Selection Criteria and Co-Management Guidelines for Harvest Reserves in Tropical River Fisheries

Monitoring Programme Implementation Report

UK Department for International Development
Fisheries Management Science Programme
Project R7043

Central Research Institute for Fisheries, Indonesia
Provincial Fisheries Services, Indonesia
MRAG Ltd, UK

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Executive Summary

1. The aims of this project are to identify ecological and institutional criteria for the selection and beneficial use of harvest reserves in tropical, artisanal river fisheries; and develop guidelines for their co-management in Indonesia. The purpose of the guidelines will be the delivery of economic benefits to fishing communities, derived from enhanced recruitment to exploited fish stocks.

2. A 'reserve' is often understood to mean an area totally closed to exploitation for the purpose of nature conservation. In contrast, this project defines a *harvest reserve* as a spatially defined area of water, managed with any specified set of technical regulations, intended to sustain or increase the potential fish yield available from existing, natural fish stocks, for the benefit of fishers.

3. The project will run from November 1997 to March 2000, and involves collaborators from MRAG Ltd (UK), the Central Research Institute for Fisheries, Indonesia (CRIFI), and three provincial *Dinas Perikanan* (Fisheries Extension Service) offices in West Kalimantan (*Kalbar*), Jambi and South Sumatra (*Sumsel*) in Indonesia.

4. The project includes the following five main phases or activities:
   Inception and Legal Workshop (project inception and prospects)
   Regional Reserve Survey (reserve identification and fieldwork planning)
   Monitoring Programmes (biological, socio-economic and institutional surveys)
   Analysis of Reserve Benefits (estimation of reserve benefits, and their causes)
   Dissemination and Training (preparation and presentation of guidelines)

5. This report describes the Monitoring Programme, as finalised and implemented during field activities during July and September 1998. This Monitoring Programme Implementation phase was undertaken by seven main collaborators from CRIFI and MRAG, with both biologists and socio-economists from each institute. This team was supported and guided by locally-experienced *Dinas Perikanan* officers in each province.

6. The objectives of the Monitoring Programme are to collect data on a range of study sites, as required to (1) approximately estimate the impacts of different types of reserves (how useful might riverine reserves actually be?), (2) determine what is important for the effective management of reserves (the selection and co-management criteria), and (3) demonstrate also the broader implications and requirements of other management tools and approaches for floodplain river fisheries, to show how reserves might be integrated into existing systems.

7. This report is divided into five main sections, plus annexes. The objectives, rationale and overall approach of the Monitoring Programme (MP) are described in Sections 1. and 2. of the report. Specific details on the survey methodologies are given for the biological MP in Section 3., and for the Socio-economic MP in Section 4. The timetable of future MP events and the required inputs at each stage is given in Section 5.

8. As described in Section 2. of this report, the MP includes both Biological components (BMP) and Socio-Economic components (SEMP). The 'BMP' will investigate the state of fish stocks *inside* reserves, and compare them to other non-reserve sites. The SEMP will investigate the economics of the fisheries in villages with and without reserves to show the potential socio-economic outcomes of different types of reserves and other management systems. The SEMP will run for a full 12-month period in eight contrasting

villages, with 4, 2 and 2 in Kalbar, Jambi and Sumsel respectively. Full 12-month BMP studies will be undertaken on 7 waterbodies, with additional partial studies in 4 more sites for comparisons. The regular monthly studies will be undertaken by enumerators employed by the project in each field site, coordinated by *Dinas Perikanan* staff. The data will be used to generate comparative indices on the state of the fish stocks within reserves, and on the economic surplus generated by the fisheries within or around the reserves, and its distribution between village members and other stakeholders. A supporting programme of interviews and institutional analyses in February/March 1999 will explore the mechanisms contributing to the successes and failures of management.

9. As described in Section 3. of this report, the BMP is based mainly on samples of fish catches taken by experimental fleets of multi-mesh gill nets. Eight fleets of nets will be fished in each waterbody in each month over a full one year period. The catch data will be used to estimate fish abundances (measured as relative 'CPUE's) and species compositions and size compositions of fish inside reserves. These quantitative results on the present status of fish stocks will be supported by interviews on the historical changes in fish stocks within recent decades, as recalled by fishers. The combined results will indicate the level of protection given by the different reserve types to the fish inside them. It is assumed that more abundant fish stocks inside reserves would produce more benefits to the fisheries within or around them.

10. As described in Section 4. of this report, the SEMP is gathering data to estimate income flows from different fishing activities going to different stakeholder groups. A weekly household monitoring survey (based on a formally selected random sample) and records from self-monitoring by fishing groups will be used to estimate revenues. These sources will be supplemented by more open-ended interviews to estimate costs. Comparisons will be made of total catch and total economic surplus relative to the area of the waterbodies, the number of fishermen active and the number of man days spent fishing. Differences identified will not just be due to the characteristics of the local reserves but to the interaction of the entire fisheries management system operated in each area with the hydrological and environmental characteristics of its river-floodplain system. So, while the *quantification* of the economic impact of reserves is *not* feasible, the study should provide insights on a range of issues critical to the development of co-management in Indonesia.

1. Introduction

1.1 The 'Purpose' and 'Goal' of the Project

This project is designed to answer the following two broad questions:

- Which types of reserves provide the greatest benefits in which circumstances (i.e. the reserve selection criteria)?

- What management institutions and arrangements are necessary to achieve a given objective or potentially available outcome (i.e. the co-management guidelines)?

Finding the answers to these questions would result in the achievement of the '*purpose*' of the project, as specified in the Project Memorandum Logical Framework. At this level, the project would thus have produced *advice* on how to manage floodplain river fisheries. At a higher level, the '*goal*' of the project is the achievement of *actual benefits* for the project's target population of Indonesian, artisanal river fishing communities. Achievement of this higher *goal* depends on (1) the guidelines being practically beneficial (i.e. they *would* give a benefit if implemented), and (2) their subsequent uptake and effective use by the target institutes.

The full objectives of the project may thus be stated in two parts. To achieve the *purpose*, the project aims to answer the two questions stated above, as well as possible. To achieve the *goal*, the project also aims to provide the target institutes with a good understanding of (1) the biological and socio-economic dynamics of river floodplain fisheries, (2) how these vary depending on local conditions, and (3) how the project outputs (the '*Guidelines*') may build on existing systems to give real benefits to fishing communities. This depth of understanding would enable the target institutes to implement the project recommendations in the context of their existing, local management systems. There is a particular requirement here to indicate how reserves might be integrated with alternative systems of allocating access to fishing, such as waterbody auctions or lotteries of fishing positions.

1.2 The difficulties of estimating 'benefits' from reserves

As shown below, four alternative experimental approaches may be used to study the benefits or impacts of reserves. Unfortunately, none of these are entirely appropriate for this project.

- **'Edge-effect' studies** may be used to compare stocks or benefits in areas close to reserves compared to those further away. These may be appropriate for some relatively constant habitat types, such as savanna grasslands or large forests, but they are difficult to use in river systems due to the strong changes in habitat across the floodplain. A reserve in a floodplain lake may thus have good fish stocks in its surrounding floodplains because they are deeper than others further away, and not because they are closest to the reserve.

- **'With / without' studies** may compare fish stocks or benefits in those areas with reserves against those areas without them. These comparisons are difficult in floodplain fisheries due to their strong spatial variations in habitat, and the problems of finding sufficiently similar sites to act as 'controls' without reserves.

- **'Before / after' studies** of fish stocks, catches etc. recorded before and after the

implementation of a reserve are difficult to interpret due to the strong environmental variations in flood strengths and resource productivity between years.

- **'Temporal studies with controls'** offer the best possibilities for assessing reserve benefits, as a combination of the last two study types. In this case, indices of benefits would be compared before and after a reserve is introduced, *relative* to the changes in the same years in nearby, non-reserved control sites. Unfortunately, this approach requires several years of baseline data and impact data before a reliable result may be detected.

1.3 Monitoring Programme Objectives

In view of the above comments, the Monitoring Programme described in this report has been designed to collect data on a range of study sites, as required to (1) approximately estimate the impacts of different types of reserves (how useful would riverine reserves actually be?), (2) determine what is important for the effective management of reserves (the selection and co-management criteria), and (3) determine also the broader implications and requirements of other management tools and approaches for floodplain river fisheries.

As described in Section 2. of this report, the benefits of reserves will be roughly estimated only, by using a 'with / without' approach, comparing sites with reserves, with others without. It is hoped that this approach will give sufficient understanding of the potential benefits of reserves or other management measures, to stimulate adoption of the Co-Management Guidelines to be produced by the project.

1.4 Monitoring Programme Implementation Team

The MPI fieldwork was carried out by a multi-disciplinary team, including the following members from the collaborating institutions:

MRAG: Dr Daniel Hoggarth, Biologist & MRAG Team Leader
Mr Mark Aeron-Thomas, Socio-economist
Dr Ashley Halls, Biologist

CRIFI: Mr Sonny Koeshendrajana, Resource economist & CRIFI Team Leader
Dr Achmad Sarnita, Biologist
Mr Agus Djoko Utomo, Biologist
Mr Samuel, Biologist, Assistant to Socio-economic team

Diskan: Mr Herman Suherman, Provincial Coordinator (Jambi)
Mr Rooslan Saleh, Provincial Coordinator (Sumsel)
Mr Asmarajaya, Kabupaten OKI Coordinator (Sumsel)
Mr Suasa Dilapanga (Kalbar)

The survey was undertaken over a six week period between 20 July and 4 September, 1998 (see Annex A). The Jambi and Sumsel fieldwork was carried out by both MRAG and CRIFI staff, while the Kalbar fieldwork was carried out by CRIFI after the departure of the MRAG team.

1.5 This Report

The remainder of this report is divided into four main sections, followed by the annexes. Further details on the overall rationale of the MP, the sites selected and the proposed comparisons to be made are given in Section 2. of the report. Full details on the survey methodologies are given for the biological MP in Section 3., and for the Socio-economic MP in Section 4. The timetable of future MP events and the required inputs at each stage is given in Section 5.

2. Monitoring Programme Rationale and Approach

2.1 Comparisons between floodplain study sites

As mentioned in the introduction, comparisons between the different reserve types or between reserves and 'control' sites are complicated by the great local differences between study sites. River fisheries differ extensively in at least the following factors:

- Resource ecology (types of habitats, macrophytes etc. and their productivity)
- River hydrology (flooding patterns, including duration, depths, and areas and their variability between years)
- Fish ecology (fish species available, and their present abundance, potential productivity, distribution and migratory behaviour)
- Fishing practices (the intensity of fishing, the gear types used and their seasonality and effectiveness)
- Historical changes in all the above factors.

Though quantitative measures could be monitored for each of the reserves, local differences in the above factors would make it impossible to assign any given measure purely to say a reserve, or any other factor of interest.

This section describes how these difficulties are partially overcome in this MP, to give both general insights about the dynamics of floodplain fisheries and their management, and some indication of the possible benefits which may be gained from reserves.

2.2 Selection of study sites to provide insights on floodplain fishery dynamics and reserve management systems

The Regional Reserve Survey (see April 1998 report) developed a 'reserve categorisation system', which attempted to simplify some of the complexities of floodplain systems. The identified reserves were classified on the basis of five variables, selected for their potential to give useful guidance on how to select or manage reserves:

- Intended beneficiaries (local or catchment)
- Catchment position (upland or floodplain)
- Habitat type (river section, or lake)
- Management agencies (established and managed mainly by government or community)
- Management regulations (partial reserves - with 3 sub-categories - or full reserves)

Reserves were selected for the study in as many of the above category combinations as available, for the purpose of understanding what factors affect their success or failure. In addition to these study sites, some additional sites were also selected to investigate the implications of the various management systems used in the three study provinces, alongside the reserves. These include the mainly community-based lottery systems of access control in Kalbar, the government waterbody auction system in Sumsel and the more shared fishery management systems in Jambi.

The monitoring programme is designed to generate indices of ecological and socio-economic benefits at study sites in each category. To investigate the importance of the different ecological components of the study sites and their overall management systems, the indices from all the study sites will be compared as the outcome of the full eco-social system. Due to the lack of replicates and the complex interactions between factors, it will not be possible to quantify the contribution of different factors to the observed outcome. Qualitative indications and lessons are anticipated instead. In this part of the study, the integrated, interdisciplinary results from the monitoring programme will be supported by the more insightful interviews and institutional analyses from the February-March field work, with the results presented largely in a case-study approach.

2.3 Study sites to determine approximate impacts of reserves

In addition to those study site selections intended to give a general understanding of reserve selection criteria and management, a number of study sites were also selected deliberately for the purpose of roughly estimating the impacts of reserves by 'with / without' comparisons. Impacts will be estimated by comparisons between sites with reserves and those without, assuming within limits that the reserve and 'control' sites are similar in all factors except the existence of the reserve. To validate this assumption as far as possible, comparisons will be limited to sites close to each other (within the same province), having similar ecological features and similar flood strengths in the year of study. The study sites selected for this purpose are described in Section 2.6.

2.4 Investigation of local benefits

The monitoring programme is designed to investigate the impact of reserves on the status of fish stocks and on the actual benefits obtained by fishing communities from their overall management strategies. As discussed in the Regional Reserve Survey Report, reserves may be intended to give benefits to either local communities, or to whole river catchments. The impact of a reserve at a catchment level could only be investigated by comparing whole catchments, some with and some without reserves, and making allowances for the significant ecological differences between catchments. Such an approach is well beyond the scope of the present project. Instead, the monitoring programme focusses on *local* impacts of reserves, particularly as perceived by those communities most closely associated with them.

Many of the reserves examined by the RRS fell entirely within the boundaries of a single village, which had some traditional or formal authority to control the fishing activities in their waters. Most of the study sites selected fell into this category. The ecological benefits of reserves will be investigated by monitoring the state of fish stocks inside the reserve over a full yearly cycle. The socio-economic benefits of fisheries management (including the reserve) will simultaneously be assessed within the village as a whole, as obtained from all its fished waterbodies. This strategy supposes that fish protected within reserves give the maximum benefits to those waters most adjacent to them, as fished by the local village, and that such benefits may be detected in that community.

The three waterbodies established as reserves in upland parts of the Jambi catchment were not included in the monitoring programme due to difficulties in access, and the problems these would cause for managing the sites. These reserves were established by the Indonesian Government (Diskan in collaboration with LIPI), mainly for the overall benefit of the Jambi catchment. The sites will however be investigated in the Institutional Analysis phase of the project (in February / March 1999) to determine their *local* impacts and the attitude of the communities toward them.

2.5 Monitoring Programme Components and Schedule

The Monitoring Programme includes two main components. A Biological Monitoring Programme (BMP) will collect samples of fish from inside reserves and other waterbodies using multi-mesh gill nets provided by the project. These will show the species composition and abundance of fish inside the reserves, and hopefully reveal the degree of protection which reserves give to their resident fish stocks. It is assumed that those reserve with high fish numbers could give more benefits to their local fishing communities. Such benefits would only be achieved when enough fish move out from the reserve to be caught in the fished area, or just enough fishing is allowed inside the reserve to increase catches without depleting reserve stocks.

The contribution of the reserve to the village fisheries will be investigated by a Socio-Economic MP looking also at the productivity and profitability of the fisheries surrounding (or sometimes also inside) the reserves. The SEMP will determine the catches of fish and the profits and costs of the fisheries in villages with the different types of reserves. Additional samples will be taken in some villages without reserves where these may provide insights on the effects of the various overall management patterns.

The BMP and SEMP will be undertaken between the 14 months from the start of August 1998 to the end of September 1999. This period should include two dry seasons during which the abundance of fish inside the reserves will be estimated by the BMP. It also includes a full one year cycle over which the annual production and profitability of the villages will be estimated by the SEMP.

Interpretation of the outcome of the MP will be aided by the insights and understanding of management systems gained during the Institutional Analysis field trip in Feb/March 1999.

2.6 Monitoring Programme Study Sites

As outlined in the previous sections, the MP study sites were selected for various reasons:

- As a first priority, sites were selected where reserves were fully contained within the boundaries of single villages, and fished only by their inhabitants. In these situations, investigations could be made on the relationships between (1) the state of fish stocks inside the reserves, and (2) the productivity and profitability of the fishery in the village with the reserve. These sites included Arang Arang in Jambi, Benawa in Sumsel and all three of the Kalbar sites with reserves (see Table 1).

- Study sites were selected in as many as possible of the different reserve categories identified during the RRS. Only the catchment position category could not be investigated due the difficulties of working at the Jambi upland sites. Due to the lack of available study sites, and the many different types of reserves, it was not possible to select several replicates for each reserve type.

- To determine the overall impact of eco-social systems, some study sites were selected without reserves where these were expected to yield useful lessons. Such sites included Desa Dano Lamo in Jambi.

- To determine the impact of reserves by ‘with / without’ comparisons, some study sites were selected purely for comparison with reserve localities, having similar features and located nearby to each other, within the same hydrological system. These sites are

identified as the 'control' locations identified for comparisons B, C, D, E, G and H, as given in Table 2. Some of these sites will be investigated by full BMPs, while some are investigated by Partial BMPs, with samples taken only in certain dry season months (see Section 3.2).

The following notes briefly explain the reasons for the selection of each of the different study sites. These notes are summarised in Tables 1. and 2.

- The two Jambi study sites, (**Desa Arang Arang** and **Desa Dano Lamo**) were mainly selected to study the eco-social impact of their overall management systems, being in between the community oriented Kalbar sites and the more government oriented Sumsel sites. No suitable water body was available for comparison with the partial lake reserve **Danau Arang Arang**. The approximate impacts of this water body may only be investigated by comparison with the other reserves in the different provinces. The **Lubuk Mahligai** reserve in Dano Lamo was only implemented this month by Diskan and LIPI. BMP studies were not carried out on this site to give the reserve some time to develop its fish stocks without any fishing activities.

- **Teluk Rasau** reserve within the Lempuing system will be studied as an example of a government-managed, fully-closed, lake reserve. Data from the full BMP at this site will be compared with Partial BMP collected by CRIFI staff over the dry season period in a nearby, ecologically-similar water body, such as **Lebung Sulit**. The final choice of water body will be decided by CRIFI staff in discussion with Lempuing fishers. Investigations of fishing incomes on adjacent *lelang* areas will highlight the operation of the leasing system and its effects on different stakeholders.

- The biological effects of riverine reserves will be studied by Partial BMP studies at CRIFI's **Lubuk Lampam** auction unit on the River Lempuing. This unit includes some *lubuks* (deep sections in the river) which are restricted as reserves and some others which are fully fished over the dry season, using *ngesar* fish drives and other methods.

- **Desa Benawa** in Sumsel includes a large, remote lake **Lebak Nilang** identified by Diskan several years ago for eventual use as a reserve. The lake is currently withdrawn from the local auction system, but continues to be fished as before by a local 'manager' on behalf of Diskan. Socio-economic studies at Desa Benawa (without a reserve) will be carried out to enable comparisons with the results from Teluk Rasau . Biological studies at Lebak Nilang will be compared with the results from a Partial BMP at the nearby, ecologically-similar reserve water body **Teluk Gelam**. This reserve is not fished by any local community, and no socio-economic studies will be undertaken at this location.

- In Kalbar, studies on the three reserve lakes **Danau Seliban, Danau Belaram** and **Danau Batu** will be made to compare the impacts of different types of partial reserve closures (see Table 1). These study sites are less similar to each other than the comparison sites in Sumsel, and the comparisons will need to take account of the wider eco-social systems at these waterbodies. Danau Seliban, for example was reported to have serious problems of enforcing its regulations due to the close vicinity of a nearby town. Fish stocks in Desa Meliau may benefit from its reserve Danau Belaram, but also from its remote upstream position and its low fishing rates in some waterbodies said to be protected by crocodiles and evil spirits.

- The socio-economic studies in the four Kalbar villages will also be used to demonstrate the levels and distribution of benefits from Kalbar's strongly community-oriented management systems (in which the participation of village members in the fishery is

maximised by use of a lottery system for fishing positions).

- **Desa Pulau Majang** in Kalbar does not have any reserve waterbodies, and many of its fishing areas are routinely fished by tuba and/or chemical poisons in the dry season. Studies in this village will determine the stock levels and benefits achieved in this locality from external recruitment sources only, when virtually all local sources of fish are destroyed in the dry season. The stock levels and economic benefits in this village may be qualitatively comparable with the other three study sites in Kalbar.

In addition to these study sites, selected for the main Monitoring Programmes, summary investigations may be conducted during the Institutional Analysis phase (February / March 1999) at an additional four sites.

- **Desa Jambi Kecil** may be investigated as a partial river reserve in Jambi (this site was not selected for the main MP due to the lack of clearly suitable candidates for the enumerator positions, and the complexities of local traditional regulations).

- Two of the upland reserves in Jambi, **Lubuk Taman Ciri** and **Danau Teluk Kayu Puti** may be investigated in order to determine the local impacts of those reserves intended mainly for benefits to the wider catchment.

- **CRIFI's 'Swamp Project'** sites in South Sumatra may also be briefly investigated to consider the possible application of the project Guidelines at this location.

Table 1. Summary of characteristics of sites selected for socio-economic and biological studies in the Monitoring Programme

Prov-ince	Village	S-E MP?	Reserve	Biol. MP?	Reserve Management				Hab-itat
					Regul-ations	Sea-sons	Gears banned	Agen-cy	
Jambi	Desa Arang Arang	Yes	Danau Arang Arang	Full	PR	Dry	Some	C-C	Lake
	Desa Dano Lamo	Yes	(Lubuk Mahligai)	No	FR *			G-C	River
Sumsel	*Lelang* units near Teluk Rasau	Yes	Teluk Rasau	Full	FR			G-G	Lake
			Teluk Toman	Part.	None			None	Lake
			L. Lampam reserve lubuks	Part.	PR	Dry	Some	CRIFI	River
			L. Lampam fished lubuks	Part.	None			None	River
	Lebak Nilang	Yes	(Lebak Nilang)	Full	None **			G-C	Lake
	(None)	No	Teluk Gelam	Part.	FR			G-G	Lake
Kalbar	Desa Tengkidap	Yes	Danau Seliban	Full	PR	Dry	Some	C-C	Lake
	Desa Meliau	Yes	Danau Belaram	Full	PR	All	Some	C-C	Lake
	Desa Sekulat	Yes	Danau *Batu*	Full	PR	Dry	All	C-C	Lake
	Desa Pulau Majang	Yes	None	Full	None			C-C	Lake

Notes: S-E MP = Socio-Economic Monitoring Programme; Biol. MP = Biological Monitoring Programme
Part. = Partial Biol. MP (gill net fishings in selected months only)
* Reserve only implemented this year, so Biol. MP not permitted, and too early to detect benefits
** Reserve not yet implemented, so only control site
FR = full reserve; PR = partial reserve; C = community; G = government agencies

Table 2. Summary of anticipated comparisons to be made between study sites

Prov-ince	Village	Reserve	Comparisons Based on Biological Data		Comparisons Based on Socio-economic Data	
			Lake Reserves	River Reserves	Eco-social System	Lake Reserves
Jambi	Desa Arang Arang	Danau Arang Arang	A		F	
	Desa Dano Lamo	(Lubuk Mahligai)			F	
Sumsel	*Lelang* units near Teluk Rasau	Teluk Rasau	B		F	G
		Teluk Toman	B (control)			
		L. Lampam reserve lubuks		E		
		L. Lampam fished lubuks		E (control)		
	Lebak Nilang	(Lebak Nilang)	C (control)		F	G (control)
	(None)	Teluk Gelam	C			
Kalbar	Desa Tengkidap	Danau Seliban	D		F	H
	Desa Meliau	Danau Belaram	D		F	H
	Desa Sekulat	Danau Batu	D		F	H
	Desa Pulau Majang	None	D (control)		F	H (control)

Note: Main comparisons would be made between those sites marked with the same letter (A,B,C,...,H)
Assessment of Danau Arang Arang would require overall comparison of groups (A,B,C & D)

3. Biological Monitoring Programme

3.1 Introduction

The biological monitoring programme was designed to use the simplest possible approaches for generating useful, quantifiable indices on the states of fish stocks in reserves. Simple indices (eg fish abundances) were preferred over more complicated ones (eg current spawning stock biomass as a % of the unexploited biomass) to ensure that the results collected would be meaningful to artisanal fishers and fisheries extension staff having relatively little education.

The programme has two main components: a regular sampling survey covering a full 12-month cycle, and a series of supporting interviews to provide comparative data on historical conditions.

The routine sampling survey will collect quantitative data enabling the following indices to be calculated for the state of fish stocks, for the year of the survey:

- The abundance of fish
- The composition of fish stocks (by species and sizes of fish)

The supporting interviews will collect more qualitative data on the historical trends in the above indices over recent years, ie:

- Overall changes in fish abundances over time
- Any particular declines or extinctions of individual species

These components are described in detail in this section of the report. A checklist of the required activities for the full implementation of the BMP is provided as Table 3.

3.2 Seasonal variability in fish abundance

Fish abundance varies over time in an annual cycle linked to the seasonality of flooding. Most river fish species spawn at the beginning of the flood, and the overall abundance of the stock then rises during the flood season, and falls again as fish die off in the environmentally stressful conditions of the dry season. In fished rivers, catches are usually particularly high in the drawdown and dry seasons following the high water growth season. The long-term survival and productivity of river fish stocks is critically dependent on the survival of enough fish over the dry season to spawn at the beginning of each new flood season. The ecological benefit of a reserve may therefore be particularly measured in terms of the numbers or biomass of fish which it sustains over the dry season.

The actual timing of the dry season varies significantly between different localities and between years. This variability prevents the detailed advance planning of monitoring surveys intended to focus on dry season indices. To ensure that fish stocks are sampled over the unpredictable dry season period, it was decided that data should be collected over the full annual cycle in the main study sites. Comparison sites selected for the Partial BMP would be studied only during the dry season period, as identified from the nearby fully-monitored sites.

3.3 Estimation of fish abundance using CPUE data

Indices of fish abundance may be obtained from catch-per-unit-effort (CPUE) data, since a given unit of fishing gear will generally catch fish in proportion to their availability. The main constraint to this approach is that the effectiveness (or 'catchability') of fishing gears varies in many different ways. Catchability varies enormously between different gear types, and also varies seasonally and spatially in floodplain fisheries, with their strong hydrological cycles and morphological features.

To maximise the comparability of abundance indices between the different study sites, CPUE data were collected from standard fleets of variable-meshed gill nets bought by the project. Gill nets are most effective in relatively open waters at times when fish are relatively mobile, e.g. during the high water and drawdown seasons when fish are foraging for food and then attempting to emigrate from the drying floodplain. Gill net catchabilities may be lowest in the dry season when trapped fish are relatively sedentary. The high concentrations of fish at this time are usually caught by other, more active gear types. Recognising, then, that CPUE abundance indices may not be comparable between seasons, this approach is recommended on the assumption that changes in catchability may be relatively similar between the different waterbodies in the study, thereby allowing their comparison.

In addition to varying over the seasons, catchability also varies spatially: some fishing locations are simply better than others. To minimise bias due to different fishing practices between the study sites (each of which will be fished by different fishermen employed by the project), a master fishermen was employed standardise net setting practices, and provide guidance on the most appropriate fishing locations within each reserve.

3.4 Biological monitoring programme activities

In consideration of the above points, the routine biological gill net sampling activities were undertaken in each of the selected waterbodies as follows:

- Two fleets of gill nets were purchased by the project for each study location, each comprised of 4 sections of 40mx2m monofilament gill nets, with mesh sizes of 1", 2", 3.5" and 4.5". To ensure comparability, all gill net materials were purchased from the same supplier, and rigged in the same way. To minimise the effects of deterioration of the nets, two second sets of nets were supplied to be used for the latter half of the programme.

- Weighing balances of two appropriate sizes (eg to weigh up to 3kg in 0.01kg units and up to 10 kg in 0.1 kg units) and basket(s) were provided by the project for each village.

- Since the sampling programme will deplete the fish stocks in each reserve, some compensation (Rp 500,000 - Rp1,000,000) was paid to each village. In some villages, the compensation was contributed to village development funds, via the Kepala Desa. In other villages, the compensation funds were used by *Dinas Perikanan* to restock fish in the reserves after the study. To avoid any misunderstandings about the legality of fishing, both verbal and written publicity materials were distributed among village members, describing the scientific nature of the survey, the objectives of the project and the compensation paid to the village (see e.g. in Annex C).

- At each site, two gill net fishers were employed by the project and trained to set and haul the nets. An enumerator was also employed in each village to record the data from the nets, as described in Instruction Manuals provided for each village (see e.g. in

Annex B). Following suitable training, both gill nets were set overnight, on 4 selected days in each month, thereby generating 8 samples per month, from which to estimate a mean catch and its standard error. Instructions were given on the positions for setting the gill nets, intended to give a good coverage of the different parts of the waterbody. Gill net positions were specified on maps provided to the enumerators, as illustrated in Annex B, and in Figures 1 and 2.

- The programme was implemented for at least a full 12-month cycle starting from the training period at each site, and lasting up to 31 September 1999. This sampling period should ensure coverage of at least one dry season period, and possibly two.

- The total catch from each night's sampling was recorded as follows:
  the total weight of fish caught
  the number and weight of fish caught of each main species (or species group), in each of two size classes (above or below 30cm)
  Such data were recorded on a standard data form (see Annex B).

- Water height gauges were set up to enable measurements of water levels in the reserve and comparison waterbodies.

- Occurrences of '*air bangar*' low water quality or illegal fishing in the reserve since the last sample were recorded by the village enumerators. Such factors may be responsible for major sudden losses of fish, particularly over the dry season and early flood.

3.5 Biological monitoring programme staff and training

To achieve the above routine fieldwork, the following staff were employed by the project:

- Two locally resident fishermen were employed in each village for the full 12-month survey, and paid a daily salary (at an appropriate government-specified rate) to set and retrieve the gill nets 4 times a month, and land the fish caught.

- One locally-resident 'enumerator' or 'Village Coordinator' (VC) was employed in each village for the full 12-month survey to meet the fishermen and assist them to weigh and record catches on data forms supplied by the project.

- One 'Provincial Coordinator' (PC) was employed in each province to provide a liaison between the village enumerators and the project, to ensure that data were collected as required, to check data quality, and to send copies of data sheets to the CRIFI project coordinator by agreed deadlines.

- One master fisherman was employed for the duration of the MP Implementation phase to train fishermen in each of the villages to use standard fishing techniques and identify those localities in the reserve likely to produce the best catches.

The village fishermen and enumerators, and the three provincial coordinators were trained in the appropriate methods of data collection and recording during this field visit. Biological Instruction Manuals were written in Indonesian (see pre-translation draft in Annexes B and C) and provided to the employees.

3.6 Supporting interviews on historical trends

Supporting data on trends in fish stock abundances were collected during the MPI field trip, using the following short interview process. Each interview took not longer than 10-15 minutes.

- A subsample of at least 10 fishermen was selected for interview in each village (with the help of the village leaders, and randomised where possible)

- Each respondent was asked to state the number of years he/she had fished in the village waterbodies.

- The respondent was then asked to estimate the change in *average* CPUE over a stated time period within his memory (*NB: this should be CPUE for a specified number of gear units of a specified, unchanged gear type, and NOT the change in total catch, or catch per fisherman*). Since fisherman often tend to overestimate the decline in their fish stocks, some questioning was made to ensure that the respondent had compared present catches with the *average* historical catches, and not with, say, his *best day's catch in the best ever year* in that village.

- The respondents were finally asked to state which fish species had either become extinct, or increased or decreased significantly within the period of his/her experience.

3.7 Biological data analysis and fish stock indices

Data from the historical interview survey were recorded by the CRIFI/MRAG staff during the field visit, and retained by them for subsequent computer analysis.

Data from the routine monitoring survey were initially collected by the employed village enumerators. The provincial coordinators were requested to collect the data sheets on a monthly basis from all the village enumerators, and to send photocopies of the data sheets to CRIFI for entry.

Data entry should be undertaken in a suitable Microsoft Excel database by CRIFI staff. Data should be entered as soon as possible after collection to enable ongoing monitoring of results. An up-to-date copy of each month's database should be e-mailed to MRAG as soon as it is fully entered, and hard copies of the data sheets sent by post at the same time.

The historical trend interview data should be analysed to produce two visual, qualitative illustrations of the changes in fish stocks:

- A plot of the ratio (historical catch / current catch) against the year of the historical catch (values consistently over 1, or a negative trend over time would indicate a decline in fish stocks).

- A frequency distribution of the number of times each fish species is reported by a respondent as being significantly declined or extinct (illustrating the degree of correspondence between the different respondents, and identifying those species most commonly agreed to have declined).

The gill net data should be analysed to produce the following simple indices on the state of fish stocks within reserves:

- Monthly average total weight of fish caught per 160 m gill net, and its standard error

(index of seasonal fish abundance)

- Yearly average % of total catch weight of large fish (>30 cm), and its standard error (index of average fish sizes)

- Yearly average % of total catch weight of each species/group, and its standard error (species composition to illustrate abundance of preferred / valuable species)

- Yearly average sizes of fish ($\bar{3}$weight / $\bar{3}$numbers) of most common species (index of fish mortality rates by species, assuming equal growth and emigration rates)

When the full year's data have been collected, the monthly fish abundance indices should be examined to determine the maximum and minimum fish levels achieved within the reserves, and the month at which they occurred, for comparison with the hydrological cycle.

When calculated, the above indices should be compared between the reserve categories, bearing in mind the caveats mentioned in the introduction about the ecological differences between the selected waterbodies. Explanation of the observed indices will require an integrated, qualitative analysis of the full suite of data collected. A key explanatory variable, not included as a reserve 'category' could be the level of fishing activities at each site. A rough index of fishing intensity (eg fishermen / km^2 of fishing grounds) will be produced by the socio-economic monitoring programme. If fishing intensity varies significantly between the study sites (as seems likely from the RRS survey results), this index should be used as a qualitative co-variate for the comparison of results between sites.

Table 3. Checklists of Required Activities for Implementation of the Biological Monitoring Programme at Each Study Site

Historical Catch Interviews

- Select at least 10 fishers (randomly if possible)
- Conduct interviews on changes in catches in recent times

Gill Net Survey Preparation and Training

- Discuss hydro-morphology of waterbody with local fishers and master fisherman, and divide into four fishing areas
- Write and provide Biological MP Instruction Manual, to include:
  - Map / diagram showing where to set nets in reserve
  - Instructions on how and when to fish (ensure ALL catch is recorded)
  - Instructions on maintenance of gear and monitoring of condition
  - Instructions on how to sort, measure and record catches etc
- Train gill net fishermen (GNF) how / where / when to set gill nets (assisted by master fisherman, and with reference to Instruction Manual)
- Train GNF to sort and measure fish catches
- Train GNF to maintain gill net
- Train VC to monitor condition of gill net
- Train VC to record catches on data forms provided
- Provide GNF with necessary equipment (nets, bowls, buckets, balances, rulers etc)
- Provide VC with necessary recording equipment (data forms, folders, pens etc)

Monitoring of Water Heights, Air Bangar and Poaching

- Provide materials for making depth gauge for placing in reserve
- VC to make and set depth gauge in reserve
- VC (assisted by GNF) to record and report water depths weekly / twice-weekly
- VC (assisted by GNF) to be instructed to record and report any occurrences of *air bangar*, especially where it results in fish mortalities in reserve
- VC (assisted by GNF) to instructed to record and report any poaching of fish from reserve

Data Reporting

- VC to be instructed on how / when to deliver data to PC

Publicity

- Discuss distribution of sampled fish to village with kepala desa
- Pay compensation to village for fishing in reserve
- Announce programme at village meeting
- Write and distribute publicity posters

Appointment of Project Staff

- VC and GNF to be given Letters of Appointment by *Dinas Perikanan*, including terms and conditions, rates of pay, and job descriptions, as appropriate

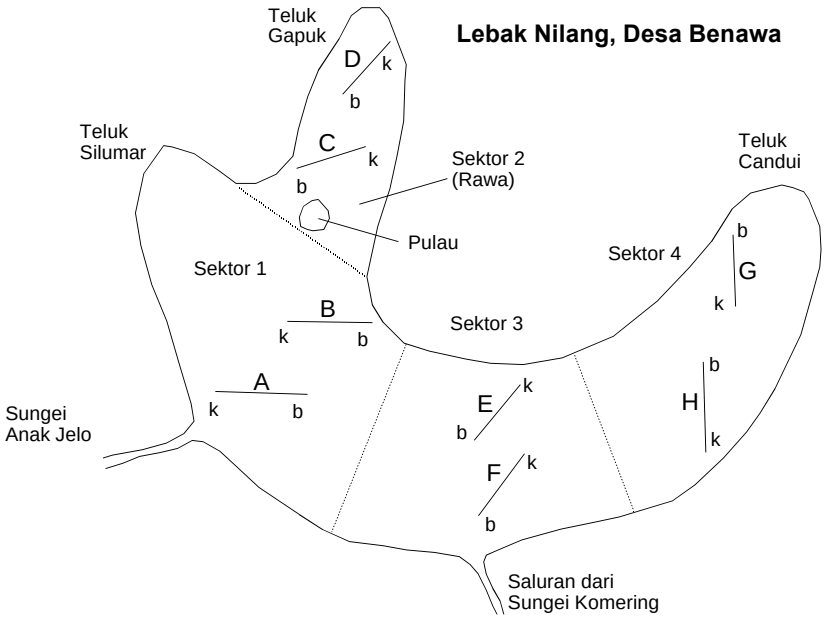

Figure 1. Experimental gill net setting positions in Lebak Nilang waterbody, Desa Benawa, Sumsel. Codes b and k indicate the large-meshed and small-meshed ends of the gill nets respectively

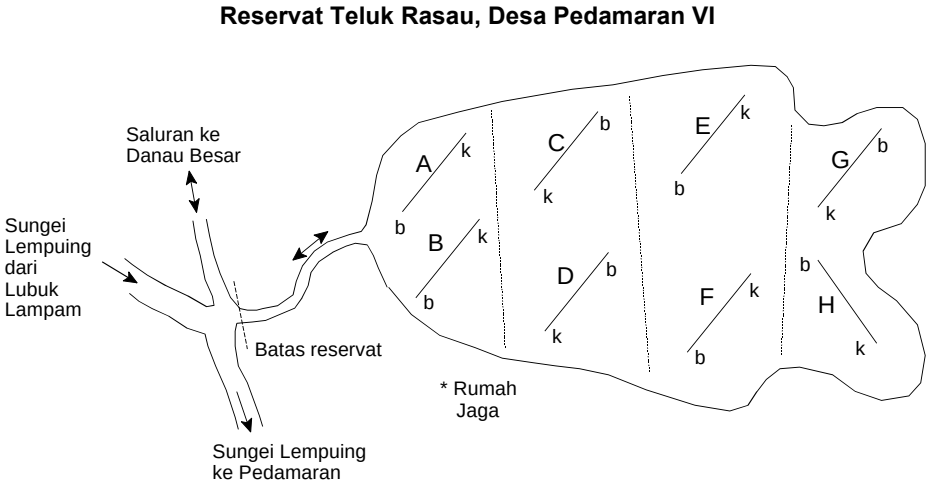

Figure 2. Experimental gill net setting positions in Teluk Rasau reserve waterbody, Desa Pedamaran VI, Sumsel.

4. Socio-economic Monitoring Programme

4.1 Introduction

The harvest reserves studied by the project form only one part of the fisheries management system operated in each area. In addition, there are numerous rules relating to fisheries access and conduct that affect pressure on local stocks and the distribution of the proceeds from fishing activity. While some of these rules, such as the ban on the use of poisons, are nationally applicable there are many local differences. These are particularly apparent at the Provincial level. A study of the socio-economic outcomes from each fishery will deepen understanding the interaction of these different sets of rules with the different sets of hydrological and biological conditions in each area.

An evaluation of the differences in the magnitude and distribution of fisheries benefits between sites will complement the results of the biological monitoring programme. It will also provide a clearer insight into who benefits from different types of fishing activity, the effect of different sets of allocation rules, and the likely winners and losers from particular changes in the management regime. These insights are critical to developing any dialogue with fishing communities - the essential first step to co-management.

With these ends in view, the socio-economic monitoring programme (SEMP) is gathering data to estimate income flows from different fishing activities going to different stakeholder groups. A weekly household monitoring survey (based on a formally selected random sample) and records from self-monitoring by fishing groups will be used to estimate revenues. These sources will be supplemented by more open-ended interviews to estimate costs. The SEMP thus has three main components: weekly household monitoring of individual fishing activities, self-monitoring of major group activities and supplementary surveys of costs. The combination of these elements and the criteria used to select respondents varied from site to site depending on the characteristics of its fishery, its management system and the number of waterbodies to be covered.

The rationale for, and details of, the approach adopted for each site is given in the following sections. Before these details, section 4.2 looks briefly at factors affecting socio-economic outcomes. The chapter concludes with an outline of the issues that may be explored further using the results collected.

4.2 Factors affecting socio-economic outcomes

Socio-economic outcomes - the flow of incomes to different stakeholder groups - are influenced by both the physical and biological characteristics of the fishery and the rules which determine access to it.

The level of economic surplus derived from the fishery is a determined by the returns (the size of catch and fish prices) and costs (of gears used, labour time etc.) of fishing. The distribution of this surplus between different stake holding groups is determined by *who* does the fishing and under what financial conditions of access.

The principal factors determining the returns to fishing are illustrated in Figure 3 below. The influences on costs and returns are identified. In this, the level and composition of gear effort is of central importance, affecting returns, through its influence on catch, and as a prime

determinant of both labour and material costs. Most fisheries management efforts either focus on this explicitly, with different forms of gear restrictions, or affect it indirectly through access controls.
In one sense, reserves are simply a complete (or at least extensive) form of gear restriction.

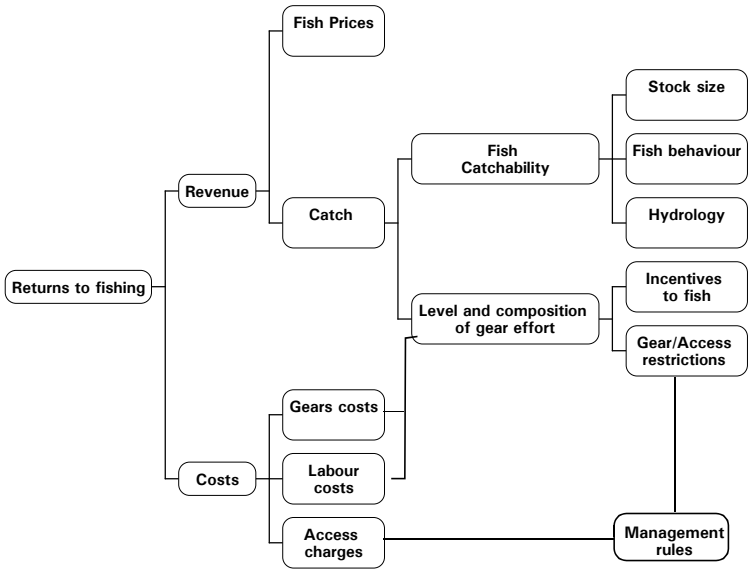

Figure 3. Factors affecting the returns to fishing.

On a full reserve all gears are banned for all seasons. But their effect and their intention is often to protect breeding stocks within a defined area. If successful, stocks outside the reserve increase as a result. This translates into increased revenue, through increased catches due to improved fish catchability.

An increased stock will thus be only one of a number of important factors affecting costs and returns. This range of confounding variables must be considered when making any evaluation of the effect of reserves from the results of this study.

4.3 Jambi: Desa Arang-Arang

Patterns of Fishing Activity and Income Flows

The main fishing areas are: the lake, Dano Arang-Arang, half of which is the seasonal reserve area; the three or four major tributaries that drain the surrounding floodplain into it; the single channel from which it drains into the Sungai Kumpeh; and the section of this river that passes through the village. In addition, the surrounding floodplains provide some fishing opportunities during the high water period and a number of depressions that are fished during the low water period.

The fishing opportunities on many of these fishing grounds are controlled in one way or another. The major leased areas, for which an auction takes place in March or April, are the three main tributaries into the lake and two deeper sections of the S.Kumpeh. There are also around 10

floodplain depressions leased for sums of around Rp.50,000, which is equivalent to the value of around 10-20 kg of fish at point of first sale. Rules relating to exploitation of the lake restrict access earlier in the year, before throwing it open for a one day fish drive, known as the Hari Berkarang, during August. Members of the community may participate for a nominal fee. For fishermen from other villages the fee is higher. Invited dignitaries are not required to pay. All monies raised, both from the auction of leases and from the Hari Berkarang, go to village funds.

Leased areas tend to be operated by groups of two to four fishermen, depending on size. The current leaseholders of the two sections of the S.Kumpeh reported that they do not plan to fish these areas at all until water levels have dropped sufficiently to mount a series of large fishing operations. An *empang* barrier is set diagonally across the river. This is joined to a U shaped compartment adjacent to the bank at the up-stream boundary of the leased area. Fish are then driven upstream towards the *empang* using a gill net hauled by a group of labourers, hired for a daily wage. When the fish are concentrated in the compartment, its open side is closed off. The fish are then removed using small lift nets. The proceeds from the sale of the fish are then divided among the leaseholding group. There can be up to 11 such operations on these leased units.

Similar operations are mounted on the channels feeding into the lake. Though undertaken less frequently (around 4 times), their catches per operation tend to be high (1-3 tonnes). In addition, members of the leaseholding group may fish individually using a variety of common gears during the period of falling water. Catch revenues are shared only from the large fishing operations.

Outside the leased areas, fishing is predominantly on an individual basis using active gears such as a *tangkul* (lift nets) and *jala* (cast nets). For much of the year, however, passive gears - *pukat* (gill nets), *pancing* (hooks), *bubu* and *tembilar* (traps) - are very important. Most fishermen are resident in the village, though there are some from outside.

Implications for Monitoring Programme

The objective of the socio-economic monitoring programme is to estimate the flow of incomes from fisheries and evaluate the impact of access control on its distribution between different stakeholder groups: the community at large, individual fishermen and leaseholders. It is therefore critical that the flows of income from the open access areas can be differentiated from those coming from areas in which fishing is controlled in one way or another.

The flows of income to the village from the lease auction and the fees from the Hari Berkarang are simple to calculate, being a matter of public record. Income earned by individual fishermen are relatively continuous. This will have to be estimated from weekly monitoring. Leaseholder incomes are hard to estimate from routine monitoring, as their group operations are considerably more complex and intermittent. Fishing by members of the leaseholding group that is undertaken on an individual basis and is spread over a longer period, however, should be covered by weekly monitoring.

The resulting components and scheduling of the SEMP are explained in the following sections.

Monitoring Fishing Outside the Leasehold Areas

*Sample fram*e

The Buku Indah Penduduk, the official record of households in the village, was not complete, having details of only 134 of an estimated 175 households. A list of all recorded households was compiled from the official record. A group of key informants, including the Kepala Desa, the Sekretaris Desa and four to five experienced fishermen were then asked to divide all listed

households into two groups: those that fished (76) and those that did not (58).

Respondent selection
The names of fifteen household heads were needed: twelve for the survey and three to act as reserves if any of these were unable to participate.

Two options were considered. First, for the computer to assign a random number to each household by the computer, sort the records on this number and then take the required number from the top of the new list. Second, to conduct an open lottery in view of members of the village.

It was decided that the latter option was preferable as it provided greater transparency to the selection process, reducing the possibility of resentment over inclusion or exclusion from the survey.

To avoid counting households twice within the overall estimation of fisheries benefits, it was necessary to exclude the 12 households with members of leaseholding groups (i.e. those taking a share of group catches or fishing individually on the leased areas) from the sample frame. Ideally, their names (or that of their household head) should have been removed from the list. This was not possible due to ambiguities in the information available about which households some group members belonged to. By conducting a public lottery to select respondents, it was possible to ensure that such households were not wrongly included in the survey. In the event that their name was selected it was dropped and the draw was repeated. (See below for details of sampling of and within leaseholding groups.)

Information collected
Information will be collected on time spent fishing and the magnitude and value of catch, together with a series of more detailed interviews relating to fishing costs other than labour. The weekly monitoring will be undertaken by the Village Co-ordinator, using a questionnaire form that has been kept as simple as possible. (This form and the english version of the notes written to accompany it are to be found in Annex X.)

Data is collected most easily on Fridays and Sundays, when fishermen are free. The number of days fished within the previous week (Friday-Thursday) will be recorded but data on activities will relate to the last day on which fishing took place. This will bias the sample towards fishing days that occur towards the end of the week - fishing on a Friday will only be recorded if it was the only day in the week on which fishing took place. This is less than ideal. Various alternatives were considered. Recording catches relating to all days fished separately was thought to result in too long an interview and too much work for both data entry and the Village Co-ordinator (VC). Summarising was thought to be too difficult for the VC, who might have to aggregate data across days in which a variable number of fishermen were working together. Asking fishermen to record their catch on all days and then choosing the day entered by lottery between days was also thought to be too confusing.

This method will have the advantage of easing recall for fishermen. The fact that they tend not to fish at all on either Friday (holy day) or Sunday (leisure), rather than fish for a shorter period, reduced the chances of an upward bias to estimates due to under-representation of low catch days occurring towards the beginning of the week. (This will be tested for.)

Cost information is to be collected from respondent households separately by CRIFI/MRAG staff. This is considerably harder to estimate and enumerate accurately using routine monitoring, as it requires a more flexible interaction with the respondent.

Calculation of open access fishing income
Gross fishing income from each sampled household can be calculated for each week by taking the number of days fished and multiplying this by the value of fish sold plus an imputed value of fish consumed. Costs for the gear used, based on the more detailed respondent interviews, can then be deducted to give net fishing income per week[1].

Calculating the income to the village will require that the estimates from the sample are scaled up. The multiplication factor used is determined by the sampling procedure used.

Only 134 of the 175 households in the village are covered in the initial list used. Of these, 76 fish. There is a high probability that some of the 41 households omitted also fished. If the proportion is similar to that of those included, there would be around 99 fishing households (76*175/134). There were 12 households with members of leaseholding groups. This implies the sample of 12 households represent 75 non-leasing fishing households. The multiplication factor is the inverse of the sampling ratio (75/12). This means the results from the sample survey need to be multiplied by 7.25.

Approximate estimates of income earned by fishermen from other villages will be based on more detailed questioning of key respondents. Issues covered will be numbers involved, period and gears used. Results of household monitoring within the village will be used to calculate income from this data.

Monitoring Leaseholder Fishing

Sample frame
Estimation of income flows from **lelang** (leased) areas is based on sampling the leased units and the households that control them. The main units in Arang-Arang are given in Table 4 below. The first three are channels that drain the floodplain into the lake. The last two sections of the S.Kumpeh.

Table 4. Leased Waterbodies in D.Arang-Arang

No.	Name of Waterbody	*Lelang* Winner	*Lelang* Value (Rp.)
1	Sungai Parit	Muhtar + 2 others	1,823,500
2	S.Gelam	Asnawi + 4 others	1,400,500
3	S.Buluram	Maknur + others from same HH	850,000
4	Teluk (section of S.Kumpeh)	Younus + others from same HH	499,995
5	Paro (section of S.Kumpeh)	Sa'ad + 1 other	360,000

Respondent selection
It would have been feasible to gather information on all units. However, with resources for the survey limited, it would then have been necessary to reduce the size of the survey of fishermen operating in the open access areas. Sampling was therefore desirable.

[1]This can be allocated to months by splitting the income of weeks that include days from consecutive months *pro rata* to the number of days in each and adding this to the other weeks in the month.

Lelang auction values differ considerably. It is assumed that this reflects to some degree the income that each can be expected to generate. As a result, simple random sampling of *lelang* units would produce estimates with a high variance. Three units were chosen. One unit was selected from S.Parit and S.Gelam, by tossing a coin. The same exercise was repeated to choose between Paro and Teluk. In both cases the pairing was determined by the similarity in both habitat and auction value. S.Buluram was chosen as the third site.

Information collected
In initial interviews the current leaseholders indicated that they were willing to keep simple records of group operations for the project. Like the weekly monitoring of individual fishermen, the information recorded will include the size and value of catch and the number of additional labourers hired. They will be encouraged to keep records of each operation, rather than a sample of them. This will involve more work for the section of the S.Kumpeh, where operations are more frequent.

This information will be supplemented later by detailed interviews on these operations and the costs involved conducted by an DP/CRIFI/MRAG team at a later date.

Information on individual fishing on the leased area by one member of each of the three groups will be collected using the weekly household monitoring form, as described above.

Complications
The leased units will be auctioned again during the sampling period. In the past control has often passed from one group to another. This is likely to happen here. This auction, unlike that held in OKI in South Sumatera, does not take place on a fixed date each year. A return visit by CRIFI staff or very close co-ordination with *Dinas Perikanan* will be needed to persuade new leaseholders to conduct self-monitoring and to include members of each group in regular weekly monitoring.

Monitoring the Hari Berkarang (Community Fish Drive)

Monitoring such a large operation in which so many participate on an individual basis is likely to be difficult. Scientifically rigorous estimates are clearly not possible. A well reasoned approach should, however, produce a credible figure that would contribute significantly towards the study. Fortunately, all those involved in the monitoring programme (VC and PC) are likely to participate. This year, if water levels allow the event to happen, they should use the opportunity to devise a monitoring plan for next year's event, which falls in the monitoring period proper.

A record of the numbers buying tickets to participate (and an estimate of how many participate without tickets) might be combined with additional questions on the weekly monitoring or more informal questioning of participants at the time.

Calculation of Incomes from D.Arang-Arang: Summary

Fishing incomes generated within the village boundary area can be calculated as follows.

Table 5. Calculation of Fishing Incomes in Desa Arang-Arang

Income to be Estimated	Data Source	Method of Calculation
Open access fishing To village HH HH from other villages	Household weekly monitoring (12 HH) for income HH interviews for non-labour costs Method to be determined	Sum net income over all HH *7.25
Leasehold areas Major activities Individual fishing by group members	Self-monitoring for major catches plus detailed interviews for costs Household weekly monitoring for income HH interviews for non-labour costs	(i) By Leasehold Area Net income for major activities + (net income of monitored HH)*(no. individual fishers in leasehold area) (ii) S.Parit * 2 S. Buluram Teluk *2
Hari Berkarang	Method to be determined	-

4.4 Jambi: Dano Lamo

The fishery in Dano Lamo shares many of the characteristics of that in Arang-Arang. As a result the strategy adopted and its rationale are similar. The text below therefore elaborates only where there are differences between the approach to the two villages. These are usually minor.

Patterns of Fishing Activity and Income Flows

Fishing in Dano Lamo is centred on the river, Sungai Berembang, that flows through the village and the numerous connecting channels that connect it to the surrounding floodplain.

Fishing opportunities on many of these fishing grounds are controlled. The core zone of the recently established reserve, Danau Mahligai, is a 969m section of the Sungai Berembang adjacent to the settlement itself. On either end of this is a buffer zone that is closed to exploitation for the moment. Off the main river, six of the largest/most valuable connecting channels are leased annually.

Prior to the establishment of the reserve, fishing on the whole river had been open access. A considerable proportion of the river within the village boundaries does, however, remain open on either side of the reserve: downstream there is a stretch of approximately 5km before the boundary of Desa Mudo; upstream there is from 3-4 km to the boundary of Desa Jambi Tulo. In addition, fishing on the all six major connecting channels remains open until they are auctioned and remains open throughout the year on the minor channels.

Leased areas are mostly operated by pairs of fishermen this season, though in previous years there were larger groups. Group members fish individually during the periods of higher water but work as a team, together with hired labourers, to undertake low water sweeping operations. These are similar to those described for Arang-Arang above.

Fishing by individuals is also similar to that undertaken in Arang-Arang, with a variety of active and passive gears in use, each having a comparative advantage in different seasons, depending on fish behaviour and hydrology. Catches vary significantly through the year and are both lower and subject to more day to day variability in the high water period.

Fishermen from the village tend to fish outside its boundaries to a greater degree than fishermen from elsewhere come in. The ratio was thought to be around 2:1. Most of the fishing was done within the village.

Implications for Monitoring Programme

The objective of the socio-economic monitoring programme is to estimate the flow of incomes from fisheries and evaluate the impact of access control on its distribution between different stakeholder groups: the community at large, individual fishermen and leaseholders. It is therefore critical that the flows of income from the open access areas can be differentiated from those coming from areas in which fishing is controlled in one way or another. Unlike Arang-Arang, where the Hari Berkarang gave some access to the reserve, the fishermen from Dano Lamo are to be excluded permanently. This issue therefore reduces to a comparative analysis of income flows to leaseholding and non-leaseholding households.

Proposed Monitoring Programme

Methods for data collection and analysis proposed for Dano Lamo are similar to that for Arang-Arang: a survey of households doing open access (*bebas*) fishing is to be accompanied by a similar survey of *lelang* group members undertaking individual fishing and self-monitoring of major group operations.

The components and scheduling of the SEMP are as follows.

Monitoring Fishing Outside the Leasehold Areas

*Sample fram*e
The Buku Indah Penduduk indicated that there were 182 households in the village. A list of all recorded households was compiled from the official record. All listed households were then divided into two groups: those that fished (77) and those that did not (105).

Respondent selection
The names of fifteen household heads were needed: eleven for the survey and four to act as reserves if any of these were unable to participate.

Selection was undertaken by drawing numbers from a bag. This ensured transparency of selection, reducing the possibility of resentment over inclusion or exclusion from the survey.

To avoid counting households twice within the overall estimation of fisheries benefits, it was necessary to exclude the households with members of leaseholding groups (i.e. those taking a share of group catches or fishing individually on the leased areas) from the sample frame. Ideally, their names (or that of their household head) should have been removed from the list. This was not possible due to ambiguities in the information available about which households some group members belonged to. By conducting a public lottery to select respondents, it was possible to ensure that such households were not wrongly included in the survey. In the event that their name was selected it was dropped and the draw was repeated. (See below for details of sampling of and within leaseholding groups.)

Information collected
The information collected will be identical to that for Arang-Arang, see above for details.

Calculation of open access fishing income
Calculation will be similar to that for households in Arang-Arang, though with a different raising factor, due to differences in the numbers of households in the village, fishing and in the sample.

The raising factor is derived as follows:

Fishing households in village	77
Leaseholding households	10
Non-leaseholding fishing HH	65
Sample size	11

Raising factor=(77-10)/11=6.1

Leaseholder Fishing

Sample frame
Estimation of income flows from *lelang* (leased) areas is based on sampling the leased units and the households that control them. In Dano Lamo, all leased areas are connecting channels. Their names, sizes, auction values and the names of those that won the most recent auction are given below.

Table 6. Lelang Areas in Dano Lamo

No.	Name of Waterbody	*Lelang* Winner	Length	*Lelang* Value (Rp.)
1	Sungai Bayur	Manaf and Bakar	200 m	1200000
2	Sungai Lampur	Hadan Hasan	200 m	200000
3	S. Pematang and channel connecting to S.Bayur	Samsudin and Muslai	50 m	40000
4	S.Keliling and S.Medak	Muh. Saleh	500 m	60000
5	S.Lebar Muaro, S.Batang and S.Sangko	M.Safri and M.Zen	—	500000
6	S.Bungur and S.Puding	Manan and Helmi	200 m	600000

Respondent selection
It would have been feasible to gather information on all units. However, with resources for the survey limited, it would then have been necessary to reduce the size of the survey of fishermen operating in the open access areas. Sampling was therefore desirable.

Lelang auction values differ considerably. It is assumed that this reflects to some degree the income that each can be expected to generate. As a result, simple random sampling of *lelang* units would produce estimates with a high variance. Four units were chosen.
One unit was selected from waterbodies S. Pematang Kebun (no.3) and S.Keliling (no.4) above, by tossing a coin. The same exercise was repeated to choose between waterbodies S.Lebar Muaro (no.5) and S.Bungur and Puding (no.6). In both cases the pairing was determined by the similarity in auction value. S.Bayur (no.1) and S.Lampur (no.2) were chosen by default, as there was no other water body similar to either.

Information collected
This will be similar to that collected to the auction units operated in Arang-Arang as described above.

Complications
Like Arang-Arang, auctions during the survey period may well require that different households are substituted for those selected, so that estimates can be made of income from these areas over a 12 month period.

Calculation of Incomes from Dano Lamo: Summary

Fishing incomes generated within the village boundary area can be calculated as follows.

Table 7. Calculation of Fishing Incomes in Dano Lamo

Income to be Estimated	Data Source	Method of Calculation
Open access fishing To village HH	Household weekly monitoring (12 HH) for income HH interviews for non-labour costs	Sum net income over all HH *6.1
Leasehold areas Major activities Individual fishing by group members	Self-monitoring for major catches plus detailed interviews for costs Household weekly monitoring for income HH interviews for non-labour costs	(i) For each monitored leasehold area Net income for major activities + (net income of monitored HH)*(no. individual fishers in leasehold area) (ii) Raising factors for leasehold areas S.Pematang Kebun *2 S.Lebar Muaro * 2 S.Bayur*1 S.Lampur*1

4.5 South Sumatra: Teluk Rasau

The lake reserve selected for biological monitoring was Teluk Rasau. This is one component of a large mosaic of lakes, swamps and flood forests that is drained by the Komering river that runs north into Pedamaran, the principal desa within the kecamatan (sub-district). The area, which covers more than xx km^2, is deeply flooded for much of the year and supports a large and locally valuable fishery. Apart from a small section of the river running into Pedamaran, all fishing areas are leased for a full 12 month period.

Estimation of total income flows to Pedamaran was far beyond the scope of the funds available for the site and would have covered an area far larger than for the other reserves studied within the project. It was therefore decided to cover only the area adjacent the reserve itself.

Patterns of Fishing Activity

Fishing in this area is undertaken both by fishing groups and by individuals acting independently. Broadly, groups operate barrier gears and undertake sweeping operations in

the more open waterbodies, while individual fishermen operate smaller gears - traps, hooks and gill nets - in the more densely vegetated fringes. Where the swamp areas drain into more defined channels, fishermen otherwise operating individually can jointly operate small barriers together with traps.

Barrier gears

The *tuguk* is a barrier across the main channel, with one or two 3-4m gaps to allow the passage of boats. It is solidly constructed of piles driven vertically into the riverbed supported on either side by more slender poles set at an angle. On the downstream side of each section of the barrier, a massive log is horizontally mounted above the waterline on these poles, firmly anchoring the structure. On the upstream side, the poles support a series of mats that prevent the fish passing through the barrier, except at the openings. A submerged bag net is set at the mouth of each opening. This net is formed by sections of decreasing mesh size (from 4" at the mouth, to 1" at its apex), and must be winched in. It is operational for 10-11 months in the year but catches vary significantly. They peak between April and June, as fish are moving downstream during the period of falling water. In this period *tuguk* can take between 100kg and 1t per day, with the net being hauled hourly. During the rising flood, usually in November, catches of 70kg per day are common. Between these peaks, there are no migrational movements of fish and catches are very low (1kg/day).

The very solid construction of the barrier implies substantial capital costs (particularly in labour time).

Another barrier gear is the *kilung*. These can be set either on the main channels, like the *tuguk*, or on smaller connecting channels. *Empang* are used to channel the fish to the mouth of the net, which has a long box like shape and extends around 10m downstream from the fence. The net is supported in the water by bamboo poles driven into the river bed. Fish accumulating at the downstream end of the net are scooped out. Its function and objective is identical to that of *tuguk.* The only difference lies in its frailer construction, making it more suited to river/channel sections with weaker flows. The timing of its catches are therefore identical.

In areas with even slower flows another means of taking advantage of fish movements is the use of *pengilar* traps in conjunction with an *empang*. The latter blocks the fish, which then take refuge in the traps.

Sweeping operations (*Ngesar)*

The *ngesar* is a sweeping operation using *kerakat* (seine nets) and *empang* (movable bamboo fence), when water levels permit. The ngesar is usually being conducted in August and September; however, it may change from year to year depending on the period of dry season. The activity can also be undertaken either in river sections or in floodplain depressions, with slight variations in procedure.

In rivers it is often done from boats, and the operation becomes feasible when the water depth is around 2.5m. The *empang* is erected diagonally across the upstream end of the channel, with a three sided enclosure (rumah ikan) adjacent to the bank at the top. A seine net is then secured to block the downstream end of the channel. Around 15m upstream, a second net is similarly installed but with a small gap at one end. From the opposite corner of the chamber, fishermen in boats then advance driving the fish in front of them by thumping the river bed with long bamboo poles. Once the chamber is clear, the gap at the end of the second seine is closed and the first net is moved to form a new chamber and the process is repeated. This continues until the fish have been driven into the prepared enclosure at the upstream end of the section. Fish are then removed as required for passing traders. There will usually be 1 or 2 such *ngesar* operations each year. Total catch from the first operation can reach 12t (Lubuk Lampam, 1994); 4t is common. Total catch from the second operation is usually much lower,

around 1t.

In the floodplain depressions, the fish are often driven by people on foot, so water depths above 1.5m make the operation difficult. Otherwise the procedure is similar, with the area being divided into sections, each being cleared sequentially before all the fish are finally driven into the *empang* enclosure.

Gear investment depends on the size of the structures required but is clearly substantial. One respondent indicated that his group had used around 100 *empang* panels (4m x 2.5m), each of which would have taken one man around two days to make and last only three years. The *kerakat* now cost over Rp.600,000 for a 100m section.

Individual fishing
Most individual fishing took place in the more heavily vegetated areas. The most common gears were *pengilar* (traps) and *tajur* (hooks), though gill nets were also used. Catches were often taken from gears set overnight. The amount caught varied through the year but 2-3kg was often cited as the normal range.

Income distribution
There was some individual fishing on the main river sections. One fisherman concentrated on catching baung using three rawai (long lines), set at the edges of the river. Each was composed of around 100 hooks set 2m apart and baited with small fish. He fished from March to December. It was estimated that he might catch 2-3kg/night.

As the entire area surrounding Teluk Rasau is leased, none of the fishing described above is open access, everyone has to pay to fish in one way or another. Leases are given for distinct areas, *lelang* units. These may be discrete river sections, lakes or floodplain depressions. Often, however, a single unit will consist of one principal type of habitat together with smaller fragments of other habitat types. For instance, a *lelang* unit on a river section may include fringing areas of swamp and any former meander bends that have formed oxbow lakes. It is common practice for *lelang* units to be subdivided by the lessee, with each being operated independently and often differently, according to habitat type.

Teluk Rasau is connected to S. Lempuing at the boundary of two *lelang* units, Sungai Aur (downstream) and Laut Sekampung (upstream). A third unit Pulau Benawo, which is an adjacent floodplain area, is also thought to be sufficiently closely connected to Teluk Rasau to benefit significantly from the enhancement of local fish stocks by the reserve. Summary information on these units and the sub-units into which they have been divided for operational purposes this season are given in Table 8 below.

Table 8. *Lelang* Units Adjacent to Tuluk Rasau, and their Sub-divisions

Water body	Sub water body and cost	Operating Group & Gear	Licenced Individuals & Gears Used
Sungai Aur Rp.16m	Lebung Sungai Aur (river section) Rp.13m	8 members *kilung, tuguk kerakat* , *jala*	1 individual *rawai* Fee Rp.300,000/yr
	Lebung Kumpai and Selebar Utang (river section) Rp. 4m	7 members *kerakat empang*	8 individuals *Sengkirai, jaring*, *tajur*, *jaring pendek (roket)* Fee Rp.400,000/f/yr
Laut Sekampung Rp.9m	Lebak (floodplain depression) Rp.4.5m	Leaseholding fish trader No group fishing	14 individuals *tembilar,jaring,tajur* Fee Rp.400,000/f/yr
	Batanghari Ulu (river section)	5 members *krakat, empang*	No individuals
	Batanghari Ilir (river section) Rp.4m	4 members *tuguk* ,*krakat*, *empang*, *jala*	No individuals
Pulau Benawo, Rp.2.6	Lebak (floodplain depression)	8 members *empang pengilar*	7 individuals (also group members) *pengilar*, *tajur*, Rp.200,000/f/yr*(ad hoc)*

Groups obtain complete control over a lease unit or sub-unit. The amounts paid for each are indicated in the Table above. The type of fishing that will take place is largely determined by the opportunities made possible by the habitat type and water depth. River sections with limited fringing vegetation may only be suited to group operations, barrier gears and/or *ngesar*. Repayment of the lease then has to be made entirely from the proceeds of these activities. Where a unit has areas of denser vegetation, particularly away from the main river, individual fishing is more advantageous. A group may therefore allow some fishermen to operate there in return for a fixed annual fee. In some cases this will be a small supplement to their main income, in Lebung Sungai Aur, the fee paid by the single individual would represent only 2.3% of the lease cost. In contrast in the lebak area of Laut Sekampung, only individual fishing took place, with licence fees generating 20% more than the lease cost (the sub-leaseholder also benefited from trading the fish caught). As an intermediate position, individual licence fees generated 80% of the lease cost on Lebung Kumpai, with the group's *ngesar* generating further revenue.

For operating groups the high capital outlays on both the lease and for barrier gears and *ngesar* operations mean that the final distribution of income between group members has to wait to the end of the fishing season. Poorer members of the group will usually require loans from the leaseholder to support their families during the season. All accumulated debts, share of lease costs and other operating costs must then be deducted from any share of receipts. A detailed set of records is kept to do this.

Where the group needs additional assistance for *ngesar*, casual fishing labour may be hired. This can be on a profit share basis. On Batanghari Ilir, eight additional labourers were needed. These shared 50% of the profits between them, with the balance being split equally between the four group members.

One respondent indicated that his share from fishing a river section last year was Rp.5m, a figure with which he was very happy. But overall profit share will vary significantly with the success of fishing due to the high capital costs. Other respondents, encountered on a previous visit, claimed to have remained in debt to the leaseholder at the end of the season.

Implications for Monitoring Programme

The types of income flows from fishing activities in this area are generally similar to those in Jambi, with the exception of the barrier gears. These are more complex as they combine high levels of capital expenditure with extended periods of daily catch that show sharp seasonal variations. As a result, the division of profit takes place at the end of the season. The records kept for this purpose may prove particularly valuable, if they are made available. Leaders of the fishing groups generally indicated a willingness to co-operate with the project and to either ensure that their own records included all the information needed or to keep a separate record. Complications will arise, however, as the survey period (October 98 - September 99) does not match the period over which records are kept (February-October/November).

Monitoring of the catches of licenced individuals will be similar to Jambi, except that there will be no single sample frame. In Jambi, the frame was all the households thought to fish within the village. Here, each sub-unit in which individual fishermen operate will require its own frame.

Proposed Monitoring Programme

To assess the income flows from the area adjacent to Tuluk Rasau it will be necessary to derive individual estimates of all the sub-units of the three leased areas. As in Jambi, this requires a combination of self-monitoring by (sub-)leaseholders and weekly household monitoring of households operating on an individual basis. The overall programme is summarised below.

Table 9. Proposed Socio-Economic Monitoring Programme for Tuluk Rasau Area

Water body	Sub water body and cost	Group Activities	Individual Fishing
Sungai Aur	Lebung Sungai Aur	Self-monitoring by group record keeper	WHM[1] of only fisherman
	Lebung Kumpai and Selebar Utang	Self-monitoring by group leader	WHM of 3 of the 8 fishermen
Laut Sekampung	Lebak	No group activities	EITHER Records of leaseholder OR WHM of 4 of the 14 fishermen
	Batanghari Ulu	Group leader unable to co-operate	No individuals operating
	Batanghari Ilir	Self-monitoring by group leader	No individuals operating
Pulau Benawo,	Lebak	Self-monitoring by group leader	WHM of 3 of the 7 fishermen

[1]WHM indicates weekly household monitoring

Monitoring of Individual Fishing

For all sub-units where individuals operate income will be estimated using weekly household monitoring(WHM), except possibly in the Lebak section of Laut Sekampung. In this area the leaseholder, to whom all the individuals sell their catch, was keen be part of the programme and to make his records available. If problems arise with this arrangement, four individuals of the 14 operating group fisher in his area will be included in the WHM.

Sample frames

A separate frame was constructed for each of the relevant sub-units. This was a list of the individuals licenced to operate this year in each.

Respondent selection
It was not possible to return to each sub-unit to draw the names openly, as had been done for the villages in Jambi. Instead, every third name was taken from the list for each sub-unit.

This process will have to be repeated at the start of next year, if the individuals permitted to fish change following the auction.

Information collected
This will be slightly simpler than that collected in Jambi, as questions relating to group size have been eliminated. The enumeration procedure will be identical.

Calculation of individual fishing incomes
Totals will be calculated for each sub-unit, using the inverse of the sampling fraction as the raising factor.

Self-monitoring of Group Activities

Lease and sub-leaseholders will be asked to maintain records in the a way similar to Jambi and to make their own records available where possible. Due to the more continuous catches coming from *tuguk* and *kilung* maintenance of records will be more a matter of routine than an occasional task. To assist them in maintaining this routine, regular contact with the Village Co-ordinator is to be encouraged by the collection of the form every two weeks.

The form to be used is attached. It is more complex than the one devised for Jambi, but it will be emphasised to the group leaders that it is only the first columns relating to amount and value of sales that are critical.

Calculation of Incomes from Fishing in the Area of Teluk Rasau: Summary

The WHM and the self-monitoring by leaseholders/groups will produce detailed information on the revenues from fishing. The WHM will also generate information on time spent fishing. Cost estimates will also be needed.

A full breakdown of costs will have to be determined by further interviews aided, wherever possible, by the groups own records. It is important that these interviews are done well. In particular, the first interviews covering the use of any gear or operation should be very thorough, so that no hidden labour costs are omitted. This can easily happen for any of the major operations requiring structures that have to be prepared in advance. Time spent assembling gears, such as seine nets, can also be easily forgotten.
Once the process is fully understood a checklist can be prepared and subsequent interviews conducted much more swiftly.

Total income flows should be estimated for each sub-unit before aggregating to the unit and then to the total area.

Table 10. Calculation of Incomes for Teluk Rasau

Lease Unit	Sub-unit and cost	Group Activities	Individual Fishing
Sungai Aur	Lebung Sungai Aur	Self-monitoring record of income less estimates of costs from detailed interview	WHM less costs derived from detailed interview
	Lebung Kumpai and Selebar Utang	As above	As above * Raising factor of 2.66
Laut Sekampung	Lebak	No group activities. But possible recording of individual catches	EITHER Records of leaseholder OR As above * Raising factor of 3.5
	Batanghari Ulu	Possible extrapolation from *ngesar* elsewhere	-
	Batanghari Ilir	Self-monitoring record of income less estimates of costs from detailed interview	-
Pulau Benawo,	Lebak	As above	As above * Raising factor of 2.33

4.6 South Sumatra: Benawa

Benawa village is the closest settlement to Lebak Nilang, the waterbody chosen for monitoring. It is a large village with over thousand households and its fishermen also operate across a large number of other waterbodies. The earlier survey identified these as the river Komering, the desa canal and a series of lakes of varying size: Air Hitam, Anak Jele, Anak Kemang, Lebak Canduy, Teluk Netani, Lebak Kalup and Muaro Duo. This fishery was operated by a complex mixture of leasing, sub-leasing, licencing and open-access fishing. Providing a comprehensive assessment of income flows to the village from fishing appeared over-ambitious, particularly as the locally recruited village co-ordinator was untested in his commitment to the project. It was therefore decided simply to assess the value of fishing incomes from the lake itself.

Patterns of Fishing Activity

Lebak Nilang is large and its dry season depth is 5m and vegetation cover make it difficult to fish out by any co-ordinated operation, such as *ngesar*. Most fishing activity in the lake is undertaken by individual gill net fishermen. *Tajur* (hooks) are used to catch fish in the fringing vegetation. Two different estimates of the number of households involved put the figure at 40 and 25.

There are two *kilung* operated by groups on channels leading from the lake. One of these channels connects to an area that has recently been turned into an oil palm estate. It is reported that the *kilung* catches in the channels have been declining significantly since.

The lake was originally operated under the *lelang* system. This was suspended when it was decided thatit would become a reserve. It now has an unusual intermediate status being managed by the head of the desa adjacent to Benawa. The gill net fishermen and the *kilung* groups operate under licence from him. The fishermen using *tajur* in the adjacent vegetation do so without legal status.

Implications for Monitoring

Fishing with hooks by individual fisher is illegal in Lebak teluk Nilang; however, many individual fisher still fish in that area by using such the gear. This fact poses problems as households asked about such fishing may be evasive or misleading. The fact that such fishing may be relatively widespread means that an important component of overall catch may be missed as a result.

The virtues of weekly household monitoring and means of providing alternative estimates of the numbers of illegal fishermen were actively considered. The bias introduced by the technical illegality of fishing was of uncertain strength. Individual fishing with hooks was widely acknowledged and accepted within the village and there had been no recorded prosecutions. It was concluded that weekly monitoring could be attempted for these households but that cross-checking of some sort on the number of man days would be essential.

Methods of introducing such cross-checks of the levels of *tajur* fishing into the weekly household monitoring form used by the gill net fishermen were considered. While both types of fishermen set their gear and collected their catch at the same time, it was felt that much activity on the lake margins would not be visible due to the height and density of the vegetation.

Proposed Monitoring Programme

A combination of weekly household monitoring is proposed for three of the eight gill net fishermen and a sample of 12 of the 40 households fishing with *tajur* on the lake. Estimates of the level of *tajur* fishing will be cross-checked at a later stage using alternative interview techniques. The final estimate will be used together with any information on catch rates to provide an approximate indication of total catch.

Both *kilung* groups will be asked to undertake self-monitoring.

4.7 West Kalimantan: Desa Sekolat

The lake reserve selected for biological monitoring is Danau Batu. It is believed that benefits of the reserve may be enjoyed by Sekulat people. The area has approximately xx km2, which almost contains water for the whole year and supports widely and locally valuable variety of fish. Water floods into the village waterbodies from Kapuas river during wet season, bringing newly spawned fish caught in traps. In the dry season, water drains from lake into Belitung river, then via Tawang river back to Kapuas river. Adjascent area to Danau Batu is germinated by many trees, such as mangrove forest (rawang forest) which is believed as a buffer zone. Fishing activities surrounding those areas (outside of Danau Batu) were done by many fishers, especially for those coming from Desa Sekulat.

Patterns of fishing activity and income flows

There are two types fishers in Sekolat village, namely individual and group fishers. Most individual fishing took place in the more heavily vegetated and rawang forest areas, adjacent of reserve, also in the river and lake that is not functioned as reserves. The most common gears used were jala (cast net), pancing/utas (hooks), pukat (gillnet), rambai (hook and lines), bubu (traps), jermal (partial barrier traps), tembilar (portable traps), tabung (traps for ornamental fish) and pesat/anco (lift net). On the other hand, group fishers mostly use jermal to catch variety of fishes (consumed and ornamental fishes). Individual fisher usually operate their gears in the fishing ground of Belitung river and many small lakes, such as D. Sekolat, D.

Genali and D. Semangit. Group fishers operate their traps in the main river, that is, Belitung river. There are 32 locations for groups of jermal for catching the ornamental fish, the names of those locations are as follows : 1) No name, 2) No name, 3) Tanah Pak Dayat, 4) Tanah Pak Dayat, 5) Lubuk keramat, 6) Makam Keramat, 7) Tanjung Gamang, 8) Tanjung Karet, 9) Tanjung Asam, 10) No name, 11) Teluk Ara, 12) Timbak Tawang, 13) Karet Sadan, 14) Teluk Jambul, 15) Lubuk Tanggalan, 16) PT Yunus, 17) Tanah Haji Fei, 18) Nanga beban, 19) Senentang Nanga, 20) Seberang Tamang, 21) Tanjung Bedil, 22) Tanjung Sawal, 23) Marbakung Besar, 24) PT Anam, 25) Tanjung Belantik, 26) Marbakung Kecil, 27) Bulu Tikus, 28) Tanjung Bekakak, 29) Kawit Semang, 30) Kawit semang, 31) Lebak Mutung and 32) Lebak Mutung. Lottery system for fisher of jermal was conducted in 6 times/year (3 times in dry season and 3 times in rainy season). There are 2 steps in lottery system: the 1st step choice the back numbers (nomor punggung) and the second taking the number of locations (nomor lokasi) given the name to determine who will be leaseholder of jermal ornamental fish catch. The lottery winner pays Rp.15,000,- for location numbers of 1 and 2, another locations from 3 to 32 pays Rp.1,500,- respectively. Number of locations 1 and 2 located at the upper-stream of the village and the way of setting jermal at the edges of river. If fisher loss in the lottery system, his money was returned to the fishermen.

Sharing from fishing activities by using jermal was divided to become ratio 40% for owners and 60% for hired fishermen. Example for this case : The owner of jermal hired 3 fisher, from catchs, they got 100 fish (ulang uli), the system use to share the fish catchs was owner : 3 hired fisher : owner as functioned hired fisher = 20% : 60% : 20%. For consumptive fish, there were 11 locations for setting jermals, the names of those location are follows : 1) Tanjung Tamang, 2) Marbakung besar, 3) Marbakung kecil, 4) Keramat, 5) Mutun, 6) Nanga Sekolat, 7) Nanga benali, 8) Duben, 9) Pintas sebuya, 10) Pintas sekali and 11) Pinanga Bayau.

Implications for the Monitoring Programme

The objective of the socio-economic monitoring programme is to estimate the flow of income from fisheries and evaluate the impact of access control on its distribution bet ween different stakeholder groups. The community at large are individual fisher and lease holder of jermal from lottery system. It is therefore critical that the flows of income from the open access areas can be differentiated from those coming from areas in which fishing is controlled in one way or another. The flows of income to the village from the lease lottery system. Income earned by individual fishermen are relatively continuus. Both activities will have to be estimated from weekly monitoring. A longer period of toman or betutu cage culture would be covered by weekly monitoring.

Proposed Monitoring Programme

Sample Frame
Accoding to *Ketua Nelayan*, the number of household recorded was about 167 KK (household), however, detail information about the number of fisher could not be found. It is believed that an approximately 95% of the household are fishers of which using various types of fishing gears.

Respondent Selection
Fifteen fisher households representing individual and group of fishers were randomly selected. The names and code of fifteen household who participated as respondent was presented in Annex 1. They (respondents) were selected based on the lottery system.

Information collected
Information from free individual fisher - Agus Sumarno, He used jala (castnet) and rabai (long lines) for fishing. Fishing activity by using jala ussually took place in dry season (May, June and

July), start fishing from 08.00 (morning) to 15.00 (afternoon), total time spent fishing used 7 haurs and the amount caught varied through the 3 months lest than 8-12 kg/day. Rabai (200 hooks) also took place in dry season, its activities was started to looking for the baits and setting 06.00-14.00 = 8 hours, and then checking tomorrow afternoon from 14.00 to 16.00 = 2 hours, sothat total times spent fishing = 10 hours, the average fish caught varied from 15 to 16 kg/day. Information from the leaseholder of jermal for catching the consumptive fish (Bapak Ibrahim). He operated 2 jermal in dry season of the 1997 the fish caught from fishing activities using 2 set jermal = 50 kg/day, pukat (20 bal) = 20 kg/day, takan/tajur (200 hooks) = 10 kg/day, tembilar (100 traps) = 10 kg/day and bubu (8 traps) = 20 kg/day.

4.8 West Kalimantan: Meliau Village

Patterns of Fishing Activity and income flows

It is believed that lake which is functioned as reserve in this village is Danau Balaiaram in which all fishing activities were banned. Fishers were only allowed fishing outside the reserve, i.e., : Danau Lukuh, Danau Tujuh and other waterbodies (floodplain forest adjascent reserve and in the small channel connecting the Laboyan River that passes through the village. The surrounding flodplain closely at the reserve provide some fishing opportunities during the high water period, and also a number of it that are fished during the low water period. Fishing regulation was affirmed by "Hukum Adat" fully obeyed by local communities, mainly by fishers. Fishing gears operated in some waterbodies (except Danau Balaiaram) were : pukat (gillnet), jala (castnet), pancing (hooks), rabai (long lines) and bubu (traps).

Implications for the Monitoring Programme

As indicated earlier, socio-economic monitoring programme aimed at estimating the flows of income from fisheries and evaluating the impact of access control on its distribution between different stakeholder groups. In the case of Meliau, the term of stakeholder is straight forward, hence selection of sample responden would be simple.

Proposed Monitoring Programme

Sample Frame
According to village record, total number of household in the Meliau Village was approximately 36 KK (household) of which considered as fishers. It was previousely observed that fishing were approximately only 25 per cent of their total annual household work, but it approximately produced 40 per cent of income.

Respondent Selection
Fifteen household were randomly selected from the total household. The selected respondents participated in the monitoring programme were presented in Annex 2. They were selected based on the lottery system.

Information collected
Information will be collected on the basis of time spent for fishing and the magnitude and value of catch, together with series or more detailed interview relating to fishing cost and fishing gears used. For example: information from Pak Lajang mentioned that time spent fishing for rabai (300 hooks) was about 10 hours (06.00-16.00) and value of catch was varied 20-30 kg/day. Pukat-180 meters length (setting : 06.00-08.00), (checking : 14.00-16.00), total time spent fishing = 4 hours and fish catchs = 25-40 kg/day. Jala (2 sets) was ussually used to look for the baits (08.00-10.00) = 2 hours and fish catchs = 5 kg/day and bubu (10 traps) from 06.00 to

16.00 (10 hours)- fish catchs = 20-30 kg/day.

4.9 West Kalimantan: Pulau Majang Village

Patterns of Fishing Activity

Condition of waterbodies at Desa Pulau Majang is more specific compared to others (Sekolat, Meliau and Tengkidap). Imformation from *Kades* and some fishers indicated that water will only be existed on the channels (main river) in dry season and flood in rainy season. Fishing gears commonly used by fishers are *jala , pukat, rabai, bubu, tabung, takan/tajur and sauk* (scoop net). *Jala, pukat, takan, rabai and sauk* can be used in all season (dry and wet/rainy), but these gears is often used in dry season from May to August. *Tabung* is usually used in flood/ high water level taken place in the months of December up to February. *Bubu* was settled during dry season using *empang* made from bamboo. Locations for setting bubu had to be lottery (lottery system) and the winners would had to pay Rp.10,000,- per dry season.

Implications for the Monitoring Programme

Socio-economic monitoring programme intended to investigate the flow of income from fisheries and evaluate the impact of access control on its distribution between different stakeholder groups. Consequently, individual and group of fishers in the village will be treated as respondent candidates for monitoring purposes. Incomes earned by individual fishermen are relatively continuous. This will be estimated from weekly monitoring.

Proposed Monitoring Programme

Sample Frame
The numbers of household in the Pulau Majang Village was around 175 KK + 22 KK of Dusun Empaik. However, only 150 KK could be classified as fishers, and only 50% of 150 KK worked on fishing regularly and actively.

Respondent Selection
The names and code of fifteen household (respondent) that participated at Pulau Majang Village was presented in Annex 3. They were randomly selected based on the lottery system.

Information Collected
Information will be collected on time spent fishing and the magnitude and value of catch, together with a series or more detailed interview relating to fishing cost and fishing gears used. Information about the gears exsisted and time spent for fishing came from *Kades* and some fisher. For example : 1) *pukat* (setting 04.00 early morning - 07.00 morning) and (checking 10.00-11.00), time spent fishing was 4 hours. 2) *tajur/takan* (300 hooks) - time activities from 06.00 to 12.00 (6 hours). *Bubu-* time activities (setting 07.00-08.00 and checking next day in morning from 06.00 to 07.00, total time spent fishing 2 hours. 3) *rabai* (200 hooks) setting for looking the baits 07.00-11.00 in the morning and checking 05.00-10.00 the next day in the morning, sothat total time spent fishing 9 hours.

4.10 West Kalimantan: Desa Tengkidap

Patterns of Fishing activity and Income Flows

Tengkidap Village was a small village which could be called a "temporary fishers' village". They

lived there just for fishing. Waterbodies functioned as reserve was Danau Seliban, that located at the right side of the village through the Tengkidap River and via Batang Seliban Channel. The Seliban lake can be reached approximately an hour by using motor boat. The patterns of fishing activity and condition adjascent of reserve was almost the same as the reserve of Danau Balaiaram. However, the Seliban lake has terrestrial land (small island) in the core side. Fishing gears operated in various waterbodies, mainly in Batang Seliban, S. Tengkidap and small tributaries were : jala, pukat, bubu and rabai.

Implications for the Monitoring Programme

The objective of the socio-economic monitoring programme is to estimate the flow of income from fisheries and evaluate the impact of access control on its distribution bet ween different stakeholder groups. The community at large and to individual fishermen. It is therefore critical that the flows of income from the open access areas can be differentiated from those coming from areas in which fishing is controlled in one way or another. Income earned by individual fishermen are relatively continuous. The activities will have to be estimated from weekly monitoring. A longer period of toman or betutu cage culture could be covered by weekly monitoring.

Proposed Monitoring Programme

Sample Frame
The numbers of household at the Tengkidap Village was approximately 44 KK. All KKs were considered as fishers and only stay there for the purpose of fishing.

Respondent Selection
The names and code (Number Seri KK) of fifteen household that participated as respondent was presented in Annex 4. They were randomly selected as respondent based on lottery system.

Information Collected
Information about the gears and time spent fishing came from Ketua Nelayan and some fishers caught in open waters at Tengkidap Village. Compared to three observed village before (Sekolat, Meliau and Pulau Majang), the time spent for fishing using the same gears were similar.

4.11 Comparative Analyses

The results of the surveys will provide a breakdown of costs and returns to fishing and the distribution of economic surplus between stakeholder groups in the eight villages/areas. Comparisons will be made of total catch and total economic surplus relative to the area of the waterbodies, the number of fishermen active and the number of man days spent fishing.

Clearly, it would inappropriate to attribute the differences identified simply to the characteristics of the local reserves. Rather, these comparisons will help document differences in outcomes from the interaction of the fisheries management system operated in each area with the hydrological and environmental characteristics of its river-floodplain system. So, while the *quantification* of the economic impact of reserves is *not* feasible, the study should provide insights on a range of issues critical to the development of co-management in Indonesia. These issues include :

- the influence of access control on the type and timing of gear effort
- the influence of access control on outcomes for stakeholders (individual fishermen,

leaseholders, government)

- the influence of current management arrangements on the incentives to conserve fish stocks
- the influence of the management system on the range of alternative management measures that are feasible and the likelihood of their acceptance
- the dependence and vulnerability of different stakeholder groups to alternative changes in management rules
- alternative co-management models appropriate in each area

5. Future Inputs to the Monitoring Programme

5.1 Summary of Monitoring Programme Schedules

The timetable of activities for the Monitoring Programmes are summarised in Table 11. Both the BMP and SEMP will begin in August 1998, and continue up until the end of September 1999. August and September 1998 will be considered training periods for both programmes before the main 12-month annual cycle from October 1998 up to September 1999. The BMP may also generate important dry season data in these early months though.

The BMP will be supported by the Partial BMP at the Sumsel study sites during both the dry seasons in 1998 and 1999. The overall programmes will be supported by the Institutional Analysis phase, planned for February / March 1999.

Table 11. Timetable of Monitoring Programme and other remaining project activities

Activities	***1998***									***1999***												***2000***		
	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Biological Data Collection																								
Survey design & field staff training																								
Interviews etc																								
Gill net fish abundance survey																								
Partial Biology MPs in Sumsel																								
Socio-economic Data Collection																								
Survey design & field staff training																								
Respondent interviews																								
Interviews etc																								
Institutional Analysis																								
Interviews etc																								
Data Analysis																								
Data entry & analysis																								
Joint MRAG / CRIFI Analysis																								
Dissemination & Training																								
Preparation of guidelines																								
Translation of guidelines																								
Dissemination / training activities																								

5.2 Future Inputs and Responsibilities for the Biological MP

The following notes summarise the additional inputs required to implement and manage the BMP at all the study sites, and the responsibilities allocated to different project personnel.

Overall Responsibilities

Sonny Ensure that all inputs by various Indonesian staff are fully implemented as listed below

Agus Ensure that data sheets etc are received successfully from Herman (Jambi) and Asmara / Rooslan (Sumsel)

Sonny Ensure that data sheets etc are received successfully from Andi (Kalbar)

Final Activities at Sumsel sites

Agus Monday 10th- Wednesday 12th August: Do second gill net fishing / training for GNF / VCs
Deliver Instruction manuals + 112 data forms (8/month * 14 months)
Ensure all job requirements fully understood

Sonny Write & deliver publicity materials (not amended for biology, since same as at Arang Arang, apart from compensation - it was agreed that the project would give Rp1m to Diskan for them to use to restock the reserves *after* the study)

Asmara Friday 14th: Announce programmes at Pedamaran / Benawa mosques (delay one week to allow finalisation of Socio-economic programmes and inclusion in publicity material)

Agus Do 4 more historical biology interviews at Laut Sekampung, or other nearby waterbody

Kalbar Trip

Team Implement MP at 4 study sites, using checklists (Table 3) to ensure all complete

Agus Train Andi in gill net data entry using project spreadsheet, and give copies of spreadsheet template / format

Achmad Arrange to set up water height gauge in Meliau village only, and instruct to use gauge at DSWR field station for other three villages.

Achmad At end of trip, send copies of Instruction Manuals given to each village to DH at MRAG, including maps of gill net positions in each waterbody.

Financial Arrangements

Dan Discuss additional funding requirements with Novenny (from MRAG or CRIFI budget due to increased exchange rate?)

C Additional Rp0.5m committed for compensation payments (2 Sumsel sites, + 4 Kalbar sites)

C Additional Rp0.2m required for depth gauge at Meliau sites in Kalbar

C Additional Rp0.1m required for depth gauge at Lebak Nilang (0.1m already paid up front)

C Additional Rp17.28m required to implement Partial BMP in Sumsel
Budget breakdown: 3 field days per week for 8 weeks (gill nets) & 1 week (cast nets)
Programme to be implemented in both 1998 and 1999 dry seasons
per diems of Agus (Rp130,000/day), Herman (Rp90,000/day) and Andri (70,000/day)
Transport allowances of Rp30,000 per week each

C Additional ??? for improvement of DFID-supplied computer at Mariana

Sonny Prepare final budget revision at end of MPI field trip to Kalbar indicating requirements for different programmes in each site. Send to Novenny & DH for discussion.

Dan Request Novenny to inform Sonny when compensation budgets will be sent from CRIFI to Diskan, for their delivery to the villages.

Sonny Ensure that funds are paid to Diskan and that compensation payments are received by villages as agreed.

Estimation of Study Site Waterbody Areas

Sonny — Contact WI-IP to request information about (or copies of?) any satellite images which may help to determine the water areas at the study sites (in high water and/or low water seasons)

Herman — Obtain kecamatan / desa maps from Bappeda, showing (1) village boundaries, (2) land use and (3) water features of Arang Arang and Dano Lamo; send to Sonny

Agus — Obtain kecamatan / desa maps from Bappeda, showing (1) village boundaries, (2) land use and (3) water features of Desa Pedamaran VI and Benawa; send to Sonny

Andi — Provide village maps for Kalbar sites from DSWR studies, showing waterbody areas etc.

Gill Net Data Entry

Sonny — Train Agus how to send emails with attachments

Sonny — Train Agus how to make backup copies of the database spreadsheets

Agus — Develop coding system for fish species names, record in SppCode spreadsheet, and only use one code for each species in gill net spreadsheets!

Agus — Obtain all gill net data from Herman (Jambi) and Asmara (Sumsel), enter into spreadsheet databases. Send files after end of every three months (ie. after September 98, December 98, March 99, June 99, September 99) as email attachments to Sonny, DH and AH. Also send copies of data sheets to AH at MRAG by post.

Agus — Make backup copies **every day** of the database spreadsheets

Sonny — Obtain all gill net data from Kalbar. Arrange for data entry (by Andi / Bogor assistant?) Send quarterly files and data sheet copies to Loka-PLM, DH and AH.

Water Depth Measurements and Data Recording / Entry

Herman — Ensure depth gauge set up in Arang Arang, and depth information being collected

Agus — Ensure depth gauge set up in Lebak Nilang (by PPL Rahman) by 10th August, pay extra Rp100,000 when complete

Agus — Receive regular depth information from Arang Arang, Teluk Nilang, Teluk Rasau and enter into gill net databases (check with Sonny that Herman will send data to Agus directly)

Agus — Obtain depth information from Lubuk Lampan, and enter into special spreadsheet (with just column of dates & column of water heights)

Agus — Send Lubuk Lampan water height spreadsheet as email attachment to Sonny, DH & AH at same times as gill net data (see below)

Historical Fishing Interview Data - Entry and Analysis

Agus — Enter historical data for 4x Kalbar sites, Lebak Nilang and extra respondents from Laut Sekampung into spreadsheet format demonstrated by Ashley

Agus — Send spreadsheets to DH & AH by email, and copies of data sheets by post

Sumsel Partial Biological MP - Lake Comparison Sites (Gill netting)

Achmad Make five more gill nets, using same materials as before. Distribute gill nets - 4 to each of 7 main BMP sites, plus 4 to CRIFI Mariana for Partial BMP sites in Sumsel

Agus Discuss waterbodies in Lempuing River close to Teluk Rasau with Andri and other fishers, and decide which one is most suitable for comparison with Teluk Rasau (e.g. Lebung Sulit). Comparison site should have similar dry season water depth, area, and ecology to Teluk Rasau.

Agus Set 2 gill nets in Lebung Sulit, and other 2 gill nets in Teluk Gelam, for four nights per month in each of September and October of 1998. Record data on standard gill net data forms and enter into spreadsheets SULITBS.XLS and TGELAMBS.XLS. Set nets on following nights:

Lebung Sulit	September 9, 16, 23, 29	October 7, 14, 21, 28	1998
Teluk Gelam	September 10, 17, 24, 30	October 8, 15, 22, 29	1998

Agus If the flood arrives before October 29, finish the programme early

Agus Repeat the exercise in months August and September 1999

Sumsel Partial Biological MP - River Comparison Sites (Cast netting)

Agus Find out when Andri is fishing Ngubek Lubuk in Lubuk Lampam river sites, and go to Lubuk Lampam to record catch from Ngubek Lubuk in normal fishing areas. Record catches using standard data form, from Lubuk Genali as 'Posisi A' in spreadsheet LLFLbBS.XLS and from Lubuk Bengkuang as 'Posisi B' in the same spreadsheet.

Agus Request Andri to also fish in CRIFI reserve Lubuk Gunung Isam, *using exactly the same fishing effort as in the other two lubuks* (e.g. both with same team of 7-10 cast netters fishing for same length of time with the same nets). Record the catch from Gunung Isam in spreadsheet LLRLbBS.XLS.

Agus Send spreadsheet files by email to DH and AH, and copies of data sheets by post.

Agus Do cast netting programme in both 1998 and 1999, depending on water levels

5.3 Future Inputs and Responsibilities for the Socio-Economic MP

Setup of SEMP in West Kalimantan

Sonny Identify any differentiating issues (*toman* culture). Revise questionnaire. Identify sample frame for each village. Stratify if necessary (*jermal* ownership?). Select respondents. Train VCs and PC in data collection procedures, checking, reporting etc.

Test phase of SEMP

Sonny Develop data entry, back-up and file maintenance procedures.

Samuel Ensure that reporting schedules are not allowed to slip. Check and enter data as soon as it arrives, sending back queries as quickly as possible. Ensure that PCS are following up on group self-monitoring.

Lelang units in South Sumatra

Samuel	At the end of the season, attempt to obtain record books of self-monitoring groups. Ensure that you understand the accounting system and contents as far as possible.
Sam/Son	Analyse the record books of self-monitoring groups to develop a clearer understanding of financial flows - revenues, expenditures, debts and repayments - which they document.
Samuel	Return to enlist new *lelang* winners in self-monitoring programme following the auction. Obtain as much information as possible about the outcome of the auction.

Annex A: Fieldwork Itinerary

Wed 22 Jul	Introductory meeting with CRIFI collaborators, CRIFI HQ, Jakarta Discussion of field activities and programme
	Flight to Jambi
Thu 23 Jul	Introductory meeting with Diskan Jambi collaborators, fieldwork planning
Fri 24 Jul	Biological Monitoring Programme Implementation (BMPI) at Desa Arang Arang (Selecting and training enumerators; visiting waterbody; 1st gill net setting)
	Socio-economic Monitoring Programme Implementation (SEMPI) at Desa Arang-Arang. Fishermen interviews.
Sat 25 Jul	BMPI at Desa Arang Arang (Hauling 1st gill nets; catch recording; historical interviews)
	SEMPI at Desa Arang-Arang. Obtaining HH lists. Leaseholder information.
Sun 26 Jul	Team meeting on MPI requirements and coordination
Mon 27 Jul	Meeting with LIPI & Diskan to discuss studies in new Desa Dano Lamo reserve
	BMPI at Desa Dano Lamo (discussing new reserve with villagers; historical interviews)
	BMPI at Desa Arang Arang (2nd gill net setting)
	SEMPI at Desa Arang-Arang. Questionnaire design.
Tue 28 Jul	BMPI at Desa Arang Arang (2nd gill net hauling and catch recording; historical interviews)
	SEMPI at Desa Arang-Arang. Questionnaire testing.
	Team meeting on MP design and data analysis
Wed 29 Jul	Write and translate Arang Arang Instruction Manuals, data forms and publicity posters
	SEMPI at Desa Arang-Arang. HH sample selection. Questionnaire testing. Manual writing.
Thu 30 Jul	BMPI finalisation (deliver manuals etc) at Desa Arang Arang
	SEMPI at Desa Arang-Arang. Fish trader interviews. Initial VC training.
	Biological team travel to Sumsel by bus

BMPI Activities in Sumsel

Fri 31 Jul	Introductory meeting with Diskan Sumsel collaborators, fieldwork planning
Sat 1 Aug	Introductory meeting with Diskan OKI collaborators, fieldwork planning
	BMPI at Teluk Rasau reserve, Pedamaran (selecting & training enumerators; visiting

	waterbody; setting 1st gill nets)
Sun 2 Aug	BMPI at Teluk Rasau reserve (hauling 1st gill nets; recording catches; historical interviews)
Mon 3 Aug	BMPI at Lebak Nilang reserve, Benawa (selecting & training enumerators; visiting waterbody; setting 1st gill nets)
Tue 4 Aug	BMPI at Lebak Nilang reserve (hauling 1st gill nets; recording catches; historical interviews)
	Write up trip report; Analyse historical data

SEMPI Activities in Jambi

Fri 31 Jul	SEMPI at Dano Lamo. HH sample selection. Manual writing.
Sat 1 Aug	SEMPI at Dano Lamo. Official opening of reserve.
Sun 2 Aug	SEMPI at Dano Lamo. Questionnaire testing. VC training. Discussions with PC.
Mon 3 Aug	Finalisation of manuals etc.
Tue 4 Aug	Final training of PC and VCs. Handover of materials. Travel to Palembang.

MPI Activities in Jambi

Wed 5 Aug	Write and translate Instruction Manuals, data forms and publicity posters for Sumsel Write up trip report
Thu 6 Aug	Final discussions on MP design and analysis, further requirements, etc Write up trip report
	SEMPI field trip to Benawa and Lebak Nilang. Interviews with fishing groups.
Fri 7 Aug	D. Hoggarth, A. Halls and A. Sarnita travel to Jakarta
	Meeting with CRIFI and DGF in Jakarta to discuss MP plans and requirements, and to prepare for final stages of project
	DH and AH travel to London
	SEMPI field trip to Benawa.
Sat 8 Aug	SEMPI field trip to Teluk Rasau. Interviews with leaseholders and fishermen.
Sun 9 Aug	SEMPI visit to leaseholders in Pedamaran. Write up programme for Teluk Rasau.
Mon 10 Aug	BMPI at Teluk Rasau (setting 2nd gill nets)
	SEMPI field trip to Benawa. Respondent selection.
Tue 11 Aug	BMPI finalisation at Teluk Rasau (haul 2nd gill nets, deliver manuals etc) BMPI at Benawa (setting 2nd gill nets)
	SEMPI clarifications in Benawa. Report writing.

Wed 12 Aug	SEMPI report writing. Manual finalization and translation.
Thur 13 Aug	SEMPI training of provincial staff and VCs. Travel to Jakarta.
Fri 14 Aug	Meeting at CRIFI. Final briefing. MAT travels to London

MP Activity in Kalbar

Tue, 18 Aug	Kalbar MP preparation in Jakarta Leave Jakarta for Pontianak Arrival and book Hotel
Wed, 19 Aug	Meet Kepala Diskan Kalbar Province, discuss brief plan of the Kalbar MP Discuss Kalbar MP plan with Diskan Kalbar Province Team Arrange an appointment with KSDA
Thu, 20 Aug	Preparing Biological and Socioeconomic Questionnaires Preparing Biological and Socioeconomic Manuals Discussion with KSDA (Erwin, should be Director of KSDA instead), for using KSDA staff as VC and possibility of using KSDA facilities Complete team arrival, preliminary discussion
Fri, 21 Aug	Presentation at the Diskan Kalbar Province, discuss detail plan of who will do what and how Leave Pontianak for Semitau
Sat, 22 Aug	Arrive at Semitau Preliminary discussion with VCs (Bambang DW, KSDA staff, and Andi Erman) Arrangement of transportation to each selected site Overnight in Semitau
Sun, 23 Aug	Leave Semitau to KSDA Takenang Preliminary training to PC and VCs Leave Takenang to Sekulat Introductory meeting with Kepala Dusun Biological and Socioeconomic MP in Sekulat
Mon, 24 Aug	Continuing Biological and Socioeconomic MP in Sekulat Leave Sekulat for Meliau
Tue, 25 Aug	Introductory meeting with Kepala Dusun Biological and Socioeconomic MP in Meliau
Wed, 26 Aug	Continuing Biological and Socioeconomic MP in Meliau
Thu, 27 Aug	Leave for Pulau Majang Introductory meeting with Kepala Dusun, Ketua Adat and Fishers Biological and Socioeconomic MP in Pulau Majang
Fri, 28 Aug	Continuing Biological and Socioeconomic MP in Pulau Majang Leave for Tengkidap Introductory meeting with VC and GNFs of Tengkidap Biological and Socioeconomic MP in Tengkidap
Sat, 29 Aug	Continuing Biological and Socioeconomic MP in Tengkidap Leave for Semitau

Sun, 30 Aug	Final Training to VCs Bambang DW, Suparto and Andi Erman) Biological and Socioeconomic Data Entry Training Leave for Pontianak
Mon, 31 Aug	Draft Kalbar MP report Completing Manuals for Kalbar MP Draft Presentation at Diskan Kalbar Discussion with KSDA (SK)
Tue, 01 Sep	Presentation at Diskan Kalbar (Team) Attending Kalbar Post Workshop on Danau Sentarum Development Programme (SK and SD) Final training on Kalbar MP and procedure for sending the data
Wed, 02 Sep	SK and AS leaving for Jakarta
Thu, 03 Sep	Palembang team (ADU, SAM and AND) leaving Pontianak for Palembang
Fri, 04 Sep	Discussion at CRIFI (SK, AS, ADU, Novenny) First draft of MPI Report

Annex B: Example of BMP Instruction Manual (before translation)

CRIFI / *Dinas Perikanan* / MRAG

DFID Project R7043:
Selection Criteria and Co-Management Guidelines for Harvest Reserves in Tropical River Fisheries

BIOLOGICAL MONITORING PROGRAMME

INSTRUCTION MANUAL

(DESA ARANG ARANG, JAMBI)

Objectives

The biological sampling programme is designed to provide simple indices of the state of fish stocks in reserves over a full 12 month hydrological cycle:

- The abundance of fish
- The composition of fish stocks (by species and sizes of fish)

The abundance of fish (particularly during the dry season period) provides a measure of how effective a particular reserve is at protecting brood stocks - a major factor determining catches in the next year. The composition of the fish stocks and the average size of fish also provide measures of the 'health' or state of fish stocks. The presence of large, high value species in the catch indicates relatively low rates of exploitation compared to catches dominated by small, low value species.

These indices, together with the results of the interviews conducted on historical fishing trends and the socio-economic survey will be used to roughly determine which types of reserve give the greatest benefit to fishing communities.

Sampling fish abundance

Fish abundance will be sampled in the reserves each month for a full year. Abundance will be measured by the average gillnet catch per night.

Setting the gill nets (and recording water height data)

Two fleets of gill nets (each comprising four sections of 40m x 2m gill nets with mesh sizes 1", 2", 3.5" and 4.5" arranged in ascending order) should be set in the reserve on four days each month, for the duration of the field study (approximately one year). Nets should be set at 17.00hrs in the evening, and hauled the following morning at 0600hrs. The nets should be set on the 3rd, 10th, 18th and 25th days of the month. If for any reason, the gill nets cannot be set on the specified day, then they should be set on the closest possible day before or after.

To ensure that the entire area of the reserve is sampled with the various mesh sizes, the reserve should be divided into 4 approximately equal size sampling sectors (Areas1- 4 in Figure 1). At the start of each month (or every 4 weeks) the two fleets of gill nets should be set diagonally across the reserve in Area 1 from opposite sides of the reserve banks. One of the fleets should be set in Position A with its smallest (S) mesh (1") net closest to the bank and the largest (L) mesh net (4.5") furthest from the bank. The other fleet should be set with the opposite orientation (Position B) so that the largest mesh (L) is closest to bank and the smallest mesh (S) is furthest from bank (Figure 1).

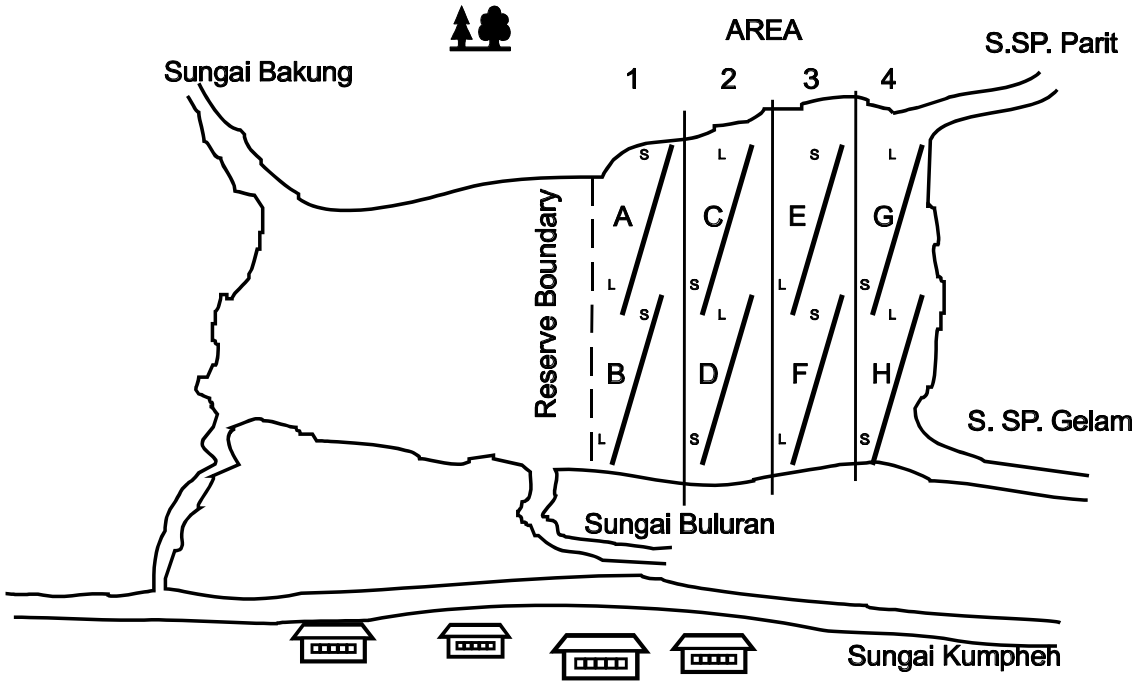

Figure 1. Schematic map illustrating the position of the reserve in Danu Arang Arang, the four sampling sectors of the reserve, and the orientation and position (A,B,C...H) of fleets of gillnets. S-small (1") mesh net, L- large (4.5") mesh net.

In the second week the fleets of gill nets should be set in Area 2 in positions C and D, in the third week in Area 3 in positions E and F and in the fourth week in Area 4 in positions G and H (Figure 1). This sampling procedure should be repeated in every month or four week period.

NB: Fish caught in each fleet of gill nets must be kept separate in the two plastic containers provided before sorting, weighing and recording.

Before returning to village, the height of water within the reserve should be recorded from the gauge by the gillnet fishermen.

Sorting, measuring and recording gill net catches

Fish caught from each fleet of gillnets should be returned to the village and sorted by fish species or species group and size (above or below 30cm). For each fleet, species (or species group) and size group, the number of fish should be counted and the total weight measured by the gillnet fishermen and recorded on the 'Gillnet Catch Survey Form' (Annex A) by the village coordinator, together with the following details:

Date of sampling
Village Name
Waterbody name
Time gillnet set
Time gillnet hauled
Gill net number (1 / 2)
The position and orientation of the gill net (position A,B,C,....,H)
Water height in reserve (m)

The village coordinator will also be responsible for collecting and recording (on the same form) the following additional information regarding recent weather and limnological conditions and fishing activities:

Rain during night of gill netting (yes/no)
Wind during night of gill netting (none, light, strong)
Fish kills due to 'air banger' *since* the last sample (yes/no)
Illegal fishing in reserve *since* last sample (yes/no)

Gear monitoring and maintenance

It is the responsibility of the gillnet fishermen to remove weed and other debris from the nets after each haul and to check for any damage or tares. Minor damage should be repaired by the gillnet fishermen, but major damage should be reported to the village coordinator as soon as possible so that a replacement net can be arranged if necessary. The village coordinator is also responsible for monitoring the condition of the nets each week.

Summary of duties and responsibilities

Gillnet fishermen

- Setting and hauling gillnets (and recovering catches)
- Sorting, counting and weighing gillnet catches
- Measuring water height in reserve
- Removing weed and debris from gillnets and monitoring overall condition of gear

- Minor repairs to gear
- Reporting major damage to village coordinator

Village Coordinator

- Ensure that gillnet catches are correctly sorted, counted and weighed.
- Recording gillnet catches and related climatic, limnological and illegal fishing activities.
- Monitoring the condition and repair of fleets of gillnets

Provincial Coordinator

- Collection of 8 data sheets (2 nets, fished 4 times per month) from Village Coordinator at end of month
- Checking of data quality and completion of form (no missing data etc)
- Photocopying of data sheets
- Posting copies of data sheets to CRIFI by 10th day of following month

Biological Monitoring Programme - Instruction Manual - Annex A

CRIFI / *Dinas Perikanan* / MRAG - River Fishery Reserves Project - 1998/99
Biological Monitoring Programme - Gill Net Catch Survey Data Form.

Date: _____, Village: _____, Waterbody: _____

Gill Net Number: ____ (1 / 2), Setting Position in Reserve: _____ (A / B / C / D / E / F / G / H)

Time Gill Net Set: _____, Time Gill Net Hauled: _____

Water Height in Reserve: _____ (cm),

Rain Overnight?: _____ (Yes / No), Wind Overnight?: _____ (None / Light / Strong)

Occurrence of fish kills due to '*air bangar*' in reserve since last sample?: _____ (Yes / No)

Illegal fishing in reserve since last sample?: _____ (Yes / No)

Fish Species	Fish caught (per night, per 1 x 160m of gill net)			
	Small fish (<30cm)		Large fish (>30cm)	
	Number	Weight (g)	Number	Weight (g)

Annex C: Example of MP Publicity Poster (before translation into Indonesian)

FISHING STUDY IN DESA ARANG ARANG

Over the next year, there will be a small study of fishing in Desa Arang Arang. Once each week, two gill nets will be used in Danau Arang Arang, and around 15 households will be interviewed about their catches. Outsiders will visit the village in July 1998 to set up the study. They will come again early next year to ask some more questions about fishing.

How will this affect the village?

The village will be given a payment of Rp1,000,000 at the start the study for using the reserve. Fish caught in the gill nets will be made available for village people to eat. Two fishermen from Arang Arang will be employed to set the gill nets in the lake. The weekly interviews with fishermen will be short and simple.

Why is this study being done?

The study will provide guidance on how to manage river fisheries in Indonesia to ensure high catches. In particular, the project will determine what is most important for the selection and management of river reserves to ensure the maximum long-term benefits to fishing communities.

Where is the study being done?

The study will examine up to nine reserves in three provinces: Kalimantan Barat, Jambi and Sumatra Selatan. In Jambi, studies will be made at Arang Arang and Dano Lamo villages in Kabupaten Batanghari. Some of the reserves were set up by government, while others were set up by local communities. Some are in lakes and some in rivers. Some of reserves allow some types of fishing, while others are fully closed all year. The study will try to find out what is important to make these different types of reserves most effective.

When is the study being done?

The Arang Arang studies will be conducted between August 1998 and September 1999.

How will the study be done?

The study is in two parts:

- Two small scientific gill nets will be fished inside the reserve once a week. The catches will show what types of fish (and how many fish) live in each type of reserve.
- A group of around 15 fishing households will be picked by lottery to be interviewed about their catches and fishing costs each week. The results will show whether the village gets large or small catches and profits from its fishery. This may help to show which reserves are most useful to local people.

Who is doing the study?

The study is being done by a collaboration between Indonesian fishing communities (you!), CRIFI, *Dinas Perikanan* and MRAG (London). In Desa Arang Arang, a local person will be employed by the project as a 'Village Coordinator'. Funding for the study was provided by the United Kingdom Government's Department For International Development.

After the study?

When the study is completed, the results will be analysed, and a set of guidelines will be written. These will help *Dinas Perikanan* to manage river fisheries using reserves and other approaches, both in this area and other provinces.

Your comments or ideas?

The researchers would welcome any comments or ideas you may have about the study. You may either talk to the local Coordinator in your village, or write to the Study Coordinator, Sonny Koeshendrajana at:

- Instalasi Penelitian Perikanan Air Tawar, Jl. Sempur No. 1, Bogor