

# **AN INTEGRATED ASSESSMENT OF INDONESIAN RIVER FISHERY RESERVES. PART 1. INTRODUCTION AND STUDY DESIGN.**

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## **ABSTRACT**

This paper (Part 1 of 4) introduces a series of studies undertaken in three Indonesian provinces – Jambi, South Sumatra and West Kalimantan – to identify ecological, social and institutional criteria for the selection and beneficial use of 'harvest reserves' in tropical river fisheries, and to develop guidelines for their management. In this DFID-funded project, investigations included initial reviews of reserves in the three provinces, 13-14 month monitoring programmes of both biological and socio-economic data at ten selected study sites, and institutional analyses at eight sites. These studies are described in the following papers. This introductory paper describes the characteristics of the study sites and explains the rationale for their selection and the design of these studies. The study sites differed ecologically, physically, socially and in the wider institutional environment under which the fisheries were managed. Comparisons between the selected reserves and 'control' sites thus required a qualitative, integrated, holistic approach, as used in the following Parts 2 to 4 of this paper.

Keywords: protected areas, co-management, floodplain river fisheries, experimental design, survey methodologies

## **INTRODUCTION**

Protected areas, reserves, parks and the like are increasingly being used as nature conservation tools in rivers and other ecosystems around the world (IUCN, 1994). In Indonesia, the provincial Fisheries Services are establishing new reserves in several river systems, hoping they will stop the decline in inland fish catches. Compared with marine ecosystems (see e.g. Alcala and Russ, 1990; Carr and Reed, 1993; Dugan and Davis, 1993; Polacheck, 1990; Roberts and Polunin, 1991 and Shackell and Willison, 1995), relatively little is known about the benefits of reserves in tropical floodplain river systems, or about the design criteria that would encourage their successful implementation.

A series of research projects funded by the UK's Department for International Development (DFID) in Indonesia, Bangladesh and Thailand since 1992 has investigated the dynamics of these floodplain river fishery systems. This research has promoted the increased use of 'harvest reserves' as one of the most promising management tools for such river fisheries, and the 'co-management'<sup>4</sup> of these resources by local people, government and other

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<sup>4</sup> Co-management is defined as 'the sharing of responsibility and authority between the government and local fishers/community to manage a fishery or other natural resource' (Pomeroy and Williams, 1994).

stakeholders (see Hoggarth et al, 1999a). The term '*harvest* reserve' emphasises the importance of such tools delivering clearly perceived benefits to fishing communities. Only then are such communities likely to make an investment in management and/or to comply with any restrictions (Pomeroy and Williams, 1994). Local community-based management in Indonesia has previously been described in Indonesian river systems, both in W. Kalimantan (Bailey and Zerner, 1992) and Jambi and S. Sumatra (Hoggarth et al, 1998). Co-management is a relatively newer concept, but opportunities for co-management in Indonesia have recently been strengthened by the enactment of the Regional Autonomy Act (UU No. 22/1999). This delegates authority for the management of natural resources (and other sectors) to the provincial level, thereby allowing different management policies to be applied in different provinces. Such flexibility is required for co-management to effectively adapt to specific local needs and community traditions.

The research described in this paper was conducted by the 1997-2000 'River Fishery Reserves' project (DFID project R7043). In brief, the project conducted a comparative analysis of the ecological, socio-economic and institutional characteristics of fisheries and their management, in villages with and without harvest reserves. The research was undertaken to develop an understanding of the extent to which, and under what circumstances, reserves may benefit floodplain river fisheries, and the communities dependant on them. This introductory paper outlines the overall design of the project and explains the rationale for the approach adopted. The companion papers (Parts 2-4) describe the institutional, biological and socio-economic characteristics of the study sites.

The insights gained from these studies were written up as policy guidelines for the selection and co-management of harvest reserves, as published in Bahasa Indonesian by the collaborating Central Research Institute for Fisheries – CRIFI (Anon, 2000).

## **MATERIALS AND METHODS**

River fishery reserves were investigated in three of Indonesia's largest floodplain river systems: the Batanghari River in Jambi, the Ogan/Komering/Lempuing River system in South Sumatra and the Danau Sentarum water bodies of the Kapuas River in West Kalimantan. Fisheries at the two Sumatran sites were previously described by Hoggarth and Utomo (1994), Hoggarth and Kirkwood (1996), Hoggarth et al (1998) and Hoggarth et al (1999b).

Four main studies were undertaken:

- an initial and exploratory 'regional reserve survey' (RRS), investigating the characteristics of river reserves in the different provinces, and selecting a sub-set of sites for further detailed study;
- institutional analyses (IA) on the design and implementation success of management regulations (for reserves and any other fisheries-related rules) in the study villages (see following Part 2 of this paper);
- a biological monitoring programme (BMP) to quantify the state of fish stocks inside reserve and non-reserve water bodies (see Part 3); and
- a socio-economic monitoring programme (SEMP) to quantify the costs and benefits of fishing in the villages associated with each water body, and their distribution between different stakeholders (see Part 4).

In simple terms, the BMP and the SEMP investigated the *outcomes* of management (in terms of the benefits achieved). The IA identified the elements of the management *process* that might be affecting those outcomes. The overall research programme was also designed

to provide lessons and insights both on the selection and management of reserves, and on the wider management of floodplain river fisheries. The methodologies used for the RRS are presented here: those for the IA, BMP and SEMP are presented in the companion papers.

The regional reserve survey (RRS) was conducted over a seven-week period in February and March 1998. Collaborating provincial Fisheries Service staff first listed all of the river fishery reserves in their province and provided initial information on their management characteristics. An inter-disciplinary, six-person team of biologists, socio-economists and institutional analysts then assessed a sub-set of four or five sites in each province, using semi-structured, checklist-based interviews, and by drawing maps and matrices with village members (see e.g. Pretty et al, 1995, for guidance on methods used). Interviews were held both with fishers and resource managers in each village. The latter included head fishermen, village leaders and traditional heads, and local government officers. The actual numbers and type of interviewees varied between sites. At each site, information was collected on a range of topics as described in Table 1.

From the information collected, the reserves were categorised on the basis of the following 'design' variables, considered potentially important for reserve selection and management:

- catchment position (upstream or floodplain);
- habitat type (river section, or lake);
- management agency (established and managed mainly by government or community); and
- management rules (partially closed reserves - with 3 sub-categories depending on whether seasons, gears, or both were restricted - or fully closed 'no-take' reserves).

Reserves and 'control' sites were then selected for inclusion in the BMP, SEMP and IA surveys to enable comparisons within these broad design variables (e.g. comparing sites with different management rules but similar characteristics for the other three variables). Due to the lack of suitable sites, and the project's budgetary constraints, it was not possible to investigate all of the above design variables, or to select several replicates in each category (see results below).

'Control' sites were selected within the same hydrological sub-catchment or 'comparison group' as the reserves. Within such comparison groups, flood strengths and exploitation levels should at least be similar, though local ecology may still differ significantly. Comparisons of reserves are most valid within these comparison groups. Comparisons between the different provinces are least valid due to the differences in their ecological and physical characteristics and their levels and histories of exploitation.

Where possible, both biological and socio-economic factors were investigated in the same study sites, and where the reserve or 'control' water-bodies were located wholly within village boundaries. In this situation, the biological states of the fish stocks in the water bodies (measured by the BMP) may be most closely related to the socio-economic benefits achieved by the associated villages (measured by the SEMP). At two of the study sites, this intention could not be achieved (see results).

## RESULTS

At the time of the survey (April 1998), the study provinces had the following numbers of river fishery reserves: 9 in Jambi; 11 in S. Sumatra; and 4 in W. Kalimantan. From these sites,

two to three reserves and zero to two 'control' sites were selected for study in each province (see Table 2).

No reserves in upstream catchment positions were investigated by the project. Although such reserves existed in Jambi province, they were excluded from the programme due to their remote location and known access difficulties in the wet season.

Little research was possible on riverine reserves. All BMP sampling was conducted in lake water bodies; only the Danau Lamo riverine reserve was included in the SEMP. Since BMP gill net sampling was impractical for these fast flowing rivers, it had been hoped that fish abundances in riverine sites in S. Sumatra could instead be estimated by fish drives and cast netting in river scour pits ('*lubuks*'), in the dry season. Water levels, however, remained too high in both the 1998 and 1999 dry seasons to allow such sampling.

Three water bodies were identified as being suitable as 'control' sites (Table 2). These were either not designated as reserves, or were 'reserves' that were not being implemented. In W. Kalimantan, the Pulau Majang water body was reported to be fished by both normal flood plain gears, and also traditionally by a remote tribal community using 'tuba' (a poison derived from local plant roots) and chemical poisons in the dry season. At this site, it is assumed that nearly all local stocks of fish are destroyed in the dry season. The site was adopted as a 'control' for the other three reserves selected in W. Kalimantan to investigate the impacts of removing all *local* sources of fish recruitment (i.e. the complete opposite of having a reserve).

In S. Sumatra, the large, remote lake Lebak Nilang was identified by Indonesia's Fisheries Service (Dinas Perikanan) several years ago for 'local management' as a 'reserve', though without any clear management rules. The lake is currently withdrawn from the district-based auction system, but otherwise continues to be fished as before. BMP studies at Lebak Nilang were conducted to enable comparisons with the fish stocks at the nearby, ecologically-similar reserve water body, Teluk Gelam (see Part 3). No SEMP was undertaken at Teluk Gelam as this was not fished by any local community. SEMP results from the fished Lebak Nilang were instead compared with the auction units around Teluk Rasau reserve near Pedamaran (see Part 4). These two sites are in adjacent sub-catchments, though the Benawa sites (Lebak Nilang and Teluk Gelam) appeared less deeply flooded than those of Pedamaran (Table 2).

No 'control' sites were sampled in Jambi. In the case of Arang Arang lake (Table 2), no comparable water bodies exist within the nearby catchment. Though a 'control' could have been found for the Danau Lamo river reserve, none was selected. This village's Lubuk Mahligai reserve was only implemented in 1998 so the potential benefits of the reserve may not yet have fully developed. Danau Lamo was also excluded from the BMP to avoid giving contradictory messages to the local fishing community (i.e. that the project was allowed to 'fish' while they, suddenly, were not). SEMP surveys were conducted at Danau Lamo mainly to investigate the impact of its licensing system on benefit distribution, for comparison with the other sites (see Part 4). Comparisons between Arang Arang and Danau Lamo were prevented by their different habitat types (one lake and one river section).

In summary then, the available comparison groups enabled examination of the *management agency* design variable (government in S. Sumatra, communities in W. Kalimantan, and a government-community partnership in Jambi); and the *management rules* variable (fully closed reserves in S. Sumatra and partially closed ones in W. Kalimantan). No comparisons were possible of the relative effectiveness of lake versus riverine reserves, or of upstream versus floodplain reserves.

## DISCUSSION

This integrated study collected detailed information on the biological, socio-economic and institutional characteristics of a range of different sites, both with and without different types of 'harvest reserves' in Indonesia. At the outset of the study, it was realised that such a holistic analysis would face challenges in the interpretation of the results, not least due to the many ecological, physical and social differences between the study sites. Recognising both the complex nature of floodplain river fisheries and the short duration of the project's field period (just over 1 year), it was neither possible nor meaningful to attempt a precise quantification or statistical analysis of the 'impacts' of reserves. For such complicated systems, it was unreasonable to attempt to assign any differences between study sites simply to the presence or absence of a reserve (or any other single factor of interest). Instead, the approach used in this study was to compare the biological and socio-economic features of sites with and without reserves, and to provide possible interpretations for these results using the insights gained from the inter-disciplinary and integrated approach adopted. Recognising the importance of such a holistic understanding of the fishery is a key recommendation of this study.

Further studies are now needed to improve understanding of the design requirements and potential costs and benefits of harvest reserves. To enable properly controlled comparisons and improve their analytical power, these studies should use combined 'with-without' - 'before-after' experimental designs (Hoggarth and Aeron-Thomas, 2000). Such studies should also be done in collaboration with local partners (village fishers and managers) to improve understanding and interpretation. Either formal analytical approaches, or simpler learning-based approaches may be used (Hoggarth et al, 1999). For the latter approach, annual discussion meetings involving villages trying out alternative types of rules may still use powerful designs and provide many useful lessons.

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**Table 1. Information collected at each study site, methodologies used and respondents, in the exploratory Regional Reserve Survey (RRS).**

Information	Methodologies	Respondents
Village characteristics: size (number of households) and homogeneity (spatial, ethnic and occupational) etc	Interviews	Village leaders, traditional leaders
River system: distribution of river channels, water bodies, water flows, dry season depths, fishing areas etc	Mapping and interviews	Fishers, other resource users
Fish ecology: main fish species caught, location of spawning areas, migration routes etc	Interviews	Fishers, government fisheries officers
Institutional arrangements: fishing regulations; who makes regulations and why, rules for monitoring and enforcement, and resolving conflicts etc	Interviews	Formal and traditional leaders, government fisheries officers, fishers
Fishing practices: gears used, seasonality of fishing, fishing access arrangements, distribution of costs and benefits etc	Interviews and matrices (gear use by season etc)	Fishers and village leaders

**Table 2. Summary of characteristics of sites selected for socio-economic and biological studies in the project's monitoring programmes.**

Comparison Group (catchment)	Village	SE-MP?	Reserve or non-reserve water-body	BMP?	Reserve Management				Habitat
					Regulations	Closed Seasons	Gears banned	Agency	
Jambi	Arang Arang	Yes	Dan. Arang Arang	Full	PR	Dry	Some	C	Lake
	Danau Lamo	Yes	Lubuk Mahligai	No	FR <sup>a</sup>	–	–	G / C	River
West Kalimantan	Meliau	Yes	Danau Belaiaram	Full	PR	All	Some	C	Lake
	Sekolat	Yes	Danau Batuk	Full	PR	Dry	All	C	Lake
	Pulau Majang	Yes	Danau Seriang <sup>c</sup>	Full	None			–	Lake
	Tengkidap	Yes	Danau Seliban	Full	PR	Dry	Some	C	Lake
Benawa (S. Sumatra)	Lebak Nilang	Yes	Lebak Nilang <sup>c</sup>	Full	None <sup>b</sup>			G / C	Lake
	(None)	No	Teluk Gelam	Partial	FR	–	–	G	Lake
Pedamaran (S. Sumatra)	Auction units near Teluk Rasau reserve	Yes	Dan. Teluk Rasau	Full	FR	–	–	G	Lake
			Dan. Teluk Toman <sup>c</sup>	Partial	None			–	Lake

Notes: SEMP = Socio-Economic Monitoring Programme (see Part 4)  
 BMP = Biological Monitoring Programme (see Part 3; 'Partial' sites only sampled during dry seasons)  
<sup>a</sup> Reserve only implemented in 1998, so BMP not permitted  
<sup>b</sup> Reserve not actually implemented, so used as a control site for Teluk Gelam  
<sup>c</sup> 'Control' or non-reserve sites  
 Management: FR = full reserve; PR = partial reserve; C = community; G = government agencies