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Improving freshwater fish seed supply and performance in smallholder aquaculture systems in Asia.

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Table of Contents

List of tables

List of Figures

Executive Summary

An approach to developing a rapid and accessible overview of freshwater fish seed supply systems was developed with partners in four parts of Asia. 'State of the System' reporting, in which primary and secondary data was collected and processed, allowed an holistic overview of current status and trends that could be cross-checked with, and by stakeholders, provided early insights into major researchable and actionable issues in a rapid and participatory way. Perceptions of the availability of quality fry were variable at the sites and among the different stakeholders involved. Most stakeholders were relatively new entrants to seed supply networks but their perceptions were often related to their level of experience, and among food fish farmers their market or subsistence orientation. A widespread perception that inbreeding was a major cause of deterioration was rejected after consideration of broodfish management practices. Strong seasonality of seed supply and demand had clear impacts on quality.

In follow up research trials managed by local partner institutions in northern Vietnam, Lao PDR, NE Thailand and NW Bangladesh no evidence was found for public seed being better quality than private sector, indeed there was evidence to the contrary. This dichotomy between perception and reality appears to be part of a general trend of disengagement that appeared to be affecting public-private sector relationships and capacity for improving and sustaining delivery of quality seed to farmers. A need to focus towards genetic improvement of fish seed, rather than addressing the non-genetic causes of poor quality, by public sector institutions, was also a conclusion of the early part of the research study.

An expectation that physical quality tests could be developed to assess seed quality at the farm gate was unfulfilled, but the activity had positive outcomes. The simple salinity based challenge test was developed and adopted by the commercial partner involved, but its usefulness was based on assessing homogeneity of size in multiple batches of seed rather than overall quality. Further research suggested that low survival immediately after transportation was the most important outcome of poor quality in seed of homogenous genetic quality. This phenomenon could most easily be assessed by holding seed in hapas and observing feeding behaviour for 72 hours post transportation.

Current wisdom among the research and policy community in Asia that monosex Nile tilapias are required to support widespread uptake and adoption of the species, were challenged by the project. High quality mixed tilapias performed as well as monosex under a variety of resource availability and market conditions. Adoption of monosex Nile tilapia is still constrained in many parts of high potential aquaculture areas of Asia through inconsistency of quality and quantity of seed produced and the seasonal nature of demand; these factors led the project to develop and assess the impact of a decentralised approach to high quality mixed sex production.

These research activities undertaken with CARE in Bangladesh have demonstrated rapid farmer-to-farmer adoption of Nile tilapia seed production in irrigated ricefields in the NW region. The introduction of high quality Nile tilapia in an area that common carp seed production in ricefields was already

established changed the overall system management, benefits and commercial orientation. Subsistence benefits, moreover, were enhanced and an important multiplier effect as benefits to traders, food fish producers and consumers was also apparent. Trials with Worldfish partner NGOs in other parts of Bangladesh suggest that the approach brings benefits over larger geographical areas.

The roles and importance of silver carp to the poor has also been established in the same research area within Bangladesh and strategies to further improve its impact compared. Improvements in seed management, especially the introduction of over-wintering in hapas by traders local to demand was found to deliver greater benefits that introduction of a new strain of the species.

A major conclusion of the project has been that attitudes to 'seed quality' need to change from a 'product' to a 'process' focus. Action research with clusters of hatchery/nursery operators in Northeast Thailand recognised the potential of establishing capacity locally for improving livelihoods related to fish seed production. The value of re-engagement between the private and public sector using a participatory approach was shown and appears to be complementary to recent broader institutional/political changes in Thailand.

Background to the Project

The availability of quality fish seed to smallholders is a prerequisite for sustainable aquaculture. Hatchery development over the last 30 years has been critical to the emergence of fish culture as an important part of livelihood systems in some parts of Asia (Edwards, Little and Yakupitiyage, 1997). Carps, both indigenous and exotic species, and tilapias make up the bulk of fish raised in the region (FAO, 1995). These fish can be produced using low levels of input, can be raised cheaply and can provide food for poor consumers. Though tilapias have rapidly gained popularity, a wide range of carp species remain predominant in many areas. Both carps and tilapias are also important in enhanced fisheries (Lorenzen, 1995). The development of appropriate hatchery systems for low cost freshwater fish has been a focus at AIT over the last decade through on-station and on-farm/hatchery trials. Technologies for tilapias in both commercial and small-holder situations (Little, 1989; Macintosh & Little, 1994, Hulata and Little, 2002), small carps such as the silver barb (*Puntius gonionotus*) (Djamanto, Little & Nietes, 1995; Kheang, 1994) and snakeskin gourami (Yoonpundh & Little, 1996, 1997; Yoonpundh, 1997) have been developed or refined.

Initially, techniques to mass produce fish and seed were largely introduced through the state sector in Asia, but the availability of fry and fingerlings increased rapidly after dissemination to and adoption by, the private sector (Little, Innes-Taylor & Surintarasaree, 1996). A variety of actors now produce fish seed in Asia, including both government and non-government organizations, but entrepreneurs probably produce the bulk of seed in countries such as Bangladesh, India, Vietnam and Thailand. Overviews of hatchery development have been completed for Vietnam (Little and Pham, 1996) and Northeast Thailand (Ingthamjitr & Little, 1997). Tilapia (Little, Sikawa & Juntana, 1994) and snakeskin gourami seed (Yoonpundh & Little, 1997) production and marketing systems in Thailand have also been reviewed.

Promotion of seed production by farmers themselves or their greater involvement in their production is now often widely promoted (Gregory, Innes-Taylor, Guttman and Little 1997). The AIT Aquaculture Outreach project has promoted aquaculture through improving the availability of quality seed fish at the farm gate. The approach has varied from introducing advanced nursing in hapas of their own fry to farmers in Northeast Thailand, where small fry are available through well developed trading networks, to institutionalizing the development of simple hatchery, nursery and distribution systems in Laos and Cambodia (Haitook, 1997, Gregory & Little, 1997).

The emerging production and distribution systems for freshwater fish seed in Asia are complex and dynamic. The role of carps and tilapias in culture systems, and farmers' expectations affect demand for seed and impacts of supply. In NE Thailand, farmers raising fish mainly for consumption prefer tilapias partly because seed is self-sustaining and cash costs are avoided (Surintaraseree, 1988). Their 'self-seeding' also provides valuable forage for wild, highly valued, carnivorous fish (Middendorp & Verreth, 1986). Production is dominated by carps in Bangladesh, but where introduced, tilapias may be important in making low cost fish available for the resource-poor (Hossain, 1995; Hassan, Edwards & Little, 1996; AIT Aqua Outreach, 1997). In some areas seasonally cool weather may favour carps and constrain early season production of quality tilapia seed when it is most required (Nguyen, 1997). Strategies to make high quality Nile tilapia seed available are also in high demand throughout the region and further afield, including those areas with low seasonal temperatures such as Northern Vietnam and Northwest Bangladesh (Nguyen, 1997; Barman, 1997).

The rapidly developing countries of South and Southeast Asia are showing marked changes in species preference, and the means to produce and disseminate fish seed. Conventional data collection typically gives only a historical idea of trends; whereas policy makers require more up-to-date and flexible information. State of the system workshops have been developed principally with the College of Agriculture and Forestry, Ho Chi Minh City to meet this need (AIT/CAF 1997). These workshops give a framework for institutions to describe, analyze and report their own situation with the stakeholders involved, which in time will lead to cost-effective improvement and monitoring of fish seed availability and quality.

Whilst fish seed supply has exploded in many parts of Asia, there now appears to be major difficulties with poor or erratic quality of seed reaching farmers. The basis for the gradual deterioration in yields and individual size of both carps and tilapias is unclear, and may be partially obscured by the characteristics of production and delivery in which many actors may be involved in bringing seed to users. The quality and/or management of brood fish may be critical to seed quality, as has been observed for hybrid *Clarias* catfish (Ingthamjitr, 1997). Hatchery practices have also been linked to inbreeding of the fecund carps (Eknath and Doyle, 1990). The stunting observed in tilapias after several generations may also be linked to negative selection or contamination by feral fish. Current schemes to upgrade stocks with wild or improved fish (e.g. GIFT) may be unsustainable unless the problem is better understood and improved management strategies developed (Little and Edwards, 1997)

Quality of fish seed from commercial producers may also be affected by poor husbandry during nursing, holding or transportation (Morrice, 1995) but despite this, one survey in Northeast Thailand found that farmers preferred to buy tilapia seed from outside the village rather than buy from neighbours, because of perceived quality differences (Sodsook, 1989). However, tilapia seed are not widely produced and availability is low as traders prefer to market only carps (Little *et al*, 1994). In the Red River Delta, Vietnam, competition between nursery producers and traders, together with typically long-distance transportation, appears to result in poorer quality seed reaching farmers (Demaine, 1996).

Simple methodologies that can be used at the hatchery or farm gate to assess seed quality are required to improve the quality of fish stocked. The application of stress tests as a method of quality control has been used mainly in shrimp post-larvae production, as reviewed by Fegan (1992) and in salmonids. The use of salinity challenge tests to assess the quality of salmon smolts has partly been stimulated by the critical nature of transfer to a seawater environment, often as part of attempts to enhance natural stocks. Blackburn and Clark first described the technique for chinook and coho salmon (1978, 1987) but it has since been developed for monitoring quality of hybrid *Clarias* catfish hatchlings based on the concept of a physiological challenge (Ingthamjitr, 1997; Wedermeyer, 1990).

Stressors may also be applied as a management tool to try and reduce the number of weak, often pathogen carrying seed. This approach, in which penaeid post-larvae are treated with formalin before stocking and after infection of white-spot baculovirus is diagnosed using PCR technology, is being promoted in Thailand (Limsuwan, 1997). Chowdhuri (1996) used scale loss and tail damage in transported indigenous and exotic carps in Bangladesh as quality indicators.

Simple and low-cost techniques are required to monitor the quality of freshwater fish seed quality in Asia by seed producers themselves, their customers and government authorities.

Project Purpose

The purpose of the project as set out in the logical framework was to sustain and develop Asian freshwater fish production through improved approaches to small-holder seed production, based on identified constraints in output, quality and supply

Research outputs & activities:

Output 1
Comparative analysis of the major constraints to seed fish availability and quality in four areas of Asia (Thailand, Lao PDR, Vietnam and Bangladesh).

Table 1.1: Activities related to output 1 - Comparative analysis of the major constraints to seed fish availability and quality in four areas of Asia.

Activity	Main findings
1.1 SOS process completed in 4 parts of Asia (Northern and Southern Vietnam, Northeast Thailand and Northwest Bangladesh)	• There is high variability of perceived seed quality and underlying causes among stakeholders • Linkages between stakeholders, especially those in Government and private sector are often weak and sometimes antagonistic • Seed produced by the public sector are considered more likely to be high quality • Evidence from the process emerged contrary to the common opinion of scientists and policy makers that inbreeding is a major cause of deterioration in seed quality.
1.2 Impacts of SOS process assessed.	• Difficulties were encountered in stimulating interest in the impacts of most of the research outcomes, including the initial SOS reports by the partner research institutions.
1.3 Research strategy prioritised at five sites in Asia	• See below

Table 1.2: Other activities carried out contributing to Output 1.

Activity	Main findings
Appraisal of historical development current status of traditional seed production clusters in West Bengal and Northern Vietnam	• Traditional systems of nursing carp seed and the networks that have developed over decades in Northern Vietnam and West Bengal remain independent of public sector involvement. • Mechanisms for involving private sector actors in development of improved seed production and delivery systems are urgently required; failure to do so will undermine attempts to promote and support improved seed availability for rural aquaculture

Table 1.3 Recommendations from State of the System workshop in Northwest Bangladesh.

Policy
1 Food Fish Production
• Disseminate information on the characteristics of good quality seed by species
• Practical methods to hold seed prior to stocking
• Quality assessment of over-wintered seed especially common carp
• Disease tolerance of different fish species
• Factors causing growth deterioration of Indian major, Chinese and common carp
2. Trading and Distribution
• The use off additives/chemicals during transport and their effects on the quality and growth of fish
• A comparison of different transport containers on seed quality based on cost and effect on quality
• Testing fry quality with traders during transportation
• Transport problems of sensitive fish species such as silver carp
3. Seed Production: Nursery
• Nursing protocols for common carp
• Safer and cheaper alternatives to pesticides currently used in nursing
• Feasibility of nursing in polyculture
• Control of glass fish and *Glossogobius gurius* in nursing and food fish ponds
• Improved techniques for overwintering carps
4. Seed Production: Hatchery
• Impact of multiple spawning on seed quality
• Possibility of broodfish exchange between hatcheries to improve seed quality
• Comparison between riverine and hatchery-produced broodfish on their effects on seed quality and food fish performance
Policy
• Improved information flow from government to farmers on broodstock quality and management.
• Government monitoring of quality of seed produced by private hatcheries and provision of certification.
• Make facilities available to traders such as clean water during transportation.
• Produce best practice guidelines on quality seed production, broodstock management, efficient seed transport and food fish production.
• Disseminate guidelines for using GIFT strains of Nile tilapia.
• Produce extension materials about tilapia to give people basic technical information.
• Government control on chemical uses including prohibition on the use of unsafe chemicals.
• Best practices for over wintering different species developed and disseminated.
• Dissemination of BFRI (Bangladesh Fisheries Research Institute) guidelines on size and age - characteristics suitable for broodfish by species.
• Nursing recommendations for 5-day old hatchlings developed and disseminated.
• Dissemination and training on the techniques of sex-reversal of Nile tilapia

and silver barb. • Dissemination programme on improved strains to private hatcheries. • Ban cross-breeding and hybrid production. • Disseminate guidelines for efficient disease control in hatcheries. • Cryopreservation techniques introduced • Best practices for using anaesthesia for transporting broodfish developed and disseminated. • National information network on broodstock availability, genetics, hatchery to be organized by the DOF. • Broodfish bank network - certain lead/regional centres to hold and keep broodfish, including introductions and importation of original strains from original sources. • Licensing of hatcheries and supervision of hatcheries producing high quality seed. • Training programmes for hatchery and nursery skill development. • Diploma-level training for seed producers.

Table 1.4 Recommendations from the State of the System workshop in Northeast Thailand.

Research
• Determine if fish seed quality differences exist between hatcheries, especially government and private hatcheries of different types. • Develop methodologies for monitoring fish seed quality at the hatchery and farm levels. • Compare the impact of hatchery/nursery methods such as feeding on seed quality. • Develop and field test systems for producing high quality mixed sex tilapia fry locally in Northeast Thailand.
Implementation/Policy
• Synthesize and disseminate information on the advantages/disadvantages of 'improved' fish seed, e.g. YY and all-female silver barb. • DoF (Department of Fisheries) to develop and implement strategies to disseminate market information regarding fish seed at the provincial centres, e.g. during the main season posting at Provincial fishery stations and regional centres of daily updates on fish seed availability by species, size and price from private hatcheries. • DoF to provide facilities for fish seed sales by local private hatcheries. • DoF to improve performance of private sector traders through; (a) development of appropriate training methods and fish culture extension information for use by fish seed traders (b) training and certification of fish seed traders • Reduce focus of DoF provincial stations on fish seed production for sale and refocus towards maintenance of improved strains and training of private hatchery sector. • Increase availability of information/extension advice on water quality and fish health management to all aquaculturists.

Table 1.5 Recommendations from the State of the System workshop in Northern Vietnam.

Research
• Compare the quality of hatchlings from government and private hatcheries and relate to hatchery management. • Develop methods that improve availability of fish species in most demand, *i.e.* grass carp, common carp and tilapia. • Develop appropriate methods for field-level identification of seed species and quality • Compare the quality of fish seed sold by various types of distributors, particularly in areas relatively well and poorly serviced by mobile traders. What level of competition between traders results in optimal seed quality for food fish farmers?
Implementation/Policy
• Plans developed for improved genetic quality of brood fish should consider private hatcheries and grow out farmers that supply brood fish. • Change in the Ministry of Fisheries policy to support private hatcheries.

Table 1.6 Recommendations from the State of the System workshop in Southern Vietnam.

Research
• Investigate the impacts of management, especially transport on the performance of tilapia seed available to food fish farmers • Develop a better understanding of the factors affecting common carp seed quality • Develop methods for assessing carp hatchling quality and use to compare production from the Southeast and Southwest • Review the disease occurrence and abnormalities occurring in trading environments around Ho Chi Minh City and on the Delta.
Implementation/Policy
• Improvement and maintenance of broodfish quality should be prioritised and a broodfish bank established. This should be accessible to private hatcheries and grow-out farmers supplying broodfish. • Support for hatchery development by giving training on hatchery techniques and management to private hatchery operators. Other actors in the seed supply network need to be trained on how to improve and maintain fish seed quality at all stages. • Policies to promote fish seed quality should be realistic; *e.g.* standards or criteria on good quality seed should be disseminated by the Ministry of Fisheries. There needs to be good co-ordination between researchers/scientists and government policy-makers so that policies and regulations are technically sound and realistic

The initial outcomes of the project (Output1) comprise a holistic assessment of the major factors that are responsible for affecting fish seed quality at various stages in production and marketing networks at important locations in South and Southeast Asia. The assessment of seed quality by different stakeholders used fairly similar criteria (Fig 1). The importance of experience among stakeholders

was identified as a major factor in the likely perception of seed quality being a problem. Large differences were found in perception based on the food fish farmers' objectives i.e. whether to mainly sell for cash or consume within the household.

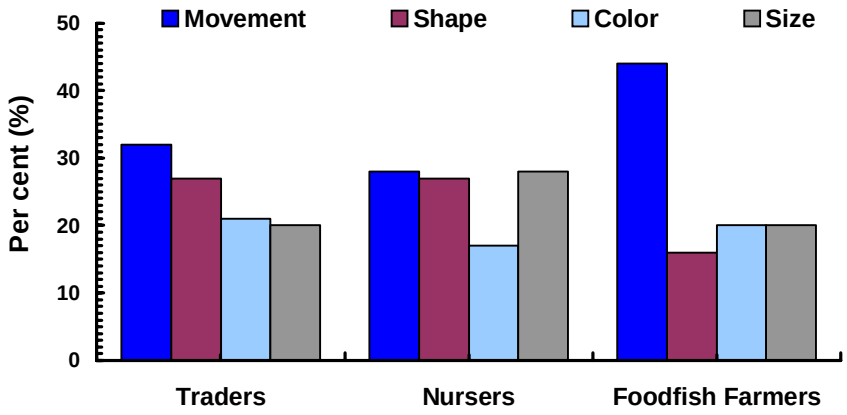


Figure 1: Criteria used by different stakeholders in fish seed production and marketing networks in Southern Vietnam assess quality (% of respondents).

Traditional centres for producing riverine carp seed are located close to riverine sources and studies of such clusters, that are now largely dependent on hatchery seed, reveal the rapid development of seed networks in the last few decades (Figure 2). The growing distance between the private sector, particularly traders, and government staff was observed in all countries, except in Bangladesh, where the partner organisation had taken pro-active steps to reverse this trend through its understanding of their important role. This has important implications for future attempts to improve sustained delivery of quality seed to farmers in rural areas.

No evidence for inbreeding being a major cause of genetic deterioration in private hatcheries was found, based on an analysis of responses about broodstock management; this contrasted with the perceptions of most public sector stakeholders. This information should have importance in terms of improved allocation of resources in the future as programmes to maintain and improve genetic seed quality are planned and implemented.

The identification of both action (policy and implementation) and research priorities by all the groups of stakeholders revealed both common concerns and variation at all sites. A role for Government to establish and manage broodstock 'banks' was a common priority as was the need for improved methods to make 'quality' Nile tilapias and common carp more available.

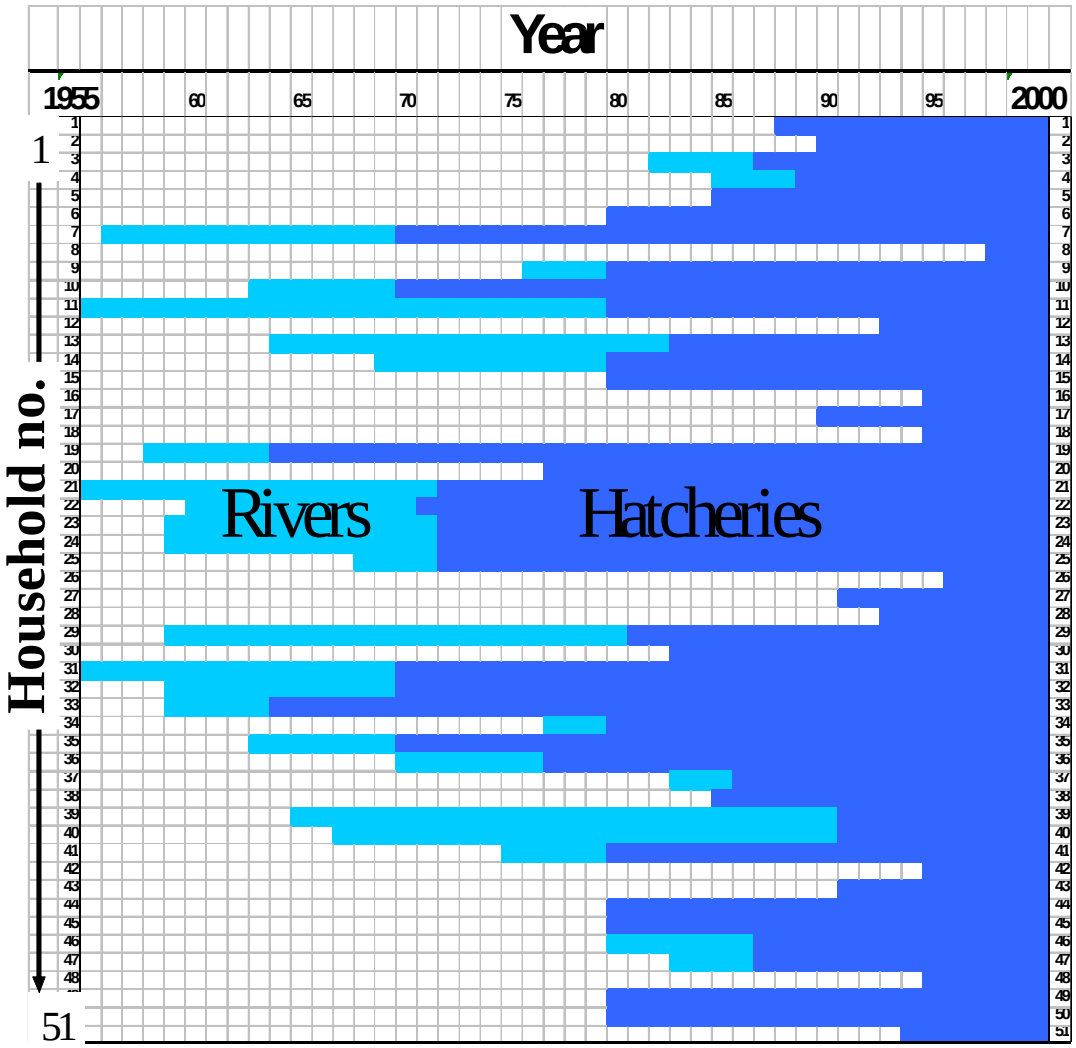


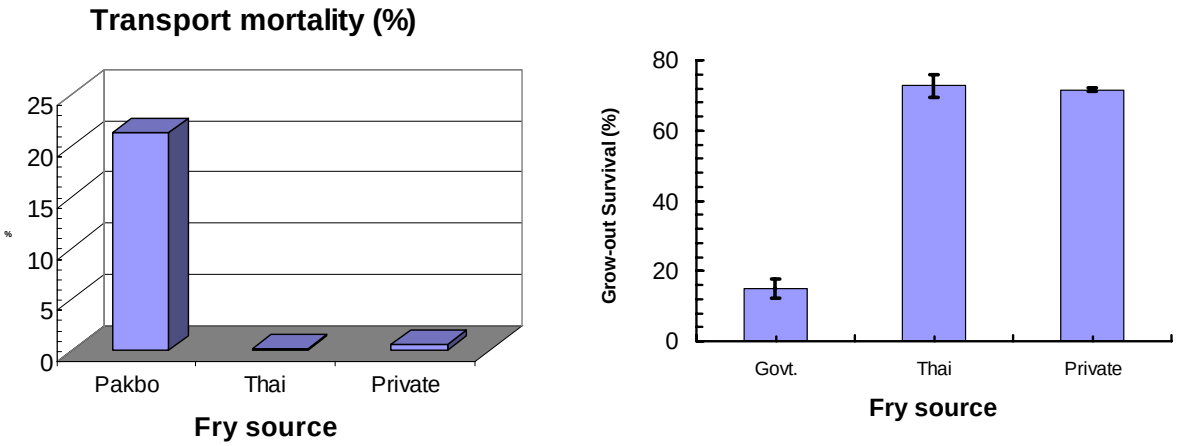
Figure 2: Schema showing the development of individual carp nurseries and source of hatchlings in Mao Dien commune Northern Vietnam.

Output 2
Preliminary guidelines on seed quality and management of seed production and delivery

Table 2.1: Activities carried out under Output 2

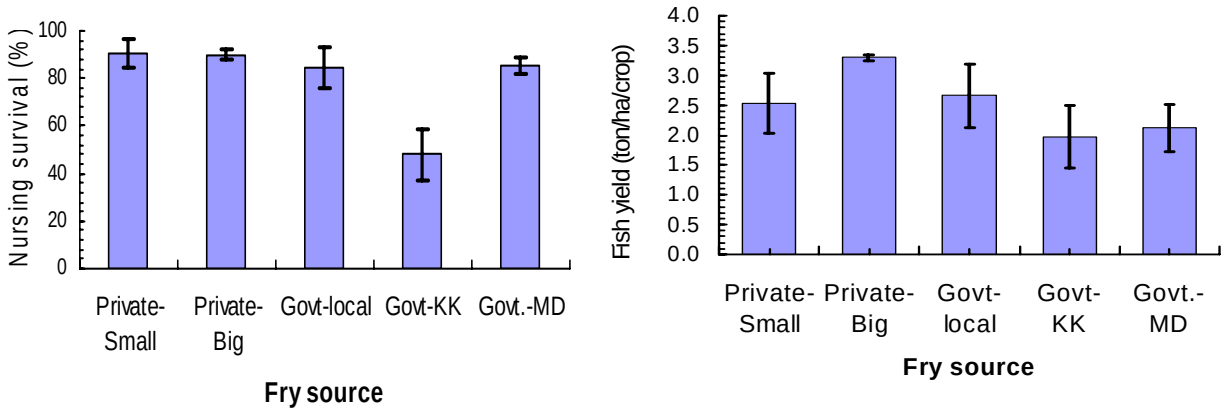
Activity	Main findings
2.1 Research topics designed and implemented over two seasons at each site.	• Variability between seed produced in private and public sector hatcheries is high and can have important impacts on the success of food fish production • Seed from public sector hatcheries is often inferior to that produced by the private sector • Seed delivery can have more important effects than genetic management on the quality of seed stocked by farmers
2.2 Research trials addressing common issues implemented with commercial partner	• A simple, salinity-based challenge testing approach developed and adopted by the commercial sector • High quality Nile tilapia can recover from poor early nursing regimes to perform well during on-growing • Long distance transportation of Nile tilapia in open systems can result in improved survival post stocking compared to conventional oxygenated plastic bags • Simple observation of feeding behaviour and survival 72 hours in hapas after arrival gave reliable indication of quality
2.3 Results analysed and conclusions drawn	• The importance of high quality mixed sex Nile tilapia availability on level of benefits to resource-poor farmers established • Strategies for tilapia seed production under seasonally cool climatic conditions based on over-wintering of either mixed or mono-sex Nile tilapia in deep hapas can improve grow-out performance compared to use of new season seed alone
2.4 Main results of the research disseminated	• In Lao PDR a manual for best practice in Silver Barb seed production was produced and disseminated through the Regional Development Committee network. • Best practice developed for government hatcheries in southern Lao PDR

The variability in public and private sector seed quality was established through trials in Northern Vietnam, Thailand and Laos (Figs 3-5). In Laos, a lack of capacity to produce and deliver seed consistently to farmers in rural areas was well illustrated with exceptionally poor survival for seed from the government source, compared to that being imported through the private sector from a neighbouring country (Figure 3). This work also suggested the advantage of locally produced seed; our partner in Laos, the RDC, had been promoting a decentralised seed approach given the physical and institutional constraints prevalent in the public sector.



(a) (b)

Figure 3: Transport mortality (a) and grow-out survival (b) for fish seed obtained from a Government hatchery (Pak Bo), Thai private hatcheries and seed produced by local farmers compared at District level in southern Lao PDR.



(a) (b)

Figure 4: Nursing survival (a) and fish yield (b) for silver barb from different hatcheries in NE Thailand (Private small, private large, Local Provincial Government hatchery and seed from distant Government hatcheries KK-Khon Kaen and MD –Mahasaraham).

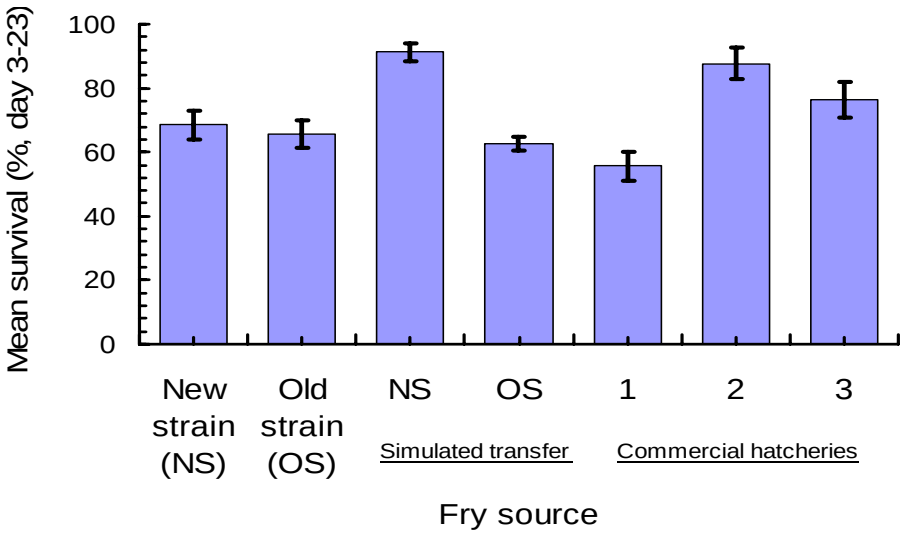


Figure 5: Mean nursing survival of silver carp from commercial hatcheries and two strains obtained from a government hatchery (New strain and Old strain with and without simulated transfer).

In NE Thailand and Bangladesh there was no evidence that public sector seed were higher quality than those from private hatcheries; the balance of the evidence indeed pointed to the contrary.

The development of a stress test with a commercial partner to identify poor quality batches of seed resulted in a test that selected for size, and size was indicative of tolerance to transportation and handling stress. The hatchery has since adopted the approach to improve their marketing of fry at distance. The major cause of poor performance of tilapias in southern Vietnam had been identified as transportation stress related to the length of the marketing chain to foodfish producers on the Mekong Delta. Poor survival post transportation appears to be the major issue however; using genetically homogeneous high quality seed markedly different early management had no subsequent effect on growth in a controlled study (Bourhill, 2000). Improved transportation could improve the quality of tilapia seed reaching customers from centralised locations (Fig 6) and this trial also established that simple pre-stocking in hapas and monitoring feeding response over 72 hours was a useful indicator of likely survival and overall performance.

A focus on developing centralised monosex tilapia hatcheries was challenged by the project research outcomes. The appropriateness of promoting monosex tilapia depends on many factors including the value of large (>350g) and small (<200g) individual fish, the hatchery, and the broader infrastructure, communication and support from Government. Seasonal temperature regimes and profiles of demand for seed are also important. Strategies for producing young and high quality mixed sex fish were identified as a key developmental objective on the basis of analysis of performance of both monosex and high quality mixed sex fish (Fig 7).

Performance of both types of tilapia under resource-poor conditions typical in the Region suggested mixed sex fish performed adequately.

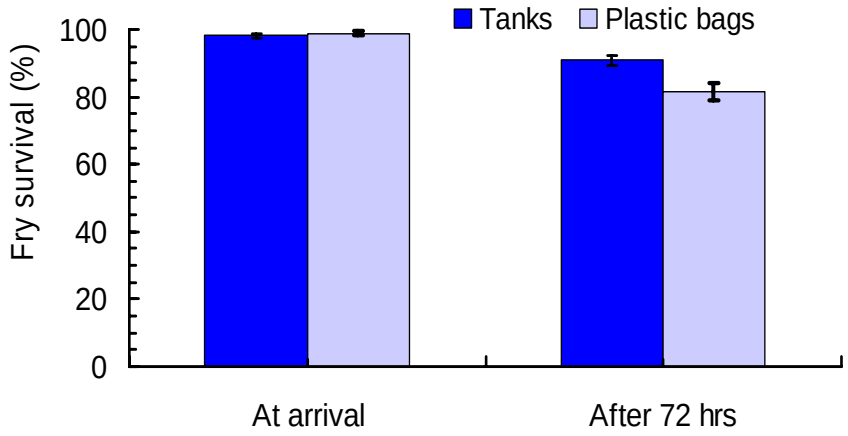


Figure 6: Survival of tilapia at arrival after long distance transportation either open or closed systems compared to survival after 72 hours in hapas.

Activities in Lao PDR focused on improving the performance of Government hatcheries through an iterative participatory workshop approach based around development of a simple manual and data collection protocols. This resulted in immediate uptake of the findings of the work by those involved, which were mainly concerned with following simple management steps consistently.

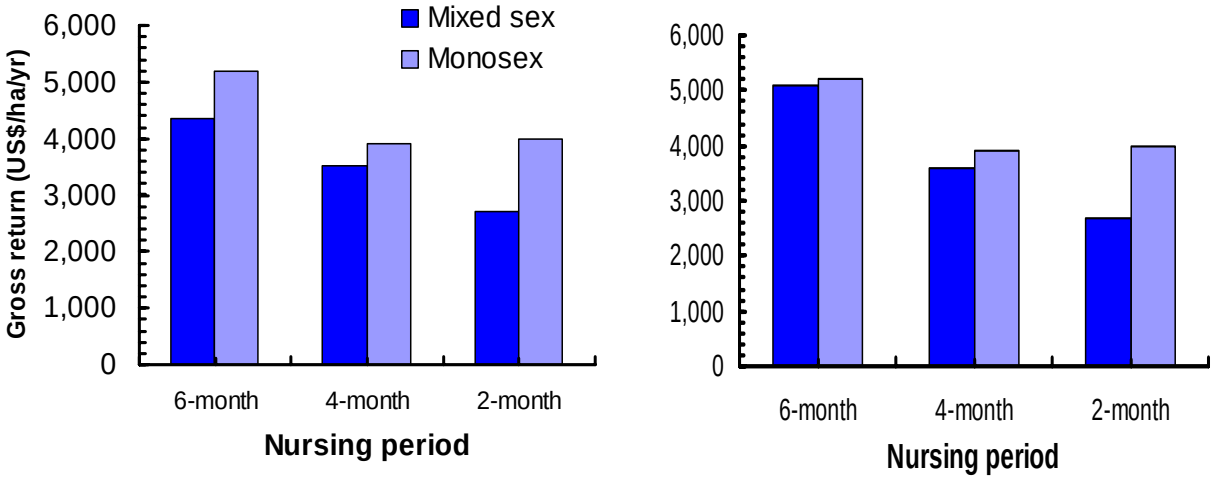


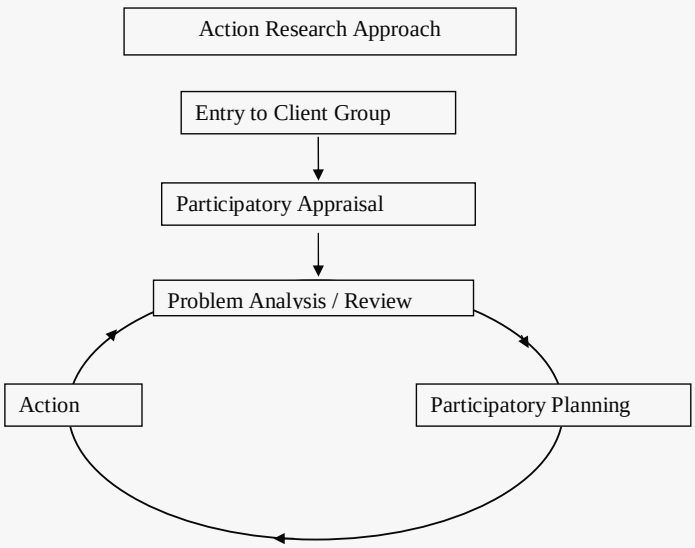
Figure 7: Gross returns of grow-out farmers stocking either monosex or mixed sex Nile tilapia after variable duration of nursing where (a) larger fish are more valuable than smaller fish and (b) fish of different sizes are of similar value.

Output 3
Improved understanding of the existing knowledge systems of the private hatchery operator's cooperatives, especially the locally-based institutional support structures.

Output 4
Development of a participatory methodology which will allow stakeholders to effect a continuous improvement in the quality of fish seed available in the seed supply system of Northeast Thailand.

In planning it was anticipated that outputs 3 and 4 would be separate. However in practice output 3 was an activity of output 4. The participatory methodology that was adopted in this situation was Participatory Action Research (PAR) and recognizes the value of understanding trends and issues using participatory tools in distinct localities that are important within larger seed supply networks. The methodology is represented in Box 1.

Box 1: Action Research Methodology.



The objectives of outputs 3 and 4 were not to arrive at generalisations about seed production, but to engage members of communities that are critical nodes in seed supply networks in the process of investigation; collecting the data, analyzing and theorizing about the nature of the problem. The appraisal leads to plans for action which in turn can be evaluated. Broadly there are three intended outcomes;

(1) Action to improve a situation,
(2) Research activities that will contribute to community/stakeholder knowledge and
(3) Development of self-help competencies of participants, that in turn leads to sustained quality seed delivered to farmers

Actions that were taken by participants are detailed below. Evaluation of the learning outcomes was based on qualitative feedback from participants who were asked to reflect on the actions individually and in group discussion. An essential element was that, together, we were addressing issues that the farmers felt were most important and we were able to assist them to systematically investigate these issues themselves. The enthusiasm/motivation generated by these activities enabled the participants to arrive at solutions, raise new issues, develop networks/relationships for innovation with service providers and private sector individuals and organisations, and work together in ways that they felt were appropriate and productive.

In the time available we were only able to work directly with the hatchery operators in conjunction with biologists from the Department of Fisheries as 'participant observers'.

Table 3.1 and 4.1 summarise the emergent issues and trends.

Table 3.1: Emerging issues from a participatory appraisal of farmer knowledge systems in Northeast Thailand.

Activity	**Emergent issues/trends**
3.1 Participatory appraisal of farmers' knowledge systems in two provinces of NE Thailand	• Hatchery operations in clusters have developed mostly as a result of diffusion of innovations within the rural community. These innovations include both good and bad management practices. • Problems do not exist in isolation; they are part of the complex system of events and conditions of life in the household, community or region including the production system, technical knowledge issues, resource access issues (including knowledge), markets, value systems and service provision.

Table 4.1: Emerging trends from action research with hatchery communities in Northeast Thailand.

Activity	**Emergent issues/trends**
4.1 Action research with hatchery communities in two provinces of NE Thailand	• The most important issues raised by farmers were socio-economic factors; specifically related to financial management of their production system, and the market. • The participating farmers were, on the whole, very satisfied with this co-researching process and its' outcomes, as were the participant observers from the DoF Inland Fisheries Stations.

Table 4.2: 'Top three' issues raised in six separate focus groups of hatchery operators in Surin and Mahasarakam Provinces. Group 1 were a group comprised of ordinary members and some committee members of a registered cooperative. Groups 2 to 4 are formal farmers groups operating at village level, 5 is an informal village group. Groups 6 and 7 were the committee members of registered cooperatives. Bullet points indicate separate issues that were ranked as equally important.

Group	Main issue	Secondary issue/s	Tertiary issue/s
1	Cash flow – especially lack cash at the time of year when they need to buy brood stock or feed for nursing.	Lack brood stock and knowledge about taking care of them – (a) Knowledge about seed production has not advanced, There should be new production techniques. (b) Know very little about selection or about improved strains	High cost of inputs
2	Market - low price, high competition, no new markets, dependent on middlemen	Lack of money -no source of low-interest credit	High cost of inputs
3	Poor survival particularly in nursery – (a) insect predation (b) lack of money to buy feed	Market – (a) low price (b) only customers are mobile traders	Low hatching rate – (a) lack knowledge (b) depend on weather
4	High cost of feed	No new markets	Water supply irregular and quality not good
5	Lack of capital	High price of feed	• Low price of seed • Uncertain market – due to climate and limited number of customers (deal mostly with middlemen)
6	High cost of inputs	Uncertain market - (a) no new customers (b) unpredictable climate.	• Poor quality brood stock - through lack of knowledge, money, good sources and care. • Low price of seed • Cheating • Weak seed from hatchery and after transport poor growth • Grow-out farmers don't know about raising fish
7	Market – (a) The government doesn't buy seed from co-op (b) Low market price of seed (c) Expensive input/raw materials (d) Some mobile traders and some members cheat on numbers and size – co-op gets blame, and (e) Lack of people to work on the marketing.	Lack of capital – (a) Capital only comes from membership fee (b) No subsidies and/or government support	. Management of cooperative – (a) Lack of cooperation (b) The operation does not meet its' goals (c) There is no continuity (d) No master plan or vision (e) Committee lack experience of management and coordination (f) no public relations to disseminate information

Table 4.3: Examples of activities, outputs and outcomes that took place under the action research programmes with farmer groups. The first example shows a one-off activity while the second three activities were parts of an iterative process of planning, action and review.

Activity	Output	Outcome
Meeting with DoF Inland Fishery station chief and staff (objective: *to discuss perceived competition between the station and private hatchery operators*)	• Clarification of seed production and sales policy of DoF stations • Discussion and practical advice on marketing, seed production and planning • Offer of training at station in seed production and production planning • Hatchery operators given Chitralada 3 tilapia strain	• Improved understanding of government policy and plans among hatchery operators (participants reported the main points of the meeting to an open review meeting of hatchery operators from the local area) • Improved understanding of farmer perceptions by government staff. • Strengthened relationship between farmers and government officers. • Dissemination of improved fish strain
A chain of activities to achieve the objective*: to reduce the cost of fish feed*		
1. Discussions with DoF biologists from Inland Fisheries Station which led to;	Understanding of the practicalities of feed production and information about private sector feed production in the area	Raised awareness and Strengthened relationship between farmers and government officers
2. Study tour to commercial scale on-farm feed producer in Kalasin, which inspired farmers to request;	Knowledge and understanding of small-scale, commercial shrimp feed production	Improved capacity for innovation through contact with private sector individuals
3. Training in on-farm feed production	Knowledge and understanding of the theory, techniques, materials and equipment used to make on-farm feed	• Anticipated reduction in production costs for seed producers • Farmers empowered through development of new skills and knowledge resulting from their own research activity.

Output 5

Table 5: Impacts of novel seed production approach assessed for two species in Bangladesh

Activity	Main findings
5.1 Development of MOU with DSAP-Worldfish/CARE in Bangladesh	• Both CARE and DSAP-Worldfish were keen to collaborate towards a process-led approach to improving livelihoods of the poor through enhancing quality seed availability • Current field activities of both organisations were missing opportunities • Lack of understanding of the impacts of promoting decentralised common carp production in irrigated ricefields • Understanding of potential roles for, and benefits of, decentralised seed production were low • Poor current understanding of the relatively high potential of silver carp and Nile tilapia on poor livelihoods compared to other species promoted
5.2 Design and implementation of field work with partners	• Potential impacts on poor livelihoods of improved management of silver carp seed were much greater than introduction of improved germplasm • Benefits to a range of stakeholders would be forthcoming if local over-wintering of silver carp was promoted among seed traders • Silver carps and unimproved tilapias are the most popular species overall among small-scale producers of fish in NW Bangladesh for a range of reasons but this is not reflected in current DOF and scientific opinion • Silver carp are the most important stocked species in aquaculture in terms of benefits to the poor; the poorest people tend to select and consume small silver carp rather than other species because of its high availability and low price. • Promotion of decentralised common carp production in irrigated ricefields was sustainable and was meeting some farmers' needs • Introduction and promotion of Nile

	tilapia led to rapid organic spread and enhanced livelihoods compared to use of common carp alone in numerous ways
5.3/2.5 Advise Development of Sustainable Aquaculture project	• A range of advisory inputs to DSAP has resulted in major changes in the focus of this USAID-funded development project
5.4 Analysis and reporting	• See outputs for status
5.5 Dissemination	• The range and fora of project outputs suggests the effort towards dissemination of the research findings • Early scepticism of the research findings has begun to change to acceptance and changes in policy and action.

The current and potential benefits of two species of cultured fish, the silver carp and Nile tilapia, to poor people in Bangladesh have failed to stimulate an adequate policy and action response. This is partly explained by lack of adequate pond, community and market orientated research that had left their role in the diets of poor marginalised groups largely unreported. Moreover improved strains of both species had been introduced without the potential risk and benefits of their dissemination being unexplored. Research activities within the project established expected outcomes for poor groups through introduction and use of improved strains and weaknesses in the current attempts to promote them.

Silver carps are having major impacts on poor peoples' livelihoods in NW Bangladesh through benefits to seed producers, traders, farmers and growers, who recognise their specific values. Studies in markets and of poor consumers suggest that small silver carp (<250g) is the cultured fish most likely to be purchased by the poorest people, and is sold by more vendors, in greater quantities than any other species. This knowledge should inform the research and development community to focus their efforts towards further reducing the production cost of this product, which would lead to direct increases in their consumption by the poorest groups for whom consumption is only limited by low purchasing power. Specifically, genetic improvement efforts should seek to optimise productivity of high yields of small fish rather than individual fish growth *per se*. This research suggests that a greater focus on improving management of seed in rural areas through promotion of local nursing and over-wintering would yield greater benefits than a concentration on introduction of new strains (Fig.8).

The lack of quality tilapia seed in rural areas of Bangladesh, despite the introduction of superior strains more than a decade ago, led to an assessment that in common with Northern Vietnam, Bangladesh currently lacked appropriate approaches for seed production. This situation has been exacerbated by similar factors i.e. seasonal low temperatures, followed by a peak in demand for seed after onset of the monsoons, and the dominance of established carp hatcheries and food fish polycultures. A long established programme to promote decentralised

common carp seed production in irrigated rice fields in NW Bangladesh that had been piloted by our research partner almost a decade earlier became an opportunity to assess sustained impacts and the potential for inclusion of tilapias.

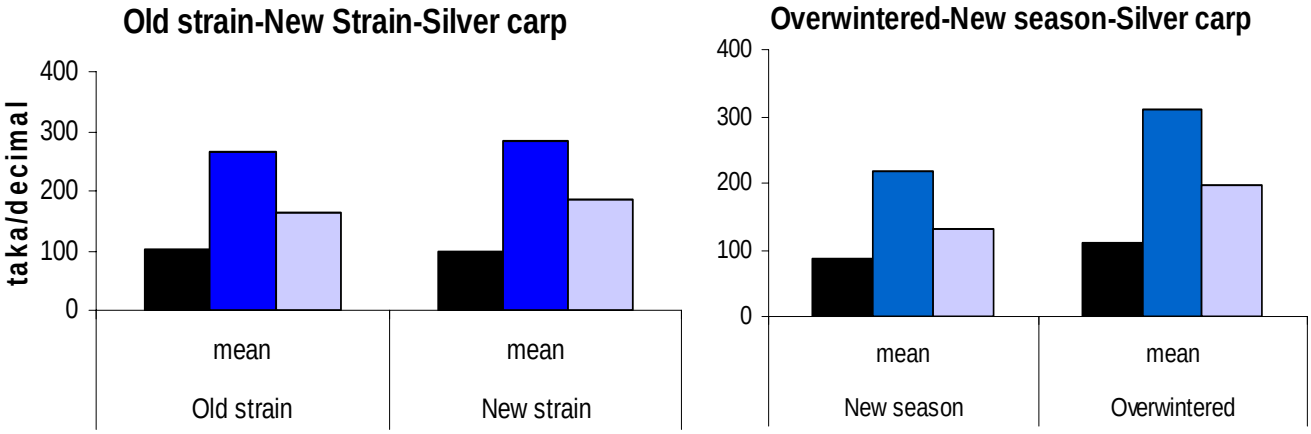


Figure 8: Local overwintering of silver carp improves benefits to farmers more than adoption of a new strain.

It was found that common carp seed production in the irrigated *boro* rice crop was meeting needs, especially through support of subsistence orientated food fish production in the following *amon* season.

Introduction of small numbers of high quality Nile tilapia, together with basic information as to how to manage their breeding, has led to greater transformations of livelihoods of producers and, as the tendency has been to produce seed for sale, associated traders, foodfish farmers and consumers. Cash incomes, fish retained for subsistence consumption, the propensity to stock and nurse other carps have all increased sharply where seed production of improved Nile tilapias has been established. Moreover the robustness of the approach has meant that farmer field schools can incorporate the level of information required within IPM curricula. The efficiencies of promotion by different types of NGOs in different parts of Bangladesh is currently under study within a Worldfish-USAID project that has taken up project recommendations but an early assessment seems to confirm its potential outside of the Northwest region where it has now been extensively trialled and its positive impacts assessed.

A case study has documented that its organic spread between farmers is rapid; 120 households in surrounding communities had adopted the practice after piloting the approach and supplying broodfish to 4 households initially within 3 years (Fig.9). Analysis has suggested the reasons for the rapid spread without any further formal promotion. Links to better-off pond owners who can retain breeding fish between seasons and poor local seed traders who gain substantially through increased availability of high quality seed appear to be critical.

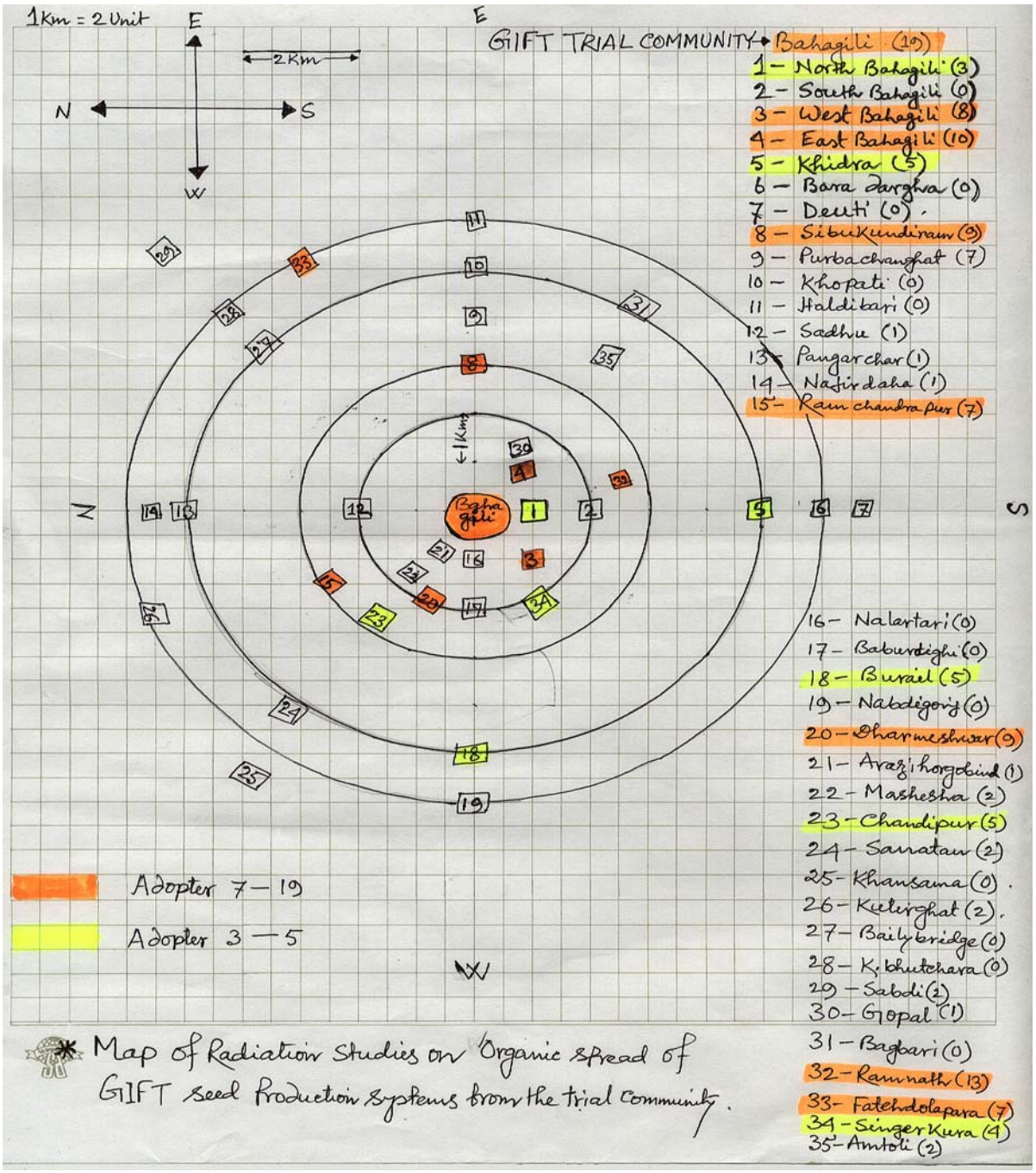


Figure 9: Spread of Nile tilapia seed production in irrigated ricefields from original village of introduction over a period of three years

Output 6

Table 6: Lessons learned and key issues for regional and national policy makers developed and disseminated

Activity	Main findings
6.1 Attendance and participation at national, regional and international fora	• Participation in a range of fora through contributions to both research process/methodology and technical/development strategy development • The perceptions/views contributed typically different to prevailing orthodoxies
6.2 Participation in other seed related practical and policy orientated activities in the region and elsewhere	• See project outputs for a complete list. In addition to this project staff has been engaged by Ministry of Fisheries, Vietnam to develop strategy for improving freshwater seed quality nationally. This work has built substantially on project outcomes and contributed to a National-level debate on the subject.
6.3 Written overviews drafted and submitted	• See list of outputs. • Forthcoming articles will be delivered at prominent Regional meetings in the coming year and project outcomes will feature as both overviews (eg Seed Quality) and as case studies in the CABI Aquaculture Compendium to be published in March 2005.

Organizational Linkages

The project was managed by the Aquaculture & Aquatic Resources Management Programme (AARM) of the Asian Institute of Technology, Pathumthani, Thailand. Most of the research was carried out through the AARM Aquaculture Outreach country programmes in Vietnam, Laos and Northeast Thailand. Work in Bangladesh was carried out in partnership with a joint Government of Bangladesh, Department of Fisheries/UK Government, and Department for International Development project. Additional work was carried out with partners in West Bengal, the Grameen Vikhas trust (GVK), Ranchi and the Institute of Wetland Management and Ecological Design, Kolkata

In the action research phase of the project collaborative arrangements were developed between hatchery producer groups which were organised either at a district or village level in Northeast Thailand

Government Sector

1. Northwest Fisheries Extension Project, Parbatipur, Dinajpur, Bangladesh
2. Regional Development Committee for Livestock and Fisheries, Savannakhet, Lao PDR.
3. Centre for Fisheries Research and Development, Udon Thani, Thailand
4. Department of Fisheries Inland Fisheries Station, Mahasarakam, Thailand
5. Department of Fisheries Inland Fisheries Station, Surin, Thailand.
6. Research Institute for Aquaculture Number 1, Hanoi, Vietnam
7. University of Agriculture and Forestry, Ho Chi Minh City, Vietnam

Non-governmental organisations

1. Surin Fisheries Cooperative, Surin, Thailand.
2. Chaniang Sub-district Aquaculture & Organic Farming Group , Surin, Thailand. Note that members of this group were also members of the Surin Fisheries Co-op but it was frequently more convenient for them to meet in their own village than the co-op office. Their contributions are included under that for the Surin co-op.
3. Kosumpisai District Aquaculture Cooperative, Mahasarakam, Thailand.
4. Hae Tai Sub-district Aquaculture Group, Mahasarakam, Thailand.
5. Hua Chang Village Rice Farming & Aquaculture Group, Mahasarakam, Thailand.
6. Don Suriyet Village Aquaculture Farmers Group (non-juristic), Mahasarakam, Thailand.

Contribution of these Outputs to Developmental Impact

The project has had wide ranging impacts on the knowledge base and perceptions regarding freshwater fish seed in Asia, focussing on issues identified by the key stakeholders. The project has developed partnership processes as key research outputs which have been trialled in different parts of Asia. A participatory approach was taken from the outset to understand the situation with partner research and/or development organisations. This approach ('State of the System')

was developed to enable a rapid and holistic overview of issues pertaining to seed production and quality to be identified and has since been used in a modified form by other research projects and other organisations. The project further developed an approach that diverged from normal research practice by initiating an action learning process with key community-level institutions in NE Thailand. A range of approaches was used and these are summarised in Table 7.

Three major issues have been clarified by the research project which, through on-going dissemination activities, are now becoming better understood throughout the region

(1) Initial expectations by the project and its partners that seed quality could be improved through the development of appropriate tests were soon largely rejected as the complexity of the systems and the causes of poor quality were identified. A process led approach was initiated that led to key stakeholders viewing improvement in seed quality as a *process* rather than a *product.*

(2) The prevailing view that the major constraint to improving the value of seed being primarily through improved genetic management is misconceived. Our research indicates that changes in management during production and delivery can have greater, more immediate and, probably, more sustained impacts on the availability of quality seed for rural producers

(3) The view that centralized Government seed is better quality and more reliable than that which can be produced by either clusters of private hatcheries or, for some species and situations, local people in rural areas was challenged. The project has documented major impacts on poor livelihoods of the decentralized production of mixed sex Nile tilapia. High quality Nile tilapia are in high demand in Northern Vietnam and Bangladesh and the project has disseminated important findings that should orientate policy towards this approach rather than an inappropriate high-tech, centralized mono-sex approach.

The level to which these issues have been taken up by key institutions is uneven and unquantified but warrants further analysis.

The project was designed to work through partner institutions closely associated with the then Aquaculture and Aquatic Resource Management Programme of the Asian Institute of Technology and, additionally, the DFID field development project, the Northwest Fisheries and Extension Programme in Bangladesh. Responsibility for research outputs was highly devolved through a process of developing detailed Memoranda of Understanding (MOU's) or terms of agreement along guidelines agreed by AARM/AIT with its partners (Appendix 7). These were modified regularly in line with progress and locally prioritised agenda. These institutions had variable contact with, and capacity for, conducting pro-poor research at the outset of the research project and were subject to considerable institutional dynamic throughout the period of the research. In both northern and southern Vietnam for example, the assigned responsible person was changed on at least three occasions and in Thailand a breakdown in working relationships between AARM/AIT and the DOF caused an 18 month hiatus in activities.

Research with partner research institutions should be managed through

- participatory development and regular updating of MOUs
- the assigned local staff member should be registered for a research degree in the institution responsible for delivery of research outputs.

Additionally to the institutions identified at the start of the project, research opportunities to cost-effectively work with other organisations were negotiated. Detailed research designs were worked out in full consultation with them and the work implemented, often with students from the University of Stirling.

The project has had both direct impacts on collaborating rural people and institutions of various kinds within the project areas (Table 8). It has also had demonstrable impacts on development outside the immediate field research areas and in the policy arena, particularly in Vietnam and Bangladesh.

In Bangladesh the uptake and adoption of decentralised seed production has occurred both within and outside the areas of direct promotion through CARE and local NGOs. The case study analysis, undertaken in one of the research communities, of farmer-to-farmer transfer of information and breeding fish explains this (Figure 9). Institutions such as Worldfish and a range of local NGOS have now adopted the strategy as a central part of their efforts to promote sustainable aquaculture in eight Districts of Bangladesh. This work has led to AFGRP development support to develop a better understanding of household, community and institutional impacts of the approach which is currently underway. In association with local and UK-based partners we are currently piloting the approach with a range of field-based NGOs in different parts of the country and identifying key constraints and factors predisposing the approach to success.

In Vietnam work undertaken by project staff has led to fish seed quality being placed high on the agenda of the Ministry of Fisheries and becoming a central tenet of their attempts to promote aquaculture nationally. Indication of this recognition includes the subsequent contracting of project staff to advise on national strategy.

Table 7: Use of approaches and techniques at each project site with respect to research and dissemination process

Method/approach	Research process/techniques	Eastern India	Southern Lao PDR	Northern Vietnam	Southern Vietnam	Bangladesh	NE Thailand
Situation appraisal	• Participant observation	+	+	+	+	+	+
	• Semi-structured interview	+	+	+	+	+	+
	• Participatory techniques		+				
	• Structured interview		+	+	+	+	+
	• Workshops			+	+	+	+
Processing of information	• with ultimate beneficiaries			+	+	+	+
	• with field promoters	+		+	+	+	+
	• with partner institutions			+	+	+	+
	• by researcher	+	+	+	+	+	+
Feedback of information	• to ultimate beneficiaries						
	• to field promoters			+	+	+	+
	• to partner institutions	+	+	+	+	+	+
Experimentation (design and implementation)	• by/with ultimate beneficiaries					+	+
	• by/with field promoters		+			+	+
	• by/with partner institutions	+	+	+	+	+	+
Feedback/broader dissemination	• to ultimate beneficiaries					+	+
	• to field promoters			+	+	+	+
	• to partner institutions	+	+	+	+	+	+
	• to researchers	+	+	+	+	+	+
	• to policy makers	+	+	+	+	+	+

Table 8: Scope of research and relative focus with different partners and towards outcomes for different beneficiaries (**Key:** +minor focus ,++ intermediate focus, +++major focus)

Country	Partners	Ultimate beneficiaries				Intermediate beneficiaries		
		Hatchery	Nursery	Traders	Foodfish farmers	Research	Development/ commerce	Policy
Thailand	DOF- provincial level	+++	+++	+	+	+	+	
	Department of Fisheries						+	+
	Commercial farm	+++	++	++	++	+	+++	
	Seed producer organisations	+++	+++			+	++	+
	Private sector	+++		+	++		+++	++
Lao PDR	Gov. District staff	++	++++				+	+
	Provincial L&F and RDC staff		+++	++	+++		+++	+
	Government hatchery	+++	++	++	++	+	+++	+
Northern Vietnam	RIA 1	+++	+	+	+	+++	+	+
	MOF							
Southern Vietnam	UAF	+++	+++	+		+++	+	+
	MOF							
Bangladesh	DOF/NFEP	++	+++	++	+++	+	+++	+
	DOF/*Upazila* level				++		++	+
	NGO staff	++	+++	++	+	++	+++	
	DOF- Dhaka					+	+	+++
	Worldfish-Dhaka					+	+	+++
	Ex NW NGOs	+++	+++	+	+	+	++	++

Outputs 1 through 4 were specific objectives, none of which are related to impact. Output 5 is an approach that has impact as the intended outcome. Box 2, below lists the quantitative and qualitative evaluation of impact.

Box 2: Evaluation of Action research phase.

Quantitative indicators
Detailed information related to the summary presented in this section is held by participating group members.

- Problem issues identified and prioritised by 5 community-based hatchery operators organisations representing around 270 individual hatcheries which produce annually 700 million fish seed for sale throughout the Northeast, North and Central Thailand and Laos (some of this seed may end up in Cambodia and even Vietnam)..
- Research goals and objectives to address the main problems identified in 4 community-based hatchery operators groups. One group which participated in the initial appraisal, operated as a kind of 'club' for larger operators and ceased to join our meetings when we insisted that they should be open to all hatchery operators in the district no matter the scale of production.
- 8 Action plans to meet the objectives prepared by 4 community-based hatchery operators groups. 4 review and action planning workshops in Surin, 2 in each of Ban Hae Tai, Ban Don Suriyet and Ban Hua Chang.
- Activities towards meeting objectives including 12 separate meetings of group representatives with government officers;

Provincial Fishery Offices in Surin and Mahasarakam,
Inland Fisheries Stations Surin, Mahasarakam and Kalasin Provinces
Provincial Agriculture Office Surin,
District Agriculture Office Kosumpisai, Mahasarakam,
Provincial Community Development Office Surin
Bank of Agriculture and Agricultural Co-operatives Kosumpisai, Mahasarakam
Provincial Administration Organisation, Planning Department Surin,
Provincial Administration Organisation, Representatives Office, Mahasarakam
Provincial Co-operatives Department Mahasarakam

- Other activities were; study tour to share experience in catfish disease prevention with farmers in central Thailand, study tour to see commercial small-scale feed production, training in *Pangasius* spawning techniques, training on on-farm feed production.

Qualitative indicators
Refers to intangible measurements of value which arise from the participants observations, perceptions and attitudes. Participants were asked to evaluate the meetings and activities immediately upon their completion and in addition there were final evaluation workshops.
Same-day evaluations
- Most participants felt that they had gained knowledge.
- The social nature of the activities, working together as a group was often stated as important.

Final evaluations (some comments)

Successes
- Increased knowledge which can be applied to improve hatchery operation.
- Groups have developed their contacts in the government sector and public relations have improved.
- The project catalysed the group to do something about their problems.
- Members' participation in group activities has increased and the group works together better than they used to.

Problems
- Not enough time, project should continue
- Initially many people did not come because they did not think there would be anything to be gained from another research project. It took time before people could see the way the project was working.
- It is not always possible to stop work to join meetings and activities.

Appropriateness
The project was well received by all participants except the group who wanted to monopolise the process and it could be argued that they wanted to do this because they recognised the value. Particularly important to many participants was that they were doing the research themselves about the issues that concerned them most, they were being asked to evaluate and there was always some follow-up for every activity. Their previous experience was that research projects generally extract information and give nothing in return.

Effectiveness
- Now we know things we never knew before and have seen things that we have never seen before.
- Have met many government officers from different departments and learned the way to contact them in the future.
- The research team provide a welcome mediator between the group and government officers.
- Got improved strain of Tilapia (GIFT) from DoF (Surin Inland Fisheries Station).

Changes
- The group has become stronger with increased participation.
- Have learned more about the market through open discussion.
- Previously we only got information from our relatives and neighbours, the project has helped us to get information from outside the sub-district.
- By the end of the project farmers are not afraid to talk to government officers (observation by DoF biologists in the 2 provinces)

Advantages
- Open meetings where villagers are comfortable to express their feelings and opinions.
- Dealing with real problems in steps from raising the issues through to evaluation of the results.
- Villagers going to meet the government institutions and officers to get information
- Information is shared among the group.

Disadvantages
- Should do the research when farmers are not so busy (In Mahasarakam because of time constraints, we had to work with farmers at the height of the spawning season)
- It was not clear at the outset what farmers would get from the project.
- Time was too short so many issues remain unresolved.

Disclaimer:

Publications and other outputs:

Improving freshwater fish seed supply and performance in smallholder aquaculture systems in Asia

Peer Reviewed

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Appendices:

Appendix 1

Revised Logical Framework for Fish Seed Quality R7052

Hierarchy of Objectives	**Objectively verifiable indicators**	**Means of Verification**	**Important Assumptions**
Goal Productive benefits of aquatic resources for poor people generated and sustained through improved knowledge of aquatic stocks and their selection, enhancement and culture	By 2005, knowledge gains allow 500,000 poor people in S & SE Asia to improve food supply by 20% and income by 20%, based on yield increases related to better aquatic stocks, sustainable aquaculture and enhancement practices, and at least 100,000 people positively impacted by development activities incorporating programme outputs.	By 2005, knowledge gains allow 500,000 poor people in S & SE Asia to improve food supply by 20% and income by 20%, based on yield increases related to better aquatic stocks, sustainable aquaculture and enhancement practices, and at least 100,000 people positively impacted by development activities incorporating programme outputs.	National, FAO fisheries/aquaculture sector surveys and statistics, environment report - Evaluation of RNRKS and AFGRP - National reports to regional organisations.- reports of target institutions/key locations - household and community surveys/ monitoring against base-line data.
Purposes Asian freshwater fish production sustained and developed through improved approaches to small-holder seed production, based on identified constraints in output, quality and supply	-by 1999 quality and yield of seed and food fish improved under a variety of physical social and economic conditions -monitoring of fish seed quality using project methodologies	❑ Project fields reports ❑ Commercial hatchery records	
Outputs 1. A comparative analysis of the major constraints to seed fish availability and quality in four areas of Asia 2. Preliminary guidelines on seed quality and management of seed production and	❑ SOS process followed and finalised ❑ Other sites analysed and reported ❑ Situations compared and contrasted ❑ Causes of variability	❑ SOS reports ❑ Field reports/working papers, thesis, institution reports ❑ Article for workshop/newsletter ❑ SoS reports	

delivery 3. Improved understanding of the existing knowledge systems of the private hatchery operators cooperatives, especially the locally-based institutional support structures. 4. Development of a participatory methodology which will allow stakeholders to effect a continuous improvement in the quality of fish seed available in the seed supply system of Northeast Thailand 5. Impacts of novel seed production approach assessed for two species in Bangladesh 6. Lessons learned and key issues for regional and national policymakers developed and disseminated	of poor seed quality evaluated ❑ Guidelines produced and disseminated By April 2002 knowledge network diagram's are displayed in the hatchery operators cooperatives in 4 provinces of NE Thailand. By April 2002 action plans stating at least five points which will effect the improvement of fish seed produced by the hatchery cooperatives are completed in stakeholder workshops in 4 provinces of NE Thailand. By November 2005 there will be a reduction in the production costs of hatchery operators by 5% of the 2001 figure. ❑ Livelihoods assessment of representative households ❑ Institutional analysis of extension process ❑ Key issues defined and reported	❑ Research reports ❑ Local language publications ❑ Field and workshop reports ❑ Institutional and field reports ❑ Outcomes of part. M&E ❑ Working paper ❑ Workshop reports ❑ Workshop. Conference proceedings ❑ Local language reporting of findings ❑ Overview published in international fora	

Activities 1.1SOS process completed in 4 parts of Asia (Northern and Southern Vietnam, Northeast Thailand, Northwest Bangladesh) and detailed analysis of seed production and delivery in a further two sites (Southern Laos and West Bengal). 1.2Impacts of SOS process assessed 1.3Research strategy prioritised at five sites in Asia 2.1Research topics designed and implemented over two seasons at each site 2.2Research trials addressing common issues implemented with commercial partner 2.3Results analysed and conclusions drawn 2.4Main findings of research disseminated. 3.1/4.1Formation and training of local research teams 3.2/4.2Participatory appraisal of knowledge system of hatchery operators 3.3/4.3 Semi structured interviews with key stake holders identified in appraisal 3.4/4.4Development of an action plan 3.5/4.5Implementation of action 5.1Development of MOU with ICLARM and CARE 5.2 Design and implementation of field work with partners 5.3/2.5 Advise Development of Sustainable Aquaculture project 5.4Analysis and reporting 5.5 Dissemination 6.1Attendance and participation at national, regional and international fora 6.2Participation in other seed related practical and policy outcome orientated activities in the region and elsewhere 6.3Written overviews drafted and submitted			

Appendix 2

Project staff and affiliated institutions.

United Kingdom

Institute of Aquaculture, Stirling
Dr. David Little, Principal Investigator
Mr. Angus MacNiven
Mr. Gary Milwain
Mr. Anton Immink
Mr. Alan Bourhill
Mr. A G Hartley-Alcocer

Thailand

Asian Institute of Technology (AIT), Aquaculture Outreach Program
Dr. Peter Edwards
Facilitator: Mr. Danai Turongrang

Centre for Fisheries Research and Development, Udorn, Thani
Ms. Noppanun, Fisheries Biologist
Mr. Supon, Director

Department of Fisheries, Ubon Rathathani University
Mr. Kriengkrai Sataponvanit, Department of Fisheries
Mr. Noppannun Yoorong
Mr. Ram Bhujel

Nam Sai Farm, Ban Sang, Prachinburi Province, Thailand
Warren A. Turner

Lao PDR

Provincial Livestock and Fisheries Section (LFS)
Mr. Khamton Vongpach, Fisheries Officer, Kammouane
Mr. Sonesai Kosy, Fisheries Officer, Savannakhet
Mr. Douangchith Litdamlong, RDC Co-ordinatory
Mr. bountien Somtaboun, Deputy Section Head of LFS, Savannakhet province

AIT, Aquaculture Outreach Project, Lao PDR
Mr. Nick Innes-Taylor, Manager

Northern Vietnam

Institute of Aquaculture, Bac Nin
Pham An Tuan, Research Biologist
J. Prax
Nguyen Cong Dan, Research Biologist

P.V. Sao
P.A. Tuan

AIT, Aquaculture Outreach Project
Le Thann Lu, Manager, Northern Vietnam

Southern Vietnam

AIT, Aquaculture Outreach Project
Nguyen Van Tu, Manager, South Vietnam

College for Agriculture and Forestry (CAF), HCM City
Mr. Tran Ai Ouoc, Faculty member
Mr. Vu Cam Luong, Faculty member
Dr. T. Troung Giang, Faculty of Fisheries Dean

Bangladesh

NWFP Project
Mr. Ehtesham Karim Habib, Project Director, Parbatipur

DFID
Mr. Don Griffiths, Project Team leader

AIT
Mr. Benoy Barman, PhD candidate

Northwest Fisheries Extension Project
A.O. Shafer

Appendix 3

ANNUAL REPORT

1st April 1998-31st March 1999

FISH SEED QUALITY IN ASIA

David Little[1,2] and Peter Edwards[2]

[1]Institute of Aquaculture
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Asian Institute of Technology
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Progress during the last year has been steady with the State of the System (SOS) reporting process being carried out in 4 locations resulting in research and policy needs being identified and prioritized. In the Lao PDR situation appraisal has built upon previous research carried out by the PI's and the AIT Aqua Outreach project and a number of activities have identified clear knowledge gaps that can now be researched.
Information collection, synthesis, triangulating and reporting is now well advanced for Northern Vietnam, Southern Vietnam and Northeast Thailand. The last SOS workshop was held in late January in Northwest Bangladesh and extra information collection and editing of text is underway. A workshop held in Lao PDR to identify knowledge gaps constraining the production of a key indigenous species, the silver barb among Government hatchery staff resulted in a manual of 'best practice' to be developed. This, together with a curriculum of the workshop, have been developed in close collaboration with our partners in Laos and have led to planned research and policy activities with them at the District level.
The main outcomes are

- Situation specific identification of prioritized research needs and policy action at each site
- Research activity plan drawn up for each partner institution
- Common research needs identified and synergistic activities planned

Project Summary

A major constraint to successful aquaculture among smallholder producers is the poor and erratic quality of fish seed available for stocking. The project aims to identify and characterize the nature of quality constraints in carp and tilapia seed production in five areas of Asia and develop templates for strategies to deliver quality fish seed. A series of workshops involving farmers, hatchery and nursery operators, traders and policy makers have been held to establish current status at four of these locations and to identify major seed quality issues. Trials on-farm and with local institutions are

now underway or planned to compare and quantify performance differences between seed available to farmers. Project findings will be used as guidelines for the partner institutions to improve research, extension and policy foci.

Project progress

Highlights of Achievement

Progress has been made towards the delivery of both Outputs 1and 2 working at 5 different sites in Asia and a host of institutional partners (Appendix 1). Information collection from the range of actors within seed production and delivery networks has been carried out and the production of SOS reports is at various stages of completion. The iterative process of analysis, interpretation, text editing, layout in two languages is time consuming and has taken longer then expected but the process is well advanced for 3 of the reports. The level of partnership in the production has also been high; the Thai draft was circulated and comments received from 6 DOF staff and two English-speaking editors. Their comments will hopefully result in a final report that better meets the needs of the institutions involved. Preliminary field research has begun at three sites on foci identified during the situation analysis. A meeting was held during the Asian Fisheries Forum in Chiang Mai with representatives from each of the sites where the project is working to discuss issues of common interest. Several synergistic activities were identified for the follow-on phase including the production and dissemination of ' fish seed quality images', video report exchange and the development of simple descriptive keys for species and quality (See Appendix 2).

Thailand

Availability of trained manpower in our main partner institution (DoF) was a constraint to the planning and implementation of the situation appraisal, with a large Mekong River basin development project being initiated and implemented at the same time. However this organization and staff of the new Department of Fisheries, University of Ubon Ratchathani, showed a high level of interest and commitment and assigned key staff for data collection and analysis. In particular the scope of the situation appraisal was made more ambitious through the encouragement of Mr Kiri, Director of the Inland Fishery Division, DOF who has responsibility for the all the region's provincial seed production facilities. The involvement and support by DOF field staff made a survey of grow-out farmers in 6 representative provinces possible. This process has developed an up-to-date framework for assessing aquaculture development in the region.

A very good mixture of fish seed network actors and government staff attended the SOS workshop held in December in Udorn Thani. It was enthusiastically supported by Mr Supon, the Director of the Provincial Centre for Research and development who was an active participant throughout the meeting. Mr Benoy Barman, who had responsibility for organizing the Bangladesh workshop, also joined the meeting. Both the AIT Information Unit and Media Unit of the Thai DOF are currently editing an advanced draft of the report. Recommendations are given for both research and policy priorities (Appendix 3). The research agenda identified priority activities for the rest of the current and follow-on phase which are now being planned.

The project was also called to offer inputs to several related issues during the year, particularly regarding the production and dissemination of improved tilapia seed in the region. A review of hatchery options has been drafted between the project, AIT Aqua Outreach and DOF staff to clarify the situation.

Another output of the SOS reporting process is the proposed research activities which are included in the draft work plan (Appendix 2). These activities will be initiated after a workshop held by the DOF to design the research in the near future. Some research on the development of hatchery-level quality indicators has already begun with the commercial private sector.

Vietnam

SOS workshops were held in July/August and the reports are in the final stages of completion for both the North and South. Preliminary field research is underway at both locations. The monitoring of carp broodfish management at 6 hatcheries (3 private, 3 government) is underway in the Red River Delta. Hatchling quality from the hatcheries will be compared during the coming season.
The SOS workshop in southern Vietnam had identified transportation of tilapia fry to be a major cause of poor quality for fish raised on the Mekong Delta. Preliminary trials of impacts of transportation stress on tilapias in southern Vietnam are underway.

Lao PDR

A workshop was held in Southern Lao PDR for provincial hatchery staff (July1-7th 1998) in which a simple manual for the production of silver barb seed was drafted around the practical activities and experiences of the participants. It was reviewed at a meeting of Provincial hatchery staff held in Pakse, Champassak Province, January 6-8th 1999 that included participants from northern in addition to southern Provinces. Final editing, including redrafting of certain figures and lay-out changes are currently being carried out to improve readability.

A training curriculum suitable for district and provincial staff to upgrade their carp hatchery management was also developed. It is currently being finalized with the RDC Training Unit who have adopted it for use in future training activities. Silver barb is an indigenous fish that is being produced by all southern Lao provincial fishery stations and is popular with food fish farmers.

A major constraint to improved hatchery productivity was identified as the lack of accurate monitoring of survival through the process and new method has been successfully testedby Khammuane Station. It was agreed that all three collaborating Provincial hatcheries would use the system a minimum of three times in the 1999 season.

An activity plan and MOU for the follow-on phase was revised with RDC staff (Appendix 4). A workshop will be held in early May with District-level staff to design a simple trial to compare common carp fry quality in the Province.

Bangladesh

The SOS workshop was eventually held at the Caritas Training Centre, Dinajpur, between 3-4th February 1999. The meeting was particularly successful as a good representation from traders was achieved and a high level of interest and support was obvious from the DOF and NWFP-II project. Triangulation during the meeting revealed deficiencies in the information collected from nursery operations and this is currently being rectified, while other sections of the report are being edited. The outcomes of the workshop and subsequent meetings are given in Appendix 5.

Progress towards outputs

The comparative analysis of major constraints to fish seed availability and quality is well advanced through the SoS information gathering and workshop process.

Partner institutions and policy makers in the region are already using project findings. In Northern Vietnam, for example, a large DANIDA-funded inland fisheries development project with our partner institution, RIA Number 1, has a large component planned to focus on improving fish seed quality.

As a result of the research agenda developed in southern Vietnam, the project co-ordinator, Mr Nguyen Van Tu will begin his AIT doctoral research investigating the impact of improved quality tilapia fry on food fish farmers.

The project forward work plan was submitted to the PAC in February and approved, extending the project for a further 2 years. Mr Benoy Barman, a PhD candidate at AIT, is carrying out research of great significance to the improved availability of quality tilapia seed in Northwest Bangladesh. He has submitted an article 'Small-scale fish culture in Northwest Bangladesh-a participatory appraisal focusing on the role of tilapias' for publication that highlights the importance of appropriate methods for seed production and dissemination. The article will be published in a monograph, Rural Aquaculture, to be published by the Asian Fisheries Society and will also include an article 'Status of freshwater fish seed quality in Asia'. Both articles were presented at the Asian Fisheries Forum, Chiang Mai, Thailand, 11-14th November 1998.

The need for quality tilapia seed was discussed in an article published by Fish farmer magazine (July/August) 'Options in the development of the 'aquatic chicken'.

An article has been accepted for presentation at the World Aquaculture Symposium, Sydney, 'The effect of duration of nursing on the quality of 2 Indian Major carps raised in polyculture with Nile tilapia. (Hossain and Little, 1999).

An article explaining the objectives of the project was published in the AARM newsletter (3,3) and our approach in Bangladesh is explained in the forthcoming DFID Fisheries Programme magazine 'Finding out about fish seed quality in NW Bangladesh'.

Modifications/Problems in the next year

Several issues of importance are expected to occur in the coming months. The resignation of Ms Arlene Nietes as the project research associate at the end of the current financial year is likely to place strain on the planned activities in the coming months. Her role has been central to the success of the project so far, and many thanks are due to her and her husband Kriengkrai Satapornvanit who have carried out extensive regional travel during the last 18 months. Kriengkrai, through his position as lecturer at University of Ubon Ratchathani has been a full partner in the SOS process at each site and especially active with colleagues in the process in Thailand.

In order to mitigate the effect of her departure we have advertised the position, which we hope to fill with either a technical or social scientist (Appendix 6). An issue of importance that has emerged form the initial phase of the project is the convergence of seed supply methods and systems in Asia and the importance of markets and information to the production of seed of the required species and quality. The role of the position will therefore change towards facilitation of our partners local research activities and drawing together of some of the important broader themes. Ideally the position would be filled by a person who can be registered as a PhD candidate at Stirling, whilst being based and working from AIT.

The continuance of the AIT Aqua Outreach project in Northeast Thailand has been assured for a further 6 months but thereafter the role of the project in fish seed quality research in the region will need to be reassessed. Project activities have been cost-shared with the DFID-funded project to date.

Appendix 1
Individuals and Institutions with which the project has interacted

Location	**Key staff in local institution**	**Other key Partners/ Facilitators**
Thailand	Mr Danai Turongruang, AIT Aquaculture Outreach project Ms Noppanun, Fisheries Biologist, Centre for Fisheries Research and Development, Udorn, Thani . Mr Kriengkrai Satapornvanit, Department of Fisheries, Ubon Rathathani University, Ubon Rathathani. Nam Sai Tilapia hatchery	Mr Supon, Director, Centre for Fisheries Research and Development, Udorn, Thani . Ms Panthip, Director of Media and information, Division of Extension
Lao PDR	Mr KhamtonVong phach, Fisheries officer, LFS, Kammouane Mr Sonesai Kosy, Fisheries Officer,LFS Savannakhet,	*Mr Douangchith Litdamlong , the RDC Co-ordinator, Mr Bountien Somtaboun, the deputy section head of LFS, Savannakhet province* *Mr Nick Innes-Taylor, Manager , AIT Aquaculture Outreach Project, Lao PDR*
Northern Vietnam	Pham An Tuan, Nguyen Cong Dan, Thien N.V., Biologists. Research Institute Aquaculture-1	Le Thann Lu, Manager Aquaculture Outreach Project, Northern Vietnam
Southern Vietnam	Nguyen VanTu, Ait Aquaculture Outreach Project manager-South Vietnam, College for Agriculture and Forestry, HCM City Mr. Tran Ai Quoc, Faculty member, CAF Mr. Vu Cam Luong, Faculty member CAF	Dr. T. Troung Giang, Dean, Faculty of Fisheries CAF
Bangladesh	Mr. Ehtesham Karim Habib, Project Director, NWFP, Parbatipur, Bangladesh	Mr. Don Griffiths<, Project team leader, DFID project Benoy Barman, AIT PhD candidate

Appendix 2

Draft work plan for ARP Project: Fish Seed Quality in Asia (Phase 2)
Milestone charts over the life of the project.

Activity	A	M	J	J	A	S	O	N	D	J	F	M	Product
Year 1 (1999/00):													
1.1. Survey: Thailand, Lao PDR, Vietnam, Bangladesh to describe seed supply context, identify problems and significance; locate communities/areas where fish seed quality is a constraint	X	X	X	X	X	X	X	X	X	X	X	X	SoS reports finalised and disseminated at 4 sites
1.2 Local workshops with partner institutions seed networks and farmers describe current practices and constraints for quality of smallholder fish												X	
1.3 Performance testing of seed	X	X	X	X	X	X							Comparison of government and private hatchery carp seed quality (Thailand, N, Vietnam)
					X	X	X	X	X	X	X	X	Impacts of feeding strategy on nursed fish seed quality (Thailand)
										X	X	X	
	X	X	X	X	X	X							Methods for quality mixed sex tilapia seed tested with farmers (Thailand)
	X	X		X	X	X							An assessment of tilapia seed quality form commercial hatcheries (South Vietnam)
			X			X	X	X	X	X	X		Overwintering of carp fry with new season (Bangldesh, N. Vietnam)
		X		X	X								Compare the performance of common carp from traders, provincial hatcheries and locally spawned fish (Lao PDR)
			X										
	X				X								
			X										

													Monitor the production of silver barb in 3 provincial hatcheries
1.4 On-station challenge test development	X	X											Tilapias- student research in Thailand
2.1 Project findings for use by researchers, planners and policy makers, hatchery and nursery operators	X	X	X							X	X	X	Production and dissemination of fish seed 'quality images' . Video report of hatchery practices
2.2 Produce preliminary guidelines on appropriate management of seed production and delivery										X	X	X	Derived from SoS reports and other project data-produce an overview for a peer-reviewed journal
Year 2 (2000/01):													
1.3 Performance testing of seed	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X			Methods for quality mixed sex tilapia seed tested with farmers developed (Thailand) Comparison of carp seed quality from traders and nurseries (N. Vietnam) Assessment of tilapia seed transported to and marketed in the Mekong Delta (South Vietnam)
1.4 On-station challenge test development	X	X											Carps (various locations)
2.1 Project findings for use by researchers, planners and policy makers, hatchery and nursery operators	X X	X X	X X										Video report of hatchery practices Development of simple descriptive keys for species and quality for fish seed of different sizes, multi-language, water-proof paper
2.2 Produce preliminary guidelines on appropriate management of seed production and delivery	X	X	X	X	X	X	X	X	X	X			Policy and technical papers

Appendix 3:

Draft recommendations for research and policy in State of the System report (Thailand)

Research

- Determine if fish seed quality differences exist between hatcheries, especially Government and private hatcheries of different types

- Develop methodologies for monitoring fish seed quality at the hatchery and farm levels

- Compare the impact of hatchery/nursery methods e.g. feeding on seed quality

- Develop and field test systems for producing high quality, mixed- sex tilapia fry locally in Northeast Thailand.

Implementation/Policy

- Synthesise and disseminate information on the advantages/disadvantages of 'improved' fish seed (e.g. YY and all female silver barb)

- DOF to develop and implement strategies to disseminate market information regarding fish seed at the provincial centres e.g. posting at provincial fishery stations and regional centres of. daily updates on fish seed availability by species, size and price from private hatcheries during the main season

- DOF to provide facilities for fish seed sales by local private hatcheries

- DOF to improve performance of private sector traders through:
  - development of appropriate training methods and fish culture extension information for use by fish seed traders
  - training and certification of fish seed traders
- Reduce focus of DOF provincial stations on fish seed production for sale and refocus towards maintenance of improved strains and training of private hatchery sector

- Increase availability of information/extension advice on water quality and fish health management to all aquaculturists

Appendix 4 Revised log frame, Lao PDR

	OVI	Means of Verification
Purpose Freshwater fish production in three Southern provinces of the Lao PDR sustained and developed through improved approaches to small-holder seed production	By March 2002, the DLF/RDC will have facilitated the development of farmer-based operations producing fish seed for local distribution in 2 of the last 3 years in at least 50% of districts.	DLF records, district office record books, Outreach monitoring data, district staff reports
Outputs • An improved understanding of the major constraints to the supply of quality freshwater fish seed to small scale farmers in southern Lao PDR	• By March 1999, an overview of fish seed production and supply produced and submitted for publication in English and Lao • By March 2000, operating strategy in each of the Provincial hatcheries changed to more effectively service the needs of farmers in the Province • By March 2001, a published strategy in 50% of all Districts for maintaining and increasing quality fish seed supply to farmers • By December 1999, appropriate seed supply strategies identified for three districts in each province	draft article RDC reports, Provisional hatchery records, Outreach monitoring data District records, reports of RDC activity Co-ordinators, Outreach monitoring data DLF and District reports District office reports, RDC training modules, district office record books
• Practical strategies to increase the number of quality fish seed produced in southern Lao PDR. • Simple methods for monitoring fish seed quality that can be used at the hatchery or pond-side.	• By March 2000, at least 3 critical management points affecting seed quality in farmer-managed seed production systems identified, and solutions incorporated in training materials and implemented at the village level • By March 2002, refined methodologies for quality seed production and distribution promoted by at least 2 other agencies • By March 1999, comparable data collection at Provincial hatcheries adopted • By March 1999, monitoring system for seed quality at Provincial hatcheries agreed By March 2002, District-level monitoring of fish seed quality undertaken regularly	Project reports, Outreach monitoring data RDC and Provincial hatchery reports, Outreach monitoring data RDC and Provincial hatchery reports, Outreach monitoring data District reports, RDC activity Co-ordinators reports

Appendix 5
Bangladesh

RESEARCH and ACTION AGENDA DEVELOPED BY PARTICIPANTS OF THE SOS WORKSHOP, DINAJPUR 5-6TH FEBRUARY 1999

Group	Research Foci	Action- policy or practice
Grow-out	1. Information on the appearance of good, compared to poor, quality seed, by species 2. The effects of short-term holding of seed just purchased and could not be stocked yet 3. Quality of over wintered common carp fry	1. Improve information flow from government to field regarding: broodstock quality & management 2. Monitor seed produced by private sector and give certification for high quality seed 3. Make facilities (e.g. clean water) available to traders at the District level to rest seed before further transportation and sale 4. Produce and disseminate best practice guidelines
Fry Trader	1. Effect of additives and chemicals on seed quality and later growth of fish 2. Appropriate polycultures including GIFT and local tilapias 3. Effects of different transport containers on seed quality, especially plastic containers as aluminum is expensive (low-cost containers for transportation of seed); consider their heat insulation properties 4. Testing of fry quality with traders d 5. Techniques to mitigate the effects of transport stress on sensitive fish species such as silver carp 6. Disease tolerance of different fish species 7. Factors causing the deterioration of Indian carps, Chinese carps and common carps (growth)	1. Produce and disseminate best practice guidelines for using GIFT tilapia, including realistic estimates of growth and average final size.
Nursery	1. Improved nursing protocols for common carp 2. Safer and cheaper alternatives for pesticides currently used in nursing 3. Nursing in polyculture 4. Impacts of multiple spawning on quality of hatchlings 5. Control strategeis for glass fish & *Glossogobius gurius* (mudskipper) in nursing and grow-out ponds	1 Introduce controls/ban pesticides which are not safe 1. Ban the production of hybrid carps 2. Produce and disseminate known best practices for over wintering different species

	6. Improvements in over wintering techniques for grass carp and Catla	
Hatchery	1. Broodfish exchange between hatcheries as a technique to improve seed quality 2. Impact of multiple spawning on seed quality 3. Comparison between riverine and hatchery broodfish on seed quality and grow-out performance	1. Disseminate FRI guidelines on recommended size and age of broodfish 2. Develop recommendations for hatcheries to sell only standard age (5-days post hatch) hatchlings to nurseries 3. Develop recommendations on broodstock management 4. Introduce cryopreservation of milt of selected carp broodfish for sale to private hatcheries 5. Disseminate & train hatcheries on the techniques for the sex-reversal of Nile tilapia and silver barb 6. Once improved strains have been established a dissemination program to private hatcheries should be immediately implemented 7. Ban cross-breeding and hybrid production of carps
Government	1. Better understanding on the size and age of broodfish by species on quality of seed 2. Improve fry transportation techniques for local nurserers and other levels 3. Impacts of chemicals used by nurserers and traders on fish seed quality and subsequent performance 4. Optimal strategies for over wintering different species 5. Comparison of performance between new season and over wintered seed under NW conditions 6. Impacts of over wintered seed on hatchery production and aquaculture 7. Advanced nursing of species other than common carp in ricefields 8. Grow-out of over wintered seed of all species in ricefields 9. Impacts on over-all performance of hybrid species in polyculture 10. Impacts of multiple spawning on seed quality 11. Comparison on the performance of natural and hatchery – produced hatchling	1. Identify best practice guidelines for disease control in hatcheries 2. Introduce cryopreservation of milt 3. Introduce best practice/guidelines for introduction of sex-reversal tilapia technology into NW Bangladesh, primarily with DOF and later the private sector 4. Disseminate best practices for the use of anaesthesia for transporting broodfish 5. Develop a national information network on broodstock availability, genetics, hatchery to be organized by the DOF (first priority) 6. Plan a broodfish bank network based on lead/regional centers holding and maintained the genetic quality of key broodfish species 7. Develop a system to license and monitor seed quality of hatcheries 8. Identify needs for further introductions and importation of original strains from indigenous sources 9. Initiate diploma-level training to develop skills in hatchery and nursery operations 10. Control of chemicals used in hatcheries

SOS Meeting Parbatipur 31st Jan-7th February 1999

1-8 comments; 9-17 action points

1. Preparation of information for the meeting was advanced by the time I arrived. Jigz and Key had arrived a few days earlier and each section already had key information in a presentable form.
2. The Caritas training centre was perfect for the workshop, having both a larger hall and several rooms with mats for small group work. Logistic support throughout was very well arranged.
3. Assignment of presentation tasks was made and presenters and facilitators revised materials in line with needs if each group. The questions and inconsistencies raised by the analysis were noted down and used as framework for each session.
4. Groups were arranged based on growout farmers, nursery operators, hatchery owners and traders. In each case DOF staff joined each group but information was presented and discussed separately (2 sub-groups in the same room)
5. The schedule was revised to allow time for different groups to triangulate the information with each other group.
6. Report back just before lunch on day 2, given the presenters time to summarise key findings. DCL and MIG gave presentations of the results of two research studies on overwintered seed. One issue that emerged was that in the period between identification of overwintering as a problem and the completion of research-a better understanding of the value of overwintered seed had already emerged within the country.
7. Research and policy/practice agendas was drawn up by five separate groups; the 4 groups of private sector in addition to the DOF staff in their own group.
8. First draft SOS report writing was completed on Thursday 4th and reviewed on Sunday 7th. It was clear that the nursery survey needed additional information to give a complete and accurate picture-too little information had been gathered on nursery operations in the Northwest region itself. Although documentation from NFEP was useful in understanding the situation-it was outdated (‘93,’94). Most of the 7th was spent clarifying the information from traders, facilitated by a group of traders who were present for technical training at the time, and access to NFEP reports. It became clear that all the inputted data, especially the large data sets from growout and trader needed careful checking with raw data.
9. The results of the outputs of the working groups should be typed up in Bengali as a reference for the information used in the SOS report
10. All survey and workshop-related materials should be filed together for later use. The SoS report should precede the use of the materials for other purposes.
11. All inputted data should be checked.
12. A revised English draft will be produced by DCL on the background, growout and hatchery, trader sections and sent back to NFEP for checking for clarity (the English should be simple, concise and clear) meaning and consistency with the Bengali version. It will be sent as an attached Word 7 file to Don Griffiths. Figures will then need to be finalised and added to begin laying out the report..
13. Another SoS report will be sent by Jigz to Don as an example, who will co-ordinate the finalising of the English/Bengali report.
14. Further information needs to be gathered from the NW region, representative of the region. It was suggested that a slightly modified form should be used to collect information from 5 nurseries from each District and additionally, a few from the

Champtali concentration within the next month. The information will be incorporated into the current nursery analysis and, additionally, analysed seperately to compare practices in the NW with nurseries around Bogra. Benoy took responsibility to discuss with Don about how the extra information will be collected and analysed.

15. It is estimated that this further information collection, analysis and writing can be completed within 3 months. At this stage the document should be laid out in Parbatipur as alternate English/Bengali pages, as with the other SoS reports.
16. No decision was made on where and how the reports would be printed, promoted or disseminated. A decision on this will be made jointly by NEP-2 and the FSQP after finalisation of the proofs. Ideally the report will be an official DOF document and disseminated widely.
17. AIT Aqua Information unit can assist in international dissemination of hard copies and can put an electronic version, along with other SOS and project reports, on its homepage.
18. In a final meeting attended by the Project Director, Rabani, Benoy and Nick, much of the above was discussed. Additionally

- NWEP-2's activities towards disseminating and sustaining GIFT tilapia in the region was discussed. The role of the hatchery as a pure broodstock bank and relationships with District level GO/NGO's was discussed in relation to Benoy's and other Project initiatives to date.
- A preliminary schedule of research activities, identified by the meeting was proposed (see Table 1). The appointment of a new trials manager by NFEP-2 was identified as an immediate need if the research is to proceed on schedule. Limited sequential activities, were suggested as the resources available, especially researcher time is limiting.
- The Project Director suggested that the research/action agenda should be produced and disseminated as soon as possible to participants. DCL will revise the meeting output with some commentary and forward to NFEP. Ideally, and in keeping with the project policy, it should be finalised in English/Bengali within the same document.
- The group was briefed on FSQ-phase 2 project activities that were raised and endorsed at a recent meeting of representatives of the partner institution (PI) during the AFF in Chiang Mai, and requiring NFEP-2 collaboration.

These involved

1. Production and dissemination of 'Images of fish seed production in Asia-98-99'. A collection of scanned images with commentary in the languages used by the partner institutions. This will be used as an information resource by the institutions involved and be the first step in developing collective experience of FSQ issues in a participatory way. A copy will be circulated for each PI to add text and other relevant information before final layout by the project. It is expected the product will be disseminated on disc/CD ROM for local dissemination and use.(Timing-draft circulated by June 1999)
2. The development of a visual key to fish seed quality of the major species raised in the region. The first step will begin with the development of a standard process, based on tilapia in Thailand. This will then be used as a basis for the different PI's to use the standard method to develop a key for 1-2 species-and the information collected for publication and dissemination (Timing-process developed by July 1999).

3. Production of a video on the fish seed production and delivery, initially in Northern Vietnam and Bangladesh. The script will be developed to cover all stages of fish seed supply and developed to form a series of short sequences that can be used as an extended version or as out-takes for training purposes. Both versions will be edited into 3 languages initially (English, Vietnamese and Bengali).(Timing aim for script developed by November 1999, final product September 2000)

Appendix 6

Freshwater Fish Seed Quality in Asia
Research Position

We are looking for a suitable candidate to be based within the Aquaculture and Aquatic Resource Management Program of the Asian Institute of Technology (AIT), near Bangkok, Thailand as a research associate on a project investigating the impact of freshwater fish seed quality in Asia.

Most global cultured fish production occurs in Asia, and fish is particularly important in the diets of people living in the 4 countries in which research activities are underway i.e.Thailand, Vietnam, Laos and Bangladesh. The production of juvenile fish for stocking culture systems is now common in these countries, often in the private sector, but their quality is a cause for concern. AIT is conducting this research with partner institutions in these countries and has completed a situation appraisal phase. Initial findings suggest many common features of seed supply production and delivery practices between the countries. The research associate will, in addition to facilitating the on-going research with partner institutions, focus on the development of an overall model for quality fish seed production and delivery to expanding rural markets. The candidate will draw heavily on experience from the production and marketing of other highly perishable agricultural products, theory of poor producer and consumer behaviour, and markets and marketing in developing economies. Understanding the role of fish seed networks in the livelihood systems of poor people in rural and peri-urban areas will be integral.

It is expected that the candidate could have either a social or technical science background and willing to develop the required expertise. Experience in working in developing countries is highly desirable and an ability to communicate effectively, both orally and in writing, is essential. The position will require frequent travel within Asia and the successful candidate will be energetic, diplomatic and independent. The research associate would be appointed according to local terms and conditions at AIT and, additionally, receive an annual return flight to the UK. The successful person would be registered as a doctoral candidate at the Institute of Aquaculture, University of Stirling.

The principle investigators of the project, funded by the Department of International Development, UK, are David Little, Institute of Aquaculture, University of Stirling and Peter Edwards, Asian Institute of Technology

Candidates are asked to submit a full CV to David Little by the 31st March 1999.

Institute of Aquaculture
University of Stirling
Stirling, FK9 4LA, UK
Email d.c.little@stir.ac.uk

Appendix 7

INSTITUTE OF AQUACULTURE
UNIVERSITY OF STIRLING

Equipment Purchased for Seed Quality Project with AIT, Bangkok, Thailand

Equipment Description	Make and Model	Serial No	Date Received	Purchase Price £	Location
Scanner	Primax, 9600 Profi	005957101001	04.09.1998	200	IOA, Room F17

Appendix 4

ANNUAL REPORT

1st April 1999-31st March 2000

FISH SEED QUALITY IN ASIA

David Little[1,2] and Peter Edwards[2]

[1]Institute of Aquaculture
University of Stirling
Stirling, Scotland FK9 4LA, UK

[2]Agricultural and Aquatic Systems Programme
Asian Institute of Technology
P.O.Box 4, Klong Luang, Pathum Thani, 12120, Thailand

Progress in current year

Progress has been made towards design and execution of research prioritized by the participatory stakeholder approach reported last year. Preliminary research findings have been developed in northern Vietnam, Lao PDR and northeast Thailand. Administrative and weather reasons delayed field research in southern Vietnam and northwest Bangladesh but are now underway at both sites. Publication of State of the System reports has been delayed by the practical difficulties of producing quality bilingual reports at a distance but two reports have gone to press (Thailand and Southern Vietnam), and the northern Vietnam is at the proof-reading stage. The Bangladesh report is also at an advanced stage of production. Mr Angus MacNiven started in August 1999 as a programme specialist and has since been heavily involved with facilitating field research at the five sites.

Highlights of Achievement

- Variable seed quality observed in a comparison of silver barb available to farmers in northeastern Thailand. Fish seed produced form Government stations found to be inferior in some cases to private hatchery seed. .Major impacts of poor quality seed appear to be related to poor survival immediately post stocking rather than poor growth or survival during growout.
- Variation in seed performance of both grass carp and mrigal obtained from different hatcheries in northern Vietnam but this appeared independent of hatchery status i.e. government and private operations. Performance during food fish performance was similar
- In a trial comparing the performance of fish seed produced with pituitary glands or LH-RH, there was no significant difference between early survival (21days,

64%and 58% respectively). Small but significant differences were found in later survival (90 days; LH-RH 97%, PG 94%).

- In Lao PDR, a trial at the District level comparing performance of seed locally produced by a member of the hapa spawning network, imported from Thailand and distributed by middlemen and fish from the provincial Government hatchery found important differences. Government-produced seed were consistently poorer in quality than either fish produced locally or transported over long distances from Thailand.
- Provincial government hatcheries were able to use the monitoring system that had been developed together in a workshop held the previous year. This allowed constraints to their hatchery management to be established and in particular to establish the continuing poor nursery pond management prevalent in one hatchery.
- Mr Nguyen Van Tu, the coordinator of project activities in southern Vietnam has begun doctoral research funded by DANIDA focusing on fish seed quality issues identified by the project.
- A Danida funded project in northern Vietnam is focusing on improvement in the availability of quality fish seed as a major objective. The FSQP, in its earlier workshop

Progress towards Outputs

- An analysis of the importance of poor fish seed quality and priorities for research is well advanced through the State of the System process.
- Dissemination of Lao workshop findings through development of a manual and workshop curriculum

Dissemination Outputs during the year

- Health management issues in freshwater fish hatcheries, nurseries and fry distribution, with emphasis on experiences in Vietnam and Bangladesh. David C. Little, Pham Anh Tuan and Benoy Barman . In Proceedings of a DFID/FAO/NACA Asia Regional Scoping Workshop in Primary Aquatic Animal Health Care in Rural, Small-scale Aquaculture development in Asia.
- New approaches to fish seed supply. Theerachai Haitook, Sonesai Kosy and David C. Little. Appropriate Technology, 25 (4), 26-28.
- Development and evaluation of a stress challenge testing methodology for assessment of Nile tilapia (*Oreochromis niloticus*, L.) fry quality. Angus MacNiven and David C. Little. Submitted to Aquaculture Research
- Rice field-based fish seed production-understanding and improving a poverty-focussed approach to the promotion of aquaculture in Bangladesh. David Little, Isail Golder and Benoy Barman. AARM Newsletter,4 (2). 7-10.
- 'Finding out about fish seed quality in NW Bangladesh'. Bangladesh Fisheries Programme Newsletter.
- The Research-development mosaic. How research in local-level nursing of fish seed brought benefits to farmers throughout Asia. David C. Little and Kenny MacAndrew. AARM Newsletter, 4 (4), 10.

- Entry points and low risk strategies appropriate for the resource poor to participate in cage aquaculture. Ken McAndrew, David C.Little and Malcolm C.M Beveridge. Cage culture in Asia Conference, Taiwan.
- Silver barb seed production in Southern Lao PDR. K. Vongpachan et al. Manual published by Regional Development Committee for Livestock and Fisheries Development in Southern Lao PDR/Fish Seed Quality in Asia, AIT. 24pp.
- Workshop held for the CARE cages project
- Participation in the NACA/FAO Aquatic Animal Health Workshop in Dhaka

Planned modifications of project implementation

Project activities are now based on a work plan developed over the last few months with project coordinators.

- In northern Vietnam we are investigating differences in quality between seed derived form broodfish held at different geographical locations. A study of fry quality obtained from traders selling fry around the Delta will also be carried out. A network study of a traditional centre of fry nursing and trading is also planned for April-May.
- In southern Vietnam, a comparison of tilapias obtained from different sewage-based hatcheries and access the impact of transportation on them.
- In southern Lao PDR , the investigation began last season on seed quality available at the District level will be broadened to include areas more distant from government and imported seed and repeated to validate recent findings.
- In northeast Thailand the impacts of nursery practice on tilapia seed quality and transportation on silver barb seed will be conducted
- In northwest Bangladesh a comparison of introduced and current strains of silver carp will be finalised, a trial in which overwintered and new season seed are compared at the nursing, trader and food fish farm level is underway. It is planned to access the livelihood impact of hatchery compared to self recruited seed for poor producers and consumers
- The impact of the State of the System reporting process on institutions and policy will be monitored.11

Dissemination outputs expected during the next year

- Completed SOS reports
- A peer reviewed article on variation in seed quality in northeast Thailand

Other comments

The thesis proposal of Angus MacNiven is expected to be finalized in the current year and will be circulated to country coordinators for comment. The focus will be a systems approach to seed supply in Asia.

Appendix 5

ANNUAL REPORT

1st April 2000-31st March 2001

FISH SEED QUALITY IN ASIA

David Little[1,2] and Peter Edwards[2]

[1]Institute of Aquaculture
University of Stirling
Stirling, Scotland FK9 4LA, UK

[2]Agricultural and Aquatic Systems Programme
Asian Institute of Technology
P.O.Box 4, Klong Luang, Pathum Thani, 12120, Thailand

Progress in current year

Research field trials have now been completed at all five sites involved in the project and analysis is at various stages of progress. The four State of the System reports have been published and an assessment of their impact begun. An implementation plan has been negotiated with the Thai department of Fisheries for the project to develop an appropriate methodology for improving the quality of fish seed available to farmers.

Highlights of Achievement

- State of the System Reports for Northern Vietnam, Southern Vietnam and Northeast Thailand have been disseminated and a checklist to aid in a follow on study of their impact has been developed and distributed.
- The SOS report Northwest Bangladesh is in print following final editing at Stirling during Dr Benoy Barman's visit in December. The main findings will be presented at the end of project workshop of the NFEP II in Dhaka 18-20th March.
- Preliminary analysis of the completed technical trial in Southern Vietnam to establish the variation in quality of mixed sex tilapia seed available from hatcheries situated around Ho Chi Minh City has been completed and a report on the trial is being drafted.
- Two field trials have been completed in NW Bangladesh and data is currently being processed. Analysis of these trials to assess the value of improved quality silver carp seed on productivity and livelihoods in the region is expected to be finalised before a workshop in June .
- A 'soft' systems approach is being used to develop an appropriate methodology for improving seed supply with the Thai DOF. Initial stakeholder meetings have been held at the Provincial level.

Progress towards Outputs

- An analysis of the importance of poor fish seed quality and priorities for research has been accomplished through outputs of the state of the system process.
- The basis for variable and poor seed quality has been identified as being extremely variable and multi-factorial in nature, disallowing the effectiveness of simple tools to assess seed quality in the field.

Dissemination Outputs during the year

AIT/CAF. 2000. ***Fish Seed Quality in Southern Vietnam.*** *State of the System Report.27 pp. Aqua Outreach, AIT, Pathum Thani, Thailand.*
AIT/RIA 1. 2000. **Fish Seed Quality in North Vietnam**. State of the System Report.23 pp. Aqua Outreach, AIT, Pathum Thani, Thailand.
AIT/DOF. 2000. **Fish Seed Quality in Northeast Thailand**. State of the System Report.23 pp. Aqua Outreach, AIT, Pathum Thani, Thailand.
AIT/DOF. 2001. **Fish seed quality in Northwest Bangladesh**. State of the system report. pp. Aqua Outreach, AIT Pathum Thani, Thailand.
Shafer, A. and Little, D.C. 2000 **A comparison of silver carp (*Hypopthalmichthys molitrix*) hatchery strains in Northwest Bangladesh**. Working Paper 1. 26pp. Institute of Aquaculture, Stirling,. Scotland.
Prax, J,S.V Pham and D.C. Little. **Analysis of the fish seed production and distribution network in Mao Dien Commune, Red River Delta, Northern Vietnam**. Working Paper 2. . Institute of Aquaculture, Stirling,. Scotland.
Dan, N.C and D.C.Little.2000.**The culture performance of monosex and mixed sex new season and over-wintered fry in two strains on Nile tilapia *(Oreochromis niloticus*) in northern Vietnam.** Aquaculture 184.3-4.221-231.
Dan, N.C. and D.C. Little. 2000. **Overwintering performance of Nile tilapia *Oreochromis niloticus* (L.) broodfish and seed at ambient temperatures in northern Vietnam.** Aquaculture Research, 31, 6, 485-493.
Coward, K and D.C. Little. 2001. **Culture of the aquatic chicken; present concerns and future prospects**. Biologist 48 (1).

Planned modifications of project implementation

A project extension until 31/12/0` has been approved

Dissemination outputs expected during the next year

- A peer reviewed article on variation in seed quality in northeast Thailand
- Status of Fish seed quality in Asia article
- Analysis of SOS process impact
- Workshop proceedings

Appendix 6

ANNUAL REPORT

1st April 2001-31st March 2002

FISH SEED QUALITY IN ASIA

David Little [1,2] , Angus MacNiven[1,2] and Peter Edwards[2]

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University of Stirling
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Project Activity

The previous phase of the project under the original logframe was concluded by a workshop at AIT in June 2001. An extension to support further work was agreed until the end of March 2002. Subsequently program development funds have been secured to continue activities until the end of September 2002. The focus of these activities is Northeast Thailand and Northwest Bangladesh

Current activities are the development of case studies using (1) action research to facilitate improvement within the seed supply system among producers in Northeast Thailand and (2) participatory monitoring of household and groups that have diversified into small-scale seed production. Progress has also been made on the analysis and finalisation of written outputs of research to date including workshop reports, working papers and articles submitted for peer review. Further research priorities have been identified and support solicited as a research concept note submitted to AFGRP as 'Participatory approaches to maintaining fry quality for rural aquaculture' for which a full proposal has been invited.
(1) The most significant variation from the revised plan has been in the timeframe of field activities; getting underway was a problem as considerable time had to be invested in ensuring that senior collaborators and colleagues understood and accepted the methodology which was, for them, innovative. We use participatory methods to appraise the local system, analyse problems and work with farmers to develop action plans to help them research the issues facing them.
The delays impacted on the number of case studies that can possibly be completed. Currently the first case study, in Surin Province, has been completed to the point where ongoing activities are active research by the farmers. The project will continue to support these activities and facilitate the review and planning of further action until the end of the project. A second case study is underway in Mahasarakam Province, with hatchery operators in Kosumpisai, which will be completed by mid-May. Mahasarakam is also the base for most of the mobile fish seed traders operating in the Northeast of Thailand and we hope to be able to establish contact and work with this

important group in the seed supply system. If it is possible to do research with the traders then it is unlikely that we will be able to conduct another case study.
(2) Identification of appropriate households to which rice field-based production of common carp and Nile tilapia seed and development of a monitoring methodology has been completed with CARE field staff in Rangpur

Success stories

(1) An action plan is in place with a group of hatchery operators in Tambon Chaniang, Surin, which is based on their analysis of the problems that they face in the operation of their hatcheries. Initial aims that they have identified for action are (a) improvement of the market for fish seed, and (b) increased knowledge about broodstock management. To achieve these aims the farmers developed specific objectives and action plans to meet these objectives. This represents the beginning of a research process by the primary stakeholders in this system with a view to improving the situation themselves. The hatchery operators in the two groups we are working with produce about half a billion fry and fingerlings that is traded to small-scale farmers throughout the northeast of Thailand and into Laos and Cambodia.
(2) Improved livelihoods of farming households that have adopted seed production in ricefields are indicated through the sustained adoption and farmer-to-farmer spread of the approach in the project areas that has been observed to date.

New knowledge or innovation

(1) The activities under the action plan will lead to new knowledge for the participants. This knowledge will be shared and analysed with other hatchery operators at a review meeting and should lead to further plans for action in an ongoing process of investigation and improvement. We know that there is enough existing knowledge about hatchery.
Our methodology is a innovative process that should provide useful lessons to the research/development (or research for development) community.
(2)The mechanisms for knowledge transfer between farmers and via a range of grass-roots organizations working with CARE should become clear from the fieldwork currently underway.
(3) The analysis, finalisation and submission of results to date are contributing to the basic understanding of seed quality and supply as a general issue in the region. Describing the extent, and understanding the underlying causes, of poor quality in freshwater fish seed and practical approaches to ameliorating its impacts are major foci.

Collaborative arrangements

(1) Collaborating with Inland Fisheries Division, Royal Thai Government Department of Fisheries under an MoU with AIT and DoF. We are working closely with members of Surin Fisheries Cooperative and Kosumpisai Aquaculture Cooperative, producer organisations that have the potential to draw down services and give

farmers a voice. Unofficial collaboration/cooperation with the Fisheries Department, Rajamangala Institute of Technology, Surin.
(2) Collaboration with ICLARM , CARE and associated local NGOS in Bangladesh

Reporting

Peer reviewed

MacNiven A.M. & Little D.C. (2001) Development and evaluation of a stress challenge testing methodology for assessment of Nile tilapia (*Oreochromis niloticus*, Linn.) fry quality. **Aquaculture Research, 32, pp 671-679.**

Little, D.C.and N. Innes Taylor. 2002. **Fry nursing in rice-fish systems**. p.139-141 In Integrated agriculture-aquaculture. A Primer. FAO Fisheries Technical Paper 407. FAO, Rome.

Little, D.C., A. Satapornvanit and P.Edwards.2002 **Freshwater fish seed in Asia**.p.185-196. In Rural Aquaculture. CABI Publishing, Wallingford.

Barman, B., D.C.Little and P.Edwards. 2002 **Small-scale fish culture in Northwest Bangladesh: a participatory appraisal focusing on the role of tilapia**. p.227-244. In Rural Aquaculture. CABI Publishing, Wallingford.

Hossain, M.A., D. C. Little and R. C. Bhujel**.** 2002. **Effects of nursing duration on the subsequent performance of Indian major carps (rohu, *Labeo rohita* and mrigal, *Cirrhina mrigala*) in polyculture with monosex Nile tilapia (*Oreochromis niloticus*) at varying levels of pond fertilization.** Aquaculture Research *under review*

Little, D.C, R.C. Bhujel and T.A.Pham. 2002.**Advanced nursing of mixed sex and monosex tilapia (*Oreochromis niloticus*) fry, and its impact on subsequent growth in fertilized ponds.** Aquaculture *under review.*

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Non-peer reviewed

Aarm newsletter stuff
Other (reports, posters, theses etc please give details).
Little, D.C. & MacNiven, A.M. (2001) Workshop report. 'Improving freshwater fish seed supply nd performance in smallholder aquaculture systems' AIT Centre, Pathumthani, Thailand 5th - 7th June 2001. Distributed to all workshop participants by email.
Working papers
MacNiven, A.M., Sangkaew, S., Sittirach, N. Veerachantachart, N. (2002) Report of research findings related to the operation and function of Surin Fisheries Cooperative: A participatory consultation with cooperative members and local government officers (in Thai). A summary of the main findings in this

report was presented on 3 posters, at a special meeting of co-op members on the 8th February 2002
Sittirach, N. & Sangkaew, S. (2002) Forum for Hatchery Operators Newsletter., 200 copies were printed and distributed by post to all the hatchery operators who are members of the Surin Fishery Cooperative, the remainder were delivered for free distribution to the main aquaculture input supply shops, the DoF station and Rajamangala Institute Fishery Department.
Milwain, G., Immink, A, Kundu, N. and Little D.C. Fish seed production and distribution in West Bengal

Uptake and promotion

(1) The project approach is about process, currently we are documenting the process of the development of a methodology. Action research works on two levels; the level of outcomes for the client group and the level of improvements to the research process based on critical review of the results of the action. A basic assumption is that the local problems addressed in action research are *de facto* local, and that therefore the direct outputs of the work with specific communities will not be generalisable. The documentation and analysis of the research process will be useful for application more widely and the heterogeneous nature of producer groups in Northeast Thailand make it a good case study in this respect.

An immediate output through sharing and reviewing results from the actions which we support are impacts on the producers themselves. Furthermore, as the farmers that we are working with produce a significant amount of the seed that is traded to small farmers in the region, any small improvement to their system should benefit the other stakeholders. Our approach is geared towards developing the networks that farmers use to innovate and trade. Impacts on the client groups, other collaborators and a broader range of stakeholders are being assessed through participatory evaluation techniques at every step of the process as conventional methods are inappropriate.

The lessons learned from the research process will be disseminated through the usual channels, ideally peer-reviewed journals in addition to local language outputs that will include a handbook documenting the research approach.

(2) Working with grass-roots organizations that were partners in introducing a seed production methodology earlier in the project to assess its impact is resulting in immediate feedback and uptake by the organizations involved in terms of modifying their approach. It is planned that these organizations themselves become important promoters of the approach through their involvement in assessment of its impacts.

Appendix 7

Memoranda of Understanding

MEMORANDUM OF UNDERSTANDING

Fish Seed Project – Southern Vietnam

Introduction

- This document outlines how a research project funded by the Department of International Development, UK will be organized between the Agricultural and Aquatic Systems Programme, AIT and the Department of Fisheries, CAF, National University of Ho Chi Minh City, Vietnam.

- The project aims to assess current freshwater fish seed quality and to develop approaches to monitor and improve it.

- The project is also working with institutions in Northern Vietnam, Thailand, Lao PDR and Bangladesh.

Full details of the project can be found in Project memorandum R7052 'Improving freshwater fish seed supply and performance in smallholder aquaculture systems in Asia'

The Problem

Currently, many farmers in Southern Vietnam are using fish seed of variable quality, preventing them from raising fish successfully

The project aims to

- find out what is causing the problems of poor fish seed quality in Southern Vietnam and to develop simple methods to overcome them.
- to complement on-going or planned activities funded under the AIT Aqua Outreach Project to improve the supply and quality of fish seed to farmers

Time frame

There will be 2 phases of the project

- Phase 1 Problem identification and initial trials 15th November- 31st March 1999
- Phase 2 Development of methods for increasing availability of improved fish seed 1st April 1999-31st March 2001.

Phase 2 was funded based on the progress achieved towards solving the problem.

Outputs

- An improved understanding of the major constraints to the supply of quality freshwater fish seed to small scale farmers in southern Vietnam
- Practical strategies to increase the number of quality fish seed produced in southern Vietnam
- Simple methods for monitoring fish seed quality that can be used at the hatchery or pond-side.

Contributions of funds and resources

Both CAF and AIT will provide funds and resources for project activities.

The total allocation in US$ by each party is shown in the table below

	Nov. 1997-Mar 2000	April 2000-Mar 2001
Total AIT commitment Total CAF commitment	7392	7630
Total commitment		

For details see Appendix 1

Roles and Responsibilities

Staff from the project

- Professor Peter Edwards is based at AIT and is responsible for administrative issues.
- Dr David Little is responsible for project implementation. He will make at least three visits to the project during the phase 1 and 2 from the UK where he is based. .Mr Angus MacNiven, a project Research Associate. He will facilitate project activities, assist project implementation and coordinate technical activities (Appendix 2). He will be based at AIT from late August 1999 and will visit southen Vietnam at least twice annually spending a minimum of 2 weeks on each occasion. He is registered as an external PhD candidate at the Institute of Aquaculture, U.of Stirling, UK. He will develop a proposal towards a dissertation before February 2000 which will be circulated for comments and approval from CAF.

Staff from the CAF

- Mr Nguyen Van Tu is responsible for project coordination in southern Vietnam.
- He will be the main contact person with project staff for agreed activities. He will be responsible for administration and organisation of activities and financial and technical reporting AIT. He will ensure that office and workshop space, communication facilities, computing support and in-country transportation are

available to AIT staff. He will also make sure that visa applications are processed and invoices sent to AIT.

- Mr Nguyen Nhu Tri , will be responsible for co-ordination and implementation of research activities to agreed specifications and deadlines.
- Mr Huynh Pham Viet Huy will assist in research activities including field work and analysis and directly supervise Mr Nguyen Pham Minh Van and Ms Luu thi Thanh Truc who will carry out day-to day activities as full-time project employees.

Activities

Detailed activities for the remainder of Phase 2 are given in Appendix 3. Details of the second activity will be finalised in the next visit of Mr Angus MacNiven in May/June 2000, and at six monthly meetings thereafter.

This memorandum is signed by

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for CAF date

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for AIT date

Appendix 1

Budget

Over the remaining 12 months of Phase 2, the following money is available to support efforts of the CAF to promote improved fish seed supply and performance in Southern Vietnam

	US$
Equipment	200
Personnel	3000
Travel	2000
Publications/ training	1470
Contingency	760
Total	7630

- An invoice needs to be sent by CAF to Professor Edwards at AIT (marked Attention Ms Lucia) on a quarterly basis for estimated expenditure for the coming 3 months.
- Financial expenditure can be reported on a quarterly basis to AIT with the post codes currently used by the Outreach project
- Money will be deposited to CAF according to current AIT transfer procedures

Appendix 2

Reporting

In order to ensure the smooth coordination of activities it is agreed that email will be used on a regular basis. Any correspondence should be coded to allow tracking of lost messages ie. NVT-JS-1 (Tu sending to Jigz first message). All messages should be cc'd to both Tu and Dave.

In an email message, points should be numbered and responded to.

Interim reporting

AIT has to make quarterly reports to DFID so inputs will be required about your activities one week in advance of the following dates
Report deadlines 1st March,1st June, 1st September and 1st December

Main sections should include

Progress during current quarter
- Highlights of achievement
- Progress towards outputs
- Activities during the quarter

Planned activities for the next quarter
Planned modification to project implementation (e.g. output, log frame etc)
Dissemination outputs achieved (publications, workshops, conferences, courses etc.)

Appendix 3

Detailed Work Plan

There will be 4 main activities until the end of the project

Activity 1

- The dissemination of the SoS report of fish seed quality in Southern Vietnam to identified persons/institutions and follow up and assessment of the impact of the report.

Activity 2

- Production of a peer-reviewed journal article in which the problems of fish seed quality in southern Vietnam are described and analysed. Draft to be produced by ??

Activity 3
SVIET1
An assessment of tilapia seed quality from commercial hatcheries in Ho Chi Minh City . See appendix 1 (CAF trial1-rev).
Field work April 2000-August2000
Preliminary results and analysis September 2000
Draft for submission to peer-reviewed journal December 31st 2000

Activity 4
SVIET2
Assessment of a decentralised approach to improving tilapia seed quality for food fish farmers (see SVIET2)

Activity 5
An assesment of the impacts of variable tilapia see quality will be undertaken among food fish farmers and consumers will be undertaken through a simple survey, integrated with Activity 4.

Revised 5th April 2000

MEMORANDUM OF UNDERSTANDING

Fish Seed Quality Project - Thailand

Introduction

- This document outlines how a research project funded by the Department of International Development, UK will be organized between the Agricultural and Aquatic Systems Programme, AIT and the Department of Fisheries, Thailand.

- The project aims to improve fish seed supply and performance in smallholder aquaculture systems in the region.

- The project is also working with institutions in Northern and Southern Vietnam, Lao PDR and Bangladesh. Full details of the project can be found in Project memorandum R7052 'Improving freshwater fish seed supply and performance in smallholder aquaculture systems in Asia'

The Problem

Currently, farmers in Northeast Thailand can usually obtain fish seed, but it is often perceived as poor quality. Some farmers say that the poor quality of fish seed prevents them obtaining good production.

The project aims to

- find out the quality issues in the delivery of fish seed to both small-scale, subsistence farmers and more commercial operators in up to six Provinces in Northeast Thailand and to develop simple methods to overcome them.
- complement on-going or planned activities funded by the AIT Aquaculture Outreach Project improve quality fish seed supply to farmers.

Time frame

The current phase will be for 2 years and follows an initial phase that appraised the situation(15th November-31st March 1999). Funding is agreed for a period between1st April 1999-31st March 2001.

Outputs

- An analysis of the nature of fry quality problems in Northeast Thailand

- An improved understanding of the effects of poor seed quality to the success of aquaculture among small-scale and commercial farmers in Northeast Thailand
- Practical strategies to increase the number of quality fish seed produced in Northeast Thailand.
- Simple methods for monitoring fish seed quality that can be used at the hatchery or pond-side.

Contributions of funds and resources

Both the project, AIT Aquaculture Outreach and the DOF will provide funds and resources for project activities.

The total allocation in US$ by each party is shown in the table below

	Nov. 1997-March 1999	
Total project commitment Total AAO commitment DOF	7392	
Total commitment		

For details see Appendix 1

Roles and Responsibilities

Staff from the project

- Professor Peter Edwards is based at AIT and is responsible for administrative issues.
- Dr David Little is responsible for project implementation. He will make at least three visits to the project during the phase 1 and 2 from the UK where he is based.
- Mrs Arlene Satapornvanit (Jigsz), the project Research Specialist. She will facilitate project activities, assist project implementation and coordinate technical activities (Appendix 2). She will be based in Ubon Ratchathani and will visit project sites in Northeast Thailand on a more frequent basis.
- Staff from the DOF, Thailand
- Ms Noppanun is responsible for project coordination within the DOF and will be the main contact person with project staff for agreed activities. She will be responsible for administration and organisation of activities and financial and technical reporting to the DOF.
- Mr Supon , the Director of the Udorn Thani Fisheries research and Development Centre, who will ensure that office and workshop space, communication facilities, computing support and in-country transportation are available to AIT staff.
- Ms Panthip,will coordinate the production of the SoS report in co-operation with project staff

Staff from the AIT Aquaculture Outreach

The AITAO will facilitate

- Data collection and SoS meetings
- Involvement of other agencies and individuals where necessary
- the DOF to engage in on-farm research
- the DOF in SoS reporting
- report project finances to AIT

Activities

Detailed activities for Phase I will be planned in a workshop in Late February/early March are given in Appendix 3 . Details of later activities will be planned in a workshop in June, and six monthly meetings thereafter.

This agreement is signed by

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for DOF date

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for AIT date

Appendix 1

Budget

Over the remaining 14 months of Phase 1 the following money is available to support efforts of the AITO to promote improved fish seed supply and performance in Northeast Thailand

US$		
Situation analysis	3200	
Research	2880	
Vehicle hire	800	
Travel		256
Field support		256
Total (US$)		7392

- An invoice needs to be sent by the AITAO to Professor Edwards at AIT (marked Attention Ms Lucia) before 5th March 1998 for the estimated expenditure for the coming 6 months.
- Expenditure should be reported to AIT in the same way as is currently used by AITAO

The revolving fund used by AITO can used for project expenditure before submission of receipts when money can be reimbursed from

Appendix 2

Interim Reporting

Report deadlines 1st March,1st June, 1st September and 1st December

Main sections should include

Progress during current quarter
- Highlights of achievement
- Progress towards outputs
- Activities during the quarter

Planned activities for the next quarter
Planned modification to project implementation (e.g. output, log frame etc)
Dissemination outputs achieved (publications, workshops, conferences, courses etc.)

Appendix 3

Detailed Work Plan

AIT Aqua Outreach manager will call a meeting to introduce the project and select co-operating institutions. Representatives will form a working group to discuss and plan activities (Jigsz to join) . DT will organise meeting as part of the research-planning meeting.

Provisional
25 June-3 July: hatchery and traders survey
1-31 July: grow-out survey
August-October: finish analysis (Nopanun and Jigsz to support)
5-6 or 16-17 November: State of the System Workshop (Danai, Supon, Dave, Jigz, Noppanun, Panthip)
December: Start research/management/monitoring activities
May 1999- finalise research and reporting
Proposal preparation- Jan 1999-April 1999

Objectives of State of the System Workshop

A major output of the situation appraisal is the bringing together of information collected from different stakeholders and its presentation in a simple clear format, allowing feedback before finalisation. The workshop will also allow stakeholders to participate in the prioritization of future research. Sessions in the workshop will allow checking, modification, correction, addition of information collected during the survey phase and the development of a draft SoS report in Thai and English

Participants would include the major stakeholders *i.e.* hatchery operators, traders grow-out farmers(subsistence and commercial)

Steps in Workshop

- Presentation by facilitator and representative
- Feedback by each group on other groups info
- Identification of inconsistencies and points of disagreement
- Identification of research/management priorities
- Draft SoS report by Editorial team: Panthip, Jigz
- Review by SOS team including Supon

The SoS report would be finalised, hopefully as a DOF policy document.
Revised 11th May 1999

MEMORANDUM OF UNDERSTANDING

Fish Seed Project - Laos

Introduction

- This document outlines how a research project funded by the Department of International Development, UK will be organized between the Agricultural and Aquatic Systems Programme, AIT and the Regional Development Committee (RDC) for Livestock and Fisheries Development in Southern Laos.

- The project aims to improve fish seed supply and performance in smallholder aquaculture systems in the region.

- The project is also working with institutions in Northern and Southern Vietnam, Thailand and Bangladesh. Full details of the project can be found in Project memorandum R7052 'Improving freshwater fish seed supply and performance in smallholder aquaculture systems in Asia'

The Problem

Currently, farmers in rural Laos often cannot obtain fish seed at all, or only fish seed of poor quality. This is preventing farmers growing fish successfully.

The project aims to

- find out what is causing the problems of fish seed supply and quality in three Provinces of Southern Lao PDR (Savannakhet, Kammouane, Champasak) and to develop simple methods to overcome them.
- to complement on-going or planned activities funded by the RDC to improve quality fish seed supply to farmers.

Time frame

There will be 3 phases of the project

- Phase 1 Initial research preparation and planning 15th November-30th June 1998
- Phase 2 Problem identification and initial trials 1st July 1998-31st March 1999
- Phase 3 Development of methods for increasing availability of improved fish seed 1st April 1999-31st March 2001. Before Phase 3 is funded, progress must have been made towards solving the problem.

Outputs

- An improved understanding of the major constraints to the supply of quality freshwater fish seed to small scale farmers in southern Lao PDR
- Practical strategies to increase the number of quality fish seed produced in southern Lao PDR.
- Simple methods for monitoring fish seed quality that can be used at the hatchery or pond-side.

Contributions of funds and resources

Both the AIT and RDC will provide funds and resources for project activities.

The total allocation in US$ by each party is shown in the table below

	Nov. 1997-July 1998	July 1998-Mar 1999
Total AIT commitment Total RDC commitment	2480	4912
Total commitment		

For details see Appendix 1

Terms of Reference

Staff from the project

- The principle investigators are responsible for administrative issues and project implementation. They will also facilitate inputs from other organizations or individuals during the project as required.
- The project research specialist will facilitate project activities, assist project implementation and coordinate technical activities (Appendix 2)..

Staff from the RDC

- The project co-ordinator is responsible for project coordination in Lao PDR and will be the main contact person with project staff for agreed activities. He will be responsible for administration and organization of activities and financial and technical reporting to the RDC.

- The RDC co-ordinator will ensure that office and workshop space, communication facilities, computing support and in-country transportation are available to AIT staff. He will also make sure that visa applications are processed and invoices sent to AIT.

- The AIT Aqua Outreach Programme-Lao PDR project manager, through the RDC Support group will facilitate
  - co-ordination between the collaborators

- the RDC in reporting requirements
- the RDC in financial management

for the project

Activities

Detailed activities for Phase 2 are given in Appendix 3 . Details of later activities will be planned in a workshop in January 1999, and six monthly meetings thereafter.

Project monitoring

Progress of the collaborative activities will be monitored through output to purpose objectively verifiable indicators (OVI's), derived from the attached log framework. This is given in Appendix 4.

This memorandum is signed by

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for RDC date

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for AIT date

Appendix 1

Budget

Over the remaining 14 months of Phase 1 and 2, the following money is available to support efforts of the RDC to promote improved fish seed supply and performance in Southern Laos.
RDC will send standard headings

	US$
Research	2880
Small equipment	
Consumables	
Vehicle hire	800
Travel	256
Field support	256
Total	7392

- An invoice needs to be sent by the RDC to Professor Edwards at AIT (marked Attention Ms Lucia) on a quarterly basis for estimated expenditure for the coming 3 months.
- AIT is changing its financial management with the Outreach Project.
- It is hoped that funds for this project can also be forwarded to a dollar account based on a statement of actual expenditure sent to AIT.
- All bills should be kept for local auditing of accounts.
- Financial expenditure can be reported on a quarterly basis to AIT with the post codes currently used by the RDC.
- Money will be deposited in the bank, Savannakhet, Lao PDR according to current AIT transfer procedures.

Bank details are as follows

Bank account Name:	Nicholas Innes-Taylor
Bank account number:	01.4547000.00004
Currency account:	Dollars
Type of account:	Deposit
Seriel Number:	015302

Appendix 2

Interim Reporting
Report deadlines 1st March,1st June, 1st September and 1st December

Main sections should include

Progress during current quarter
- Highlights of achievement
- Progress towards outputs
- Activities during the quarter

Planned activities for the next quarter
Planned modification to project implementation (e.g. output, log frame etc)
Dissemination outputs achieved (publications, workshops, conferences, courses etc.)

Appendix 3

Detailed Work Plan

There will be main activities in Phase 3

Activity 1
Quality testing trial in two districts of Savannakhet Province
-Orientation of District staff and farmers in management of seed quality trials

Activity 2
Co-ordination of silver barb hatchery data analysis and presentation

Activity 3
Production and dissemination of regional seed quality perspectives in English and Lao.

Activity 4
Participation in annual RDC Provincial hatchery meeting and planning for year 2

Activity 5
- Research agenda and activities agreed for 2000-2001

Activity 6

Revised

Appendix 4

	OVI	Means of Verification
Purpose Freshwater fish production in three Southern provinces of the Lao PDR sustained and developed through improved approaches to small-holder seed production	By March 2002, the DLF/RDC will have facilitated the development of farmer-based operations producing fish seed for local distribution in 2 of the last 3 years in at least 50% of districts.	DLF records, district office record books, Outreach monitoring data, district staff reports
Outputs • An improved understanding of the major constraints to the supply of quality freshwater fish seed to small scale farmers in southern Lao PDR	• By March 1999, an overview of fish seed production and supply produced and submitted for publication in English and Lao • By March 2000, operating strategy in each of the Provincial hatcheries changed to more effectively service the needs of farmers in the Province • By March 2001, a published strategy in 50% of all Districts for maintaining and increasing quality fish seed supply to farmers • By December 1999, appropriate seed supply strategies identified for three districts in each province	draft article RDC reports, Provisional hatchery records, Outreach monitoring data District records, reports of RDC activity Co-ordinators, Outreach monitoring data DLF and District reports District office reports, RDC training modules, district office record books
• Practical strategies to increase the number of quality fish seed produced in southern Lao PDR. • Simple methods for monitoring fish seed quality that can be used at the hatchery or pond-side.	• By March 2000, at least 3 critical management points affecting seed quality in farmer-managed seed production systems identified, and solutions incorporated in training materials and implemented at the village level • By March 2002, refined methodologies for quality seed production and distribution promoted by at least 2 other agencies • By March 1999, comparable data collection at Provincial hatcheries adopted • By March 1999, monitoring system for seed quality at Provincial hatcheries agreed By March 2002, District-level monitoring of fish seed quality undertaken regularly	Project reports, Outreach monitoring data RDC and Provincial hatchery reports, Outreach monitoring data RDC and Provincial hatchery reports, Outreach monitoring data District reports, RDC activity Co-ordinators reports

MEMORANDUM OF UNDERSTANDING

Fish Seed Project – Northern Vietnam

Introduction

- This document outlines how a research project funded by the Department of International Development, UK will be organized between the Aquaculture and Aquatic Resource Management Programme, AIT and the Research Institute for Aquaculture Number 1, Bac Ninh Province, Vietnam.
- The project aims to assess current freshwater fish seed quality and to develop approaches to monitor and improve it.
- The project is also working with institutions in Southern Vietnam, Thailand, Lao PDR and Bangladesh.

Full details of the project can be found in Project memorandum R7052 'Improving freshwater fish seed supply and performance in smallholder aquaculture systems in Asia'

The Problem

Currently, many farmers in northern Vietnam are using fish seed of variable quality, preventing them from raising fish successfully

The project aims to

- find out what is causing the problems of poor fish seed quality in northern Vietnam and to develop simple methods to overcome them.
- to complement on-going or planned activities funded under the AIT Aqua Outreach Project to improve the supply and quality of fish seed to farmers

Time frame

There will be 2 phases of the project

- Phase 1 Problem identification and initial trials 15th November- 31st March 1999
- Phase 2 Development of methods for increasing availability of improved fish seed 1st April 1999-31st March 2001.

Phase 2 was funded based on the progress achieved towards solving the problem during Phase 1

Outputs

- An improved understanding of the major constraints to the supply of quality freshwater fish seed to small scale farmers in northern Vietnam
- Practical strategies to increase the number of quality fish seed produced in northern Vietnam
- Simple methods for monitoring fish seed quality that can be used at the hatchery or pond-side.

Contributions of funds and resources

Both RIA Number 1 and AIT will provide funds and resources for project activities.

The total allocation in US$ by each party is shown in the table below

	Nov. 1997-March 1999	April1999-Mar 2001
Total AIT commitment Total RIA Number 1 commitment	7392	15259
Total commitment		

For details see Appendix 1

Roles and Responsibilities

Staff from the project

- Professor Peter Edwards is based at AIT and is responsible for administrative issues.
- Dr David Little is responsible for project implementation. He will make at least three visits to the project during the phase 1 and 2 from the UK where he is based. .
- Mr Angus McNiven, a project Research Associate. He will facilitate project activities, assist project implementation and coordinate technical activities (Appendix 2). He will be based at AIT from late August 1999 and will visit northern Vietnam at least twice annually spending a minimum of 2 weeks on each occasion. He is registered as an external PhD candidate at the Institute of Aquaculture, U. of Stirling UK. He will develop a proposal for his dissertation before February 2000 which will be circulated for comments and approval from RIA Number 1.

Staff from the RIA Number 1

- Dr Pham Anh Tuan is responsible for project coordination in northern Vietnam.
- He will be the main contact person with project staff for agreed activities. He will be responsible for administration and organisation of activities and financial and technical reporting AIT. He will ensure that office and

workshop space, communication facilities, computing support and in-country transportation are available to AIT staff. He will also make sure that visa applications are processed and invoices sent to AIT.

- Mr Nguyen Huu Ninh , will be responsible for co-ordination and implementation of research activities to agreed specifications and deadlines.
- Mr Tran Trong Tri and Mr Ngo Van Chien will be responsible for field activities.

Activities

Detailed activities for Phase 2 are given in Appendix 3. Details of the status of activities completed and in progress are given in Appendix 4 .The workplan will be discussed and revised every 6 months.

This memorandum is signed by

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for RIA 1 date

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for AIT date

Appendix 1

Budget

The following money is available to support efforts of the RIA 1 to promote improved fish seed supply and performance in northern Vietnam

	US$
Equipment	1920
Personnel	8704
Travel	1760
Publications/ training	2240
Contingency	635
Total	15259

- An invoice needs to be sent by RIA 1 to Professor Edwards at AIT (marked Attention Ms Lucia) on a quarterly basis for estimated expenditure for the coming 3 months.
- Financial expenditure can be reported on a quarterly basis to AIT with the post codes currently used by the Outreach project
- Money will be deposited to RIA 1 according to current AIT transfer procedures.

Appendix 2

Reporting

In order to ensure the smooth coordination of activities it is agreed that email will be used on a regular basis. Any correspondence should be coded to allow tracking of lost messages ie. PAT-AM-1 (Tuan sending to Angus first message). All messages should be cc'd to both Tuan and Dave.

In an email message, points should be numbered and responded to.

Interim reporting

AIT has to make quarterly reports to DFID so inputs will be required about your activities one week in advance of the following dates
Report deadlines 1st March,1st June, 1st September and 1st December

Main sections should include

Progress during current quarter
Highlights of achievement

Progress towards outputs
Activities during the quarter
Planned activities for the next quarter
Planned modification to project implementation (e.g. output, log frame etc)
Dissemination outputs achieved (publications, workshops, conferences, courses etc.)

Appendix 3
Detailed Work Plan

Activities 1999

There will be 3 main activities between June –December 1999

Activity 1
Finalise State of the System report

Activity 2
Analyse and report TRIALS 1-4. Draft of NVIET TRIAL 1 submitted for publication

Activity 3
Design and implement NVIET TRIAL 5.

Hypothesis
'Quality of grass and silver carp fish seed is from hatcheries in the Red River Delta is poor and the quality from broodfish used in hatcheries in the mountain Provinces is better'

- Identify breeding fish resources in mountain and Delta provinces of silver and grass carp
- Transport to RIA number 1 before end of October appropriate numbers, tag and culture in the same pond.(A minimum of 10 male and 10 female from a minimum of 6 hatcheries (3 Delta and 3 mountain) hatcheries)
- Consult with Graham Mair about design and implementation

Appendix 4

Status of research trials carried out In Northern Vietnam

Location	Trial number	Trial description	Status	Notes
NVIETNAM	NVIET1	On-farm comparison of seed quality form mrigal induced using pituitary glands and Linpe technique	Trial complete, analysis in progress	Tuan to complete analysis for inclusion in Qreport by 27/6/99
NVIETNAM	NVIET 2	Comparison of grass carp hatchling quality from State and private hatcheries	Trial complete, analysis in progress	Tuan to complete analysis for inclusion in Qreport by 27/6/99
NVIETNAM	NVIET 3	Comparison of mrigal (April) hatchling quality from State and private hatcheries	In progress	Will continue to include grow-out phase of 6 months
NVIETNAM	NVIET 4	Comparison of mrigal (May) hatchling quality from State and private hatcheries	In progress	Will continue to include grow-out phase of 6 months
				Angus to facilitate final analysis and reporting December 1999.Planning for year 2000 trials