Successful enhancement of a lagoon prawn fishery at Rekawa, Sri Lanka

by Professor John Davenport, University Marine Biological Station, Millport (UMBSM) and Professor S.U.K. Ekaratne, University of Colombo.

Fisheries stock enhancement has a long history, and for finfish has had many successes (see report by Dr Kai Lorenzen in AQUACULTURE NEWS, June 1997). However, for prawn fisheries there have been relatively few enhancement exercises, and none which have gone beyond the hopeful addition of cultured prawn postlarvae (PLs) to the fishery area. This article summarises the conduct and performance of a two-year programme (1995-97) jointly carried out by the University Marine Biological Station, Millport and the Department of Zoology, University of Colombo with DFID funding channelled through MRAG Ltd at Imperial College, London. Mr Dan Lee carried out much of the Sri Lankan fieldwork, while Dr Jeremy Hills of UMBSM was involved with statistical design.


Post-larval holding cages (hapas) at Rekawa Lagoon

The programme was designed to address two major objectives. First, a programme at Rekawa Lagoon offered the opportunity to determine whether stock-enhancement of a prawn fishery could be biologically-effective (i.e. whether released juveniles recruited to the fishery in sufficient numbers to be detectable). This objective was expected to be of significance beyond Sri Lanka. Second, the programme was carried out to determine whether stock-enhancement of the Rekawa Lagoon prawn fishery was of socio-economic benefit to the local fishing community.

Rekawa Lagoon, closed off from the neighbouring sea by a sand bar for much of the year, supports an artisanal fishery for prawns, predominantly (90%) *Penaeus indicus*, but with a small proportion (1% by numbers, 2.5% by value) of more valuable tiger prawns, *Penaeus monodon*. Both penaeid populations are supplied naturally by incoming larvae and PLs that enter the lagoon when the sand bar is breached. The fishery opens in late September, but only *Penaeus indicus* is caught until about February/March when *Penaeus monodon* appears. All prawns are fished out by May; fishing intensity (by nets and traps [kraals]) is extremely high - in some respects the lagoon is like an extensive fish farm, rather than a conventional prawn fishery. The fishery was investigated by detailed catch monitoring, combined with mark and recapture trials upon *Penaeus indicus*. In the light of the fishery knowledge gained, it was decided that enhancement should be carried out with the less common *P. monodon*, and out of phase with the natural fishery.

THE ARTICLES ON THESE PAGES OF AQUACULTURE NEWS ARE FUNDED BY THE DEPARTMENT FOR INTERNATIONAL DEVELOPMENT (DFID) WITH THE AIM OF INFORMING A WIDE AUDIENCE OF THE WORK OF THE DFID FISHERIES PROGRAMME.

Prawn trap (kraal) at Rekawa Lagoon

In most respects the programme was successful. Two stock enhancement trials took place, the second largely outwith the period of the contract. To conduct the trials, small PLs were purchased from a commercial supplier and grown on in cages (hapas) within the lagoon for a 14-day period before release. During the first trial PLs released in July 1996 grew and recruited to the fishery (in about 70 days) even though some PLs were probably washed out to sea by a sand bar breach Catches of the released species (*Penaeus monodon*) were much higher than in the previous year (by 1400%), while overall prawn catches were 166% higher than in the previous year. This strongly indicated successful enhancement, and showed that the presence of tiger prawns had not depressed *Penaeus indicus* catches (a concern of local fishermen). However, a) historical catches of penaeids had been even higher and b) a short-duration breach between the lagoon and the sea suggested that some of the apparent enhancement could be due to natural recruitment from the sea. Set against these reservations, it must be emphasised that (by design) the post-enhancement *Penaeus monodon* catches occurred 6 months out-of-phase (mainly in September and October) with the normal tiger prawn catch (March-May); local fishermen had never previously caught tiger prawns at this time. At the time of writing, *Penaeus monodon* are being caught following the second out-of-phase release of PLs (70,000). Release occurred in July 1997. When the fishery opened in September, adult tiger prawns were immediately caught, though no breach in the lagoon mouth had taken place. In this case no source of tiger prawns other than the PLs can be postulated, so significant enhancement *must* have taken place.

The programme was not cost-effective in its present form for three reasons: 1) equipment costs were greatly-inflated because imported cage (hapa) materials were used for speed and convenience; 2) a number of PLs were lost during the first restocking exercise; 3) PL purchase price was high. All three factors are susceptible to amelioration (by use of local materials, more experience of handling PLs, and rearing of PLs from a smaller (cheaper) size respectively). After initial caution the fishing community found the programme of great value and evidence was collected which showed that the additional income generated by the enhancement had been used for purchase of new fishing gear, bicycles, school uniforms and books. The additional money also reached the fishermen at a time of year when their normal income was depressed, and therefore reduced their reliance upon welfare payments.

A modelling exercise was conducted to consider how the restocking exercise might be improved. It was concluded that a 4-times per year restocking exercise at the current level (*ca* 70,0000 PLs per release) would be the best from a point of view of maximizing economic return and maintaining occupation of fishermen, whilst minimizing interference with the postlarval holding cages (hapas) at Rekawa Lagoon *Penaeus indicus* fishery.

Overall, our programme demonstrated the potential for an environmentally-friendly interaction between aquaculture and artisanal lagoon fisheries. The Sri Lankan government is already considering PL release schemes elsewhere in the country. From a research point of view it would be desirable to investigate whether stock enhancement can be effective in rather less enclosed lagoon systems.

THE ARTICLES ON THESE PAGES OF AQUACULTURE NEWS ARE FUNDED BY THE DEPARTMENT FOR INTERNATIONAL DEVELOPMENT (DFID) WITH THE AIM OF INFORMING A WIDE AUDIENCE OF THE WORK OF THE DFID FISHERIES PROGRAMME.

Participatory monitoring of systems change in integrated aquaculture: matrices for learning from farmer-managed trials in Laos

by Anna Lawrence, University of Reading, Graham Haylor, Institute of Aquaculture, and Eric Meusch, Provincial Government Savannakhet, Laos

To date, many of the attempts to involve farmers in the evaluation of technologies have been applied to simple technologies which can be compared with each other by one or a small group of farmers, who have observed all of the options. The most common example is the evaluation of a range of crop varieties (e.g. Ashby, 1990; Joshi & Witcombe, 1995). However, many of the technologies appropriate for sustainable or low-input aquaculture involve more complex changes which affect management of the whole farming system. This has two implications for monitoring and evaluation: the impact of the technology is more wide-ranging, and it is not likely that one farmer will be able to compare a range of different options within the space of a small farm.

The Laos Project approach and gender issues

As previously reported in Aquaculture News November 1995 the DFID Aquaculture Research Programme project 'Addressing technical, social and economic constraints to rice-fish culture in Laos, emphasising women's involvement' is co-ordinated by the

Systems Group of the Institute of Aquaculture (IoA), University of Stirling with the collaboration of staff from the Livestock and Fisheries Section (LFS), Savannakhet, Laos and the Lao Women's Union (LWU) and the Agricultural Extension and Rural Development Department of the University of Reading. The LFS in Savannakhet Province is at an early stage in its institutional development and is currently supported by the Asian Institute of Technology (AIT) Outreach Project to strengthen its capacity to develop and extend aquaculture and fisheries technology. Staff have no concrete experience with research, and do not have a national or local research system from which they obtain technical recommendations, so the LFS is currently concerned to strengthen its own institutional procedures for formulating and testing recommendations. The IoA project is working with the Section and interested farmers, to investigate and address their constraints to raising fish in rice.

The project takes a systems approach; trials designed by farmers are based on a combination of local and scientific knowledge, government institutional support, use of Participatory Monitoring and Evaluation (PM&E) to facilitate this two-way learning process, and elicitation of indicators through group processes with a range of actors.

In Laos PM&E is novel in the institutional culture and has had to be formalised to fit in to the institutional way of doing things. The project area is in rain fed rice fields, a highly variable and risk-prone environment (with flooding and drought). This diversity, and a lack of appropriate technology recommendable for the zone, was the key to proposing a participatory technology development approach in the project. The government institution involved was keen to work in the geographical area, and had relevant technical knowledge, but had no direct experience with that technology in that zone, and no ready-made technology to offer. Before the project, relevant farmers' knowledge had not been studied in detail. The project began by drawing out local knowledge, attempting to understand constraints and priorities, and then working with individuals to plan trials. This diagnostic and planning process explicitly drew attention to the diversity of farmers' experience and goals. Feedback indicated that this was an important result of the diagnostic process, establishing that there are several different valid opinions within the community. Formerly, the attitude of government staff had been that there was one single version of reality which must be described by consensus, often from the senior male point of view. The realisation of diversity was one factor which led to an appreciation of the need for PM&E.

Gender is a neglected aspect of rural development in many cultures. PM&E was conceived as an essential tool to help access women's experience and opinions in the project. The technology development is likely to affect women and men differently. The section is not used to consulting women farmers, and staff tend to assume either that women have the same knowledge as men, that it is only necessary to talk to the men because they in turn will discuss the issues with their wives, or that women are not relevant to the technology development in question. Aquaculture in Laos is seen as 'men's work', but women are much more closely involved than researchers originally described. PM&E has been necessary to access this difference in knowledge, experience and attitudes.

Description of the PM&E experience

The project in Laos was planned to include a situation analysis followed by a period of support for farmer participatory research. The mechanism by which this might be put into action was not pre-planned. It was intended that institutional links would be developed amongst DFID researchers, the LFS and the LWU at provincial and district level and that district level staff would work with farmers directly. From the outset it was clear that farmers' knowledge, institutional knowledge and outsiders knowledge were all important components of the situation analysis and the subsequent research process. The local institutions had close contacts with the farming communities but little experience of sharing and recording information systematically. The outside researchers had experience of information collection but no local knowledge, and there were cultural and language barriers to communication. A participatory system of recording and developing recommendations developed out of a series of workshops involving farmers, conducted throughout the province to determine a structured methodology for conducting, in participation with farmers, an analysis of the farming and communication systems and options for aquaculture development. The model which is described here is a

component of that system which was developed as a way of exploring farmers' experience of the participatory trials.

A tool which has been used with great effect in PM&E is matrix-scoring, which allows farmers to compare a range of qualities for a range of crop varieties. For the reasons discussed above, this is not so straightforward with farming systems interventions, but it is possible to develop the tool to help farmers and researchers explore the impact of systems changes. The basic concept is that, instead of comparing a range of technologies, members of the farm-household compare their perceptions of the farming system before and after the trial. An important part of the PM&E process is defining the indicators, and this was done by a group consisting of various actors drawing on farmers' own experience. The definition of indicators by farmers is considered to be a key tool in helping scientists to understand farmers' priorities.

PM&E evolved as a process with the following steps.

- improved understanding of the interlinking components of farming systems diagnostic phase;
- discussions with individuals who have experienced systems changes as a result of incorporating new practices (soil conservation or fish culture);
- discussion with other farmers (in groups or singly) of their expectations of change through incorporating the new practices;
- definition with a group of farmers and researchers, of a list of indicators to show how various components of the system would change,
- refining the list in the field with more farmers,
- use of the list in matrix diagrams, to rank / score changes.

The institutions involved in Laos were not used to any form of participatory research or evaluation, and there were

Some pictures of women in Nanokien village in Atsphangtong district in Laos at the Aquaculture Research Program Rice - Fish Project workshop facilitated by Graham Haylor and Anna Lawrence

communication difficulties based on language. The process had to approach the need for PM&E through the perceptions of the institutional staff, and had to develop more structured tools to overcome language barriers and lack of confidence about using flexible methods. In particular the project staff felt a need to access the responses of individuals in the households which are conducting trials, to find out the different reactions of individuals rather than lose detail in the group discussions which they had used up to that point.

The process began by asking individual farmers to describe their farming systems, including some who had already incorporated fish in rice fields. Together with research staff, a group of scientists facilitated drawings of systems diagrams, based on the methods developed by ICLARM (Lightfoot et al., 1993) which indicate that integrated systems are only shown to have a net benefit to farmers if factors other than fish production are taken into account. Figures 1 and 2 show two diagrams drawn by Mrs Nouna (a farmer in Khantabouli district who is working with the project) , who showed graphically the complexity of her current rice-fish system (Fig. 2). When she was asked how it was before, she drew a much simpler diagram (Fig. 1). It was clear to the research team how many factors had changed simultaneously, when she included fish in the system. This led on to a discussion which indicated that wild fish populations had in fact increased as a consequence of digging the ditches to help fish cultivation, and that rice yields had increased probably because Mrs Nouna started adding fertiliser at the same time as she started fish culture.

These differences between the two systems became the starting point for a discussion with extension workers, on the indicators which might change as a result of participatory trials. The discussion considered the benefits and risks of fish in rice (food, money, work, land), and then expanded into side effects such as time saved looking for food, money saved from buying food, nutrition, rice production, and wild fish numbers. The group rejected 'status / opinion of other farmers' as an indicator, and also rejected 'decreasing resources for other activities' as they said there was not much competition for resources except labour. The group drew up a checklist of eight factors when brainstorming the process. Two more factors were added after interviews with farmers, which showed that improved family diet and income are perceived as important effects of rice-fish culture. The final list is shown in forms 1 and 2, and includes inputs and outputs; it allows for further additions if respondents feel other important factors have changed as a result of the trial.

The team developed two matrices to monitor changes in importance of these factors, and quantity of each factor (see appendix 1). The extension team felt the method was particularly valuable in helping them to identify differences between households, and between men and women in each household. The first results from this process, i.e. ranking of factors before the trial, provides some interesting reflections. Both men and women prioritise topics that represent risk or costs above topics that represent benefit. It might be expected that these priorities would change if fish production was successful.

As with other PRA methods, both the resource flow diagrams and the matrices 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

'Addressing technical, social and economic constraints to rice-fish culture in Laos, emphasising women's involvement' is funded by DFID through the Aquaculture Programme, project R6380CB. We are grateful for feedback on the process through discussions with colleagues in LFS.

dfid *report*

Form 1 for Monitoring of fish-in-rice

district ....

village ....

interviewer ....

person interviewed ....

topic	importance level		comments
	date before fish culture	date after fish culture	
● time			
● investment			
● labour			
● land			
● rice production			
● wild fish yield			
● technical knowledge			
● cultured fish yield			
● living expenses			
● income			
● food			

other comments ....

Explanation

- use this form (1) for monitoring fish-in-rice, to interview before and after (two times) raising fish
- make small cards and write each topic on one card
- let the villager arrange the cards in order of importance
- record the order of importance assigned by the villager, by writing the number in the column beside the topics (1,2,3,..........., 11).

Form 2 for Monitoring of fish-in-rice

province ....

district ....

village ....

interviewer ....

person interviewed ....

date ....

topic	before fish culture	after fish culture	comments
time			
investment			
labour			
land			
rice production			
wild fish yield			
cultured fish yield			
technical knowledge			
living expenses			
income			
food			
other			
other			

Explanation

1.

many	10	xxxxx xxxxx
middle	5	xxxxx
few	1	x

2. Interview participants once only, after raising fish, and ask the importance of the topics both before and after raising fish. This comparison is to identify possible differences between before and after.

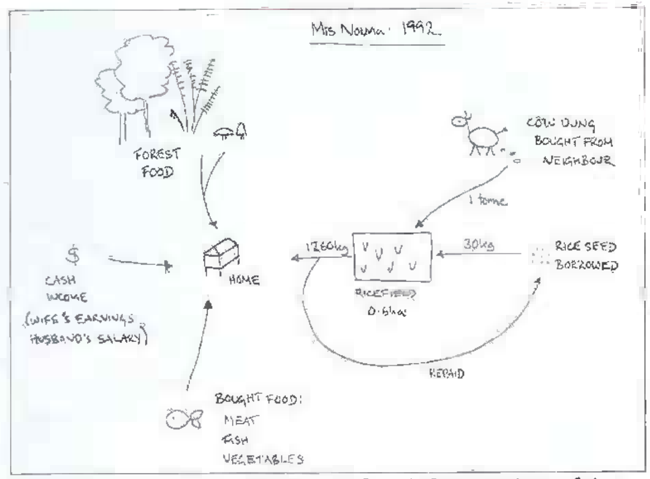

Figure 1: resource flows on Mrs Nouna's farm before introducing fish to her ricefield

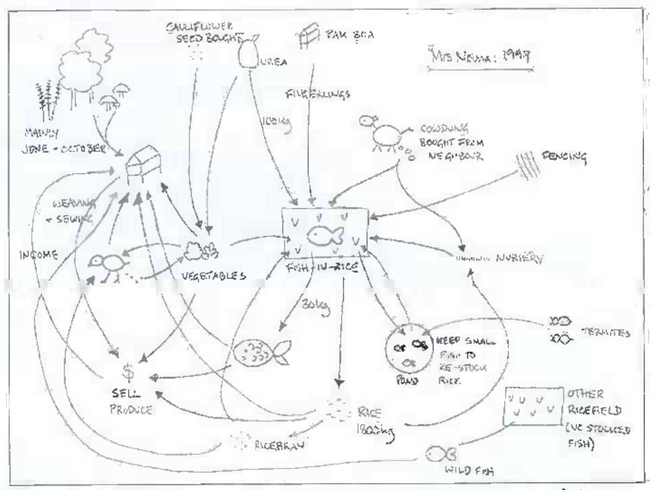

Figure 2: resource flows on Mrs Nouna's farm after introducing fish to her ricefield, showing 'multiple simultaneous innovation' and a variety of factors changing as a result of the innovation.

[1] Agricultural Extension and Rural Development Department (AERDD), University of Reading, Box 238, Reading, RG6 6AL, United Kingdom

[2] Institute of Aquaculture, University of Stirling, FK9 4LA, United Kingdom

[3] c/o LFS, Savannaknet, Laos

REFERENCES

Ashby J.A. (1990) Evaluating technology with farmers: a handbook. IPRA projects, CIAT, Colombia.

Joshi A and Witcombe J R (1995) Farmer participatory research for the selection of rainfed rice cultivars. Proceedings of the IRRI Conference 1995. Fragile lives in fragile ecosystems. IRRI.

Lightfoot C., Bimbao M.A.P., Dalsgaard J.P.T. and Pullin R.S.V. (1993) Aquaculture and sustainability through integrated resources management. Outlook on Agriculture 22 (3): 143-150.