

equipment and materials. Therefore, measures to carry out joint purchases of fishing equipment and materials with the fishermen's cooperatives will be pursued in the distantly located fishing villages. In addition to joint retail activities, fisheries support services such as fuel supply and repairs are also needed.

2.5 Aquaculture Technology and Its Development Potential

2.5.1 Status of Mariculture in Indonesia

Three types of aquaculture are found in Indonesia - mariculture, brackish water pond culture, and freshwater culture. This development project is concerned with mariculture and brackish water pond culture. Of these two forms of aquaculture, brackish water pond culture is the more commonly practiced and statistics on mariculture is minimal.

Of the total fisheries production volume of 4.6 million tons for 1998, aquaculture comprised 14 percent or 600,000 tons. Of this figure, brackish water pond culture comprised 7.7 percent of the total fisheries production volume or 35,400 tons. The major fishery products that are cultured in brackish water pond culture are milk fish (*Chanos chanos*) and the giant tiger prawn (*Penaeus monodon*). A secondary fishery product is the banana prawn (*P. merguensis*, *P. indicus*). Culture technology of these fishery products is well established in the private sector.

Of the provinces, south Sulawesi has the highest production volume in aquaculture and its brackish water pond culture produced 79,738 tons in 1998. This was followed by east and west Java provinces with 74,483 tons and 63,494 tons, respectively. These three provinces produce about 60 percent of the total production volume or 217,715 tons (see Table 2.5.1). The production volume of NTB and NTT provinces in the study area were 7.162 tons and 176 tons, respectively. The number of fisher households engaged in brackish water pond culture was 144,411 nationwide (see table 2.5.2). Of this figure, the number of fisher households in NTB and NTT provinces were 2,459 and 282 households, respectively.

The production volume per unit area that is utilized in brackish water pond culture ranges widely from 300 to 3,000kg/ha. Although this figure differs according to the fish species that is cultured, traditionally practiced extensive aquaculture is common in many regions. In the NTB province, the production volume per unit area is 1,474kg/ha, which is higher than the national average of 1,157kg/ha, but it is comparatively low in NTT province at 733kg/ha (see Table 2.5.3).

In contrast, mariculture is just beginning to emerge in Indonesia. The major product of mariculture is seaweeds (*Eucheuma* spp.). Seaweed culture initially began in Bali in 1977 and rapidly spread to Lombok, Java, and Kalimantan islands. Pearl oysters are another mariculture product and are cultured in Maluku, Lampung, and Sulawesi.

The Directorate General of Aquaculture (DGA) has begun to promote the culture technology for groupers and is presently reviewing the culture of sea cucumbers as well.

2.5.2 Existing State of Aquaculture Technology

(1) Major Aquaculture Research Institutions

The national aquaculture research institutions are the Aquaculture Centres/Stations that are under the jurisdiction of the DGA, and the Aquaculture Research Center under the jurisdiction of the Board of Marine and Fisheries Research. The most representative mariculture research center of the Board of Marine and Fisheries Research is the Gondol Research Institute for Mariculture. The role of this institute is to develop new fish species, develop culture technology and other research and development activities. In contrast, the role of the Aquaculture Center/Station under the jurisdiction of the DGA is to corroborate the new technology developed by the Gondol Research Institute for Mariculture and to improve existing techniques by disseminating this new technology in the private sector.

1) Gondol Research Institute for Mariculture

Under the Japanese government technical assistance scheme, a shrimp culture project was implemented from 1988 to 1993 and "Multispecies Hatchery Project" was implemented from 1994 to 1999 at the institute. Presently, the Gondol institute possesses the most advanced aquaculture technology in the country. The institute is presently focusing its efforts on the seed production of humback grouper (*Chromileptes artivelis*), tiger grouper (*Epinephelus fuscoguttatus*), and orange spotted grouper (*Epinephelus coioides*) in addition to trial production of mud crab and sea cucumber seeds. It also possesses advanced technology in fish diseases.

2) Lampung Mariculture Center

The cage culture of groupers has been successfully implemented in Lampung district in south Sulawesi province, which has drawn the attention of relevant institutions in the region. The Lampung Mariculture Center of the DGA is located in the district.

The center is mainly involved in the production of marine fish seeds and presently, efforts have focused on the production of grouper seeds. The fingerlings, which are about 5cm in size, have the potential to spawn 20,000 seeds at one time. Due to the preparation of seed production water tanks and the restrictions in spawning volume, seeds are produced every two to three months.

The fish species produced by the center and the prevailing conditions are shown below.

Fish Species	Culture Level
Humbback grouper	Seed production technology is established. Survival rate is about 5 percent.
Tiger grouper/Orange spotted grouper	Seed production technology is established. Survival rate is about 10 percent.
Giant sea perch	Although seed and rearing technologies are established, cultured volume is very small, due to cheap wholesale price.
Snapper	Brood stock preparation stage. It is the target of culture research, but there is very little market demand.
Napoleon fish	Culture is still in the research stage. Low survival rate.
Sea horse	Aquarium fish for pleasure viewing. Produced for Chinese medicine.
Pearl oyster	Culture is in the research stage. Survival rate is 2 to 3 percent.

This center is also engaged in trial non-feed culture of the sea cucumber. Natural sea cucumber seeds that are 5 to 10cm in size, are cultured in pens in sandy areas until they reached a weight of 300g in four months. However, in trial seed production activities, a period of two years was required to produce sea cucumber seed.

3) Situbondo Brackish Water Pond Culture Center

The Situbondo Brackish Water Pond Culture Center is located in Situbondo, Sulawesi on Java Island. The facility is comprised of fish culture and prawn culture divisions. The fish culture division possess ten water tanks with the potential to produce about 5,000 to 6,000 grouper fry at one time. Humback grouper seeds that are 5cm in size are sold at Rp.7,500 to Rp.10,000. The center also produces and sells tiger grouper, orange spotted grouper, milk fish, and giant sea perch fry. Giant sea perch seeds are mainly sold to Riau province.

Cage culture is not conducted at the center and intermediate rearing activities are not carried out. Cages for demonstration use has been requested for the next fiscal budget. Neighbouring fishermen who are engaged in intermediate rearing activities purchase seeds from the center or from the Mariculture Center. In addition to grouper fry, fertilized eggs are also sold and purchased by local private seed producers.

The Situbondo Brackish Water Pond Culture Center also conducts training courses in seed production and accepts trainees from the private sector.

(2) Potential Mariculture Fish Species

According to the Research Center for Aquaculture, the level of seed production and rearing technology is high for a diverse variety of marine fish and shellfish as shown in Table 2.5.4. However, brackish water pond culture of shrimp and milk fish dominates the private sector and the culture of marine fish species is nearly nonexistent. Mariculture conducted in the private sector is centered on seaweed, pearls, and the pearl oyster.

Potential fish species for mariculture and the prevailing culture conditions are explained below.

1) Giant Sea Perch

The culture technology for giant sea perch which is widely established in Southeast Asia is not that popular in Indonesia. The stagnant market price in recent years has contributed to a drop in culture activities. Aquaculture in Indonesia is mainly centered on brackish water pond culture which produced 2,039 tons nationwide in 1998. The main production regions are south Sulawesi and Java Island. Cage culture of the giant sea perch is also conducted in Riau province, although the activity is not recorded in national fishery statistics. The activity is financed by Malaysian capital and the cultured product is also exported to Malaysia.

2) Streaked Spinefoot

The streaked spinefoot is commonly served as grilled fish in Indonesia. Under the Japanese government technical assistance project, Shallow Sea Aquaculture Project,

implemented in 1979 to 1986, the research topic was producing streaked spinefoot seeds. But presently, seed production is not carried out because natural seeds are readily available. Currently, streaked spinefoot is not cultured in Indonesia.

3) Grouper species

Indonesia is the only Southeast Asian country that has successfully achieved large volume production of grouper seeds. Due to the success of the Multispecies Hatchery Project implemented by the Gondol Research Institute for Mariculture, the seed production technology for humback grouper, the highest priced grouper species on the market, was established. This production technology was transferred to the neighbouring private backyard hatcheries and presently, many of them produce grouper fry. The production volume of grouper fry was about one million during 7 months between January and July 2002 in Bali (see Table 2.5.5).

However, only a segment of the intermediate rearing activities have succeeded and the majority of the activities are still in the trial stage. The state of the intermediate rearing technology for groupers will be explained later.

4) Red Snappers

According to the Research Center for Aquaculture, the seed production technology for the emperor snapper (*Lutjanus sebae*) should be targeted following the grouper. However, research is still at the stage of culturing adult fish and it is not ready to be introduced to the private sector. The culture of other red snappers seeds are also being researched and produced. But due to the low market price of red snappers, in contrast to groupers, the demand for red snapper seeds is minimal.

5) Milk Fish

Milk fish is widely cultured in brackish water pond in Indonesia as well as in the Philippines. Although seed production technology is well established, the price of seeds is low due to the abundant supply of natural seeds. Subsequently, natural seeds are mainly used in culture activities. The technology for both seed production and fish stocking for the milk fish is well established. Approximately 158,666 tons were produced nationwide in 1998.

6) Crustaceans

Brackish water pond culture of giant tiger prawns and seed production are popular in the private sector. In addition, the banana prawn is also cultured using traditional extensive culture methods.

The market price of the mud crab, which is exported to China, Taiwan, and Singapore, is high and is a promising product for aquaculture. However, the seed production technology for mud crabs is not established and a segment of the region utilizes natural seeds for small-scale stocking activities.

7) Shellfish

Shellfish that is a promising aquaculture product is the pearl oyster. Seed production and rearing activities have been carried out by private companies, but in recent years,

fishermen have been consigned to raise pearl oysters from seeds on a trial basis. Presently, the trial culture of oysters and blood cockles has been conducted by research institutions, but the technology has not been introduced to the private sector. The problem has become especially prominent for blood cockles due to the inability to harvest a large volume of natural seeds, as in the case of Malaysia.

In addition, the seed production of abalone is carried out by national research institutes and the seeds are stocked.

8) Sea Cucumbers

The DGA has included sea cucumbers as one of the fishery products to be developed by mariculture. Although the seed production technology for sea cucumbers has been developed by research centres, it has not been introduced to the private sector due to a rearing period of more than one year. Stocking activities using natural seeds have been carried out in the private sector and in projects by the Directorate of Fisheries.

(3) Aquaculture Technology for the Groupers

The Indonesian government has placed the highest priority on developing the culture of groupers. As mentioned earlier, seed production technology for groupers was developed under a JICA technical assistance project. Due to the popularity of skipjack tuna which is harvested and shipped by the fishing industry, shippers stock the small groupers until they reach marketable size before shipping them to the market.

However, the 5cm fry that are shipped for culture activities have succeeded in only a segment of the region. Subsequently, the intermediate rearing technology for the grouper species has not been disseminated and although the Directorate of Fisheries and private companies have undertaken trial rearing activities, they have not been successful. Intermediate rearing activities using cage culture were conducted under this project by the fishermen in Lampung and Situbondo who have successfully reared intermediate stage grouper species. The findings are explained below.

1) Lampung

The Kelompok (fishermen group) in Lampung were the first to successfully culture groupers during the intermediate rearing and fish stocking stages. One Kelompok undertook the culture of groupers in 1999 and following their success, there are presently 13 Kelompok and two private aquaculture companies engaged in the culture of groupers since August 2001. In addition, the first Kelompok that succeeded in this endeavour has increased their cage rearing facilities and they are utilizing it as a training center for the culture of groupers.

The highest priced grouper species in the market, the humback grouper, requires a stocking period of more than one year. In contrast, the tiger grouper grows to market size in about eight months. The survival rate of 5cm fry is about 60 to 70 percent and the fry tend to perish during the initial four-month period at the start of culture activities. The survival rate rises when the fish grow to more than 150g.

The success of the kelompok in Lampung has drawn nationwide attention among relevant parties and it has led to the culture of groupers in different regions of the country.

2) Situbondo

Trial stocking activities of groupers by kelompok in Situbondo are currently underway with the assistance of the provincial Fisheries Office and BAPPEDA. The initial investment costs related to fry and cage facilities and the feed related costs of the project conducted by the provincial Fisheries Office were financed by the said Fisheries Office. In addition, the Kelompok members were paid a salary of Rp.250 to Rp.350,000/month. The members fed the fish and watched the ponds on a rotation basis (2 times/day).

A unique characteristic of this project is that the project facilities belong to the Fisheries Office at the initial start of the project, but the ownership is transferred to the Kelompok with a payment of 50 percent of the sales for three periods to the Fisheries Office by the Kelompok.

Hence culture technology for groupers has been gradually disseminated to the private sector. Presently, the issues are the non-existence of a system of culture technology extension to other regions and a low production volume of seeds that has been unable to meet the demand.

2.5.3 Extension System of Aquaculture Technology

An extension system of aquaculture technology in the study area is slotted into a part of fisheries extension system which is mentioned on "2.9.2 Fisheries Extension". Only few mariculture activities are carried out in the study area, and extension activities is also not conducted. Therefore, technical extension process of "Multispecies Hatchery Project" which was implemented from 1994 to 1999 in the Gondol Research Institute for Mariculture is studied as a case study. The technical extension process of "Multispecies Hatchery Project" divides into two, one is governmental activities and the other is its on private bases.

The Gondol Research Institute for Mariculture conducts training for officials of (IPPTP) and aquaculture centres / stations. Results of "Multispecies Hatchery Project" also were extended to aquaculture sector through this training.

In general officers in Indonesia are permitted to work outside the officer hours. Some staff members in the Gondol Research Institute for Mariculture has started seed production business of milk fish as a side job when the Gondol Research Institute for Mariculture developed seed production technology of milk fish in 1980s. These members hired village people as workers, as the staff members have to work in the Gondol Research Institute during office hours. Low cost milk fish hatchery and seed production technology for inexperienced fish farmer were established through this process. Many of villagers started seed production business using this hatchery model and seed production technology.

The staff members also started to produce grouper seed using milk fish hatchery when

the Gondol Research Institute for Mariculture established seed production technology of groupers by the "Multispecies Hatchery Project". Due to the high profitability of grouper seed production business, many of milk fish hatcheries in Gondol area changed their target fish to groupers, although the technology of grouper seed production is more difficult than seed production of milk fish. As the result, about 2 million of groupers seed was produced in the Gondol area in year of 2001.

As mentioned above, technical extension to local people in Gondol area was launched through the side business of staff members in the Gondol Research Institute for Mariculture. The seed production facility which is applicable by local people took role of demonstration facility.

2.5.4 Fish Species Suited for Aquaculture in Terms of Cost and Benefits

As explained earlier, despite the existence of established culture technology for a wide variety of fish fry, fry that are cultured by private companies are minimal. This survey study has examined the fish and shellfish species that are suited for aquaculture in terms of cost and benefits, excluding shrimp and milk fish where a culture industry currently exists.

(1) Fish species

Of the fish species listed in section 2.5.2 (2), seed production technology is established for the giant sea perch, the streaked spinefoot, and the grouper species. The profitability of cage culture of these fish species was investigated. Although grouper species can be cultured in a relatively short period of time, the low priced tiger grouper and the high priced humpback grouper with a long culture period were studied.

As shown in Table 2.5.6, the cost of one cage (4x4x4m) and the initial input cost for culture related equipment were about Rp.29 million. The depreciation period of a cage is a minimum of three years. Hence a reserve fund to cover the annual depreciation cost of Rp.9.6 million is needed.

The depreciation reserve fund per 1kg of fish product was calculated based on the production volume per cage unit and the culture period required for the four fish species mentioned above; and the details are shown in Table 2.5.7. Additionally, the operation cost for each fish species (seed purchase cost, feed cost, labour cost, etc.), the total amount of depreciation reserve fund per 1kg, and balanced income and expenditures in terms of retail price are shown in Table 2.5.8. The wholesale price for skipjack tuna was used for the grouper species, but the fresh fish price was used for the streaked spinefoot and giant sea perch since a live fish market is nonexistent. Subsequently, the humpback grouper was the fish species with the highest profitability, followed by the tiger grouper and the streaked spinefoot. Those engaged in aquaculture from each area indicated that the culture of the giant sea perch was not profitable due to its fresh fish price.

The grouper species are exported to overseas live fish markets. Groupers and the

Napoleon fish are shipped from NTB and NTT provinces to mainly Hong Kong and China. The import volume of live fish by Hong Kong in 1999 amounted to about 9,000 tons according to the foreign vessel ship's registry and an import volume of about 4,500 tons according to the domestic vessel ship's registry (see Tables 2.5.9 and 2.5.10). Of this import volume, approximately 40 percent or 5,600 tons was comprised of groupers.

If the culture of groupers becomes widespread in Indonesian and other Southeast Asian nations in future, there is the possibility that the market price may fall due to an oversupply. Therefore, the balance in income and expenditures was calculated based on a 50 percent decrease in current shipping costs. The calculations showed that the humpback grouper remains profitable despite a 50 percent drop in the wholesale price, but the tiger grouper loses its profitability (see Table 2.5.11).

However, under current circumstances where there is a shortage in the supply volume of grouper seedlings and the culture technology has not been disseminated, the cultured production volume is not anticipated to increase suddenly within a short period of time. Therefore, the humpback grouper and the tiger grouper will remain species that are suited for the aquaculture industry.

However, Bali Island, a major tourist spot, is also a large potential live fish market. Presently, the market price of the tiger grouper as live fish in the Denpasar market is about Rp.70,000/kg. If stable production of live fish is achieved, it will also be a supply source for the domestic market.

(2) Seaweeds

The cost of seaweed culture using 7m² bamboo rafts is Rp.306,000 (see Table 2.5.12); and the cost of seaweed culture using long lines is nearly identical. The bamboo rafts can be used in four cycles and long lines last about four to five years. Hence after two years of culture activities, the total cost, comprised of the purchase cost of seaweed seeds and the set up cost, is about Rp.200,000.

Following a 30 to 45 day stocking period, seaweed amounting to a dry weight volume of 71kg is harvested. If the purchase price is estimated at Rp.3,500/kg, a profit of about Rp.248,500 is generated. However, due to the severe fluctuation in the wholesale price of seaweeds, profitability is lost at certain times of the year. Some of the NTT districts began seaweed culture activities, but failed when buyers did not appear.

Although there are some problems related to drying methods, seaweed culture technology is well established. The culture period is short and is suited for small fishermen. However, the selection of the culture site is important and adequate circulation must exist.

2.5.5 Aquaculture in NTB and NTT

(1) Transitions in Culture Production Volume

The production volume of brackish water pond culture in NTB and NTT rose from 5,045 tons in 1990 to 7,739 tons in 1999. More than 90 percent of the production volume is generated by NTB province and NTT's aquaculture activities are extremely minimal (see Table 2.5.13). The major production regions in NTB are Bima, Sumbawa and Dompu districts. Aquaculture is not conducted in the districts of Ende, Sikka, and East Flores Island in NTT and production statistic records are nonexistent.

Production volume statistics according to cultured fish species show that the production ratio is nearly the same in all the districts for both fish (mainly milk fish) and crustaceans (mainly giant tiger prawn). However, the about 90 percent of the production volume in East Lombok district are crustaceans and fish species comprise nearly 100 percent of the production in Bima district (see Tables 2.5.14 and 2.5.15).

Nearly 97 percent of the pond area is also found in NTB. The pond area nearly doubled from 4,855ha in 1990 to 10,556ha in 1999 due to two aquaculture projects that were implemented in NTB in 1999 (see Table 2.5.16). One project was implemented by the West Lombok district Fisheries Office in Sekotong Tengah. These brackish water ponds are managed by an individual aquaculturalist. But due to the mainly traditional extensive culture method employed, productivity is not very high. The other project was implemented in Pototano and aimed at developing brackish water ponds for the immigrants in Sumbawa district from the other islands.

A large disparity in the productivity of brackish water pond culture exists according to district. Although the yearly fluctuations in production is great, production ranges from 1 to 2 tons/ha in NTB, excluding Dompu district (see Table 2.5.17). In contrast, the productivity in many districts is below 500kg/ha due to the traditional extensive culture that is practiced.

The productivity in both the West Lombok and Sumbawa districts dropped abruptly in 1999. Despite the increased area of culture ponds due to the projects mentioned above, decreased production was caused by the inadequate production activities of these ponds.

Mariculture statistics show only the production volume of seaweeds and the pearl oyster (see Tables 2.5.18 and 2.5.19). However, production data for seaweeds after 1997 do not exist in NTT and recorded data for the pearl oyster are nonexistent. Seaweed production volume is also much higher in NTB and the production volume in NTT was less than 7 percent of the production volume in NTB. The major seaweed producing districts in NTB are Sumbawa and Central Lombok. Pearl oyster culture is mainly carried out in Sumbawa and Bima districts.

(2) Status of Aquaculture in NTB

The NTB province is comprised of the Lombok and Sumbawa islands. In addition to

the Lombok Aquaculture Station mentioned above, aquaculture is also taught at the Fisheries Department of Mataram University 45 in Lombok.

In contrast, the aquaculture industry is limited to the culture of seaweeds and the pearl oyster in the NTB province and mariculture statistics are limited to data on these two products. Trial culture of groupers species has been conducted by the provincial Fisheries Office and the university, but the results have not been successful to date.

1) Brackish water pond culture

The culture production volume according to fish species in 1999 were mainly comprised of the milk fish for fish species and the giant tiger prawn for crustaceans (see Table 2.5.20). Approximately 4,430 aquaculture fisher households are engaged in brackish water pond culture activities of which half or 2,659 households are concentrated in Bima district. The culture pond area of the majority of these aquaculture households is under 2ha and they are small-scale operations (see Table 2.5.21). Giant tiger prawn culture activities range widely from small operations that utilize brackish water and natural seeds, which are reared in ponds according to the traditional extensive culture method, to aquaculture farms where intensive culture is carried out using fry purchased from hatcheries. Additionally, there are two types of aquaculture operations - one that only cultures prawns and the other which rears a mix of prawns and milk fish (see Table 2.5.22). The seed price of milk fish and the market price of adult fish are both declining recently. According to aquaculturalists engaged in intensive culture on Sumbawa Island, milk fish is not cultured due to the unprofitability of feed culture. Moreover, prawn culture is completely led by the private sector and the District Fisheries Office does not provide technical assistance for prawn culture. Technical transfer activities in prawn seed production is also completely conducted by the private sector. Some fishermen begin backyard hatcheries by initially working for a prawn culture company and learning seed production techniques there prior to becoming independent. Brackish water pond culture is conducted year-around in NTB province and consistent production volume for each quarterly term has been achieved (see Table 2.5.23).

2) Seaweed culture

Seaweed culture technology is facile and the initial investment cost is minimal. The culture period is short and seaweed is harvested every 30 to 45 days. Due to these advantages, District Fisheries Offices in NTB implemented many seaweed culture projects. In addition, private companies (seaweed processing factory) also invested initial cost to Kelompoks which implement the seaweed culture. Now a day, seaweed is widely cultured in Sale and Waworada Bays and it has become firmly established in many fishing communities due to seaweed culture projects implemented by the District Fisheries Office. However, many projects getting assistance from private company have also been terminated due to a breach of contract by fishermen who sell their products to buyers other than the investor buyer. The seaweed farmer dries produced seaweed and sales it to seaweed collector in the village. The village seaweed collector sells these products to large scale collector in the area. The product is finally sold to processing factories in Lombok and Surabaya through these seaweed collectors.

One of the major problems faced by fishermen engaged in seaweed culture is the large fluctuation in selling price that occurs seasonally and in different regions. Fishermen were asked about price fluctuations for the past one year period in the survey study and it was found that the difference in the price for dried seaweed was more than double and ranged from Rp.4,500 to Rp.2,000/kg. Many sea weed farmers interviewed in the field pointed out that Rp.2,500/kg was a break-even point of sea weed culture.

There has been an occurrence of the disease, ice-ice in Sare and Dompu Bays. Generally, this disease occurs in water areas with low salinity levels and poor circulation. In ocean areas where Ice-ice occurs frequently, the suitability of the area for seaweed culture must be studied very carefully.

3) Mariculture /Live fish shipment

Live fish buyers will stock high-priced fish such as the Napoleon fish and groupers, caught by trap and/or hand line, in cages for a short period of time in Sale and Sape Bays until the fish reach market size, although there are no mariculture activities in NTB. The live fish buyers in each areas sale collected live fishes to live fish transportation boats which dispatched by fish exporters, and make rounds in these water areas periodically. The many fish exporters who operate in the study areas are based in Denpasar, and export collected live fish to Hong Kong and China.

Purchase price of live fish from fishermen is much higher than it of fresh fish, and it is differences on the price between fish species. Wholesale price of fresh groupers in NTB is about Rp.10,000 to 15,000/kg, and no difference between species. In contrast, wholesale price of live groupers is much different from Rp.30,000/kg of tiger grouper, Rp.90,000/kg of coral trout (*Plectropormus* spp) to Rp. 150,000/kg of humback grouper.

The purchase price of the fish exporter in Denpasar was US\$ 9/kg of tiger grouper and US\$35/kg of humback grouper. According to the fish exporter, the buying price of live fish by the shipping vessel visiting each site in NTB and NTT provinces is about 10 percent lower than the price in Denpasar, due to the transport cost that is incurred. However, the buying price of live fish from fishermen is about one-half the price given above; because of high ratio of the fish that is sold by the fishermen perish and on average, 25 percent perish before they are shipped.

4) Others

Pearl oyster culture is conducted by private companies in each district. In recent years, projects by the provincial and district Fisheries Office have assigned fishermen to rear pearl oyster spats, which are then purchased by culture companies. However, many fishermen are unable to produce oysters of the quality that is in demand by companies.

There is trial experiment of sea cucumber culture implemented by Kelompok in Sumbawa, but never succeeded.

(3) Status of Aquaculture in NTT

1) Brackish water pond culture

In contrast to NTB province, brackish water pond culture and mariculture remains undeveloped in NTT province. A minimal amount of extensive milk fish culture is conducted in Manggarai and Ngada districts, but prawn culture as an industry is nonexistent. According to the Ngada district Fisheries Office, many prawn companies have visited the district to study its potential as a culture site, but due to the undeveloped electricity, roads, and water related infrastructure, all of the companies abandoned the district as a potential culture site. This was especially notable for the four districts of Ende, Sikka, East Flores Island, and Lembata, where aquaculture is nonexistent.

The fish framers in Manggarai and Ngada conduct only extensive culture, and fish farmers interviewed during field survey don't grasp their own production volume. The fish trading volume in market in NTB and NTT depends on the catch volume of Bagan. Therefore, fish farmers in Manggarai and Ngada ship their milk fish to the market during full moon period when production volume of Bagan decreased.

2) Seaweed culture

Seaweed culture is carried out in Gata, Liun, Sikka, and Pulau Busar districts, but the scope is small in comparison to NTB. One of the problems is the non-existence of a marketing route for the products. The East Flores District Fisheries Office implemented a seaweed culture project for the fishing communities on the northern coast of Handin harbor, but due to the lack of buyers, the project has failed.

3) Mariculture/Live fish shipment

In the area of mariculture, there is less water area suited for mariculture in contrast to NTB province. Wide bays such as Sare and Waworada in the NTB province do not exist in NTT province and many of its water bodies are affected by the east, west monsoons. The channels between islands are also deep. The only area of water that is adequate in scope for aquaculture is located around Labuan Bajo in Manggarai district and the channel to the east of East Flores district. There are also areas around Komodo Island offshore from Labuan Bajo that are also suited for aquaculture, but due to the designation of the area as a national park, aquaculture activities are banned. Other water areas suited for aquaculture are located within the small bay along the northern coast of Flores island. Presently, cage culture of groupers is being carried out in Labuan Bajo (NGOs), Ende district, and Kota Balu (private company). In February 2001, BAPPEDA provided fishermen with cages to conduct stocking activities of natural grouper fry in Manggarai district. However, due to repeated failures, the project was not in operation at the time of the field survey in August 2001.

In addition, small activities to rear sea cucumbers in pens and brackish pond culture have been carried out by several districts. But all are still trial activities and they have not made the transition to commercial production.

(4) Advantage of aquaculture

The Advantages of brackish water pond culture and Mariculture in NTB and NTT are as follows.

1) Difference of wholesale price of high marketable fish

Wholesale price of fish landed on NTB and NTT ranges from Rp. 4,000 to 20,000/kg, and large difference isn't shown between species, and also between regains. In addition, any additive value for live fish also isn't shown, and the live fish sales almost same price as fresh fish. In contrast, wholesale prices of the live fish exporter in the region are much higher, for take instant Rp 30,000/kg for Tiger Grouper, Rp 90,000/kg for coral trout, and Rp 150,000/kg for Humpback Grouper.

It is said that the Mariculture targets high marketable fish is one of the feasible method for increasing income of artisanal fishermen.

Most of these high marketable live fishes are exports to Hong Kong. However, the planning area locates next of Bali Island, the largest resort island in Indonesia and large number of sea food restaurants run. These high class restaurants in Bali would also be one of the sales targets of live groupers, when the planning area products live fish constantly.

2) Selling Aquaculture Production during Lean Fishing Season

Traditional extensive culture and fertilizing culture of milk fish are conducted in the study areas. Although the wholesale price of milk fish is not expensive, there are some cases which are taken a sales strategy to adjust the needs of market.

Fish landing volume in the survey area has been influenced by the phase of moon, and decreases sharply during full moon period. As the result, wholesale price of fresh fish increases due to insufficient supply of fish to market. Milk fish farmer supplies their product to the market during the full moon period only. Thus the fish farmer increases their profit, and market also is supplied fresh fish constantly. Brackish water pond culture which can adjust supply volume of fish to market during lean period of catch is one of the effective method for constant supply of fish to the market.

(5) Development of Aquaculture Technology and Extension System

1) Lombok Aquaculture Station

The Lombok Aquaculture Station, a DGA aquaculture research institute, is located on Lombok Island in NTB province. It is in responsible for conducting mariculture activities and extension activities in seed production technology in both the NTB and NTT provinces. The fish species targeted for culture by the center as of the study survey period in July 2001 are shown in the table below.

Fish Species	Level of Culture Activity
Humback grouper	Achieved successful trial seed production activities. 500 fry (4cm-5cm) were produced last year.
Tiger grouper	Presently at the rearing stage of adult fish and seed production has been unsuccessful.
Giant sea perch	Seeds are not produced due to low price despite the existence of an established seed technology.
Napoleon fish	Seed production activities have been unsuccessful.
Abalone	Although trial seed production activities have succeeded, large scale production has not been carried out.
Seaweed	Seaweed is cultivated at the station and sold to buyers.
Pearl oyster (<i>P. Maxissima</i>)	Trial seed production activities are planned.

The Lombok Aquaculture station is under the Lombok Aquaculture Center or Situbondo Aquaculture Center and the technical level is low. In principle, it is responsible for aquaculture extension activities in NTB and NTT, but it has been unable to fulfil that role.

(6) Aquaculture Extension System of the Fisheries Office

An aquaculture section exists within the district Fisheries Office and provides technical guidance for aquaculturalists. The fisheries officer at the Agricultural Extension and Information Center under the Agriculture Office collects data on aquaculture production data from each village community.

The technical aquaculture extension activities conducted by the district Fisheries Office include training using the demonstration culture ponds and training for fishermen in each region when an assistance project is implemented. However, according to information collected in the interview survey conducted in this study, the technical assistance provided by the Fisheries Office in Lombok was limited to explanations on technical concepts and practical guidance was not provided.

Staff members from each district Fisheries Office also undergo training to improve their technical knowledge on aquaculture at the aquaculture centres in Lombok, Situbondo, and Jepara. However, the district Fisheries Office has also concluded that the technical expertise of the Lombok Aquaculture Station was low and it has not sent their staff members for training there.

2.5.6 Development Potential Area

The Indonesian government conducted a nationwide evaluation of the fishery resources according to ocean area. Based on the resource survey findings, the DGCF set up the appropriate aquaculture species by water bodies

Water bodies	Bottom condition	Water depth	Distance from coast	Target species
Brackish water	Sand/mud	5 to 30 m	-	Giant sea perch
		0 to 5 m	-	Cupped oyster, Blood cockles
Sea water	Sand/mud	1 to 6 m	-	Sea cucumbers
		5 to 30 m	-	Grouper
	Coral	0 to 5 m	-	Pearl oyster, Abalone
		-	1km	Sea weeds

Source: Potensi Lahan Pengembangan Budidaya Pantai dan Laut Indonesia, 1997/98,
 Proyek Pengembangan dan Pemanfaatan Sumberdaya Perikanan Laut, Direktorat Jenderal Perikanan

The provincial Fisheries Office in both NTB and NTT calculated the potential area for aquaculture development within the provinces separate from the national survey findings. However, a calculation standard for the potential development area of each district does not exist and the figures are a compilation of values calculated according to the individual district officer-in-charge. Each district officer visited his respective district and estimated the fishery product composition and the existence of culture facilities (if groupers were being landed, the potential culture of groupers was indicated). These statistics also included the findings of past trial culture activities implemented in each district and the data of private aquaculture operations. Therefore, they do not reliably reflect the current state of culture activities in the district. The national survey findings do not include data on sediment according to fish species or standards on water depth and also contain many areas that need to be improved.

The potential area for aquaculture development according to fish species and each district Fisheries Office is shown in Table 2.5.24. However, according to the statistics on the depth of each water body, many areas within the harbours are more than 30m deep. The suitable depth for cage culture ranges from 12 ~ 25m; subsequently, it is deduced that the actual area of water with development potential is much smaller.

In actuality, due to the lack of basic data such as water quality, sediment, and current in each ocean area, it is difficult to estimate the potential area for aquaculture development.. Therefore, the water areas suited for potential cage culture activities was estimated from the viewpoint of natural conditions and location of existing cages which confirmed by field survey are shown in Fig. 2.5.1.

In addition to the water areas shown in Fig 2.5.1., there are small areas suited for cage culture along the coastal frontage of each village. Installing the cages in the shallow areas can carry out aquaculture. But the fish species that can be cultured in areas such as the river mouth, where there is an inflow of inland water, will be limited due to the low saline concentration.

Mariculture remains undeveloped in the NTB and NTT provinces and fish feed, equipment, materials, and other aquaculture related industries do not exist. Therefore, fish feed for cultured activities must depend on the trash fish that is caught in the frontage waters along the coast. In many areas, the fishing method, Bagan, is commonly used to land trash fish. But the landing volume of trash fish fluctuates greatly throughout the year—decreasing suddenly during the full moon months or during the seasons of the east west monsoons when the ocean is

too rough for fishing operations.

As fish feed must be supplied daily in aquaculture during the initial development stage, the supply volume of trash fish during the lean fishing season must be included in the estimated potential area required to develop aquaculture, in addition to water quality, tidal conditions, and other natural conditions.

2.5.7 Development Issues

As described previously, mariculture has not developed yet in both NTB and NTT. However, live fish shipment system is already established in NTB, and live fish is sold exporter in Denpasar for more than several fold of local market price. On the other hand, certain areas of brackish water ponds are already developed in NTB. Aquaculture production volume would be increased without large amount of initial investment, if these developed ponds are utilised effectively.

The main issues that exist in promoting aquaculture in NTB and NTT provinces are summarized as follows.

1) **Main issues in both NTB and NTT**

a. **Lack of a technical extension system in mariculture**

Aquaculture in Indonesia is centered on brackish water pond culture of milk fish and prawns. Mariculture remains undeveloped in the country and the district Fisheries Office in the study region that possesses knowledge and technology on mariculture were not found.

The district Fisheries Office has implemented various aquaculture projects and in principle, technology transfer is conducted through these projects. However, fishermen engaged in actual culture activities were not observed in the field study. According to fishermen participated the projects, the technical transfer activities referred to by the district Fisheries Office have been limited to explanations of culture methods and they have not included practical, hands-on technical transfer activities.

Although cage culture technology for groupers is well established outside the region, the provincial and district Fisheries Office does not possess adequate knowledge and technology on mariculture; and measures to introduce this information have not been implemented. A technical extension system for mariculture is nonexistent in both NTB and NTT provinces.

b. **Low productivity of brackish water pond culture**

In Taiwan and the Philippines where fertilizers are efficiently utilized, an annual production volume of milk fish ranging from 2,000kg to 2,500kg/ha has been recorded. In the study area, a consistent production volume of 2,000kg/ha has been achieved in Bima district. But as shown in Table 2.5.17, the productivity of brackish water pond culture in most of the districts is under 1,000kg/ha. In districts with a production volume of under 500kg/ha, it is deduced that culture without fertilization is conducted. Productivity levels abruptly dropped in

West Lombok and Sumbawa districts in 1999. This is due to the extremely low productivity of the culture ponds that were built in 1999.

Measures to raise the productivity of these culture ponds should include the introduction of culture methods from high productivity districts such as Bima.

c. Lack of disease countermeasures

There has been an onset of disease in the intensive prawn culture and seaweed culture industry on Sumbawa Island, but due to the lack of technical knowledge on culture-related diseases by the provincial and district Fisheries Office, a system of disease identification and prevention is nonexistent. In conjunction with efforts to promote mariculture, the importance of disease countermeasures will increase.

The Lombok Aquaculture Station has the potential to cope with this problem in the region, but presently, it lacks the equipment and human resources that are needed. Although the Gondol Research Institute for Mariculture is the top-ranking institute for aquaculture disease test activities in the country, a disease testing system for NTB and NTT provinces does not exist.

d. Inadequate supply of seeds

Presently, mariculture activities in the private sector are limited to seaweed and pearl oyster production. In addition to these activities, the Fisheries Office and private operators are conducting trial culture of groupers and the sea cucumber, but these activities have not reached the stage of commercial production. The shortage of a seed supply is one of the factors that have impeded the development of grouper and sea cucumber culture. Groupers are presently cultured in only three districts by the Gondol Research Institute for Mariculture and nearby private seed production farms, the Lombok Mariculture Station, and the Situbondo Brackish Water Pond Culture Center. The number of seeds produced in these three districts is small and it is unable to meet market demands.

Seed production in brackish water pond culture and mariculture in NTB and NTT provinces is limited to the giant tiger prawn and the pearl oyster (by private companies). Seed production of fish species requires the culture of plants and animal plankton, the rearing of fry and many other technical tasks. However, private companies do not possess such expertise and there are no training institutes in the region.

Improving the supply of seeds is a major issue that must be resolved in order to promote aquaculture in the NTB and NTT provinces.

e. Lack of basic information

As explained earlier, despite the required area of water needed to develop aquaculture activities listed in various technical reports, a unified calculation method has not been established in Indonesia. One of the major underlying reasons is the lack of data on transitions in the water quality and ocean conditions of each region for consecutive years. This data is

essential in selecting the fish or crustacean species that will be cultured. In addition, the currently available data on water body area suited for aquaculture development is based solely on topographical conditions. Electricity, roads, and other basic infrastructure are major factors in selecting aquaculture sites.

Culture projects that have failed due to cage nets torn by rough waves or the remote location of the culture site and poor roads were observed in the field study.

In addition, since grouper and prawn culture activities target the export market, it is risky to prepare an aquaculture development project based solely on the area or dimensions of the potential site. For example, seaweed is cultured in the Philippines, Malaysia, and Tanzania. The supply and demand of the international market for exported seaweeds is balanced and sudden increases in the demand are not anticipated. Therefore, it is important that a development policy for exported seaweeds is formulated based on an adequate understanding of market conditions. However, the provincial Fisheries Office presently does not have information on market conditions and basic data is not available.

f. Required production volume from the marketing viewpoint

Because no live fish market exist in NTB and NTT provinces, products must be sold to the live fish shipping vessel that regularly makes its rounds of the production sites, if high-priced fish such as groupers are cultured. Hence road conditions are no longer an important criterion in the selection of a culture site.

However, the minimum purchase volume of the live fish shipping vessel is 200kg. Therefore, culture farms must produce a shipment volume of more than 200kg per trip.

2) Main issues in NTT

a. Limited productivity of trash fish for feeding

There is less water area suited for mariculture in contrast to NTB province. The only area of water that is adequate in scope for aquaculture is located in Manggarai district and the channel to the east of East Flores district.

Many fishing villages scatter along the channel to the east of East Flores district, and fishermen land their catches on the front beach of villages. Trash fish landed on the beach is used for feed for mariculture, when artisanal fishermen engage in mariculture. However, productivity of the trash fish are influenced on the production volume of Bagan, and it reduces sharply during full moon period. Therefore, productivity of trash fish during full moon period becomes a important key factor to decide available farming volume of fish in the village, in case of village that couldn't purchase trash fish from neighbouring villages because of bad road condition.

b. Limited marketing network

As mentioned earlier, due to the poor road conditions in NTT, seaweed culture in remote communities failed due to the lack of buyers. Prawn culture businessmen from other provinces visited NTT to review potential culture sites, but due to the inadequate state of the

infrastructure, the idea was abandoned.

Due to less farming activities in NTT, any necessary equipment and medicines should be purchased from Surabaya. In case of mariculture (feeding culture), ice or refrigerator / cold storage is required to keep trash fish. However, ice supply volume is quite low in eastern area of Flores Island, and many villages are not electrified yet. Quality control of feed is also one of important factor development in these villages. Thus, lack of infrastructure is one of the constraints for the aquaculture.

In addition, final processing of the products of sea weed culture in the study area is done in Jakarta and/or Surabaya. NTT is located further than Bali and Sumbawa from the final processing points. Therefore, it is said that the NTT is at a disadvantage for sea weed development due to higher transportation cost than other areas.

2.6 Fish Marketing and Processing

2.6.1 Fish Marketing

(1) Fish marketing system and distribution area

1) Fish distribution channel and methods

The participation of women in local fish marketing activities is prevalent in most of the fishing villages in the study area. However, their range of activity is limited not only in scale (dealing volume: less than 50kg/person/day), but also by the distances to the market (within 2 hours by vehicle). In general, village women play a key-role in fish marketing in the rural areas where the activities of fish traders/collectors are very limited. On the other hand, fish traders/collectors are engaged in large-scale fish distribution activities from major fish landing places to the markets. The major fish distribution channels in the study area can be divided into six types as shown in the table below (See Table 2.6.1 for details).

Type	Channel	Dealing Volume per person	Remarks
A	Fishing boat -> (Boat Owner's wife) -> Village woman - Consumer	Less than 50 kg/day	Bagan/Purse-Seine: Boat owner's wife has the right to sell fish. Hand-line/gill-net: Direct selling by fishermen wives
B-1	Fishing boat -> Fish vender -> Consumer	Less than 50 kg/day	Vending mainly by men using motorcycles or bicycle
B-2	Fishing boat -> Beach trader -> (retailer in market) -> Consumer	100-300 kg/day	Dominated by medium scale traders (both women and men)
B-3	Fishing boat -> Fish agent -> Beach trader/Retailer -> Consumer	500 - 3,000 kg/day	Receives the entire catch of boats (mostly large-scale boat owners), wholesale to trader/retailer or transport to market by himself.
B-4	Fishing boat -> Fish collector (boat) -> Beach trader/Retailer - Consumer	500-1,000 kg/day	Random collection of fish from fishing boats at sea, wholesale to trader/retailer.
C	Fishing boat -> Fish collector/Fishing Company -> Inter-Island/Export markets	Depends on scale	Collect fish from fishing boats on a contract basis, and ship to markets.

The boat owner (or his wife) decides who the fish catch is sold to, with the exception of fishermen who are contracted to a fish collector. The catch is paid for in cash by buyers in face-to-face price negotiations. An auction-like system for each fish catch has already been introduced at some fish landing sites. Most of the fishermen who are contracted to a fish collector are given financial assistance (for fishing gears) and are obligated to sell their entire catch to him. Under current circumstances where the support is for small-scale fishermen by the government is limited, fish collectors are important partners for fishermen and play an important role in ensuring a stable fish production, additionally, most of the collectors are local people.

2) Range of fish distribution

Fish distribution in the study area is generally limited to each district and it is centered on the district capital as the main market. Due to the lack of infrastructure for fresh fish marketing and the insufficient transportation network, fresh fish has to be principally distributed to consumers. This is one of the major constraints that have impeded the widespread marketing of fresh fish.

On the other hand, the inter-island fish marketing in the study area is conducted only through a network of existing fish collectors, and consists of a) frozen tuna/skipjack directly exported from the eastern part of Flores and Timor (Kupang), b) demersal fish (live and fresh) transported and exported via Denpasar and c) dried fish supplied to Java. An outline of the currently conducted inter-island fish marketing is as follows.

Type of Fish	Destination	Major Collecting Area	Shipping Method
Fresh demersal fish	Denpasar (to Hong Kong, Taiwan)	Western Region (up to Labuan Bajo)	By truck (twice a week), Partly by air.
Alive demersal fish	Denpasar (Hong Kong, Taiwan)	East coast of Lombok, North Coast of Sumbawa (Alas - Teluk Saleh), North coast of Flores (Lb. Bajo - Maumere)	By collecting boat (twice a month/place), By alive fish transport vehicle (Sumbawa)
Frozen tuna / skipjack	Java Japan (export)	East Flores (Maumere, Lantang)	To Java: Inter-Island cargo / own transport vessel To Japan: Refrigerated trumper
Dried fish / squid	Java	Sape (Bima), Labuan Bajo (Manggarai), Selat Selor (Flores Timur)	Sumbawa: By truck Flores: By Inter-Island cargo
Dried seaweed	Lombok (Mataram)	South coast of Lombok, Teluk Saleh (Sumbawa)	By truck

Note: Details are as shown on Table 2.6.2.

As shown in Figure 2.6.1, overall fish production and distribution in the study area are generally distributed from west to east. Taking into account the conditions as described earlier, the per capita fish consumption of the entire study area in 1999 was estimated at 21.4 kg/year exceeding the national average (19 kg), but largely varies by sub-areas. Sumbawa (50.6kg) and Alor (40.8kg) enjoy extremely high fish consumption, while it is lower than the national average in the western part of Flores (11.1kg), Lombok (12.9kg) and Sumba (12.5kg) (See Table 2.6.3).

3) Fish price

The price of fish for the local market is negotiated between the fisherman and fish buyer based on their intuition of the recent fish landing status. The price difference between the high and low fishing seasons is about double. There is no price difference in terms of fish freshness or quality at the landing site, since all the catch are from one-day or one-night fishing. Nevertheless, prices differ according to species and size. Regionally, the buying price at remote fishing villages is rather low due to the high marketing risk with that of urban fishing villages. In addition, the difference between the beach price (fishermen's price) and retail price is about 1.5 to 2 times, because of the higher risk margin of fish sales. The price of fish also differs by size and quality. Adult fish is about 30 to 50 percent higher in price than juvenile fish, while the fish landed the previous day tends to sell by about 20 percent less.

In contrast, fresh fish for export is basically transacted at a fixed price that has been agreed on between the fish collector and the contracted fishermen, based on the potential loss incurred by international market price fluctuations and foreign exchange rates. Fish price is determined according to species, size, and quality, but differ depending on the site and fish collectors. As in the case of locally sold fish, the marketing margin becomes higher as the distance and transportation time become longer, in order to lower the risk.

The price (June to July 2001) of major species sold in the local market as well as for export is shown in Table 2.6.4.

(2) Fish transportation

Fish is generally transported from the fishing village to the nearby market by public bus or mini-bus. Due to the road conditions and the higher price of fuel in the rural areas, the transport cost is relatively expensive and public transportation is limited in the remote villages. Fish is also distributed to inland villages (mountainous area) around fish landing sites by motorcycle or on foot. In the case of fish traders dealing in more than 200kg/person/day, chartered vehicles are sometimes used by a group, but these efforts are limited since it takes more than 2 hours to reach the wholesale market. Table 2.6.5 and Figure 2.1.4 show the main routes, required times and method of transportation in the study area.

(3) Supply and use of ice

Excluding block ice that is supplied to contract fishing boats by fishing companies or collectors, the ice supply is extremely limited and is ice sold in plastic bags produced by small domestic freezers. Thus, the absolute volume of ice is limited and sold at extremely high prices (Rp.330-500/kg in Sumbawa, Rp.660-1,000/kg in Flores) in comparison to block ice (Rp.150-200/kg in Lombok, Rp.120-150/kg in Bali/Java, refer to Table 2.6.6.)

1) Ice for fishing

Ice is seldom used by small-scale fishing boats in the study area, because fishing

operations are limited to one-day or one-night fishing. The fish appears to be relatively fresh at fish landing sites despite being kept onboard without ice as in the case of one-day (night) operations. However, fish that has been landed 5 to 6 hours after the first catch are also included, so it is surmised that there are some adverse effects in maintaining fish freshness during the post-harvest stage. In general, it is difficult to ascertain the level of fish quality, therefore the price of fish is the same irrespective of whether ice is used or not for one-day (night) fishing. This is one of the main reasons why ice is not used by small fishing boats, as well as the cause of the shortage of ice and scale of fishing boats.

2) Ice for fish marketing

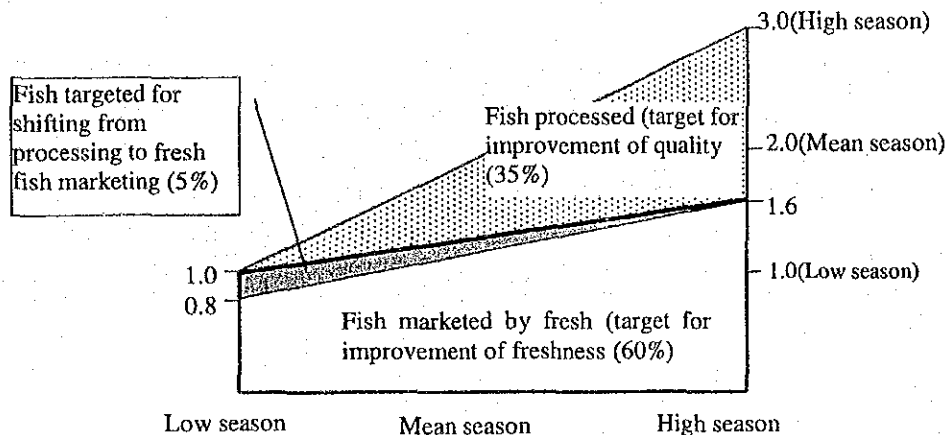
The ratio of ice to fresh fish for local consumption becomes lower from the western to eastern areas of the study region (Sumbawa, 30-60 percent, Flores, 10-25 percent regardless of the means of transportation and preservation). In addition, the cool box (insulated fish box) is rarely used in local marketing. Fresh fish that is kept for one night at home are maintained in a plastic container with a little ice and covered by a blanket. Small-scale fish retailers (village women) at Banyuwangi market (East Java) use cool boxes with a 100 percent ratio of ice while selling the fish, but nobody uses cool boxes in the markets of the study area. Furthermore, in the case of fish landed in the early morning, ice is not generally used transporting fish to a market that is within 2 hours, but it is added at the market. It seems that village women feel that it's better to expend their energies selling fish rather than wasting time packing the fish in expensive ice.

According to the results of the questionnaire survey of fish traders/retailers that was conducted in this study, about 70 percent of the respondents pointed out the lack of ice, fish preservation, and maintaining quality as technical problems. Improvements in fresh fish marketing and processing technology are mostly needed (see Figure 2.6.2 for further details).

2.6.2 Fish processing

Fresh fish is mainly marketed in the study area, and only unsold surplus fish is used in traditional processing (mainly salted/dried fish). The ratio of processed fish appears to be linked to the scale and distance to the local market. Processed fish is available even during the low fishing season at the villages, which are more than two hours away from the capital market (about 50 percent of the fish catch is dried). In addition, the isolated small islands have no other means of processing dried fish, even high-value demersal fish. In some regions, about 50 percent of the total catch is processed during the peak fishing season for small pelagic fish.

Based on all these factors, at least 40 percent of the annual fish landing volume is utilized in traditional processing.



Quantitative Model to Improve Freshness and Quality of Fish Catch

In addition to the main salted/dried fish processing method, several other traditional methods exist in the study area; namely, salted/boiled (locally called as “Pindang”) in Lombok, salted/grilled (“Pindang Selepi”) in the south coast of Sumbawa Island, using eastern little tuna (Tongkol), scad mackerel (Layang), and others. These processed fish products can be normally kept unrefrigerated for about one week, and they are widely consumed by the people in Java, Lombok and Sumbawa.

The major problems in fish processing are as follows.

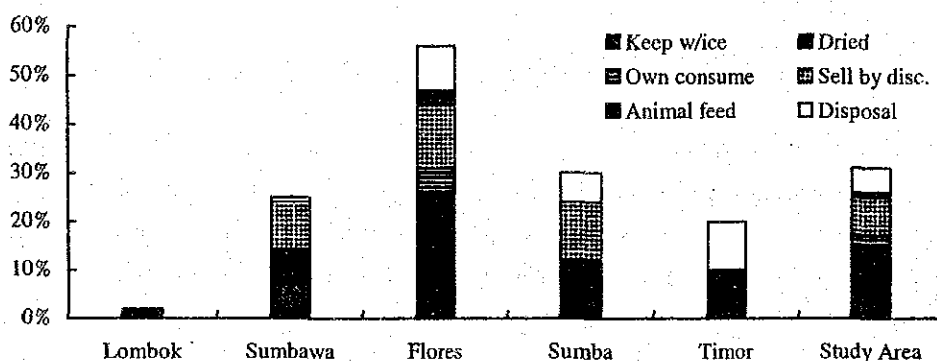
- It takes about one week to dry fish outdoors during the wet season (normally 1-2 days), which is also the peak fishing season for small pelagic fish. Due to limited space and manpower, it is difficult to dry the fish adequately, resulting in lowered quality.
- The areas where processed fish products are distributed are limited due to the lack of adequate packing and appropriate advertisement.
- Limited fish processing methods creates stiff competition and low market prices.

2.6.3 Economic Loss during Marketing and Processing Stage

Due to the lack of ice and fish preservation facilities in the study area, unsold fish must be salted/dried or sold at a discount. The price of salted/dried fish is about 50 percent less than the price of fresh fish according to raw fish weight. In particular, since salted/dried fish become abundant during the peak fishing season and is difficult to sell at the local markets, most of the fish are sold to large-scale fish traders at further discounted prices. Even though fresh fish can be kept overnight, the fish quality drops due to inadequate preservation methods. Therefore, the selling price is about 20 percent lower. Furthermore, it is difficult to maintain the quality of

salted/dried fish which results in lower prices because the wet season overlaps into the peak fishing season.

According to an interview survey of traders during the field survey by the study team, unsold fish was not thrown away. About 30 percent of the respondents said that they have had leftover unsold fresh fish, and only 1 percent of the respondents stated that they disposed of the fish. In an analysis according to region, the amount of fish that was disposed was the highest (about 9 percent) in Flores, which also had the highest rate of unsold fish (about 55%), while Lombok's traders seldom faced the problem of disposing unsold fish (only 2%) (see figure below).



Source: Socio-economic survey (June-July 2001) by JICA Study Team

Method of Treatment of Unsold Fish by Region

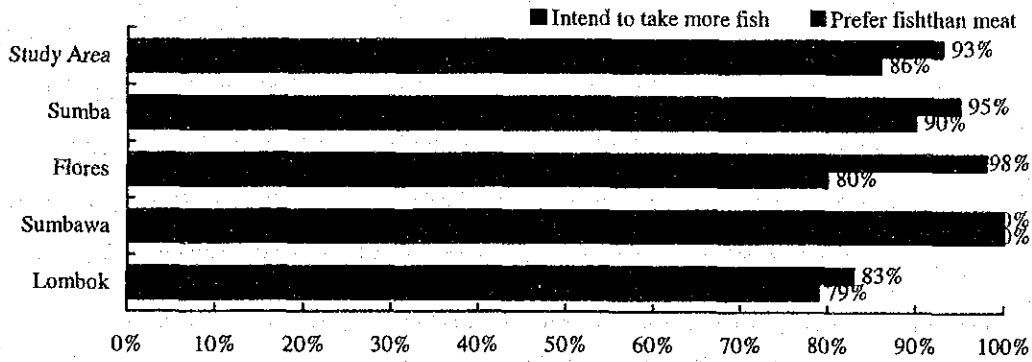
2.6.4 Consumption Trend in Fishery Products

(1) Fish Preferences

Based on the results of a consumer survey at the major fish markets in each district, over 90 percent of consumers prefer fish to meat and over 80 percent would increase their fish consumption if financially allowed. The intake of fish and meat averaged 5 times/week and 1-2 times/week, respectively. The preference for fish appears to be extremely strong among the local population in terms of taste, price and health. In a review according to district, Sumbawa residents consume fish daily (100% preference on fish), while Lombok residents are rather conservative and adhere to the traditional diet (Sasak food mainly served with freshwater fish and chicken) and their preference for fish is slightly lower than other regions (see figure below).

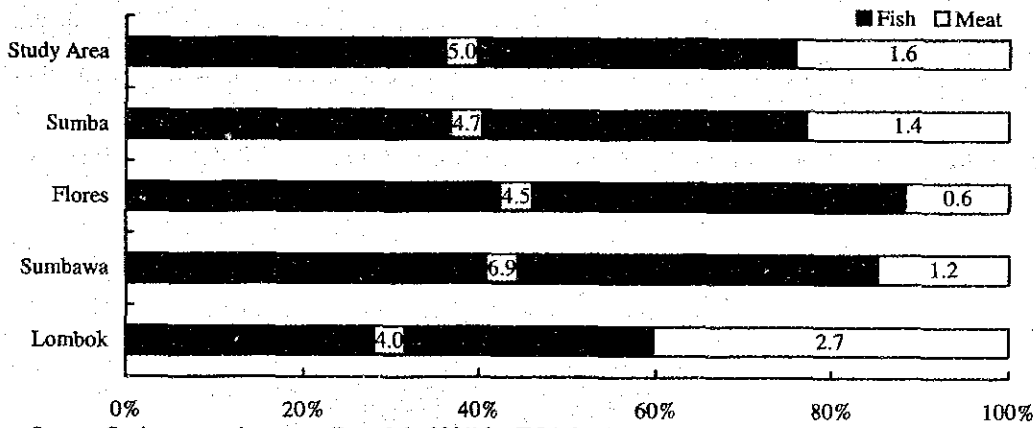
In a review according to type of fish, all regions strongly prefer fresh fish followed by frozen fish (particularly in Flores and Sumbawa). Although the demand for fresh fish is the highest, frozen fish will be consumed by the local population if the supply of fresh fish is limited. Obvious differences in the preference for processed fish have also been observed in the

regions. In Lombok and Sumba, salted/boiled processed fish is preferred, while salted/dried fish are preferred in Flores and Sumbawa (see figures below).



Source: Socio-economic survey (June-July 2001) by JICA Study Team

Preference on Fish



Source: Socio-economic survey (June-July 2001) by JICA Study Team

Frequency to intake fish and meat (times/week)

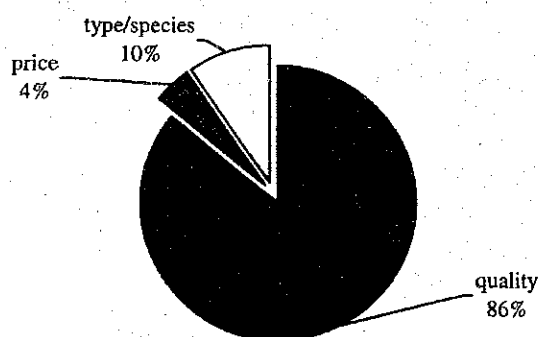


Source: Socio-economic survey (June-July 2001) by JICA Study Team

Preference of Type of Fish (by Region)

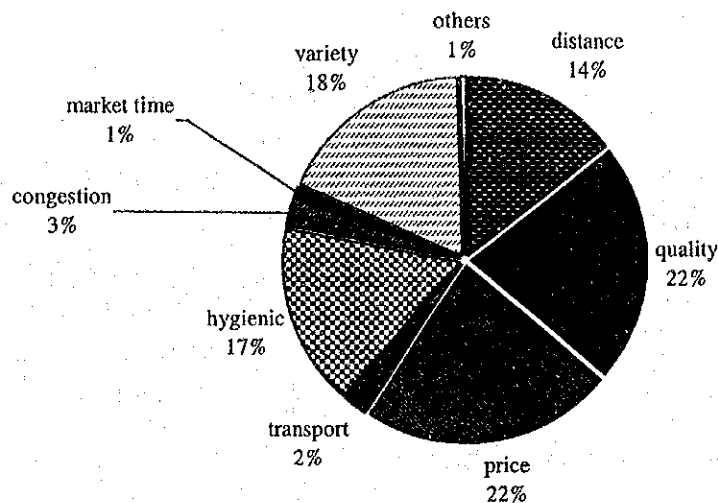
(2) Points to be considered and problems in the purchase of fish

Fish quality was the most important factor according to 86 percent of the total respondents. More than 40 percent of the respondents stated that the low quality of fish, the poor environment of the market (in terms of sanitation and space) were problems in marketing, while others pointed out high prices, a low variety of fish, and the long distance to the market. It was concluded that the foremost priority was to provide consumers with a better quality of fish within the current price levels (see figure below, and Figure 2.6.4 for further details).



Source: Socio-economic survey (June-July 2001) by JICA Study Team

Point to be considered to buy Fish



Source: Socio-economic survey (June-July 2001) by JICA Study Team

Major problems to purchase fish (Whole Study Area)

(3) Fish Retail Areas

According to the results of the consumer survey on major fish markets in each district, almost all consumers (97%) purchased fish at the public market, which showed a higher dependency on fish than meat (69%), rice (67%) and vegetables (83%). The consumers usually buy fish in the early morning at markets close to fish landing sites, and in the late afternoon at the inland markets when the early morning fish catch reaches the markets. These results show that consumers buy fresh fish by going to the markets when it is the optimum time to buy fresh fish.

There is at least one public market in each district capital, and fish is sold in one corner. Fresh fish is usually sold in the aisles and/or outside the market compound under the inferior sanitary conditions. Although this is due to limited market space, this situation is largely caused by the fact that the village women cannot afford to pay the facilities charge because of the minimal sales revenue that they earn due to the small volume that they handle (20-50kg/day). Fish sold at the Pasar Seketeng (Sumbawa Besar) and Pasar Portulando (Ende) are the only markets where fish is sold in a relatively systematic sales area. Sumbawa Besar is the only market in the study area where scales are used to sell fish in kilogram units.

The current situation of major fish markets in the study area are as shown in Table 2.6.7.

2.6.5 Development Issues

The development issues in fish marketing and processing at the study site are as follows.

(1) Economic Loss Due to Drop in Fish Freshness

Despite the strong consumer preference for fresh fish in the local community, a stable supply of fresh fish is unavailable. This is due to shortages in the absolute volume of ice used in marketing fresh fish, high ice prices, deficient fresh fish storage means, and inadequate handling of the fish catch on board the fishing boat. To resolve these problems, appropriate ice prices to ensure a stable fish supply and the development and spread of inexpensive insulated fish boxes are needed. In addition, educational and extension activities to raise consumer awareness about fish freshness among the fish traders and fishing village women engaged in fish marketing activities should be jointly conducted with these measures.

(2) Lack of Adequate Fish Processing Methods

Fish processing methods are extremely limited and with the exception of processed bonito flakes for export produced in East Flores and salt broiled and salt boiled processing carried out in Sumbawa and Lombok islands, dried and salted products are the only major processed products available. Therefore, there is a need to conduct trial production, marketing, and retail activities for new processed products (semi-broiled products, fish balls, semi-dried products) to diversify processed fishery products.

The quality of the existing oil broiled, dried and salted products are inferior, and processing is greatly affected by the rain during the wet season when it is difficult to achieve a high quality dried product. The problem is further compounded by the shortage of manual labor during the peak fishing seasons and the lack of outdoor drying space for the fish, which has made processing a time-consuming and laborious task. As a result, the storage time of the existing dried products is less than one month and short. The retail price is 50 to 75 percent less than the price of fresh fish (fresh fish weight conversion); and it is handled as a B quality product in outside markets. Therefore, space-saving drying racks and extension activities on preliminary processing techniques of raw fish (removal of oil) are needed.

(3) Lack of Efficient Shipping and Transport Means

Small-scale, individual retailers and traders and women from the fishing villages conduct much of the shipment and sale of fresh fish. Joint shipment activities by village women groups from the production site to the market, wholesale activities by village women utilizing their surplus time, and measures to reduce transport costs are recommended.

In addition, the extremely limited means of transportation to the remote fishing villages (especially in the outlying island areas of East Flores), the restricted means of fresh fish shipments, compounded by high transport rates are factors that have impeded fresh fish marketing activities. Supplying fresh fish to the inland areas is also a major issue in addition to shipments to urban markets. Therefore, a multipurpose means of transport used exclusively by the fishing village for fish shipments is needed.

(4) Unsanitary Environment of the Fish Retail Activities

The area of the city markets is narrow, and fresh fish is generally sold along the passageways of the market or in the outdoor un-shaded areas surrounding the market. Subsequently, although the conditions differ at each market, many retailers lay their fish out on the ground under very poor sanitary conditions. In order to establish a sanitary supply of fresh fish, a fresh fish retail area with concrete floors and roof is needed to ensure a minimum standard of sanitation. To expand and improve the market, market user fees should be collected; and the viewpoints of the local retailers, who are the users of the market, should be solicited in the construction and layout of such a facility.

(5) Lack of Market Information

Fresh fish is transported from several production sites and sold in the consumption markets, but the fishing villages at the production site presently have no access to market information in each region. As a result, the fish traders and retailers have absolutely no choice in the selection of destinations and face high risk marketing conditions. To establish a stable fresh fish supply to the markets, the fresh fish-marketing infrastructure described above must be developed in conjunction with a marketing information network.

2.7 Fishery Infrastructure

2.7.1 Current Conditions of Main Fish Landing Infrastructure

(1) Distribution of the fishing ports

There are four types of fishing ports in Indonesia as shown in the table below, and their distribution is shown in Table 2.7.1 and Figure 2.7.1. Most of the ports are concentrated in Java Island.

Type of Fishing Port	Classification	Land Availability (ha)	Size of Fishing Vessels (GT)	Frequency of Fishing Vessel (units/day)	Number of Fish Production (tons/day)
Type A	Oceanic Fishing Port	50	>100	>100	>200
Type B	National Fishing Port	30-40	50-100	50-100	100-200
Type C	Coastal Fishing Port	10-30	30-50	20-50	50-100
Type D	Fish Landing site	10	<30	<20	<10

The fish landing sites in NTB and NTT are shown in Table 2.7.2 and Figure 2.7.2 and are concentrated mainly in NTB.

Number of Fishing Ports in NTB, NTT

Province	Type-C	Type-D (PPI)		Other TPI
		APBN	APBD	
NTB	1 (Labuan Lombok)	6	22	13
NTT	1 (Kupang)	5	-	2

Remarks: Type-C: Coastal Fishing Port, Type D: Fish Landing Place (PPI-Pusat Pendaratan Ikan)
 APBN: National Budget, APBD: Province / District Budget, TPI: Tempat Pelelangan Ikan

Two fishing ports, Labuhan Lombok in NTB and Kupang in NTT are type C used as fishing operation base; the Kupang fishing port was rehabilitated by the SPL22 fund, and the detailed design of Labuan Lombok fishing port for rehabilitation was completed by the same fund. Type-D fishing ports (PPI) are to be allocated either by the APBN or APBD to raise funds for improvement plants. Type-D fishing ports are Tanjung Luar (East Lombok District), Labuhan Mapin (Sumbawa District), Soro Kempo (Dompu District), Soroadu (Dompu District) and Sape (Bima District) by APBN and Teluk Santong (Sumbawa District) by JBIC-SPL Loan in NTB and Labuhan Bajo (Manggarai District), Ende (Paupanda, Ende District), Maumere (Nangafure, Sikka District), Larantuka (Oka, Flores Timur District) and Karabahi (Alor District) in NTT.

(2) Improvement and utilization of fishing port facilities

Almost all the Type-D landing sites (PPI) are extremely old and depreciated that they are rarely used in fishing operations. Even in the case of some of the recently improved PPI, the utilization level is very low, with the exception of Tanjung Luar in Lombok Island, due to the problematic locations, function, structure and management. PPIs have only landing facilities such as jetties and handling facilities and do not have functional facilities such as ice plants, oil facilities, storage, open yards, etc.

Since the fishing port is located in a calm basin, protective facilities like breakwaters do not exist. The landing jetty is generally a T-type pier with the same structure as the commercial harbours and the ferry ports used by large vessels. Therefore, the crown of the jetty at low tide is so high that small fishing boats have difficulty mooring. The fishing boats are anchored in the basin or moved to the beach during the normal break except during fish landings.

The handling facilities are well equipped, but without the ice plant, the functional facilities are inadequate for the distribution system. As Type-D fishing ports are principally PPI (Pangkalan Pendaratan Ikan), the landing facilities have been improved. The auction yards are managed within the PPI or independently, but there are only a few auction yards that are utilized like a PPI.

The funds for a PPI are allocated either by the APBN or APBD, but if it is funded by the APBD it falls under the category of TPI.

The fishing boats that utilize the fish landing places are motorized boats, Bagan boats, small outrigger boats, canoes, etc. Motorized boats and Bagan boats are always anchored in

the basin while small outrigger type boats and dug-out boats are beach landed in most cases.

Since the landing facilities are undeveloped, motorized boats and Bagan boats, which usually anchor off the beach, must unload the fish catch to dugout boats which transport the fish catch to the beach, while other small boats directly unload the fish catch on the beach.

2.7.2 Current Conditions of Fishing Village Infrastructure

(1) Location of the fishing communities

Fishing villages in the study area are located near the natural coast, along the sandy beaches on the north coast and along the slopes behind the gravel and rocky south coast. In the inner bay areas, a private simple coral-stone revetment has been built to protect houses against erosion and overtopping by waves and the tide. The personal use of the coastline hinders the improvement of the community fishing activities. The majority of fishermen houses are stilt-type houses with the exception of houses along the south coast. The space under these houses is used to store small boats and to repair fishing gears. In addition, fishing villages in the inner bay area are inundated by seawater during the high tide. In the landing zone located in Bima (Bima District, Sumbawa Island), Paupanda (Ende District, Flores Island) and Maumere (Sikka District, Flores Island), the fishermen live in the town with other residents and have not formed independent fishing communities.

Classification of Fishing Communities According to Geographical Conditions

Area	Geographical conditions	Features
North Coast	Hinterland of sandy beach	Residence so crowded in gentle hinterland; mostly stilt type architecture
South Coast	Slope land of rock reef zone	As mountains approach to coastal line, residences cluster in slop zone; mostly one-storied houses; alleys are of step type like labyrinth.
Inner Bay/ Inland Sea	Tidal area along coast	Houses stand as far as coastline; all stilt type architecture because of location in tidal area; coastline is provided with simple revetment constructed by piling up coral stones and is belonging to private property.
Residence	Residence	Fishery workers live in town without any independent fishing community.

(2) Fishing communities in NTB and NTT

Fishing villages are supplied with electricity by the local government, with the exception of a few isolated villages such as Lamalera (Lembata District) in NTT province. However, the service is generally limited only during the night, excluding a few regions which are provided with full-day service. The water supply is limited in contrast to urban areas; subsequently most of fishing villages must depend on wells as their main source of water in the area. The capacity of well water is inadequate and the water is slightly saline in some villages. The fishing villages located on small, isolated islands have to buy or transport drinking water from outside. Well water that is located close to the coast is not adequate to drink due to its slight salinity, so the water is used only for washing, bathing and other daily life functions. Villagers, especially women, have to transport water from the inland wells or other services to secure drinking water. They are compelled to do the heavy work of transporting drinking water

on foot several times a day, and expend much time and labor. These are negative factors that have hindered improvements in the living environment and the development of fishery activities.

The road network has improved in many villages, but there are only winding step-type paths that are unconnected to any trunk line roads along the coast for villages located on the slopes. Consequently, the transport of fish catch, fishing equipment and materials, and daily commodities depends on human labour. This has hindered fishing activities. Isolated fishing villages are unable to communicate with other areas due to the poor condition of the connecting roads. Community roads need to be improved, excluding areas where stilt houses are concentrated.

The drainage system has not improved for most villages, and this problem has been compounded by stagnating sewage stemming from an accretion of refuse. The sanitary conditions are considerably worse, owing to the untreated discharge of domestic waste water, dumping of refuse and livestock sheds in the village compound. As the amount of precipitation during the rainy season differs greatly from the dry season, there are several problems such as stagnation of domestic wastewater

To ascertain the actual condition of the social infrastructure, a questionnaire survey was conducted on community leaders of 31 major fishing villages. The results are shown in Figures 2.7.3~2.7.7.

- The road conditions are fair, but the probability of flood damage is approximately 90 percent for community roads and 80 percent for connecting roads. This high ratio is due to the defective structure and capacity of the drains (Fig. 2.7.3).
- The local governments supply drinking water to about half of the 31 villages, but facilities have not improved for five fishing villages. The water supply source is comprised of about 50 percent shared spring water and 30 percent well water. The water quality is sufficient only in about 50 percent of the villages, while about 40 percent have water shortage problems.
- About 80 percent of the villages suffer from floods due to a defective drainage system. Only 10 percent of the villages have satisfactory sanitary levels, 90 percent are inadequate, and 40 percent are in serious condition (Fig. 2.7.3).
- Electricity is supplied to most of the villages by the local government, but the service is limited to only night hours for 30 percent of the villages. Moreover, two villages do not have the infrastructure to receive electricity.
- Many villages suffer from numerous disasters such as earthquakes, tsunami, typhoons, storms and floods. In the central and eastern area of Flores Island, the inhabitants were seriously affected by earthquakes and tsunami, which causes the greatest damages as in

the case of the earthquake and tsunami that, occurred off Maumere (Sikka District) in Flores Island on December 12, 1992 (Fig. 2.7.3).

- As shown Figure 2.7.4, about 50 percent of the inhabitants own private toilets in Kupang (Kupang District) and Sumba Island, while 50 percent of the residents in Flores and Sumbawa islands and 90 percent of the inhabitants in Lombok Island do not possess toilets.
- In the public service sector, as shown Figure 2.7.5, education, medical care, tele-communication, transportation have improved to some extent, but telephone service is not available in 12 fishing villages and bus service is not available in 6 villages. As shown in Figure 2.7.6, health and social institutes and the transportation network are adequate, while the levels of hygiene, education and tele-communication services are unsatisfactory as pointed out by more than half of the village leaders.
- As shown in Figure 2.7.7, problems related to the sanitary environment are of serious concern. Furthermore, deterioration of the fishing ground environment due to the discharge of untreated domestic water to the sea and blast and drug dependent fishing operations is also a serious issue. These issues must be addressed to develop fisheries and revitalize fishing villages.

2.7.3 Development Issues

(1) Fish Landing Infrastructure

An interview survey was conducted on fishermen in 31 major fishing villages. An analysis of the findings according to area is shown in Figures 2.7.8 to 2.7.10. Lombok Island has a specific advantage in comparison to other areas due to highly improved facilities, their efficient utilization, and location of a consumer market in the hinterland.

Generally, the shortage of ice and the deterioration in fish quality have been indicated as factors that have impeded fishery activities. This trend is very noticeable in Sumbawa Island. Other principal problems are restricted landing time, shortage of brokers, and insufficient information on fish prices.

Therefore, the improvement of the landing facilities and also the development of administrative infrastructure are deemed urgent subjects for more effective utilization. According to the interview findings, the problems related to the fish landing sites are summarized as follows.

- Existing PPI/TPI are not effectively utilized.
- The new PPI/TPI plans must be based on a more practical policy.
- Fishing activity is restricted owing to natural conditions such as waves, topography, tidal level, etc.
- Sanitary environment is poor due to the scattering of refuse and dumping of

wastewater.

- The quality and fish freshness deteriorate due to fish handling activities that are carried out under the scorching sun or on the ground.
- It has not fulfilled its role as the centre of fishing communities.

(2) Fishing village infrastructure

Based on the abovementioned survey findings, the problems, which confront the fishing communities, are summarized as below.

- Progressive fishery activities are disrupted because the fishing communities are located in the inner bay / inland sea areas. The houses cluster along the coastline and the simple coral-stone revetments built along these coastlines are private property. Thus, public access does not exist.
- The sanitary environment is poor because domestic wastewater, garbage, and refuse accumulate within the community area. Owing to a defective drainage system, the refuse and domestic wastewater flood the villages during the rainy season and stagnate during the dry season.
- The discharge of domestic wastewater and refuse into the sea seriously affects the fishing environment.
- The living environment is very inadequate due to a low water supply, the hard labour of transporting drinking water, a defective drainage system, and an ineffective public access network.

2.8 Fishing Village Society and Gender

2.8.1 Summary of Fishing Village Society

(1) Administrative Unit

In Indonesia, the regional administrative units are composed of Propinsi (province), Kabupaten (district), Kecamatan (sub-district), Desa (village), Dusun (sub-village), RW (Rukun Warga: community) and RT (Rukun Tetangga: neighbour). The smallest unit is the RT, which is composed of several neighbouring households. Fishing villages are categorized into Desa, Dusun or RW based on their size.

(2) Administrative Structure

The Desa administration is authorized to govern inhabitants based on regional rules and customs that are approved by the central government.

The chief of the Desa is called the Kepala Desa, is elected by the Desa residents, and recognized by the Bupati (district governor). Kepala Desa has the authority to decide the rules and regulations in the Desa and he refers to the opinions of BPD (Badan Perwakilan Desa:

Village Representative Board), which is a village-level congress.

The BPD members are elected from among the villagers. BPD's chairman, deputy chairman and other officials are elected by the BPD members. The chief of the Dusun is called the Kepala Dusun, who is selected by Kepala Desa based on the recommendation of the BPD or elected by the Dusun inhabitants and is recognized by the Kepala Desa.

Kepala Desa is responsible for reporting to the Bupati and Camat (sub-district governor) and to execute their instructions. Kepala Desa controls the overall village administration with the support of the Kepala Dusun and his secretariat. The secretariat supports the Kepala Desa on clerical matters regarding village administration, finances, economy, development, and security and welfare.

Under the Dusun level, there is no administrative structure that corresponds to the BPD. The chiefs of RW and RT are elected from among the inhabitants, but they do not have any administrative authority.

(3) Major fishing Villages in the Study Area

Information on the current conditions of 31 major fishing villages obtained from interviews of village leaders (Kepala Desa, school principals, etc.) are given in the table below.

1) Size of fishing villages

In Lombok, Sumbawa and Flores Islands, there are large fishing villages comprised of over 1,000 fishermen combined with smaller villages. In Sumba and Roti / Sabu Islands, the villages are generally smaller. In Alor Islands, at least two are medium sized villages with 500 to 1,000 fishermen. These major fishing villages are composed of a core fishing village together with a number of affiliated Dusun level villages. Six out of the 32 villages surveyed are comprised of more than 10 Dusun, of which five are located in Flores and Alor Islands.

The fishing villages in Sumbawa have a comparatively larger fisher population with less than five Dusun. The unit size of these villages seems to be relatively larger than villages on other islands.

2) Ratio of income from fishing activities

In Sumbawa, the number of fishing villages composed of fishermen, whose fisheries income occupies was higher than 75 percent of the total household income, was comparatively larger. There were a few such villages in Sumba and Flores Islands. Of the 31 villages surveyed, only eight exemplified such villages. Many fishing villages were composed of fishermen whose ratio of fisheries income was lower than 75 percent. The number of villages composed of fishermen whose fisheries income ratio was lower than 50 percent was 13 out of 31 villages. The number of fishing villages with a fishermen household ratio of more than 75 percent was only 6 out of 31 villages (19.3 percent). Many fishing villages were also comprised of farmers.

3) Location of fishing villages

Nearly all of the fishing villages were located within a 2km distance from their fish landing sites, and 24 out of 31 villages were located within 10km of their consumer markets.

4) Land ownership in the fishing villages

The land in the fishing villages is comprised of public and private land. More than 75 percent of the land in eight villages out of the 31 villages surveyed was comprised of private lands, and more than 75 percent of the land in the same number of villages was composed of public land.

5) Transport network

Thirteen villages out of 31 responded that their village roads were in bad condition. The village road conditions in Lombok Island seem comparatively worse than the other islands. Twelve villages out of 31 stated that the connecting roads to the nearby urban areas were bad, except on Lombok Island. This signifies that the fish marketing conditions of the fishing villages on the other islands, especially Flores Island, were disadvantaged.

6) Education related infrastructure

All the villages had elementary schools, and 20 villages out of 31 had secondary schools. Only a few of the smaller villages in Sumbawa, Sumba and Flores Islands did not have a secondary school. Only 10 villages out of 31 had high schools. All of the villages did not have adult education facilities.

7) Health related infrastructure

About 26 villages out of 31 had health clinics, which are urgently needed for community development. Doctors regularly visit 20 of the 31 villages. According to a review of the distribution pattern of the doctor's visits to the villages, they are less likely to occur for villages with poor road connections.

(4) Condition of Fishermen Livelihood

A socioeconomic study was carried out on 1,002 fishermen households (462 in NTB and 540 in NTT) located in the 31 fishing villages mentioned above. This study and other related surveys describe the living conditions of fishermen in the study area as follows.

1) Family structure

A typical household unit in the study area is composed of a couple and their unmarried children. The average birth rate of married women of 15 to 49 years old is 3.18 in NTB and 3.34 in NTT, respectively. These figures exceed the national average of 2.86 for rural areas (BPS Statistics Indonesia, 1997 National Socioeconomic Survey).

2) Religion

A total of 462 fishermen in NTB are Muslims. Of the total of 540 fishermen living in NTT, 147 are Christian. All of the respondents in Manggarai, Ende, and East Sumba were Muslims (see Table 2.8.1). It is general knowledge that Muslims predominate in NTB and Christians are concentrated in NTT in comparison to other religions. However, the fishermen are mainly of the Muslim faith in both in NTB and NTT.

3) Living environment

The typical housing structure in the fishing villages in the study area is a flat or stilt type of structure. The stilt type houses are usually built on fringes of the beach, and the space around the stilts are full of the droppings of goats and fowls, sewage from the kitchen and plastic waste products. In addition, the beaches and water areas are used as toilets. These living conditions have led to unsanitary and odorous conditions near the housing areas when the sea bed is exposed during the ebb tide. Many houses are not equipped with water supply facilities. Women carry water from a public well in the village or from a nearby water source. Many aspects of the living environment need to be improved in terms of sanitation and these improvements will differ according to the housing structure.

4) Working condition of women in the fishing villages

Housewives of 250 households out of 462 households in NTB (40 percent) and 416 households out of 540 households (77 percent) were employed. In particular, the employment rate of housewives exceeded 90 percent in Ende, Sikka, East Flores and Alor. The majority of the housewives in Sikka, East Flores and Alor were employed in fishery related activities. In contrast, the employment rate in Ende was high, but most of the housewives were not employed in the fisheries sector (Table 2.8.2).

5) Fishermen household income

Based on the results of the socio-economic survey on fishing communities in NTB and NTT implemented by this study team, the regional differences in fishermen household income are shown in the table below.

There were income differences between regions. It was found that the fishermen household income in Sumbawa Island was generally higher than fishermen households on the other islands.

As of 2001, the lowest monthly salary of a local government employee was about Rp.650,000. It is surmised that the income level of many fishermen households is below this level.

Province	District	Monthly Income (Rp 10,000)						Total
		10	10	30	30	50	50	
NTB								
	Lombok Barat	-		22%	70%	8%	-	100
	Lombok Tengah	-		75%	25%	-	-	100
	Lombok Timur	-		86%	14%	-	-	100
	Sumbawa	7%	14%	15%	46%	18%	100	
	Dompu	2%	31%	3%	24%	40%	100	
	Bima	5%	29%	12%	37%	16%	100	
	Sub-total	4%	35%	19%	27%	15%	100	
NTT								
	Alor	2%	43%	30%	20%	5%	100	
	Flores Timur	3%	38%	23%	31%	6%	100	
	Sikka	1%	33%	31%	30%	5%	100	
	Ende	24%	69%	6%	1%	-	100	
	Ngada	34%	46%	6%	10%	4%	100	
	Manggarai	3%	40%	31%	16%	10%	100	
	Sumba Barat	-	3%	33%	63%	-	100	
	Sumba Timur	5%	38%	28%	23%	5%	100	
	Kupang	3%	43%	3%	-	50%	100	
	Sub-total	9%	42%	22%	21%	7%	100	
Total		6%	39%	21%	24%	11%	100	

Average annual per capita income of fishermen of 33 villages surveyed is estimated at Rp1,289,573 which is lower than that of the national average income of small-scale farmers with farm land less than 0.5ha (Rp.1,631,410/year). And in nine villages (27.2 percent), the monthly income of fishermen was lower than the national average poverty line of Rp.74,272 a month in 1999 (See Table 2.8.3).

In view of the fact that the per capita GDP in NTT and NTB were the first and the third lowest among all provinces in Indonesia, income level of fishermen in the study area appear to be the lowest in Indonesia.

6) Average annual operation days and gross sales and expenses per operation

Based on the findings of the socio-economic survey of fishing communities in NTB and NTT implemented by this study team, the average annual operation days and gross sales and expenses per operation of each fishing village surveyed are shown in Table 2.8.4. Their regional characteristics are as follows.

- The villages located along the Flores Sea engage in fishing operations for about 300 days annually, and the villages facing the Indian Ocean of the eastern area of Sumbawa Island are engaged in fishing for 210 days a year. Fishing villages bordering the Komodo Channel that connects the Flores Sea and Indian Ocean engage in fishing activities for 240 days in one year.
- The net income per operation according to region is generally similar to fishermen income patterns described in (5). Lombok Island has the lowest net income per operation, followed by the western part of the Flores Island. In these areas, both gross sales and expenses per operation are generally small. It can be said that the net income level in the eastern part of the east of Flores Island such as Sikka, East Flores, Lembata and Alor, is about 30 percent higher than Lombok and the western part of Flores Island.

However, their fishing efficiency appears to be poor because their gross sales and expenses per operation are more than double. The net income of fishing operations in Sumbawa and Sumba Islands are generally two to three times higher than other areas, and the pattern of gross sales and expenses per operation were similar. It can be said their fishing operations are gaining in scale merit, but their fishing efficiency has not improved.

7) Income gap between motorized boat and non-motorized boats

The income disparities between motorized and non-motorized boats based on the findings of the socio-economic survey on fishing communities in NTB and NTT implemented by this study team are shown in Table 2.8.5. The characteristics of the income disparities are as follows.

- The income of motorized boats was larger than that of non-motorized boats in all the villages. The income disparity was 1.8 to 2.8 times for 15 out of 33 villages and 1.5 to 1.8 times in the remaining 15 villages (all boats were non-motorized in two villages, and all were motorized in one village). Accordingly, motorizing fishing boats generally contributed to an increased income for fishermen in the study area.
- Motorization is necessary not only to increase fishery income, but improved fishing techniques are also needed, because some of the fishing villages in Lombok show a very low annual income despite the fact that their motorization rate is more than 50 percent.

8) Education

The national average of elementary school (7 to 12 years) matriculation ratio in rural Indonesia was 94.56 percent for girls and 93.83 percent for boys in 1997 (BPS Statistics Indonesia, 1997). But in fishing villages in the study area, some parents have been forced to take their children out of school because they were unable to pay the school tuition. In other cases, children have left school in order to help their families with fishing operations. In the case of Nangahale village (Sikka), although 301 children attended school in early 1999, 11 percent of the children, 17 boys and 16 girls, had left before the year 2000. Boys working as fishing crew have been observed in this village. The illiteracy rates in NTB and NTT are higher than the national average as shown in the table below.

Illiteracy Rate in Rural Areas

Area	10-19 Years		20-44 Years		45 Years of Age and Over	
	Female	Male	Female	Male	Female	Male
NTB	5.9	5.0	28.2	16.2	69.4	36.8
NTT	6.5	7.2	15.0	12.1	59.9	37.6
Indonesia Rural	2.4	2.1	12.3	6.1	50.2	23.6

Source: BPS-Statistics Indonesia, 1997 National Socio-Economic Survey

The illiteracy rate of women over 45 years is especially high. The illiteracy rate is lower as for the younger generation. In terms of gender, the illiteracy rate for girls is higher than for boys, with the exception of the 10 to 19 year age group in NTT. For adult groups in the

20-44 year age group, the illiteracy rate in NTB is higher for women at 28.2 percent, in contrast to men at 16.2 percent.

Parents want their sons to enter military service or teaching, and their daughters to be teachers or nurses. Most mothers want their sons to take up occupations other than fishing by providing them with education. But due to financial limitations, many fishermen are unable to send their children to institutions of higher education.

2.8.2 Summary of Village Women Activities

(1) Economic activities of women

About 60 percent of the village women in the study area engage in economic activities such as fish sales, fish processing, farming, shop tending, and others. There are six major types of activities as shown in the table below.

Type of Women's Economic Activities

Type	Characteristics
Type 1	Husbands go fishing, and the wives help in fish landing, bring fish to market and sell it.
Type 2	Fishing operation composed of a boat owner, a captain and crew. Wives buy fish from this fishing boat and sell it. The role of a wife depends on the position of her husband on the boat. A wife of the owner or the captain can buy all the fish of the boat. She sells the fish to wives of the crew and/or buyers, or fish dealers on the landing beach. Crew wives bring fish to a market and sell it. Some wives buy fish from other boats as a buyer, and sell it at a market.
Type 3	Buyers or big scale traders buy fish directly from fishing boats. Women can buy fish in case of small catch, or some fishes restricted for local consumption.
Type 4	Buyers buy all of fish from fishing boats. Women do not sell fish. They produce farming products like nuts and coffee, salt, ikat or textile, coconut oil and others. These products are sold at a market.
Type 5	Wives participate to fishing operations on board with their husbands.
Type 6	Wives engage only in their home business. Buyers buy all the fish on board.

Source: Socio-Economic Survey in Fishing Communities in NTB and NTT, 2001, JICA Study Team

Women play a major role in fish retail activities in the small fishing villages where large buyers and fish collectors do not operate. These women are individual fish retailers. They take their fish products to the market using public transportation and sell them in small units. Markets in the study area are usually small and they can not provide selling space for these women. This restriction prevents women from buying more fish for retail activities. The activities of these women are the only means of fish distribution for small fishing villages in the study area. Thus, flexibility is required for these fish marketing activities.

The variety of processed products is not large in the fishing villages. The main products are of simply sun dried, salted and smoked fish. Processing activities are carried out when there is a surplus of fresh fish in the village, unsold leftover fresh fish, or when the market is too far to transport fresh fish.

Under such circumstances, competition among village women emerges as identical processed products are produced at the same time in the same village.

Single women seldom find jobs in the fishing villages. Some work as maids in Singapore, Saudi Arabia and other countries. In the case of Pulau Bungin village (Sumbawa Dist.), some parents provide their daughters with a small grocery store when they graduate from school, to prevent them from working outside the village. In this small village, there exist many small grocery stores within a stretch of several meters along the village road and alleys. These shops are not expected to be successful business operations.

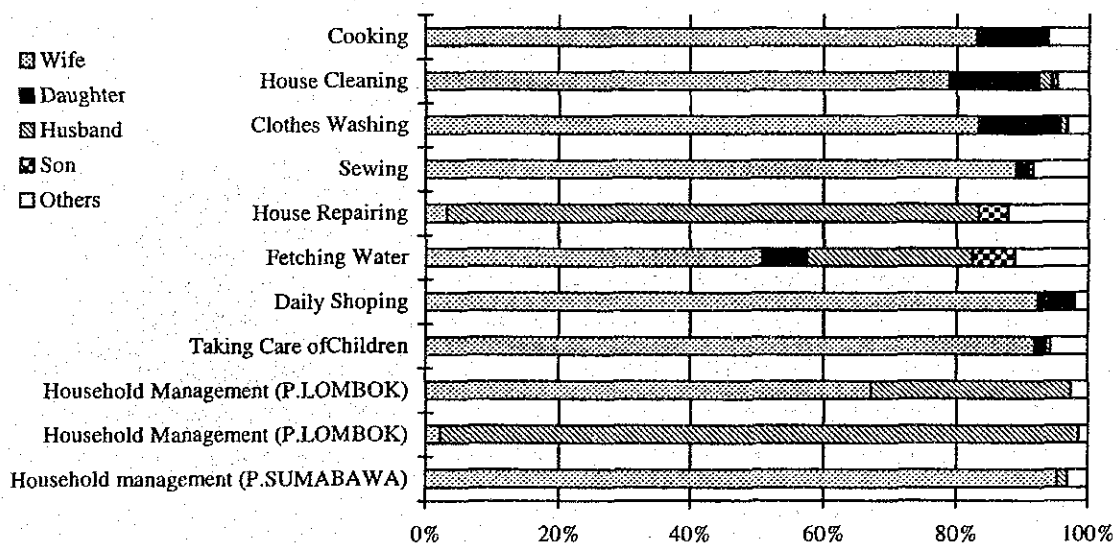
In contrast, five women including three unmarried women, formed a group for fish processing in Mautapaga village (Ende Dist.) in August, 2001. One member of the group received three months training in fish processing through the aid fund of the local government fishery office. The group is planning to produce Bakso (a kind of fish paste) using their kitchens and will dry the fish at the beach.

Women's group activities exist at many sites. Core members of these groups are PKK (Pembinaan Kesejahteraan Keluarga: Family and the aim was to improve the living standards of the home environment through various economic and health activities. PKK activities are community cooperative works like road cleaning and maintenance, and men and women of the group usually join to teach Arabic to children, participate in health control like vaccinations and economic activities based on a credit system for women called P2K and P4K.

(2) Time sharing of women

The results of the socio-economic survey conducted in the study area are summarized below.

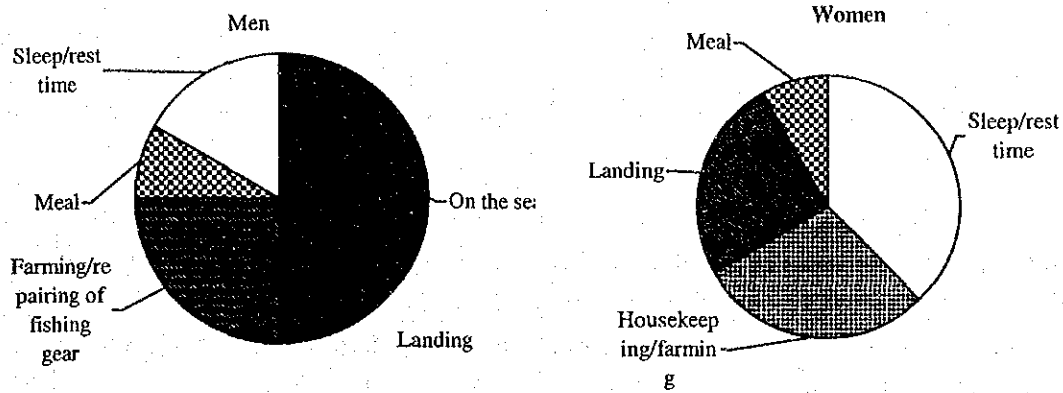
Working shares of housing activities in fishing families are shown in the following figure.



Source: Socio-economic survey (June-July 2001) by JICA Study Team

Share of Housekeeping Chores by Family Members NTB

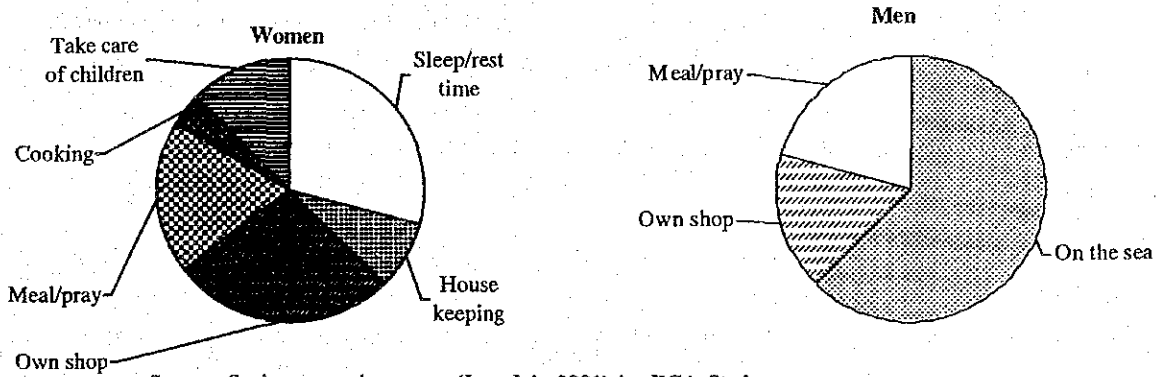
Men and women in this district are also engaged in part-time work such as cultivating cashew nuts, tapioca, papaya and others, salt making, etc. Women sell farm products as well as fish.



Source: Socio-economic survey (June-July 2001) by JICA Study Team

Time Schedule of Fishermen Whose Wives Engage in Fish Marketing in Mokantarak

In Kolo village (Bima Dist.), buyers directly visit the fish landing sites on the beach; wives participate in only two hours of fish retail activities at the beach. The rest of the time is spent on household chores and other work.



Source: Socio-economic survey (June-July 2001) by JICA Study

Time Schedule of Fishermen Whose Wives Participate in Fishing in Kolo

The daily life of the women is generally divided into many small segments of time, whereas a larger portion of the men's daily life are dedicated to fishing activities. Apart from the major work of selling fish, women must spend a lot of time at other tasks such as waiting for the return of the fishing boat, going back and forth between the market and home, housekeeping chores, and other minor activities. Thus, it is very difficult for women to have their own time.

As the men are usually at sea for more than half the day, most of their time onshore is spent eating and sleeping. Thus, they expend only short a time on other activities and this in turn, requires women to undertake a variety of work onshore.

There are four to seven off-fishing days in a month during the full moon phase. An off-fishing day is also an off day for women selling fish. During such off days, women assist in the preparation of the next fishing operation and engage in daily household chores. Thus, women do not really have a substantial holiday. Women seem to have one or two hours a day for themselves in some villages such as Kolo village, where fish is sold on the beach or retail areas are located near to their villages.

When a woman is physically unwell, she can take a day off and neighbors or sisters and relatives will assist in her fish retail activities, but she will usually continue to do her household chores despite her physical condition.

Many women believe that their husbands are understanding and cooperative. But in actuality, the husband's cooperative attitude means that he does not complain about his wife's performance regarding household chores, despite his dissatisfaction. Due to the traditional custom known as "Adat", it is very rare for husbands to help out with the household chores, irrespective his wife's illness.

(3) Fund aid system

Separate from a traditional mutual financing system called "ARISAN, there are other fund aid programs for women such as P2K and P4K based on the aforementioned PKK system. Examples of loan assistance for women in the study area are shown in Table 2.8.6.

ARISAN is composed of a group organized by 10 to dozens of community women, and a certain amount of money is collected from each member, which is saved daily or weekly. The decision to distribute the saved money is decided by the group members in a periodically held meeting. Each member will receive a certain amount of money from the savings based on the decision that is reached. The money that is distributed can be used for any purpose.

P2K and P4K are public loan systems for start-up women business groups (for details refer Section 2.9.3 on Fisheries Credit). The women apply for a loan from the government. When the loan money is obtained, the group distributes this money to each member to use for individual business activities such as buying fish, making salt, baking sweet cakes, and others.

In Nangamese village (Manggarai Dist.), Group "Suasana Baru" comprised of five women received a fund of Rp 5 million. Each member received Rp 1 million. All members invested this money in the fish marketing business, which enabled them to increase their business operations. The repayment period was 18 months with an interest rate of 15 percent. The local fishery office deposits the repayments to a bank, and the office uses this fund for other business groups.

In another case in Labuan Bajo village (Sumbawa District), the repayment plan of the group has been stopped because of the group leader's irresponsible distribution of the money and management of the repayments.

(4) Status of women

In view of the role of women in household chores as explained earlier, the management of household income of most fishermen families appear to be carried out by women, with the exception of families in Lombok Island where the husbands manage the household income. In other areas, husbands hand over their incomes to their wives, even in cases where they are directly engaged in fish retail activities or where wives are full-time housewives. However, wives do not know if the money received from their husbands is the entire amount, because husbands do not keep records of fish catch or fish sales.

It may be said that the status of a woman in her home is somewhat high based on her responsible role of managing household income. However, the entire management of the household falls on the shoulders of the wife.

Each district has different rules regarding women's participation in community meetings. Kolo village decided to admit the participation of women in village meetings in 1980. Meetings at Wuring village were organized only by men. However, a few years ago, women's participation in the village meeting was accepted. Nowadays, the village meeting is attended by men and women. The number of women who attend these meetings is smaller than the number of men. Local resident participation in village management activities appear to depend on the participation of both genders. In Nangahale village, there are no village meetings. In this case, the management of village is implemented at meetings between the Kepala Desa and district officials and only the men are informed of the decisions.

(5) Women's opinions on economic activities

The interview findings obtained from the study area show that village women have positive opinions about engaging in economic activities. The major reasons are the ability to earn income, to socialize with other village women who sell fish at the market, and finally to achieve their goals to increase the scope of their economic activities in fish retail.

2.8.3 Development Issues

The development issues related to fishing communities and gender in the study area are summarized as follows.

(1) Fishing village society

1) Low utilization of toilets

The socio-economic survey findings show that 288 households (62%) out of 462 households in NTB and 237 households (44%) out of 540 households do not utilize toilets. The residents use the beach or the forest and this practice aggravates the sanitary conditions of the seacoast and pollutes water resources. The dissemination of toilets is a major issue that must be resolved in order to improve living conditions in the rural areas.