Reservoir Fisheries Management in Savannakhet Province, Lao PDR

Final Report
Fisheries Management Science Programme
Overseas Development Administration

MRAG Ltd. August 1997

RNRRS PROJECT COMPLETION REPORT

Reservoir Fisheries Management in Savannakhet Province, Lao PDR

R6338Cb

RNRRS:	Fisheries Management Science Programme
PROGRAMME MANAGER:	MRAG Ltd
SUB-CONTRACTORS:	Livestock and Fisheries Section, Agriculture Division, Savannakhet Province, Lao PDR
RNRRS PROGRAMME PURPOSE:	Yields from enhanced fisheries increased by optimising strategies for stocking and harvesting
PRODUCTION SYSTEM:	Land/water interface
COMMODITY BASE:	Floodplain and lacustrine finfish
BENEFICIARIES:	Artisanal and subsistence full and part-time fishermen, communities
TARGET INSTITUTIONS:	Livestock and Fisheries Section, Agriculture Division, Savannakhet Province, Lao PDR
GEOGRAPHIC FOCUS:	Southeast Asia

	PLANNED	ACTUAL
START DATES:	01.06.95	01.06.95
FINISH DATES:	31.05.97	31.07.97
TOTAL COST:	£ 45,400	£ 46,900

1. Project purpose

To devise management strategies to increase the individual and community income from reservoir capture and culture fisheries, while maintaining the role of reservoirs in providing subsistence and dry season habitat for natural fish populations.

2. Outputs

Reservoir fisheries in Savannakhet were analysed in ecological/technical, socio-economic and institutional terms. Particular emphasis was placed on enhancement fisheries in small waterbodies. Stocking enhancement and community management of small waterbody fisheries are actively promoted by the provincial government, and are spreading rapidly.

Small waterbody fisheries studied were of four types: open access without stocking, open access with stocking, restricted access (rented out to individuals) without stocking, and community management with restricted access and stocking. Access restrictions had a strong positive effect on the standing stocks of fish in small waterbodies. Stocking alone was not sufficient to increase standing stocks. However, stocked waterbodies with restricted access showed the highest standing stocks of wild fish, plus variable but often substantial stocks of stocked fish. Pending a final analysis, there appeared to be no significant effect of stocking on fish species diversity. A preliminary analysis suggests that yields from community fisheries are lower or at best equal to the yields achieved from open access waterbodies. Catch per unit of effort in community fisheries was substantially higher than in open

access fisheries, often by an order of magnitude. The given yield can therefore be achieved with much lower effort.

Community fisheries and waterbodies rented out generated substantial income for villages. Villages with community fisheries tended to have a higher income than other villages, with the fisheries often contributing more than 50% of the total. Renting out also generated significant income. Village income was used mainly to improve the school and temple, or for other infrastructure development (road, electricity).

The contribution of community fisheries to household fish consumption was marginal (less than 10%), with more than 80% of household consumption based on fishing in open access water bodies. However, the village income derived from the fishery has led to a reduction of household contributions to village activities and thus provides an indirect benefit to individual households. A significant proportion (often more than 50%) of the community fishery yield is exported from the village, reflecting a low in-village demand to buy fish.

All community ponds were located close to villages, and were fished by most households prior to the introduction of access restrictions. Villagers are now fishing in alternative waterbodies except in one village where no alternative waterbodies exist nearby and individual fishing with small gear is still allowed in the community fishery. In all the villages surveyed, the major part of household fish catches was obtained from flooded rice fields and from rivers, not from small waterbodies, which suggests that the loss of individual access to community fisheries has only a small effect on household consumption. Villagers generally regarded the community fishery as beneficial, with community income being the largest perceived benefit.

To summarize, enhancement as currently practised in community fisheries can raise significant community income, has a negative but generally marginal effect on individual fish consumption and income from fishing, and protects stocks of wild fish in the enhanced waterbodies. Substantial improvements in overall yield and community benefits are technically feasible, but would require improved marketing. Improvements in individual benefits are also possible and desirable, not least to ensure the institutional sustainability of enhanced fisheries, but may require more complex institutional arrangements. The results suggest various ways of improving management, but substantial uncertainties remain which would best be resolved through an adaptive approach to further development efforts aimed at small waterbodies.

The close integration of technical, socio-economic and institutional analysis in the project has led to significant advances in the understanding of enhancement fisheries systems. A first publication summarizing this integrated approach, with particular reference to the predictability of enhancement outcomes, has been presented at the FAO/DfID Expert Consultation on Inland Fisheries Enhancements in Dhaka, Bangladesh.

A review on the population biology of tilapia, the main species used in stocking enhancement in Savannakhet, was started as an internal project report but has now been developed into a book chapter.

3. Contribution of outputs to project goals

The project purpose has been achieved: the technical effects, socio-economic benefits and costs, and key institutional aspects of alternative management and development options for reservoir fisheries in Savannakhet have been analysed. Results indicate that, while enhancement as currently practised does not increase yields, it has substantial benefits in terms of community income, conservation of wild stocks, and increased returns to labour. Low effective demand appears to be the main factor limiting yields from community fisheries, and improvements in marketing and/or access arrangements are crucial to increasing yields. Communities are actively experimenting with management regimes to identify improvements, and this process may be facilitated by appropriate support from the provincial government. The reduction in fishing effort and increase in wild stocks observed in community fisheries shows how enhancement, by precipitating institutional change, may contribute to a more sustainable exploitation of aquatic resources. This potential should be explored further. Overall, the project results are a significant step towards an integrated understanding of enhanced fisheries systems.

4. Publications

Lorenzen, K. & Garaway C.J. (in press) How predictable is the outcome of stocking? In: Expert Consultation on Inland Fisheries Enhancements. FAO Fisheries Report 559, Supplement.

In preparation:

Garaway, C.J. (in prep.) Community fisheries in Laos, Phd Thesis, University of London.

Lorenzen, K. (in prep.) Population Dynamics. In: Tilapias: Biology and Exploitation. Edited by M.C.M. Beveridge & B.J. McAndrew. London: Chapman and Hall.

Lorenzen, K., Garaway, C.J. & Chamsingh, B. (in prep.) Impact of stocking and access restrictions on fish stocks and yields in small water bodies in Savannakhet, Laos. To be submitted to *Journal of Fish Biology*

5. Internal reports

Garaway, C.J. (1997) Aspects of the management and utilisation of small waterbodies in Sonbuli District, Savannakhet Province, Laos. Internal Report.

Garaway, C.J. (1997) Report on the community fisheries workshop. Internal Report to the Livestock and Fisheries Section.

6. Other dissemination of results

Oral presentations at conferences and seminars

FAO International Expert Consultation on Inland Fisheries Enhancements, Dhaka, Bangladesh (Lorenzen & Garaway)

Seminar at the Asian Institute of Technology, Bangkok, Thailand. (Lorenzen)

Workshops and training courses organised

Training workshops on Rapid Rural Appraisal (RRA) methods (C. Garaway); test fishing with multi-mesh gill nets (K. Lorenzen); identification of indigenous fish species (T. Warren).

Final project workshop (K. Lorenzen & C. Garaway).

7. Follow-up indicated/planned

A key area where further research is required is the development of co-operative, adaptive management systems to support experimentation by resources users. This area is relevant to the intensification of common pool resource use in general, and a concept note has been submitted to the DfID Flexibility Fund.

8. Name and signature of the author of this completion report

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Final Report

Title of Project	Reservoir Fisheries Management in Savannakhet Province, Lao PDR	
Programme Manager/Institution:	MRAG Ltd. 47 Princes Gate London SW7 2QA UK	
Reporting Period:	1 June 1995 to 31 July 1997	
Name:	C.J. Garaway	K. Lorenzen
Signature:	_____	_____

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List of Appendices

1. Executive Summary

(1) A study of reservoir and small waterbody fisheries management was carried out in Savannakhet Province, Lao PDR. The study covered a set of reservoirs and small waterbodies under different management systems (open access, community management, or renting out to individuals). The outcomes of different management systems and practices were studied in terms of their effects on fish stocks and the benefits derived from the fishery.

(2) Access restrictions had a strong positive effect on the standing stocks of fish in small waterbodies. Stocking alone was not sufficient to increase standing stocks. Stocked waterbodies with restricted access showed the highest standing stocks of wild fish, plus variable but often substantial stocks of stocked fish.

(3) Yields from community fisheries are lower or at best equal to the yields achieved from open access waterbodies. Fishing effort in community fisheries was lower by almost an order of magnitude, and catch per unit of effort was substantially higher than in open access fisheries. The given yield is therefore achieved with much lower levels of effort.

(4) A preliminary analysis did not indicate significant effects of management (stocking or access restriction) on fish species diversity.

(5) Household consumption of fish was based, to more than 80%, on subsistence fishing by household members, mostly in rivers and flooded rice fields. The contribution of community fisheries to household fish consumption was insignificant.

(6) Access restrictions in community fisheries are associated with loss of subsistence yields from these sources. Villagers regarded this loss as significant only where no suitable alternative fishing grounds were available, and in these cases, subsistence fishing with small gear in community fisheries was allowed. This shows that local needs are being taken into consideration, and highlights the benefits of locally developed management.

(7) Community fisheries and waterbodies rented out generated substantial income for villages. Villages with community fisheries had a higher income than other villages, with the fisheries often contributing more than 50% of the total. Community income was used to improve village infrastructure, and is the only way in which villages can work towards their own development goals.

(8) Village income derived from the fishery has led to a reduction of household contributions to village activities, and thus provides an indirect benefit to individual households.

(9) Villagers generally regarded the community fishery as beneficial, with community income being the largest perceived benefit.

(10) Community management systems appeared to be designed in a way that keeps management costs low, rather than to maximise benefits. The level of exploitation is low and benefits are below their potential. Further benefits from community fisheries would require the provision of stronger incentives for participation, and improved marketing arrangements, though this may not be a high priority for villagers.

(11) Adaptation of access arrangements, incentives for participation, and technical management measures to local conditions is crucial to the success of management. Villagers use experimentation to arrive at locally appropriate regimes, a process that can and should be actively supported by governmental or non-governmental organisations.

(12) Stocking has facilitated the development of community management systems, thereby reducing fishing effort and conserving wild stocks. This effect of stocking is the result of institutional dynamics linked to technical change, and illustrates the necessity to integrate institutional and technical analysis when predicting stocking outcomes.

(13) An integrated framework for the analysis and prediction of stocking outcomes has been developed.

2. Background

Laos is a landlocked country of 236,800 square kilometres (approximately the size of Great Britain), bordered by Thailand, Myanmar, China, Vietnam and Cambodia. The population of Laos numbers approximately 4.5 million, of which about 80% live in rural areas. The population consists of more than 70 distinct ethnic groups, commonly grouped as lowland Lao (Lao Loum, 60 % of the population), upland Lao (Lao Theung, 30 %), and a small but ethnically diverse group living at the highest altitudes, the Lao Sum (10 %). Laos is regarded as one of the 20 poorest countries in the world, with a per capita income of US$ 170.- (in 1987), and a life expectancy of 47 years.

About 70 % of the country is mountainous, with the remaining 30 % being lowland plains principally around the capital, Vientiane, and in Savannakhet province in the South. The climate is tropical with a marked monsoon season in May to October, and a dry season in November to April.

Fish is the main source of animal protein in the diet of the majority of the Lao people, particularly in the lowland areas in which approximately 70 % of the population live. The largest part of fish consumption is based on subsistence fishing in rivers, rice paddies, and lakes and reservoirs, but there is also a growing import of marine and freshwater fish products from the neighbouring countries, particularly Thailand. While most fishing is conducted for direct subsistence, some fish are also sold to generate income.

Fisheries in Laos are widely perceived by resource users and external observers to be overexploited, and this view is also reflected in documents by governmental and non-governmental organisations (DLVS 1994, Claridge 1996). In addition to overexploitation, fisheries are under increasing pressure from habitat modifications such as the construction of reservoirs, irrigation schemes, run-of-the-river dams, and flood control embankments.

In response to the perceived problems of overexploitation and habitat degradation, a number of initiatives to improve aquatic resource management have been promoted by the Lao Government and by NGOs. In particular, community management is seen as priority for river fisheries (Baird 1994, Claridge 1996), as well as reservoirs and small waterbodies. Studies of fisheries resources and management in Laos have so far concentrated largely on the Mekong River, and the large Nam Ngum reservoir, while little is known about the fisheries in the floodplain areas.

The present project was initiated to study the fisheries in reservoirs, particularly the widely distributed small waterbodies, within the lowland areas. The project was designed to evaluate the effects of active management through stocking and the regulation of exploitation on fish stocks, yields and benefits from the fisheries. The principal means of regulating exploitation in the project area were community management, and the renting out of waterbodies to private parties. The study covered 17 small water bodies of 4 to 100 ha (mostly natural lakes modified by building earth dams), and four sites at a large (2000 ha) reservoir. All sites were located in the Xe Champhone wetland area (Claridge 1996), at the confluence of the Xe Champhone and Xe Sangsoi rivers, in the eastern part of Savannakhet Province.

3. Project Purpose

The overall purpose of the project was set out in the project memorandum as follows:

To identify management strategies to increase the individual and community income from reservoir capture and culture fisheries, while maintaining the role of reservoirs in providing subsistence and dry season habitat for natural fish populations.

A variety of management regimes for reservoir and small waterbody fisheries were present in Savannakhet at the beginning of the study, ranging from open access exploitation without any active form of management to community fisheries with complex institutional structures and technical enhancement through stocking. The diversity of management regimes in the project area provided a unique opportunity to evaluate different regimes with respect to the criteria outlined above. More specifically, the project aimed to evaluate the different regimes with respect to their impact on:

- total yields
- standing stocks of fish and their species composition
- benefits from the fishery
- distribution of benefits among socio-economic groups

4. Research Activities

Field research in Savannakhet was carried out from June 1995 to July 1997. Overall coordination of the project was carried out by the principal investigator, Dr Kai Lorenzen, and the Head of the collaborating Livestock and Fisheries Section of Savannakhet, Mr Douangchith Litdamlong. Research on technical and ecological aspects was also carried out by Dr Kai Lorenzen. Socio-economic and institutional analyses were conducted by Ms Caroline Garaway, who was supported jointly by the project as a part-time Research Assistant, and through an ESRC PhD studentship. Ms Garaway assumed responsibility for the management of the field programme in Laos for all aspects of the project. Mr Bounthanom Chamsingh, Head of Fisheries in the Livestock and Fisheries Section of Savannakhet Province, coordinated and maintained the various survey programmes throughout the project. Mr Terry Warren, independent consultant, conducted a workshop on fish identification and produced pictorial keys. Mr Nick Innes-Taylor, DfID-TCO in the Livestock and Fisheries Section, facilitated the start up of the project and helped with financial management in Laos. A large part of the routine survey work was carried out by the District Livestock Officers, Mr Boathong and Ms Gaew in Champon, and Mr Southone and Mr Sipsueth in Sonbuli.

4.1 Research philosophy and approach

Research in the project was guided by two principles:

- Close integration of technical/ecological and social research throughout, and
- Two-stage design with a broad-based exploratory phase informing a subsequent, focused phase of quantitative analysis.

The following sections describe the methodologies used in the different phases, i.e. rapid / participatory rural appraisal (RRA/PRA) methods used in exploratory research, and the structured test fishing, baseline and household surveys used in the second phase.

4.2 Exploratory research using RRA/PRA methods

No research had previously been carried out on community fisheries in Savannakhet and very little was known about the management systems in operation.

Research at this stage was therefore exploratory and focused on obtaining an overview in two broad areas: The process of management of community fisheries and the impact this management had had on users of small waterbodies. Biological impacts were dealt with in other studies within the project.

Given logistical and time constraints, the research was limited to seven villages with between 4-7 days being spent in each village. Site selection was based on selecting villages which were operating community fishponds (Table 4.2a) and some villages without such management systems for comparative purposes (Table 4.2 b).

At the time of the research, there were only four villages in the Province that were known to have been operating the systems for more than a year. These were in Champon and Sonbuli districts. The other three villages were selected at random from Sonbuli district. These villages were stratified with respect to the number of perennial waterbodies they had access to. This was considered to be one of the most important factors that would affect the use and importance of water bodies in general.

Table 4.2 a - Community fishery villages and their access to perennial waterbodies

Groups showing number of water bodies a village had access to	*Group I 1-2*		*Group II 3 - 4*	*Group III > 4*
Village name	Xieng Hom	Nong Hong	Bung Xiang	Kong Knak
District	Sonbuli	Champon	Sonbuli	Sonbuli
Perennial water bodies (> 2Ha in dry season)	1	1	3	7
river - perennial	Sangsoi	-	Sangsoi	Sangsoi

Table 4.2 b Villages selected for comparative purposes

No of waterbodies	*Group I 1-2*	*Group II 3-4*	*Group III >4*
Village name	Nong Pham	Nong Hua Xiang	Naho Luang
District	Sonbuli	Sonbuli	Sonbuli
Perennial water bodies	1	2	4
access to river - perennial (shared)	Champon	Sangsoi	Champon

A checklist of subject areas to be investigated was drawn up. This list was informed by previous experience of small waterbody use and village fishponds in N.E Thailand (Garaway 1995), the knowledge and experience of the Provincial and District staff and available secondary data (Phonvisay, 1994, Claridge *et al*, 1995). The data collected is summarised in Table 4.2 c.

A mixture of RRA/PRA methods was used to collect these data. As the research necessary for this stage was conducted at village level, was highly exploratory and wide-ranging in nature, required the pooling of knowledge of local people, and was undertaken under both financial and time constraints, it was considered the most appropriate methodology. The methods used in this research have been widely used and documented elsewhere (Garaway, C.J. 1995; Khon Khaen, 1987; Townsley, P. 1992; IIED, 1988, 1992, 1995). The specific diagramming and visualisation techniques used are shown in Table 4.2 d. Unless stated otherwise, all diagrams were drawn/ filled in by members of the local community.

The approach taken allowed for considerable flexibility and variation in the use of methods between villages as seemed appropriate. However, there was a general framework to the procedure which developed as research progressed. This framework is shown in Figure 4.2a. A more detailed explanation of methods and results of this research can be found in Appendix II.

Table 4.2 c Data collected in exploratory research

	Data Type	Objective
1	Background village information	• location relative to water resources, markets • major livelihood options • economic and social homogeneity of the population • size and stability of population • organisational structure
2	Socio-economic profile of villages	• allow exploration of differences with respect to socio-economic status
3	Basic physical & ecological description of small waterbodies.	• contextual information
4	History of small waterbody management	• historical precedent for natural resource management • presence of long term social norms for collective action
5	Current management strategies & institutions making them: Operational rules - rules which determine how resource is managed on a day to day basis and consequently the individual choices people face Decision making processes - who can decide what, when.	• presence of active management • How communities have tried to overcome problems often associated with collective action • supply of rules • compliance with rules • monitoring and enforcement of rules
6	Household use of small water bodies	• Profile of users and uses. • Seasonal variation in use & why. • Socio-economic variation in use & why. • Options facing different user groups. • Dependence on natural resources.
7	Importance of small water-bodies in general to individual households. Contribution to the fish diet and to household income	• Potential impact of restricting access. • Differences between socio-economic groups.
8	Community income and the % contribution brought in by enhanced fisheries.	• Importance of community income. • Importance of role of enhanced fisheries in .
9	Opinions on benefits/costs & impacts of these new management systems	• Homogeneity of views. • Presence of conflict.

Table 4.2d Diagramming & visualisation methods used

Method	Method's use	information collected on	Respondents
maps	spatial relationships	• waterbodies • village and surrounding area • district	• groups of local people • govt. staff
wealthranking	classification/ranking of people	• socio-economic profile of villages	• groups of local people
Venn diagrams	relationships between people	• village organisation • pond management	• village administration • pond committee/ village administration
seasonal calendars	cyclical variations in activities	• seasonal use of water bodies • market fish prices	• individual h.holds/ groups of local people • traders/ local women
timelines/ trend matrices	major events and changes through time	• history of village • history of water body management	• elders • elders/ village administration
'pie' diagrams	proportions	• Natural food products coming from different waterbodies. • Total fish caught Vs bought/ yr. • of fish sold versus consumed / yr.	• individual households
matrix scoring / ranking	comparing and ranking items on a range of criteria	• relative importance of different waterbodies • comparison of use of waterbodies by different user groups	• individual h.holds/ group of local people • individual h.holds/ groups of local people

4.3 Test fishing survey

A comparative test fishing survey with multi-mesh gill nets was carried out in order to gain baseline information on wild fish stocks, and to assess the impact of different management regimes on standing stocks, species composition and diversity. This approach takes advantage of the high degree of replication in the management of small waterbody fisheries to gain insights into the effects of management which, in larger-scale fisheries, can only be derived from variation of management over time and/or the use of sophisticated models.

Sites for test fishing were selected to cover the range of management regimes identified in the exploratory appraisals: open access, community fisheries, and water bodies rented out to individuals or groups. All community fisheries and some open access fisheries had been stocked, but none of the waterbodies rented out. At the beginning of the study, the project area covered only four community fisheries and three waterbodies rented out. All of these waterbodies were included in the test fishing survey. Open access sites included several waterbodies used by villages with community fisheries, which were monitored to complement the household survey in these villages, and a number of sites selected at random from a water body map drawn by District Officers.

Physical and management details of the waterbodies are given in Table 4.3 a. Overall, the test fishing survey covered 21 sites, including four community fisheries, three waterbodies rented out, ten small waterbodies with open access, and four sites in the large Sui reservoir.

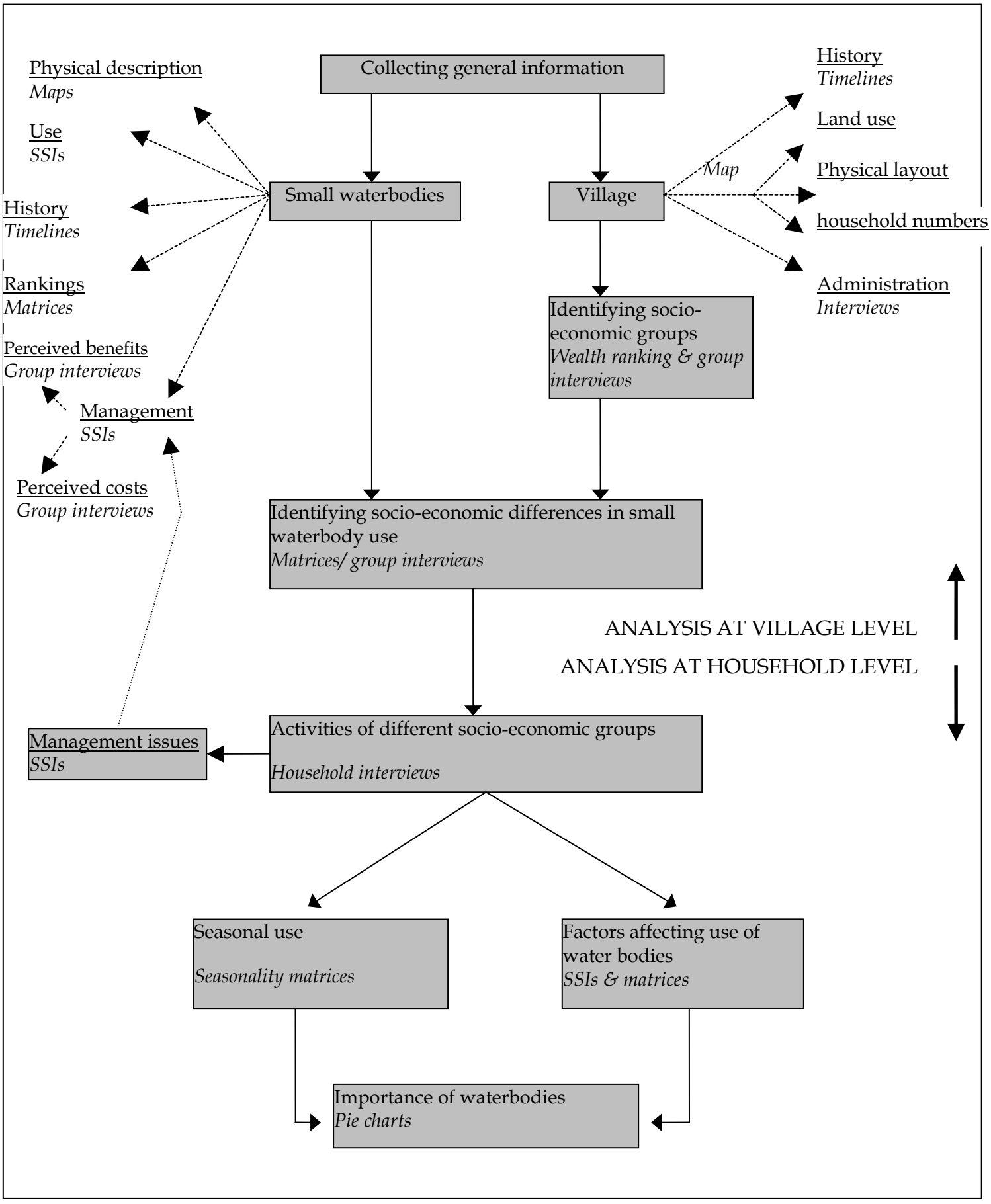


Figure 4.2a. Method Sequence for exploratory research

Table 4.3a Waterbodies included in the test fishing survey. Secchi depth and conductivity measurements in March 1997. Access arrangements: open access (O), community management (C), rented out (R).

Waterbody	Village	District	Area [ha]	Depth [m]	Secchi [cm]	Cond. [µS]	Access	Stocked
Huoy Piklee		Champon	5	1	20	250	O	N
Huoy Chiao		Champon	> 100	3	27	135	O	N
Koud Ban	Kong Knak	Sonbuli	5	2.5	31	115	C	Y
Koud Long	Kong Knak	Sonbuli	2.1	1.5	30	162	O	Y
Koud Xe Hak Noi	Kong Knak	Sonbuli	6	1.5	36	55	O	N
Koud Yang	Nongbuaxang	Sonbuli	4	1.5	100	60	O	N
Nong Bua	Xieng Hom	Sonbuli	7	5	41	71	C/O	Y
Nong Bung	Bung Xiang	Sonbuli	4	1.5	17	510	C	Y
Nong Deune	Kengkok	Champon	30	1.5	6	380	O	N
Nong Hang	Kong Knak	Sonbuli	1.2	1	4	96	O	N
Nong Hong	Nong Hong	Champon	5	2	55	95	C	Y
Nong Khai	Nahoualouang	Sonbuli	10	1.2	4	150	R	N
Nong Lad	Kengkok	Champon					O	N
Nong Phai	Bung Xiang	Sonbuli	2	2	41	175	O	Y
Nong Sim	Nahoualouang	Sonbuli	> 100	1.5	4	154	O	N
Nong Thom Leung	Nongpham	Sonbuli	4	1	5	630	R	N
Nong Thom Neung	Nahoualouang	Sonbuli					R	N
Sui_1	Xakhun	Champon	2000	5			O	N
Sui_2	Phonthong	Champon	2000	5			O	N
Sui_3	Donggnang	Champon	2000	5			O	N
Sui_4	Phonmuang	Champon	2000	5			O	N

In order to develop a test fishing methodology that can be adopted widely by the district livestock offices to gain comparative information on the fisheries in their area, it was decided to use a set of commercial gill nets rather than the multi-mesh panel research gill nets used in other studies (e.g. Mattson & Mutale 1992). The commercial plastic nets are cheap and widely available in Laos, and the full set can easily be transported to remote locations on bicycles or motorcycles.

Throughout the project, all test fishing data were collected with a single set of nets (although some nets had to be replaced in the course of the study), so that all data are comparable between test fishing events. The set comprised 11 nets of 2, 3, 3.5, 4, 5, 6, 8, 10, 12, 14, and 16 cm stretched mesh. The nets varied in size according to the commonly available commercial specifications. All test fishing data provided in this report are based on catches with the given set of gill nets, i.e. are internally comparable.

Nets were transported to the test fishing sites by District Livestock Officers and set by experienced local fishermen. All nets were set to cover the entire water column from surface to bottom. Nets were set in the evening (around 6:00 pm) and retrieved in the following morning (around 6:00 am). All fish were recorded individually (species, length, and mesh size of net). Individual weights were recorded only for sub-samples, and length-weight relationships were used to estimate weights in the other samples.

The District Livestock Officers were trained in the identification of the more common fish species, using a photographic key developed by the officers and an outside consultant specialising in fish taxonomy. While it was considered important to obtain an overview of the fish species present in project area, the proper identification of all fish to species level proved too difficult to implement in the routine sampling programme. Hence catches were recorded at genus level, with individual species recorded where these could be correctly identified by District Officers and fishermen.

Because test fishing aimed primarily to identify the impacts of management on standing stocks, rather than to describe the properties of individual stocks at a high level of precision, the sampling programme was designed to maximise the number of true treatment replicates. Hence sampling effort

was distributed to cover a large number of waterbodies, each of which was fished only once per season. With a few exceptions, all sites were fished in Autumn 95, Spring 95, Summer 96, and twice in Spring 97.

4.4 Household surveys

The primary objective of these surveys was to measure benefits and costs of community fisheries to individual households and, particularly, whether benefits and costs of community fisheries were distributed evenly between socio-economic groups.

The exploratory research outlined in section 4.2 gave the baseline information for more detailed investigation of this. The research was carried out using a more formal and structured survey approach. The selection of respondents, questions, layout and range of possible answers were based on the knowledge gained from the exploratory research.

The survey was focused at household level. Two interdependent surveys were developed (baseline & monitoring surveys).

4.4.1 Objectives of the baseline survey

The baseline was a 'one-off' survey. One of its major objectives was to collect household socio-economic data necessary for grouping households in future analysis. The variables measured were primarily chosen on the basis of wealth-ranking exercises in the exploratory research. This survey also investigated: Households' previous & current uses of small waterbodies; benefits, particularly non-nutritional benefits, as identified in the exploratory research; individuals' perceptions of the benefits and importance of community fisheries; individuals' perceptions of changes in their patterns of obtaining fish since the introduction of the new systems.

To avoid excessive interviewing time, this survey was split into two sections, and done with the monitoring survey at relatively slack times of the year.

4.4.2 Objectives of the monitoring survey

The monitoring survey investigated the total supply of fish coming into a household (monitored over a year), the route through which it came (bought, caught by households themselves, earnt, or received as gifts) and how it was used (consumed, sold, processed and sold, given as gifts). One of the major objectives was to show the contribution community fisheries made to the diet and income of households compared with other sources. It also showed the overall importance of fishing in small water bodies in general, and catch and effort data gave some indication of yields from these resources. The study also highlighted any differences between socio-economic groups in their *patterns* of obtaining fish, testing hypotheses formulated after the exploratory research. Particularly relevant was the degree of dependence on subsistence fishing and the extent to which households were willing or able to buy fish.

This survey was the most labour intensive, a major factor determining sample size as discussed in the next section. It was carried out over a year (May 96 - April 97) at two monthly intervals. One monitoring period (August/September 1996) was not covered as serious flooding during these months made it impossible to reach these villages.

4.4.3 Household selection

The total number of villages that were operating community fisheries at the time selection took place was only four and therefore these represented the total population of community fishery villages. One hundred and three households were selected from these four villages with a constant sampling fraction of 20% from each village. The breakdown is shown in Table 4.4a. The sample size was limited by labour constraints, which allowed for 50 man hours over two weeks every two months (for 1 year). As well as overall sample size, these constraints affected when and how often the monitoring survey could be carried out, which was a major determining factor in survey design.

Table 4.4.a Household selection from community fishery villages

	Xieng Hom	Nong Hong	Kong Knak	Bung Xiang
Total no. of households	97	80	214	124
Households in sample	19	16	43	25

Fifty percent of households from each of these villages (100% in Nong Hong) had already been subject to wealth-ranking in the exploratory research, giving an overall indication of the relative wealth of each household (For more information on this see Appendix II). These households had been selected at random from the total village population. To make good use of this additional socio-economic information, thereby increasing the chances of a representative sample, it was decided to make this smaller group the sampling frame. Households were ordered according to socio-economic rank and then selected using linear systematic sampling (LSS),(i.e. every fifth household). Selected households were visited five times over the year period.

4.5 Village Data collection

Another important source of information in this project were village records. Before the research, the village administration kept records of fish sales and fish yields, but these were not always complete nor often written down in a systematic way, making interpretation difficult. To improve the accuracy of this information as well as increase the range of information collected, the village administration were provided with record keeping equipment, trained how to keep records and they incorporated these new procedures into their existing ones. This required very little, if any, extra work or time. The administration were keen to improve their own records as they had already participated in workshops and study tours with other villages where such information was deemed important. They were also increasingly being asked for information from government staff as they were seen as “pioneer” villages. Finally, the exploratory research had created some sense of village involvement in the project and villagers could see the value of producing data that could be compared across the villages. Records were kept primarily on fish sales (see Table 4.5a), but also fish used for other purposes and community income expenditure.

This data, along with the surveys & interviews, enabled us to get estimates of the following: Total yields from community fisheries, total income generated from fish sales, distribution of yield to different sectors (e.g. fish sales, fish for guests & meetings, fish as wages, subsistence fishing); fishing effort and proportion of fish leaving the village.

Table 4.5a Example of form used to record information on fish sales from community fisheries

Date	Buyer name	Buyer village	No of fish	Kg	Price/Kg	Total Price	No of gear	No. of fishers	Time spent	Comment

5. Project Outputs

5.1 Overview of management practice

As mentioned previously, the project classified water bodies as open access, waterbodies that were rented out and community fisheries. Whilst these were not the only systems in operation, they were the most common for small waterbodies in the districts under study. The three classifications are discussed below.

5.1.1 Open Access

Open access waterbodies were those bodies that were under no active management at all. People were able to fish there whenever they wanted at their own discretion. However, even in some of these cases, informal rules were present and resources were being managed as common property rather than strictly open access. For example, in many of the waterbodies there was an unwritten rule that the waterbodies belonged to specific villages and only village members could fish there. The term "open access" has been used here to distinguish these waterbodies from the other types which are under more active management.

5.1.2 Waterbodies that were rented out

In the study there were three waterbodies that were "rented out". This was a reasonably common practise in the study districts and others districts within the Province. The practise was common before 1975 when the country came under communist rule. From 1975 up until around 1990 when certain policies were relaxed, the renting of natural waterbodies to private individuals was banned. Since that time it has become more popular again, and increasingly, villages are considering policies of stocking and then renting out on a yearly basis to generate community income.

There was no stocking in the three waterbodies that were being rented out in this study. The waterbodies 'belonged' to two villages that operated the same policy. The village administration would rent the waterbodies out in the dry season on a year by year basis. In the rainy season the waterbody came back under village control and was generally open to all for fishing again. The price was set by the village administration and agreed to by village members at an open meeting. Any person or groups of people who were willing to pay this price were given temporary ownership rights of the waterbody. If no-one agreed to this price, the waterbody was not rented out. Generally, waterbodies would be rented out to groups of 10-20 people with a majority coming from the village. Once under private ownership the new owners generally sold fish to middlemen. They fished with varying degrees of intensity, likewise with guarding their property. Sometimes, they completely dewatered the resource though more commonly the rains started before this was possible. Waterbodies under this classification were not investigated fully with respect to the benefits, community or individual, that they generated. A full investigation of benefits focused on the community fisheries that are described below.

5.1.3 Community fisheries

Community fisheries were the focus of study of the socio-economic research. There were four operating in the study districts at the start of the project. Community fisheries refer to small waterbodies (<15Ha) which were jointly owned and managed by the members of a single village community. Management of these waterbodies was organised by the village and involved stocking with cultured fish. Stocking was done on, at most, a yearly basis and relatively small quantities/ha stocked. Generally fish were harvested by village fishing teams with individual access either prohibited completely or heavily restricted. Criteria for the selection of fishing teams and those involved with marketing or other aspects of management varied from village to village. In some villages, all households were involved on a rotational basis. At the other end of the spectrum, there was a fixed fishing team which fished for the whole season. Remuneration also varied from a share of the overall financial profits to a small percentage of the fish catch at the end of a fishing day. Fish caught by the fishing teams was generally sold or used for village activities. The resulting income was generally spent on community development projects. Benefits from community fisheries are discussed in section 5.3. This type of management was only recently introduced with the first known example in Bung Xiang village, starting in 1991. However since 1995, there has been a growing interest in these systems from villages and government alike.

5.2 Effects of management on fish stocks

Open access fisheries were exploited year-round with a wide range of gear, including gill nets of all mesh sizes, various traps, hook and line, and dewatering. Waterbodies rented out to private parties were also exploited by a variety of gear, but exploitation was concentrated during a short period towards the end of the dry season (dewatering with diesel pumps was attempted in several of the rented waterbodies, but never achieved during the study period). In community fisheries, exploitation was limited to the dry season, and only large mesh nets were used (usually gill nets of at least 10 cm mesh size). An exception was the community fishery in Nong Hong, a village with access to only one waterbody, where the use of gill nets was reserved for the community fishery while individual fishing with small gear was not restricted.

Test fishing revealed a diverse fish fauna in the small and larger waterbodies, comprising at least 36 genera and well over 40 identified species. Table 5.2a gives an overview of the identified genera and species, their total contribution to the test fishing catch by weight, frequency of occurrence, and number of waterbodies in which the species was dominant.

Overall, 5 species/genera account for about 50 % of the test fishing catch: *Hampala dispar* (15 %), *Oxyelotris marmorata* (10 %), *Oreochromis niloticus* (10 %), *Channa striata* (7 %) and *Cyclocheilichthys* sp. (7 %). These species were also widely distibuted (with the exception of *O. niloticus*), and dominated all but four of the 21waterbodies. The tilapia *O. niloticus* was found in all six waterbodies in which it had been stocked, and dominated the catches from two of these. In spite of its relatively limited distribution, it made a significant contribution to overall test fishing catches. Exotic common, Chinese and Indian major carp have also been stocked occasionally, but only common carp, *Cyprinus carpio*, was caught in the test fishing survey, and only at one site.

Analysis of standing stocks, estimated as average test fishing catches per unit of effort (CPUE), showed that these were strongly influenced by the access regime of the waterbody. Sites with any form of access restriction had significantly higher standing stocks than open access sites. Stocking as an independent variable was partially correlated with access restrictions (only two stocked waterbodies had unrestricted access, and four out of seven restricted waterbodies had been stocked), and also showed a significantly positive impact on standing stocks.

Figure 5.2a shows the average test fishing CPUE for the different sites, grouped by access arrangement in small waterbodies and also separating the sites in the large Sui reservoir. Total CPUE is broken down into wild and stocked fish, the latter comprising tilapia and common carp. One waterbody, Nong Bua, supported a community fishery for part of the study and became an open access fishery in the last year, and the relevant CPUE values are shown in both categories. The graph clearly shows the substantial impact of access restrictions on standing stocks, particularly of wild fish. All waterbodies with restricted access show higher standing stocks of wild fish than any of the open access sites. Stocked fish contributed to standing stocks in six waterbodies, making substantial relative contributions in two of these (Koud Ban and Nong Phai). Total standing stocks in restricted access waterbodies are, on average, three times as high as those in open access waterbodies. Stocking in itself may contribute significantly, but is not sufficient to increase standing stocks.

The overall mean lengths of fish in the test fishing catch are shown in Figure 5.2b. Mean lengths are highest in the restricted access small waterbodies, and lower in the open access sites including Sui. However, there is substantial variation within access categories and the differences between categories are not statistically significant.

Table 5.2a Preliminary list of species or genera of fish caught in the test fishing survey. Scientific and Lao names, overall contribution to the test fishing catch in weight, number of sites in which the species was present, and number of waterbodies in which the species was dominant. Total number of sites: 21.

Species/genus	Lao name	Weight [%]	Sites present	Sites dominant
Anabas testudineus	Pa Keng	2	15	1
Chanda siamensis	Pa Khap Khong	1	12	
Channa striata	Pa Kho	7	14	2
Chela labuca	Pa Seu	1	13	
Cirrhinus sp.	Pa Kabok, Pa Huakeng	5	11	
Clarias Batrachus	Pa Duk	2	9	
Corica sp.	Pa Keo	0	3	
Cyclocheilichthys spp.	Pa Tokniuw, Pa Tasai	7	15	2
Cyprinus carpio	Pa Nai	2	1	
Hampala dispar	Pa Sou	15	17	7
Kryptopterus apogon	Pa Nang Khok	0	1	
Kryptopterus cryptopterus	Pa Nyon	0	1	
Labeo chrysophekadion	Pa Phia	1	5	
Labiobarbus sp.	Pa Khouilam	3	13	
Macrochirichthys macrochirus ?	Pa Hangfa	0	1	
Macrognathus sp.	Pa Lot	2	10	
Mystus sp.	Pa Kanyeng	2	12	
Notopterus chitala	Pa Thong Gai	1	1	1
Notopterus notopterus	Pa Thong	3	13	
Ompok bimaculatus	Pa Seum	5	13	
Oreochromis nilotica	Pa Nin	10	6	2
Osteochilus sp.	Pa Ethai, Pa Khao Mon	3	13	
Oxyelotris marmorata	Pa Bou	10	10	4
Paralaubuca cf. typus	Pa Katep	3	15	
Pristolepis fasciatus	Pa Ka	0	3	
Puntioplites spp.	Pa Sakang, Pa Queng	3	11	1
Puntius gonionotus	Pa Pak	4	12	
Puntius orphides	Pa Kabuk	1	6	
Puntius altus	Pa Vienfai	0	4	
Rasbora sp.	Pa Sieu	1	7	
Scaphognathops bandonensis	Pa Ta Lo	1	6	
Sikukia cf. stejnegeri	Pa Mak Mang	0	2	
Thynnichthys thynnoides	Pa Keum	1	10	
Trichogaster trichopterus	Pa Kadeut	2	13	
Trichopsis vittatus	Pa Mat	1	7	
Xenentodon cancilla	Pa Top Thong	0	3	
(to be determined)	Pa Ekha	1	5	
(to be determined)	Pa Kingbang	1	4	1

The average number of species/genera recorded per fishing event ranged from 4 to 13, and was not significantly related to either access arrangements or stocking. There was no significant evidence, therefore, of management impacts on species diversity. However, this result should not be mistaken as positive evidence that overexploitation or stocking do not impact on biodiversity in small waterbodies. The high degree of variation between waterbodies implies a low level of statistical power, the sampling gear used was not unselective, and not all fish could be identified to species level.

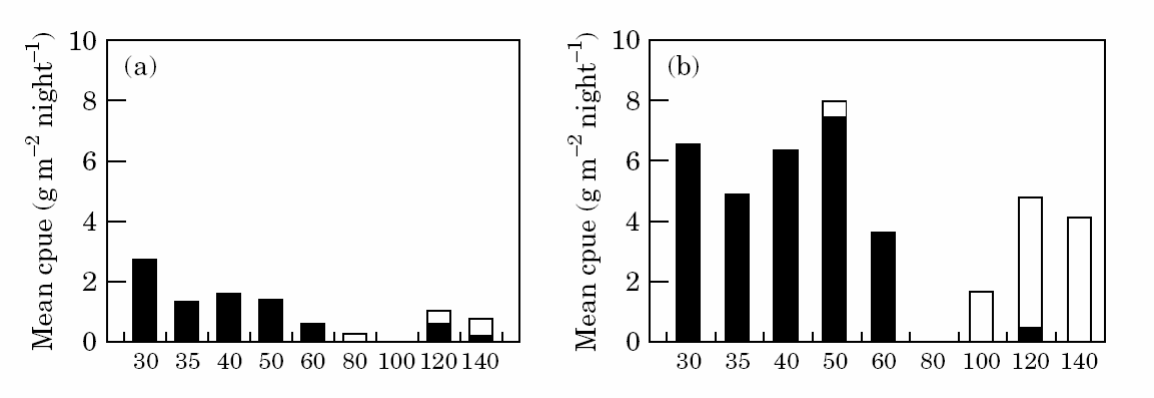


Figure 5.2a Standing stocks of wild fish (black) and stocked fish (white), as indicated by test fishing catch per unit of effort (CPUE), in water bodies under restricted(b) or open access (a).

(Unavailable)

Figure 5.2b Mean length of fish in the test fishing catch from waterbodies under restricted or open access.

Total catch and effort estimates were available from village records for the community fisheries, and from the household survey for several open access fisheries. The estimated catch and effort, on a total and per area basis, and catch per unit of effort, are summarized in Table 5.2b. The data for open access fisheries are based on only the first three rounds of the household survey and should be regarded as preliminary. Results so far indicate that average catches per unit area are lower in enhanced community fisheries than in open access fisheries. Average effort in open access fisheries is higher, by almost an order of magnitude, than in community fisheries. Average catch per unit of effort (CPUE) in open access fisheries is about one third of that in community fisheries, a figure that corresponds well to the relative CPUE estimates from the test fishing survey. While the figures, particularly those for open access fisheries, must be regarded as preliminary, it is clear that community fisheries do not at present increase yields over those obtained under open access. They do, however, result in a more efficient exploitation of fish stocks in that the given catches are obtained with much lower effort.

An important question with regards to the further development of active fisheries management through access restriction and stocking enhancement is whether such management can at least in principle improve yields. A preliminary analysis suggests that active management has this potential because wild stocks are very little exploited in community fisheries, which are targeting almost exclusively stocked fish, and stocked fish do not appear to suppress wild stocks in these systems. Fishing effort in the project area occurs at two distinct levels separated by almost an order of magnitude, and it appears likely that maximal yields are achieved at an intermediate level between the present community management and open access extremes. A more definitive, quantitative analysis on this issue will be conducted once all survey data have been processed.

Table 5.2b Catch and effort in small waterbody fisheries under community management and open access.

Waterbody	Area [ha]	Total		Per unit area		CPUE [kg/h]
		Catch [kg/year]	Effort [h/year]	Catch [kg/ha/year]	Effort [h/ha/year]	
Community fisheries						
Koud Ban	5	3005	3360	601	672	0.89
Nong Bua	7	271	3150	39	450	0.09
Nong Bung	4	2221	3360	555	840	0.66
Nong Hong	5	1837	13000	367	2600	0.14
Average				391	1141	0.45
Open access						
Koud Long	2	2124	6429	1062	3215	0.33
Nong Phai	2	1906	29080	953	14540	0.07
Xe Hak Noi	6	2027	40964	338	6827	0.05
Average				784	8194	0.15

5.3 Socio-economic effects of management regimes

Results in this section are based on the analysis of data collected in the exploratory research, baseline and monitoring surveys and the village data collection. It focuses primarily on the four community fishery villages. Exploratory results are mentioned only if these are not elaborated on in the latter stages of the research. A detailed account of exploratory results can be found in Appendix II. Analysis of the large quantity of data produced by the surveys (particularly the monitoring survey) is still being carried out and this section gives some of the preliminary results. Further results will be published in future publications (Garaway, C.J; forthcoming).

All the water resources under study were natural lakes usually modified by raised embankments, which, prior to the set up of the community management fishery systems, had been open for fishing by individual households throughout the year. As can be seen in Table 5.3a, this was no longer the case with use being prohibited or heavily restricted. This results section starts by looking at the possible costs of such restriction to households. (Other activities, such as the collection of other aquatic products, were still allowed and are therefore not discussed in this report). To do this, section 5.3.1 describes the importance of small waterbodies in general, and the previous importance of these lakes in particular, as sources of fish for household consumption and/or income. After describing these opportunity costs, the section goes on to mention briefly some of the set up and maintenance costs of the new management systems and who these were borne by. Section 5.3.2 discusses the benefits of current systems, their significance, what the main benefits were perceived to be and how they were distributed amongst users. Summary and conclusions are presented in section 5.3.3.

Table 5.3 a Uses of waterbodies before and after the introduction of new management systems

POND NAME	*NONG HONG*	*NONG BUNG*	*NONG BUA*	*KONG KNAK*
Village	NONG HONG	BUNG XIANG	XIENG HOM	KONG KNAK
Year started	1992	1991	1993	1993
fishing	√ (gear restrictions)	X	X	X
collecting small fish and shrimp	√ (gear restrictions)	√ (gear restrictions)	X	X
collecting wild vegetables	√	√	N/A	N/A
collecting snails	√	√	√	√
collecting crabs & other fauna	√	√	√	√
vegetable irrigation	N/A	N/A	√	N/A
crop irrigation	√	√	√	√
water for livestock	√	√	√	√
water for domestic use		√	√	√

Key		
	N/A	Not applicable
	X	No longer allowed
	√	Still permitted

5.3.1 Costs of community fishery management systems

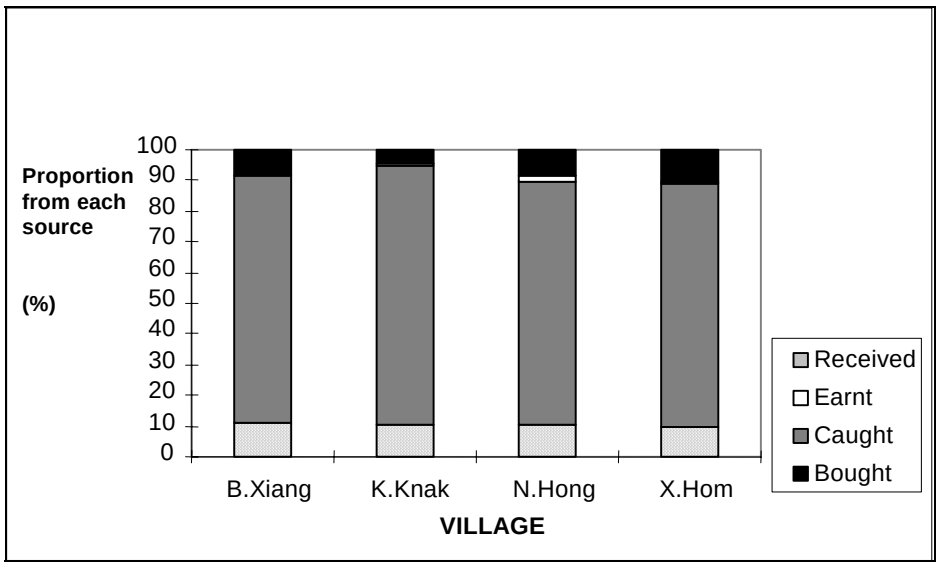
This section deals with some of the more obvious costs of community fisheries. The section has been split into three parts which are: Opportunity costs (5.3.1.1); set up costs (5.3.1.2); and maintenance costs (5.3.1.3)

5.3.1.1 Opportunity costs of community fisheries

As mentioned in the introduction, fish is considered to be the most important source of animal protein in rural Lao. In the exploratory research, subsistence fishing was found to be the most important source of this fish in all but one of thirty households interviewed across seven villages. The monitoring survey results supported this conclusion. Fig 5.3.1a shows that, on average in all villages, around 80% of fish brought into the household had been caught by household members. Fishing was therefore an important household activity. Exploratory research suggested that poorer groups in the community fished more in general and therefore would be affected more by changes to such systems.

Preliminary analysis of survey data has been inconclusive on this point but further analysis is necessary.

Data regarding the importance of small waterbodies, over other water resources, is still being analysed. Preliminary results suggest that the majority of fish was caught in the wet season, particularly from rice fields and rivers when the annual flood recedes. Small waterbodies appear to play a secondary role at this time of year. However, these small waterbodies played a very important role in the dry season when other sources become unavailable. At this time of year villagers relied on processed fish caught at times of year when fish were relatively abundant. Small water bodies were one of the important sources of fresh fish at this time. Given their significance, particularly at this time of year, the costs of management strategies that restrict or ban fishing to individual families must be properly considered. There is a danger that this could be overlooked with the desire for rapid



expansion of these systems to other districts and provinces.

Figure 5.3.1a Percentage of fish coming into the household from different sources (data from first three rounds of monitoring survey)

Having looked at the role of waterbodies in general, the specific roles of those waterbodies that had changed their management regimes to community fisheries are discussed next. An indication of the perceived previous importance of these natural waterbodies is shown in Fig 5.3.1b.

It shows that the majority of 103 households used the community fisheries for fishing. This was not unexpected as these waterbodies were all situated very close to the village and were the most convenient water resources. Nong Bung in Xieng Hom village was less popular because it was considered too deep in most areas.

Other evidence of these waterbodies' importance came from individual and group interviews in the exploratory research. The waterbodies were ranked highly (either first or second) over other sources as important for fish and the collection of shrimps. This information was collected using counters on matrices to indicate the importance of each available fishing resource (the more counters, the more important it was perceived to be). Results are summarised in Table 5.3.1a

To simplify the table, resources other than community fisheries have been grouped together showing total number of counters only. To get an indication of overall importance, the number of counters for the community fishery was expressed as a percentage of the total and this is shown in the last column. Overall importance varied considerably between villages. There were three instances where the score for the community fishpond is greater than 50%. These were: Importance of Nong Hong for fish and shrimp; importance of Nong Bung for shrimp.

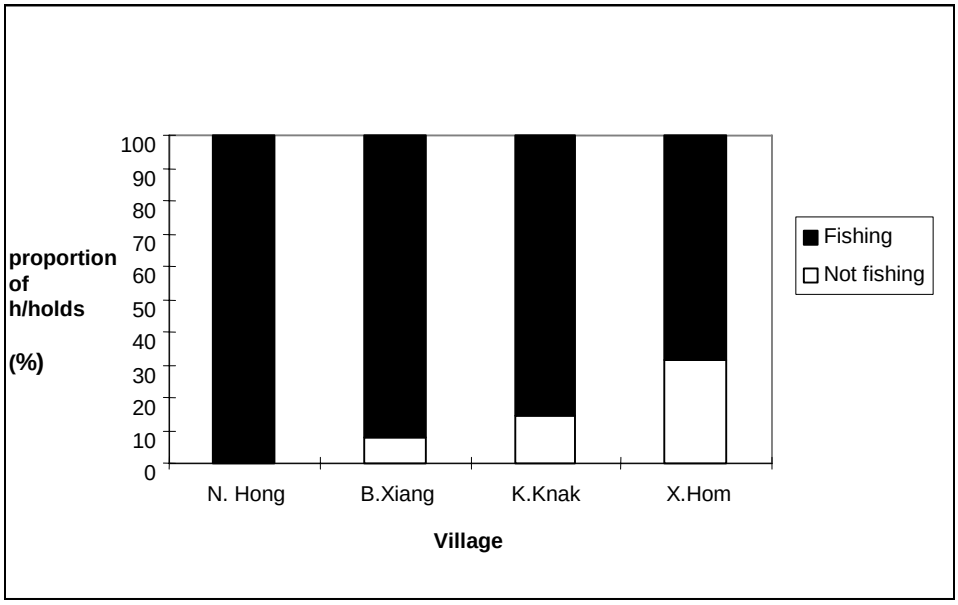


Figure 5.3.1b Proportion of households previously fishing in community fisheries (data from baseline survey)

Table 5.3.1a. Perceived importance of different water resources as sources of fish and shrimp

Product	community fishery	Other available water resources	rank of importance community waterbody	perceived importance of community fishery
	Nong Bung/ Bung Xiang village	Nong Phai, Nong Phu Huay Lamung, River Rice fields		
Fish	3	14	2=	18 %
Shrimp	6	5	1	55 %
	Kong Knak/ Kong Knak village	Long Mai, Nong Hang, Se Hak Noi, Nong La Pau, Se Hak Gnai, River, Nong Lam Tuk, Nong Weul, Koud Vang Hin, rice fields		
Fish	5	32	2=	14 %
Shrimp	5	23	1=	18 %
	Koud Nong Bua,/ Xieng Hom village	River, Nong Khe, Nong Bua, Rice fields Nong Kasai		
Fish	5	14	2	26 %
Shrimp	6	17	1	26 %
	Nong Hong/ Nong Hong village	Rice Fields		
Fish	5	3	1	63 %
Shrimp	5	3	1	63 %

Interestingly, fishing and shrimping were allowed in these cases whilst in all others they were prohibited. This suggests that rules for use of community fisheries have been adapted to local circumstances, allowing use when dependence on this resource is high.

This consideration of local circumstances may also explain why, even though their role had previously been significant, villagers perceived few disadvantageous effects of losing access, wholly or partially, to an important fishing resource. All interviewed said it was not a problem as they could fish elsewhere. The majority thought that any decline in fish catch (which *was* widely reported) was due to

a trend of increasing human populations and decreasing fish populations. They believed it had little or nothing to do with the loss of access to one resource.

These results show the benefits of local, context specific management strategies developed by users of the resource aware of local needs. It also highlights the dangers of people from outside the communities standardising management strategies to ease application elsewhere. Small waterbodies are important resources for natural food collection and removing this could have detrimental effects, particularly in areas where water resources are scarce.

5.3.1.2 Set up costs

The set up costs of community fisheries can be sub-divided into financial and non financial costs. All villages preferred to keep financial costs low with little preparation of the waterbodies before stocking, avoiding possibly beneficial, but more costly activities such as liming or clearing the pond of wild predatory fish. Fingerlings were the only real financial cost. Nets and other gear were borrowed from village members for the first season. The government has a policy of paying a percentage (up to 50%) of fingerling costs when a village stocks for the first time and, in some cases, villages were given free fingerlings from NGO's working in the area. Whilst this type of practice has been known to create village dependency, and lack of interest, this was not the case in this instance. However, in some other parts of the Province, handing out *unrequested* free fingerlings has had little beneficial impact (Garaway, PhD forthcoming) suggesting it is not necessarily an appropriate strategy. Finally, villages also tended to stock relatively few fingerlings further keeping costs low.

Non financial costs of community fisheries included the costs of devising and setting up new institutional arrangements regarding the use, maintenance, allocation of benefit, monitoring and enforcement of these systems and persuading water body users to accept and obey them. These costs were also low for a number of reasons, some of which are discussed below. The subject is covered in detail in Garaway, C.J forthcoming.

Persuading people was made easier by the fact that financial costs were very low and costs of access restriction were also perceived to be low. Also, rules were devised using the pre-existing institutional structure of the village administration and council of elders. These groups were trusted and respected by villagers and no additional effort was required to build up new institutional bodies. The new rules were also seen to be flexible, adapted to local circumstances and reversible if necessary, with all villagers having some means of being involved in the decision making. Lastly, villagers had seen the benefits that were obtainable from community fisheries by visiting the first village to set up a community fishery, Bung Xiang. With risks low, and the information that benefits could be high, consensus was less costly to achieve.

5.3.1.3 Maintenance costs

The maintenance costs of community fisheries were also low. Firstly, technical management was extensive with no supplementary inputs put into the waterbody such as feed or fertilisers. Fingerlings were paid for out of the profits made from fish sales. In some villages, nursing of fish and in some cases spawning was carried out in the village, keeping costs low. There was little maintenance work carried out on the resource itself. Occasionally embankments would be rebuilt, or villages would pump out the remaining water at the end of the dry season in an attempt to clear the pond of wild fish. When such work was required, it was carried out at the slack period of the year so that labour could be supplied by village members, who were accustomed to being called on to do community work. Other costs included: Fishing; marketing; monitoring and enforcing rule adherence. In all cases rules were chosen that would keep operational costs at a minimum. This appeared to be more important than maximising yields/benefits from the resource. For example, use rules generally included a total ban on individual use and a restriction of community fishing to the period after rice harvesting and before planting. Given the position of the affected waterbodies right next to the village, a total ban could be more easily monitored by villagers as they went about their work, therefore not requiring additional monitors. The restricted fishing season reflected the time availability of a village workforce. These factors were the primary determinants of the decline in fishing effort mentioned in section 5.2. Changing fishing rules to increase effort, whilst possibly increasing yields, could also substantially increase costs and be less desirable to villagers.

Rules for distribution of the benefit were chosen to satisfy the need to repay the fingerling loan, the desire for community income, and the rights of all villagers to benefit from the resource. Setting up a collective enterprise was perceived to be the least costly way of achieving this.

5.3.2 Benefits of community fishery management systems

Yields from community fishponds were used in several ways producing several benefits. A diagram showing the distribution of fish yields and follow on benefits is shown in Fig 5.3.2a. This diagram shows only material benefits, but there were also non material benefits and the creation of opportunities, both of which are discussed later in this section. The material benefits have been sub divided into financial, nutritional and improved services in the diagram. Most were direct benefits but some were indirect as they reduced other costs faced by households. The latter are represented by dotted line boxes in the diagram. A final classification relates to *who* they were benefits to. Some are benefits to all villagers, as it was difficult/costly to exclude them irrespective of their involvement in the provision of the benefit (provision being, amongst other activities, fishing, marketing fish, organisation and administration) or fulfilment of other criteria (e.g. payment, membership of a particular group). Other benefits *were* more easily excludable and were linked to these activities/criteria.

The principle of excludability is one of the main criteria distinguishing private (excludable) and public (non excludable) goods (the other being subtractability). This distinction is important in that there can be incentive problems associated with the provision of public goods, with people attempting to free-ride on the work of others. Incentives to provide these goods are often created by institutionalising private benefits (not necessarily material) for those willing to provide the good. Private benefits in this case could include fish as payment, a share of profits or increased prestige. A balance must be made between providing public and private benefits.

Preliminary analysis suggests that, in the case of community fisheries, public benefits outweighed private benefits in some villages, leading to incentive problems which could ultimately threaten the sustainability of the enterprise. This issue is discussed more fully in Garaway, C.J forthcoming.

Fish yields were distributed to people in and outside of the village. Income was generated from fish sales and the majority given to the community development fund, with some going to fishing teams and the committee, in some instances.

Not all benefits were available in each village. In particular, subsistence fishing was only allowed in one village (Nong Hong) and, until recently, Bung Xiang was the only village which gave its fishermen a share of the income generated from fish sales. Benefits in the remainder of this section are discussed under the sub divisions: Nutritional benefits (5.3.2.1); financial benefits (5.3.2.2); service and non material benefits (5.3.2.3) and lastly villagers perceptions of the main benefits from community fisheries (5.3.2.4).

5.3.2.1 Nutritional Benefits

It was shown in section 5.2 that overall yields appear to have reduced, or at best stayed the same, as a result of the community fishery management systems. This was primarily due to a reduction in fishing effort which was brought about by the new institutional arrangements. Under open access, all fish had been utilised by village members only. Now, some fish was consumed by and/or sold to non village members. This suggests that, overall, the waterbodies were playing less of a nutritional role within the village than they used to, and that nutritional benefit had been replaced by financial benefit.

Figure 5.3.2b gives a breakdown of how the yields from the community fisheries have been distributed. Only those years were data has been analysed and checked are presented here (data for Nong Hong does not include yields from subsistence fishing.) Figure 5.3.2c shows the proportion of *sold* fish leaving the village.

Figure 5.3.2b shows that, in all cases, a substantial proportion of yield was sold to produce community income. The majority of the rest was split between guests and “festival and other” (gifts, community work). Unfortunately it was not possible in most cases to split this latter group. Where information was available, the majority went to the village festival. With the exception of sold fish, it was not possible to ascertain how many of the consumers were village members.

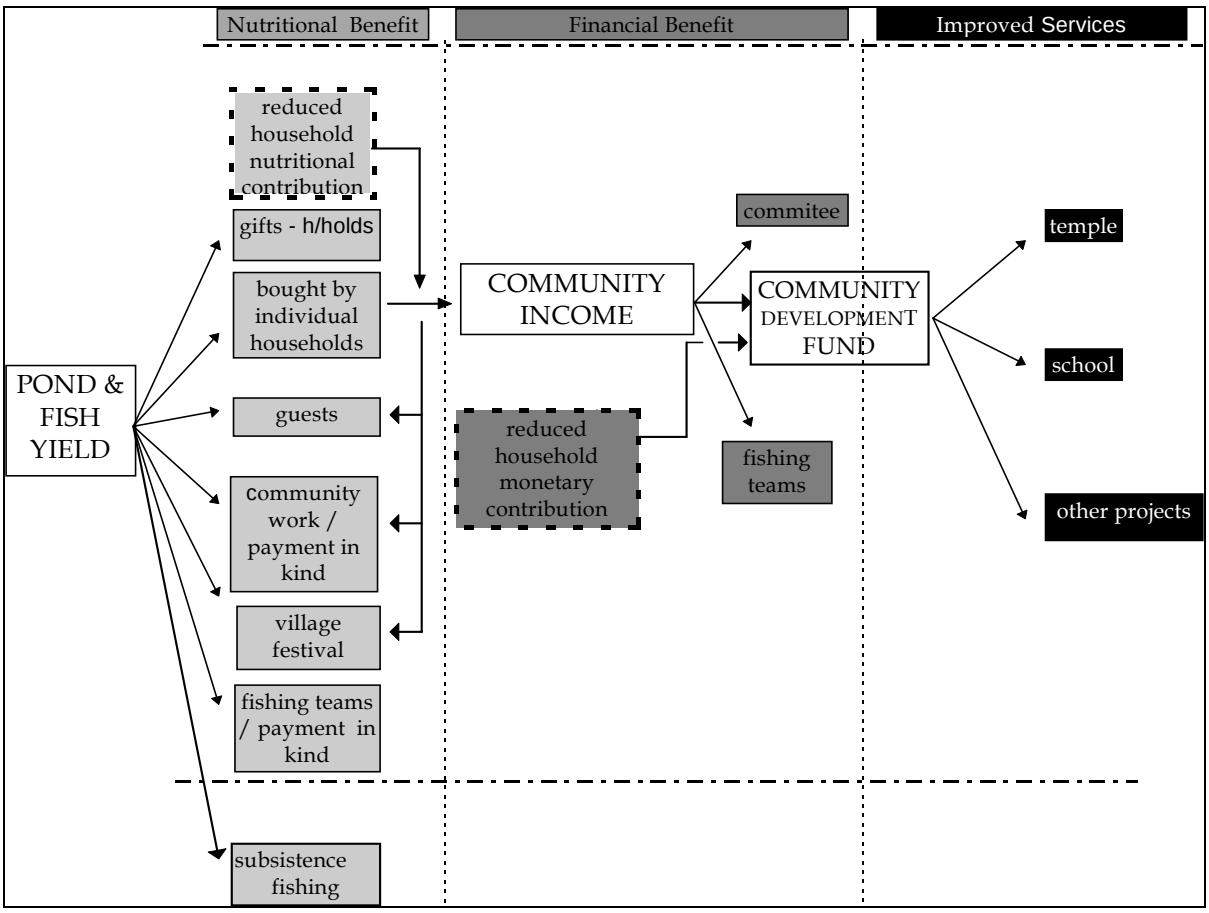


Figure 5.3.2a Overview of potential material benefits from community fishery management systems

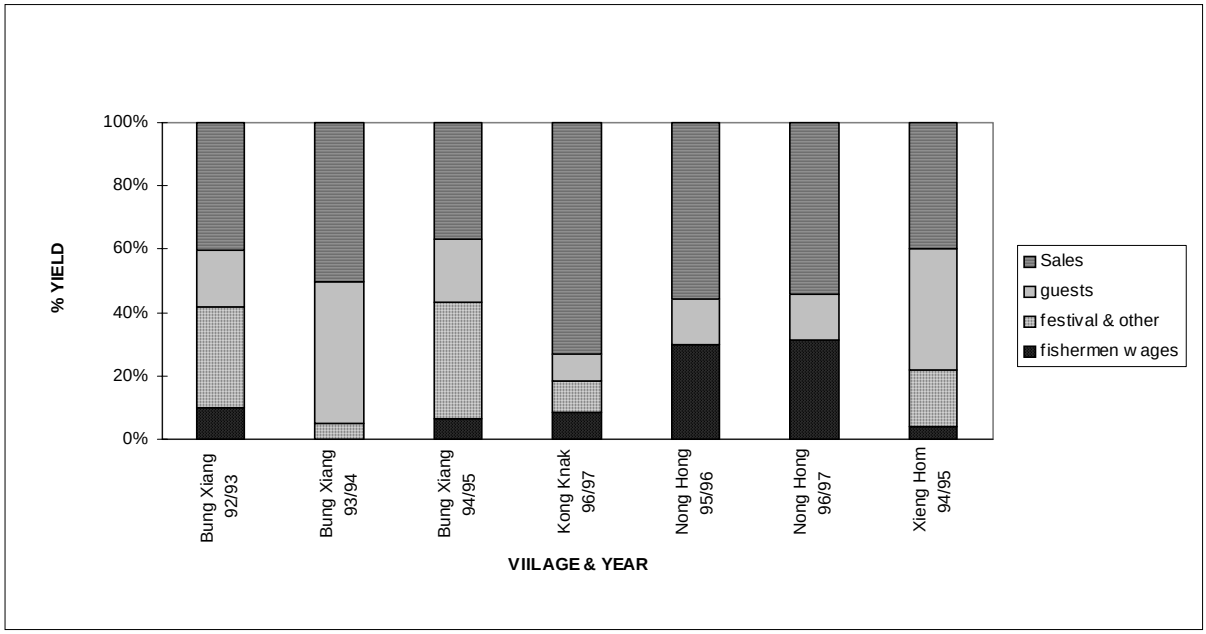


Figure 5.3.2b Destination of yields from community fisheries

With the exception of Nong Hong village, only a very small share of the overall yield was given to individual fishermen. As mentioned previously, this may explain the problems some villages had had with recruiting fishermen. In some cases the fishermen were given cash instead of or in addition to fish (e.g. Bung Xiang 1993/1994). This seemed to have a positive effect but it was not common.

Fig 5.3.2c shows that, in all cases, a significant part, if not the majority, of fish sold was leaving the village, further suggesting that the role the community fishery played in providing a source of protein for the village had been reduced. This could cause significant problems in villages where fish resources for village consumption are already low, but was not seen as a problem in these cases.

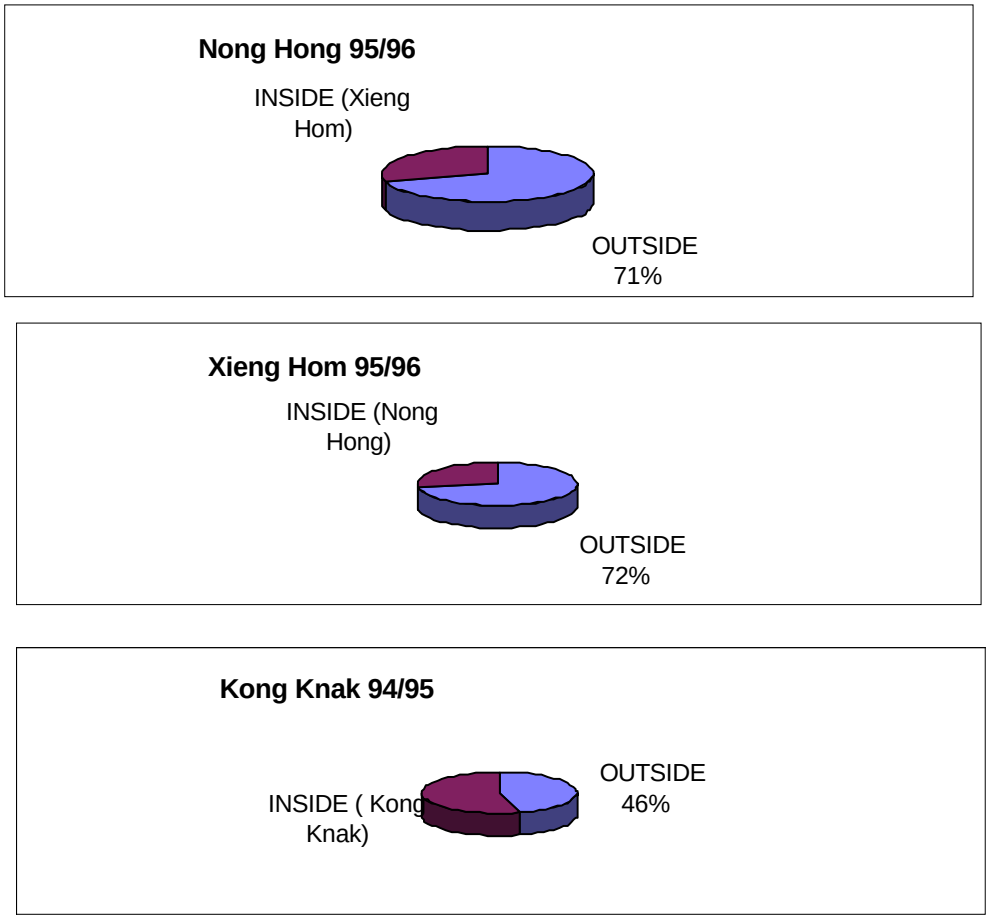


Figure 5.3.2c Proportion of sold fish staying in the village after the introduction of the community fishery management system

The overview of benefits in Fig 5.3.2a showed that an indirect benefit of the new system was that households were no longer obliged to contribute as much food for village festivals or when guests came as they had previously. Data on food contributions has yet to be analysed. However, preliminary investigation suggests that it had reduced, though it was not thought to be hugely significant.

Finally, another benefit was the creation of the villagers' o*pportunity* to buy and earn fish from the community fishery. The community fishery provided an additional source of fish at below market prices. Fig 5.3.1a showed how important bought and earned fish were as sources of fish utilised by the household. Bought fish made up less than 10% of total fish coming into the household with earned fish making up less than 1%. The majority of bought fish did not come from the community fishpond. Villagers capacity/ desire to buy fish (and their desire/capacity to earn it) was limited and so also, therefore, was the in-village demand for bought fish. This is another factor which constrains further development of these systems without further development of marketing systems.

Whilst the community fishery did not contribute significantly to fish coming into the household overall, Fig 5.3.2d shows the percentage of people from the village who had bought fish, at one time or other, from the fishery.

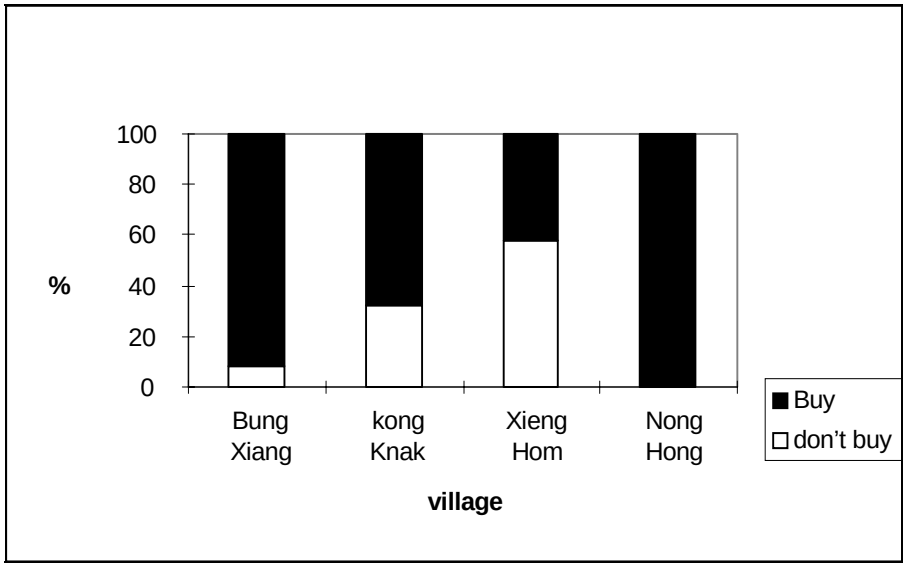


Figure 5.3.2d Households buying fish from community fisheries

This percentage varied considerably from village to village (45% - 100%) and was a reflection of the availability of other sources of fish and the degree to which the community fishpond management system had been in operation. Fish was often bought on special occasions - at times when there was a marriage/funeral in the family or when there was intense household work to be done (e.g. building/repairing houses). Generally this was more common than buying small quantities of fish on a day to day basis and the community fishery fulfilled a useful function of providing relatively large quantities of cheap fish (further discounted when it was for a funeral) at times of need. This could be particularly important for poorer families who do not have the resources to fund a funeral but are under a social obligation to do so. Whether this is the case or not has yet to be investigated fully.

Fig 5.3.2d does not give information on any differences between groups of households on how much or how often people buy fish (from the community fishpond). Fig 5.3.2 e, by looking at how much people from different socio-economic groups buy fish in general, gives an indication of *who* is most likely to be benefiting from the community fishpond's role as a source of cheap, good quality fish.

It shows the average quantity of fish bought per household per week stratified by socio-economic group. The figures are calculated using only the first three rounds of the monitoring survey as the

others have yet to be analysed. These first three rounds cover 24 weeks between April 1996 and November 1996. As can be seen, total quantities were low. However, richer people were buying significantly more fish than both the poorer and the middle groups. This is significant at the 95% level of significance. As rich people are buying more fish in general, it is expected that they are the people taking most of the in-village sold fish from the community fishery.

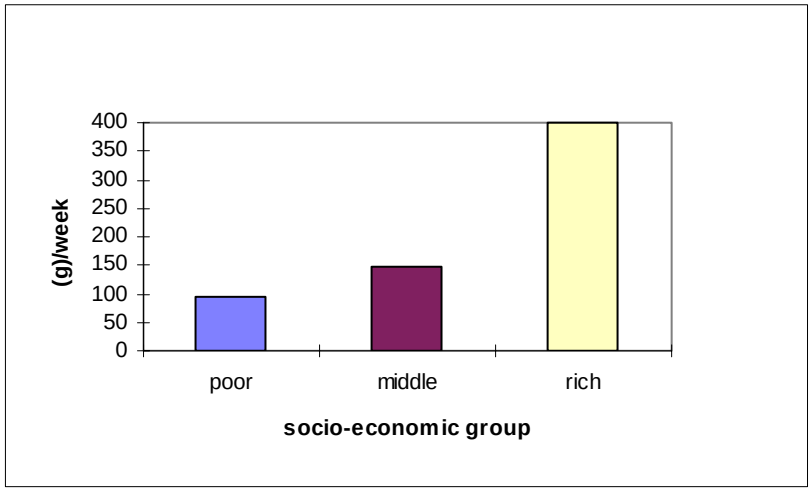


Figure 5.3.2e Buying fish - differences between socio-economic groups

In summary, nutritional benefits to the village as a whole have probably decreased or at best remained the same. There has been a real but not substantial reduction in the food contributions individual households were obliged to give to the village. A substantial quantity of people bought fish from the fishery but not on a regular basis. It is expected that richer households got more benefit from the fishery's role as a source of cheap fish as they had the means to buy it. However, buying fish was still a minority activity suggesting that demand for bought fish was still low.

5.3.2.2. Financial benefits

Community fisheries, with the exception of Xieng Hom village, generated significant community income compared to other sources. Fig 5.3.2f shows the percentage contribution profits from community fisheries had made to overall community income over the last few years in the study villages.

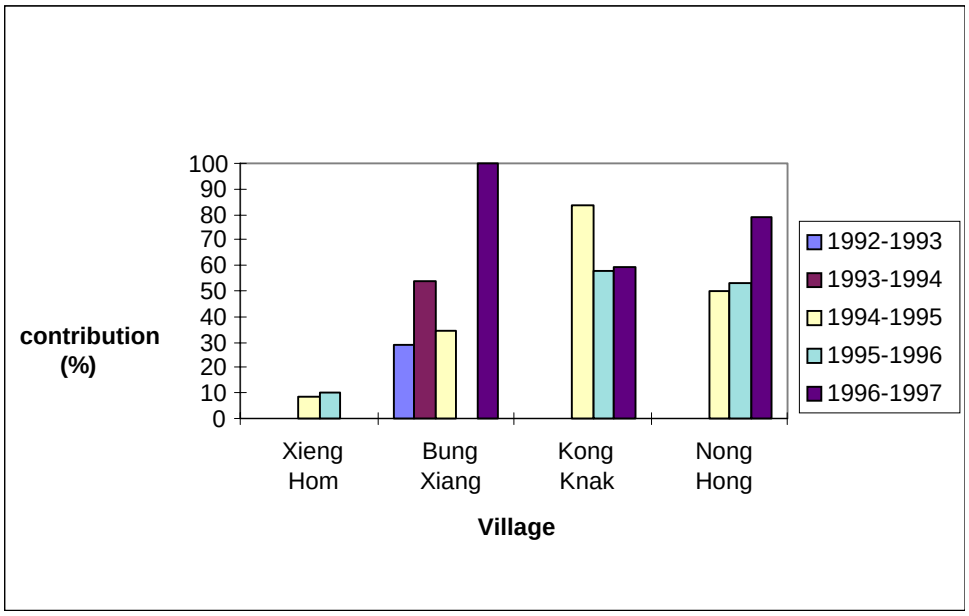


Figure 5.3.2f Percentage of community income generated by community fisheries in 4 study villages (from village records)

These results were supported by the exploratory research where community income was compared between community fishery and non-community fishery villages over a period of a year. These results are shown in Fig 5.3.2.g. Generally, those villages with community fisheries generated more community income than those without and community fisheries contributed significantly to this. Significant income was also made through renting waterbodies, a strategy not uncommon in the Province and employed by two villages in this study. Other main sources of community income, besides selling fish were village festivals and contributions from relatives outside of Lao PDR. Community income was spent on improvement of village services and infrastructure which was available to everyone and in that sense benefited all equally.

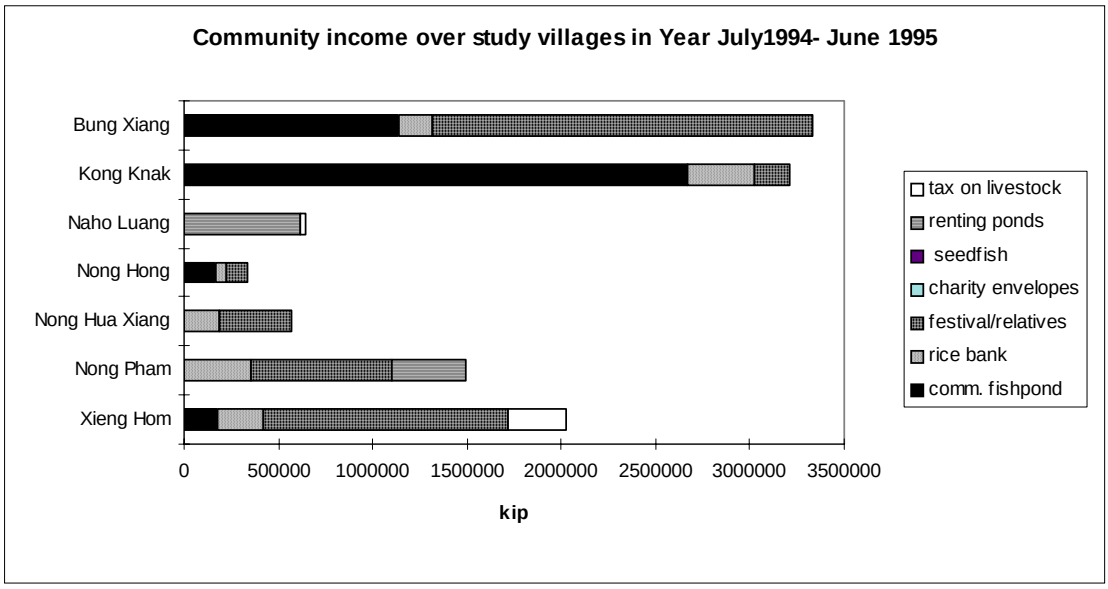


Figure 5.3.2g Community Income of villages in year July 1994 - June 1995

As well as producing community income, the community fisheries brought financial benefits to individual households. Individual household cash contributions to the villages' community development fund have decreased in the last five years. With the exception of households in Xieng Hom , (a village which had shown low and inconsistent profits from its community fishery), more than 80% of households in the household survey felt that the community fishery was the most important, or one of the most important factors in its reduction. Fig 5.3.2h shows the average household contribution before and after the advent of the new management policy.

The household contribution to the village had gone down with the average benefit to each household being between 4000-5000K ($4-$5 per year at current exchange rates). Whilst this may not seem substantial, it is equivalent to 3-4 days wage labour making it perhaps more significant than it initially appears, especially to poorer members of the community.

5.3.2.3 Services & non material benefits.

The community income generated was used most commonly for building or repairing schools and temples. It was also used to help pay for the building of an access road (Kong Knak) and villagers were now saving to provide their villages with electricity. Village improvement is almost completely in the hands of villages as there is little government funding for development at this level. Community income generating activities are therefore essential and take high priority in village life. As will be seen in the next section, this was perceived to be the most fundamental role of the community fisheries and one which it fulfilled better than most other activities.

5.3.2.4 Villagers own perceptions of benefits

Fig 5.3.2i shows which benefits the villagers saw as the most important. Each household in the survey chose 3 benefits which, in their opinion, were most important and ranked them. Benefits were weighted depending on whether they were ranked 1st, 2nd, 3rd to produce fig 5.3.2i The results give an indication of the relative importance of the different benefits.

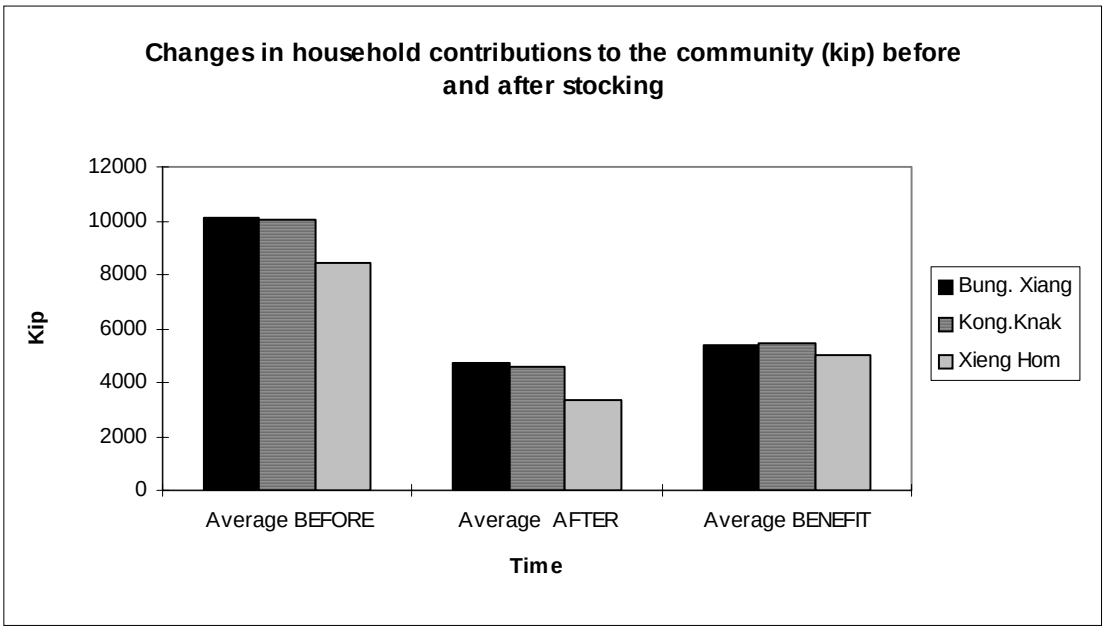
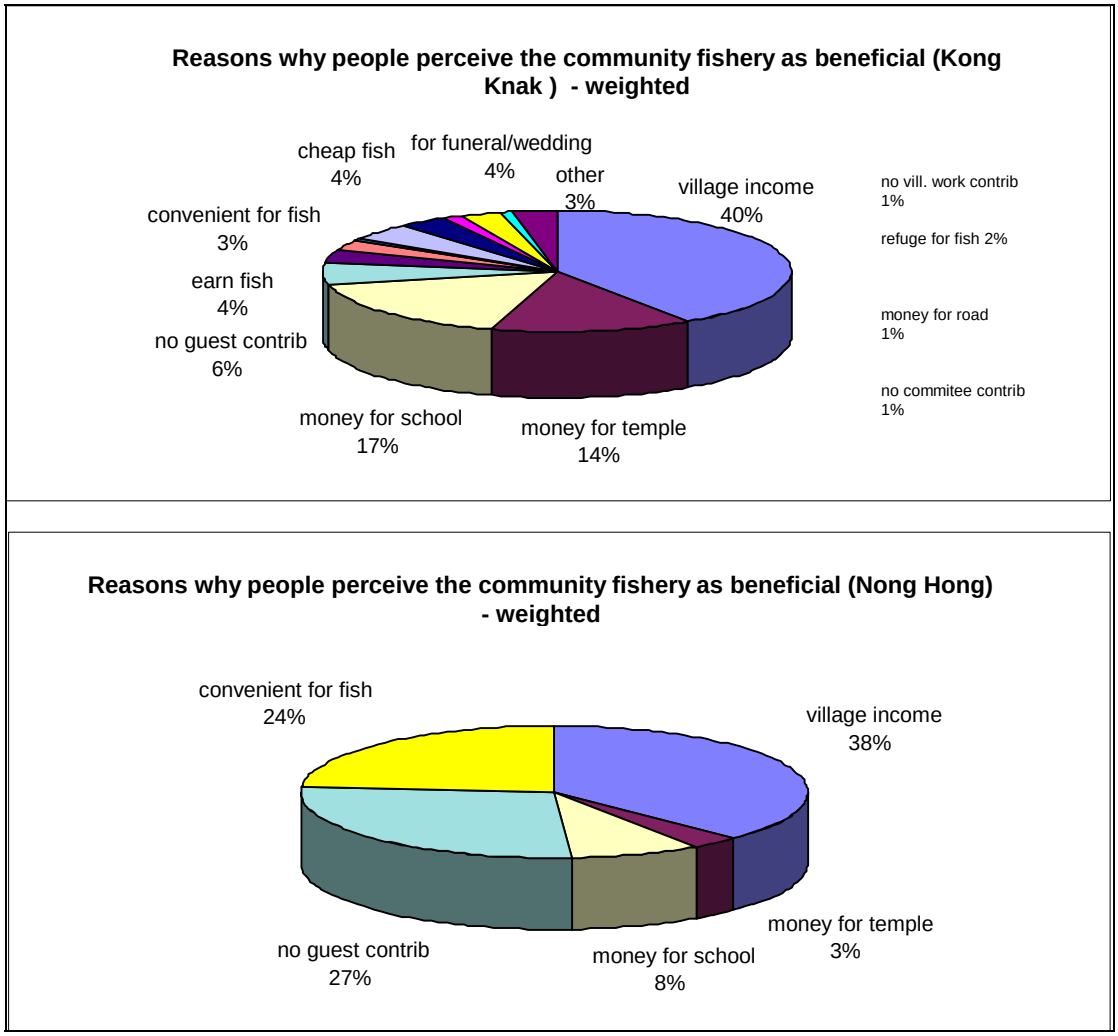


Figure 5.3.2.h Household contributions to the village (results from baseline survey)



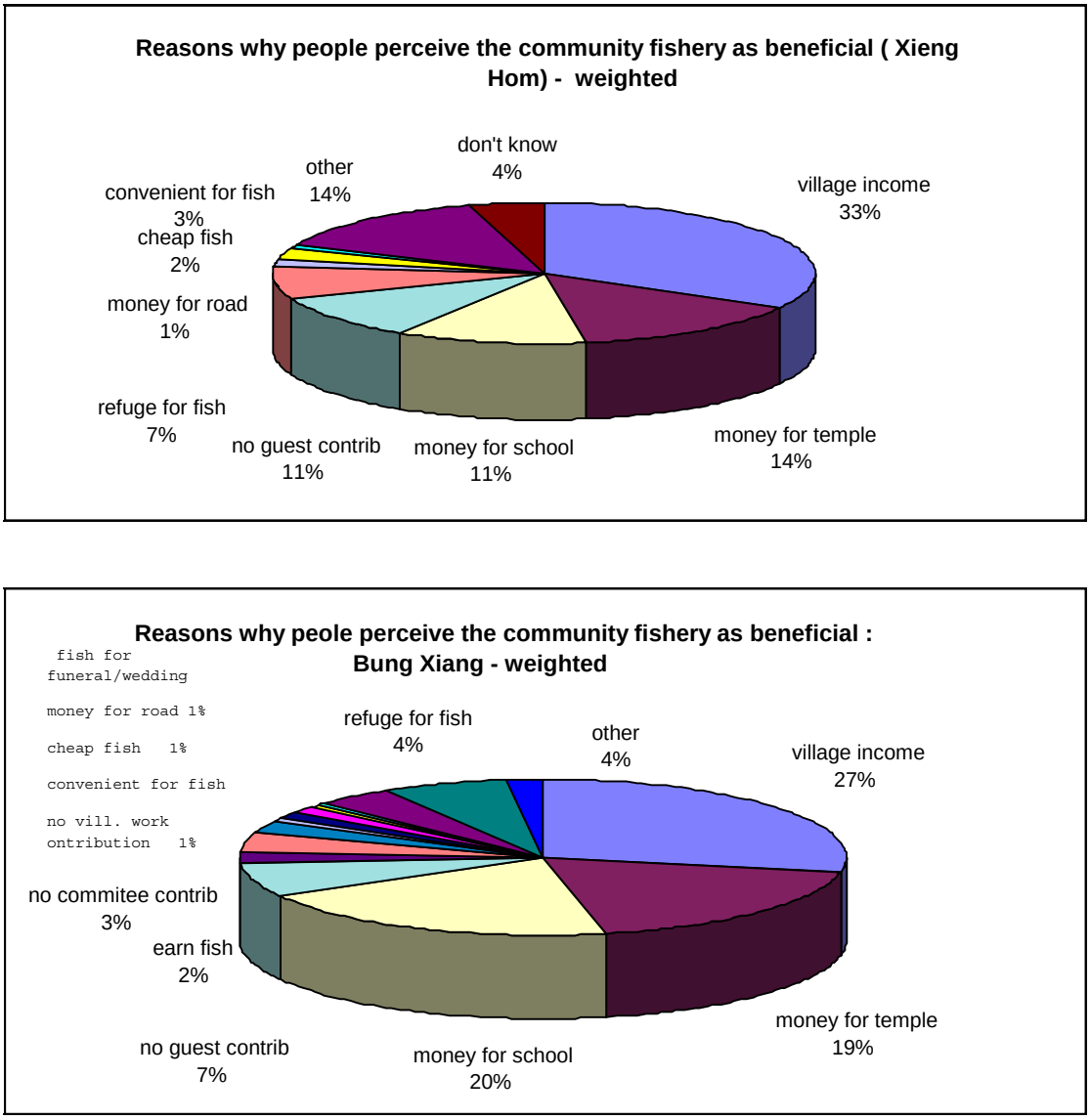


Figure 5.3.2i - Villagers perceptions of the benefits of the community fisheries

These charts show that there were many benefits mentioned, but that it was the community benefits: (income in general and income for the temple and school in particular) that were overwhelmingly thought to be the most important.

To conclude, community income generated from community fisheries was substantial and was more important than most other income generating activities. The generation of community income was a high priority for villagers and was perceived to be the most important function of the community fishery. Individual financial benefits were not that substantial and did not rate highly as a community fishery benefit. Financial benefits for fishermen were uncommon and low. More attention should be paid to compensating those who work to provide the community fishery if it is to be sustained.

5.3.3 Summary and conclusions

There are benefits to be gained from community fisheries. Financial benefits are greater and are perceived to be more important than nutritional benefits. Financial benefits to the community in general are favoured over financial benefits to individuals. Richer people buy significantly more fish than other groups making them the principle direct benefactors of the source of cheap fish. Poorer groups are less able to take advantage of this benefit.

The costs of setting up and running these systems are low, but are so at the expense of improved yields. Minimising risk and costs is a higher priority than maximising yields and/or income. However,

even if yields were improved, without a simultaneous increase in demand for bought fish, or improved marketing networks, it would be difficult to increase the community income currently generated.

Private benefits to individuals providing the systems are low and have been identified as a possible constraint to the sustainability of these enterprises. This should be taken into account, especially if there are moves to intensify the systems. The opportunity costs appear low in these cases, but these could be significant in places where fisheries resources are already scarce. This cost is more likely to be nutritional than financial. Local conditions should be properly considered before the implementation of new rules.

5.4 Conclusions and development implications

The main conclusions from the study are:

- Fish stocks in open access waterbodies are heavily exploited, most likely overexploited. Average standing stocks in open access waterbodies are less than a third of those in waterbodies with some form of access restriction.
- Fishing effort in community fisheries is lower, by almost an order of magnitude, than in open access fisheries.
- Yields per area from stocked community fisheries are lower, or at best equal to those achieved from open access fisheries.
- Community fisheries appear to be underexploited, primarily due to a lack of local demand to buy fish and/or a lack of incentive to fish and adopt more active marketing.
- Stocking may contribute significantly to standing stocks and yields, but is not in itself sufficient to increase either stocks or yields.
- Stocking appears to be a key factor facilitating the development of community management systems. Community fisheries exploit primarily stocked species with large mesh nets, while only lightly exploiting the natural stocks of mainly smaller species.
- Community fisheries conserve wild stocks in small waterbodies, with potential benefits in terms of recruitment to the open fishery in the seasonally flooded rice paddies.
- Community fisheries raise substantial income for villages. Villages with community fisheries had higher income than those without, and the fishery often contributed more than 50 % of the total.
- Income from community fisheries makes important contributions to village development through improvements to school and temple, and infrastructure development such as roads and electricity supply.
- Management systems in community fisheries appear to be designed to minimise management costs rather than maximise benefits. The low degree of exploitation of community fisheries is linked to the minimisation of costs.
- Villages have experimented with alternative management systems to resolve problems of incentives as well as technical management, and should be encouraged and supported in doing so.
- The contribution of community fisheries to household fish consumption is insignificant. More than 80 % of the fish entering households was obtained from fishing in open access waterbodies, primarily rivers, and from rice paddies.
- Community fisheries as presently managed do not convey nutritional benefits to villagers. The high stock levels maintained in community fisheries could, however, contribute to food security if their exploitation was permitted in times of emergency.

- Loss of access to small waterbodies for subsistence fishing can be a significant cost of community fisheries, but villagers have evolved management systems to minimise these costs where they are significant. Such adaptation of community fisheries systems to local conditions is crucial to their success and should be encouraged.

- Community fisheries provide indirect individual benefits in the form of reduced financial contributions to village activities.

The key implications of these results for the further development of active management systems are:

(1) Community fisheries in small waterbodies may be promoted to provide community income and related benefits, to conserve fish stocks, and to increase the efficiency of aquatic resource use (returns to fishing effort).

(2) Community fisheries as presently managed do not confer nutritional benefits to villagers and should not be promoted in areas where nutrition is considered a key development problem.

(3) Adaptation of management systems to local conditions is of crucial importance to the achievement of benefits from, and sustainability of active management systems. Programmes to promote community fisheries should support, rather than constrain, experimentation with management systems by villagers. In particular, the promotion of management systems that provide little incentive for individuals to participate, and extension of pond culture techniques that may be inappropriate for semi-natural small waterbodies, should be avoided.

(4) Governmental and non-governmental organisations should adopt an active role in supporting the experimentation of villagers to develop locally appropriate management regimes. As shown in this study, comparative analyses of a set of fisheries can provide crucial management information that is difficult to gain from individual fisheries, and provincial or national level organisations can play an crucial role in facilitating such analyses.

5.5 Results of strategic significance

The project has yielded results of strategic significance, in addition to the location-specific results already discussed. In particular, the close integration of technical, socio-economic and institutional analysis has resulted in a more integrated understanding of culture-based fisheries production systems. The need for such an integrated approach is self-evident from the project results. While previous technical and economic analyses have warned that stocking may lead to increased fishing effort and thereby endanger natural stocks, the reverse is true in the case of small waterbody fisheries in Laos. Stocking, in connection with various other factors, precipitates institutional changes that effectively result in a more sustainable exploitation (if not under-exploitation) of natural stocks. This result could not have been predicted by technical analysis alone.

The insights gained from the present project have been crucial to the development of an integrated framework for the analysis and prediction of the outcomes of culture fisheries development. Stocking is a technical intervention into aquatic resource systems of great complexity. The outcomes of stocking are determined by natural, institutional and socio-economic conditions which vary greatly between individual systems, and this implies a need to adapt management regimes to local conditions in order to achieve desired outcomes. Prediction of the outcomes of different potential courses of action is a key step in the development of appropriate management regimes. Various models are available to predict outcomes of stocking in technical, institutional and socio-economic terms. Predictions are usually fraught with uncertainties, which may be extremely large in situations where little knowledge of the resource system and previous experience of stocking outcomes exist. It is therefore important to conduct a broad-based diagnosis of the resource system prior to a prediction of stocking outcomes, and to make provision for adaptive learning from management experience, with consequent changes in policies and procedures. In situations of large uncertainty, deliberate management experiments may be conducted to generate the information needed to develop appropriate management regimes. Rigid guidelines for management may prevent adaptive learning and should be avoided unless there is solid empirical evidence for their superiority over alternative regimes that might evolve from the learning process. The role of analysts should be to facilitate and

guide the learning process, rather than to devise rigid guidelines on the basis of insufficient information. The new approach and framework has been presented at the FAO/DfID Expert Consultation on Inland Fisheries Enhancements in Dhaka, Bangladesh, in May 1997. The paper is included here as Appendix III.

6. Contribution of Outputs

6.1 Contribution to DFIDs developmental goals

The primary goal of DfID is the eradication of poverty, together with the promotion of economic growth and economic reform, and the mitigation of environmental problems. The outputs of the present project contribute to the achievement of these goals in a variety of ways. The active management of reservoir and small waterbody fisheries was shown to have important actual and potential benefits. Community income generated from the active management of fisheries improves services, particularly education, and also provides a buffer of community funds to cope with emergencies. As such, active management of fisheries contributes to the eradication of poverty. Community income also makes villages more self-sufficient and enables them to work towards their own development objectives. This is in line with the aim of promoting economic reform. The use of community funds derived from the fisheries to improve education and to connect villages to the electricity grid is expected to promote economic growth. Finally, active management has been shown to conserve wild fish stocks, mitigating the ecological problem of over-fishing.

Active management as practised at present does not confer nutritional benefits to villagers, but this is not seen as a significant problem by the villagers themselves who have consistently emphasized the benefits of active management. Where subsistence fishing in community waterbodies is crucial to nutrition, villages have taken this into account in the design of access regimes.

The study indicates that active management has the potential to yield much higher benefits than presently realised. In order to achieve the full potential of active management, the management regimes must be developed further and adapted closely to local conditions. This will be achieved primarily through experimentation by the villagers, a process that can be greatly facilitated by governmental and/or non governmental organisations. The project provides a framework for the implementation of such adaptive approaches to the development of active fisheries management regimes.

6.2 Identified promotion pathways

Uptake of results has been promoted in a variety of ways including publications and reports, presentations at conferences and seminars, and the organisation of workshops and training courses.

6.2.1 Publications and reports

Publications in press:

Lorenzen, K. & Garaway C.J. (in press) How predictable is the outcome of stocking? In: Expert Consultation on Inland Fisheries Enhancements. FAO Fisheries Report 559, Supplement.

Lorenzen, K. Population Dynamics. In: Tilapias: Biology and Exploitation. Edited by M.C.M. Beveridge & B.J. McAndrew. London: Chapman and Hall. [invited contribution undergoing final revisions]

Publications in preparation:

Garaway, C.J. (in prep.) Community fisheries in Laos, Phd Thesis, University of London.

Lorenzen, K., Garaway, C.J. Chamsingh, B. & Warren, T. (in prep.) Impact of stocking and access restrictions on fish stocks and yields in small water bodies in Savannakhet, Laos. Abstract submitted to the FSBI Tropical Fish Biology conference, July 1998. To be published in the *Journal of Fish Biology*.

Further publications on socio-economic aspects will be prepared upon completion of C.J. Garaway's PhD Thesis.

Reports:

Garaway, C.J., Lorenzen, K. & Chamsingh, B. (1997) Reservoir fisheries management in Savannakhet. Abridged version of the final report. Lao translation in preparation.

Garaway, C.J. (1997) Aspects of the management and utilisation of small waterbodies in Sonbuli District, Savannakhet Province, Laos. Internal Report.

Garaway, C.J. (1997) Report on the community fisheries workshop. Internal Report to the Livestock and Fisheries Section.

Warren, T. (1995) Photographic key to the common wild fish encountered in the project area. Booklets distributed to collaborating Livestock Officers.

Article

Fisheries ehancement research: getting the wider picture and dealing with uncertainty. Aquaculture News 23, June 1997.

6.2.2 Presentations at conferences and workshops

FAO International Expert Consultation on Inland Fisheries Enhancements, Dhaka, Bangladesh (Lorenzen & Garaway)

Seminar at the Asian Institute of Technology, Bangkok, Thailand (Lorenzen).

6.2.3 Workshops and training courses organised

Training workshops on Rapid Rural Appraisal (RRA) methods (C. Garaway); test fishing with multi-mesh gill nets (K. Lorenzen); identification of indigenous fish species (T. Warren).

Final project workshop (K. Lorenzen & C. Garaway).

6.3 Uptake of project results

Staff of the target institution, the Livestock and Fisheries Section of Savannakhet, were directly involved in all phases of the study. During the final project workshop, Section staff analysed data from the test fishing and household surveys to obtain key results from the data they themselves had collected. Hence project outputs have become working knowledge in the target institution and have also been relayed to representatives of the project villages. Both Livestock Section staff and village representatives emphasized the demonstrated benefits of community fisheries (community income, increase in catch per unit of effort, and conservation of wild stocks), and did not see the costs (possibly lower yield, loss of free access, slight decline in household fish consumption) as very significant. Hence project results are unlikely to lead major policy changes. However, villagers and Livestock Section staff are interested to increase the existing benefits of community fisheries through improvements in marketing and technical management.

At a more strategic level, the presentation on the new framework for analysing and predicting outcomes of culture fisheries development generated a great deal of interest at the Expert Consultation. The postulated need for a closer integration of technical and institutional analysis was widely recognized. The recommendation to adopt a generalized adaptive approach to culture fisheries development was more controversial, but received strong support from development practitioners.

6.4 Follow-up necessary to promote uptake

A key area where further research is required is the development of co-operative, adaptive management systems to support experimentation by resources users. This area is relevant to the intensification of common pool resource use in general, and a concept note has been submitted to the DfID Flexibility Fund.

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APPENDICES

APPENDIX I

Fisheries enhancement research: getting the wider picture and dealing with uncertainty

K. Lorenzen

APPENDIX II

Aspects of the management and utilisation of small waterbodies in Sonbuli District, Savannakhet Province, Laos

C.J. Garaway

APPENDIX III

How predictable is the outcome of stocking?

K. Lorenzen & C.J. Garaway