ODA Natural Resources Systems Programme: Aquaculture Research

R6380CB: Addressing technical, social and economic constraints to rice fish culture in Laos, emphasising women's involvement

Project Report Volume 3

Identification of technical, social and economic constraints to the rearing of fish in rice fields in Lao PDR: Resource management and information systems - A Situation Analysis

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Resource management and information systems - A Situation Analysis

Prologue

Following a period of in-country project planning[1],research teams were brought together in three districts through out Savannakhet Province in June 1996. Asituation analysis was conducted in six villages during a 6 month period between June and December. At the outset a workshop (3-14.6.96) was conducted in Savannakhet and in districts in which the project was to operate, with the three principal aims of team building, training and planning. Workshops were conducted with the provincial and district Livestock and Fisheries Section (LFS) staff, as well as collaborating staff of the Loa Women's' Union (LWU) to introduce some aspects of "PRA" techniques, as well as the concept of a participatory approach to understanding issues within, and characteristics of, local communities. It also proved necessary to reinforce the concepts of forward planning and work breakdown structure amongst research collaborators at the district level. In this regard the workshops were successful in enabling district teams to produce a detailed six-month plan to conduct participatory research in two villages in each of three districts throughout Savannakhet province. The plan incorporated research by equal numbers of female and male researchers, with men and women respondents. Team working was reinforced and the district teams developed modes of working together hrough a variety of learning-by-doing exercises throughout the workshop (see Loa Project Report 2). The teams took the opportunity to use different methods of information collection with a range of farmers, and to reflect on their findings in a follow-up workshop in Savannakhet (February 1997).

These workshops contributed to the development of improved strategies for farmer managed research being undertaken by the Asian Institute of Technology Aqua Outreach - Lao PDR (Outreach Program Laos Progress Report, May, 1997) and a process within the Livestock and Fisheries Section of empowerment and decentralisation. They also consolidated information on the farming systems in the study area. This report describes the farming systems based on the workshop reports and supplementary information.

[1] A visit to the Lao Peoples Democratic Republic (PDR) was made by the project co-ordinator and the collaborating social scientist/ NR specialist, in January 1996 with the purpose of planning the first stage of the Lao Rice-Fish Culture project. In particular to conduct project activities 1.1 and 1.2 regarding planning and management and begin exploring specific and contextual issues relating to rice-fish farming, activity 1.3 in the project logical framework, (Project memorandum R6380Cb, 1995).

Box1: The research teams

Key field researchers:

Khantabouli
Mr. Somboun, District Livestock and Fisheries Section, Khantabouli
Mr. Bounthavy, District Livestock and Fisheries Section, Khantabouli
Mrs. Nouna, Ban Xok Lao Women's Union / District representative Lao Women's Union
Mrs. Syronphan, Ban Gnang soung, Lao Women's Union

Atsphangtong
Mr Somphit Head of District Livestock and Fisheries Section
Mr Phonphet District Livestock and Fisheries Section
Mrs Khanthamala District representative Lao Women's Union
Mrs Khanthong Ban Nanokien LWU
Mrs Leoudone Ban Lian-xai LWU

Sepon
Mr Samlan Head of District Livestock and Fisheries Section
Mr Baula District Livestock and Fisheries Section
Mrs Okham District representative Lao Women's Union
Mrs Khounsy Ban Sepon LWU
Mrs Home Ban Thakhong LWU

Provincial support staff:

Mr Bounthiane Deputy Head, Provincial Livestock and Fisheries Section, Savannakhet
Mr Khamchanh, Provincial Livestock and Fisheries Section, Savannakhet
Mr Bounthong, Provincial Livestock and Fisheries Section, Savannakhet
Mr Bounthanom, Provincial Livestock and Fisheries Section, Savannakhet
Mr Thonglay, Provincial Livestock and Fisheries Section, Savannakhet
Mr Tingkham, LWU, Provincial Office, Savannakhet

Training and other support:

Mr Graham Haylor, IoA, Stirling
Ms Lawrence, AERDD, Reading
Mr Meusch, Local consultant, Savannakhet

Contents

1. Introduction

This report contributes to output 1, the 'situation analysis' of the Department for International Development (DfID), Aquaculture Research Program project R6380Cb, 'Addressing technical, social and economic constraints to rice fish culture in Laos, emphasising women's involvement'. The project is a collaboration between the Institute of Aquaculture, University of Stirling, the Agricultural Extension and Rural Development Department, University of Reading and two organisations in Savannakhet Province in Lao Peoples Democratic Republic (PDR), the Livestock and Fisheries Section (LFS) [of the Department of Agriculture] and the Lao Women's Union (LWU). The LFS is Facilitated by AIT Outreach Lao (part of the Asian Institute of Technology Outreach Program) in its contact with the project. Two previous reports provide a country overview and project outline (volume 1) and details of a research methods workshop (volume 2), and should be referred to in conjunction with this report.

To date, most research into farming and resource systems has focused upon areas of reliable rainfall or irrigated systems, so called high potential areas[2]. Under these circumstances, a Development Potential - the gap between Realisable Potential[3] and Achieved Production (see Jones *et al.* 1996; Harvey, 1992) can be defined, and basic research can lead to "green revolution" technologies being developed and implemented. However, as attention turns to more complex systems in rain-fed areas, such as the rice fields of Lao PDR, there is more uncertainty in the estimation of Realisable Potential and the nature of the research agenda is less easily determined because resource systems are diverse and conditions more erratic. Farmers in rain fed areas need to engage in complex integrated systems of resource use. These systems are continually adapted by their operators in response to many factors but especially: fluctuations in the timing and intensity of rainfall, the consequences that these hold for local resource systems, and the affect that such fluctuations have on ongoing strategies. In addition, because of the marginal nature of most rain-fed farming systems, the families that farm them are poor and especially vulnerable to the effect of unreliable rainfall. Such "peripheral poverty" described by Chambers (1988) is characterised by water scarcity, resource degradation, lack of infrastructure, distance from markets, etc. The communities who manage diverse, risk prone agro-ecosystems therefore rarely adopt pre-packaged "complete solutions" developed by outsiders. The development of renewable natural resource (RNR) recommendations in support of poverty elimination, requires a different approach.

The key elements of the approach used here are:

?? To involve RNR-based poverty reduction strategies for the peripheral poor, targeting the needs of small and marginal farmers (see Project Memorandum).

?? To involve farm families as key participants in the definition of the research agenda and the development of recommendations (see LPR Vol. 2 and figure 1.1).

?? To adopt approaches based around the flexible livelihood strategies employed by farm families in rainfed areas (defined by a situation analysis).

[2] E.g. Punjab in Pakistan, Haryana in India, the rice deltas of South Asia, etc.

[3] That which can be attained by optimal sustainable use of presently recognised resources.

?? To involve local institutions as key participants in the implementation and management of the process (e.g. LWU LFS, see LPR Volume 1 & 2), as part of a structured planning process, to ensure sustained farmer involvement.

An important focus of the appraoch has been the emphasis on women's roles in the farming system, and the scope for working with women in developing fish-in-rice systems. The project does not aim to work only with women, but recognises that women's activities and requirements are less apparent than those of men, and that therefore a special effort is needed to document their roles, and to offer them the opportunity to participate in the project. Phase one of the project included methods designed to communicate and interact specifically with women, and this report includes a section which focuses on gender-related roles in the communities studied. The implications of women's activities and attitudes are discussed separately in the conclusions.

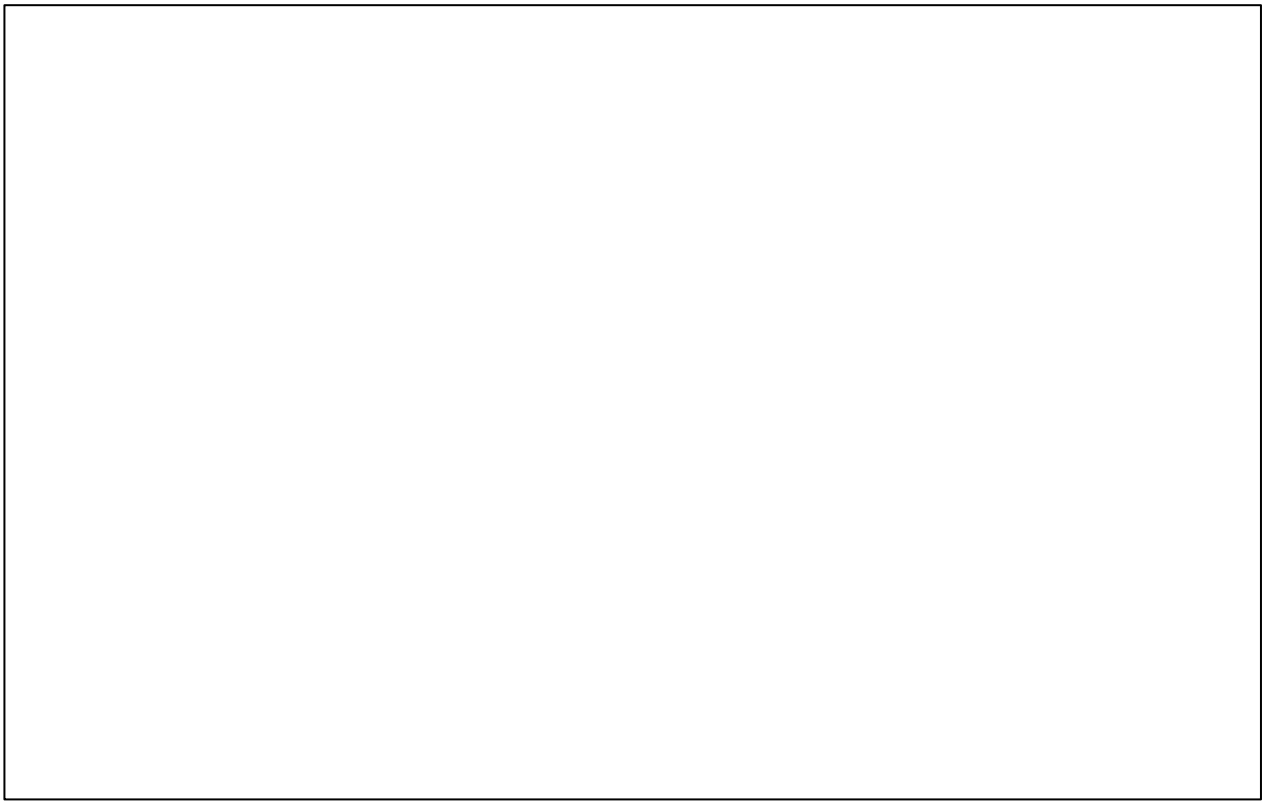


FIGURE 1.1: THE DEVELOPMENT OF PARTNERSHIP TRIALS WHICH INVOLVE FARM FAMILIES AS KEY PARTICIPANTS IN THE DEFINITION OF THE RESEARCH AGENDA AND THE DEVELOPMENT OF RECOMMENDATIONS

This report covers the situation analysis and the definition of the research agenda used to begin to address constraints to the production of fish in rice based agro-ecosystems in Savannakhet province, Laos.

2. Methods used and data reliability

The research procedure followed in phase one was:

1. reconnaissance visit by external project staff, January 1996;
2. review of published and 'grey' literature, Jan - June 1996;
3. discussions with key informants (project staff) to identify range of agro-ecological zones and villages for study;
4. two-week training workshop for district staff, in data collection methods and appropriate PRA tools; most of this workshop was field based and allowed the researchers to collect further information by:
5. semi-structured interviews
6. direct observation
7. group discussions
8. observation of trainees ability to use the methods
9. review of conclusions by trainees
10. six months of planned data collection by district research teams, during which a range of socioeconomic groups were interviewed, and a range of topics explored;
11. review of data by provincial staff during the report writing phase, December 1996;
12. review and analysis of data during presentations and feedback at workshop, February 1997, by both provincial and district staff;
13. identification of information gaps by UK, provincial and district staff at the same workshop: principally inadequate or superficial information on gender-division of work and attitudes; and lack of detail on individual farming systems;
14. development of specific research tools to address these gaps, with project staff;
15. focused group discussions with women (see below for more detail), February 1997;
16. systems diagrams drawn by selected farmers to describe their farming systems;
17. targeted interviews with key informants (oldest villagers) to strengthen information on change;
18. a series of 22 farm walks throughout Ban Xok, Ban Gnang soung, Ban Nanokien and Ban Lien xai
19. cross-checking with key informants (village leaders, project staff, researchers) to seek an explanation of data patterns.

The project incorporated elements of PRA, in the sense that it was strongly dependent on some of the tools which have been developed for PRA (participatory mapping, transects, matrices, historical diagrams and seasonal calendars). However it is important to recognise that researchers external to the village were the controllers and analysers of the data. This process, more akin to RRA, is more reasonable when the agenda is set and limited by the outsiders so that, although they can offer farmers full control of the research process within a given field (rice-fish culture), support is not being offered for all of the identified needs of the villagers (Whiteside 1997). One lesson of the research methods workshop is that it is not necessary nor desirable to package all such diagnostic work as 'PRA', especially when great leaps of institutional procedure would be required to take on board the community-focus development philosophy of PRA. It was also found that, where outside researchers have a wider agenda, and are searching for generic quality in the work, it is necessary to

complement PRA with other more conventional methods (Abbot and Guijt, 1997) - which gave PRA a specific niche in a range of methods used to complete the case study.

The basic approach used for the situation analysis was that of a multiple case study, depending almost entirely on qualitative data collection methods. In case studies, standard procedures are followed for ensuring that the data collected through case studies, whether quantitative or qualitative, and / or participatory data, are useful. The principles of such data collection are summarised in Box 2 after Yin (1994).

Box2: The principles of collecting the data (after Yin, 1994)

Construct validity: establishing correct operational measures for the concepts being studied; to fulfil this criterion we need to be sure that measures of change do reflect that change. Construct validity can be enhanced

?? using multiple sources of evidence (often referred to as *triangulation* by PRA practitioners);
?? establishing a chain of evidence, in other words providing sufficient information to allow the reader to follow the linkages from cause to effect;
?? reviewing the output with key informants.

Internal validity (for explanatory studies only): establishing a causal relationship, whereby certain conditions are shown to lead to other conditions; this is not relevant to these descriptive case studies.

External validity: establishing the domain to which a study's findings can be generalised; external validity is enhanced by

?? generalising to a theory, not to a description;
?? using multiple case studies.

Reliability: demonstrating that the operations of a study - such as the data collection procedures - can be repeated, with the same results; reliability is enhanced by

?? documenting the procedures followed;
?? establishing a case study database so that the data can be accessed and re-interpreted by others.

In this study, validity is been ensured through repeated review of the findings, and by the use of multiple sources of information. As a result, both district staff and external researchers have been able to overcome their lack of familiarity with either the methods or location, by sharing a process of iteration and triangulation. This process has been quite the opposite of a blueprint approach to research design; it has developed in response to the learning process achieved by the project team, and adapted to the specific social, institutional and geographic conditions of Savannakhet Province.

Triangulation itself is achieved in a variety of ways; Yin (1994) again elaborates on these:

?? multiple data sources (data triangulation)
?? multiple researchers (investigator triangulation)
?? multiple perspectives on the same data set (theory triangulation)
?? multiple methods (methodological triangulation).

The research process outlined above indicates how each of these were used , with the exception of theory triangulation. Project staff were considerably more interested in 'doing' rather than 'analysing', which is a reflection of their profession. In one sense theory triangulation was achieved by the iteration described above - whereby outside researchers form conclusions from the data and test them by presenting them back to local researchers.

The project has been methodologically innovative in designing and adapting research tools, and a few of the most important are described in appendix 1.

3. Research sites

The location of selected research sites affects the issues which are highlighted by the project and the constraints to fish production in rice paddies that are identified. Particularly noteworthy in this regard are the huge *topographic variations* encountered throughout the country, from floodplain to high mountain and the *ethnic groups* within Laos, with different livelihood strategies, which tend to be stratified by the land type and altitude at which they live (see section 4 and LPR volume 1). In addition, location affects *access to local and imported resources* and markets. Villages located close to forested areas have access to a wide range of local foods, production-enhancing inputs and grazing, that are unavailable to villages in dry or deforested areas. Larger towns and communities close to the Mekong have access to a range of imported goods, many originating from Thailand, whilst further east transport and communication are impaired and such resources are scarce. The *age of a village* can also play an important role in determining its characteristics; long-established villages, often with several centuries of development of land and water management infrastructure, contrast with newly-established villages, currently creating small dams, reclaiming dry forest areas and bunding paddies. New villages are often made up of resettled refugees returning from Thailand or 'over-spill' from villages which have outgrown their available local land holdings; village structures and community attitudes may therefore also vary with age of village. In addition, older villages may be strategically located beside forest or water courses whereas recent villages are often close to main traffic routes (such as route 9 through Savannakhet province from the Mekong to the border with Vietnam); this can affect relative access to natural and imported items.

Finally, location also largely determines the *impact and legacy of bombardment* resulting from recent conflicts affecting Indochina (associated with the war in Vietnam). This can include: the incidence of unexploded ordinance, bomb craters (now commonly small perennial or seasonal ponds, depending upon soil type), the importance of scrap metal as a rural income generating activity, post-war sex ratios within villages, the incidence of limblessness, and enthusiasm for pond digging and earth moving.

The project is working in Savannakhet Province (see Figure 3.1), the largest and most low-lying in Lao PDR. The province is quite varied topographically, and as such contains areas representative of much of the country. Lowland areas of Laos are represented in Savannakhet Province by the Savannakhet Plain (below 200 m), which borders the River

Mekong and one of its tributaries Xe Banghiang, here the project is working in the district of Kantabouli. The central part of the province comprises rolling upland areas, found elsewhere in Laos, some covered by dry *dipterocarp* forest and other areas now deforested. This area is represented within the project by the district of Atsphangtong. To the west of the province, towards the border with Vietnam, are the heavily forested (and heavily bombed) highland areas characteristic of much of Laos, with mountains and upland valleys, some of which are farmed. In this region the project is working in the district of Sepon.

The Lao project staff (see box 1) have selected 2 contrasting villages in each of these 3 topographically distinct districts to provide a snap-shot of the range of circumstances encountered across the province and the country. The location of research sites are shown in figure 3.1; detailed local maps are shown in figure 3.2, 3.3 and 3.4 and the features of each district and village are described in the following sections.

FIGURE 3.1: THE LOCATION OF THE DISTRICTS AND VILLAGES IN WHICH THE PROJECT IS WORKING (ADAPTED FROM MICROSOFT 1994)

3.1 Kantabouli district

Kantabouli is a lowland district close to Savannakhet town, characterised by lowland paddy farming, with new road and community irrigation projects being developed, with relatively good transport and access to inputs and markets from the provincial capital, and via river

transport from Mukdahan and N. E. Thailand. Loamy sand soils predominate in Kantabouli, with widespread phosphorus deficiency in areas bordering the Mekong (Schilling, 1996).

The research team in Kantabouli have focused on two villages, Ban Xok and Ban Gnangsoung (the location of Ban Xok and Ban Gnangsoung are shown in Figure 3.2.):

Ban Xok is located on Route 11 (the Savannakhet to Paxse main road), 12 km from Savannakhet (approximately 25 minutes by bus, two wheeler tractor or motor cycle). The village which is 435 years old, is made up of 240 households. Xok Neua lies to the east and Xok Thai to the west, to the south above the village is forest. The area of forest and the numbers of wild fish have decreased markedly over the last 25 years and population has risen. Ban Xok has lateritic soils (some recently sold to contractors for the upgrading of route 11) and 7-8 villagers have made use of buldozers recently for earth moving and pond building. Fish seed are available from a private seed supplier (Mr Kumar who has close ties with B. Xok) close to Savannakhet.

Ban Gnangsoung is located several kilometers off Route 11, 15 km from Savannakhet (approximately 50 minutes by two wheeler tractor or motor cycle). The village is 103 years old and comprises 168 households. A forested area lies to the south of Gnangsoung which is surrounded by 3 other villages. Ban Gnangsoung has poorer quality sandy soils, fertiliser is often required, there is little water management, native rice varieties are commonly grown. Over the past 25 year the forested area locally has decreased, the number of wild fish have decreased and population has risen. Fish seed is now available in Gnangsoung from a local supplier.

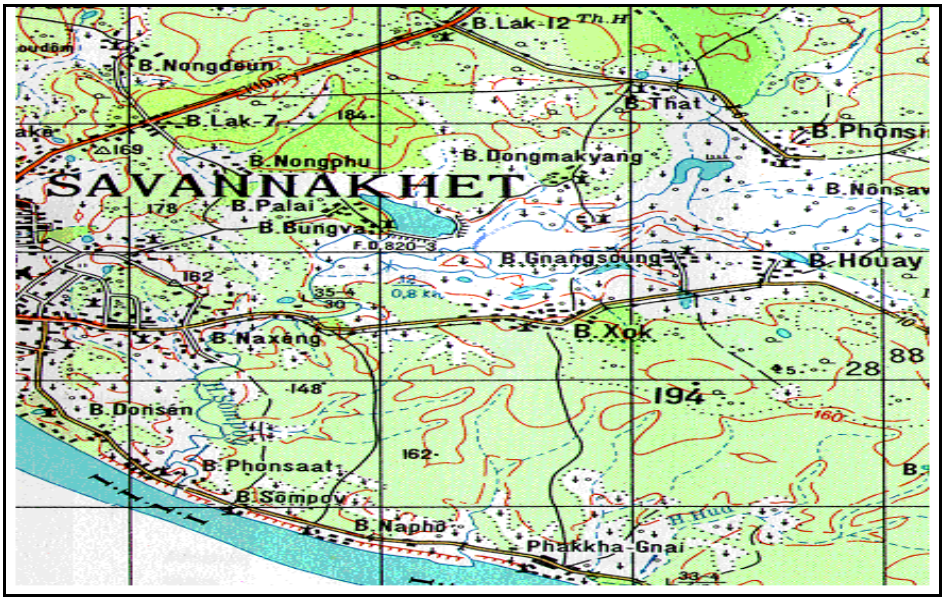


FIGURE 3.2:BAN XOK AND BAN GNANGSOUNG IN KANTABOULI,

3.2 Atsphangtong district

Atsphangtong is a district about 90 km from Savannakhet town and the Mekong, characterised by dry dipterocarp forest in rolling upland, some of which is converted to paddy. There are numerous small watersheds amongst the rolling hills but no large or

medium irrigation schemes. The district has no major towns but is bisected by Route 9 (the main road from Savannakhet to Vietnamese border) which is an important trade route. Sandy soils and marginal lateritic/sandy soils predominate in Atsphangtong,. Village age (see previously) is an especially important characteristic in the district where many newly settled villages are developing along route 9.

The research team in Atsphangtong have focused on two villages, Ban Nanokien and Ban Lieng Xai (the location of B Nanokien and B Lien Xai is shown in Figure 3.3.).

Ban Nanokien is located some distance from Route 9 (the main route from Savannakhet to Vietnam), 15 km from Atsphangtong (approximately 1.5 h walking, 45 minutes by bicycle, 30 minutes by two wheeler tractor - there are currently 2 in the village). There is no vehicular access to the village and during the rainy season the only means of reaching Atsphangtong is by foot. The village which is 156 years old, is made up of 105 households. By Astphangtong district standards, Nanokien is well resourced and relatively self-sufficient, surrounded by paddy and two perennial streams. However, the area of forest and the numbers of wild fish (still both, highly important sources of food) have decreased markedly over the last 25 years and population has risen. A weir on a local stream impounds 2.5 ha of water used for irrigation where fish catching is banned.

Ban Lien Xai is located on Route 9 (the main route from Savannakhet to Vietnam), 20 km from Atsphangtong (approximately 1.5 h walking, 45 minutes by bicycle, 20 minutes by two wheeler tractor - there are currently 2 in the village, buses are also available). The village which is 10 years old, is made up of 56 households. Lien Xai is surrounded by dry forest and some newly developed paddy and mini-dams (100 ha of dry forest have been cleared by the villagers. The village is far from any river. There are two community water bodies nearby, one for drinking and one stocked with fish. The village of Sai Buatong lies to the east. The dry forest is poor, productivity is low and villagers lead a marginal existence. Drought is a major problem. As mini dams are created in small water-sheds locally the numbers of wild fish (migrating long distances from rivers) have risen. Chemical fertiliser is used for cropping and much experimentation is underway to identify good crop varieties.

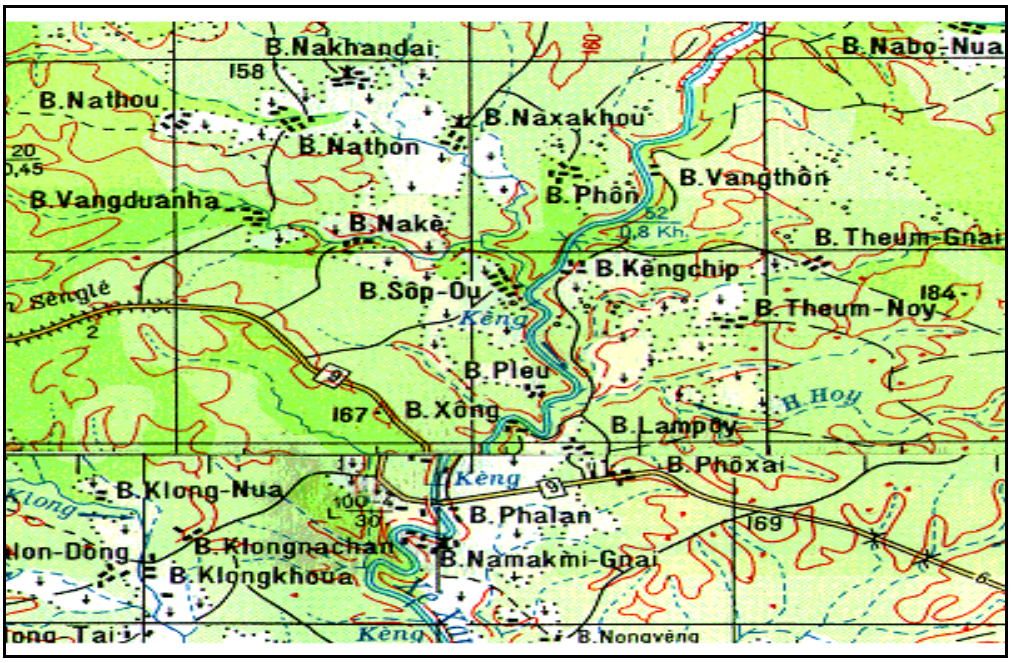


FIGURE 3.3: BAN NANOKIEN AND BAN LIANXAI IN ATSPHANGTONG,

3.3 Sepon district

Sepon is a remote district about 210 km east from Savannakhet town and the Mekong, close to the border with Vietnam. The district is characterised by high mountainous terrain. Route 9 (the main road from Savannakhet to Vietnamese border) which is an important trade route passes through the district. There is little institutional development, poor access to external resources and markets and poor transport infrastructure. Soils are predominantly lateritic and marginally fertile.

The area was severely affected by the war in Indochina from 1964 to 1973, suffering particularly heavy aerial bombardment. The landscape is littered with bomb craters (now commonly small perennial or seasonal ponds, depending upon soil type) as well as unexploded ordinance. In many areas defoliated during the war, bamboo now predominates. Scrap metal is an importance rural income generating activity, and there is little enthusiasm for pond digging and earth moving.

The research team in Sepon have focused on two villages Ban Sepon and Ban Thakong (the location of Ban Sepon and Ban Thakong is shown in Figure 3.4.):

Ban Sepon is located some 4 km from the nearest town away from Route 9. There is no vehicular access to the village during the rainy season. The village which is 125 years old, is made up of 46 households. The village has community forest to the south and lies close to the Pone river and the Huay Seniem stream. However, the area of forest and the numbers of wild fish (still both, highly important sources of food) have decreased markedly over the last 25 years and population has risen since the end of the war in Laos and Vietnam. Flooding is a major problem in the ricefields

Ban Thakong is the district headquarters located on Route 9 (the main route from Savannakhet to Vietnam. The village which is 70 years old, is made up of 105 households.

Thakong is surrounded by paddy land and community forest. The village is close to the Bang Hieng river and the Pone river.

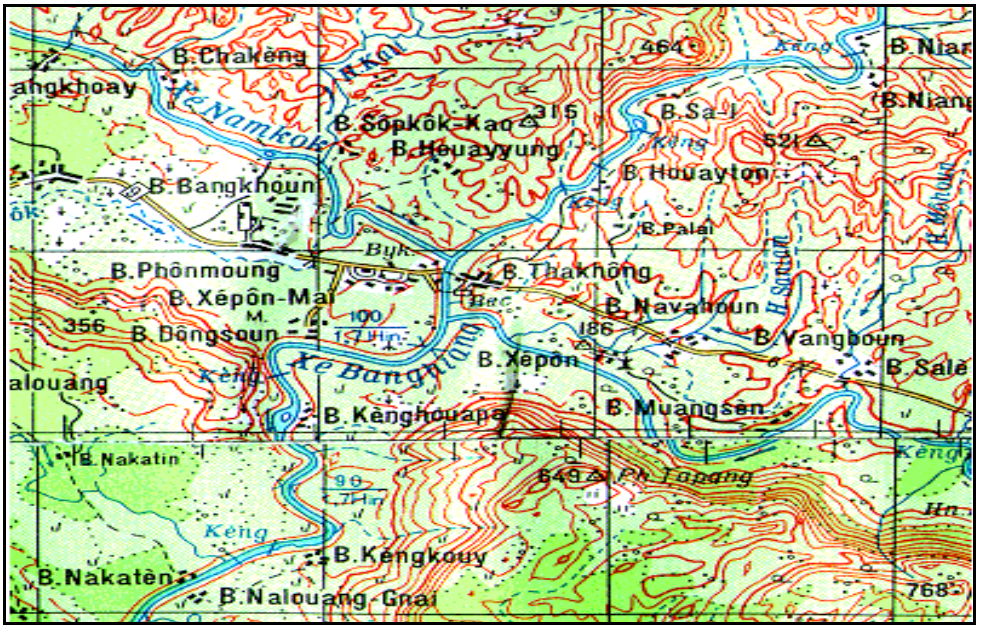


FIGURE 3.4: BAN SEPON AND BAN THAKONG IN SEPON DISTRICT

4 Situation analysis

4.1. National context

Laos, until recently one of the worlds most isolated "people's republics", is emerging from its isolation and the devastation of successive wars in Indochina. Its former alignment and almost exclusive trading relationships with Vietnam and the previous Soviet Union are diminishing and Loa's new foreign policy orientation appears more broad ranging. Foreign trade is increasing with near neighbours such as Thailand and the expanding Chinese economy, with many implications for supplies of production enhancing inputs, pest control chemicals, fish seed supply, etc. as well as markets for a range of products including fish.

A range of regional and national development issues currently pose a number of challenges for farming and fish production in Laos. The biggest developments pending in the Mekong basin are a series of hydroelectric dams that would change the face of the river for most of its length (Lohmann, 1991), one third of which is in Laos, which also contains 40% of the rivers tributaries. Many of these water management changes herald negative impacts for the 90% of Mekong fish that spawn, not in the river but the surrounding lakes and submerged fields, during and following the rains. Nationally, within Laos, logging and the construction of dams is also resulting in social changes, such as resettlement (at Nam Theun 2) and environmental changes to land and aquatic environments, such as altered flooding patterns, soil compaction, erosion and siltation, and loss of natural fertility, which will impact on fish production.

Rice production is the central feature of the farming systems in Laos, occupying more than 80% of cropped land, with annual national production ranging from 1.2 - 1.5 million tonnes (Committee for Planning and Co-operation, National Statistical Centre, 1995). 97% of rice production is rain-fed, about one quarter of which is upland rice, the remaining 3% is irrigated lowland rice. Although a broad range of agro-ecosystems produce rice, the National Policy on rice production focuses on the rain-fed lowland environment, with efforts directed towards greater self-sufficiency of production, the expansion of small scale irrigated schemes, reduced rice cultivation in the long term in upland areas and improved stability of the environment. The majority of rice production across the country currently comes from lowland rain-fed paddy, (much of it from Savannakhet province which occupies just over 9% of the country yet accounts for over one fifth of the country's rice production). Small-scale dam-based irrigation schemes are beginning to support paddy in lowland areas, whilst at higher elevations, upland rice and even mountainous "swidden" rice production systems occur widely, with some paddy cultivation in upland valleys.

Natural fish stocks in Laos are declining due to a range of unfavourable human interventions such as water pollution, deforestation and dam construction (Phonvisay, 1994). Fish has traditionally contributed the major portion of animal protein intake of the rural population in the Lao PDR (85% of the total) but due to increasing population pressure, consumption levels are currently very low (7kg/person/year) (Phonvisay, 1994). The Laotian riverine fisheries have declined by 20% over recent years (Cavas, 1994) and production in lakes and reservoirs has declined by 60% in the past 15 years (Phonvisay, 1994). As a consequence, aquaculture is the first priority programme of the Department of Livestock and Veterinary Services, Ministry of Agriculture and Forestry and is widely recognised as having great potential to offset current declining fish production trends (Phonvisay, *pers. comm.*). Currently, however institutional development in support of farming and fish production is at an early stage in Laos. There is an embryonic extension service at provincial and district levels (the Livestock and Fisheries Section of the department of agricultural services) but currently no national research system. The Lao Women's Union has an interest though little experience of developing fish production.

In view of growing limitations on the availability of land and water resources, the importance of rice farming in Laos and the shortfall in fish supply there is considerable interest in integrated rice fish production in agro-ecosystems in which this can be accommodated. Available information to guide the development of fish production in rice fields in Laos is currently limited to a model developed by FAO for irrigated rice (LAO/89/003) (Singh, 1994) (and therefore principally of relevance to those with access to well developed resources) and some base-line trials conducted by the Lao-IRRI project during 1993, 1994 and 1995. These studies were considered inconclusive, in 1993 because of lack of farmers' experience in fish raising and in 1994 and 1995 because of severe flooding, resulting in fish and rice losses (Schiller, 1996). Further trials are not planned (Schiller, *pers. Comm.*).

4.2 The local context

This section deals with the local context including issues of the social structure of rural communities, land tenure, the local economy and agricultural information systems.

4.2.1 Social structure of rural communities in Savannakhet

There are important variations in socio-economic status within the communities where the project is working. This has implications for the introduction of new resource management systems which may not necessarily be adoptable by all, but may have other indirect effects, such as changes in wild food availability, employment opportunities and nutrition.

There are three broad ethnic groups in Laos: the Lao Lum, the Lao Theung and the Lao Sun (see LPR volume 1 for a detailed description of Lao ethnic groups) which tend to inhabit lowland, upland and mountain areas - the second and third of these are commonly referred to as 'ethnic minorities'. While the project is working in communities which are almost entirely lowland Lao (Lao Lum), it is worth noting the factors which led to this and which make fish production in rice paddies a management system which is less likely to be adopted by the upland Lao groups. In general the upland Lao have fewer material possessions, and less access to good land or irrigated valley bottoms. Meusch (1996) found that upland Lao reported less land cultivated per household and lower use of improved rice varieties, compared with Lao Lum people. Tanaka (1993) found a similar situation in upland villages of Luang Prabang, where the Lao Lum were engaged in more wet rice cultivation than the Lao Theung, who concentrate more on slash-and-burn strategies; Roder *et al*. (1995) also found the Lao Lum more likely than Lao Theung to own paddy and to adopt income-enhancing technologies in the uplands. Therefore, although it is increasingly a Lao government priority to focus development on the uplands, and a DFID priority to target the poorest, technology developments involving aquaculture are unlikely to be immediately appropriate to Lao Theung peoples and those dwelling on the upper slopes of mountains. The investigation of the potential economic and nutritional benefits of increasing the fish supply through the stocking of rice fields has important implications for the poor of lowland Laos, many of whom currently fail to produce sufficient to meet their needs.

The villages in Laos are characterised by a strongly integrated social structure, with a well-defined sense of mutual responsibility and care for the less well-off. Ireson (1992) describes systems of labour exchange in lowland villages which not only provide economic security but also village solidarity, and says that the ideal of a unified village is still accepted despite political and economic changes. He also points out that these systems help to prevent strong economic stratification, so that although there are wealth differences among families, these differences are not extreme. Older people are particularly respected and their example is likely to be followed by other villagers. The current study supported this but found that the labour exchange systems are being abandoned in favour of waged labour, so that an economic situation more similar to that in north-east Thailand is evolving.

Each village is headed by a group of village elders, who in the project villages are all men. The role of president is largely administrative, and decisions are taken by the elders collectively. Elders are widely respected for their knowledge of all the households in their village. Most women in the villages belong to the women's committee which is linked to the national Lao Women's Union (LWU). Lao communities have a tradition of committee

decision-making. Ireson (1990) has documented this process for water management (). Villages with irrigation schemes have Water Users' Groups which allocate water from the reservoirs, and everyone who has land in the command area belongs to the group.

The household is also an important decision-making unit since land is owned and controlled by the family, not by the community. Women' social position is relatively high in Laos, as in much of Southeast Asia, based on men's and women's mutual dependence for production in subsistence farming, and particularly on women's traditional economic role as pursekeeper and vendor in the marketplace (Ireson, 1992). Lowland Lao women have higher status than the highland groups, and usually stay in the village of their birth, their husband moving into the matrifocal family. Our gender analysis showed a clear pattern of joint decision-making by husband and wife (although the male role is more conspicuous and the husband is designated 'head of household' by Lao officials unless the woman is widowed). In a few cases women stated that their husbands would tell them what to do (usually in older couples) but almost all group and individual discussions indicated that women and men clearly see themselves working together interdependently, and that both would be affected by the implications of a decision so both should consider it beforehand. Men tend to initiate decisions affecting farming and aquaculture, while women tend to initiate decisions concerning horticulture and marketing, but this is not universal. The village studies showed that many villages have more women than men, which is largely attributable to losses during the war, rather than outmigration of men in search of work. The differences are small but reflect a general trend across Laos, whose population consists of 52% women. As a result, all the study villages have a small number of female-headed households, although widows tend to remarry within a few years.

While rural communities are poorer than urban ones, there are variations in wealth between the families in each village. Wealth is widely perceived (by government officials at least) to be the consequence of hard work, poverty the reward of laziness, but in fact wealth is inherited (see below, section on tenure). In Kanthabouli and Sepone the district research teams included a wealth ranking (see appendix 1) in their summary reports. In both Sepone villages, and in Gnang Soung, the number of families in the poorest of three categories is more than half of the total population, while in Ban Xok the majority of families was placed in the middle wealth category (see table 4.1).

Table 4.1. Distribution of wealth categories as perceived by village headmen

Village	% poor families	% middle families	% rich families
Xok Kang	15	64	21
Nyang Soung	55	39	7
Thakhong	50	30	29

Sepone	61	39	0

Perceptions of wealth depend on proximity to roads and markets - in both Kantabouli and Sepone districts, the communities with the higher proportions of rich families are those which are situated on main roads.

Wealth categories within rural communities were categorised by the district staff participating in the project as:

- ?? rich people have some of the following: a good house, with a tin roof; lots of land; a vehicle; a business e.g. a small-scale rice mill; they are never hungry
- ?? middle people usually have enough to eat but may have difficult years; they have some land but not much, and a few head of livestock; their homes are average and they have no vehicle or business
- ?? the poor have very little land and regularly produce less than they need to eat
- ?? poor people are the same in all three districts, but rich people in Kanthabouli are richer than in Sepone, where a rich family would not have a motorcycle, only a few head of cattle
- ?? in Sepone there is enough land for everybody so this is not a feature of poverty; poor people are thought of as lazy (but may have other labour constraints); on the other hand in Ban Xok land is limited and there is nowhere else for poor people to go to.

Villagers in Nanokhien also grouped families in a way which has been used in other , more detailed wealth-ranking studies in South-east Asia (e.g. Belsky, 1984; Garaway, 1995). Villagers classed households in three socio-economic groups according to their ability to supply household rice needs from home production (rice surplus, sufficiency or deficit).

4.2.2 Land tenure

In principle, all land is owned by the state, and farmers pay taxes for the rights to cultivate that land. In effect, because the system is stable and such rights are hereditary, rice fields are individually owned. One family may own rice fields in more than one village because of marriage and inheritance patterns. Usually, the only common land is that containing the temple, cemetery and school. Forest tenure is more variable, reflecting population density. In the west, in Kantabouli, the grazing land in the forest is divided between the families of the village who have hereditary rights to it; this system is also recognised in parts of Atsaphangtong but in the newly settled villages such as Lianxai the forest is open-access. Anyone can forage there, but it can be claimed and improved, by converting it to rice fields, in which case the tenure becomes private. Even on private land wild resources are common property, and anyone may catch wild fish from a private rice field. If that field is stocked with fish, however, the owner will deny access. Ponds are owned by those who dig them on their land, while irrigation reservoirs may be the property of individuals or the community.

4.2.3 The local economy: labour, income sources and trading

Laos ranks among the poorest countries in the world, having a per capita income of US$230. Until 1986 the economy in Laos was centrally planned; government policy now

focuses on increasing the employment opportunities and income levels of small farmers and thus improving gradually their standard of living.

When discussing the pros and cons of various enterprises, farmers in this study took into account labour, cost, frequency of inputs and speed of results. Land is not yet scarce in Savannakhet - even in the most densely populated district, Kantabouli, almost no families are landless, and in Atsaphangtong and Sepone the area cultivated is limited by the amount that the family can clear and work. Labour is the more critical economic factor, along with capital. Credit is rarely available, although there are now government credit schemes targeted at the poorer rural areas.

Shared labour is commonly described in Lao villages (Ireson, 1992) but seems to have declined in the last two decades; wage labour is comparatively much more common now. In Nanokhien, wage rates of K1000 / day were quoted whilst local road contractors 3 km from Nanokien paid labour rates of 1800 kip/day. Although few families there use a system of waged labour some farmers commented that shared labour creates debts and ties, and is difficult particularly for the poorer households to provide the food to host a working group.

Income tends to be generated from weaving and the sale of vegetables, bamboo poles, bamboo mats, thatch, and hired labour. The sources of income vary considerable between the villages. Lao lao (a spirit distilled from fermented rice) made by the women, is important in the local economy of some villages including Nanokhien,. Weaving is an important source of income for women, but mainly where electricity allows them to work in the evenings.

In Ban Xok the main sources of income are vegetables, and thatch weaving. Those who have ponds get more income from fish. A high proportion of villagers in Kantabouli case study villages were ranked as rich and because of their proximity to Savannakhet, many have salaried work in the town (about half of the families in Nyang Soung). In Atsaphangtong district only one or two residents of the villages studied have salaries; other families receive remittances from their relatives living in cities.

Vegetable prices there are higher in the rainy season because of lower availability - most people are busy producing rice; and because they rot more quickly. In Lianxai wild harvest was the most important source of income - contrasting with the other villages especially in Kantabouli - although even in this most populated district villagers sell mushrooms from the forest . The significance of natural resources for income is further emphasised by the importance of wood-sawing in Lianxai. Both women and men are involved, often working as a husband and wife team; they saw wood *in situ* in the forest then carry out the planks by cart.

Men and women tend to have different sources of income, which are summarised in table 4.2 below. Women are the pursekeepers but continue to fulfil their traditional role as vendors in the marketplace, and men put in an appearance to sell large animals. Decision to spend money are made jointly.

Except in Kantabouli there are few opportunities for non-agricultural income generation. In both villages in Kantabouli at least half of the households had one member receiving a salary usually in the provincial capital. There are also few cash crops, although in the upland district of Sepone these are the focus of several development projects.

Table 4.2: General patterns of income by gender in the three districts

	Kantabouli	**Atsaphangtong**	**Sepone**
women	weaving sale of fish (wild and cultured), vegetables	rice labour sale of wild produce (not fish) hired labour (more than men)	marketing on border
men	salaries	sale of large animals	
both		sawing hired labour	sale of scrap metal

The systems diagrams revealed a range of marketing options - farmers sell within the village, in the district town and in Savannakhet town, where they also buy some agricultural inputs. Purchased items are few, mainly clothes, seasoning and food. The time of greatest expenditure in Ban Xok is when they buy food in December to supplement the little available just before the harvest; in other communities they said they couldn't afford it and just had to make do. In the other communities, money was spent before the planting season, for inputs.

Fish is an important marketed commodity, and prices vary according to which market they are sold in, the season, and whether the fish is cultivated or wild. Wild fish is considered to have better flavour, and prices also rise in the dry season due to scarcity (table 4.3 below). Smaller fish fetch lower prices - these are the ones often caught by women (Garaway, 1995).

Table 4.3: Variation in fish prices, Savannakhet province (the absolute prices are not so important as the comparisons between categories)

Fish prices (Kip / kg)	dry season	rainy season
wild fish	4000	2500-3000
cultured fish	3000	1500-2000

4.2.4 Aquaculture and agricultural information systems

The formal research and extension system in Savannakhet is represented by the provincial Agricultural Services Department, in which aquaculture comes under the Livestock and Fisheries Section (see LPRvol1). The principal role of LFS is in extension, though there is currently no formal procedure for formulating recommendations nor links to research stations. The LFS is better developed in Savannakhet than in other province within Laos, partly the result of two years of interaction with the AIT Outreach project, but there is effectively little research for officers to extend. Until recently all extension was in veterinary services and this is still a major emphasis, with a strong focus on vaccination of cattle and intensification of meat production. However, since 1994 each district has had at least one official trained in basic aquaculture. Information flow continues to follow more or less traditional patterns, with external information being directed at the male village elders, who pass it to community members. The LWU also has a role in information flow, having a network which reaches every village in the province. Much rural planning remains top-down, (for example, the irrigation project in Nam Pou which was planned with minimal consultation with the community, according to the village elders).

Over the last few years in Laos and especially in Savannakhet Province the position with regard to research has begun to change. Two international organisations (IRRI and FAO) have conducted research locally. Since 1993 IRRI has been researching the culture of fish in rice fields in Laos. In 1993 and 1994 IRRI conducted trials in rain-fed rice-fish systems in the provinces of Vientiene, Champassak and Xieng Khouang involving nine collaborators (see box 3 &4).

Box 3: IRRI fish in rice trials in 1993

?? Jan-April ponds dug in rice fields 75 cm deep up to 10% of paddy area. (Notes: the rice fields adjacent to ponds ranged from 340m^2 to 3504m^2.)
?? Nursery ponds stocked in late July-August with fingerlings of Common Carp(*Cyprinus carpio*), tilapia (*Oreochromis niloticus*) and Silver Barb (*Puntius goniotus*) obtained from govt hatcheries. Stocked shortly before transplanting using 1-2 cm fingerlings. The stocking rate aimed for was 7000 fingerlings per ha (of paddy plus pond).
?? Some feeding was given in the nursery ponds (rice bran termites and broken rice, buffalo and cow manure was occasionally added to stimulate algal growth.
?? Rice variety was farmers choice usually maturing 130-145 days. At transplanting rice received a basal application of 150 kg/ha of 16:20:00 and a second application of urea 50 kg/ha 45 DAT.
?? Fish were harvested within a week of the rice harvest. Growing period for the fish was 90-120 days. Farmers harvested 6-21 kg and 2-10 kg of wild fish.

Box 4: IRRI fish in rice trials in 1994

?? Additional recommendations were that paddies should be at least 200m^2 and fish ponds should not exceed 2-5% of the area and 85-100 cm in depth. Paddy levees should be upgraded by at least 50 cm with fields to be serviced by at least two overflow outlets.
?? Sesbania to be planted and incorporated 45 DAS for rice and fish fingerlings released as soon as sufficient water.
?? Stocking rate 3500-5000 /ha reduced from 7000 in 1993.
?? Rice varieties with a maturity time of 135-145 days.
?? A 1-2 day workshop was provided for farmers.

Studies in 1993 and 1994 were inconclusive . In 1993 this was because of lack of experience in 1994 because of wetter than usual conditions and severe flooding effecting fish and rice losses.

Box 5: IRRI fish in rice trials in 1995

?? some farmers tried tilapia alone at 5000/ha and some tried common carp and tilapia in a ratio of 2:1 at 3000/ha
?? yields of tilapia ranged from 5-12 kg from 100 and 250 fingerlings and 22 kg from 1200 fingerlings
?? all fish in the common carp-tilapia trials were lost in floods

In 1995 the polyculture trials were flooded and all fish lost. Growth of fish was poor. Annual technical reports are produced, however it is unclear what efforts are made to distribute these research results within Laos.

The most recent FAO project (Lao/89/003) on fish culture extension was conducted between 1992-96 with the main objective of transferring fish culture technologies to rural farmers. The project produced some recommendations for irrigated rice fish production on posters as well as other output. The system involves digging trenches 1-2 m wide and 75-100 cm deep and raising bunds around paddies. Unfortunately 97% rice cultivation in Laos is rain-fed.

Box 6: FAO system for raising fish in irrigated rice

Day	Activity
0	prepare seed bed
1	soak rice seeds
3	broadcast germinated seed
10-24	paddy field preparation and basal fertilisation
24	collect rice seedlings
25	transplant rice
32	stock fry or fingerlings at 3000/ha; raise water level by 7-10 cm
75	reduce water by 5 cm top dress with 75 kg/ha of 48-0-0 or 150 kg/ha of 16-20-0
76	increase water by 10-15 cm
96	increase water by 20 cm
125-30	drain paddy and harvest fish
130-35	harvest rice

A number of other active research and extension projects are taking place, many in association with the LFS; all are fish related (see LPR volume 1). Two projects (MRAG and IDRC) are principally for research purposes, but the direct involvement of members of the Livestock and Fisheries Section in the research process means that the results have high potential to affect the recommendations made by staff. A UNDP project is conducting fisheries extension in two districts, using a system based on the development of model farms. The AIT-Aquaculture Outreach project promotes small-scale aquaculture development in every district of Savannakhet, encouraging the decentralisation of fish production through the

nursing network, and promoting efficient management of district extension services, for example by record-keeping and profit-sharing. The fry nursing network being established by LFS, as well as a local source of fish is also an important source of aquaculture information in villages. For example in Kantabouli, Mr Newgain (formerly of the LFS) who spawns and nurses fish in Oxbow lakes close to Gnang soung was independently identified as an important source of aquaculture information by four local farmers.

In addition to the 'formal' and less formal information systems being developed, there are important informal networks through which aquaculture information is channelled. A number of local aquaculture entrepreneurs are already becoming established in the province. One such example is Mr Kumar, a fish farmer and fish seed producer based close to Savannakhet. Mr Kumar is the key source of seed and extension information regarding aquaculture techniques in a number of neighbouring villages. In Ban Xok for example, Mr Boonkam, one of the most knowledgeable and successful local fish producers sources fish and information from Mr Kumar. Mr Boonkam in turn is considered an important local source of aquaculture information.
During this study, farmers in Kantabouli noted a lack of external information to support aquaculture, and the improvement in information flow was identified in Nanokhien as a factor helping them to start aquaculture. This was illustrated through a series of systems diagrams. Some LFS district staff were aware of the FAO information and could highlight its shortcomings for rainfed agroecosystems.

Information to guide the development of recommendations for fish production from rice fields remains an important constraint. In particular extension approaches are needed which can begin to address the needs of poor farm families and which take account of the diverse agroecosystems which they manage.

4.3 Farming systems and wild food resources

In Laos generally, livelihoods are based on four components: food production systems, the collection of wild food resources, other income generating activities and other essential activities .Therefore, reference to farming systems alone can not adequately represent the livelihoods (especially the satisfaction of food security needs) of people in villages across Savannakhet. A variety of rice-based agro-ecosystems exist across the province with associated and neighbouring wild food resources which provide for (or fail to provide for) food security through out the year; farm families allocate local and external production enhancing inputs and human resources to different components of their livelihood systems. The importance of farming systems and wild food resources are considered below.

4.3.1 Farming systems

The production of rice dominates most of Laos agriculture, although many other components of the rain fed rice field ecosystems are harvested by those who operate or live close to them. The non-rice products often include many species of fish, frogs, insects, vegetables, etc.

An IRRI survey in 1990-91 located 73 local varieties of rice in use. 85-90% of the rice cultivars grown are "glutinous varieties" , commonly RD6, RD8 and RD10 as well as the

non-glutinous Khow Dok Mali 105 (all of Thai origin). RD 10 is preferred by many farmers due to its large seed and good eating characteristics and is particularly good for dry season irrigated conditions (IRRI,1996). Current efforts toward varietal improvement are aiming for medium maturing (130-135 days) or photoperiod sensitive varieties which flower September-October. New varieties include: Niaw Thadokkham 1 (Thai x IRRI material cross) which reportedly has good potential and adaptability for central Laos. Although the variety is photoperiod insensitive and unsuitable for late or delayed planting and prone to drought when there is an early end to rains, it was being widely adopted by farmers in central and southern Laos in 1994. Many farmers grow longer stemmed native (traditional) varieties and in some circumstances 'floating rice' (Chow loy). Farmers often grow 2-4 varieties of rice of varying maturity time, which helps to distribute labour demand and acts as an insurance against variable weather conditions. Early maturing rice tends to be grown on land that retains water for short periods, whilst late maturing varieties are grown on land that retains water well. Within each maturity category different varieties are often planted to spread risk of loss due to disease or pests (Meusch, 1996). Farmers report experimenting with a wide range of rice varieties especially when moving into new environments.

The main constraints to rice farming in Savannakhet are considered to be drought, crabs and snails and then insects (Schiller, 1995; 1996). The pests most reported by farmers (IRRI,1995) are crabs, gall midge, thrips, stem borer and brown plant hoppers. In 1993 the worst pest problems were gall midge (a common problem to which all varieties are sensitive and the biggest pest problem in fertile areas) and neckblast (less common partly due to lower levels of fertiliser used) (IRRI,1995). Stem borers are a significant cause of yield loss specially under dry season irrigated conditions. Furadon[4] is widely used as an insecticide (and in Ban Xok, soaked into rice seeds also as bait for crabs) as well as methyl parathione, carbyl and monocrotophos diazinon, short stem sections of a climbing plant *Tinospora crispa* Miers (Khua kaw hor), a Euphorbiacea *Jatropha curcas* L. (mak nyao) and other local preparations containing lemon grass, soap powder and others for pest control. Furadan insecticide (applied 7,21,45 and 65 DAT[5])can result in yield differences but applications earlier than 45 DAT have no significant effect on stem borer control. Most farmers believe that pesticides enhancecrop production but cannot afford to use them. However, benefits from insecticide use against gall midge, for example, may only be noticed when used in combination with fertilisers. In a 1994 IRRI survey, 28% of respondents used pesticide, most commonly on rice seedbeds. Respondents in this study suggested that the heaviest use of pesticides was in vegetable culture. The incidence of pesticide use in Kantabouli is higher than in other districts possibly due to accessibility (from Thailand) and a greater degree of irrigation development and use of improved varieties.

The rice farming systems used by farmers show some variation within and between the districts studied in the province (see table 4.4).

[4] Furadan = Carbofuran is a broad spectrum carbamate pesticide that kills insects, mites and nematodes on contact or after ingestion. Available from Thailand at K 1500/kg (1997). It is used against soil and foliar pests in liquid and granular formulations it is soluble in water and has a moderately lengthy soil half-life (3-60 days). Carbofuran is very toxic to chickens, ducks and fish. The 96-hour LD50 for fish is 150 ug/L.

[5] DAT = days after transplanting

Table 4.4: Rice farming systems used by farmers interested in raising fish

		Number of farmers			
		Kantabouli		Atsphantong	
		B Xok	B Gnang soung	B. Nanokien	B. Lien xai
rice varieties	improved	11111111	1	1111	111
	local		111	11	
PEI	manure		111	1111	
	chemical		1		111
	none	1111	1	11	
pesticide use	local	1			
	chemical	11111	1		
	none				

(Data from semi-structured interviews and 22 farm walks carried out in March 1997 with farmers interested in fish production in rice-field ecosystems)

Rice cultivar selection appears to depend mainly on seed availability and local conditions. The high incidence of irrigated systems in Ban Xok and prevailing windy conditions there favour the use of (short stemmed) improved varieties. In Gnang soung local varieties suit better the rainfed paddy conditions. In Atsphangtong, Nanokien occupies a relatively fertile site close to two rivers where improved varieties tend to perform well and are commonly selected by farmers. In Lien xai farmers are without local varieties (which may be well know and adapted to local conditions) most farmers are still experimenting with many different improved varieties in newly created paddies.

Soil fertility and fertiliser use vary throughout the province. In general, on sandy loam and loam of central Laos P deficiency commonly needs to be addressed. Loamy sand soils predominate in Kantabouli, with widespread phosphorus deficiency in areas bordering the Mekong (Schilling, 1996). In addition, there are very important local variations. Some localities are sufficiently fertile to produce a good rice crop without additional fertiliser. Ban Xok for example has rice lands down stream of the village and on the site of the old village, both factors resulting in important residual sources of fertility. Manure is commonly used to fertilise rice paddies, often by tethering buffalo in paddies. Where cattle or buffalo herds are small and yet soil fertility is low, e.g. in newly settled dry forest areas, such as in Ban Lien xai, farmers are reliant upon chemical fertilisers (e.g. 16-20-0, 46-0-0, 16-8-8)[6], commonly applying 50% before transplanting and 50% 28 DAT, urea is applied just before flowering. Fertilisers are sometimes purchased on credit in return for a (large) share of the rice crop[7] (the equivalent of 100% interest). Vegetable production is an important component of the farming system across Savannakhet. Labour shortage in the wet season results in less vegetable production and higher prices. Manure is commonly used for vegetable production and pesticide use for vegetable culture is reportedly high, especially in the dry season.

[6] Lower phosphorus, potassium containing fertilisers tend to be used on the edge of depressions used to grow rice and 16-20-0 nearer the centre

[7] 50 kg of 16-20-0 retails for 17,000 kip, one 50 kg bag on credit requires 170 kg of rice as pay back (34,000 kip equivelent)

The incorporation of fish production into farming systems varies across the province. Pond building and paddy renovation is occurring at a fast rate in Kantabouli district Road construction has particularly helped this, through the sale of base material for road construction creating borrow pits, and the availability for hire of earth moving equipment). Kantabouli farmers have better access to fish seed than farmers in other more easterly districts, both from the Livestock and Fisheries Section Hatchery at Bak Bor (near to Savannakhet) and from Thai suppliers, although this is expected to change with mre decentralised spawning and fry nursing being encouraged by the LFS in Savannakhet.

In Atsphangtong aquaculture development is occuring more slowly. Many newly settled villages are being established along route 9 with the development of associated rice paddies and dammed micro water-sheds. The most important crops are rice and vegetables, often grow within and beside depressions in which water collects for part of the yearAway from permanent water courses the rolling uplands are relatively dry though micro-watershed development is occurring at a rapid pace. All locations remote from Savannakhet currently have poor access to fish seed. However the development of water bodies and improvements to fry supply auger well for continued aquaculture development.

The farming systems in Sepon district vary with ethnic group (see LPR volume 1), with settled farming practises as well as shifting cultivation practised in upland forests. The lowland Lao inhabitants of the district farm more accessible areas often characterised by upland rice, with some mountain valleys planted to paddy. The most important crops are rice and vegetables, though forests and water bodies are especially important sources of food in the district. In Sepon also, farmers have poor access to fish seed, although this is expected to change with plans by the LFS in Savannakhet to extend their fry nursing network to the district.

The general pattern of rainfall obviously plays a key role in the scheduling of farming systems. Figure 4.1 provides an overview of the management and issues surrounding rice-based agro-ecosystems in Savannakhet Province, Laos. It is derived from information collected in semi-structured interviews with women and men in the research sites across the province (see section 3) supplemented by information recorded during 25 farm walks in Kantabouli and Atsphangtong.

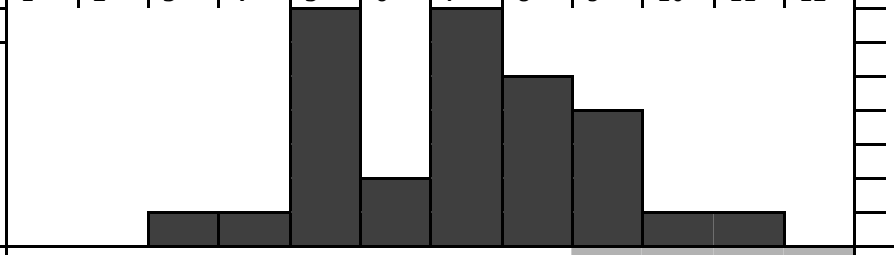
Months	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	
Rainfall In Savannakhet varies annually 1088 - 1710 mm with double peak													300 mm 200 mm 100 mm
Rice production													
1st plowing													
nursery beds													peak labour demand May
transplanting													
general care													weeding, fertiliser, pest manage.
Harvest								E		M		L	peak labour demand Aug-Oct
Fish in paddies													
wild fish enter													
spawning													
fish grow													
capture													October peak wild fish harvest
Other crops													
vegetable													
orchard													
Livestock													
chicken													
ducks													
pigs													
Wild food collection													
vegetables, etc.													wild vegetables, frogs, bamboo
fish													wild fish until December
Food security													
enough food													
insufficient food													dry season; not lack of rice but everything else (no wild food)
fertiliser management													
manure for rice													
chemical fertiliser													
wild materials													?
Other income generating activities													road construction, work in neighbouring urban areas,
weaving													
outside labour													helping with rice farming
Cash flow													
main income													sell wild vegetables from the forest, frogs; domestic animals are sold; Make Laolao.
main expenses													paying for rice labour
other essential activities													
roof thatching													
house building													
HRM (busiest)													rice planting and harvest
rice production													
fish capture													

FIGURE 4.1: MANAGEMENT OF RICE-BASED AGRO-ECOSYSTEMS IN SAVANNAKHET PROVINCE, LAOS

4.3.2 Wild food in the agriculture system

The sixvillage case studies cover a range of conditions across central Laos under which people supplement their diet or economic activities with wild foods, even at times relying on them entirely. The importance of wild foods in farming systems worldwide (often especially to the poor and to women) is receiving increasing attention in the literature (Scoones *et al.*, 1996) and these studies add detail from the perspective of a country where low population and economic activity increase the importance of wild foods.

Some general trends can be observed here. Women are the principal foragers for plants and small animals (insects and frogs) but men are also involved especially after dark, e.g. for catching frogs. Wild food dependence decreases with greater population density and proximity to towns, which also offer alternative sources of food and income. The systems diagrams drawn by farmers reveal a great diversity of plants and animals collected, including several leafy vegetables, bamboo shoots, mushrooms, frogs, crabs and fish. The study did not focus on these specifically but it is clear that such resources are declining, while larger game (deer, monkeys, wild pig) have disappeared in some places - although snake is still widely eaten. The less popular species such as crabs are still abundant.

At the same time diversity of edible species does not necessarily decline - Meusch (1996) found that numbers of fish species increase with the age of a village (and therefore the time that fields have been flooded). Forest use is related to ethnic group, the upland Lao being more extensive land users, more dependent on wild food (Meusch 1996). A study in Luang Prabang (upland Lao) found that 25% of families gather wild food every day, and 75% gather at least once a week (Ireson, 1992). This study also found greater forest use in the west (where there are more upland Lao) but even among those interviewed, who are mainly lowland Lao because they are the ones who predominantly cultivate paddy, there was detailed knowledge and use of wild foods. The defoliation of vast forest areas during the Vietnam war has converted much of the Sepone forest into bamboo thickets, which provide an essential source of carbohydrate during the dry season for many. The study showed that one clear indicator of wealth is dependence on wild foods, and respondents noted that 'only the poor are always dependent'. The women's activity charts showed that many spend most of the day foraging, during the dry season, and even part of the day during the growing season if food is insufficient.

Fish is an important component of the diet, and until very recently almost all fish was caught from the wild. Rivers are the most important source of fish, but not every community has a river whereas every community uses ricefields. In an extensive case study of 11 villages in Atsaphangtong district, every household used the ricefield fishery to some extent (Meusch, 1996). Wild fish species are highly prised compared with species which are cultured.

The use of wild resources as feed for fish is widespread, especially the collection of termites and green vegetation.

4.4 The role of women in farming systems

Development projects in Laos have not widely addressed the concept of gender, perhaps because the social status of women is not seen as a constraint to their development compared with some other Asian cultures. However according to the 1997 Human Development Report, gender disparities in basic human development in Laos are similar or worse then those of neighbours with similar Human Development Indices (see Table 4.5)

Table 4.5: Gender related development Indices

Country	HDI*	GDI**	GDI/HDI***
Laos	137	114	0.832
India	138	118	0.855
Pakistan	139	120	0.863
Bangladesh	144	128	0.889
Vietnam	121	101	0.835
Thailand	59	39	0.661

* Rank of Human Development Index (based on longevity, knowledge a decent standard of living),
**Gender related development index (HDI but taking account of gender disparity in basic human development
***GDI/HDI - the low the value of the quotient the greater the gender disparity

Among a range of women's projects listed in a review commissioned by SIDA, none include agricultural or natural resource management topics (Iinuma, 1992). While women have a closely integrated role in the agricultural system, it is necessary to understand the separation or overlap of roles and perceived constraints, in order to support women who may want to take up aquaculture.

Our research found that there are clear gender-roles in the farming systems, but many jobs are shared. Men are described as the head of family, and (especially in older families) are often portrayed as the decision-makers about farming, but according to most respondents, husband and wife discuss new ventures together and make decisions together. Women's status is indicated by their economic role (marketing, saving money). Women are responsible for the care of the family (food preparation, housework, childcare), garden crops and raising smaller animals; they are also the main foragers for forest plants; men prepare the rice fields, and hunt for larger animals (Ireson, 1992). .The population data show that most villages have more women than men (average about 52% women), attributable mainly to the war rather than to economic migration. Families headed by single women are the most vulnerable in such a labour-constrained farming system, and every village has a few such households, although widows tend to remarry or move in with their grown-up children whenever possible.

Because women undertake the majority of transplanting / harvesting of rice, and much of the foraging for forest food, they have less free time than men and less flexibility in their work schedules. Male farmers often noted that women had more work, and that it was good to have more women in the village because that meant the work would be done faster. Their

assessment of women's work is illustrated in table xx below, where villagers' indicated how much men and women were involved in various aquaculture tasks but took care to point out that women had a lot of other work as well. Women's tasks are often classified as 'lighter', but when necessary women are just as likely as men to undertake the heavy work such as digging ditches.

The study focused particularly on women who are involved in fish management, mainly ponds, to find out more about their knowledge, attitudes and activities related to aquaculture. A marked general pattern emerged, which indicated that while men are more involved in the initial (decision-making, digging and stocking phases), both work together in the routine production activities, while women are more involved in the processing end of the production. There are some variations on this: women whose husbands have salaried jobs may take over much of the work, while others have little involvement in the productive activities at all. However the general pattern indicated by women, is given in table 4.6. Single women (widows) all said that they would be interested in rice-fish culture, but are deterred by the amount of labour they assume it would require. This labour demand is generally associated with digging of ponds and trenches, and women do work together with their husbands on this initial stage, but none in the study felt able to do it alone, because other demands on her time are higher than for married women.

Table 4.6. Resource use and activity matrix typical for women and men
Data from group discussions with women, validated by interviews with men.

Question	**Wife**	**husband**
Who owns the pond?	x	x
Who decided to culture fish?	(x)	x
Who dug or improved the pond?		x
Who decided how many fingerlings to stock?		x
Who bought the fingerlings?		x
Who has knowledge about fish management?	(x)	x
Who finds food for the fish daily?	x	(x)
Who feeds the fish and takes care of them daily?	x	x
Who puts manure in the pond?	(x)	x
Who catches the fish?	(x)	x
After catching, who decides what to do with the fish?	x	
Who cooks the fish?	x	
Who sells the fish?	x	
Who saves the money from sale of fish?	x	
Who uses the money from the sale of fish?	x	x

Women and men share most of the activities involved in fish culture. Some roles are consistently taken by men; they buy the fingerlings and stock the ponds, while digging may be shared with women, but never done by women alone. Women are more involved in foraging for feeds, but both take responsibility for feeding the fish. There is also a strong and somewhat surprising tendency for men to catch cultured fish, although both men and women are skilled at catching wild fish; part of the explanation appears to be women's aversion to deep water, because of the need to take care of small children (Meusch, pers. comm.). While women cook and sell fish, and save the money, household funds are spent jointly.

Women portray themselves as more cautious about new enterprises than men; some said they were less willing to take risks including taking up aquaculture. A lack of confidence on the part of women is indicated by the fact that where women and men jointly manage fish culture, women tend to say men have more knowledge about it, and training for aquaculture is usually attended by men. Those women who do produce fish have found benefits though, as they spend less time foraging. - This may also be related to wealth factorsasthe poorest families do not have ponds or fish in rice.

Table 4.7: Villagers' perceptions of men's and women's involvement in aquaculture related activities

	rice / fish	fish pond	modern[1] culture techniques	traditional[2] culture techniques	other work
find feed	xxx 0	xx 00	xx	xxx 000	000
look after	xxxx 0	xxxx 00	xxx	x 000	000
harvest	xx 0	xxx 00	xxx 0	xx 0	000

x=men; 0 =women

[1] 'modern' culture means intensified culture, with feed, stocking and harvest goals; [2] 'traditional' means stocking without management.

In summary, the main constraints for women's involvement in aquaculture are the need for labour in the initial stages, and low confidence in their own knowledge and constraints related to their role as principal child carers..

4.5 Local experience with fish production

Farmers in the villages in which the project is working were invited to share their experiences of aquaculture and rice field fisheries with the researchers. In a series of farm walks within the case study villages (conducted in February 1997) a range of local experience with aquaculture in rice based agro-ecosystems was identified ranging from extensive systems with few inputs, little management and low yields to more developed systems with higher capital and variable costs involving production enhancing inputs and attentive management and maintenance. In all the more intensive systems, fish has become the main object of production within the system. Many rice fields are an important source of wild fish, as well as crabs, snails, shrimps, frogs and wild vegetables.

Prior to discussions with farmers there was a strong consensus among project research teams that it is easier for rich people to grow fish, since rich and middle-ranked people have more land, which is of better quality. However they also reported that not all rich or middle people are interested because some of them are more attracted to business, so not everybody would stock their paddy even if the technology is successful. In fact, current aquaculture activities fall into 3 categories: "extensive" - fish stocking in paddies without further investment in time or inputs is carried out by a number of farmers, "semi-intensive" - increasing stocking rates and supply of feed to fish during some part of the culture period and "intensive" involving increased stocking density, continuous feeding and management and often erecting and maintaining net barriers to deter wild fish, ducks and buffalo. The gross margins associated with these three systems are estimated as well as approximate capital and labour costs as shown in table 4.8.

Fish stocking in paddies without further investment in time or inputs is carried out by a number of farmers. Gross margins in such extensive systems appear very favourable and return from fish can be as much as one third of the return from paddy from the same system[8]. The capital cost requirements for extensive systems relate principally to earthworks (e.g. raising bunds) and are very site specific. Major modification required to accommodate fish are likely to result in pay back periods in excess of 10 year and are unlikely to be justified based on the returns from extensive fish production. However, where farmers already grow paddy in fields appropriate for stocking with fish extensive systems provide a low investment access point to aquaculture.

Success with stocking of fish in paddies has lead to some farmers increasing stocking rates and supplying feed during some part of the culture period, sometimes raising yields to around 250 kg/ha. This requires around a six fold increase in variable costs compared to extensive systems (the equivalent of investing 50% of the estimated gross margin from an extensive system see table 4.8). The requirement for earth working is similarly site specific and the associated capital cost requirement for semi-intensive systems are similar to those for extensive systems although the associated increase in fish yields reduces the estimated pay back period to around 1 year.

The most intensive systems of culturing fish in paddies in Savannakhet produce over half a tonne per hectare and commonly involve increased stocking density, continuous feeding and management and erecting and maintaining net barriers to deter wild fish, ducks and buffalo. Gross margins are 3 times those of semi-intensive systems, though estimated capital costs also tend to by 3 times higher. The estimated pay back period for intensive systems is around 1 year. Variable costs are greatly increased and these comprise over 85% labour costs. This increase in effort reflects the increase investment in still rather risk prone environments. The rice component of systems used for more intensive fish production (worth approximately one tenth of the fish value) is rarely harvested but left as shelter and feed for the fish and to enhance residual fertility.

[8] Based on table 4.6 and recorded unmilled rice yield of 1.25 tonnes/ha @ 220 kip/kg

Table 4.8: Gross margins in Savannakhet fish in rice production systems: Fish raised in late maturing (June-November) improved rice (Financial prices 1997) (Kip/ha)

Cost and income estimates [1]	"extensive"	"semi-intensive"	"intensive"
Gross income			
Fish Yield (kg/ha)[2]	30	250	563
value (Kip/kg)[3]	2500	2500	2500
Gross income (/10^6)	**0.075**	**0.625**	**2.499**
Variable costs			
seed (@ 5kip each)	5,000 (1000/ha)	13,400 (2680/ha)	62,500 (12,500/ha)
organic fertilizer*	-	-	-
inorganic fertilizer*	-	-	-
feed (vegetable waste, termites (both must be collected 24 days @1800kip/day), rice bran average 5kg/week @ 100kip/kg)	-	18,400	55,200
maintenance (24 days @1800kip)			432,000
Total	**5,000**	**31,800**	**723,400**
Gross margin (/10^6)[4]	**0.07**	**0.5932**	**1.7756**
Capital costs			
earthworks (raising bunds/trench building @ 200,000kip per rai on flat land (1600m^2)[5].	Up to 800,000[8]	584,112	1,250,000
netting (@80,850/ha)[6] and posts (@133,333/ha)[7] (for fence)			214,183
labour 144 x (quarters of man days)			64800
Total Capital Cost (/10^6)	**0.8**	**0.58**	**1.53**
kip/man day	1800	1800	1800

* depending on the rice production system fertiliser is sometimes used for rice (see table 4.4)

Notes on table 4.6

1 Cost and income estimates are based on information provided by farmers from their direct experience.

2 Actual reported yield under farm conditions (in excess of family consumption)

___

3 The value of fish depends on source and availability/season. Most producers sell locally. Cultured fish ranges in value from 1500-2500kip (wet season) to 3000kip (dry season)

4 Gross margin represents a contribution to capital costs and labour (excl. Maintenance and wild feed collection already included as variable costs).

5 "semi-intensive" involves 400 m of bunds per ha, "intensive" involves 160 m of bunds per 1 rai (1600 m2) on flat land. Some paddy in gently slopping valleys is only bunded on one side (like a dam) thus reducing this capital cost substantially. Capital cost is therefore very site specific. Labour and tractor hire costs are very similar for this work. N.B. The cost of earth moving is reduced by about 33% if laterite is provided to nearby road building contractors in part exchange for carrying out earthworks. Using ones own labour with some help can reduce the cost by 66%.

6 netting comes from Thailand 400 m^2 encloses 1ha i.e.14 rolls @150 Bht per 30 m role (38.5 kip = 1 Bht)

7 posts every 1..5 m for 400 m @ 500 kip each locally.

8 specific example of cost for barrage type paddy bunds where fish stocking is practised (B. Xok)

Around 60% of farmers interested in stocking their rice fields currently harvest wild fish from their systems (see table 4.9).

Table 4.9: Methods of fish production amongst farmers wishing to stock paddies

Fish production in paddies	Current activities of farmers interested in stocking rice fields
wild fish collection	~~1111~~ ~~1111~~ 111
extensive fish production	111
semi-intensive fish production	1111
intensive fish production	11

(Data from 22 farm walks in Atsphangtong and Kantabouli districts, February, 1997. See appendix XX for details)

The rice field fishery is open and unregulated and neither the total catch or the fish taken by the farming family are normally quantified. Some farmers who own low lying land where water and wild fish collect or where fish traps or trap ponds are set up on fish migration routes appear to harvest up to 40 kg of wild fish from their land, where as many farmers report 6-10 kg from their flooded paddy. Harvest rates for wild fish per unit area of paddy can therefore be misleading as fish density is far from uniform, access is open and catches unrecorded, and some farmers attempt to enhance rice field fisheries (see table 4.8). However, it is clear that rice fields are an important source of fish. In a survey by Meusch in 1995 in Atsphangtong villagers reported harvesting up to 23 different species of wild fish. In addition, most farmers report a decrease in wild fish availability over the last 2 decades from paddies and other water sources. An exception to this is the case study village of Lien Xai, newly established in 1986, where wild fish availability from the dry forest area (10 km from nearest permanent river) is low but appears to be increasing as a result of micro-watershed development around the village.

Table 4.8: Methods used to enhance rice field fisheries

method	**comments**
use of "attractants"	bufalo hide, mud from fish rich waters, skin, bones, blood entrails from cattle

digging refuge pond	the siting of ponds is important, local knowledge of migration routes is widespread in most communities
making alterations to local watershed	micro-dam developments tend to enhance wild fisheries locally

5 Conclusions

The assessment of the context and the agro-ecosystems operated by farmers in Savannakhet leads to the identification of those which might incorporate fish and the constraints which may have to be overcome.These are discussed in the following sections.

5.1 Rice based agro-ecological systems that can incorporate fish

Following the presentation (by the district teams) of the results of the situation analysis back to the villagers with whom it was collected, the research teams undertook farm walks with all villagers who wished to collaborate with the project. Farmers and the specialist continued to share information about the potential of different agroecosystems to incorporate fish. This process identified a range of rice based agro-ecosystems close to each village that might incorporate fish.

Based on the systems identified in individual villages a more general system for the classification of different agro-ecosystems throughout Savannakhet was developed into a decision tree matrix by Provincial support staff and researchers which might be used by district LFS to classify different agro-ecosystems in future (see Box 7).

Box 7: Decision tree matrix for categorising paddy agro-ecosystems suitable for fish production

The classification distinguishes 8 separate agro-ecosystems in Savannakhet. Each of these systems has different characteristics. Of particular relevance is the times during the year which each holds water. This is shown in figure 5.1.

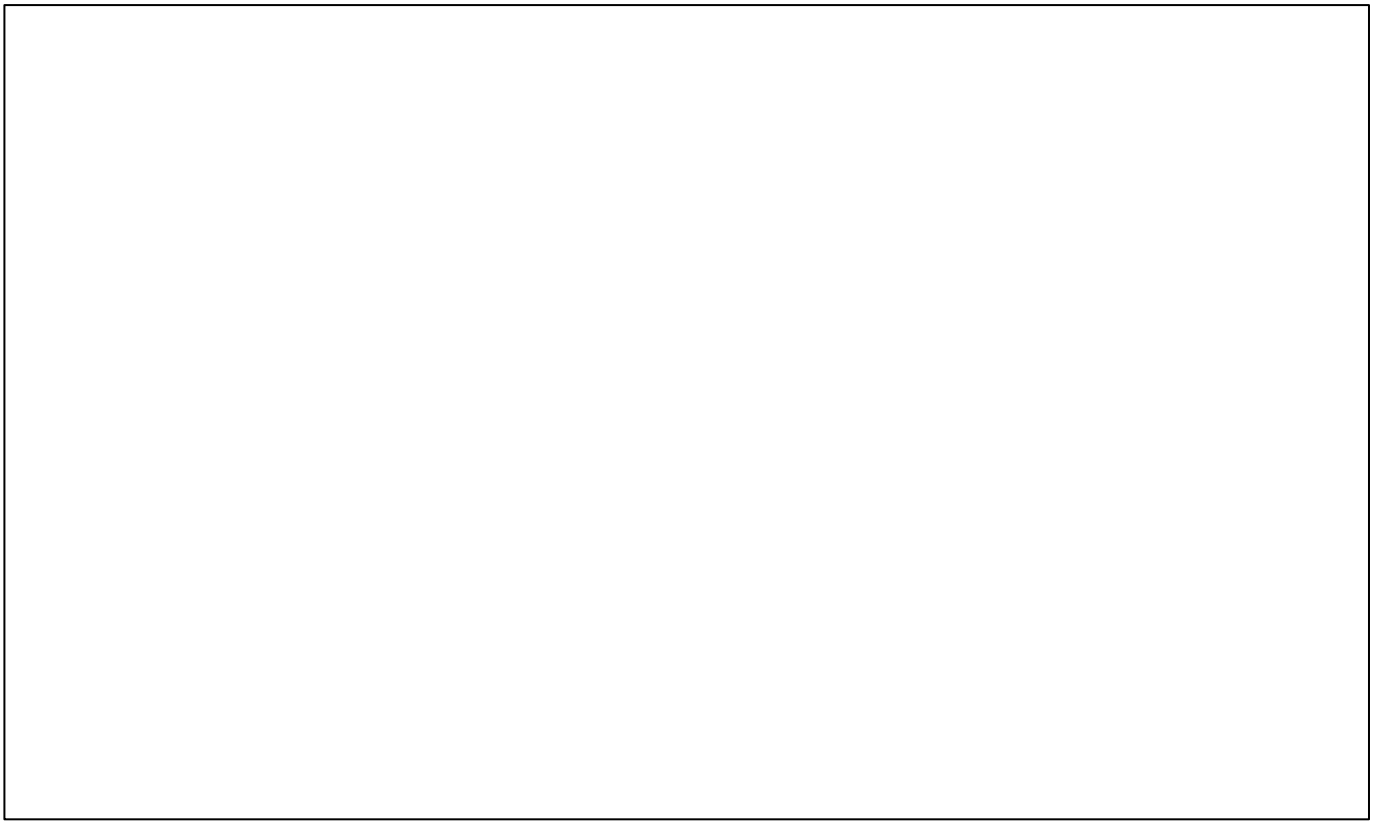


FIGURE 5.1: RICE BASED AGRO-ECOLOGICAL SYSTEMS THAT CAN INCORPORATE FISH

(The boxs represent the 8 agroecosystems identified, the arrows indicate the seasons of water availability'. The bottom line refer to the season in which an agroecosystem can best accommodate fish)

Generally, from left to right across the figure the environment for fish production becomes more marginal with decreasing periods of water availability, increasing aridity and dependence upon rain water and (far right) areas with reduced water holding capacity.

The agroecosystems close to each of the project villages in Kantabouli and Atsphangtong are detailed in Appendix XX, see table 5.1

Table 5.1: Agro-ecosystems that can incorporate fish in project villages.

location	number of rice-base agro-ecosystems	detailed in table ?
Ban Xok	4	Appendix 2 table 1
Ban Gnang Soung	4	Appendix 2 table 2
Ban Nanokien	4	Appendix 2 table 3
Ban Lien Xai	2	Appendix 2 table 4

A range of potential fish production options exist for farmers depending on the agro-ecosystems which they operate, their circumstances and wishes (see table 5.2).

Table 5.2: Fish production options in rice based agro-ecosystems in Savannakhet

option	likely investment	variable labour requirement*	production	likely suitable agro-ecosystem
rice field fishery	none	fishing often daily in wet season peak wild fish harvest October	10's of kg from common land holdings varies widely with location	2,3,4,5,6,7,8
enhanced rice field fishery (see table 4.8)	important labour cost for refuge digging	fishing often daily in wet season, protection from theft after rice harvest	10's of kg may be up to 40 kg varies widely with location	2,3,4,5,6,7,8
extensive fish culture in rice field	seed and seed acquisition cost	fishing often daily in paddy/ final fish harvest	around 30 kg/ha	1,2,3,4,5,6,7,8
semi-intensive fish culture in rice field	possible modification to infrastructure, seed, feed	feeding, security, fishing often daily in paddy/ final fish harvest	around 250 kg/ha	1,2,3,4,5,6,7
intensive fish culture in rice field	possible modification to infrastructure, predator control, seed, feed, labour,	feeding, security, maintenance of infrastructure, pest and disease monitoring and control, fishing often daily in paddy/ final fish harvest	around 500 kg/ha	1,2,3,4,5,6,7

*Variable labour requirement is that require to operate the system[this table (5.2 above) needs more explanation - e.g. where the options are described. It is not clear why 'extensive fish culture in ricefields' has no labour requirement.

The likely opportunities and constraints related to the incorporation of fish into the identified rice based systems discussed between farmers and researchers is summarised in figures 5.2 and 5.3 for Kantabouli and Atsphangtong respectively.

months	1	2	3	4	5	6	7	8	9	10	11	12	
Agroecosystems KANTABOULI Ban Xok													**opportunities/ constraints**
Som Phoy dry season irrigation scheme		seed			Area floods during wet season								fry nursing for stocking in May (tilapia, common carp and Bighead carp can be spawned in February)
Stream fed bunded paddy in forested valley					Flowing water through paddy					seed			bunds open until October to prevent flooding, raising fish from October. EUS risk, mrigal not recommended as they tend to migrate
spring fed irrigated rice paddies		seed			seed								double cropping option for rice and fish, EUS risk, seed production opportunity (?), some risk of flooding
Stream irrigated paddy													double cropping option for rice and fish, EUS risk, seed production opportunity (?), risk of flooding
Ban Gnangsoung													
paddy that dries out if there is a break in the rains							seed						high risk of loss of stocked fish. Opportunity to develop water storage/ fish refuge/ trap pond to encourage and collect wild fish instead of culture
Natural depression/ low lying paddy										seed			risk of flooding stocking after flooding risk, , raising fish from October, EUS risk
Permanent water body (ox-bow lakes)		seed											double cropping option for rice and fish, EUS risk, seed production opportunity (?), floating rice as fish feed
Paddy is drained to harvest rice							seed						opportunity to stock fish at low density, fast growing puntius/common carp options. short HYV rice less compatible with

													puntius

FIGURE 5.2 OPPORTUNITIES AND CONSTRAINTS IN KANTABOULI
(shading represents period of water availability, seed = proposed timing of fish seed introduction)

months	1	2	3	4	5	6	7	8	9	10	11	12	
Agroecosystems													
ATSPHANTONG Ban Nanokien													**opportunities/ constraints**
Paddy that is drained to harvest rice							seed						opportunity for stocking at low density, fast growing puntius/common carp options. dwarf HYV rice less compatible with puntius
Low paddy area										seed			opportunity to stock fish in October following flooding, EUS risk, risk of flooding
Bomb craters in paddies					seed								opportunity for early season nursing in hapa in crater opportunity for holding in bomb crater after rice harvest, EUS risk,
Stream fed bunded paddy										seed			bunds open until October to prevent flooding, opportunity to stock fish in October following flooding, EUS risk, Mrigal not recommended as they tend to migrate
Ban Lien Xai													
Natural depression - paddy area shrinks to a central pond in dry season	water in pond					seed							Opportunity to stock fish though risk of drought from July so low stocking density recommended, risk of poor water quality and theft from pond
Permanent pond & paddy, drained to harvest rice				seed	water in pond								opportunity to nurse fry in pond before wild fish arrive June - July opportunity for holding in pond after rice harvest, risk of poor water quality and EUS risk

FIGURE 5.3 OPPORTUNITIES AND CONSTRAINTS IN ATSPHANGTONG

(shading represents period of water availability, seed = proposed timing of fish seed introduction)

5.2 Researchable constraints to fish production in rice farming systems

Many farmers are motivated to enhance fish production in rice farming systems and appreciate the need to research constraints to the introduction of fish. The majority of farmers interested in increasing fish production within their agro-ecosystems have no experience with the culture of fish in paddies (see table 4.7). This has also been identified elsewhere in Laos as a constraint by IRRI (1996) (see section 4.2.4) and has been highlighted by farmers in this project who consider lack of experience to be a significant constraint. At this early stage in the development of fish production in paddies few farmers are in a position to identify more specific constraints. Most farmers' research priorities are therefore to investigate the effectiveness of some of the efforts being made by other farmers toward rice field fishery enhancement, semi-intensive and intensive fish culture options (see table 5.2).

The current motivation for farmers to enhance fish production in paddies is: the reduction in availability of wild fish, the recent increase in up-grading of paddies via earth moving and bund building[9] (as a result of available earth moving equipment associated with road construction) and the availability of support from LFS and this project.

The two key components of the project research approach (as highlighted in Section 1), are:

- ?? to involve local institutions as key participants in the implementation and management of the process, as part of a structured planning process, to ensure sustained farmer involvement;
- ?? to involve farm families as key participants in the definition of the research agenda and the development of recommendations.

The situation analysis conducted with the LFS and interested farm families from six villages across the province represents the first component of the project research approach. Conducting and institutionalising farmer trials, represents the second part of the project. This project, together with the AIT Outreach Project have been working with the LFS in Savannakhet to develop a system where district extension workers begin to document the recommendations that they offer to farmers, and where these are "best guess" options, to begin to conduct with farmers, trials to test the usefulness of those recommendations.

Currently in Savannakhet fish culture options centre around efforts to provide feed and to exclude predators (see Section 4.5). These are therefore the main researchable constraints identified by LFS extension staff in discussions with farmers as the basis for farmer trials and the institutionalised farmer centred research process (see table 5.3 and appendix IV for details).

[9] A significant capital cost - see table 4.6

Table 5.3: Farmer trials being implemented and managed by the LFS

District	Recommendation	Village	Trials	area (m^2)	stocking density	species*	treatment
Kantabouli	Feed fish stocked in paddy locally available feeds such as rice bran, termites manure.	B. Xok	Mr Now	800	1 per $2m^2$	Cc,Pg	fed
			Mr Phet	800	1 per $2m^2$	Cc,Pg	fed
			Mr Kak	1600	1 per $2m^2$	Cc,Pg	unfed
		B Gnang soung	Mr Poon	1600	1 per $1m^2$	Cc,Pg,t	fed
			Mr Poon	1300	1 per $1m^2$	Cc,Pg,t	unfed
			Mr Tongdee	2000	1 per $1m^2$	Cc,Pg	fed
	Surround the paddy with blue netting to exclude fish predators.	B. Xok	Mrs Wien	1200	1 per $2m^2$	Cc,Pg,t	not surround
			Mr Pome	400	1per $2m^2$	Cc,Pg,t	surround
		B Gnang soung	Mr Supome	1600	1 per $1m^2$	Cc,Pg	surround
			Mr Somsi	1600	1 per $1m^2$	Cc,Pg	surround

*Cc =common carp, t =tilapia, Pg =puntius

The key constraints identified by 22 farmers who already stock rice paddies with fish or are preparing to do so this season are listed in table 5.4.

Table 5.4: Key constraints faced by farmers in 14 rice based agro-ecosystems

constraint	number of systems in which constraint is faced
wild fish	~~1111~~1111
EUS	~~1111~~111
Flooding	~~1111~~
Drought	11
Theft	11

(Data from farm walks in Atsphangtong and Kantabouli districts, February, 1997)

Wild fish - The most commonly perceived constraint is wild piscivorous fish entering paddies and predating on stocked fish. Depending on the agro-ecosystem and the specifics related to certain sites, some farmers intend to overcome this by stocking larger fry or fingerlings or by stocking at times which avoid contact between small fry and wild piscivores. The availability of large fry or fingerlings at the on-set of the rains is however a related constraint, not only to avoid heavy rates of predation, but also to maximise the period available for growth of fish during paddy inundation, especially in agro-ecosystems where the periods of availability of water are relatively short lived (see figure 5.1). Trials are therefore suggested to investigate the production of fingerlings during the dry season in systems which can accommodate available fry (tilapia, puntius, Common carp and Bighead carp) at this time.

Erecting perimeter netting is also considered useful to exclude predators (and deter, bufalo, ducks and children fishing) and is currently being tested in LFS farmer trials (see table 5.3).

EUS - In Laos, many farm families face food shortages from January to March. (see figure 4.1), therefore where agro-ecosystem conditions permit (see figures 5.1, 5.2 and 5.3) farmers are keen to keep fish to provide food during periods of poor food availability in January, February and March and also for Lao new year celebrations in April. Under these circumstances the disease epizootic ulcerative syndrome (EUS) characterised by extensive necrosis of skin and muscle, resulting in deep ulcers is a commonly cited problem. EUS is most prevalent in December - January, amongst wild fish (e.g. snakehead) and cultured species, especially puntius and catfishes, as well as Indian major carp (especially fingerlings), the Chinese carps and Common carp appear less susceptible and tilapia rarely succumb. EUS is a widespread problem which has had significant economic impact in recent years in South and S E Asia (Lilly *et al*., 1992). The selection of less susceptible species for agro-ecosystems which accommodate fish during December-January should be considered in relation to fish stocking strategy (see table 5.5).

In addition, the investigation of agents considered effective against EUS should be undertaken. One such local medicinal plant used by some farmers is the Euphorbiaceae, *Jatropha curcas* L., known locally as Mak Nyao. Mak Nyao which when planted close together in rows is used as a "living fence" is also split down its length and staked into the shallow water of paddies to help to treat fish with EUS. Trials are therefore being conducted in association with the Aquaculture Research Project R6979 to assess the effect of Mak Nyao on *Aphanomyces invaderis* (the fungal pathogen of EUS).

Table 5.5: Stocking strategies to avoid problems with EUS

agro-ecosystem (see figure 5.1)	time of stocking	time of harvesting	suitable species	comments
Paddy that dries if there is a break in the rains	July	Oct-Nov	any	rarely suitable for fish culture
Paddy that is drained to harvest rice	July	Oct-Nov	any with EM* and MM*, use tilapia (possibly common carp) avoid puntius and catfish with LM* rice	wild fish susceptible to EUS tend to collect in such paddy
Excavated area e.g. trench	Apr-May(fry)	Oct-Nov Jan-Feb	any use tilapia (possibly common carp) avoid puntius and catfish	wild fish susceptible to EUS tend to collect in such paddy
Bomb crater	Apr-May(fry)	Oct-Nov Jan-Feb	any use tilapia (possibly common carp) avoid puntius and catfish	wild fish susceptible to EUS tend to collect in such paddy
Natural pond /low paddy	Apr-May(fry)	Oct-Nov Jan-Feb	any use tilapia (possibly common carp) avoid puntius and catfish	wild fish susceptible to EUS tend to collect in such paddy
Permanent water body	Febr; Oct.	May Febr	any use tilapia (possibly common carp) avoid puntius and catfish	fingerlings; e.g. where late stocking avoids floods
stream or spring	Febr; Oct.	May Febr	any use tilapia (possibly common carp) avoid puntius and catfish	fingerlings; e.g. where late stocking avoids floods
irrigation system	Febr;	May	any	fingerlings

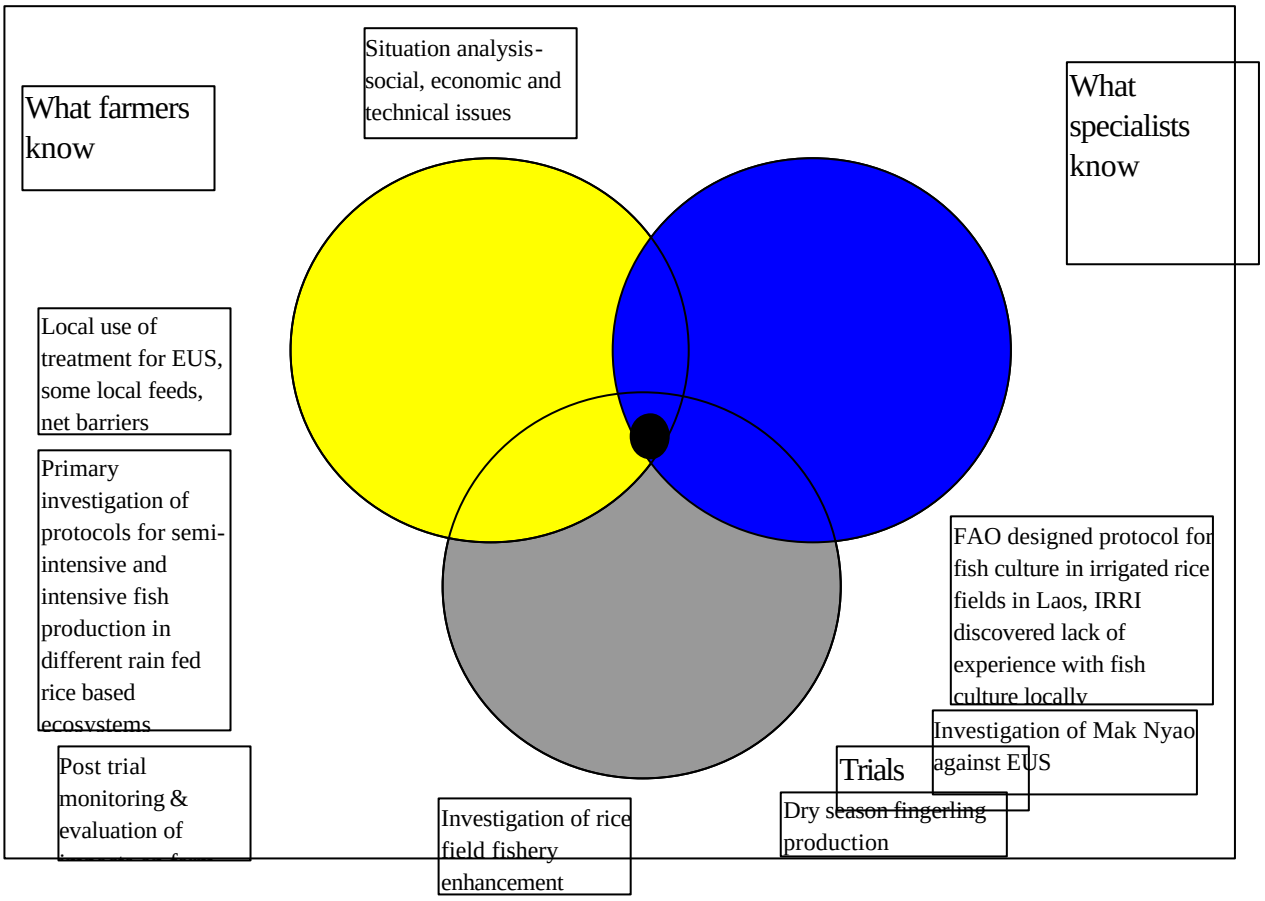
* EM =early maturing, MM =medium maturing and LM =late maturing

Flooding and drought - Such constraints are endemic to risk-prone rain-fed agro-ecosystems. The times where these can be predicted to occur in particular agro-ecosystems are known to farmers. Equally an assessment of risk of loss from flooding and drought versus the scale of investment involved with different fish production opportunities (table 5.2) can be conducted by farmers. Figure 5.2 and 5.3 include suggestions regarding timing of stocking in relation to flooding risk. It should be noted however that the timing of stocking in relation to minimising EUS risk (Table 5.6) are unlikely to be compatible with those that would minimise risk of stock loss due to flooding.

Theft - Some farmers reported up to 20% of stock is lost to theft. Other reported that especially children engaging in fishing have most difficulty in distinguishing between open access rice field fisheries and those deemed owned by farmers, by virtue of their investment in fish production. The incidence of this type of theft would be expected to decline as increasing numbers of farmers invest in ricefield fish production enhancement. The social

issues relating to loss of access to fisheries by the poorest community members needs to be researched and addressed.

As farmers gain more experience with fish production, more constraints will be highlighted. The process of encouraging LFS extension workers to record recommendations, test these in trials with farmers and share this information at annual workshops offers the opportunity to identify these constraints and research them as they arise. The process of encouraging the LWU to monitor trials provides for a more in depth assessment of a broader range of issues relating to enhancing rice field fish production, especially sociological issues which are difficult to conceptualise in advance of introducing experimental systems, and to share this information at annual workshops.



FIGUR5.4: A SUMMARY OF PARTNERSHIP TRIALS PLANNED FOR 1997-8

5.3 The social context for rice-fish research

The situation analysis shows clear technical constraints to rice-fish culture which can be addressed through a farmer-participatory research programme. While this is the focus of the project, it is important to take into account aspects of the socio-economic context which will affect the impact of the research results, particularly aspects relating to gender, wealth distribution and market development. As research, the project does not have the function of facilitating social change, but rather of seeking to understand the interactions between social

and technical factors, and develop a process to include a range of social groups within the action-research component of the project. Monitoring and evaluation must then analyse the results of the action-research to improve understanding of project impact on socio-economic factors, and recommendations for future technology development practice.

The project title highlights the role of women in rice-fish production, to give the necessary emphasis to a neglected component of natural resources research and ensure that gender-related aspects are treated as an integral component of the project. It does not imply that it is a 'women's project' and, as the situation analysis has found, many women do not view fish-in-rice as an area in which they have a dominant decision-making role. Decision-making is distinctively a shared process in lowland Lao households, and women will be very much involved in the decision to start a rice-fish trial, but for most of them it will be primarily the responsibility of the male head of household. Above all, the women are often fully employed all year round, cultivating rice, searching for wild food and caring for the family. Men usually have more spare time than women in the livelihood systems studied here.

Two factors may change the attitude of women. First, the main reasons that women gave for not taking the initiative in aquaculture were related to the heavy labour involved in the early stages, and reluctance to fish in deep water. Fish-in-rice as a system has the potential to avoid both of these constraints. Women who are single heads of household particularly emphasised the labour constraint, and are less willing to risk time or money in a new activity. Some of the options proposed for trials under this project have very low labour inputs, and may appeal to single women in the future. Secondly, women's low interest in rice-fish is related to two aspects of the information network: most extension communication and training is directed at male farmers, and fish seed is available at population centres often remote from the villages where the project is working, and where it is more difficult for women to spare the time to travel to. The project is making particular efforts to include women in all community-level communication and to promote this through collaboration with the LWU. At the same time, the LFS is supporting the decentralisation of seed supply to district towns and villages. Both of these factors will improve women's access to information and inputs.

The project also has a responsibility to monitor the project impact on equity, and poverty alleviation. There are several aspects to this and it is difficult to predict the overall effect. Rice-fish culture is a technology which is only applicable on lowland rice fields, and in some of the communities included in this study, there is a clear correlation between wealth, and ownership of such land. Where a community consists of various ethnic groups (as is the case in Sepone District) the lowland Lao usually own such land, while upland Lao farm upland rice in slash-and-burn systems. In other words, the wealthier are more likely to be in a position to try out the technology. This is not always the case however; there are certainly female-headed families with access to such land, and the participants in the trials include some of the poorer families. A different concern is the tendency for community members to lose their common access to wild fish from their neighbours' paddy fields, when cultured fish are also being produced there. If all the owners of suitable lowland rice fields were to start culturing fish, and fence off their rice fields, this could deny the poorest of a source of fish, but this is unlikely given the diversity of interests of farmers who are in a position to innovate.

On the other hand, fish production could increase its availability in the village, reduce prices (because culture fish is cheaper than wild) and potentially provide employment for those who have insufficient land.

As a process project, it is important to observe and analyse the effect of these changes, taking into account the range of factors identified here. The project has developed a participatory method for assessing the effect of rice-fish trials on a range of aspects of the livelihoods of women and men, in participating families [*insert as appendix?*]. Valuable lessons about the impact on the community and its socioeconomic relations will be lost, however, if evaluation does not include an overview of other families in the community, to assess with them the qualitative costs and benefits of improving fish production on certain farmers within the community.

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Appendix 1: The project research methods

Gender analysis.

The project needs a clear understanding of current women's roles in the farming systems, particularly relating to fish, to fulfil its emphasis on women's involvement in rice-fish experiments. In stage one, when the district staff were conducting the village-level diagnostic surveys, gender issues were addressed by using teams of four researchers, two men (who interviewed men) and two women (who interviewed women). The significance of gender disaggregated data was not clear to the district staff however, who tended to search for a single consensual view representing 'the truth'; given the structure of the teams this meant that the consensus was drawn up by the male staff. Mosse (1996) has drawn attention to various problems associated with PRA and gender analysis, particularly the public nature of research (which inhibits socially reticent women from expressing differing views from the dominant one), and the tendency for results to represent consensus not diversity. Although it is important to emphasise that our diagnostic study was not a PRA, in the sense that the initiative, data collection and analysis belonged to the staff not the farmers, its public nature led to the same problems. These deficiencies were recognised in the data analysis workshop, and new methods designed.

We had only a short time available, so the research was highly focused. We also had to take into account the translation difficulties that we had encountered during earlier fieldwork, which made semi-structured interviewing a less than usually valuable exercise (Lawrence and Haylor, 1996). Taking this into account, a small team of women researchers planned a few structured research tools addressing fish-related topics, which were used in group discussions with women, and a checklist of a few more open questions to be discussed in larger mixed groups.

The tools were used in a sequence; we began by asking for responses to a set of attitude statements to open the discussion (table A below); gender matrices to separate the various activities in fish culture (table B below); seasonal calendars to focus on work and cash availability patterns (table C below), and daily activity charts for rainy and dry season to explore the work patterns of individual women (table D below).

An interesting result of this more focused work was that the activity patterns and decision-making responsibilities were revealed to be largely as described by the much more superficial assessments of the district staff reports. The gender analysis allowed us to describe roles in more detail, and with considerably more confidence, but in effect the two research strategies served to support each other.

Table A. Attitude statements

Statement	Agree	Disagree	Comments
1. fish culture is more important for women than for men because the women have to take care of the food for the family			
2. women are too busy with other work to have time for fish culture			
3. women have more knowledge than men about fish culture			
4. men make the decision to culture fish			
5. men do the heavy work, women do the light work in fish culture			

Description of the experience of each respondent:

Table B. Resource use and activity matrix

Only used with respondents who have experience in raising fish

Question	Wife	husband	other
Who decided to culture fish?			
Who dug or improved the pond?			
Who decided how many fingerlings to stock?			
Who bought the fingerlings?			
Who has knowledge about fish management?			
Who finds food for the fish daily?			
Who feeds the fish and takes care of them daily?			
Who puts manure in the pond?			
Who catches the fish?			
After catching, who decides what to do with the fish?			
Who cooks the fish?			
Who sells the fish?			
Who saves the money from sale of fish?			
Who uses the money from the sale of fish?			
Who owns the pond?			

Table C. Seasonal calendar (example from Nanokhien)

	1	2	3	4	5	6	7	8	9	10	11	12	
busiest													rice planting and harvest
main income													sell wild veg from the forest, frogs; domestic animals are sold; Make lao lao.
main expenses													paying for rice labour
enough food													wild vegetables, frogs, bamboo wild fish until December
Insufficient food													dry season; not lack of rice but everything else (wild food)

Table D. Daily activity charts (example from Lian Xai)

Farming season

time of day	activity
0300 or 0400	get up
0415	housework (cooking for eating in the ricefield; cleaning house, take care of babies and children, feed them etc.)
0600	breakfast, go to ricefield for planting, harvest etc.,
1200	cook lunch
1230	eat lunch; take a half hour break
1400 - 1630	pull up rice seedlings
1700	return home
1730	cook dinner
1900	eat dinner
2000	sleep

Non-farming season (dry)

time of day	activity
0500	wake up, housework
0800 - 1030	go to look for food, weave,
1100 - 1200	cook and eat lunch
1200	some take a break, some look for food, some weave again
1630	cook dinner
1800	eat dinner
1900	take break
1930	sleep

Specific PRA tools:

Mapping proved to be a particularly useful and valuable tool in generating discussion and communicating our purpose in working in the village. The district staff used the maps and

transects interactively; the map was used to plan the transect, which in turn was used to cross-check the map and improve it.

The transects themselves were not planned as straight lines to cut through a cross section of the village land, but instead were a walk designed to link features of interest for fish and lowland rice production. They were planned with lively discussion about the items to be included, and resulted in circular or zig-zag walks. Such transects have been referred to elsewhere as 'investigative transects' (Mishra and Mohantry, 1995) who note that straight lines may miss out significant parts of the village; conversely, as we found, they may include much which is of little relevance for the topic in question (although it would be dangerous to rely only on the preconceptions of local staff regarding what is suitable for aquaculture).

Finally, a note on wealth-ranking is in order. During the research methods training workshop, trainers suggested that it would be useful to conduct a wealth ranking with two or three key informants, to ascertain local wealth criteria and which groups were benefiting from the project. In practice, although two districts reported the results of a wealth ranking, they had found a much quicker method, noting that 'it is easy to wealth rank because everybody knows who is rich, middle or poor'. They simply asked the village headman to count the number of families in each categoryin each village. This method is not verifiable, but it is also questionable whether a more rigorous method would have been desirable; there was a consensus on wealth indicators and on the expectations that the wealthier are more likely to have land appropriate for rice-fish culture, as reported above. The effect of the wealthier producing more fish will have to be documented as the project progresses.

Use of systems diagrams in technology planning and evaluation.

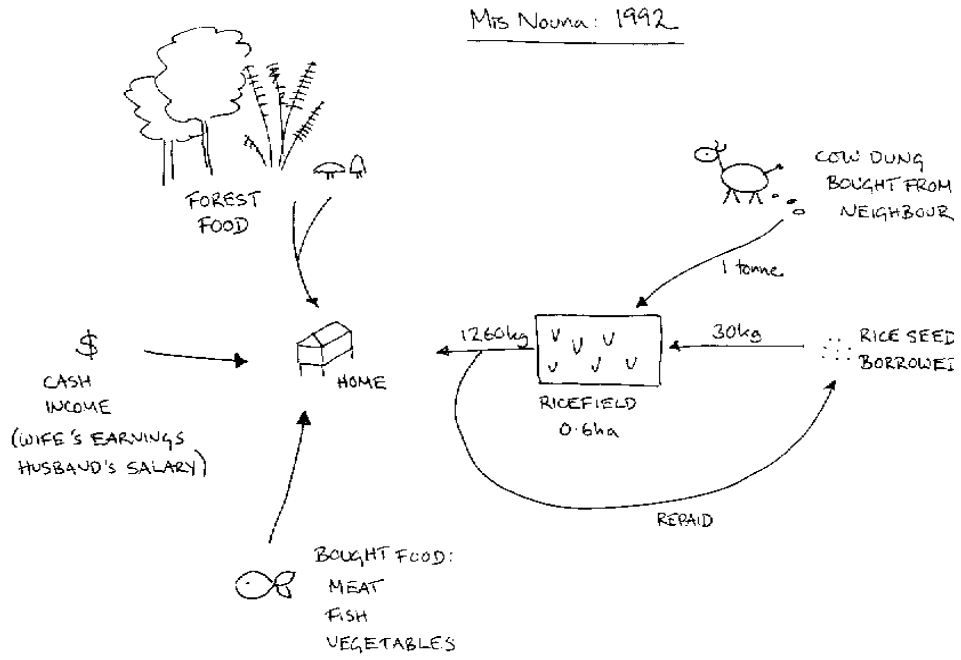
During the later stages of the diagnostic phase, in which the investigation was moving from the general to the specific, we found the resource-flow diagrams developed by ICLARM to be a useful tool. They also proved popular with provincial staff who used them on their own initiative to discuss changes in the farming system and plan future interventions. As with other PRA methods, the diagrams give a permanent visual image of the results, which has been developed together with the villager and which both the villager and the researcher understand (even if nobody else does), and which overcomes many language barriers. Some felt that the diagrams were difficult to understand, and this is a drawback for those not involved in preparing them, but the process of preparation and the explanation which accompanies them are key features of planning systems interventions; perhaps the product itself is less important.

For the rice-fish project the method has four main uses:

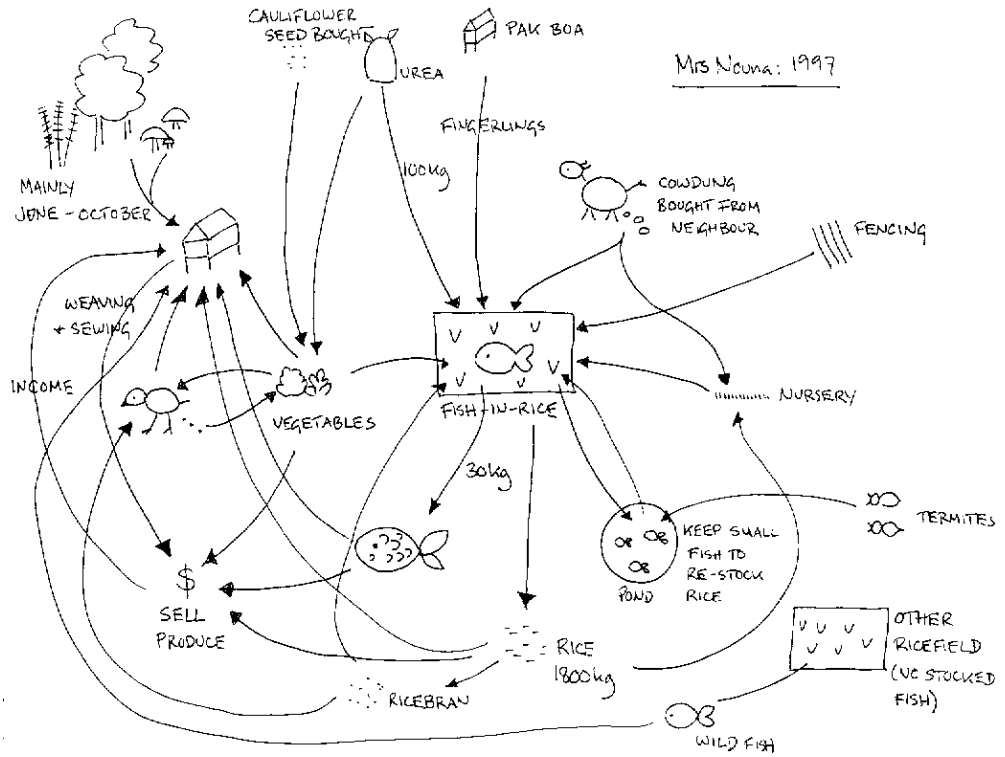
?? understanding change or planning an experiment: by drawing a diagram representing current farm management, and then another indicating the past system, or the expected future situation;

?? quantifying resource flows: the shared, accessible diagram allowed researchers to ask for more detail about inputs and yields, without the tedium of filling in long forms; it also facilitated cross-checking

?? evaluating impact of a new technology: comparing the 'before' and 'after' resource flow diagrams revealed a wide range of systems components which change as a result of culturing fish in rice fields; in particular changes in labour use patterns and cash flow were highlighted using this method.



Resource flows on Mrs Nouna's farm before introducing fish to her ricefield



Resource flows on Mrs Nouna's farm after introducing fish to her ricefield, showing 'multiple simultaneous innovation' and a variety of factors changing as a result of the innovation.

Appendix II: Rice agro-ecosystems that might accommodate fish

Table 1: Rice agro-ecosystems that might accommodate fish in Ban Xok

Type	location	rice fish	comments
spring fed irrigate rice paddies (Mr Boonkam; Mr Poom)	on low lying fertile land below village, 18+ ha	double cropped rice and vegetables, some fish culture in rice paddies. Rice mainly GK 6 &10 in dry season (need short season variety to allow time to prepare paddy for wet season crop, too windy for tall traditional varieties), fish mainly Puntius, tilapia, common carp, mrigal and big head	receives a certain amount of waste in run off from the village. The residual fertility of the paddy land, which was previously the site of the village, is also high. Wild fish grow well here.
Som Phoy dry season irrigation scheme	NW of B.Xok close to Ban Buangvar, c.16 ha belongs to B.Xok	rice, rice seed beds and vegetable cultivated in dry season (Dec- April/May)	whole area floods in rainy season. Along way from village, security a problem
Stream fed bunded paddy in forested valley (Mr Kak)	To S above village, gently sloping, bunded valley in forest	rice, improved long season (120 day) variety (GK 16), fish, common carp, tilapia, puntius	flowing water during rains to avoid flooding water stored from October
Stream irrigated paddy (Mrs Nouna)	on low lying flat land bordering a small permanent water course	?	rice straw left *in situ* to increase residual fertility

Table 2: Rice agro-ecosystems that might accommodate fish in Ban Gnangsoung:

Type	location	rice fish	comments
Paddy is drained to harvest rice (Mr Somsee)	high bunded area of paddy with perennial pond on flat low land that floods	rice: DG 6 (120 day), fish: tilapia, common carp and silver barb	stocks pond allows fish into paddy after water clears. Wild fish collect in pond.
Natural depression/low lying paddy area (Mr Supomb)	sandy soil, close to village, deep water	native long season glutinous rice. Small fry from Bak Bor	lack of water management precludes use of improved varieties; many wild fish
Permanent water body (ox-bow lakes) (Mr Newgain)	flat land near to village	irrigated maize, native "floating rice" Chow loy - as fish feed. Fish: common carp, puntius	Spawns fish for sale, local fry source. Ex LFS.
paddy that dries out if there is a break in the rains (Mr Seeya)	sandy soil, close to village	native rice varieties, fish: common carp, puntius and tilapia	trench dug but fills in because of sandy soil; on fish migration route for wild fish, uses fertiliser, fish improve rice yield

Table 3: Rice agro-ecosystems that might accommodate fish in Ban Nanokien:

Type	location	rice fish	comments
Paddy that is drained to harvest rice (Mr Janpowan)	on low lying fertile land below other paddy land	rice: traditional varieties. Fish: common carp and puntius	receives a certain amount of waste in run off from the other fields. Uses no fertiliser Wild fish grow well here. Rice plants left in paddy to be used for feed for fish not harvested
Low lying paddy that is drained to harvest rice (Mr Sokjeleum)	short distance from village	rice,GK 6 (LMV) GK 8 (MMV). fish, tilapia, puntius	
Paddy that is drained to harvest rice (Mr Boonlaoun)	Paddy on edge of stream floodplain	rice GK 6;Fish puntius monoculture	rich villager, also fish pond owner/operator
Low paddy area (Mr Kampuri)	Paddy on edge of stream floodplain between Nong Xeno, Pone Boke and Nanokien	rice, traditional varieties. Fish tilapia and Mrigal	whole area floods in rainy season. Tether buffalo in paddy for manure, wild fish (Clarias and snakeheads)
Bomb craters in paddies (Mr Sokjeleum	close to village	rice,GK 6 (LMV) GK 8 (MMV).	bomb craters in sandy soil filling in, now only 1 - 1.5 m deep 8 - 10 m diameter.
Stream fed bunded paddy (Mr Khanya; Mr Kamoon)	Above village, gently sloping, bunded valley	rice, improved and traditional varieties. fish, common carp, silver carp, puntius	flowing water during rains, also raises fish in pond, mrigal less popular as they tend to migrate

Table 4 Rice agro-ecosystems that might accommodate fish in Ban Lien Xai:

Type	location	rice fish	comments
Natural depression - paddy area shrinks to a central pond in dry season (Mr Neupon)	depression that collect water in dry forest area 1 km from village	rice: GK 8, 10*, 6, 4 Taw Doc 1 & 2* and Lueng Keo varieties. Fish: common carp, tilapia and mrigal. (* seem best varieties)	paddies have water June-Sept. Central depression has water till March. Whole area can dry up in July. Theft a problem. Few insect pests, fertilise with NPK and Urea. "Mak nyoa" used as fencing and in pest control.
Natural pond & Paddy that is drained to harvest rice (Mr Boon Nuag)	short distance from village, 6 Paddies in contact with a natural pond	rice GK 10 & 4;Fish puntius monoculture	rich villager, also fish pond owner.

There are ?principal types of rice based agro-ecosystems close to Ban Sepon (see table 5.5).

Table 5.5: Rice agro-ecosystems that might accommodate fish in Ban Sepon

type	location	rice fish	comments
Paddy irrigated in dry season			
Low lying paddy			
Bomb craters in paddies			

There are 2 principal types of rice based agro-ecosystems close to Ban Thakong (see table 5.6).

Table 5.6: Rice agro-ecosystems that might accommodate fish in Ban Thakong

type	location	rice fish	comments

Appendix III: Methods of fish production amongst farmers wishing to stock paddies

Village	farmer	system
B Xok	Mr Kak	extensive
	Mr Chantah	wild fish collection
	Mr Boonkan	intensive
	Mr Poon	semi-intensive
B Gnang soung	Mr Somsee	semi-intensive
	Mr Newgain	intensive
	Mr Seeya	semi-intensive
	Mr Supomb	extensive
	Mr Bunchan	semi-intensive
B Nanokien	Mr Janpowan	wild fish collection
	Mr Kampuri	wild fish collection
	Mr Khanya	wild fish collection
	Mr Kamoon	wild fish collection
	Mr Boonlaoun	wild fish collection
	Mr Purkhan	wild fish collection
	Mr Kamoon	extensive
	Mr Soukjreun	wild fish collection
	Mr Boonyat	wild fish collection
B Lien Xai	Mr Neupon	wild fish collection
	Mr Onekeo	wild fish collection
	Mr Boonnuag	wild fish collection
	Mr Budong	wild fish collection

Appendix IV: LFS recommendations and farmer trials in Kantabouli

RECOMMENDATION ***FORM A***

RECOMMENDATION FORM

1 District: Kantabuli

2 Name (of person making recommendation): Somboon

3 Date (day/mo./y): May 1997

4 Subject:

FISH [X] **LIVESTOCK** [ ] **VETERINARY** [ ]

5 Topic:

Culturing fish in rice fields

6 DESCRIPTION

Feed fish stocked in paddy locally available feeds such as rice bran, termites manure.
?? Feed what is available on a regular basis, (i.e. daily, 3 times week, etc.).

TARGET FOR …19……. | 4 | Sign. ……

WILL THIS BE A TRIAL ? NO YES if yes, Please complete form B1

Trial ***Form B***

Village: Xokgang Trial holder: Mr. Now

Recommendation	**As a result of this recommendation what do you expect to change?**	**How will you know it has changed?**	**How will you measure the change?**
Feed locally available feeds.. *(will feed termites and manure on regular basis)* * 800m^2 paddy stocked at 1 fish/2m^2 with c. carp, and puntius. = 400 fish	**1.** Cultured fish will grow well. **2.**Cultured fish will have high survival. **3.**	**1.**The fish will reach an acceptable size by harvest. **2.** The % survival of fish stocked in the paddy. **3.**	**1.** Weigh a sub-sample of fish harvested. **2.**Count the cultured fish at stocking and at harvest. **3.** * The district officer will help count the fish at stocking. The farmer will keep records on feed inputs and harvest. The district officer will summarize the information.

?? **START DATE:** Two-three weeks after transplanting rice.

?? **FINISH DATE:** Harvest rice.

?? **How will you report your results? When?**

Report during workshop / write article for newsletter

Trial ***Form B***

Village: Xokgang Trial holder: Mr. Phet

Recommendation	**As a result of this recommendation what do you expect to change?**	**How will you know it has changed?**	**How will you measure the change?**
Feed locally available feeds.. *(will feed termites and manure on regular basis)* * 800m^2 paddy stocked at 1 fish/2m^2 with c. carp, and puntius. = 400 fish	**1.** Cultured fish will grow well. **2.** Cultured fish will have high survival. **3.**	**1.** The fish will reach an acceptable size by harvest. **2.** The % survival of fish stocked in the paddy. **3.**	**1.** Weigh a sub-sample of fish harvested. **2.** Count the cultured fish at stocking and at harvest. **3.** * The district officer will help count the fish at stocking. The farmer will keep records on feed inputs and harvest. The district officer will summarize the information.

?? **START DATE:** Two-three weeks after transplanting rice.

?? **FINISH DATE:** Harvest rice.

?? **How will you report your results? When?**

Report during workshop / write article for newsletter

Trial ***Form B***

Village: Xokgang Trial holder: Mr. Kak

Recommendation	**As a result of this recommendation what do you expect to change?**	**How will you know it has changed?**	**How will you measure the change?**
Feed locally available feeds.. *(will not feed to act as comparison with Mr. Now and Mr. Phet)* * 1600m^2 paddy stocked at 1 fish/2m^2 with c. carp and puntius. = 800 fish	**1.** Cultured fish will grow well. **2.**Cultured fish will have high survival. **3.**	**1.**The fish will reach an acceptable size by harvest. **2.** The % survival of fish stocked in the paddy. **3.**	**1.** Weigh a sub-sample of fish harvested. **2.**Count the cultured fish at stocking and at harvest. **3.** * The district officer will help count the fish at stocking. The farmer will keep records at harvest. The district officer will summarize the information.

?? **START DATE:** Two-three weeks after transplanting rice.

?? **FINISH DATE:** Harvest rice.

?? **How will you report your results? When?**

Report during workshop / write article for newsletter

Trial ***Form B***

Village: Yangsoong Trial holder: Mr. Poom

Recommendation	**As a result of this recommendation what do you expect to change?**	**How will you know it has changed?**	**How will you measure the change?**
Feed locally available feeds.. *(will feed termites, rice bran and manure on regular basis)* * 1600m^2 paddy stocked at 1 fish/1m^2 with tilapia, c. carp, and puntius. = 1600 fish	**1.** Cultured fish will grow well. **2.**Cultured fish will have high survival. **3.** Increased fertilizer for rice plants.	**1.**The fish will reach an acceptable size by harvest. **2.** The % survival of fish stocked in the paddy. **3.** Rice will do well.	**1.** Weigh a sub-sample of fish harvested. **2.**Count the cultured fish at stocking and at harvest. **3.** Rice production. (*hard to determine because factors related to weather are more important, but will try*) * The district officer will help count the fish at stocking. The farmer will keep records on feed inputs and harvest. The district officer will summarize the information.

?? **START DATE:** Two-three weeks after transplanting rice.

?? **FINISH DATE:** Harvest rice.

?? **How will you report your results? When?**

Report during workshop / write article for newsletter

Trial ***Form B***

Village: Yangsoong Trial holder: Mr. Poom

Recommendation	**As a result of this recommendation what do you expect to change?**	**How will you know it has changed?**	**How will you measure the change?**
Feed locally available feeds.. *(will not feed to serve as a comparison with Mr. Poom and Mr. Tongdee)* * 1300m^2 paddy stocked at 1 fish/1m^2 with tilapia, c. carp, and puntius. = 1300 fish	**1.** Cultured fish will grow well. **2.**Cultured fish will have high survival. **3.**	**1.**The fish will reach an acceptable size by harvest. **2.** The % survival of fish stocked in the paddy. **3.**	**1.** Weigh a sub-sample of fish harvested. **2.**Count the cultured fish at stocking and at harvest. **3.** * The district officer will help count the fish at stocking. The farmer will keep records on harvest. The district officer will summarize the information.

?? **START DATE:** Two-three weeks after transplanting rice.

?? **FINISH DATE:** Harvest rice.

?? **How will you report your results? When?**

Report during workshop / write article for newsletter

Trial ***Form B***

Village: Yangsoong Trial holder: Mr. Tongdee

Recommendation	**As a result of this recommendation what do you expect to change?**	**How will you know it has changed?**	**How will you measure the change?**
Feed locally available feeds.. *(will feed termites on regular basis)* * 2000m^2 paddy stocked at 1 fish/1m^2 with c. carp, and puntius. = 2000 fish	**1.** Cultured fish will grow well. **2.**Cultured fish will have high survival. **3.**	**1.**The fish will reach an acceptable size by harvest. **2.** The % survival of fish stocked in the paddy. **3.**	**1.** Weigh a sub-sample of fish harvested. **2.**Count the cultured fish at stocking and at harvest. **3.** * The district officer will help count the fish at stocking. The farmer will keep records on feed inputs and harvest. The district officer will summarize the information.

?? **START DATE:** Two-three weeks after transplanting rice.

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RECOMMENDATION ***FORM A***

RECOMMENDATION FORM

1 District: Kantabuli

2 Name (of person making recommendation): Somboon

3 Date (day/mo./y): May 1997

4 Subject:

FISH [X] **LIVESTOCK** [ ] **VETERINARY** [ ]

5 Topic:

Culturing fish in rice fields

6 DESCRIPTION

Surround the paddy with blue netting to exclude fish predators.

?? Drive short bamboo poles in the ground all the way around the paddy to secure the blue netting to.

?? Secure the blue netting to the poles.

?? Dig a shallow trench and bury the bottom part of the netting to keep pests from going under it.

?? Check the netting regularly to look for holes.

TARGET FOR …19……. | 3 | Sign. ……

WILL THIS BE A TRIAL ? NO YES if yes, Please complete form B1

Trial ***Form B***

Village: Xokgang Trial holder: Mrs. Wien

Recommendation	**As a result of this recommendation what do you expect to change?**	**How will you know it has changed?**	**How will you measure the change?**
Surround the paddy with blue netting to exclude fish predators. (*This paddy not surrounded to compare with the paddy of Mr. Pome)* * 1200m^2 paddy stocked at 1 fish/2m^2 with tilapia, c. carp, and puntius. = 600 fish	**1.** Wild fish won't enter the paddy. **2.**Cultured fish will have high survival. **3.**	**1.**The number of predatory wild fish found in the paddy..(vs. a paddy without netting.) **2.** The % survival of fish stocked in the paddy. **3.**	**1.**Count the predatory wild fish (snakehead, climbing perch, clarius) found in the paddy at the time of harvesting the cultured fish. **2.**Count the cultured fish at stocking and at harvest. **3.** * The district officer will help count the fish at stocking. The farmer will keep records at harvest. The district officer will summarize the information.

?? **START DATE:** Two-three weeks after transplanting rice.

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?? **How will you report your results? When?**

Report during workshop / write article for newsletter

Trial ***Form B***

Village: Xokgang Trial holder: Mr. Pome

Recommendation	**As a result of this recommendation what do you expect to change?**	**How will you know it has changed?**	**How will you measure the change?**
Surround the paddy with blue netting to exclude fish predators. * 400m^2 paddy stocked at 1 fish/2m^2 with tilapia, c. carp, and puntius. = 200 fish	**1.** Wild fish won't enter the paddy. **2.**Cultured fish will have high survival. **3.**	**1.**The number of predatory wild fish found in the paddy..(vs. a paddy without netting.) **2.** The % survival of fish stocked in the paddy. **3.**	**1.**Count the predatory wild fish (snakehead, climbing perch, clarius) found in the paddy at the time of harvesting the cultured fish. **2.**Count the cultured fish at stocking and at harvest. **3.** * The district officer will help count the fish at stocking. The farmer will keep records at harvest. The district officer will summarize the information.

?? **START DATE:** Two-three weeks after transplanting rice.

?? **FINISH DATE:** Harvest rice.

?? **How will you report your results? When?**

Report during workshop / write article for newsletter

Trial ***Form B***

Village: Yangsoong Trial holder: Mr. Supome

Recommendation	**As a result of this recommendation what do you expect to change?**	**How will you know it has changed?**	**How will you measure the change?**
Surround the paddy with blue netting to exclude fish predators. * 1600m^2 paddy stocked at 1 fish/1m^2 with c. carp, and puntius. = 1600 fish	**1.** Wild fish won't enter the paddy. **2.**Cultured fish will have high survival. **3.**	**1.**The number of predatory wild fish found in the paddy..(vs. a paddy without netting.) **2.** The % survival of fish stocked in the paddy. **3.**	**1.**Count the predatory wild fish (snakehead, climbing perch, clarius) found in the paddy at the time of harvesting the cultured fish. **2.**Count the cultured fish at stocking and at harvest. **3.** * The district officer will help count the fish at stocking. The farmer will keep records at harvest. The district officer will summarize the information.

?? **START DATE:** Two-three weeks after transplanting rice.

?? **FINISH DATE:** Harvest rice.

?? **How will you report your results? When?**

Report during workshop / write article for newsletter

Trial ***Form B***

Village: Yangsoong Trial holder: Mr. Somsi

Recommendation	**As a result of this recommendation what do you expect to change?**	**How will you know it has changed?**	**How will you measure the change?**
Surround the paddy with blue netting to exclude fish predators. * 1600m^2 paddy stocked at 1 fish/1m^2 with c. carp, and puntius. = 1600 fish	**1.** Wild fish won't enter the paddy. **2.**Cultured fish will have high survival. **3.**	**1.**The number of predatory wild fish found in the paddy..(vs. a paddy without netting.) **2.** The % survival of fish stocked in the paddy. **3.**	**1.**Count the predatory wild fish (snakehead, climbing perch, clarius) found in the paddy at the time of harvesting the cultured fish. **2.**Count the cultured fish at stocking and at harvest. **3.** * The district officer will help count the fish at stocking. The farmer will keep records at harvest. The district officer will summarize the information.

?? **START DATE:** Two-three weeks after transplanting rice.

?? **FINISH DATE:** Harvest rice.

?? **How will you report your results? When?**

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