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

Socio-Economic Monitoring Programme Report

UK Department for International Development
Fisheries Management Science Programme
Project R7043

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May 2000

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1 Objectives of the SEMP

The socio-economic monitoring programme was designed to quantify, over a period of a year, three of the principal outcomes from the fishery - fish production, the economic surplus generated and its distribution between the main actors. It was recognised that these outcomes would be influenced by the existence or absence of reserves (through their effect on resource status) but that this was only one influence among many. Attempting to quantify the impact of reserves through comparisons of villages was therefore inappropriate.

The purpose of the SEMP was to develop a greater understanding of the outcomes themselves, the types of relationship that can exist between them and some of the mediating factors in each village.

Fisheries outcomes and the factors that influence them

Fisheries can make important contributions to livelihoods on the floodplain. This contribution tends to be particularly important where flooding is extensive and prolonged, as this both restricts opportunities for alternative livelihood activities based on agriculture and supports the growth of fish biomass. But the relationship between fish stocks and human livelihoods is complex, with an array of natural, social, institutional and economic factors having a potential role. Some of the more important of these are illustrated in the Figure below.

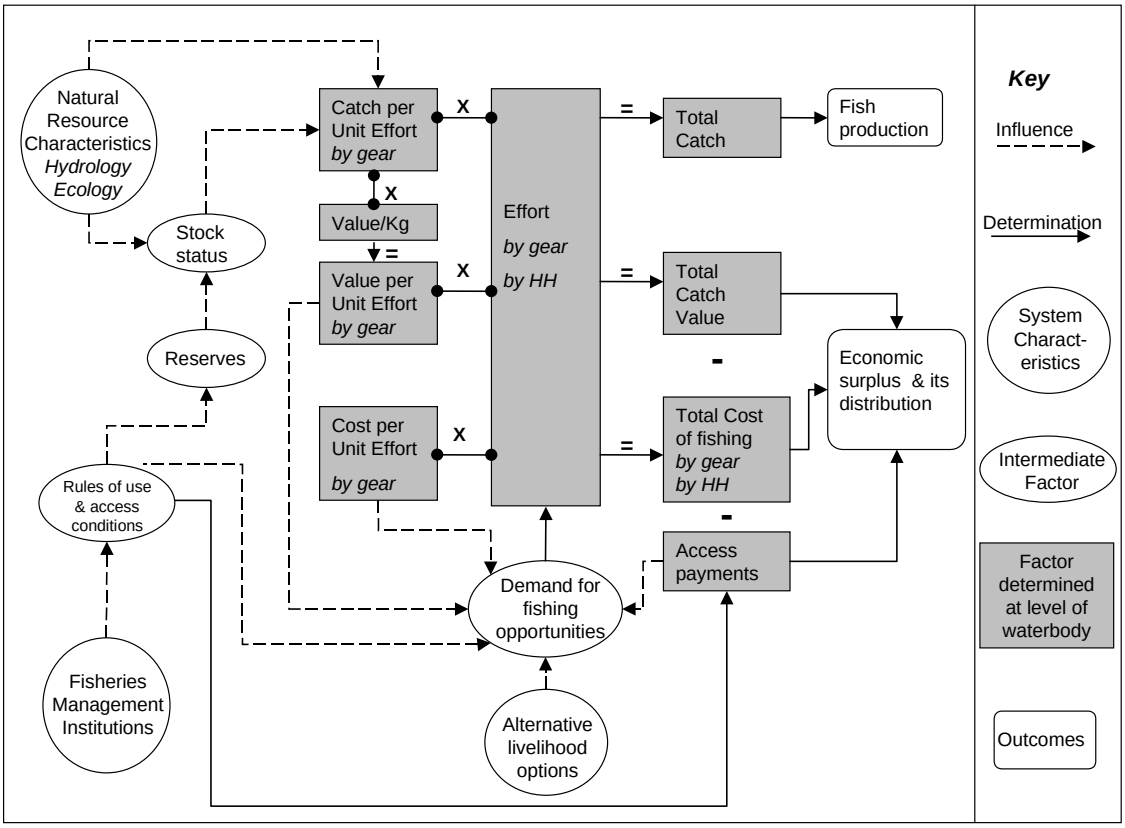

Figure A5.1 Factors influencing outcomes on floodplain fisheries

The Figure is arranged to highlight the outcomes (round-cornered boxes, arrayed on the right) and the immediate factors that determine them (shaded rectangular boxes occupying the centre of the diagram). Thus fish production, the simplest and most commonly monitored outcome, is determined by the catch per unit effort (CPUE) and the level of effort applied in any given period. Socio-economic outcomes are more complex, being influenced by the values of the catch and the cost of the effort (for economic surplus) and the variations in the consequent income flows between categories of agent (for economic surplus distribution). These factors determining outcomes are, however, influenced by an array of other variables, such as the local natural resource characteristics, fisheries management institutions and the more general social and economic conditions within the area.

Outcomes and reserves

The problem of measuring the impact of reserves on outcomes can be best understood in the light of this Figure. Reserves, when well designed/managed, provide some degree of protection to locally important species at times, such as the breeding season, when they might otherwise be particularly vulnerable to overfishing. This contribution to stock status will translate into higher CPUEs[1] and, ultimately, through to outcomes along the pathways indicated. The chains of cause and effect that link them are, however, neither rigid nor linear, being subject to the influence of a number of other components

[1] In the reserve waterbody itself (if fished at any stage) and/or more generally in other local waterbodies with which it is connected in the local floodplain complex.

within the model. Most important of these is the level of effort applied, which is the co-determinant of fish production and a major influence on the level of economic surplus. Effort in floodplain fisheries is highly variable in quantity (hours) and composition (by gear type) over both space and time.

The incentive for an individual to fish reflects the returns to fishing opportunities with the gears he owns, which must be weighed against alternatives livelihood options in the light of current or anticipated household needs. The CPUE will have a positive influence on this but it is only one influence among many, with current fish prices having a direct mediating effect and a wide variety of other factors, from the demands of the agricultural cycle to the need to pay school fees, all potentially playing a role.

The aggregate number of individuals choosing to fish will be strongly influenced by fishery access conditions. Where the fishery is open, the numbers fishing will simply be a function of the number of households for which fishing is the best available livelihood option. Thus population density combines with the factors operating at the individual household level to determine the quantity of effort applied. Where access is controlled, the numbers of households entitled to fish is restricted, sometimes to the members of the community, sometimes to a few individuals who are employed by the leaseholder or who have an agreement with him. In reality, control over fishing access is usually less than complete. Here the individual decision to fish (poach) will be based on an additional set of considerations, such as the probability of detection and the social, physical or financial losses that might follow. The more effective is the control over fishing, the more imprecise the connection between CPUE and the level of effort.

Thus, while there are good biological/ecological reasons to anticipate that reserves will translate, through improved stock status and CPUEs into higher fish production and economic surplus from fishing, it is unlikely that the impact of reserves could be estimated by comparisons in outcomes between a small number of villages - there are too many confounding variables.

Understanding outcomes

Instead of aiming to measure the impact of reserves on outcomes, the SEMP chose to look in greater detail at the outcomes in each village, their relationship to each other and the influence factors such as access regime might have on them. In particular, the relationship between fish production and economic surplus was to be examined, focussing on the role of markets and prices. So too was the relationship between economic surplus and surplus distribution, focussing on the role of access conditions.

The reasons for adopting this approach were that in general, these issues are:

- neither well documented nor well understood,
- critical to an improved understanding of the influence of access regimes on the returns to different stakeholder groups
- of great importance in situations where improved fisheries management is proposed as a means of alleviating poverty on floodplains

2 SEMP Methodology

Issues in sampling design

To meet the objectives of the SEMP, it was necessary to adopt a survey design that included both weekly household surveys of those fishing routinely, with daily self-monitoring by fishing groups, whose activities were more intermittent, and one-off surveys of fishing costs[2].

Survey types

Floodplain fisheries can be monitored in a number of ways. Catch-effort surveys of different waterbodies derive estimates of production, often from direct observations of the level of effort and measurement of catch. These are useful if detailed information of the individual waterbodies, the species composition or species size distribution are required but calculating economic surplus and its distribution is difficult without knowledge of *who* took the catch. Household surveys of fishermen have been used as a means of deriving estimates of either effort or catch or both. These are usually based on recall, limiting their value for issues requiring fine detail, such as the biological characteristics of the stock or estimates of catch rate by species. But, as long as a suitable sampling frame is established, they can be of great value in estimating aggregate catches or daily receipts from sales and hence the flows of income to different groups. Given the objectives of the study, sampling of households was preferred.

However, basing estimates on simple household sampling would have run into significant methodological difficulties, due to the various mechanisms used to control access within the surveyed villages, see Box below.

> Floodplain fisheries are highly seasonal. The migration of fish out onto the floodplain as the waters rise, their growth there in the nutrient-enriched waters, and their return to permanent water bodies as the floods fall provide a range of fishing opportunities that vary significantly in their value in time and space. Large concentrations of fish occur naturally in floodplain depressions or connecting channels and these can be accentuated by delaying fishing and/or by using barriers to prevent fish from escaping. Catches of more than a tonne are not uncommon for groups of as few as four fishers acting together. Systems for allocating access rights have arisen that serve to reduce conflict over these opportunities. Where control is ceded for the whole season, or the relevant portion of it, a fishing method can be adopted that makes the most these opportunities, increasing catch rates and the potential surplus that can be extracted.

Box A5.1 Floodplain variation, management systems and sample design

Estimates of values of village catch or total economic surplus based on a simple random sample of households might have been seriously affected by the inclusion or exclusion of households with control of the more valuable waterbodies: stratification was required.

Estimating catch, income and recurrent costs

Wherever waterbodies were leased, these were identified and local fishers questioned about their characteristics: size, waterbody type, fishing operations undertaken and lease value. A sample frame was then established, grouping all sites similar enough to be considered replicates. If a waterbody was both unique and large/valuable, it was

[2] The full rationale for the sampling programme is to be found in Appendix 3. This section gives a brief introduction and a summary of the main issues to allow this document to stand alone.

considered a category on its own. Waterbodies were then chosen at random from each category. For waterbodies where catch was taken using smaller gears in near continuous operation, fish production and income were recorded as part of the weekly household survey, see below. Otherwise, leaseholders were asked to undertake self monitoring, using a separate form.

A list of all the households fishing in each village was collated in consultation with representatives of each village. Households with leases for waterbodies were then set aside and the sample of open access/independent fishers was then drawn from the remainder. These were then questioned on their fishing activities on a weekly basis.

Estimating fishing costs

While household benefits from a fishery are largely continuous, the costs of items such as gears occur irregularly. Many can last more than a year and therefore might not be picked up with a regular monitoring survey which simply recorded costs as they occurred. For the large gears, used by groups fishing on behalf of leaseholders, construction can be an extended and complex process requiring significant inputs of labour to gather and assemble materials and incurred well in advance of the period when the fish are caught. To get estimates of these fishing costs, a separate survey was therefore planned.

Sampling method: by village

The SEMP had 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 below.

Desa Arang Arang

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, which had lease values of Rp.850,00, Rp.1.4m and Rp.1.8m and two deeper sections of the S.Kumpeh, leased for Rp.360,000 and Rp.500,000. 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 notionally[3] restrict access earlier in the year, before throwing it open for a one day community 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

[3] The Institutional survey found that fishing rules were not adhered to closely.

required to pay. All monies raised, both from the auction of leases and from the Hari Berkarang, go to village funds.

The leased areas were divided into three groups, taking the two larger and more valuable of the tributaries of Danau Arang Arang together, the two sections of Sungai Kumpeh, with the smaller tributary of the lake, having no replicates, being taken on its own. Members of the groups fishing these areas, who fished individually, were included in the weekly sampling programme. Leaseholders were asked to fill routine monitoring sheets.

Table A5.1 Summary procedure for Desa Arang Arang

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 catch and net income over all HH for sample, using a raising factor of 7.25 to get village total.
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) Raise income from leasehold area by the number of waterbodies in category (i.e. 1, 2 and 2)
Hari Berkarang	Survey during HB itself.	-

Danau Lamo

The fishery in Danau Lamo shares many of the characteristics of that in Arang Arang. As a result the strategy adopted and its rationale are similar. Fishing is restricted permanently in the core area of the newly established reserve and seasonally on the six major channels connecting the river to the surrounding floodplain, which are auctioned. Auction values varied from Rp.40,000 to Rp.1.2m, see Table below. These values appeared completely independent of length of the section involved.

Table A5.2 Lelang Areas in Danau Lamo

No.	Name of Waterbody	Length	Lelang Value (Rp.)
1	Sungai Bayur	200 m	1,200,000
2	Sungai Lampur	200 m	200,000
3	S. Pematang and channel connecting to S.Bayur	50 m	40,000
4	S.Keililing and S.Medak	500 m	60,000
5	S.Lebar Muaro, S.Batang and S.Sangko	—	500,000
6	S.Bungur and S.Puding	200 m	600,000

One unit was selected from the two lower valued waterbodies (3 and 4), and one from those of intermediate value (5 and 6) . In both cases the pairing was determined by the similarity in auction value. Waterbodies 1 and 2 were both selected, as there were no others with which they might be paired.

Fishing is also undertaken by individuals from 77 of the 182 households. The 12 households involved in fishing the leased areas were discarded and 11 selected from the remainder to represent open access fishing. The estimates of household catch and income were raised by the inverse of the sampling fraction to give village totals.

Table A5.3 Calculation of Fishing Incomes in Danau Lamo

Income to be Estimated	Data Source	Method of Calculation
Open access fishing To village HH	Household weekly monitoring (11 HH) for income HH interviews for non-labour costs	Sum net income over all HH *6
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

Pedamaran

Fishing activities around Teluk Rasau, the reserve area, were monitored on three adjacent leased areas, two of which had been further divided, making seven units altogether. Fishing operations varied according to the habitat type, with leaseholder sponsored groups using large barrier gears (*tuguk)* on the main channels and smaller

barriers *(kilung lulung)* on the connections to the floodplain; licensed individuals fished independently using small mobile gears in the more vegetated low-flow areas.

Table A5.4 Monitoring of fishing incomes adjacent to Teluk Rasau

Lease Unit	Sub-unit and cost	Group Activities	Individual Fishing
Sungai Aur	Lebung Sungai Aur	Self-monitoring record of *tuguk* income less estimates of costs from detailed interview	1 fisher. Weekly household monitoring (WHM) less costs derived from detailed interview
	Lebung Kumpai and Selebar Utang	Self-monitoring record of *lulung* and *ngesar* income less estimates of costs from detailed interview	3 out of 8 fishers monitored using WHM.
Laut Sekampung	Lebak	No group activities.	4 out of 14 fishers monitoring using WHM.
	Batanghari Ulu	No co-operation from leaseholder	-
	Batanghari Ilir	Self-monitoring record of *tuguk* income less estimates of costs from detailed interview	No individual fishers
Pulau Benawo,	Lebak	Self-monitoring record of *kilung* income less estimates of costs from detailed interview	3 out of 7 fishers monitored using WHM.

The leaseholder of Batanghari Ulu, one of the sub-units of Laut Sekampung, was unwilling to co-operate with the survey and this section was therefore dropped[4].

Lebak Nilang

This fishery adjacent to Lebak Nilang was highly complex, with an array of interconnected waterbodies operated under a mixture of leasing, sub-leasing, licencing and open-access fishing arrangements. 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.

Lebak Nilang is large and its dry season depth (5m) and vegetative cover make it difficult to fish out by any co-ordinated operation, such as *ngesar*. Most fishing activity is on 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 were 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.

[4] Comparisons between the absolute magnitude of catch and economic surplus in each village/survey area were not being made. So the exclusion of this area was not an issue.

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

West Kalimantan Villages

None of the four villages in West Kalimantan (Meliau, Pulau Majang, Sekolat and Tengkidap) used leasing as a means of regulating access to their fisheries. Lotteries were used to determine who got first choice in placing a limited number of traps in the connecting channels during fish migrations. However, compared to the exclusive access to entire waterbodies granted through leasing, the benefits of winning such a lottery are relatively non-distortionary. All monitoring was therefore of households.

3 Problems with data collection

The data collection programme encountered significant difficulties. Due to considerable civil disturbance during the monitoring period, supervisory visits were curtailed and a number of the elements of the programme suffered.

Weekly household monitoring

Most of the weekly household monitoring data was collected as requested. The data from all the villages displayed occasional anomalies. When these occurred early in the programme, action was taken to ensure that corrections to procedure were made.

Table A5.5 Data collection problems, by village

Village	Problem / Comment
Arang Arang	Members of leaseholder groups omitted. Initially, it was assumed that they had not started fishing.
Danau Lamo	Data appears sensible
Meliau	Data appeared too static, with insufficient variation in the implicit value of catch per kilogram between either gears or seasons. This was explained by a contract with the local oil palm estates, which paid a fixed rate for fish. Village data included on the assumption that this explanation was correct.
P. Majang	Data correlates well with that of Tengkidap. Apparent anomalies have plausible explanations. No data for a number of weeks.
Sekolat	Enumerator changed during course of monitoring. Subsequent errors in data recording, when spotted, were difficult to rectify quickly because of remoteness and civil unrest. Data set unusable and village discarded.
Tengkidap	See comment on P.Majang.
Lebak Nilang	No significant problems.
Pedamaran	Monitoring of individual fishers operating in leasehold areas was successful. Leaseholder gear costs missing. Catches on group gears uncertain.

The cost survey collected information on the small household gears but was less successful in providing the detailed narrative description and quantity estimates needed to cost the large leaseholder gears. This caused problems in arriving at estimates of economic surplus in Pedamaran and Lebak Nilang. It caused less of a problem for Danau Lamo, where leaseholders used nets rather than hard structures to block off the channels they fished.

4 Results

The questionnaires used for the SEMP are to be found in Annex 1. For both the weekly household monitoring surveys and self-monitoring forms used by the leaseholders, every attempt was made to keep the information gathered to a minimum and for questions to be simple and easy for the respondents to relate to.

Estimation of key variables

Fisher days

For the leaseholder self-monitoring (LSM) the number of fisher days was taken to be the number of members in the team on the day the catch was recorded. The total fisher days in any given period was simply the sum of this value across the days the group was fishing.

For the weekly household monitoring (WHM), it was hoped to get a more precise estimate of actual fishing time by recording the hours fished and then translating this to a "standard" day. In part, this desire stemmed from the variation in the level of commitment to fishing which individual fishers were thought likely to display, i.e. an hour or two in the evening after working in the fields ranging to a 15 hour day attending nets or lines. It also reflected the greater precision that the interview format allowed - one respondent relating details of his activities on one day to one enumerator.

Of particular concern was the treatment of passive gears, since the objective was to record the human time absorbed by fishing activity rather than the hours the gear was in the water. However, despite extensive training, the question relating to hours fished was completed so unevenly that, for the analysis, a fisher day was taken to be the number of fishers active in the team[5] for the day for which catch was recorded.

Total fisher days for a week was calculated for the household from the estimate for the last day fished (i.e. the day for which details were recorded) multiplied by the number of harvests in the week. This figure was multiplied by the appropriate raising factor and summed across all households to arrive an estimate of the fisher days for the village.

Catch

For LSM the catch in kilograms was recorded directly for each day in which fishing took place. For WHM the weight of catch of other fish (i.e. non-ornamentals) was recorded for the last day fished. This was raised to weekly household and village estimates using identical procedures to those outlined in the last section for fisher days.

Economic surplus

For LSM, information was available on the value of the catch taken and the variable costs of the keeping the fishing group in operation (cigarettes, oil, rice, bread, coffee, vegetables, kerosene etc.). (Gear costs were not available, due to the cancellation of the relevant survey, as noted above.) The "surplus" calculated was thus a partial one.

For the WHM, the data was more complex and more complete. Total revenues from fishing was calculated as the value of the ornamental fish sold plus the value of "other

[5] In Jambi and South Sumatra, fishers completing the WHM predominantly fished alone. In West Kalimantan, fishing in pairs was a more common mode.

sales", plus the imputed value of catch retained for household consumption. This latter figure was the weight of fish consumed multiplied by the implicit value per kilogram of that which was sold by that household on that day. In the few cases where the household consumed but did not sell, the average value/kg was taken from sales by other households in the same village in the same week. In West Kalimantan, some households also sold cage cultured *toman* (a snakehead) that had been fed a sizable portion of catch taken. The value of these sales were added.

Gear costs were based on the results of a supplementary regional survey. The average purchase cost of each gear was divided by its life expectancy. This was then divided by the average number of days in which each type of gear was used in each region to arrive at a cost per day. Own labour costs (the opportunity cost of labour) were assumed to be Rp.5,000 per day, in line with the wages paid to fishing labourers[6].

Economic surplus per household per day was calculated as total revenue less the costs. This was raised to weekly and village values using the procedures described above.

[6] No opportunity costs of labour were assumed for the leaseholder groups, as all fishers had their living costs covered.

Village by village

Desa Arang Arang

The leaseholder activities described to the socio-economic team during the design phase were not recorded by the monitoring programme, as noted above. Thus the catches and incomes from both the group operations and the individual fishing activities of the members of the group are not included in the analysis.

There are four main gears: gill net (GN), hook and line (HL), lift nets (LN) and traps (TR). GN and HL are the most important overall, occupying the great majority of fisher days, though the former are used to a greater extent during the falling flood and the latter more within the rising flood. The situation in the dry season is clearly influenced by hydrology. In DS98, fishers using HL were very successful, taking a high catch and generating a high surplus. In the shorter dry season in 1999, the use of HL (while still the dominant gear), generated only moderate catches and a limited surplus. Despite having average catch rates per fisher day that differed little, the HL generated a significantly higher average surplus (Rp.4,300 per day compared to Rp.2,200). This reflects the selectivity of HL, which take higher value predator species, compared to the more indiscriminate GN.

Table A5.6 Effort, Catch and Returns to individual fishers in Arang Arang

	Season	GN	HL	LN	TR	Grand Total
Fisher days	D98	442	1,595	167	638	2,842
	RF98	638	1,675	384	508	3,205
	W	2,356	2,523	73	413	5,365
	FF	1,958	1,030	493	326	3,806
	DS99	464	138	210	109	921
	RF99	152		116	22	290
Catch (kg)	D98	1,457	5,909	323	2,095	9,784
	RF98	1,345	3,800	558	1,026	6,729
	W	4,670	4,347	283	856	10,155
	FF	4,322	2,319	1,472	630	8,744
	DS99	751	289	479	93	1,611
	RF99	613		410	87	1,109
Economic surplus (Rp.'000)	D98	2,731	17,348	1,392	3,143	24,613
	RF98	-246	2,552	1,308	-304	3,310
	W	2,881	4,040	273	1,316	8,510
	FF	6,526	5,284	2,917	1,013	15,741
	DS99	49	549	93	327	1,017
	RF99	984		896	193	2,073
Total fisher days		6,010	6,960	1,443	2,016	16,429
Total catch (kg)		13,158	16,663	3,524	4,786	38,131
Total surplus (Rp.000)[1]		12,925	29,772	6,878	5,688	55,263
Catch/fisher day (kg)		2.2	2.4	2.4	2.4	2.3
Surplus/fisher day (Rp.000)		2.2	4.3	4.8	2.8	3.4

Lift nets, which are located in considerable numbers along the main channel that links the river and the lake, show a different seasonal pattern, being relatively less active during the wet season and more active during the main migratory periods.

The significance of the omission of leaseholder fishing is impossible to quantify. The reports of leaseholder fishing obtained during the preparation for the monitoring survey, see Box A5.2 below, and the results from Danau Lamo below suggest that the catches of these groups and the level of economic surplus that they might have generated are probably important, particularly during the falling flood and the dry season, when fish can be concentrated more easily.

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.

Box A5.2 Leaseholder fishing operations in Arang Arang

The overall picture for those members of the village undertaking open-access fishing is that of modest catches and, on average, a moderate economic surplus being generated. Apart from gill nets and traps in the RF98, there is a positive economic surplus on all gears in all seasons and, overall, the surplus is on average around Rp.3,400 per fishing day. Overall fishing thus appears to be a modest contributor to livelihoods - providing, after gear costs, the equivalent of the wage obtained by fishing labourers plus 60%.

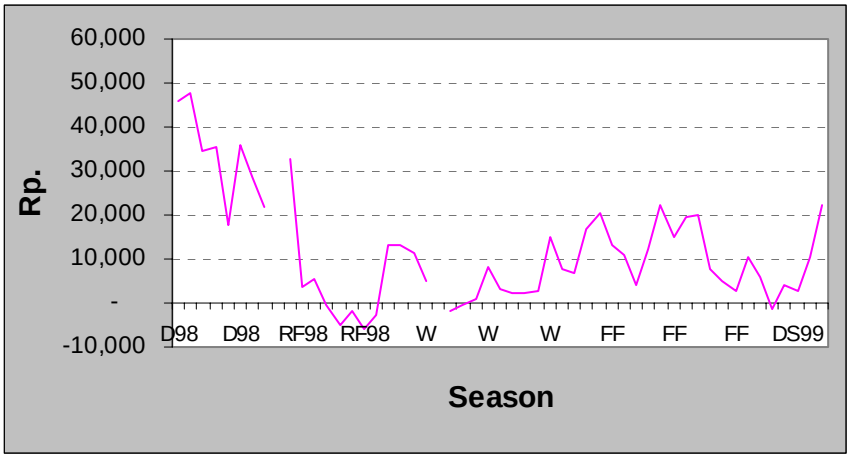

Figure A5.2 Average weekly net income for those fishing, Arang Arang

There are, however, important seasonal variations with average weekly surplus (for those fishing) higher during the dry season and the falling flood.

Danau Lamo

The four main gears used in Danau Lamo - gill net (GN), hook and line (HL), lift nets (LN) and traps (TR) - are the same as those used in Arang Arang. Their relative significance are, however, reversed. GN and HL are minor, with most of the effort being concentrated on LN and TR.

Table A5.7 Effort, Catch and Returns to individual fishers in Danau Lamo

	Season	GN	HL	LN	TR	Grand Total
Fisher days	D98		207	1,165	1,055	2,428
	RF98		360	581	738	1,679
	W	360	329	1,209	1,238	3,136
	FF	348	73	2,445	708	3,573
	DS99			713	37	749
	RF99			55	79	134
Catch (kg)	D98		644	7,152	3,791	11,587
	RF98		1,495	3,753	2,903	8,150
	W	1,696	1,915	10,676	4,574	18,861
	FF	1,577	244	30,845	2,675	35,340
	DS99			4,022	238	4,260
	RF99			168	927	1,095
Economic surplus (Rp.'000)	D98		2,008	19,417	7,638	29,063
	RF98		6,679	15,818	9,094	31,591
	W	5,442	8,395	35,051	24,402	73,289
	FF	6,752	1,163	143,229	17,386	168,530
	DS99			13,471	96	13,567
	RF99			293	715	1,008
Total fisher days		708	970	6,167	3,855	11,699
Total catch (kg)		3,273	4,297	56,615	15,108	79,293
Total surplus (Rp.000)[1]		12,193	18,247	227,278	59,331	317,048
Catch/fisher day (kg)		4.6	4.4	9.2	3.9	6.8
Surplus/fisher day (Rp.000)		17.2	18.8	36.9	15.4	27.1

The overall levels of catch and the economic surplus generated show a marked contrast to Arang Arang. Catch rates per fisher day are considerably higher (6.8 kg) and, combined with the higher average prices obtained in DL, this results in a considerably higher economic surplus. Thus the 4.4 kg/day on HL here generates an average surplus of Rp.18,000, compared to the Rp.4,300 generated by the 2.2 kg/day in the other village.

While the catch per day is broadly similar for GN, HL and TR, at around 4 kg, LN have an average catch that is more than twice this. This reflects the use of LN by leaseholders, who have control over the main channels connecting the river to the floodplain. During the falling flood these gears account for 20% of the fisher days expended, take 39% of the total catch and generate 45% of the total surplus. It should be noted that these figures aggregate both leaseholder and open access fishers, all of whom use LN during the year. The average catches of LN operating in the poorer open-access areas are more modest, ranging from 2-10 kg/fisher day, while those of leaseholders range from 20-52 kg/fisher day.

These results underline the important role that leaseholding can have in realising and directing the potential economic surplus available from the fishery. However, all fishers do well, with an economic surplus per fisher day more than three times the average

fishing wage on all gears used. This indicates that the fishery makes a significant contribution to livelihoods for all parties. The magnitude and seasonality of the average income flows generated by the fishery is illustrated below.

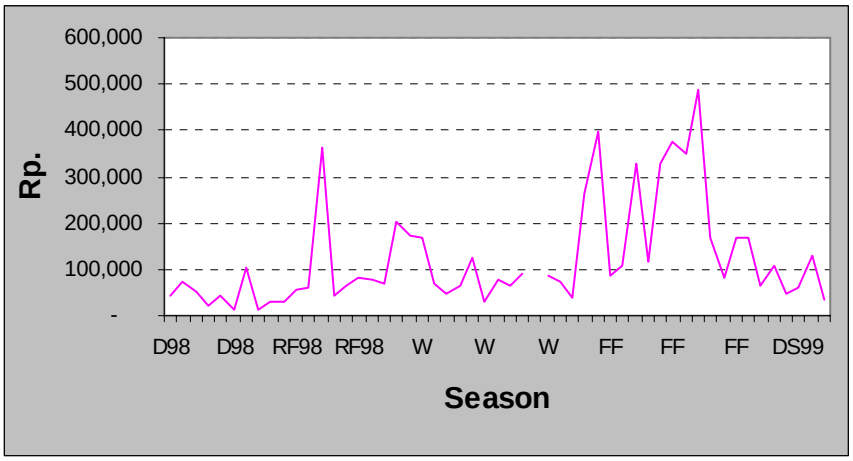

Figure A5.3 Average weekly net income for those fishing, Danau Lamo

The very high peaks in economic surplus generated during the falling flood will be noted, reflecting large leaseholder catches. But average incomes are generally high throughout the year.

Teluk Rasau

As noted above, 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.

Leaseholder groups

Catches taken by fishers from the leaseholders groups are shown below. These vary between waterbodies/leased units by gear and season. All the gears are group gears, except the *jaring* (gill net), which is used by fishers during slack periods. The most important is the *tuguk*, which took around half of the recorded catch.

Table A5.8 Catch by group fishers in Teluk Rasau (Pedamaran)

Waterbody	Season	Gear Used								Grand Total
		Jaring	Kilung	Krakat	Lulung	Ngesar	Ngesar Lulung	Ngesek	Tuguk	
Batanghari Illir	RF98		41							41
	W								316	316
	FF								2,301	2,301
	DS99								1,255	1,255
Lebung	D98	150				355				505
Kumpai	RF98	522						40		562
	W	702	141		160					1,003
	FF	37			528		641			1,206
	DS99			673	183	3,121				3,977
Pulau	D98	119								119
Benawo	RF98		166					212		378
	W	358								358
	FF	46	629		221					896
	DS99		333			220				553
Sungai Aur	D98								1,048	1,048
	RF98								314	314
	W								3,426	3,426
	FF								1,677	1,677
	DS99								403	403
Grand Total		1,934	1,310	673	1,092	3,696	641	252	10,740	20,338

The *tuguk* is a barrier across the main channel, with one or two 3-4m openings to allow the passage of boats. It is solidly constructed with 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.

Respondents interviewed during the preparation for the monitoring programme reported that the peak was between April and June, as fish move 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 were said to be common. Between these peaks, there are no migrational movements of fish and catches were reported to be very low (1kg/day). These patterns are consistent with previous studies on fisheries biology conducted by CRIFI in this system. The monitoring data collected corroborated this seasonal picture, with the peak periods of catch being March-May and in November, but the values recorded were nowhere near as high as those suggested above. During the earlier period, monthly average catches ranged from 24-31kg, in November they were 38kg. This divergence from well documented patterns suggests caution is needed in the interpretation of this data. Leaseholders, fearful of being seen to profit too highly, may have encouraged their fishers to underreport catches.

The *ngesar* is a sweeping operation using *kerakat* (seine nets) and *empang* (movable bamboo fence), when water levels permit. It can 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. There are usually one or two such operations each year. Catches from the first operation can reach 12t (Lubuk Lampam, 1994); 4t was reported to be common. Catches from the second are 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.

In the years it takes place, it happens in August and September. Monitoring, which started in September 1998, caught the tail end of this catch in 1998 only in Lebung Kumpai (LK). The late subsidence of the floods in 1999 was said to have reduced catches below normal expectations, with just over 3t taken in LK.

Another barrier gear taking a significant catch is the *kilung*. These can be set either on the main channels, like the *tuguk*, or on smaller connecting channels. *Empang* are used to direct 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 more gentle flows. The timing of its catches are therefore identical.

The detailed cost surveys for the group gears did not occur as planned. Omission of these costs clearly distorts any calculation of the economic surplus generated. This may be moderated, however, by the fact that most of the costs for the large barrier gears are labour costs and thus may be covered in the data already collected. The *tuguk* and the *empang* panels used both with it and a number of the other fishing methods are made largely from locally available materials (tree trunks, bamboos etc.), which must be gathered from the surrounding forests and assembled. Moreover, the larger barriers now in place last for several years, needing only replacement of different elements as they wear or decay. If these "investment" activities are carried out simultaneously with the fishing and by the same team, the mandays required will already have been factored into the calculations. The costs of nets are more important omissions - the *kerakat* (seine net) used in the *ngesar* cost over Rp.600,000 for a 100m section. The returns to different types of fishing operations are given in

Table A5.9.

Table A5.9 Gross revenue less variable costs, group gears in Teluk Rasau (Pedamaran)

Waterbody	Season	Gear Used								Grand Total
		Jaring	Kilung	Krakat	Lulung	Ngesar	Ngesar	Ngesek	Tuguk	
Batanghari Illir	RF98		52,900							52,900
	W								1,376,500	1,376,500
	FF								8,655,850	8,655,850
	DS99								2,287,550	2,287,550
Lebung	D98	352,500				737,500				1,090,000
Kumpai	RF98	1,179,000						105,000		1,284,000
	W	1,236,575	271,500		404,500					1,912,575
	FF	57,625			947,550		1,716,750			2,721,925
	DS99			1,584,700	324,250	6,857,500				8,766,450
Pulau	D98	219,000								219,000
Benawo	RF98		188,000					683,000		871,000
	W	740,325								740,325
	FF	107,450	1,179,400		467,800					1,754,650
	DS99		813,325			915,110				1,728,435
Sungai Aur	D98								2,279,300	2,279,300
	RF98								806,500	806,500
	W								11,783,500	11,783,500
	FF								5,616,400	5,616,400
	DS99								801,500	801,500
Grand Total		3,892,475	2,505,125	1,584,700	2,144,100	8,510,110	1,716,750	788,000	33,607,100	54,748,360

These estimates of total "surplus" are, in many ways, surprisingly low. As noted above, catches for the most important gears are lower than anticipated and, as a result, so too is the economic surplus generated. This is perhaps best illustrated in reference to the average difference between revenues and variable costs for each fisher day, which was only Rp.12,858 over the entire monitoring period. This is more than the amount generated by individual fishers using small gears in the same area, see below, but perhaps not by as large a margin as might be expected given the size and expense of the gears that they operate[7].

Individual fishers

The individual fishers licensed to operate in different leased sub-units use a variety of gears or gear combinations. Most of their effort is concentrated on passive gears that can be used in the often dense, swamp vegetation on the edges of the main channel and its surrounding floodplain, though some use is made of cast nets in the dry season.

[7] Indeed once the payments for access are made (licence fees from the individual fishers to the leaseholders and lease fees from leaseholders to the government), net returns for individual fishers are significantly higher than for group fishers, see Table A5.20 below.

Table A5.10 Effort, Catch and Returns to individual fishers in Teluk Rasau

	Season	CN	GN	HL	HL&TR	TR	Grand Total
Fisher days	D98		242	68	157	274	740
	RF98		323	42	156	220	741
	W		1,146	625	977	783	3,531
	FF		55	49	1,377	2,034	3,515
	D99	21	12	122	492	234	881
Catch (Kg)	D98		1,577	333	2,515	2,248	6,673
	RF98		3,516	190	1,785	2,098	7,590
	W		7,809	2,934	11,312	5,898	27,953
	FF		345	233	13,989	17,314	31,880
	D99	420	93	713	4,077	2,354	7,657
Economic Surplus	D98		984	281	2,908	2,146	6,319
(Rp.'000)	RF98		2,634	374	2,127	2,295	7,431
	W		5,395	4,927	10,907	4,170	25,399
	FF		290	318	12,636	9,988	23,232
	D99	566	172	996	3,596	1,716	7,046
Total fisher days		21	1,778	905	3,159	3,545	9,409
Total catch (Kg)		420	13,340	4,404	33,678	29,913	81,754
Total surplus (Rp.'000)		566	9,475	6,896	32,175	20,316	69,427
Catch/fisher day (kg)		20.0	7.5	4.9	10.7	8.4	8.7
Surplus/fisher day		26.9	5.3	7.6	10.2	5.7	7.4

The relative significance of different gears varies between seasons, with gill nets of greater prominence in the rising flood and wet season and hooks and traps more important in the falling flood and dry season. Overall, catch rates are high (8.7 kg/fisher day), as is the economic surplus generated (Rp.7,400). Slightly lower catch rates for hooks and lines do, however, translate into higher surpluses, due to the higher unit value of the species caught.

Clearly, fishing on an individual basis in Teluk Rasau provides a good income (more than twice the wage for fishing labour). The need to spend long periods away from the homestead, due to the remoteness of the location, does, however, mean that it is an activity that largely precludes the fisher himself from other income generating activities.

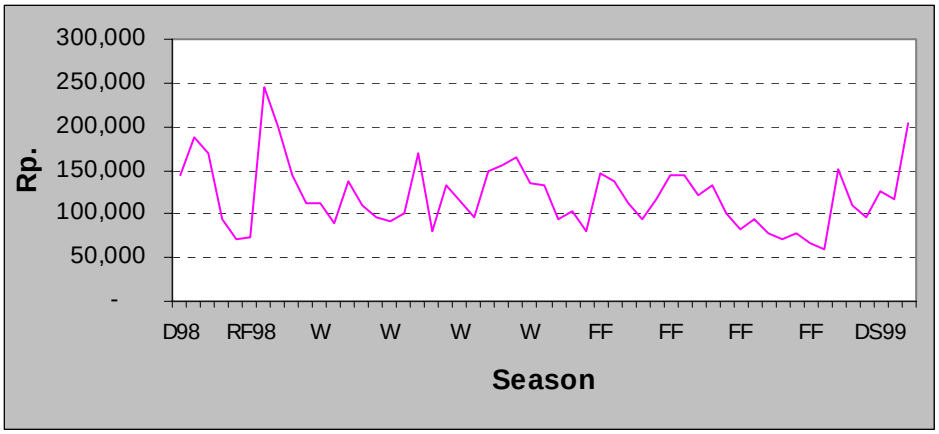

Figure A5.4 Average weekly net income for individuals fishing, Teluk Rasau

Lebak Nilang

Group fishers at Lebak Nilang operated two gears, the *kilung*, a moderate to large sized barrier trap (described above on page 17) and *jaring* (gill nets), which can be operated individually. Catches were largely concentrated in the dry season and the wet season but catch rates were highest in the DS and the rising flood.

Table A5.11 Returns to group gears, Lebak Nilang

			Gear Used		
Waterbody	Season	Data	Jaring	Kilung	Grand Total
LN	D98	Fisher days	4	56	60
		Catch (kg)	58	632	690
		Net income	86,200	1,466,000	1,552,200
	RF98	Fisher days		32	32
		Catch (kg)		251	251
		Net income		603,000	603,000
	W	Fisher days		164	164
		Catch (kg)		943	943
		Net income		2,244,000	2,244,000
	FF	Fisher days		96	96
		Catch (kg)		332	332
		Net income		767,000	767,000

Given that *kilung* are designed to intercept fish as they move, the low catch rates in the falling flood (3.5 kg/fisher day) are a source of concern, suggesting that either the seasonal classification was inappropriate or that there might have been some problem in data collection.

Individual fishers

Fishers operating on the lake and in the lake margins relied largely on passive gears (GN and HL), though cast nets were used effectively in the dry season. Average catch rates were low compared to other areas, at 2.3 kg/fisher day, as was the average economic surplus generated.

Table A5.12 Effort, Catch and Returns to individual fishers in Lebak Nilang

	Season	CN	GN	HL	HL&GN	Grand Total
Fisher days	D98	116	228	1,097	413	1,854
	RF98	72	136	683		891
	W	52	888	2,527		3,467
	FF		472	1,203		1,675
	D99		136	293		429
Catch (Kg)	D98	131	865	2,138	1,609	4,743
	RF98	72	414	2,041		2,527
	W	27	3,544	4,619		8,190
	FF		1,426	1,818		3,244
	D99		336	417		753
Economic Surplus (Rp.'000)	D98	325	142	1,035	538	2,040
	RF98	56	119	1,476	-	1,651
	W	69	1,247	2,253	-	3,569
	FF	-	406	422	-	827
	D99	-	61	103	-	164
Total fisher days		240	1,860	5,803	413	8,317
Total catch (Kg)		230	6,584	11,033	1,609	19,456
Total surplus (Rp.'000)		449	1,975	5,289	538	8,251
Catch/fisher day (kg)		1.0	3.5	1.9	3.9	2.3
Surplus/fisher day		1.9	1.1	0.9	1.3	1.0

This surplus varied from gear to gear but was only just positive on average, providing fishers with little more than the minimum wage for fishing labourers.

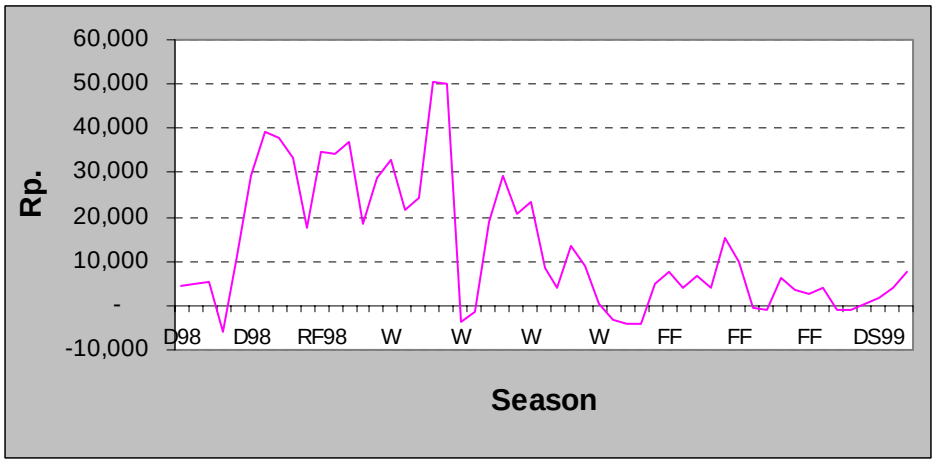

Figure A5.5 Average weekly net income for individuals fishing, Lebak Nilang

The seasonal variations in the surplus generated can be seen in the Figure above, indicating a higher level in the rising flood and the earlier part of the wet season, with declines in the falling flood and dry season.

Meliau

The catches and returns to the West Kalimantan village of Meliau provides a striking contrast to the picture at Lebak Nilang. A variety of gears are used, though HL and GN take the majority of the catch. Catches are extremely high at around 10.8 kg/fisher day.

Table A5.13 Effort, Catch and Returns to individual fishers in Meliau

	Season	CN	GN	HL	HL&GN	LN	PS1	TR	TR2	Grand Total
Fisher days	W		521	511	588		7			1,627
	FF	38	154	727	420	29	43	67		1,478
	DS99	89	137	298	173			72	5	773
	RF99	43	77	89	125		17	17		367
Catch (kg)	W		6,353	5,892	5,608		86			17,939
	FF	528	1,802	7,164	4,735	538	631	661		16,060
	DS99	1,008	1,649	3,061	1,930			587	19	8,254
	RF99	605	606	644	1,500		144	125		3,624
Economic	W		20,201	20,593	16,844		306			57,944
surplus (Rp.'000)	FF		6,772	28,274	16,408	2,252	2,302	1,814		57,823
	DS99		6,780	13,381	6,826			1,329	3	28,320
	RF99		2,107	2,376	5,789		628	257		11,156
Total fisher days		170	888	1,625	1,306	29	67	156	5	4,246
Total catch (kg)		2,141	10,410	16,762	13,772	538	862	1,373	19	45,876
Total surplus (Rp.000)			35,859	64,625	45,867	2,252	3,235	3,400	3	155,242
Catch/fisher day (kg)		12.6	11.7	10.3	10.5	18.7	12.8	8.8	4.0	10.8
Surplus/fisher day (Rp.000)		No sale	40	40	35	78	48	22	1	37

Despite the remote location of the village, good prices were obtained for the fish caught, due to a contract with the local oil palm estate (see comments in Table A5.5). As a result, high catches were translated into very high levels of economic surplus per fisher day. This contract must have allowed them to generate significant additional financial benefits from this highly productive fishery, allowing them to generate good cash income with a relatively modest input of effort (the hours spent fishing per day were lower in Meliau than any other village surveyed).

The preparatory surveys for the SEMP indicated that fishing was only a secondary activity for households in Meliau, with cultivation the major use of their time. Interviews suggested that their forest fallow period had been reduced by the greater population pressure and competition for land from other activities (such as the oil palm estate itself). This would normally have placed the village on a downward spiral of declining agricultural yields. In these circumstances, the opportunity to generate additional cash from the fishery may be an important compensating mechanism. As long as excess pressure is not placed on fish stocks (and they are not too damaged by environmental change), livelihood strategies within the village can be adjusted beneficially. Additional fishing income can support increased purchases of rice, reducing the need to shorten further the forest fallow period.

Pulau Majang

Fishing in this village was more heavily dependent on an active gear (cast net), than any other. Nevertheless, GN and HL dominated, with the latter being more important during the wet season and the former being the principal gear in other seasons.

Table A5.14 Effort, Catch and Returns to individual fishers in Pulau Majang

	Season	CN	GN	HL	HL&GN	TR	TR2	Grand Total
Fisher days	W	589	1,219	5,404	930	83		8,225
	FF	103	5,518	4,650			382	10,654
	DS99	186	4,898	930				6,014
	RF99	1,612	1,488			124		3,224
Catch (kg)	W	5,063	5,453	29,582	3,302	31		43,431
	FF	723	39,313	21,344				61,380
	DS99	1,860	43,224	4,464				49,548
	RF99	21,266	17,391			4,650		43,307
Economic surplus (Rp.'000)	W	16,420	2,407	110,684	-353	-586		128,572
	FF	330	30,263	58,823			181	89,597
	DS99	300	15,170	6,048				21,518
	RF99	-5,553	-3,777			820		-8,510
Total fisher days		2,490	13,123	10,984	930	207	382	28,117
Total catch (kg)		28,913	105,382	55,389	3,302	4,681		197,666
Total surplus (Rp.000)		11,497	44,062	175,555	-353	234	181	231,176
Catch/fisher day (kg)		11.6	8.0	5.0	3.6	22.7	-[1]	7.0
Surplus/fisher day (Rp.000)		4.6	3.4	16.0	-0.4	1.1	0.5	8.2

[1] Ornamental fish

Catches on GN were on average higher (8 kg/ fisher day) than HL (5 kg). Despite this difference, the economic surplus generated by hook and line fishing was higher, due to a considerable differential (by a factor of two) between these gears in the unit value of catch landed. The combination of HL & GN was reported less often than elsewhere but had low catch rates and economic surplus. It is not clear why. Also unexpected was the relatively high usage during the rising flood of the cast net, which is more commonly preferred during the calmer and clearer conditions in the dry season.

The negative economic surplus in the rising flood will be noted for both the CN and GN, despite very high catch rates. This reflects very low unit values, possibly as a result of oversupply. The combination of high catch rates with low economic surplus for traps will also be noted. This is a direct function of the low unit value of catch and probably reflects the market value of the species which these gears target (the average unit value of catch was much higher for other gears operating in the same period).

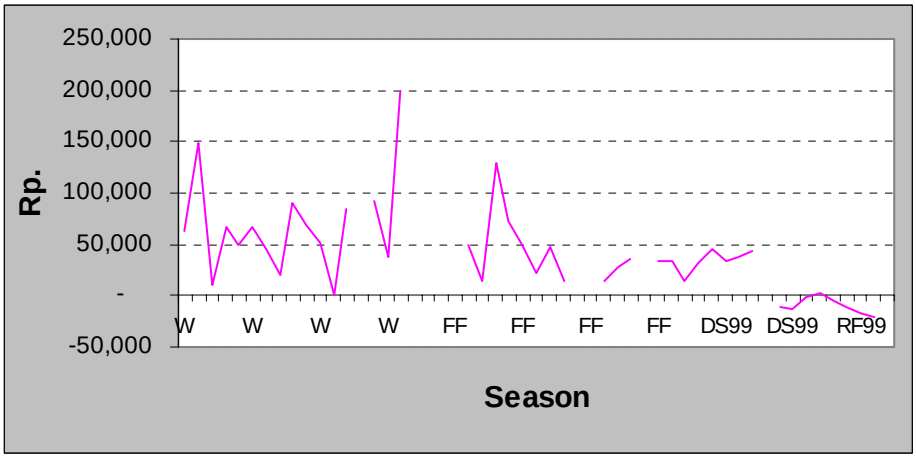

Figure A5.6 Average weekly net income for those fishing, Pulau Majang

The contribution of the fishery to livelihoods can be seen in the Figure above. The series is somewhat erratic, oscillating around Rp.50,000 per week during the wet season and the falling flood before dipping into the negative during the dry season, due to poor prices obtained for catch.

Tengkidap

This settlement is, in some ways, more similar to the fishing camps established by fishers in Pedamaran, than the other more permanent villages. The main household of many fishers is elsewhere and they come from there to fish.

Gill nets and hooks are the predominant gears, occupying the majority of fisher days, taking most of the catch and generating the bulk of the economic surplus. As in the other villages, catch rates were higher for GN but the economic surplus generated was higher for HL. However for none of the gears were the returns even close to that of Meliau.

Table A5.15 Effort, Catch and Returns to individual fishers in Tengkidap

	Season	BR	CN	GN	HL	PS1	TR	TR2	Grand Total
Fisher days	W	191	317	3,065	1,555	167			5,295
	FF			4,966	906		53	15	5,940
	DS99			3,177	132			346	3,655
	RF99			516	141		1,367		2,024
Catch (kg)	W	1,687	2,534	13,951	8,117	915			27,204
	FF			30,325	4,330		1,276	44	35,974
	DS99			21,205	625				21,830
	RF99			4,459	1,320		19,228		35,974
Economic	W	1,809	1,411	5,694	17,899	1,916			28,728
surplus (Rp.'000)	FF			20,444	12,450		1,286	339	34,519
	DS99			16,630	1,589			5,462	23,681
	RF99			-428	566		3,077		3,216
Total fisher days		191	317	11,725	2,734	167	1,420	361	16,914
Total catch (kg)		1,687	2,534	69,939	14,391	915	20,504	44	110,015
Total surplus (Rp.000)		1,809	1,411	42,340	32,504	1,916	4,364	5,801	90,144
Catch/fisher day (kg)		8.8	8.0	6.0	5.3	5.5	14.4	0.1	6.5
Surplus/fisher day (Rp.000)		9.5	4.5	3.6	11.9	11.5	3.1	16.1	5.3

The highest rates of return were obtained were on *tabung* (TR2), a small bamboo trap used to capture ornamental fish. The lack of a recorded catch for this gear in the DS will be noted, as will the high economic surplus relative to the average catch. This is because the number, rather than the weight, of ornamentals caught was recorded, as specimens are small . So only when there was an incidental catch of other species was a catch rate given.

The contribution to livelihoods can be seen from the average weekly net income for those fishing in the Figure above. The series is, like that of P.Majang, erratic in comparison with some of the other villages. Significant flows of income occur in some weeks, while in others earnings are little more or even below the wage received by fishing labour. As in P.Majang, the importance of markets to livelihoods can be seen at the end of DS/beginning of RF, when high catches are translated into poor and even negative economic surplus by low average prices.

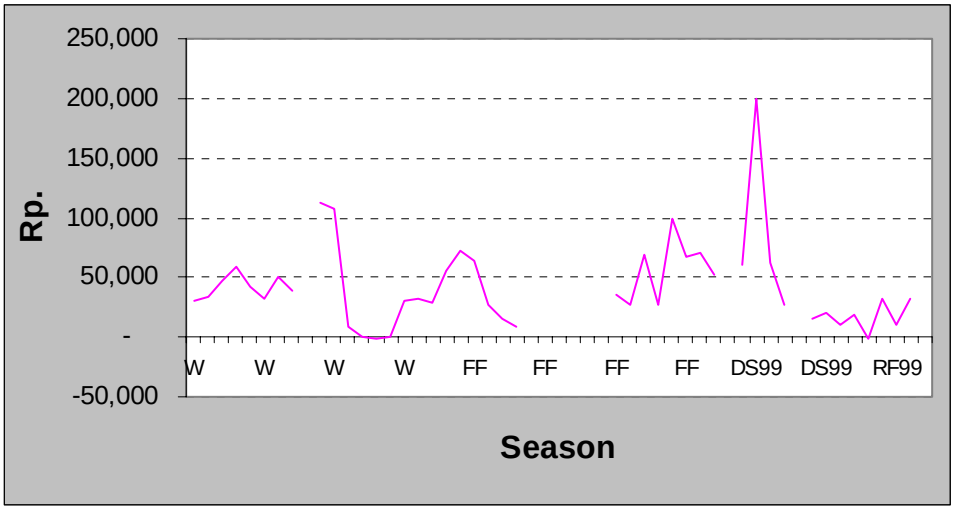

Figure A5.7 Average weekly net income for those fishing, Tengkidap

Inter-village comparisons

On floodplains reliable estimates of catch are hard to obtain in themselves. Where these are available, it is frequently assumed that these are a good proxy for the economic value of the fishery and that the benefits that are generated will accrue to poor fishers.

This section puts these assumptions to the test. It starts with a discussion of the levels of fishing effort, with which other variables are normalised to allow meaningful comparison, before moving on to catches, economic surplus and its distribution.

Levels of fishing effort

As the sample was stratified for the South Sumatra and Jambi villages, the results had to be calculated for each village and then normalised in relation to number of fishing days, fishing households, or area fished to allow comparisons. The numbers of households fishing and the flooded area of each village were known. The number of fishing days are given below.

Table A5.16 Effort levels (fishing days)

Desa	D98	RF98	W	FF	DS99	RF99	Total	Days/HH.	Days/Ha.
Arang-Arang	2,842	3,205	5,365	3,806	921	290	16,429	166	110
Danau Lamo	2,428	1,679	3,136	3,573	749	134	11,699	152	117
Meliau	-	-	1,627	1,478	773	367	4,246	118	15
P. Majang	-	-	8,225	10,654	6,014	3,224	28,117	181	5
Tengkidap	-	-	5,295	5,940	3,655	2,024	16,914	384	25
Lebak Nilang	1,914	923	3,631	1,771	429	-	8,669	155	58
Pedamaran	1,019	1,171	4,744	4,820	1,912	-	13,667	291	16

The distribution is ordered, in the first instance, by season, as defined by the water level measurements, see BMP. These seasons were of variable timing and length relative to the survey period, the wet season (high flood) having already started in West Kalimantan before the waters in South Sumatra and Jambi had even started to rise.

It will be noted that the relative intensity of fishing, relative to both the number of fishing households and the area flooded varied significantly between villages. Days per household are particularly high for Tengkidap and Pedamaran, the two temporary fishing villages/camps. In both fishers are there simply to fish, many being away from their main homesteads, where their wives and families remained. The very high total for Tengkidap reflected the practice of members of the same team to share accommodation within the village. With fewer alternative livelihood activities to distract them, they fished almost continuously while on site. Meliau, a Dayak village in which fishing was a supplementary activity designed to meet household cash needs, had the lowest intensity. Days fished relative to flooded area shows a clear low intensities in the more deeply flooded areas, West Kalimantan and Pedamaran, with significantly higher intensities in the Jambi villages.

Catches

Average catch rates, in kilograms per fishing day, by season are given below. In principal, these should provide the closest point of comparison with the results of the BMP and would be the factor affected most directly by a functioning reserve. Any comparison must be qualified by the differences between villages in the combinations of gears used and in the hours fished per gear per fishing day.

The significant differences between villages will be noted. For the villages common to both surveys, the results are broadly similar, though catch rates per fishing day in Tengkidap are lower than those in P.Majang. This reflects the longer days fished in the latter village (average of 6.6 compared to 5.3 hours/fishing day). Measured in catch rates per person hour, catches in Tengkidap are higher[8]. In both villages catches peaked sharply in the rising flood (RF99), probably reflecting the influx of whitefish into the system. The deviation of Meliau from the seasonal pattern apparent in the two other W.Kalimantan villages remains unexplained.

Table A5.17 Catch rates per season (Kg/fishing day)

Desa	D98	RF98	W	FF	DS99	RF99	Total	Kg./HH.	Kg./Ha.
Arang-Arang	3.4	2.1	1.9	2.3	1.7	3.8	2.3	385	254
Danau Lamo	4.8	4.9	6.0	9.9	5.7	8.2	6.8	1,030	793
Meliau			11.0	10.9	10.7	9.9	10.8	1,274	161
P. Majang			5.3	5.8	8.2	13.4	7.0	1,275	38
Tengkidap			5.1	6.1	6.0	12.4	6.5	2,500	159
Lebak Nilang	2.8	3.0	2.5	2.0	1.8		2.5	387	144
Pedamaran	8.2	7.6	7.0	7.9	7.2		7.5	2,172	122

Catch rates are low in Arang Arang and Lebak Nilang. In the case of the former, the omission of leaseholder fishing was clearly a major contributory factor - in Danau Lamo, the other Jambi village, catches per day of those fishing in open access areas were a seventh of their local leaseholders (but still more than twice those in Arang Arang). In Lebak Nilang catch rates were poor for all fishers, possibly reflecting the fishery impact of the conversion of much of the surrounding swamp forest into an oil palm estate.

[8] Catch per fishing hour was not used as the primary index because of differences between Provinces in the way fishing hours appear to have been calculated.

Catch rates per household are determined by these catch rates and the overall levels of effort, significantly raising the relative position of Pedamaran and Tengkidap. The overall level of production, relative to flooded area, is substantially lower in P.Majang than elsewhere. It is by far the highest in Danau Lamo. In part, this is likely to be a reflection of the stocking programme that was undertaken by the Department of Fisheries to coincide with the establishment of the reserve, combined with the high level of effort per unit area. This latter factor explains the relatively high areal productivity in Arang Arang.

Economic surplus

There are a number of variables that feature in the transformation of catch rates into rates of economic surplus (ES). Total revenue (TR) is a function of the catch taken and the local price of fish per kilogram at the time of sale, while total costs (TC) must reflect the average costs of the gear used and the opportunity costs of labour[9]. The economic surplus rate (i.e. ES divided by any of the variables used to allow inter-village comparisons – fishing days, number of households or flooded area) is thus a function of catch rate and any of these additional variables. The most important of these is the price of fish.

Table A5.18 Average value of fish sold (Rp./kg)

Desa	D98	RF98	W	FF	DS99	RF99	Total
Arang-Arang	4,755	4,011	4,586	3,467	1,964	2,677	3,965
Danau Lamo	3,899	4,801	5,625	5,663	4,817	3,100	5,083
Meliau	-	-	3,992	4,777	4,987	5,000	4,552
P. Majang	-	-	3,718	3,097	1,658	821	2,736
Tengkidap	-	-	2,624	2,482	1,913	834	2,274
Lebak Nilang	4,888	5,296	5,775	5,312	5,192	-	5,399
Pedamaran	3,439	3,927	3,942	2,995	3,889	-	3,547

The price obtained for fish sold was calculated from catch weights and total sales values. This imputed price varied significantly between villages: the annual average in Tengkidap is less than half that of Lebak Nilang, while seasonal differences are even greater. Differences between villages can be seen as a function of access to markets. Villages obtaining high prices were Meliau, which had a contract with the local oil palm estate, and the villages in Jambi and South Sumatra, the more densely populated Provinces. Differences between seasons are largely explicable by relative catch rates. Thus the glut of fish in RF99 in Tengkidap and P.Majang (catch rates 13-14kg/fishing day) resulted in exceptionally low prices.

Where high catch rates coincide with high prices (Danau Lamo, Meliau and Pedamaran) total revenue is also high. The other villages all had either low catch rates or low prices. Deducting costs, which were largely similar per fishing day, from these totals resulted in the patterns of economic surplus given below. It will be noted that the relative variance between the villages is substantially higher for all rates of ES than for the corresponding rates for catch.

[9] Lease or license fees are strictly *transfer payments* and so are not deducted from the economic surplus at this stage. Opportunity cost of labour was taken to be the wage paid to fishing labourers in Pedamaran – this may have exaggerated the costs for the, more remote, West Kalimantan sites.

Table A5.19 Rates of Economic Surplus (Rp/fishing day)

Desa	D98	RF98	W	FF	DS99	RF99	Total	*Rp./HH.*	*Rp./Ha.*
Arang-Arang	8,660	1,033	1,586	4,136	1,105	7,148	3,364	558,217	368,423
Danau Lamo	11,970	18,818	23,368	47,168	18,111	7,510	27,100	4,117,506	3,170,480
Meliau	-	-	35,609	39,112	36,646	30,381	36,565	4,312,273	544,708
P. Majang	-	-	15,631	8,410	3,578	-2,640	8,222	1,491,459	44,034
Tengkidap	-	-	5,426	5,811	4,985	1,589	5,007	1,924,582	122,727
Lebak Nilang	4,526	6,739	4,136	2,142	1,366	-	3,955	612,232	228,567
Pedamaran	21,022	21,383	17,874	16,367	17,310	-	17,799	5,175,592	289,587

The average contribution of fishing to livelihoods measured by total economic surplus per household is greatest for fishermen in Pedamaran (Rp.5.1m/year), though this was achieved by high levels of effort. Its daily rate of contribution is highest, however, for Meliau (Rp. 36,565/ fishing day). Danau Lamo produced the highest ES per hectare flooded. It will also be noted that high catches and high economic surplus do not always go together, with P.Majang getting a negative surplus during its period of highest catch.

Distribution of benefits

From a policy perspective, the distribution of the economic surplus is as important as its magnitude. A number of factors can play a role in this, including fishing skill, ownership of particular gears and the amount of time devoted to fishing. All of these effectively lie beyond policy/social influence. In contrast, the different mechanisms to allocate fishing rights to the more valuable waterbodies/fishing opportunities has the potential to affect distribution and is socially determined.

In West Kalimantan, lotteries were used to determine who positioned their traps first. Limited in both the period and the areal extent of control and with all fishing households having the same chance of success, this mechanism is unlikely to affect outcomes significantly. Thus the per household economic surplus given in Table A5.19 above is a true index of the benefits generated by the fishery.

In South Sumatra and Jambi the use of leases, on the other hand, was expected to have an important influence on distribution, making such averages potentially misleading. The Table below provides a breakdown of catches, revenues and returns to different types of fishing operations in the three villages where data on leased units was collected. The data for Pedamaran is subdivided by leased unit/sub-unit.

Table A5.20 Total Economic Surplus and its Distribution in South Sumatra and Jambi

		South Sumatra										Jambi	
		Lebak Nilang		Pedamaran									
				Sungai Aur				Laut Sekampung		Pulau Benawo		Danau Lamo	
				Lebung Sungai Aur		Lebung Kumpai		B'hari Illir	Lebak			Lesees	Free
		Group	Individ.	Group	Individ.	Group	Individ.	Group	Individ.	Group	Individ.		
Fishers	No.	4	52	6	1	3	8	5	14	3	7	6	67
Total catch	kg	2,216	19,456	6,869	1,747	7,253	22,200	3,913	40,709	2,304	17,097	16,219	63,075
Revenue	Rp. m	7.2	84.4	29.8	10.3	19.3	74.1	15.2	120.8	7.1	53.2	102.8	290.2
Fishing costs												0.0	0.0
Gear costs[2]	Rp. m		11.2		1.1		5.1		7.3		4.8	0.3	11.2
Operating costs[3]	Rp. m	1.8		8.5	0.0	2.8	0.0	2.8	0.0	1.8	0.0	0.0	0.0
Wages (labourers)	Rp. m	0.2		0.0		0.7		0.0		0.0		0.0	0.0
Labour costs (imputed)	Rp. m		44.3		1.8		13.5		24.3		12.0	2.5	61.8
Fishing Surplus/Deficit	Rp. m	5.2	28.9	21.3	7.5	15.8	55.4	12.4	89.2	5.3	36.4	100.0	217.1
License payment	Rp. m	0.0	[4]	0.0	0.3	0.0	3.2	0.0	5.6	[1]	1.4	0.0	0.0
License income	Rp. m	0.0	0.0	0.3	0.0	3.2	0.0	5.6	0.0	1.4	0.0	0.0	0.0
Lease payment	Rp. m	0.0	0.0	4.0	0.0	13.0	0.0	4.0	0.0	2.6	0.0	2.6	0.0
Net Income	Rp. m	5.2	24.9	17.6	7.2	6.0	52.2	14.0	83.6	4.1	35.0	97.4	217.1
Catch per fisher	kg	368	374	734	1,747	2,200	2,775	446	2,908	618	2,442	2,703	941
Per Capita Surplus	Rp. m	1.3	0.5	2.9	7.2	2.0	6.5	2.8	6.0	1.4	5.0	16.2	3.2
Total Surplus Distribution													
Individual fishers	Rp. m	24.9		7.2		52.2		83.6		35.0		217.1	
Group fishers/Leaseholder	Rp. m	5.2		17.6		6.0		14.0		4.1		97.7	
Cummunity/government	Rp. m	[4]		4.0		13.0		4.0		2.6		2.6	
Revenue as % Total Value		[4]		10.0%		13.9%		2.9%		4.3%		0.7%	
Revenue as % Total Surplus		[4]		16.1%		22.3%		4.1%		6.7%		0.8%	

[1] Information on leaseholders in Arang-Arang not collected

[2] Gear costs only available for individual fishers

[3] Operatonal costs, including cigarettes, food, parafin

[4] Status of revenue payments uncertain for Lebak Nilang

These results are subject to some important qualifications. First, there is no data on the benefits of illegal fishing. Second, the fishing season in Pedamaran was known to be a poor one for leaseholders, due to extended flooding[10]. Third, and most importantly from a methodological perspective, the absence of detailed cost information on the large leaseholder gears undermines the value of the estimates of economic surplus for leaseholder groups in South Sumatra.

In Lebak Nilang group fishers working on behalf of the leaseholder took only 8% of the catch but, due to the higher catch rates, took 15% of the economic surplus. Similar per capita catches were translated into per capita economic surplus that was over twice as high.

In the leased units in Pedamaran the situation was rather different. Group fishers operating the large static gears and using the highly orchestrated fish drives had per capita catch rates that were exceeded by the individuals licensed to operate within the same area using small mobile gears. After access payments, per capita economic surplus was substantially lower for the former. In Danau Lamo, results were more in line with expectations, with leaseholders generating a per capita surplus of Rp 16.2m from an average catch of 2,703 kg. This was thanks to the very high catch rates taken when the connecting channels to the floodplain were blocked during the drawdown.

The revenues generated for local or provincial government by leasing was significantly higher in Pedamaran than in Danau Lamo, whether this is measured against total value of catch or total economic surplus generated.

[10] Catches on the gears that would have been less affected by flood timing were also considerably lower than expected from reports in more informal interviews. This raised the suspicion that underreporting may have taken place, perhaps due to the sensitivity of the issue.

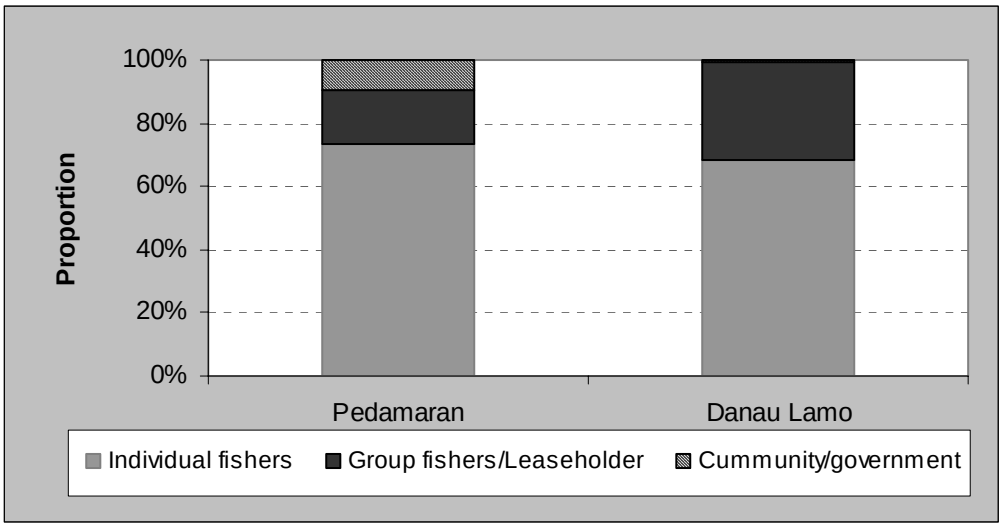

Figure A5.8 Distribution of surplus in systems using leasing

The proportionate distribution of surplus is shown above. In Danau Lamo, where auctions are restricted to village members, the revenue is nominal and so small relative to the overall surplus (0.8%) that it is not visible on the graph. Leaseholders appear to be the principal beneficiaries of this system.

In Pedamaran a smaller proportion of catch and surplus accrued to leaseholders and government revenues were proportionately higher. Whether these figures provide an adequate reflection of the true flows within this system must remain an open question.

5 Conclusions

The results of this analysis underline a number of important methodological points for those with an interest in floodplain fisheries, whether as researchers or managers.

1) Floodplain fisheries systems are highly complex and outcomes can be affected by a variety of different factors that are often very local in their character.

Researchers on the floodplain must endeavour to take the interactions of these factors into account. This makes reliable broad scale investigations difficult to accomplish without a significant investment of time and energy: crude replications at too high a level of abstraction are likely to suffer from high noise:signal ratios and lead to heightened confusion rather than understanding. For socio-economic variables in particular, open-ended dialogue with key respondents will often generate more useful information than remotely interpreted formal questionnaires.

Managers must accept that they will rarely have as detailed a picture as they need to identify what an appropriate management strategy might be, particularly for fisheries where local stocks dominate. The inclusion of those with the greatest local knowledge - the fishers - is therefore essential. Co-management should be looked to as the best means to achieve this.

2) Outcomes are not necessarily correlated. In particular high catches do not necessarily result in a high economic surplus; this influences the nature of their contribution to local livelihoods.

Researchers must recognise that catch measurements are not a reliable proxy for socio-economic outcomes. High catches per fisher may be a necessary condition for positive economic outcomes but they are not sufficient. Market opportunities/systems are critical to the value generated.

Managing the fishery to encourage high catches may be of little benefit if these accrue during periods when there is already oversupply. Access systems/fishing arrangements should reflect this.

3) Access control can be a powerful influence on the gears that are used and the outcomes that result.

When structuring research, the role of access controls in determining the types and levels of effort in different seasons must be factored in if inappropriate pooling of data is to be avoided. Where the most valuable areas are leased, these can be used as a basis for stratifying the analysis. This will also help in evaluating distributional issues. Though problems can arise, if leaseholders are reluctant to divulge information that is of potential value to their competitors at future auctions or that might prompt changes in the system from which they benefit.

Of all the factors affecting outcomes, access arrangements is the one that is most often open to influence by managers. Options should be systematically reviewed and evaluated to ensure that the system used is, in fact, the one most likely to generate the

outcomes preferred. The use of gear placement lotteries, as in West Kalimanatan, certainly appeals in terms of equalising the expected benefits from the fishery, which is desirable from a social perspective and may also serve to encourage adherence and support for local management rules.

But which allocation system is most appropriate must be a local decision. First, because it is the ecological and hydrological features of the local system that, together with comparative advantage of different gear technologies, will determine the trade-offs involved. Second, because the relative need for economic surplus, government revenue or improved equity is a value judgement and should reflect the preferences of those most affected.

4) The highest catch rates per fisher tend to be where the resource is relatively lightly exploited, where there is a reserve or where there is stocking (or some combination of these).

For managers this clearly underlines the importance of supporting the stock when fishing pressure is mounting or is anticipated. Devolving spatial control can assist with this, as in Pedamaran. Alternatively, stocking can be considered.