APPENDIX 9. MANAGEMENT PLAN FOR THE LEMURU FISHERY IN BALI STRAIT

This plan is developed on the basis of the plan developed in April 1999[5] with strong new inputs of what has happened during the two-year period until the Banyuwangi workshop of May 2001. Considering the large fluctuations in the landings of lemuru in the history of the fishery, it makes sense that the management plan should also address issues during the lean season as some of the fishers fish for other species as well. In that sense the Management Plan addresses the fisheries in the Bali Strait with primary attention to the lemuru fishery. The terms of reference of the Management Committee established in 2000 also indicate clearly that the Committee has overall responsibility for all the fisheries in the Bali Strait.

1. DESCRIPTION OF THE FISHERY

Bali Strait is located between Java and Bali (see Figure 1). It has a funnel shape with a northern opening of about 2.5 km wide and a southern one of 55 km. The shelf area extends from north to south with an average depth of 50 m. The Bali Strait becomes deeper in the southern area especially in the centre part bordered by a narrow shelf in the western and eastern part. The width of the shelf in the western part ranges from 0.5 to 1.8 km, while in the eastern part it ranges from 3.5 to 15 km from the coast. The water mass of the Bali Strait tends to be mainly affected by the water mass of the Indian Ocean. Upwelling occurs inside the Strait during the Southeast monsoon and reaches a peak in July-August.

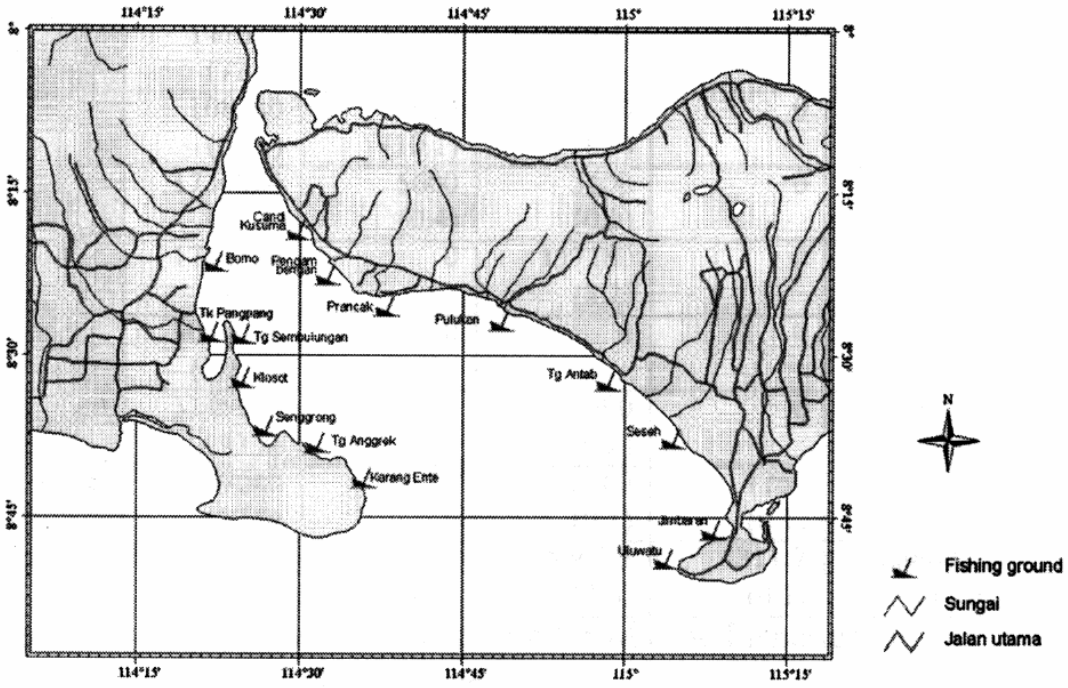

Figure 1. Bali Strait

[5] Published as Appendix 5 of FAO/FISHCODE Field Report F-3

The fishery in the Bali Strait exploits mainly Bali sardinella (*Sardinella lemuru*), locally called lemuru. Other small pelagic species caught as by-catch include other sardine species (*Sardinella* spp.), round scad (*Decapterus* spp.), bonito (*Sarda* sp.), mackerel (*Rastrelliger* spp.) and small tunas (*Auxis* spp., *Euthynus affinis*). The purseseine is the main fishing gear used by fishermen from East Java (based in Muncar) and Bali (based in Kedonganan). Fishing is done during the night, mainly in one-day trips. The fishing season occurs during the northwest monsoon, from September to January. However, due to rough seas from late November to March, some of the purseseiners will not operate, especially those based in Kedonganan (Bali), because there is no harbour. Other gears used in the fishery of the Bali Strait include payang, gillnet, handlines and the stationary lift net ("bagan"). The latter is common especially close inshore, where it catches small-sized lemuru (sempenit) during a certain time of the year.

The size of fishing boats used by fishers from East Java based in Muncar (East Java) and those by fishers from Bali in Negara and Badung (Bali) is generally comparable. The fishing boats are made of wood, purseseiners are of 20-30 GT, payang are of 10-15 GT, gillnetters are of 10 GT for Muncar and 2-3 GT for Bali and handliners are of 3-4 GT for Muncar and 2-3 GT for Bali. The powered boats use mostly outboard engines.

1.1 Status of the fishery

Following the adoption of purseseine fishing in 1974, the catch of lemuru has increased significantly, in line with the increased number of vessels. However, the catch has shown a marked fluctuation, typical of a small pelagic fishery. The first peak was reported in 1983 with a total catch of 48,075 t. The catch then declined to an all-time low of 4,661 t in 1986, then it slowly increased and reached a peak of 61,669 t in 1991. In the following years the catch showed another decline and in 1996 the catch was only 13,327 t, it then climbed up again in 1997 to 50,202 t, followed by a higher catch in 1998 of 78,000 t. The catches in 1999 and 2000 fell below 10,000 t. When lemuru catches are low some of the fishers aim for other species. Fishing for ribbonfish (*Trichyurus* spp.) with hand lines has been popular due to the high demand of this fish for export to Korea. It was reported that during the period of low catches of lemuru in 2000 there was a boom of jellyfish (*Rophelia* spp.) of which 15,000 t was landed in Muncar only.

A large number of fisherfolk are involved, including those in the post-harvest sector. The 1996 statistics indicated that there were about 12,000 from the East Java and 9,000 from the Bali Provinces engaged in the Bali Strait fishery. Most of the products are for domestic consumption and the canned products are for inter-island trade.

Illegal fishing using cyanide has escalated recently in the reef areas of the East Java coast and fishermen believe that it had a bad impact on the young lemuru that are commonly found in shallow waters.

Stock assessment of a shoaling fish like lemuru is not easy. Catch per unit of effort is poorly related to the abundance, as the stock may also be influenced by environmental factors. Wudianto (2001)[6] indicated that the biomass of lemuru is very much governed by temperature and salinity distribution. Taking into account the Southern Oscillation Index into a surplus

[6] Wudianto, 2001. Analyses on the distribution and amount of sardine stock (*Sardinella lemuru* Bleeker, 1853) in the Bali Strait; its relation to fishing optimisation. Unpublished dissertation, Bogor, IPB: 221p. (in Indonesian).

production model, Ghofar *et al.* (2000) showed a better fit, however, the environmental mechanism behind the process is still not clear.

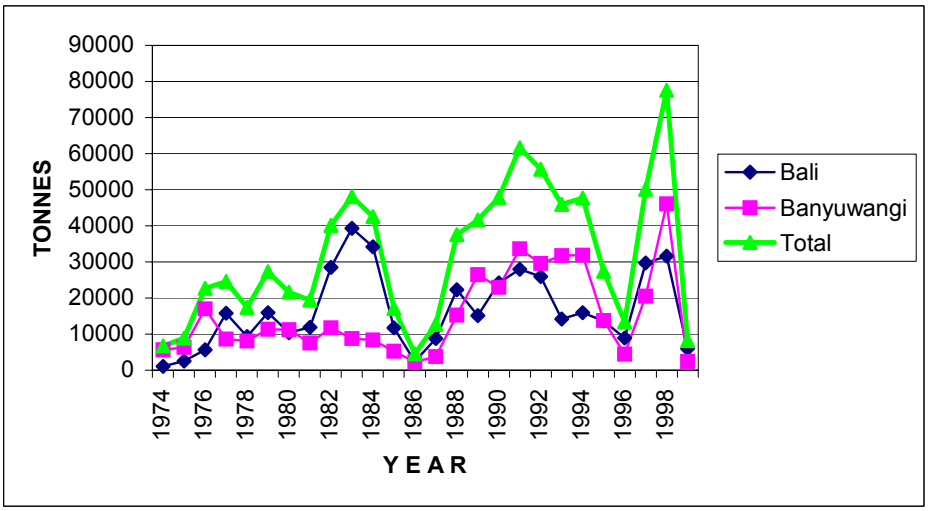

Figure 2. Trend of lemuru catches in Bali Strait

2. JURISDICTION AND LEGISLATION\

With the establishment in 2000 of the Ministry of Marine Affairs and Fisheries (MoMAF), the overall responsibility of fisheries development and management in Indonesia has been transferred from the Ministry of Agriculture to MoMAF (cq. Directorate General of Capture Fisheries or DGCF). The work of DGCF is backed up by the Fisheries Law No. 9/1985. In implementing this responsibility, DGCF has delegated some of its mandate to Provincial Fisheries Services. Fishing and registration for vessels of less than 30 GT falls under the responsibility of Provincial Governments, i.e. the Provincial Fisheries Services. As purse seine fleets operating in the Bali Strait are of less than 30 GT, the East Java and Bali Provinces issue their licences. The enactment of the Autonomy Law No.22/199 will result in a further decentralization process of responsibility to the governments of the Districts (Kabupaten).

Since 1977 there have been several joint agreements between East Java and Bali Provinces regarding the management of the lemuru fishery in the Bali Strait. The latest agreement, dated 1995 and still in operation, contains various important elements:

- Zoning, which delineates distribution of fishing for artisanal fishermen (without powered vessels – Area I, see Figure 3) from those with powered boats (Area II);
- Dimension of purse seines for fishing in Area II, being 300 m of maximum length and 60 m minimum depth;
- Limitation on the number of fishing boats with a total of 273, of which 190 for East Java and 83 for Bali Province.

In addition, the Ministry of Agriculture Decree No. 123/Kpts/Um/3/1975, imposing a minimum mesh size of 1 inch (2.5 cm), still applies to this fishery, although there has been some resistance by fishermen. In practice fishermen have been using ¾ inch (1.9 cm) mesh nets.

In the absence of law enforcement in fisheries, the Provincial Fisheries Services rely on the work by the Coordinating Committee on Sea Security, headed by the Navy, for the implementation of rules and regulations.

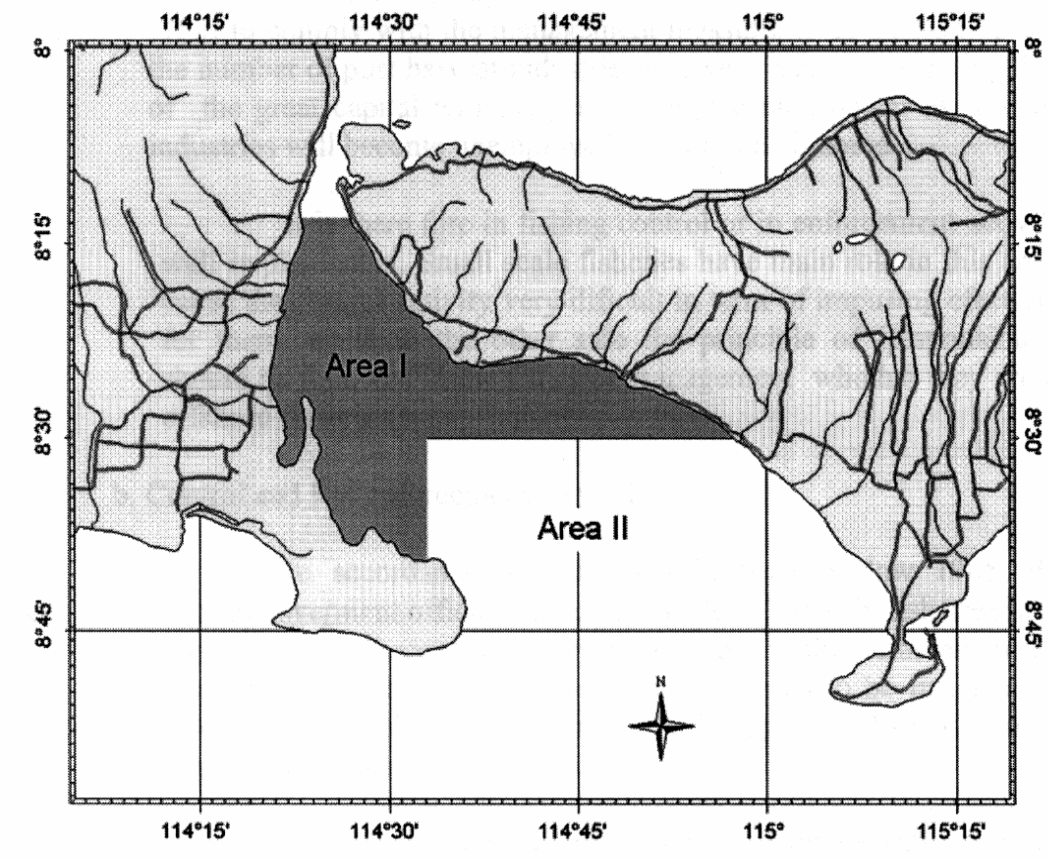

Figure 3. Distribution of fishing area (Area I: for non-powered fishing vessels and area II: for powered fishing vessels)

With the enactment of the Autonomy Law No. 22/1999 the Central Government has delegated its authority to the Provincial and District level focussing on the District level. According to this new Law the government of a district has area jurisdiction up to 4 miles from the coast line, the provincial government from 4 to 12 miles from the coast line, while the central government is responsible for the area from 12 up to 200 miles. The Law is still being debated

and the rules and regulations related to marine jurisdiction have not yet been finalized. Considering that a large proportion of the Bali Strait is located within the 24 miles distance, physically the Bali Strait remains within the responsibility of the two Provinces, including the relevant District Governments of the two Provinces. Therefore, the fisheries in the Bali Strait are still within the responsibility of the two Provinces and thus the status of the Management Plan still holds and the initiative needs to be strengthened.

3. OBJECTIVES OF THE PLAN

General objectives stated in the national fisheries development plan of the Directorate General of Capture Fisheries serve as the main reference although specificity of the Bali Strait fishery is taken into consideration. The general objectives include:

(a) To increase fishery production and export;

(b) To increase fishermen's income;

(c) To provide employment opportunities; and

(d) To protect and conserve fishery resources.

Management objectives of the fishery fall within various disciplines or interests as in the following:

a. Biological objective:

- To ensure fishing concomitant with the carrying capacity of the resources, thus without endangering the resources for the benefit of current and future generations.

b. Ecological objectives:

- To assure responsible fishing, minimize discards; and
- To prevent habitat destruction.

c. Social objectives:

- To provide employment;
- To increase fishers' income;
- To protect traditional fishers.

d. Economic objectives:

- To improve the economy of fishing community; and
- To ensure sustained profit from fishing.

e. Extension objective:

- To promote public awareness on responsible fisheries;
- To introduce modern but responsible fishing and processing technology;
- To promote healthy environment for fishing community.

f. Compliance objective:

- To ensure fishing practices according to adopted rules and regulations.

It is clear that the various objectives listed above are not compatible with each other. Certainly, both Provincial Governments' main concern is towards the fishermen. The present fishing fleets still employ a large number of fishers (30-35 people per boat), but modernization of fishing technology may reduce this number. It is high time to spell out the objectives of the lemuru fishery, a responsibility that the management authority ought to establish in order to have a clear formulation for the future.

4. OPERATIONAL MANAGEMENT

Despite the absence of management units in each individual Provincial Fisheries Service, various rules and regulations are aimed at supporting the management of the fisheries. Regulations on mesh size, length and depth of purse seine net, zoning by gear and limitation in the number of vessels are measures that have been taken. Ineffectiveness in the enforcement of regulations has been very much related to the absence of management units in the Fisheries Offices.

Fishers were critical of the Ministerial (Agriculture) Decree No. 123/1975 regarding the mesh size limit of 1 inch (2.5 cm) as the use of 1-inch mesh of purse seine inhibits clean practice in fishing (the fish get gilled). Realizing the importance of the nursery area, fishers wish that the government establishes protection zones where no fishing will take place. With regard to accidents at sea, fishers also wish to have an insurance scheme to cover accidents occurring at sea (especially during rough seas).

Efforts by local government to protect fishers are reflected in the price policy at the peak season, during which time a minimum price of lemuru will have been determined. In practice, however, the regulation was not effective as the market price has always been above the minimum price set by the government.

Landing statistics had been collected by the staff of Provincial Government at the landing places where the costs of the auctioning of the catch used to be covered by a small service fee. This practice stopped early 1999 because of a new rule enforced by the Ministry of Home Affairs (Ministerial Instruction No. 10/1998), which prohibited such services fees. As a result, without the income of the landing fee, all auction halls became inoperational. In the absence of catch monitoring through the auction, it became difficult for the Provincial Fisheries Service to collect statistics of catch and fishing effort.

The issuing of permits for the construction of fishing vessels falls under the authority of the Directorate General of Sea Transportation, while licensing for processing factories falls under the Department of Industry. Unless each of these permits would also require the consent of the Directorate General for Capture Fisheries, the situation could cause problems to the fisheries sector.

5. RESEARCH AND STOCK ASSESSMENT

Scientists of the Research Institute for Marine Fisheries in Jakarta and also staff of various Universities, including the Brawijaya University in Malang, the Diponegoro University in Semarang and the Bogor Agricultural University, have conducted research on the lemuru fishery.

Sardinella lemuru is a fast growing fish with a life span of about 2 to 3 years. Many studies have been carried out on the growth and mortality of lemuru, but the most recent one is by Merta (1992). He determined the following biological parameters:

$K = 0.961$/year; $t_o = -0.1789$ year; $L_\infty = 22.71$cm; $M = 1.00$ and $F = 3.38$.

Various attempts have been made to assess the impact of fishing on the resources using various methods. Most of the analyses indicate that the fishery has reached a level of overfishing, as shown in Tables 1 and 2.

Stock assessment of lemuru, as is the case for most small pelagic fish resources, is constrained by the schooling behaviour of the fish. Fluctuation in abundance as reflected by variation of the schools has challenged the assumption of constant catchability. This leads one to question the validity of the method used in the assessments as summarized in Tables 1 and 2. The ability to predict the catch in the years ahead, which is always in the mind of the industry, is still far from reality.

From an acoustic survey it was indicated that the potential yield of the small pelagic fish in the Bali Strait was about 66,000 t per year (Sujastani, Amin and Merta, 1972). The fishing practices at that time and still now are not effective in locating and catching schooling fish at greater depths, where the schools are found during certain seasons (Venema, pers.comm.). Further studies in this area are recommended in order to comprehend the dynamics of the school and its implication to fisheries.

A recent acoustic survey (Wudianto, 2001) indicated that the concentrations of small pelagic fish (presumably lemuru) are distributed over four main grounds (see Figure 4):

(1) In the vicinity of Karang Ente close to the coastal area of Banyuwangi district;

(2) In the middle of the Bali Strait (highest concentration);

(3) Close to the eastern part of the Bali Strait; and

(4) In the vicinity of the Blambangan Peninsula.

Wudianto further showed the distribution of CPUE and its associated length of the fishes according to the fishing ground as shown in Table 3.

Research on lemuru has been concentrating on biology and stock assessment, while little attention was paid to environmental and socio-economic aspects. The strong request from fishers on the need for a sanctuary certainly requires the back-up from research on ecology especially on larval ecology. Research on socio-economic aspects has been very rare. Cost-benefit analysis on the type of fleet and other bio-economic analyses of the fishery need to be conducted to understand the dynamics of the fishery.

Table 1. Assessment of lemuru stock in the Bali Strait using surplus production models

Year	Model	MSY (t)	$F_{(opt)}$	Level of exploitation
1986 [1)]	Schaefer	66,306	238	Over fishing
	Fox	62,317	242	Over fishing
1986 [2)]	Schnute	80,332	207	Over fishing
	Gulland (with moving average)	60,559	123	Over fishing
	Schaefer: q = 0.00108	49,440	260	Over fishing
	q = 0.00068	48,835	257	Over fishing
	Jacknife: q = 0.00108	49,581	259	Over fishing
	q = 0.00068	47,512	320	Over fishing
1992 [3)]	Schaefer	40,000	180	Over fishing

Table 2. Assessment of lemuru stock in the Bali Strait using analytical models

Model	Y/R_{max} (g)	F_{max} (y^{-1})	Level of exploitation
Beverton and Holt [4)]	14.22 – 11.85	0.5 – 0.8	Fully exploited
Beverton and Holt [5)]	3.90	1.2	Over fishing
Jones [6)]	25.83	3.0	Over fishing
Thompson and Bell [7)]	34,041 t (total yield)	X= 0.8 (F-array)	Over fishing

[1)] Martosubroto, P., N. Naamin and S. Nurhakim (1986). Menuju manajemen perikanan lemuru yang rational. Jurnal Penel. Perik.Laut, 35: 59-66.

[2)] Salim, S. (1986). Assessment of the lemuru (*Sardinella longiceps*) fishery in the Bali Strait, Indonesia. MSc Thesis . School of Anim. Biol., Univ. Coll. North Wales, Bangor, U.K.: 52p.

[3)] UNDIP (1992). Studi penyusunan dan penataan zona penangkapan perikanan industri dan skala kecil di perariran Selat Bali. Jurusan Perikanan, Fakultas Peternakan UNDIP, laporan akhir Proyek Pengembangan Desa pantai, Ditjenkan, Deptan, Jakarta, 95p.

[4)] Ritterbush, S.W. (1975). An assessment of the population biology of the Bali strait lemuru fishery. LPPL 1/75-PL.051/75: 37p.

[5)] Gumilar (1985). Tingkat upaya penangkapan ikan lemuru (*Sardinella longiceps*) di perairan Selat Bali. Karya ilmiah, IPB Bogor, tidak dipublikasikan.

[6)] Merta, I G, S. (1992). Dinamika populasi ikan lemuru, *Sardinella lemuru* Bleeker 1853 (Pisces : Clupeidae) di perariran Selat Bali dan alternatif pengelolaannya. Disertasi. Program Pasca-sarjana, IPB, Bogor. 201p.

[7)] Merta, G. S. dan H.M. Eidman (1995). Predicted biomass, yield and value of the lemuru (*Sardinella lemuru*) fishery in the bali Strait. **In**: Potier, M. and S. Nurhakim (1995, eds.) Biodynex. Pelfish, Jakarta: 137-144.

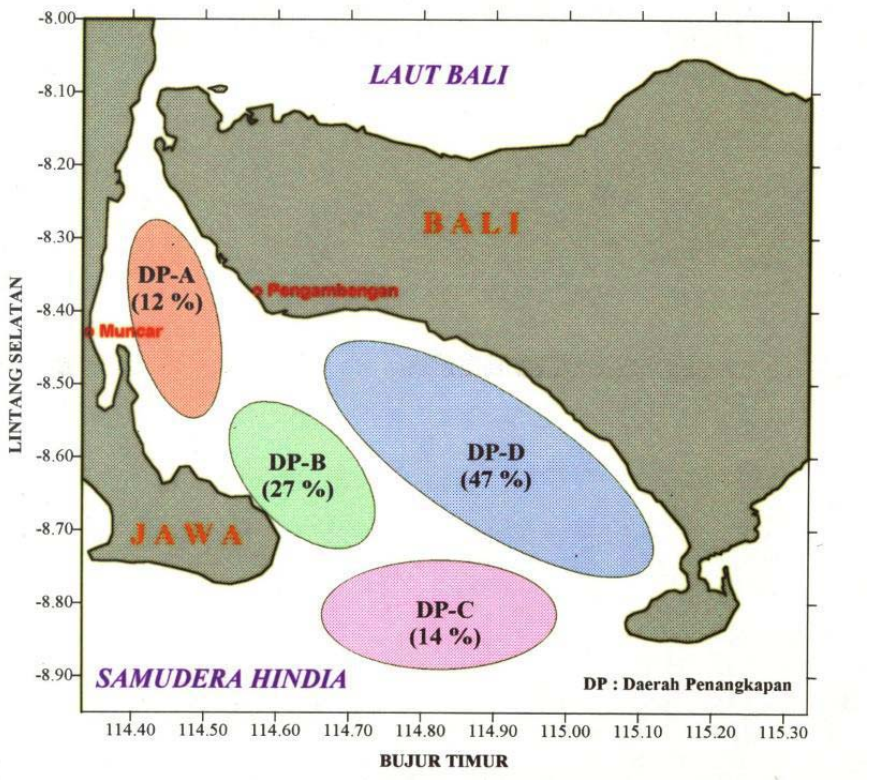

Figure 4. Fishing grounds of lemuru (Wudianto, 2001)

Table 3. CPUE and range of fork length of lemuru according to fishing season (Wudianto, 2000)

Period	Fishing ground	Average CPUE (kg/day/vessel)	Modal Range FL in cm
West Monsoon (December-February)	A	1,070	11-12
	B	2,150	13-14
	C	1,542	13-14
	D	2,412	12-13
First Inter-Monsoon (March-May)	A	734	12-14
	B	1,320	13-16
	C	1,265	19-20
	D	1,074	19-20
East Monsoon (June-August)	A	2,629	8-10[7])
	B	-	-
	C	-	-
	D	3,859	13-16
Second Inter-Monsoon (September-November)	A	3,315	9-12[8]**)
	B	4,506	12-13
	C	-	-
	D	5,263	12-13

[7] sempenit

[8] sempenit and protolan (these Indonesian terms denote small size groups of lemuru)

6. MONITORING, CONTROL AND SURVEILLANCE (MCS)

One of the tasks of MCS is aimed to monitor fisher's compliance with agreed rules and regulations. However, as mentioned in the earlier sections, the Provincial Fisheries Offices in East Java and Bali do not have an MCS unit. Law enforcement by patrol vessel is conducted by the Co-ordinating Committee on Sea Security (BAKORKAMLA) under the chairmanship of the Navy. The existence of conflicting articles in various laws and regulations (Criminal Law, Fisheries Law and EEZ Law) makes the work of MCS inefficient. Based on the Criminal Law, the Police Department is the main actor, while based on the Fisheries and EEZ Laws the main actor is the Navy. On the other hand, the newly initiated MCS units in the Directorate General of Capture Fisheries as well as in the Provincial Fisheries Services are relatively young and need to be strengthened. This uncertainty obviously is the cause of the limited attention given to MCS in the institutes concerned, with as a consequence a lack of budget support. This needs to be addressed during discussions on the revised Fisheries Law under the Project TCP/INS/8892. There has been an agreement between the Provincial Fisheries Services of the two Provinces and SATGASKAMLA (a part of BAKORKAMLA) to encourage the Fisheries Officer with MCS responsibility (PPNS) to take a leading role in the MCS operations.

In terms of fishing operations, there has also been a "gentlemen's agreement" between Provincial Fisheries Services in East Java and Bali to the effect that only fishermen from the coastal areas of the Bali Strait are allowed to fish there. Any foreign intruder into the Bali Strait will be forced to leave by the local fishermen. However, recent developments in Banyuwangi has allowed ten small purseseiners from Situbondo, equipped for light attraction, to fish in the Bali Strait through a special arrangement with local fishers and government.

Apart from institutional strength and budget availability for operations, the effectiveness of MCS also depends on infrastructure and other factors in the fisheries management. MCS could assist in monitoring the flow of information to the Fisheries Services. The logbook system on fishing vessels is aimed at obtaining information on fishing operations, including time of operation and catch, important data for stock assessment. MCS could also help fishers in rescue operations when an accident happens. MCS activities in ports are of importance, especially during landings of the catch, while data monitoring and checking in the auction hall could also be conducted to verify the information.

7. CONSULTATION WITH STAKEHOLDERS AND EXTENSION

Development of a management plan needs a strong participation from the stakeholders, as those are the ones most concerned with the sector as income generating sources. Apart from government (the Fisheries Services), fishers, fish processors and the whole fisheries industry needs to be represented. Fishers' associations such as HNSI have been in existence for many years but they still need strengthening. It was common practice in the past that the fisheries cooperatives provided services to fishers in return for a fee collected during auction. The enactment of Ministerial Home Affairs Decree No. 10/1998, prohibiting collection of that fee, has caused a weakening of the cooperatives' role.

The association representing the post harvest sector is the association of canning factories (APPI) which is a strong association. In the discussion of the current Management Plan the representatives of those stakeholders participated actively and contributed useful inputs.

It has been agreed by the Provincial Government of Bali and of East Java to have a regular consultation among fisheries staff to discuss matters relating to the lemuru fisheries (see SKB No. 238/1992 and 674/1992) and a regular consultation between government and other stakeholders in the individual provinces has also been established. In Muncar, through the assistance of ADB/Co-Fish Project a monthly consultation has been arranged to discuss matters relating to the coastal fisheries of the Banyuwangi District, while in Bali a monthly meeting has also been practiced between APPI and the fishers. It is encouraging to see that participation of stakeholders in the fisheries sector has improved.

8. POST HARVEST SECTOR

In this fishery, fresh fish consumption is relatively low compared to consumption of processed fish. Ice is available but mostly in block form owing to the small number of ice crushers. The quality of ice is still below standard. Most of purse seine boats bring ice while some are already equipped with a well insulated fishhold to maintain the temperature of the refrigerated sea water system. Facilities at the landing places are still inadequate with a limited source of a good quality water. The practice of collecting and transporting fish from boats to the landing place using the traditional "serok" (a large basket) may reduce fish quality.

The processed foods are in the form of three products: boiled-salted (pindang), dried-salted and canned. The rest is converted into fishmeal or silage. Total number of processing facilities in the two provinces is indicated in the table below:

Province	Type of processing plant	Number
East Java	Boiled-salted (pindang)	49
	Fishmeal	25
	Cannery	12
Bali	Boiled-salted (pindang)	155
	Fishmeal	2
	Cannery	7

In addition, all canning factories also produce fishmeal as secondary products.

The "boom and bust" nature of lemuru production provides a special challenge to the processing industry in dealing with the processing operation. During low catches, the capacity of processing may be underutilized, while during peak seasons the facilities could be overused. To make use of the facilities during low lemuru catches some canning factories have canned other fish such as tuna and mackerel. Some have even imported the raw materials from abroad.

9. REVIEW OF THE PLAN

This Management Plan contains information on the Bali Strait fishery with a focus on the lemuru fishery. The plan presents the status of the fisheries, issues and problems as well as potential for further action. The plan has been developed on the concept of sustainable fisheries for the benefit of the present and future generations. By having the Management Plan one would be able to see a benchmark on the development and management of a fishery.

The plan is not static but dynamic and, therefore, regular review is needed and has already been anticipated.
A Management Committee was established in March 2000 during a joint meeting in Malang (East Java) between the Provincial Fisheries of East Java and Bali. From the terms of reference of the Committee it is clear that the task of the Committee has been extended from only covering the lemuru fishery to overall fisheries management in the Bali Strait. The Management Committee was able to meet once in Banyuwangi and members of the Committee were also present in the present workshop. A proposal was submitted to modify the structure of the Management Committee to a higher level to enable the Committee to work more efficiently. In the proposal the Heads of the Provincial Fisheries Services should alternate as Chairman of the Committee, however, no conclusion was reached. The matter will be discussed further between the two Provincial Fisheries Services.

In the terms of reference of the Management Committee it was suggested that it should meet twice a year. Consultation with stakeholders is of importance and consequently the inputs will be discussed during the review process.