ws	18.35	26.73	20.88	5.53	15.11	7.14	2.99
	(0.00)	(20.1)	(5.81)	(2.98)	(10.61)	(1.84)	(2.12)
Wl	1.53	2.18	1.64	0.51	1.27	0.54	0.37
	(0.00)	(1.62)	(0.74)	(0.33)	(0.85)	(0.20)	(0.27)
Wb	6.85	8.79	6.28	1.87	3.33	2.47	1.19
	(0.00)	(6.33)	(1.96)	(1.05)	(2.58)	0.64	(0.80)
Wr							
	(0.00)	(7.48)	(1.49)	(0.89)	(1.67)	(0.47)	(0.56)
Wt	26.72	45.17	53.94	8.78	28.10	10.69	5.11
	(0.00)	(35.52)	(28.28)	(5.24)	(20.01)	(3.15)	(3.75)
Ground total							
Ws	18.35	35.38	35.27	9.00	25.32	10.02	5.31
	(0.00)	(27.12)	(16.69)	(5.68)	(18.25)	(3.75)	(4.27)
Wl	1.53	3.37	3.43	1.07	2.71	1.01	0.81
	(0.00)	(2.63)	(2.17)	(0.80)	(2.02)	(0.54)	(0.68)
Wb	6.85	12.43	12.64	3.38	7.62	3.77	2.23
	(0.00)	(9.23)	(6.81)	(2.18)	(5.75)	(1.45)	(1.74)
Wr							
	(0.00)	(8.81)	(2.55)	(1.45)	(3.13)	(0.87)	(0.99)
Wt	26.72	59.98	53.94	14.89	45.49	15.73	9.34
	(0.00)	(47.78)	(28.28)	(10.10)	(33.44)	(6.61)	(7.68)

Remarks;

1) Tree species for charcoal. Calculated using V=0.6534 + 2.2490 x Log D

2) Values are oven-dried weights Calculated using Komiyama's equations
Tree species for charcoal in parenthese.

Table 6.7 Annual Increment of Mangrove Forests Resources (Estimated)

		Forest types						
					LRh		LRh-S	
		Av	HRh	MRh	P.Rupat	Except P.Rupat	P.Rupat	Except P.Rupat
Effective volume for charcoal (m^3/ha)	1)							
4 ≦ D < 10cm		0	3.2	6.8	2	4.2	1.8	2.4
10≦ D		0	0.6	0.3	0.3	0.3	0.2	0.4
Total (4 ≦ D)		0	3.8	7.1	2.3	4.5	2	2.8
Above ground bidmass (t/ha)	2)							
4 ≦ D < 10cm								
Ws	3)	0	3.2	6.8	2	4.2	1.8	2.8
Wt	4)	0	6.7	13.5	4.6	8.8	4.8	4.7
10≦ D								
Ws		1.6	0.6	0.3	0.3	0.3	0.2	0.4
Wt		2.7	2.3	1.4	0.7	1.2	1.1	0.7
Ground total								
Ws		1.6	3.8	7.1	2.3	4.5	2	3.2
Wt		2.7	9	14.9	5.4	10	5.9	5.4

Remarks ; Approximate mode of individual V increment (V:0.004m3/ind. yr, Fig.6.1.5) x Number of ind./ha of trees. Oven-dried weight.

2) Approximate mode of individual W increment x Number of ind./ha of trees (Ws 4kg /ind yr, Wt 6.7 kg /ind yr,Fig 6.1.6, 6.1.7). Oven-dried weight.

3) Only trees for charcoals

4) All trees

Table 6.8 Leaf Analysis Results

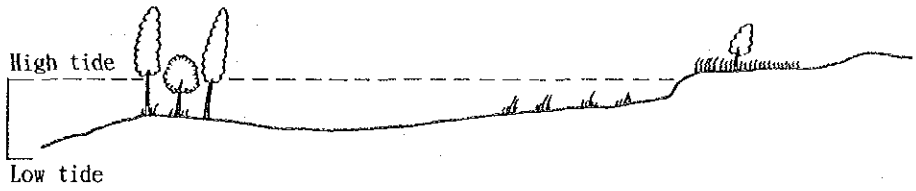
Collected date	Na(mg/g) 1)	K(mg/g)	P(mg/g)	N(%)	Ashes(%) 2)
19/2/93	13.3	10.5	29.4	0.6	18.4
04/03/93	10	12.8	22.5	7	12.3
19/03/93	8.9	9.4	21.7	6.1	9.3
03/04/93	10.2	10.5	18.7	5.9	7.3
04/05/93	11.9	6.9	29.2	0.7	9.4
19/05/93	9.3	9.2	28.7	6	11.6
Average	9.5	10.3	23.4	6.2	10.3

Remarks

1) oven-dried weight

2) in weight

Open sea type



Inland sea type

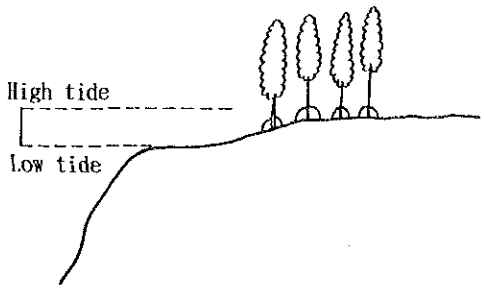
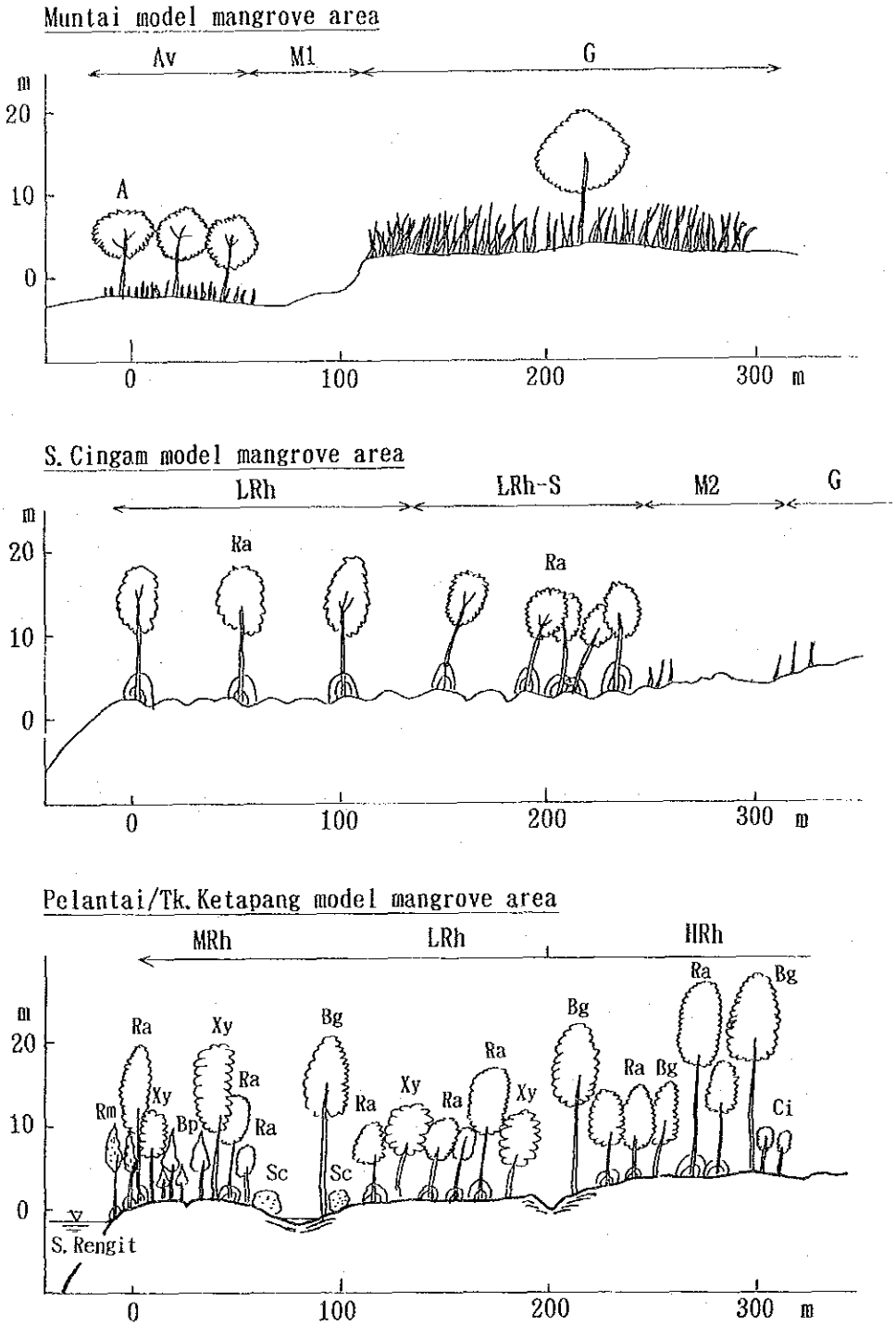


Fig. 6.1 Illustration on Tipical Coast Land and Tide Level in Model Mangrove Areas



Remarks

A : Avicennia spp.	C : Ceriops spp.	Ci: Cissus adnata
Rm: Rhizophora mucronata	Bp: Bruguiera parviflora	Bc: Bruguiera cylirdrica
Ra: Rhizophora apiculata	Bg: Bruguiera gymnorriza	
Xy: Xylocarpus spp.	Sc: Scyphiphora hydrophyllaceae	

Fig. 6.2 Typical Profile of Mangrove Forest in Model Mangrove Areas

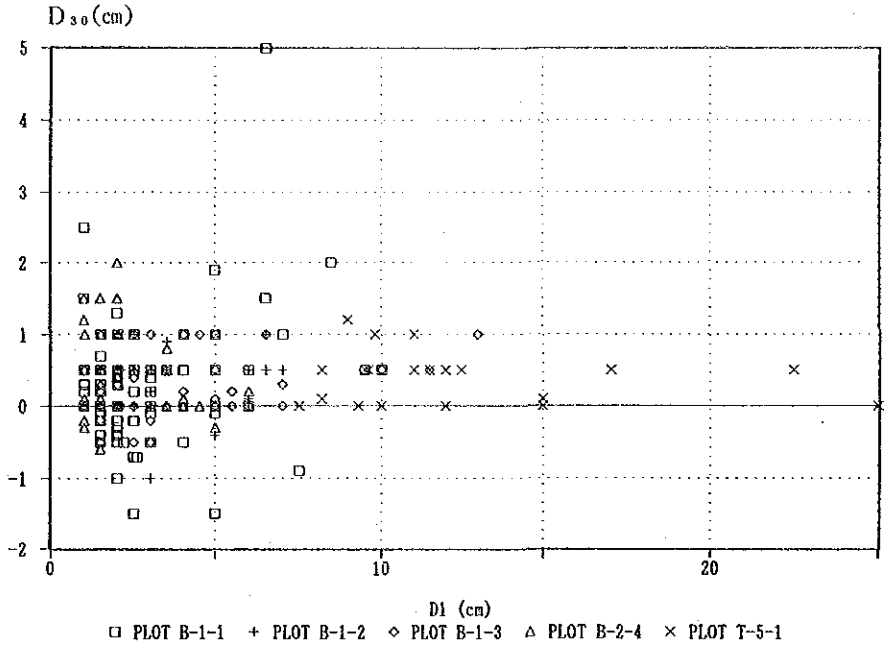


Fig. 6.3 Individual D Increment (in 9 months)

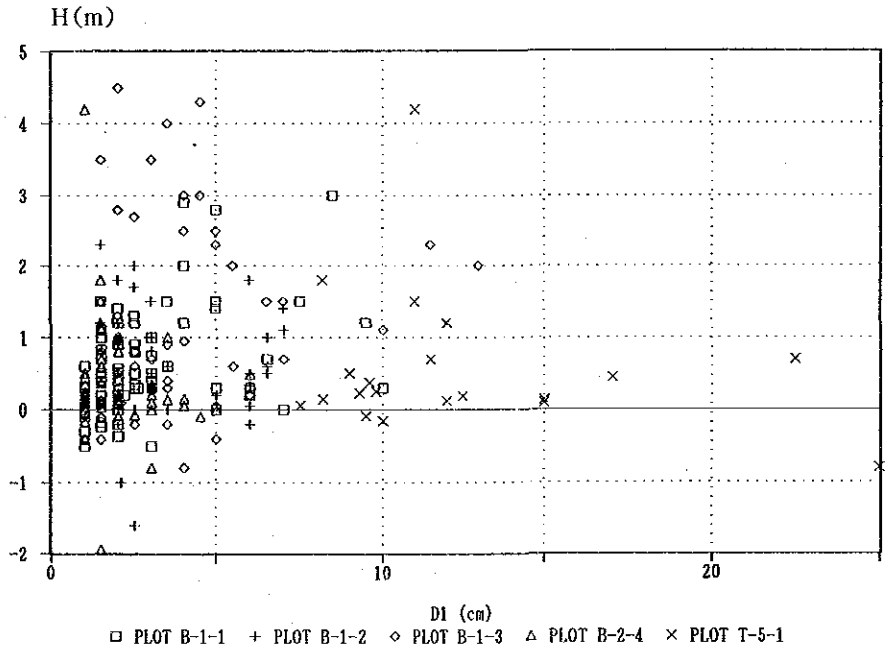


Fig. 6.4 Individual H Increment (in 9 months)

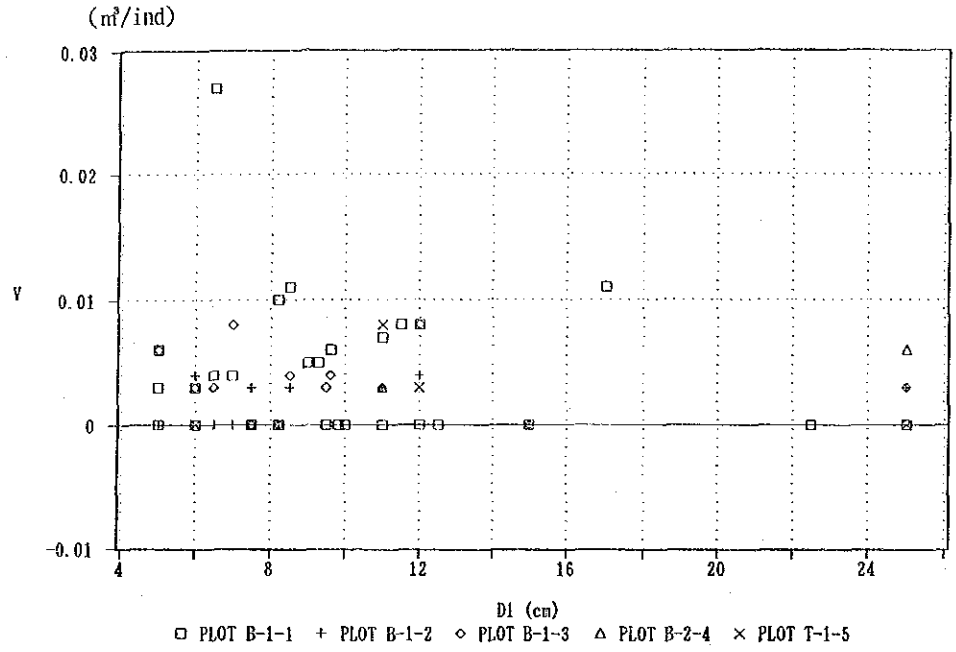


Fig. 6.5 Individual V(effective) Increment (in 9 months)

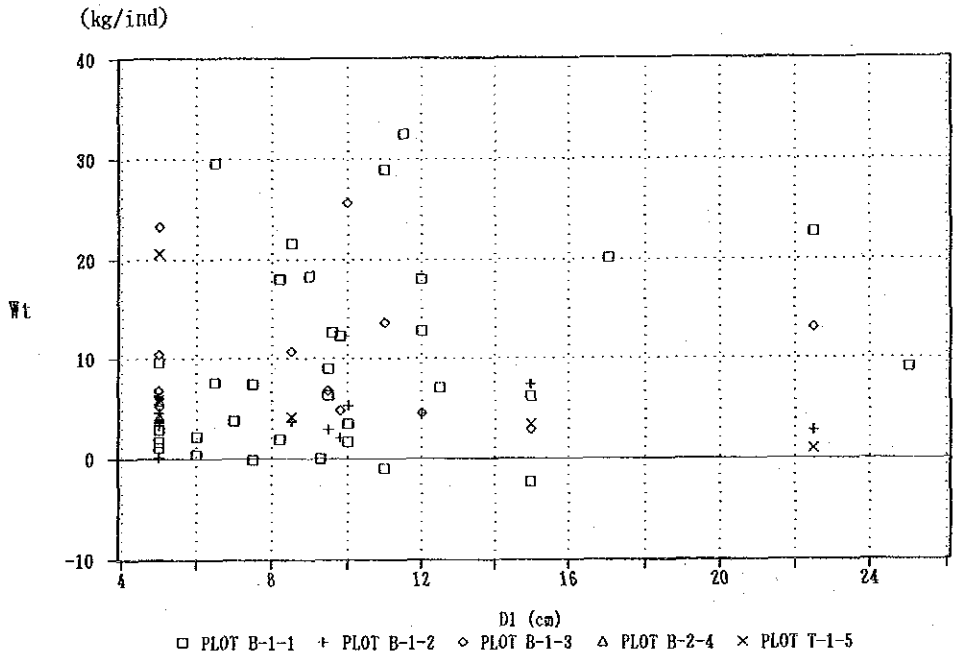


Fig. 6.6 Individual Wt Increment (in 9 months)

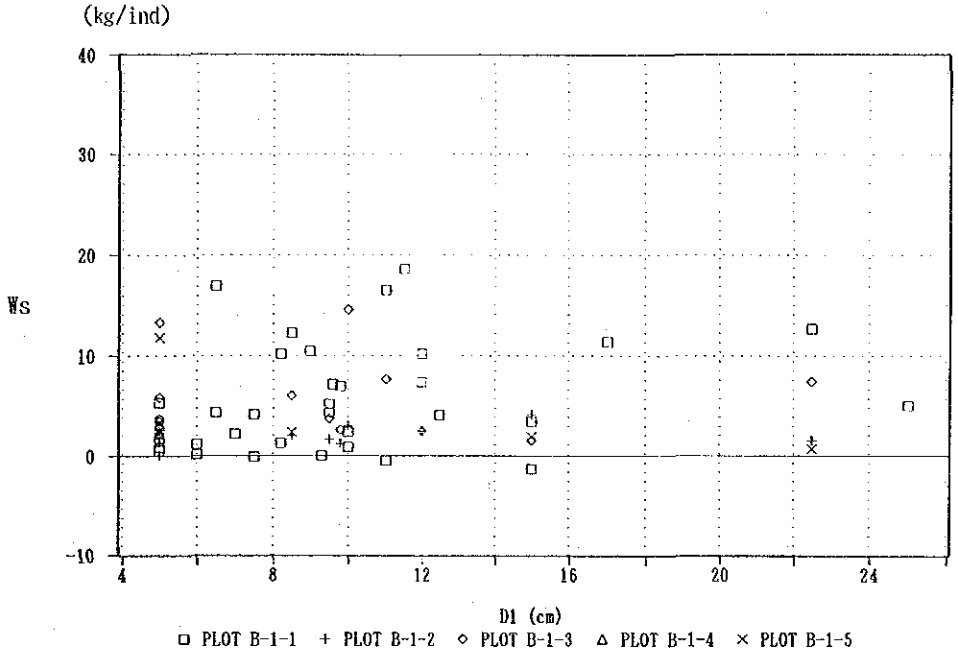


Fig. 6.7 Individual Ws Increment (in 9 months)

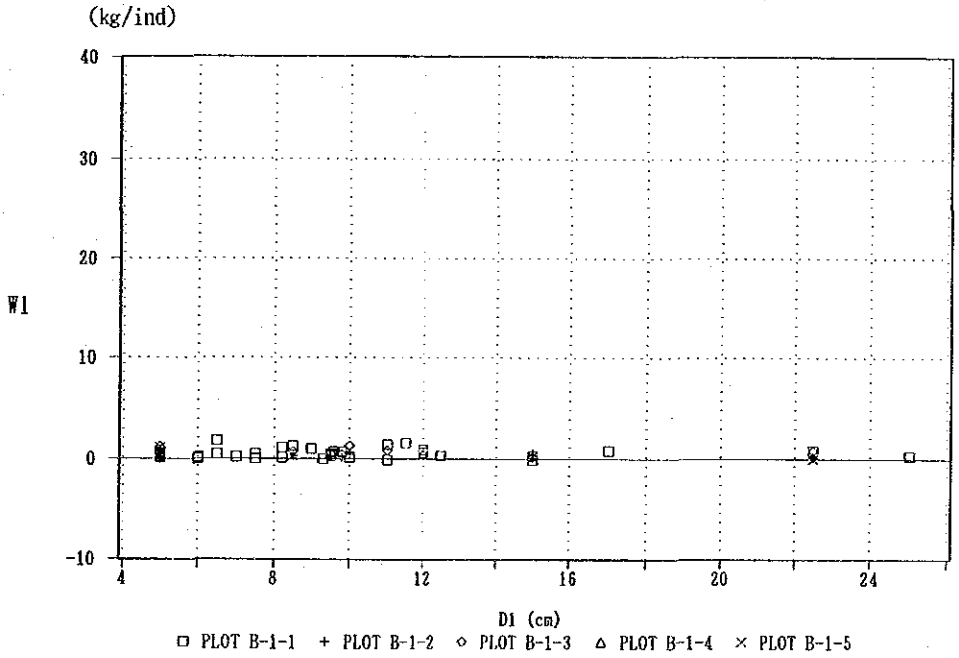


Fig. 6.8 Individual Wl Increment (in 9 months)

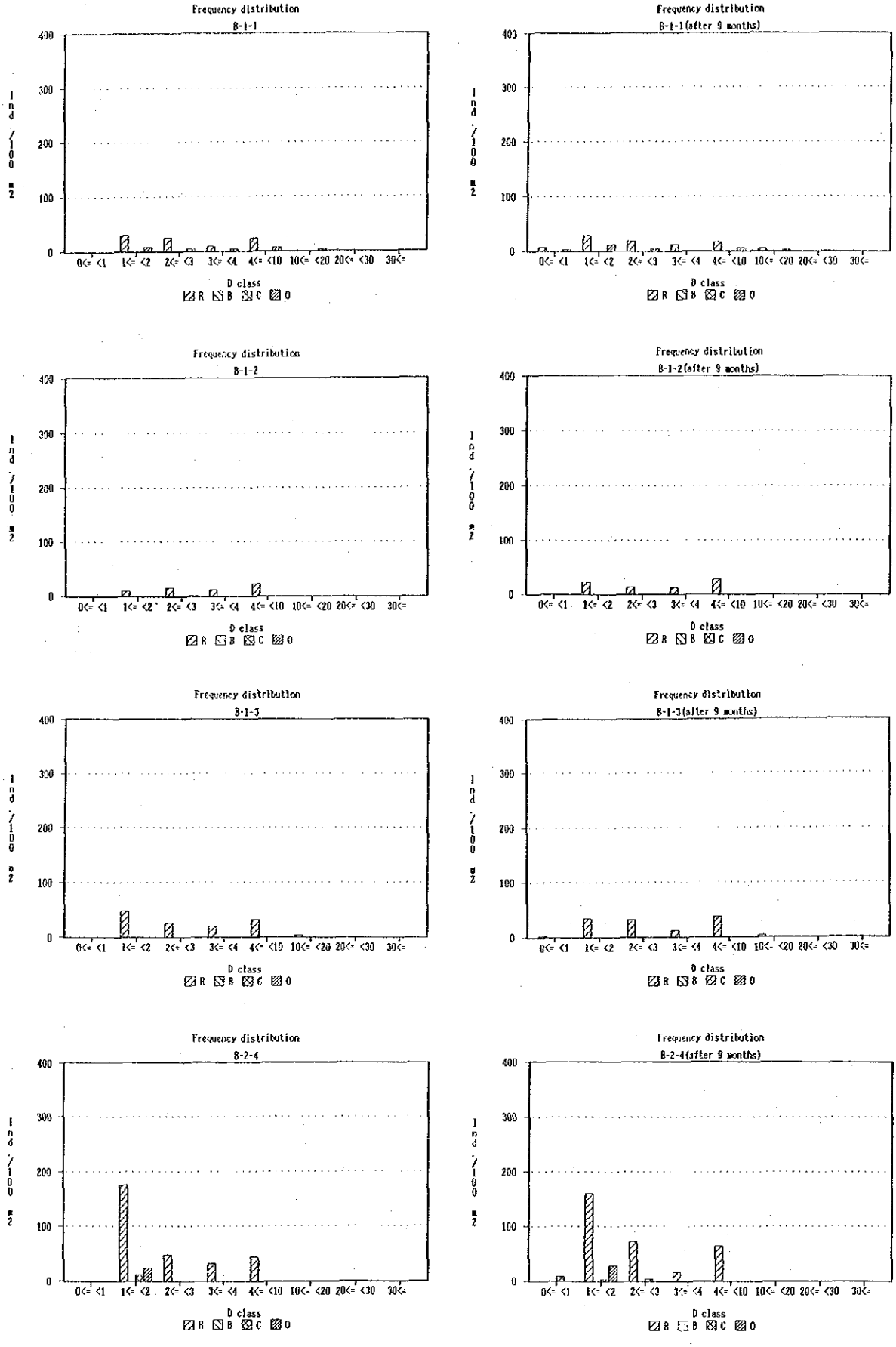
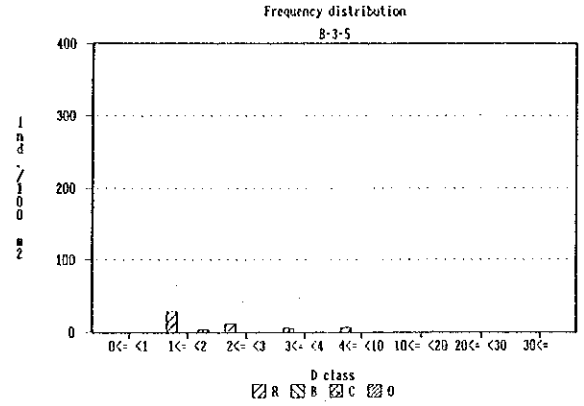
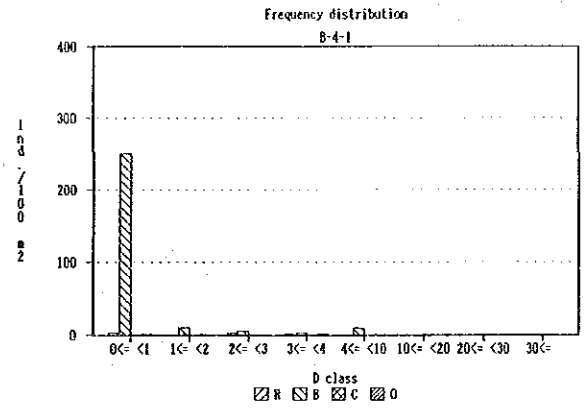
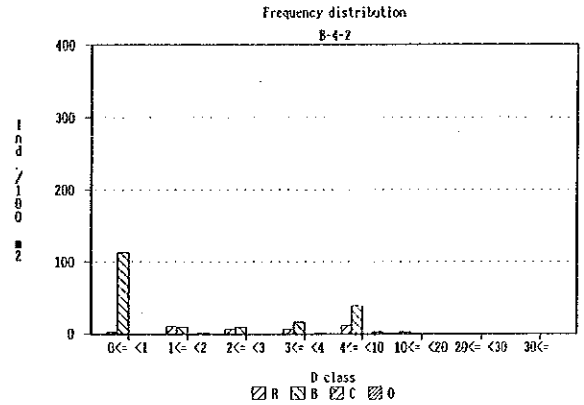
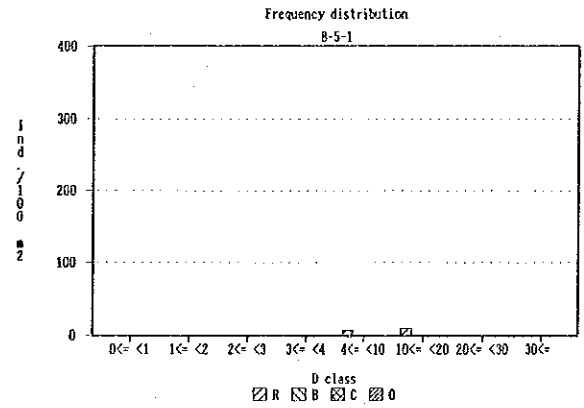


Fig. 6.9 Frequency Distribution of D









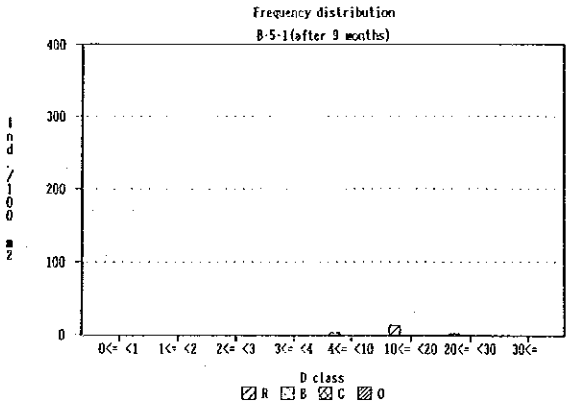
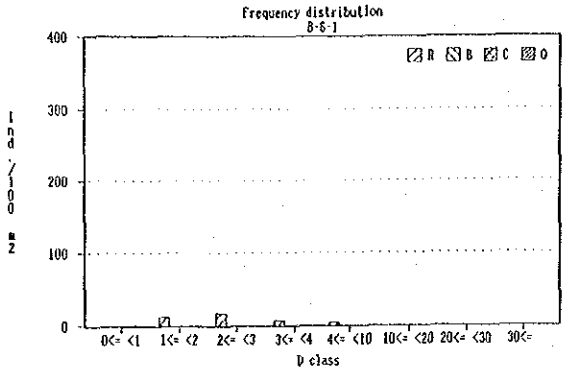
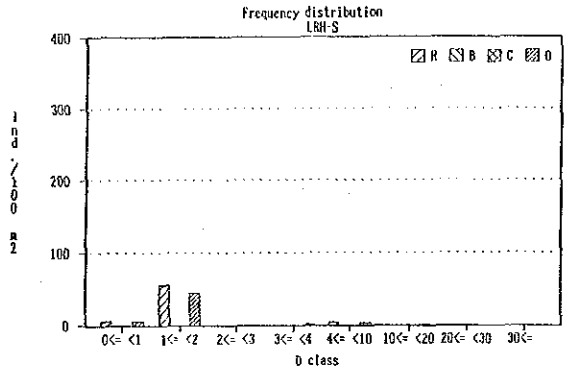
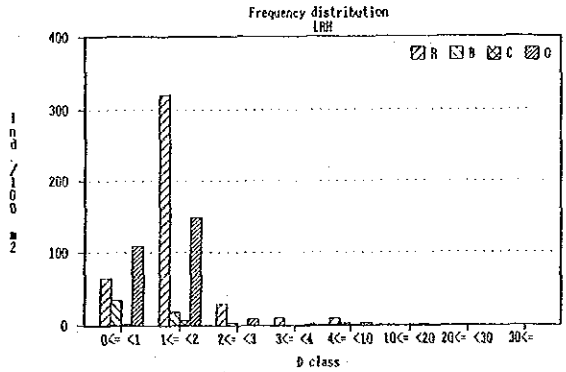
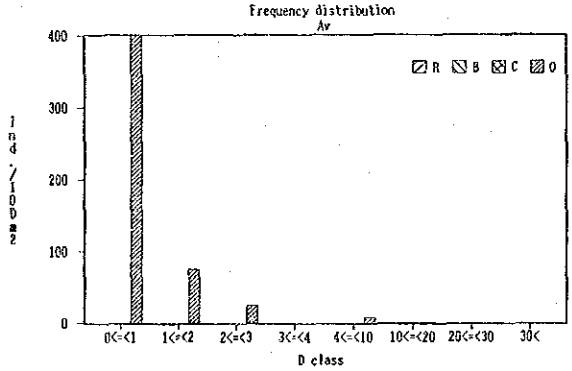


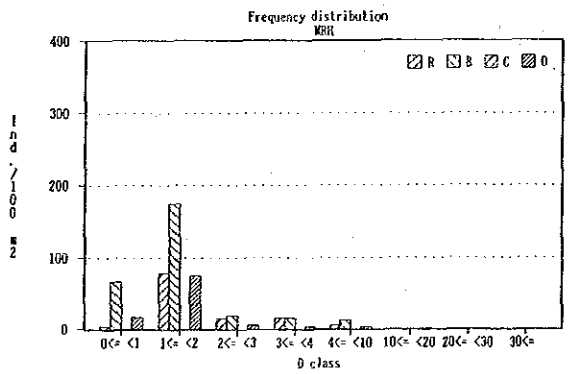
Fig. 6.9 Frequency Distribution of D （2／3）

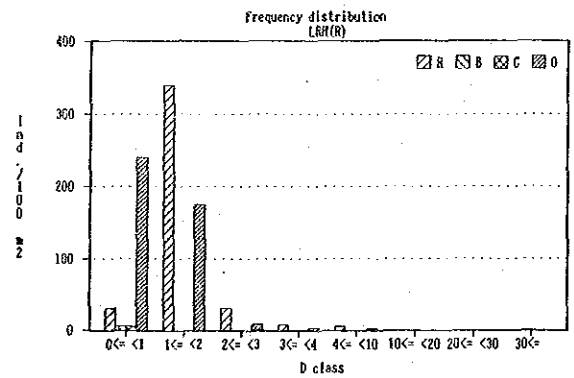












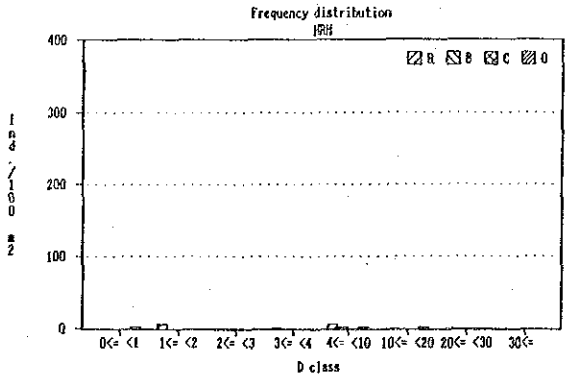
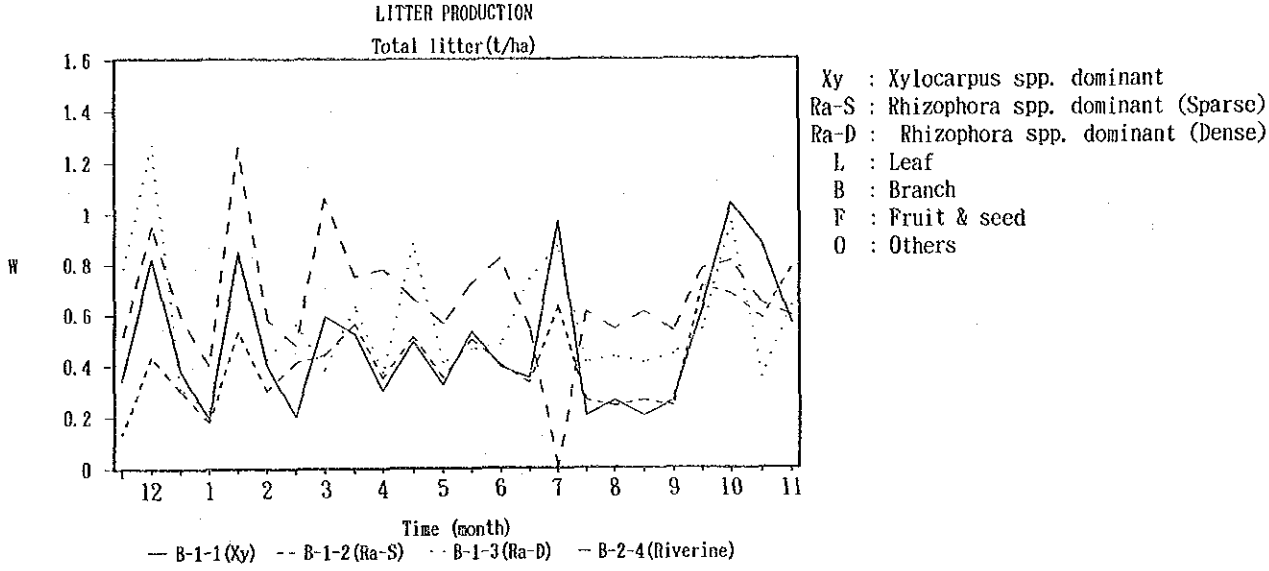


Fig. 6.9 Frequency Distribution of D (3／3)



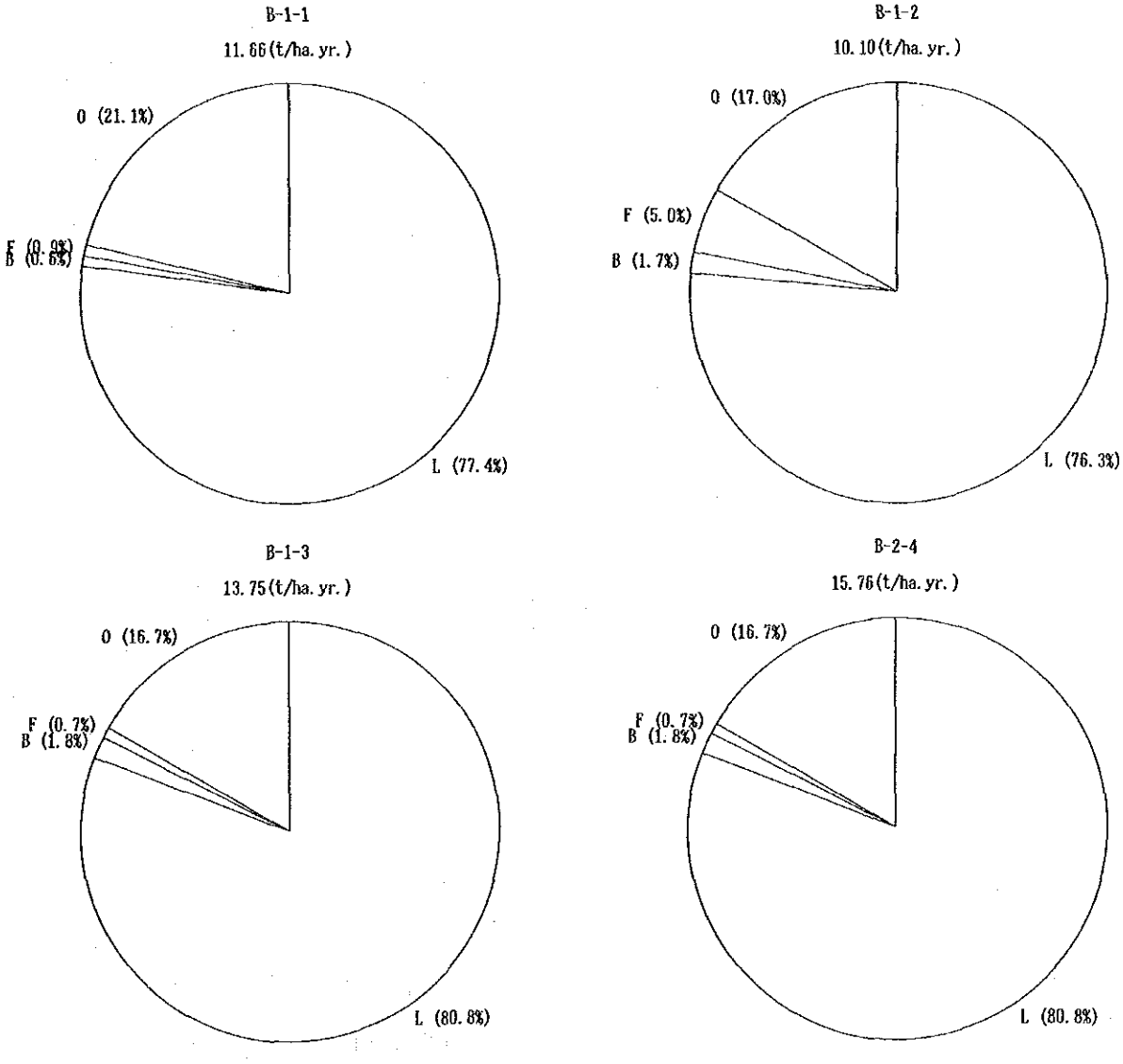
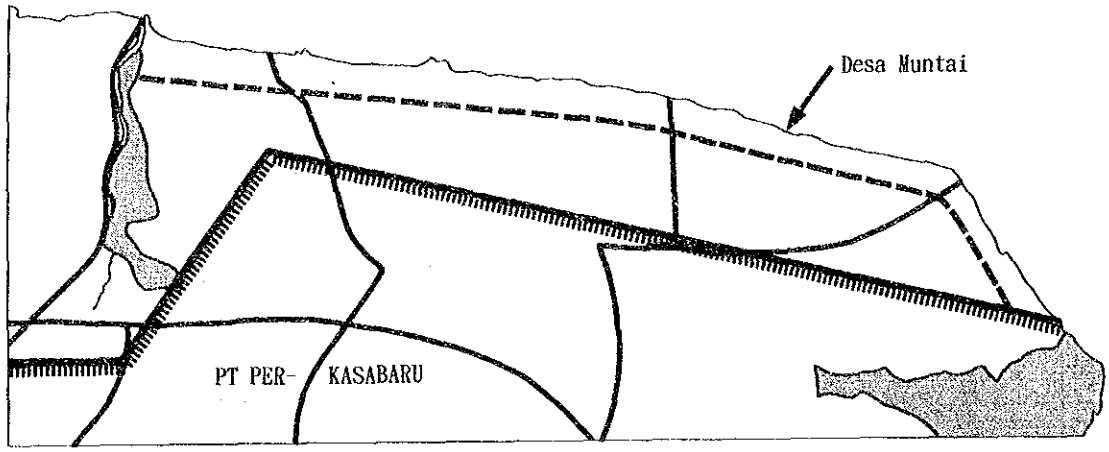


Fig. 6.10 Litter Production

Muntai model mangrove area



S. Cingam model mangrove area

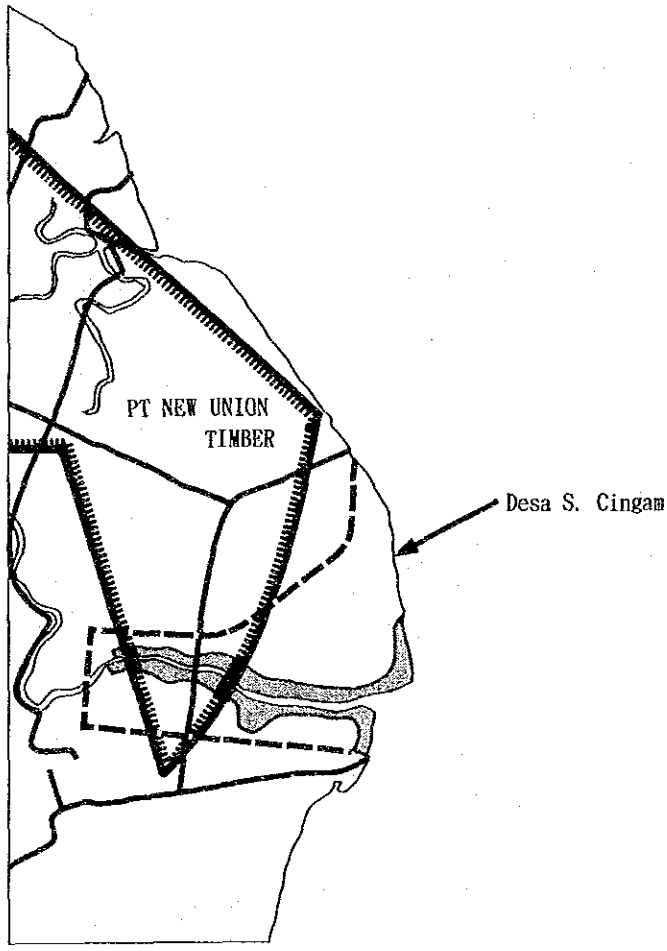


Fig. 6.11 Approximate Distribution of HPHH in Model Mangrove Areas (1 ／ 2)

Sources : PETA HAK PENGUSAHAAN HUTAN DALAM WILAYAH KERJA BAGIAN KESATUAN PEMANGKUAN HUTAN DUMAI 1:100,000, 1991 (Indonesian)
PETA HAK PENGUSAHAAN HUTAN DALAM WILAYAH KERJA BAGIAN KESATUAN PEMANGKUAN HUTAN BENGKALIS 1:100,000, 1991 (Indonesian)
PETA TIPE BAGIAN KESATUAN PEMANGKUAN HUTAN SELATPANJANG 1:100,000, 1991 (Indonesian)

Pelantai - TK. Ketapang model mangrove area

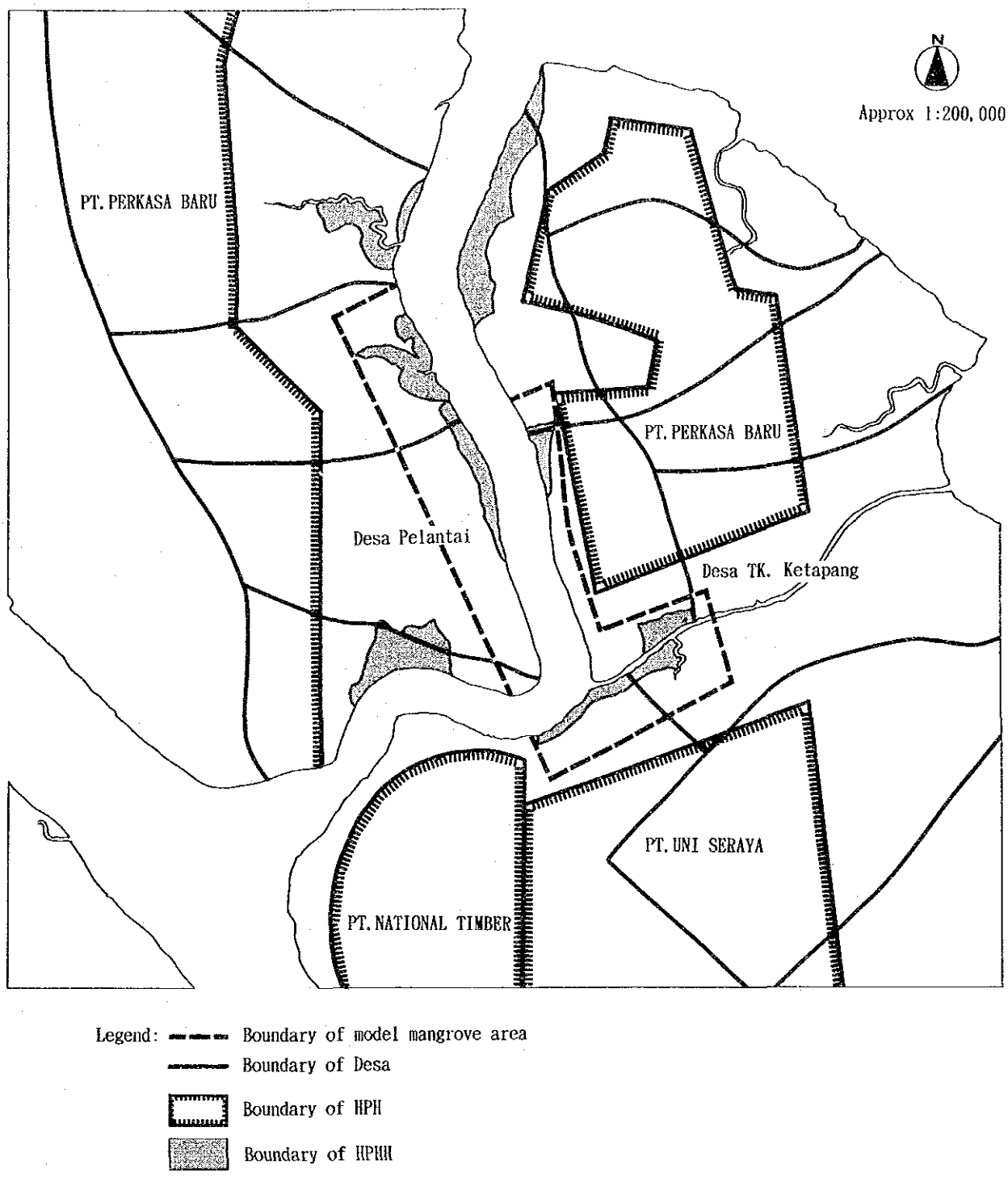


Fig. 6.11 Approximate Distribution of HPHH in Model Mangrove Areas (2 / 2)

7. Environmental Considerations

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7.1 Environmental Considerations for the Model Areas and for Their Surroundings

In the planning of the four model areas selected for the fishing village development, the most important environmental considerations should be the pollution of sea water by mineral oil as well as coastal erosion. Another is gambut, a kind of peat characteristically distributed in the soil of this area.

The extent to which these factors affect the area depends on the area's location in relation with the ocean, wind directions, water current and the frequency of wave attack, etc. Each of the environmental considerations will be briefly discussed in the following sections.

7.1.1 Water Pollution by Mineral Oil

Producing about 60% of crude oil in the country, the drilling area in Riau Province is divided into 20 drilling lots extending over the eastern part of the Malacca Straits area and the Natuna area. The Study Area is included in No. 10 drilling lot (the Malacca Straits lot) exposed to the ocean and No. 6 drilling lot (the CPP lot) facing the Panjang channel.

Crude oil shipping ports are located in Desa Tlk. Belitung on the east coast of Padan island as well as in Sungai Kerau on the west coast of the same island. Each shipping port has a wharf to moor a large tanker. Desa Sei Pakning on the east coast of Kab. Bukit Batu on the main island of Sumatra faces the Panjang channel and has a shipping facility for a refinery of more than 50,000 BPD capacity (see Data No. 1).

The oil drilling area is Padan island where crude oil shipping ports of Tlk. Belitung and Sungai Kerau are located. The Lalang area in Kab. Sungai Apit on the main island of Sumatra is on the west coast of Panjang channel. This area has several offshore rigs installed at a distance of about 500 m from each other. In the middle of this channel, another rig is now under construction by a large dedicated ship. Other oil drilling projects are planned, and exploratory drilling has partially started in some areas of the islands of Rangsang, Padan, Tebing Tenggi and Bengkalis. These oil development projects are being carried out by LASMO, a joint-venture company operating under a 25-year contract with Pertamina.

Tankers dump ballast water in the offing of the Malacca Straits before they arrive at their ports of shipment. Such dumping is not controlled at all in the absence of any environmental pollution monitoring system.

7.1.2 Sediment Outflow and Erosion

In the dry season, water near the shore generally looks bluish green as is water in the ocean, but it turns to brown in the rainy season because of sediment outflow. Water in the Siak river is always brownish, while water in the Kampar river appears whitish due to sediment outflow from upstream. Water in the river mouths and the neighboring shores changes color according to wind directions. That is to say, the color of the water tends to become brownish under the strong current of the Siak river in the northerly wind and turns whitish due to the Kampar river running rapidly when the wind is southerly.

Wide areas of coastal mangroves have been reclaimed and converted to plantations, where the eroded shore frontages are often observed. In Anak Setahan, located in the north of Rangsang island, the shoreline is being eroded by as much large as 20 m a year as an aftermath to excessive tree felling. The same type of land erosion is taking place in Prepat Tungal, a village facing the ocean in the northwest part of Bengkalis island.

The survey team observed in many places a large number of tree trunks cut and left as well as quite a number of sampans and men working to fell trees. The team did see a pulp company in Slatpanjang planting trees after trees were firewood though this was an exception. In many cases, coastal forests are converted to plantations, etc. instead of reforestation.

7.1.3 Gambut

The dark brown water indicating acidity comes from gambut produced by the decomposition of fallen trees and leaves. It comes up in the deep end of coastal inlet where mangroves grow thick, emerging mainly in the rainy season. Its effect on fishery is considered to be minimal.

Gambut, formed in a layer scores of centimeters thick beneath the top soil, is distributed mostly on shores in Riau Province, and in marshlands in West Kalimantan Province and Irian Jaya Province. The layer has about 30% organic substances and is characterized by light weight, high moisture content and vulnerability to erosion. Its formation process, though similar to that of coal, completes within several years. Some gambut is dried and used as fuel while the rest is exported as organic fertilizers to promote the growth of grass on golf courses. It has no ability to form clay and easily flows out, bleeding brown water in the downstream river basin. In some shores, the brown water also contains sulfuric acid (see Data No. 2).

7.1.4 Industrial Effluent

Although no information or damages directly having impact on the Study Area have been reported, woods and forests near crude oil drilling sites and paper/pulp plants in the basin of the Siak river are dying from the effluent of industrial operations. In the southern region, one of the largest pulp plants in the province started operation last year and began discharging effluent into the Kampar river. In order to deal with such water pollution, the provincial BAPPEDA is going to investigate the water quality of the Kampar river soon. The authority's response to the pollution of shores, however, is still in the planning stage.

The only cases of effluent discharge from small scale sago palm processing plants were observed in the Study Area. However, it would not be required to take any anti- pollution measures for the reason that the pollution is not significant.

At present, no effluents containing a large amount of inorganic substances have been observed.

7.1.5 Drinking Water

The drinking water supply seemed insufficient in every place of the Study Area. Most of the people drink rain water or well water after boiling. Because the supply of drinking water is certain to become a critical issue in future, some measures to encourage the best use of rain water should be undertaken.

7.2 Desa Muntai

The village of Desa Muntai is located in the north-east end of Bengkalis island. Looking out on the Malacca straits, the village is directly exposed to ocean waves. Gambut accumulates on the shores and settles in the mouths of rivers in such a quantity that it blocks the river mouths in the northerly wind season of December through February. In January in particular, the sedimentation of gambut is observed almost every day. Because the gambut sedimentation extends into the sea covering an expanse of about 200 m from the shore three or four days a month during this period, powered fishing boats cannot approach to the shore. They must stay in the offing, with sampans shuttling between the boats and the shore.

(1) Sediment outflow

The color of the water near the shore turns to gray or brown due to sediment outflow after a rain. Also, a considerable amount of brown water bleeds from gambut, dyeing the sea a black brown color over an expanse of about 1 km from the shore.

(2) Felling mangroves

Wide development of plantations is seen around the village, leaving scarcely any mangroves on the shore due to excessive felling. Erosion by the ocean waves appears to have had a heavy impact on the terrain of some shores.

(3) Water pollution by mineral oil

Oil films and tar balls from tanker sludge are observed to drift to shore once or twice during the northerly wind season of January through April. Fishing operation is not affected, however.

(4) Other considerations

The shore is an unstable and shallow beach consisting of a mixture of sand and gambut sedimentation. Facing the ocean, it is also exposed not only to the north wind but also to a coastal current alone the shore. Under this condition, if any structure is built directly on the shore, it may cause sand drift or erosion in the surroundings. Accordingly, special consideration should be paid in the planning of marine structures to prevent such sand drift and erosion.

7.3 Desa Sei Cingam

The pertinent village is located on the eastern exit of the Marong channel, separating Rupat island into two parts. Heavy tanker traffic is seen in the offing because it is situated to the west of the line connecting the oil shipping port of Dumai and the ocean.

(1) Sediment outflow

The color of water in the Marong channel turns to brown, gray and bluish green by the season. This change of color has become especially remarkable in the past several years although it was not noticeable more than 10 years ago.

In the Alohong zone facing the Malacca straits, the sea water is blue during the season of northerly wind and alternately changes between gray and brown during the other seasons. It is reported that, when the color changes from gray to brown in October through December, the fish catch becomes poor, but that a large catch can be expected in June through August when the sea turns from gray to bluish green.

(2) Felling mangroves

Mangroves have been felled over a long period of time and their presence has become scarce in many places. There is no mangrove in the Alohong zone, where other trees are being felled.

In the seasons of easterly or northerly wind, the land is eroded by sea waves around the exit of the Marong channel. In the surroundings of Alohong, the shoreline has receded about 30 cm from the erosion of waves during the past 30 years.

(3) Water pollution by mineral oil

Oil smelling fish catches are not experienced now, although they were frequent about 20 to 30 years ago. Because of the nearby oil shipping port of Dumai, oil films and tar balls drift to the shore more than once a year in the time of easterly or northerly wind. It is reported that fishing operation is continued regardless of such drifts.

(4) Other considerations

It should be remembered that the erosion of the shore in the Alohong coast has forced 14 fishermen's families to move to other places during the past four years. It is highly likely that more families will move in the future. Thus, in the planning of development projects, special attention should be paid to the possibility of fishermen moving to other places.

7.4 Desa Pelantai

The village of Desa Pelantai is located in the eastern part of Padan island and to the south of the Asam channel. The direction of tidal flow in the channel is changeable; from north to south at high tide, and from south to north at low tide. The depth of water is a few meters near the shore and reaches about 25 m in the middle of channel. Sea water in the channel intermingles with the change of tide, and current rips are conspicuous.

(1) Sediment outflow

The sea water drastically changes in the Asam channel. The ocean water flows into the middle of the channel at high tide to turn the water bluish green. In the rainy season, land water flowing from the Panjang channel spreads into the sea and turns the entire channel water light brown.

Erosion by the action of waves is seen in some places along the shore. Near the Dusun Kengkam jetty, the shoreline is gradually moving inland.

(2) Felling mangroves

Felling mangroves is one of the main sources of income in this village. Mangrove forests suitable for felling have diminished within this village, and some villagers go to other villages to fell mangroves.

(3) Water pollution by mineral oil

The occurrence of oil films has been observed in the Asam channel at a frequency of one to three times a month for the part 10 years. Oil smelling fish are caught, infrequently though.

In 1991, exploratory crude oil drilling was done at RW03 of the Asam channel. The site is still off-limits. Nearby drilling stations include those at the north of Belitung, Lalang and Sungai Kerau. These facilities started operation in the middle of 1980's. No oil spills or other damages have been reported to date.

Drifting tar balls are observed almost every day. They drift to the shore at a frequency of more than once a month and stick to the roots of mangroves. The drifting of oil films from ballast dumped by tankers prior to their entry into the north Belitung port is noticeable in the season of northerly wind.

(4) Other considerations

The Asam channel is a route for various ships and boats such as ferry boats cruising around nearby villages. Therefore, when set net fishing is introduced in any development plan, in addition to bag net fishing such as Gombang now popular in the channel, it is essential that ship navigation routes should be secured in the plan.

In view of the speed of current reaching as high as 0.77 m /sec. in the channel, any marine structures built under this project must be designed to withstand the current.

7.5 Desa Tlk. Ketapang

The village of Desa Tlk. Ketapang is located on the south-west part of Merbau island, opposite Desa Pelantai across the Asam channel. The jetty of Dusun Terus is a ferry boat departure point where many other boats also arrive and depart frequently. Around the jetty, there is a cluster of houses of people living on the water, and many wastes from daily life are floating around.

(1) Sediment outflow

To the south of this village is the Rengit channel running between Merbau island and Tebing Tenggi island. This channel is a ship's route connecting Pekan Baru and Slatpanjang and has heavy ship traffic. The Rengit channel is so small, with a breadth of only about 100 m, that waves produced by ships coming and going through the channel have a great impact on the erosion of shoreline. In the forests along the shoreline, many mangroves were observed toppled by soil erosion around their roots.

(2) Felling mangroves

Crude oil drilling is in operation in north Bletung to the north. The drilling station completed facility construction and started operation in the middle of the 1980's. No oil spills have been reported yet. However, drifting oil films and tar balls are continually seen all the year around. Similar to Desa Pelantai, felling mangroves is a popular means of making a living. Although the shores of Asam channel and Rengit channel are covered by mangroves, many clearances are seen on the Asam channel side, which is rather densely populated.

(3) Water pollution by mineral oil

The condition is as in the case of Desa Pelantai

(4) Industrial effluent

There is a sago palm processing plant operating under KUD on the shore of Asam channel at RW02. The plant started its operation in 1991, processing three tons of materials a day. At present, the effluent is not treated but simply drained to the Asam channel. Though the brown effluent gives off a strange odor around the plant, it might not induce any serious water pollution to the channel because the amount of discharge is very limited.

(5) Other considerations

In the Rengit channel, it is difficult to conduct fishing operation or build any structures on the water because of small channel breadth and heavy ship traffic. In the Asam channel, the influence of a tidal current must be taken into consideration, as in the case of Desa Pelantai.

8. Inhabitants' Opinion on Protection and Development of Coastal Resources

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8.1 Survey Approach

An interview survey on the inhabitants of the model areas for fishing village development (4 fishing villages) regarding their opinions and understanding of measures to protect and develop coastal resources was consigned to Riau University. The contents and findings of that survey are shown below.

(1) Surveyed area

Four fishing villages selected as the model areas and the surrounding areas were covered in the survey. They are as follows:

- Muntai: Bengkalis island, Kec. Bengkalis
- Sei Cingam: Rupat island, Kec. Rupat
- Pelantai: Padan island, Kec. Merbau
- Tlk. Ketapang: Merbau island, Kec. Merbau

(2) Subjects surveyed

The household head or spouse were the subjects of the interview.

(3) Sampling method

The interview survey was implemented mainly in RT of each model area with large numbers of fishermen. The objective was to interview 75 households with income from fisheries and 25 households utilizing mangroves. If this objective could not be met, the survey was extended to include neighboring villages that were easily accessible.

(4) Outline of survey items

a. Personal data (race, religion, type of household)
b. Occupation and income
c. Village meeting
d. Use, felling, and conditions of mangroves
   - Mangrove cutting
   - Mangroves condition
e. Fishing activities
f. Opinions regarding protection of coastal resources
   - Mangrove management
   - Conditions in fisheries and protection of fishery resources
   - Protection of mangroves from the viewpoint of protection of fishery resource

8.2 Characteristics of Interviewed Subjects

The number of subjects successfully surveyed in each model area are shown below.

Model Area	Total	Within Desa	Adjacent Desa (name)
Muntai	107	90	17(Tlk. Pambang)
Sei Cingam	93	50	43(Tlk. Lecah)
Pelantai	94	94	-
Tlk. Ketapang	63	63	-

Malays are predominant in Riau Province and the majority of the subjects surveyed were Malay. More than 90 percent of the interviewed subjects in Pelantai and Tlk. Ketapang were Malays. Moreover, due to immigrants from Java island, 10 and 16 percent of the population in Muntai and Sei Cingam, respectively, were Javanese. Generally, the population of Rupat island has a high number of Chinese Indonesian inhabitants in comparison to other areas. Hence 21 percent of the subjects interviewed in Sei Cingam were Chinese Indonesians.

Although the aforementioned 21 percent of the Chinese Indonesian respondents were Buddhist, 90 percent of the interviewed subjects in other model areas (Muntai, Pelantai, Tlk. Ketapang) were of the Islamic faith.

The number of members per household was about six in Muntai, Pelanti, and Tlk. Ketapang and seven in Sei Cingam. The number of children per household was about four in Muntai, Pelantai, and Tlk. Ketapang and five in Sei Cingam.

8.3 Occupation and income

The majority of the household heads in Muntai and Sei Cingam, 79 percent and 89 percent, respectively, were fishermen. Likewise in Tlk. Ketapang 72 percent of the respondents were fishermen, followed by 27 percent who were self-employed. In Pelantai the majority of the subjects or 72 percent were self- employed, and only 22 percent were fishermen.

The number of employed members per household was fairly uniform in all areas with 2.4 members in Muntai, 2.2 in Sei Cingam, 2.0 in Pelantai, and 2.1 members in Tlk. Ketapang.

The ratio of agriculture among the occupations of the interviewed subjects, was 13 to 24 percent and appear to have increased percent. In Muntai the ratio of fisheries was 47 percent, the category of others was 26 percent, and agriculture was 13 percent. In Sei Cingam the ratio of fisheries was 53 percent, agriculture was 24 percent, and others was 13 percent. In Tlk. Ketapang the ratio of fisheries was 39 percent, labor was 20 percent, the self-employed occupied 20 percent, and agriculture was 16 percent.