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Project title

Integration of aquaculture into the farming systems of the eastern plateau of India

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NRSP Production System	*Date*
High Potential System	31 October 2000

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Glossary

BtOR	Back to Office Report
CIFA	Central Institute for Freshwater Aquaculture
CO	Community Organiser
DFID	Department for International Development (UK Government)
DoF	Department of Fisheries
EIRFP	Eastern India Rainfed Farming Project
FO	Field Officer
FS	Field Specialist
GDP	Gross Domestic Product
GNP	Gross National Product
GoI	Government of India
GVT	Gramin Vikas Trust
Hapa-based	Relates to the production of fish in fine-mesh net structures fixed into larger water bodies.
HP	High Potential
ICAR	India Council of Agriculture Research
IMC	Indian Major Carp (Rohu, Catla, Mrigal)
IoA	Institute of Aquaculture
KRIBP-E	Kribhco Indo-British Rainfed Farming Project (East) (former name of EIRFP)
MoU	Memorandum of Understanding
MPR	Monthly Progress Report
NGO	Non-Government Organisation
NRSP	Natural Resources Systems Programme
Panchayat	Community-level government
SHQ	State headquaters
SRI	Society for Rural Industrialisation
WIRFP	Western India Rainfed Farming Project

Table of Contents

List of Figures

List of Tables

1. Executive Summary

Title: Integration of Aquaculture into the Farming Systems in the Eastern Plateau of India

It was hypothesised that the development and uptake of recommendations for the integration of fish into smallholder rain-fed farming systems would benefit from farmers participating in the process. Preliminary discussions were held with: the Eastern India Rainfed Farming Project (EIRFP), the Gramin Vikas Trust, the supporting team of consultants recruited by the Centre for Development Studies, Swansea and the Central Institute for Freshwater Aquaculture, Bhubaneswar. The Institute of Aquaculture (loA), University of Stirling in Scotland, subsequently proposed a research project, which DFID funded in November 1996 with inputs from the EIRFP The outputs of the project would be the identification of researchable constraints, aquaculture opportunities and a process for delivering research support to farmers in rain-fed environments.

The eastern plateau region of India is characterised by a short rainy season; limited water storage capacity and a prolonged dry season. Farming systems provide only one rice crop per year. Aquaculture is limited to extensive stocking of fry, mainly in perennial water bodies, with no management practised. The rural population of the plateau region consists mainly of Scheduled Caste and Scheduled Tribes, who can be categorised as Deficient, Sufficient or Surplus.

Aquaculture, identified as a High Potential System, was included for the first time in 1996, in the program of farming systems technology development (EIRFP), which contains cropping systems, agroforestry, soil and water conservation, irrigation, livestock management, other on and off-farm activities. Because of the inappropriateness of the aquaculture messages extended to farmers in the area, where aquaculture is extended at all, it was felt necessary to research aquaculture methods suitable for the resource-poor farmers of the rain-fed plateau region.

In conjunction with farmers, the research team, composed of staff from the loA and GVT, identified key research requirements within the rain-fed area of the plateau region of eastern India (southern Bihar, western West Bengal and northern Orissa). Through training of project staff at CIFA and farmer group leaders (jankars) at the local NGO, the Society for Rural Industrialisation (SRI), the capacity for research, development and uptake of appropriate aquaculture was enhanced. Trials with small groups within communities demonstrated strong interest in aquaculture by farmers in the project area, especially in the use of under-utilised community seasonal ponds.

The adoption of group-based aquaculture in the project area proved significant, with 57% of all farm groups within the EIRFP conducting managed aquaculture by the end of the project. The concept of 'staged' fish production i.e. the production of various stages of fish locally (hatchlings, fry, fingerlings) apart from food fish was also trialed with groups. This demonstrated that decentralised fish seed production was possible and could meet a variety of needs. It also suggested that linkages with current private sector seed networks, could be strengthened to benefit a wider range of stakeholders and improve the sustainability of the approach.

New varieties of fish were also evaluated in community seasonal ponds and were demonstrated to complement current strains and species.

The project also addressed issues of dissemination, having proposed and tested several costed techniques, including bulletins and drama. The development of some of these would compliment the organic spread of the aquaculture message already observed in villages, especially where farmers produce intermediate stages of fish.

2. Background

Estimates place India's population between 1000 million and 1100 million, growing annually at 2.0%. With *per capita* GNP at around US$ 300, India has nearly 30% of the population of the world's low-income countries and 40% of the world's absolute poor. The Eastern Plateau region, comprising the rainfed areas of Orissa, Bihar and West Bengal, is characterised by poverty and inequality, land alienation and seasonal migration. The scheduled castes and tribes targeted by the project are amongst the poorest communities in India.

Agriculture and associated sub-sectors account for nearly one third of GDP and occupy two thirds of the workforce. India's demand for food is expected to rise two-and-a-half fold in 30-40 years. Increased output from large-scale irrigated areas will not meet India's food needs and rain-fed farming systems (70% of India's agriculture) which currently produce little more than 40 years ago, will have to contribute significantly.

Two bilateral development projects have been established by DFID and GoI, in the western states of Gujarat, Rajasthan and Madhya Pradesh (WIRFP) in the early 1990s, and the eastern states of Bihar, Orissa and West Bengal (EIRFP) in the mid 1990s. Aquaculture was included for the first time in 1996, in a program of farming systems technology development (EIRFP), which contained cropping systems, agroforestry, soil and water conservation, irrigation, livestock management, other on and off-farm activities.

In many parts of rain-fed Bihar, Orissa and West Bengal, where fish forms an important part of the diet, perennial watercourses, springs and/or small-scale surface or groundwater (shallow tube-well) irrigation can be identified as High Potential Systems, which represent opportunities for enhancing fish production in such rain-fed areas. The target population has non-exclusive access to both perennial and seasonal surface- and groundwater sources. Typically a village of 50 families would contain one communal, perennial pond, a communal well (generally perennial) and a few seasonal ponds - again mostly communal, although some are individually owned, but not utilised.

Support for aquaculture in India comes from a number of sources. These include: the national and local line agencies; the Departments of Fisheries (DoF)[1]; aquaculture support schemes[2]; NGO's and the research and development efforts of the Indian Council for Agriculture Research (ICAR) fisheries institutes; and the research of a number of academic departments.

The aquaculture research needs of smallholder farmers in rain-fed areas of India have not yet been adequately addressed by national research institutions. There is currently little evidence of uptake or farmer participation in the development and execution of research towards intensification and diversification of production.

The Government of India (GoI) and the state Governments are aware of the potential of aquaculture to support the livelihoods of poor people through improved food security and income generation[3]. In addition, they are aware of the need to empower local communities, including disadvantaged groups such as Scheduled Tribes, to manage their own affairs and attain the ownership and sustainable management of their natural resources including water and fish resources[4].

However, there are important constraints to research, extension and development of aquaculture for poor farm families. Almost all national research and development support available for aquaculture promotes large-scale capital-intensive systems, which require high levels of inputs and aim to maximise production. Both DoF and NGO aquaculture development initiatives tend to make use of CIFA research conducted on-station, which is dependent on

1 The DoF has Block Extension Officers in all districts where they consider there is aquaculture development potential. The extension effort is therefore geographically very variable, though specifically targeted. The potential for DoF extension support is likely to be limited because funding is very constrained

2 The Federal Government, in line with its policy of positive discrimination toward Scheduled Castes and its interest in the potential for aquaculture development, has set up across the country a series of Fish Farm Development Agencies (FFDAs). The process began in selected districts in 1970 the FFDA remit being the intensive development of inland fish farming.

3 The Eighth Five Year Development Plan (1990-94) paid particular attention the to rain-fed farming systems, especially their accelerated growth in the eastern areas The plan called for a systems approach and the diversification and intensification of smallholder agriculture, including aquaculture and specifically initiatives to expand and intensify freshwater aquaculture.

4 The 73rd Constitutional Amendment (1992) re-introduced the ancient concept of the Gram Sabha – a combined assemble of all voters in a village and the direct election of a representative to a Gram Panchayat – an executive body with powers many matters affecting lives and livelihoods of villagers. This was extended to tribal and scheduled areas in 1996 when parliament extended the 73rd Amendment to Tribal areas (Act 40/96). This gave certain additional powers to Gram Sahbas (not Panchayats) in Tribal areas including executive rights over natural resources.

off-farm inputs and access to perennial water. The recommendations developed have largely ignored the multipurpose nature of most surface water bodies and concentrated on systems excluding other water uses and users.

The limited support for aquaculture initiatives appropriate to resource-poor farmers can be understood by reviewing the institutional context of the Indian Council for Agricultural Research (ICAR) institutes, university departments and the DoF. Problems with the process of developing and disseminating aquaculture technological innovation in India[5], have been widely recognised since the early 1990s, farmers do not achieve expected yields and there is little consideration given to farmers circumstances, their socio-economic context and resource-use priorities.

DoF initiatives such as preferential leasing of Panchayat water bodies to tribals and the provision of 50 - 100% subsidies for prescribed aquaculture and fisheries interventions respectively are attempts to support aquaculture development for poor groups. However, farmers can find they have little choice in the aquaculture system they employ[6], little control over the supply of inputs, the date of harvest, the nature of loan or repayment schedule. Many have no previous knowledge or experience of fish production and receive negligible extension support. In an attempt to address these issues, a 4-year British Government Department for International Development-funded Aquaculture Research project, co-ordinated by the Aquaculture Systems Group, Institute of Aquaculture, University of Stirling was implemented. The project aimed to select, test and develop integrated aquaculture innovations relevant to local needs and conditions in participation with farmers in farm-based trials integrated with on-station research and contextual information collection to increase systems commodities through the optimisation of inputs and outputs. The project was carried out in close collaboration with the DFID-supported Eastern India Rain-fed Farming Project (EIRFP), implemented by the Gramin Vikas Trust (Headquarters Delhi), which is supported by a team of consultants recruited by the Centre for Development Studies (Swansea). The project was implemented in association with the Central Institute for Freshwater Aquaculture (CIFA), Bhubaneswar, Orissa and the Society for Rural Industrialisation (SRI), Ranchi, Jharkhand.

3. Project Purpose

Aquaculture was not practised locally at project inception, although there was high potential for its sustainable development. The purpose of the project was to develop and promote strategies for the introduction of improved germplasm/new varieties/stock. It was intended to introduce new varieties to the market place and provide a greater range of traded and consumed crop types by capacity building within poor farming communities.

4. Outputs

The first objective of this project was to understand and priorities the key researchable constraint to aquaculture integration in the plateau region of eastern India. By involving all parties in this initial phase, it was hoped that the research would be correctly focused and that everyone would have a level of ownership from the outset. This appears to have been the case, with participating farmers and NGOs actively promoting the fruitful outcomes of the research.

Once the constraints had been understood, the opportunities to integrate aquaculture with farming systems which have additional water resources had to be identified. The utilisation of seasonal ponds to produce intermediate stages of traditional fish species and table-size examples of species new to the area has been successfully taken up by farmers both from within the project and from outside.

The development and promotion of strategies for the appropriate integration of aquaculture into the farming systems in India's eastern plateau proved successful. Gramin Vikas Trust is promoting strategies for the appropriate integration of aquaculture, developed in several villages, to all suitable villages across its project area. This is achieved through farmer-to-farmer extension, specialist visits, bulletins and drama, all developed and tested by this project.

Table 1. Outputs of the projects, showing appropriate constraints for each stage.

Output	Activity	Constraints

[5] Appaji (1991) identified, in a study carried out in West Bengal, the gap between farmers aquaculture knowledge and the package of practices of composite fish culture technology developed by aquaculture scientists. Sivasankar *et al.* (1991) identified a yield gap of 39% between on-station and on-farm yields can be identified in inland fish culture. Suresh and Selvaraj (1991) suggest lack of finance is a major cause for low levels of production in aquaculture. The level of feeding and fertilising is often less than that recommended, relating to 60% reduction of expected yields.

[6] This is determined by research that supports high input aquaculture that is aimed at maximising production carried out at ICAR institutes and extended via the DoF, the adoption of which is a pre-requisite to receiving grant aid and bank loans.

		Operational	Underlying
1. Key researchable constraint to aquaculture integration understood and prioritised.	Researchable constraints were agreed upon and prioritised following investigations prior to a planning workshop held in March 1998, discussions at the workshop and with farmer groups.		
2. Opportunities to integrate aquaculture with farming systems which have additional water resources identified.	a. Opportunities for the integration of aquaculture into farming systems were identified, especially in seasonal water bodies where conditions permitted. Given that each village has at least one seasonal water body that is not currently under significant user pressure, aquaculture should be possible, even if in a limited form.	a. For aquaculture to be possible, water quality, depth and the length of time water remains in the water body needs to be considered. The latter is often over-estimated by farmers.	
	b. Given appropriate access and availability water, the species cultured should be either fast growing or marketable at intermediate sizes. To fulfil the first of these criteria trials with Japanese puti (*Puntius gonionotus*) and common carp (*Cyprinus carpio*) were undertaken. As farmers were strongly interested in Indian Major carp species, it was decided to trial staged production[7] of the species rohu, catla and mrigal. Staged production would allow farmers to practise aquaculture whilst providing rapid turn over and limited capital outlay.	b. The view of farmers that IMC are more valuable reduced their willingness to try new species, although a sufficient number of farmers did come forward to enable trials to proceed as planned.	b. Access to and ownership of water bodies can be contested, especially once they are shown to be productive. Community water bodies are only leased to groups, not individuals.
	c. New species being cultured in the project area include *Puntius gonionotus* and *Cyprinus carpio*. Economic analysis of the first trials showed that growth of Japanese puti provided the greatest economic returns and farmers appreciated the taste of the new fish. Common carp culture was marginally successful. Staged production of IMC proved to be the most difficult to make a profit. The low return within the experimental period is understandable given that all of these farmers have not cultured fish before. However because of their perception of IMC as a valuable fish they continued to produce stages of these carp even without project support. See Annex C.ix.	c. Limited acceptability of the new species in the market place – low demand. Limited market currently for some of the intermediate stages of IMC – farmers unable to sell what they have produced.	c. Farmers do not have a tradition of fish culture and maximum possible returns cannot be expected within the first years. Because of this limited experience, non-project farmers do not have the benefit of understanding that larger seed are usually hardier, hence limited market for the larger seed at present.
	d. The following season farmers were offered technical assistance but not free inputs, to allow analysis of uptake and adaptation. About fifty percent of the groups produced a similar amount of fish using similar techniques to the previous year. Those that did not cited	d. Late rainfall meant that farmers did not trial early hatchling to fry production.	d. Limited capacity in the private fry networks to supply hatchlings and fry at the right time and of the right quality.

[7] Staged production is the production of intermediate stages of fish species, f or example producing fingerlings from fry, rather than table sized fish from fry (the latter of which would require water for a longer period of time than it is available in seasonal ponds). This enables seasonal waterbodies to be used for fish production and provides a return on investment over a shorter period of time. See Table 3 for further explanation.

	difficulties in the timely procurement of seed as the main factor in their change of culture. All farmers did however, utilise the seasonal ponds for some form of aquaculture. It was also reported that villagers from outside the groups had also taken up fish culture in additional water bodies. See Annex C.ix.		
3. Strategies for the appropriate integration of aquaculture into the farming systems in India's eastern plateau developed and promoted	a. All EIRFP aquaculture staff trained in the integration of aquaculture at the earliest possible time in the project. Jankars from the project groups have also been trained within both the aquaculture research project and the development project. b. Before the inception of the project no aquaculture was practised in the project area (activities in this direction were limited to the stocking of fry, but no management of the system took place). Now GVT reports that managed aquaculture is practised in 120 perennial ponds and 12 seasonal ponds. This means that aquaculture has been established in 57% of the 231 villages in which the development project operates. The number of seasonal ponds in use is expected to increase following recommendations from this research, although their abundance is lower in Bihar and Orissa than in West Bengal. See Annex F.i. c. Recommendations for the integration of aquaculture in the EIRFP project area submitted to GVT. d. Issues of extension addressed and costed with key extension agents and services within the project area. See Annex A.vii. e. Farmers and other extension agencies appreciated the aquaculture bulletin and there was evidence that articles featuring farmers' own problems and solutions were particularly liked. 'Rural Aquaculture' was published jointly by this project and EIRFP and has now been taken over by the latter. See Annex F.ii-iii. f. The use of street play and video could be a useful tool for dissemination of the message about the potential for aquaculture, but will require more research. See Annex F.iv.	d. Production of the video in different languages by dubbing have proved difficult for the local group involved, who, although they have significant experience in producing drama, have limited experience in dubbing videos. It would therefore be recommended to either use professional dubbing studios or to produce the drama itself in different languages that could be recorded separately	There are villages where aquaculture cannot be practised because the number of water bodies is very limited. In these villages in particular, access to, and use of, the water body, is often constrained. This occurs especially in the dry season, when limited surface water means that any water body is open to everyone and hence addition of feed and fertiliser and security of stock are problematic. d. Production of diverse extension materials, e.g. videos, is limited in the project area, especially by single organisations, giving rise to the need for further collaboration and/or capacity building.

Table 2. Livelihood Impacts of Project Activities on Capital Assets - as indicators of potential wider impacts of the project's research

Asset	Impact	Concerns
Natural	• Improved productivity of water use in rainfed environments where	• Stocking and managing

	surface water has been sub-optimally used to produce food.	water bodies can either increase or decrease production of natural fish and other aquatic products[1].
Social	• Establishment of farmer groups enabled people to discuss issues, concerning issues relating to aquaculture and more generally in the village. • One group has built a temple for the village with funds from aquaculture. • Where farmers sell fry, they have developed/strengthened their own networks and increased their entrepreneurial/business skills.	• Poor people might be excluded from groups, water bodies and benefits of aquaculture
Human	• Training in aquaculture has enabled farmers to learn specific technical skills • Improved analytical skills developed by farmers through the research-development process initiated by the project • Enhanced business skills that have enhanced other aspects of the livelihood system.	
Physical	• Improved physical condition, water retention of water bodies	
Financial	• Through savings of group funds, farmer groups have been able to give loans to fellow villagers. • Group formation increases farmer access to government assistance schemes.	

[1]This potential aspect will be researched in a new research project (R7917) funded by ARP and FMRP.

5. Research Activities

The Project Design

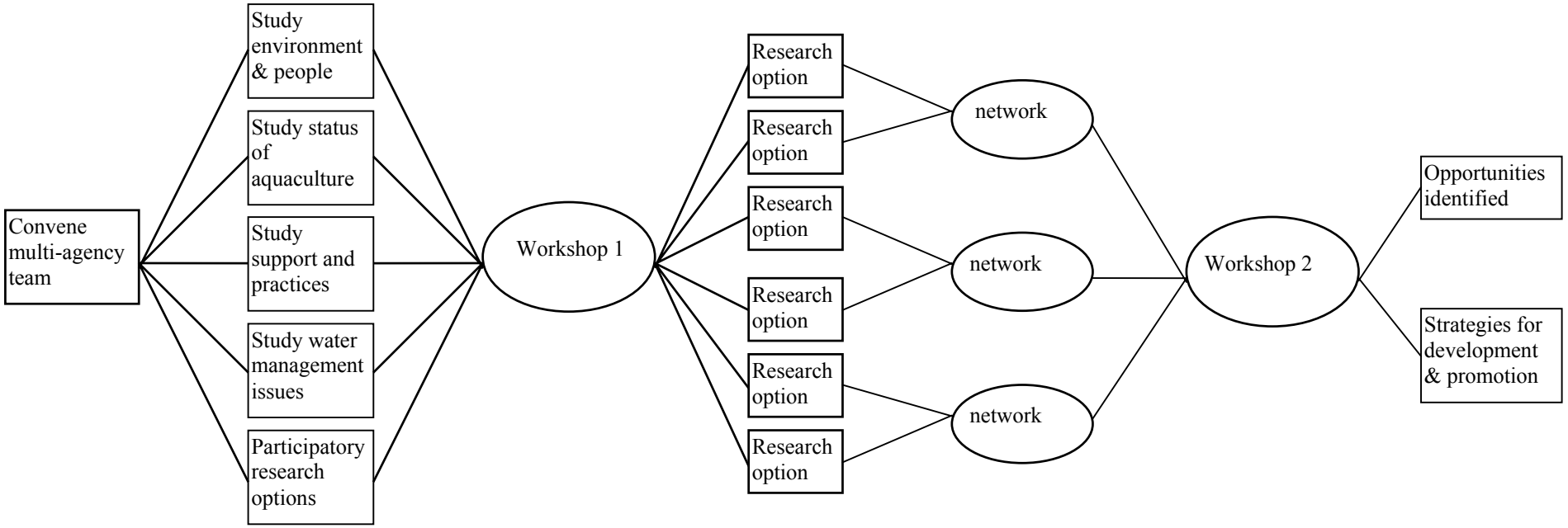
The project design (see Figure 1) demonstrates how the participatory approach to research was executed and where all stakeholders were involved. This is a valuable output that can be used to plan future projects. The involvement of all partners in all stages of the process increases the relevance of the research and should increase uptake of the project findings. It was hypothesised that strengthening networks would be invaluable to sustain research projects, e.g. informal farmer networks provided an important market for the intermediate stages of fish (fry and fingerlings) produced as a result of recommendations from the research (see annex C.ix and F.v). Because of operational issues, stage seven has occurred without stage six ever having formally taken place. However it should be considered that a strong relationship with the main partners through continuous informal discussion on the progress and development of the research means that many of the final recommendations have already been adopted within the life of the project. It is now planned that Stage 6 takes place early in 2001 to coordinate with a revised scheduled EIRFP meeting. It will also provide an opportunity to discuss outstanding research issues.

Figure 2 highlights the irrelevance of the existing aquaculture extension message for farmers in the rain-fed plateau region, who have limited perennial water supplies. This graphic was produced in the early stages of the project and shows the original thoughts for correcting these limitations for farmers who's main access is to seasonal ponds.

Table 3 highlights potential benefits and constraints to the system proposed in Figure 2. Although farmers will be more independent of outside fry producers, there will be labour conflicts, especially at the start of the rice season. Farmers identified poor quality seed from the traders as their main concern.

Following Table 3, each of the specific research activities is explained in more detail.

Figure 1. PROJECT DESIGN



Stage 1:	Stage 2:	Stage 3:	Stage 4:	Stage 5:	Stage 6:	Stage 7:
Scope project Preparation Concept Procedure	Site studies Knowledge reviews Management visits	Stakeholder analysis Problem identification Trial planning framework	Group formation Problem identification Trial planning & implementation Monitoring	Network formation Social, technical & economic evaluation of trials and production of preliminary outputs by farmers & other specialists Iteration (stage4-5)	Workshop, preliminary outputs shared with stakeholders Analyse applicability of products and process to a broader audience	Produce outputs

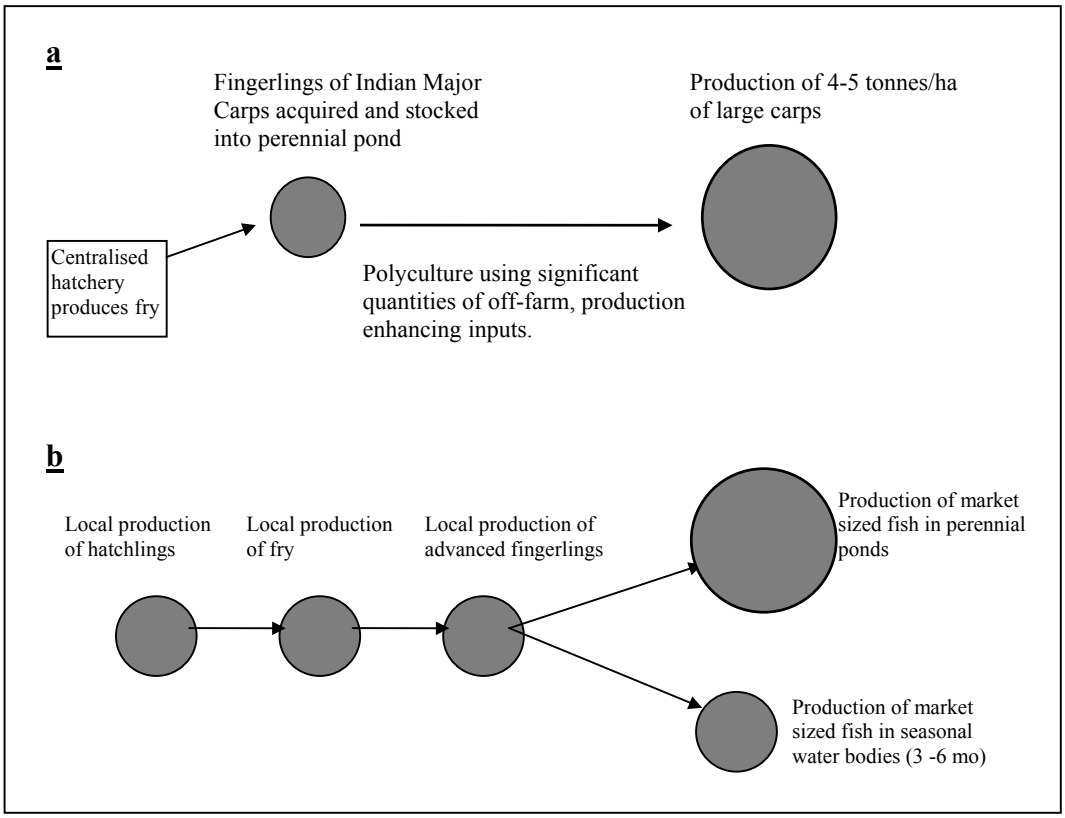


Figure 2. (a) Traditionally extended aquaculture system – as developed by CIFA. (b) Possible scenario for the use of seasonal water bodies in rainfed areas.

Table 3. Opportunities and constraints for each of the stages of production proposed.

Production stage	Opportunities	Constraints
Fry to table size	a. Traditionally extended composite carp culture raising fry to table size fish. Main species are Indian Major carps, which are perceived to be preferred by people. b. *Puntius gonionotus* and *Cyprinus carpio* culture from fry to table size is possible over a few months in seasonal water bodies. Reduces the risk of user-conflict, as seasonal water bodies tend not to be used for bathing and clothes/pot washing.	a. Traditionally requires significant inputs. Growth takes around one year, hence perennial water body required. User conflicts where perennial water bodies are used for washing and other activities. b. Requires acceptance of new fish species by consumers and timely availability of seed.
Breeding (hatchling production)	Local production of hatchlings would decrease dependence on outside supplies, which farmers identified as poor quality and not available at the right time.	Good quality perennial water required in dry season. Broodstock management and breeding are highly skilled tasks.
Hatchling to fry	Local production to overcome supply problems. Low investment, rapid returns.	For timely production, requires pre-kharif water supply. Pumping costs. Requires timely and local supply of hatchlings
Fry to fingerling	Local production to overcome supply problems. Low investment, rapid returns. Early use of seasonal water bodies.	Significant labour requirements that could clash with rice planting activities. For full benefit, requires predictable, timely rainfall. Requires timely and local supply of fry.
Fry to advanced fingerling	Seasonal ponds can be used for the production of advanced fingerlings from fry produced once the rainy season starts. Over-wintering of these fish will require a	Currently limited market for advanced fingerlings at the end of the season because of the need to over-winter in perennial water bodies.

	perennial water body, but seasonal water bodies can be used again the following season to produce large fish relatively early in the season when fewer larger fish are available in the market.	
Fingerling to table size	Production of food fish from seasonal ponds.	Requires availability of fingerlings early in the season.
Advanced fingerling to table size	Production of food fish from seasonal ponds.	Requires a supply of advanced fingerlings early in the season, not currently available.

a. Participatory Needs Assessment

In collaboration with Community Organisers of the East India Rainfed Farming Project, information was collected on the livelihoods of the farmer groups at which the project was aimed. During this process farmers' ideas and priorities for aquaculture within the rest of their livelihood options were defined.

b. Planning Workshop

This workshop was convened to provide a background to the research area, clarify beneficiaries' needs and to bring together all key players in planning the research process through the life of the project. Papers were presented by aquaculture research staff, development project senior and field staff, extension researchers from Reading and Newcastle and staff from CIFA. See Annex A.ii.

c. Farmer meetings

Following the planning workshop, during which main priority areas were established, COs and research staff met with all groups in the villages that were interested in aquaculture and were identified as having the appropriate resources from the initial studies. This enabled all participants to discuss the project's plans and ideas and to understand in greater detail the needs and priorities of the farmers. See Annex B.i.

d. Trials (fry, fingerling, advanced fingerling, table)

These trials took place in farmer-researcher selected ponds in the village locations. Trials were replicated in different locations with separate groups. Because of the lack of aquaculture knowledge it was necessary to train jankars (farmer leaders) in the basics of aquaculture and for this purpose farmers were sent to SRI in Ranchi for some on-station training in fish culture techniques. At the field sites, the day to day operations were conducted and reported by the farmers, with research staff making regular visits to answer any questions from the farmers and offer advice. Originally it was hoped the farmers could conduct some basic water quality sampling and analysis, but this proved unreliable, hence researchers conducted water quality analysis during their visits. See Annex C.

e. MASC (Matsya Anusandhan Sahayak Committee – Farmer Research Support Committee) meetings

Farmers were encouraged to meet regularly in their groups to discuss the progress of their aquaculture trials. They would meet, both with and without the research staff present, and were asked to record minutes of the meeting. The timing of these meetings was planned to allow as many women to attend as often as possible. See Annex C.iv-vii.

At the end of the trials meetings were held with farmer groups in the villages to report on the outcome of their trials and comment on what they thought of the trials and their interest in continuing with fish culture.

In the second season, the groups chose their activities and were given technical support, but no inputs. After the second season further meetings took place to assess the farmers success (or failure) and their perceptions of their performance. See Annex C.ix.

f. Solar hatchery

One of the problems raised by the farmers and identified by the research team was the quality and timely availability of seed. For staged fish production this was perceived at the time as being a major constraint. Production of seed locally was identified as a mechanism to overcome this problem, but one that would need to consider water being a major limiting factor, especially in May, which is the ideal month to produce fry. At the time of planning, the research team was aware that the Government of India and a major petroleum company would be providing solar panels very cheaply to the target groups of the project. With this knowledge, and given the limitations of water, it was decided to make use of this technology to provide the power for a recirculating hatchery system. An MSc student from the Institute of Aquaculture, Stirling was accommodated and assisted by SRI staff to design, develop and test a hatchery system suitable for the carp species in question. On-station trials for this hatchery were completed successfully, but field trials were limited and later abandoned because the solar panels were eventually not available at the subsidised rate. See Annex D.iv.

g. Fry transport unit

Poor survival of fry during transportation was another problem identified by the farmers constraining local availability of fry. An MSc student from the Institute of Aquaculture, Stirling joined the research team to develop an improved fry transport system. Farmers traditionally transport fry from the market to their ponds in

large metal bowls, known as 'hundis', which are carried on the back of a bicycle. As the bicycle is a readily available, familiar and cheap means of transport the student set out to develop an improved system around the bicycle. As with the hatchery idea, it was thought that solar panels would be available at a subsidised rate, so they could be used in the system. A trailer-based system was developed that aerated the water using a pump powered, through a battery system, by the solar panel. This was preferable to dynamo power because aeration continued even when the bicycle was stationary. On-station development was completed, but the Government's change of policy on the subsidisation of the solar panels meant that field trials were never started. See Annex E.ix

h. 'Rural Aquaculture' bulletin

In order to extend relevant information about aquaculture to a wide audience, especially in areas where aquaculture is not a traditional activity, a locally-produced newsletter was developed. The format and contents of the newsletter were devised with project staff, both office and field based. Publication was in English and three local languages of the project area (Hindi, Bangla and Oriya). It was planned to field test the first issue with farmer groups before mass publication, but delays meant that the first issue was published before field testing of the draft. Farmers, field staff and institutions were asked for their opinions on the bulletin after publication of the fifth issue. Through formal farmer discussions to informal comments the bulletin has evolved. It contains information from the different project areas and highlights the achievements and relevant problems of groups within the project. Farmers are encouraged to send in questions to the aquaculture team – either directly or through their Community Officer. This focus, with appropriate photographs of the groups concerned, has raised people's interest because of the personal factor. Although a significant percentage of the local population is illiterate, groups report that they learn of the outputs of the bulletin through group readings from the jankars and other literate locals. Copies are also sent to other NGOs, local government offices, universities and research stations. See Annex F.ii-iii.

i. Street play and video

Street plays are a popular form of local entertainment. The production of a street play in which aquaculture information was interwoven within a traditional theme allowed project outcomes to reach a broader and illiterate audience. Analysis of the medium indicated that street play are a relatively expensive option, being relatively costly for the size of audience, stimulating the production of a video based on the play. A local drama group was contracted to write and perform the street play in the local dialect Nagpuri. It was planned to dub the video into Hindi, Bangla and Oriya in order to reach a larger audience. An English subtitled edition of the Hindi-dubbed version was also produced. The reaction of villagers to the play was assessed immediately after viewing and the same for a video showing with different groups. One limitation of the video over the play, despite its reduced price and easier distribution/repetition, is the need to have access to a television, video and power source, which is certainly not available in every village. See Annex F.iv.

j. Extension needs and costs survey

To further disseminate the project findings and recommendations, a comprehensive analysis of the requirements and costs for local and national agencies to adopt and disseminate the information was undertaken. Through discussion with specific organisations this survey highlighted best practices for dissemination to the different, identified user groups. See Annex A.vii.

k. Breeding trials

Farmers, having identified problems with timely procurement of quality seed wanted to spawn fish themselves. Trials were planned with two groups who had easy access to a water supply of sufficient quality. After initial on-farm training in the techniques necessary for breeding appropriate species of fish, farmers were able to plan and execute breeding in hapa-based systems. The utilisation of hapas reduced costs and operational difficulties associated with traditional and Chinese hatchery techniques. See Annex D.i-iii.

l. Fry transport survey

Working within the EIRFP meant that research was focused on the needs of the farmers and specifically addressed issues at their level. One of the biggest perceived problems from the farmers was the limited availability of fry in time and quality. To the research management team this was an interesting point because of the proximity of the project area to southern West Bengal – one of the largest fry production areas in the world. To try to establish where the weak link in the chain was, research staff undertook a survey of the fry supply system. This survey interviewed various players at all stages of the supply chain, with particular emphasis on the transport systems used to move fry from one place to another. The general feeling amongst traders was that demand in the project area was limited. This perception may go partway to explaining the lack of quality seed available at the correct time. See Annex D.vii-viii.

Please see Annex I for a further explanation of the activities under each output.

6. Contribution of Outputs

6.1 Groups Impacted

The project has conducted research with Scheduled Caste and Scheduled Tribe groups of farmers within the EIRFP area classified by the government as either Deficit, Self-sufficient or Surplus. As a result of this research groups of men and women have benefited in all categories. Working within the EIRFP villages and systems has meant that research has been conducted with groups and not individuals. The main reasons behind this are access to water bodies (both seasonal and perennial) and distribution of the added workload. Where women's groups have conducted aquaculture, assistance has had to be sought from men to harvest the fish. In mixed groups, women usually feed the fish and men harvest the fish. The crop is either distributed amongst the group, at their own discretion, or sold, with both sexes marketing the fish, although this is a male dominated activity. Although the research was conducted solely with groups, it is known that aquaculture has been adopted by individual farmers outside the EIRFP project groups. (See Annex F.v.)

The issue of access to water bodies has been solved easily where one group member has a pond (usually a seasonal pond). If no group member has a pond, one is rented from a local pond owner on a cash and/or sharecropping basis. This has the benefit of using an otherwise underutilised resource, providing employment and potential income for the group in addition to income for the pond owner. Individuals that would not have access to water bodies can obtain access by being part of a group. This approach is complementary to current local government extension policy where Panchayat (community) water bodies can be leased only to groups.

The basis of both development and research being conducted with groups does require further analysis. Group dynamics and, particularly, the role of jankars within each group need further study to ensure group structures do not isolate and undermine the poor further. It is apparent that groups involved in aquaculture have formed from many different backgrounds. For example, one female group that conducted aquaculture trials is lead by a male jankar because the GVT group requirements insist on a literate jankar and none of the women can read. In general there are practical benefits to this stipulation, but on closer inspection of this particular group, it becomes apparent that all the women in the group are actually 'employed' by the jankar. This is not an issue in itself, as employment is provided to these landless poor, but the question is raised as to who is really benefiting from the training and resource inputs of the main development project. The jankar receives the most training in any given subject and is expected to pass on this information, but the success of this technique in the long term needs further investigation.

Another, very successful group, is headed by village elders. The returns they have achieved from aquaculture are so significant that they have been able to build and maintain a temple. Within the village context this has been an appreciated benefit, but all funds are channelled in this direction and group member conducting the work see little personal benefit for their labour. Although there have been no objections voiced so far, this arrangement may not be sustainable. These examples highlight the power issues and dynamics that are developing in the groups.

There have been local increases in the availability of fish at all stages of the life cycle. More fry, fingerlings and table size food fish have been available, with most of this at a very localised level, often remaining within the village or with local villages. In time it is envisaged that this local production will outstrip local demand, at which point there may be a demand for the development of marketing channels, especially for species or stages of fish produced that are new in the local markets (e.g. Japanese puti and advanced fingerlings of IMC).

6.2 Uptake by research partners

GVT EIRFP staff have adopted and are extending the staged production message to villages beyond those involved in the research project. The adoption of other project findings is expected after this report is submitted, as GVT is waiting for final recommendations before proceeding further.

Although CIFA were intended partners in this research there were administrative problems with ICAR that constrained their direct partnership in the research. They have, however, been involved in the training of project staff. Many of GVT aquaculture staff studied at CIFA and although there is currently no measured change in CIFA's approach to research, the direct exposure of several CIFA graduates to the farmer participatory research approach could have impacts in the long term should these project staff move onto senior ICAR positions.

The Department of Fisheries offices in all project districts have been actively informed of the project's work and have acknowledged the benefits of the approach. They have also expressed their frustration at the limitations imposed on their work by policies and their lack of freedom to adopt aspects of the project methodology. Any change in policy would require action by both State and Federal governments.

6.3 Extension needs

Important local communication and extension agencies were approached to assess their perceived needs to disseminate the project's messages. Fully costed options and proposals were suggested for various forms of extension. Further research will be required as to how successful these options are should they be put into practice and to determine what other extension methods might prove effective, in terms of the number of people reached, the quality of extension message received and comparative costs. A full explanation is given in Annex A.vii.

7. Communication materials

1. Journal articles

a. peer reviewed and published

Lawrence, A., Barr, J.J.F. and Haylor, G.S. 1999. Stakeholder approaches to planning participatory research by multi-institution groups. *Agren Bulletin, Network Paper No. 91.*

b. pending publication

Felsing, M., Haylor, G.S., Dutta, G., Kumar, B. and Natarajan, N. 1999. In need of seed – An Overview of fry production trials in Purulia District, West Bengal, 1998. In preparation for the journal Aquaculture.

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Felsing, M., Haylor, G.S., Dutta, G., Kumar, B., Shweta, S., Natarajan, A., Arora, G. and Singh, V. 2000. Carp production in seasonal water bodies in Eastern India. Paper submitted to Asian Aquaculture

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2. Symposium, conference, workshop papers and posters

Aquaculture Research Project Workshop Proceedings. Research Planning Workshop Purulia March 24th - 28th

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Kumar, B. and Dutta, G. 1999a. Production of advanced fingerling of Silver barb (*Puntius gonionotus)* and Common carp (*Cyprinus carpio* var. *communis)* in Purulia Disrtict of West Bengal. *Fifth Indian Fisheries Forum, CIFA, Bhubaneswar, Orissa, India. January 2000.*

Kumar, B. and Dutta, G. 1999b. Nursery raising of Rohu (*Labeo rohita)*, Catla (*Catla catla)* and Mrigal (*Cirrhinus mrigala)* fry in Purulia district of West Bengal. *Fifth Indian Fisheries Forum, CIFA, Bhubaneswar, Orissa, India. January 2000.*

Kumar, B. and Dutta, G. 1999c. Table size fish production of Rohu (*Labeo rohita)*, Catla (*Catla catla)* and Mrigal (*Cirrhinus mrigala)* in Purulia and Midnapur districts of West Bengal. *Fifth Indian Fisheries Forum, CIFA, Bhubaneswar, Orissa, India. January 2000.*

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3. Newsletter articles

Immink, A.J., Dutta, G., Kumar, B. and Little, D. 2000. Fry supply across West Bengal. *Aquaculture News, University of Stirling, UK December 2000*

4. Academic theses

Tarazi M. 1998. A small-scale solar-powered recirculated carp hatchery. M.Sc. thesis. University of Stirling.

Tovar ,C.L.M. (998. An alternative system of transportation for common carp fry (*Cyprinus carpio* L.) in eastern India. M.Sc. thesis. University of Stirling.

5. Extension-oriented leaflets, brochures and posters

Kribhco Indo-British Rainfed farming Project (East) (KRIBP(E)), 1998. *Rural Aquaculture.* Vol.1, no.1. Ranchi, Bihar, India. 8pp. (published in English, Hindi, Bangla, Oriya)
Kribhco Indo-British Rainfed farming Project (East) (KRIBP(E)), 1998. *Rural Aquaculture.* Vol.1, no.2. Ranchi, Bihar, India. 8pp. (published in English, Hindi, Bangla, Oriya)
Kribhco Indo-British Rainfed farming Project (East) (KRIBP(E)), 1999. *Rural Aquaculture.* Vol.1, no.3. Ranchi, Bihar, India. 8pp. (published in English, Hindi, Bangla, Oriya)
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Gramin Vikas Trust, 2000. *Rural Aquaculture.* Vol.2, no.5. Ranchi, Bihar, India. 8pp. (published in English, Hindi, Bangla, Oriya)
Gramin Vikas Trust, 2000. *Rural Aquaculture.* Vol.2, no.6. Ranchi, Bihar, India. 8pp. (published in English, Hindi, Bangla, Oriya) (in press)

6. Media presentations (videos, web sites, TV, radio, interviews etc.)

A street play written and directed by Rakesh Raman, a tribal playwright, in association with the Integrated Aquaculture Research Project and EIRFP media for aquaculture awareness raising (see Working Paper 10 for details).

Raman, R. 1999a. The Pond of the Little Fish – Performed by the Mantrana performing group - a video in Chotonagpuri edited by Fred Philips
Raman, R. 1999b. The Pond of the Little Fish – Performed by the Mantrana performing group – Hindi soundtrack by the Mantrana performing group - a video dubbed into Hindi edited by Fred Philips
Raman, R. 1999c. The Pond of the Little Fish – a video dubbed into Hindi with English sub-titles. Edited by Fred Philips

Carp breeding trials were filmed by the Bangla TV network ETV for nation-wide broadcast across India.

A web-site for the project for disseminating project output is constructed at http://www.stir.ac.uk/Departments/NaturalSciences/Aquaculture/systems/India/SysIndia.html.

7. Reports and data records

Back to office reports
Haylor (Nov 96); Haylor (Sep 97); Stewart (Nov 97); Felsing (Nov 98); Felsing (Dec 98); Haylor (May 99); Felsing (May 99); Felsing (Aug 99); Haylor (Sep 99); Felsing (Jan 00); Felsing (July 00); Little (Sept 00). Beeching (September 2000) NRSP Steering Group Assessment of R6759.

The aquaculture teams produced monthly progress reports (beginning June 1998).

Haylor 99 EIRFP Aquaculture Consultants Report on Aquaculture development and research in the project (October, 99).

Working Papers
Felsing, M. and Haylor, G.S. 1999. Aquaculture extension: Overview and a framework of options. A case study of extension planning by a DFID research Project in Eastern India. *Working paper 10. Integrated aquaculture in eastern India. DFID NRSP High Potential Systems Programme.*
Felsing, M., Haylor, G.S., Dutta, G., Kumar, B. and Natarajan, N. 1999. In need of seed – An Overview of fry production trials in Purulia District, West Bengal, 1998. *Working Paper 12. Integrated aquaculture in eastern India. DFID NRSP High Potential Systems Programme*.
Felsing, M., Haylor, G.S. and Lawrence, A. 1999. Some statistical methods for participatory research. *Working paper 8. Integrated aquaculture in eastern India. DFID NRSP High Potential Systems Programme*.
Felsing, M., Haylor, G.S. Lawrence, A. and Norrish, P. 1999. Developing a communication strategy for the promotion and dissemination of aquaculture: A case-study from Eastern India. *Working paper 9. Integrated aquaculture in eastern India. DFID NRSP High Potential Systems Programme*.
Haylor, G.S. and Barr, J.J.F. 1999. Aquaculture in the context of the rainfed environment. *Working paper 14. Integrated aquaculture in eastern India. DFID NRSP High Potential Systems Programme*.
Haylor, G.S., Felsing, M., Dutta, G., Kumar, B., Shweta, S., Arora, G., Natarajan, N., Singh, K.P. and Singh, V. 1999. Size matters - The production of advanced fingerlings by farmers groups in remote tribal

areas in India. *Working paper 13. Integrated aquaculture in eastern India. DFID NRSP High Potential Systems Programme*.

8. Project logframe

Supergoal: Productivity and productive potential in high potential production systems increased through the application of systems-based approaches.

Narrative Summary (NS)	Verifiable Indicators (OVI)	Means of Verification (MOV)	Important Assumptions
Goal: 1 Production of systems commodities increased through optimisation of inputs and outputs	1.1 By 2005, in a specified high potential production system in target areas where demand has been identified • Off take increased by 15% • Management of inputs (especially agro-chemicals) improved • Systems carrying capacity maintained or enhanced over period of land use	1.1 National production statistics - reports of target institutions - research programme reports - evaluation of NRSP - monitoring against baseline data	1.1 Enabling environment (policies, institutions, markets, incentives) for widespread adoptions of new technologies and strategies exists
Purpose: 1 Strategies for the introduction of improved germ plasm/new varieties/stock developed and promoted	1.1 New varieties grown and consumed: greater range of crop types being traded by 2000	1.1 Appearance and consumption of more/new varieties reported in market surveys	1.1 Optimal use of available genetic resources is not already being practised
Outputs: 1 Key researchable constraints to aquaculture integration understood and prioritised 2 Opportunities to integrate aquaculture with farming systems which have additional water resources identified 3 Strategies for the integration of aquaculture into the farming systems of India's eastern plateau developed and promoted	1.1 80% of stakeholders agree on prioritised researchable constraints (encompassing social, economic and technical components) within 18 months of project start 2.1 Integrated aquaculture options, appropriate to the social and economic circumstances and resource capacity of 50% of targeted recipients, defined by project end 3.1 100% of EIRFP aquaculture staff trained in strategies for incorporating fish into farming systems within 6 months of their development 3.2 15% of EIRFP target households, with access to additional water, produce fish within their farming system within 2 years of EIRFP staff training	1.1 Six-monthly project reports, bulletins and project information, e-mail lists for identified subscribers 1.2Planning workshop reports 2.1 Final project reports, peer review publications, project information, e-mail lists for identified subscribers 3.1 Impact evaluation and monitoring reports of EIRFP project 3.2 Final project reports	1.1 Farm households able and willing to participate in the project 2.1 Farm household priorities lie within the scope of the project 2.2 The project approach is able to identify opportunities 3.1 Social, economic or natural environment are conducive to the incorporation of fish within the rain-fed farming system

Activities:	Summary Budget:		See milestones chart	
1.1 Convene the multi-agency research team (ICAR and UK scientists, EIRFP staff), to conduct systems research to assess opportunities for, and constraints to, the integration of aquaculture into farming systems 1.2 Identify research sites 1.3 Conduct a research needs assessment involving identification of farm household priorities and perspectives in identified farming systems with access to additional water supplies such as springs, ground water etc. 1.4 Review the relevant components of the international and national knowledge base regarding options and approaches to integrating fish production into farming systems	Staff £83,820 Overheads £33,864 Equipment £13,513 Overseas Travel £37,808 Misc. £41,805 VAT - TOTAL £210,810			1.1 Collaboration with communities not limited by unresolvable social issues or migration 1.2 It proves possible to build appropriate linkages with EIRFP Community Organisers 1.3 Target institutions willing and able and adequately resourced to utilise research results

1.5 Conduct a planning workshop involving all collaborators to plan the focus, content and nature of the integrated aquaculture research support, to identify and define potential monitoring mechanisms and to assess the range of potential monitoring and documentation options for each type of research and the mechanisms to use 1.6. Draw up a prioritised demand-led research plan in conjunction with farmers and collaborating national and UK researchers 2.1 Co-ordinate the programme of farmer centred on-farm trials conducted at selected sites in EIRFP clusters administered by GVT Field Officers and supported by the research team over two kharif and two rabi seasons (i.e. 24 months) 2.2 Co-ordinate the complimentary on-station research by ICAR conducted at Rahara Research Station and CIFA HQ, Bhubaneswar integrated with activity 2.1 2.3 Conduct mid-trial village-based Specialist Open Days and team research assessment and planning sessions following each kharif and rabi season 2.4 Conduct on-station Farmer Open Days where station-based trials are conducted 3.1 Prepare documentation of all on-farm and on-station research and where possible evaluation by farmers and by specialists 3.2 Carry out a costed needs assessment for the development and testing of dissemination materials related to the project outputs 3.3 Analyse the applicability of the approach, and the measures developed, to a broader audience			1.4 There is good access to appropriate sources of data and literature

9. Keywords

Aquaculture, India, rain-fed, integrated, farmer-managed-research, participatory, extension, rural.

10. Annexes

A. Communication materials

i. Journal Articles

Peer reviewed and published

Lawrence, A., Barr, J.J.F. and Haylor, G.S. 1999. Stakeholder approaches to planning participatory research by multi-institution groups. *Agren Bulletin, Network Paper No. 91.*

Pending publication

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iii. Newsletter articles

Immink, A.J., Dutta, G., Kumar, B. and Little, D. 2000. Fry supply across West Bengal. *Aquaculture News, University of Stirling, UK December 2000*

iv. Academic theses

Tarazi M. 1998. A small-scale solar-powered recirculated carp hatchery. M.Sc. thesis. University of Stirling.
Tovar ,C.L.M. 1998. An alternative system of transportation for common carp fry (*Cyprinus carpio* L.) in eastern India. M.Sc. thesis. University of Stirling.

v. Extension-oriented leaflets, brochures and posters

Kribhco Indo-British Rainfed farming Project (East) (KRIBP(E)), 1998. *Rural Aquaculture.* Vol.1, no.1. Ranchi, Bihar, India. 8pp. (published in English, Hindi, Bangla, Oriya)
Kribhco Indo-British Rainfed farming Project (East) (KRIBP(E)), 1998. *Rural Aquaculture.* Vol.1, no.2. Ranchi, Bihar, India. 8pp. (published in English, Hindi, Bangla, Oriya)
Kribhco Indo-British Rainfed farming Project (East) (KRIBP(E)), 1999. *Rural Aquaculture.* Vol.1, no.3. Ranchi, Bihar, India. 8pp. (published in English, Hindi, Bangla, Oriya)
Kribhco Indo-British Rainfed farming Project (East) (KRIBP(E)), 2000. *Rural Aquaculture.* Vol.1, no.4. Ranchi, Bihar, India. 8pp. (published in English, Hindi, Bangla, Oriya)
Gramin Vikas Trust, 2000. *Rural Aquaculture.* Vol.2, no.5. Ranchi, Bihar, India. 8pp. (published in English, Hindi, Bangla, Oriya)
Gramin Vikas Trust, 2000. *Rural Aquaculture.* Vol.2, no.6. Ranchi, Bihar, India. 8pp. (published in English, Hindi, Bangla, Oriya) (in press)

vi. Media presentations (videos, web sites, TV, radio, interviews etc)

A street play written and directed by Rakesh Raman, a tribal playwright, in association with the Integrated Aquaculture Research Project and EIRFP media for aquaculture awareness raising (see Working Paper 10 for details).

Raman, R. 1999a. The Pond of the Little Fish – Performed by the Mantrana performing group - a video in Chotonagpuri edited by Fred Philips
Raman, R. 1999b. The Pond of the Little Fish – Performed by the Mantrana performing group – Hindi soundtrack by the Mantrana performing group - a video dubbed into Hindi edited by Fred Philips
Raman, R. 1999c. The Pond of the Little Fish – a video dubbed into Hindi with English sub-titles. Edited by Fred Philips

Carp breeding trials were filmed by the Bangla TV network ETV for nation-wide broadcast across India.

A web-site for the project for disseminating project output is constructed at http://www.stir.ac.uk/Departments/NaturalSciences/Aquaculture/systems/India/SysIndia.html.

***vii.* Reports and data records**

Back to office reports
See Annex H.

The aquaculture teams produce monthly progress reports (beginning June 1998).

Consultant Report
Haylor (October, 99). EIRFP Aquaculture Consultants Report on Aquaculture development and research in the project.

Working Papers
Felsing, M. and Haylor, G.S. 1999. Aquaculture extension: Overview and a framework of options. A case study of extension planning by a DFID research Project in Eastern India. *Working paper 10. Integrated aquaculture in eastern India. DFID NRSP High Potential Systems Programme.*
Felsing, M., Haylor, G.S., Dutta, G., Kumar, B. and Natarajan, N. 1999. In need of seed – An Overview of fry production trials in Purulia District, West Bengal, 1998. *Working Paper 12. Integrated aquaculture in eastern India. DFID NRSP High Potential Systems Programme*.
Felsing, M., Haylor, G.S. and Lawrence, A. 1999. Some statistical methods for participatory research. *Working paper 8. Integrated aquaculture in eastern India. DFID NRSP High Potential Systems Programme*.
Felsing, M., Haylor, G.S. Lawrence, A. and Norrish, P. 1999. Developing a communication strategy for the promotion and dissemination of aquaculture: A case-study from Eastern India. *Working paper 9. Integrated aquaculture in eastern India. DFID NRSP High Potential Systems Programme*.
Haylor, G.S. and Barr, J.J.F. 1999. Aquaculture in the context of the rainfed environment. *Working paper 14. Integrated aquaculture in eastern India. DFID NRSP High Potential Systems Programme*.
Haylor, G.S., Felsing, M., Dutta, G., Kumar, B., Shweta, S., Arora, G., Natarajan, N., Singh, K.P. and Singh, V. 1999. Size matters - The production of advanced fingerlings by farmers groups in remote tribal areas in India. *Working paper 13. Integrated aquaculture in eastern India. DFID NRSP High Potential Systems Programme*.

Literature reviews
Anon. 1997. Rice-fish farming research.

B. Background Information to the Project Area

i. Map of West Bengal
ii. Basic Group Information
iii. EIRFP resource information on West Bengal project area
iv. Rainfall in the project area
v. Site selection briefing notes
vi. Guidelines on culture
vii. Briefing, aquaculture research and development in East India

C. Trials 1998 and farmer feedback

i. Trial Planning Sheets
ii. Trial Status Report
iii. Summary of Trials
iv. MASC Briefing
v. Women's Meeting Questionnaires
vi. Farmer Network Meeting Results
vii. Matrix of responses
viii. Trial Financial Analysis
ix. 1998-99 Trial Impact Assessment
x. MASC article for Bulletin

D. Fry Production and Transportation Issues

i. Demand Identification for Breeding Trials
ii. Breeding Trials for Indian Major Carp (on-station only)
iii. Breeding Trials for Common Carp (on-station and on-farm)
iv. Solar Hatchery
v. Limitations of Solar Hatchery

vi. Solar Transport Unit
vii. Fry Supply Network in West Bengal, survey summary
viii. Fry Supply Network in West Bengal, survey raw data

E. Catfish Trials

i. Resource Identification
ii. Trials Report, 1999
iii. Trials Report, 2000

F. Extension and Dissemination

i. Aquaculture Coverage in the EIFRP
ii. Bulletin Impact Assessment with Farmers
iii. Comments on Bulletin from other observers
iv. Feedback on first video viewing
v. Organic Spread within the project area
vi. Dissemination on the aquaculture message
vii. Farmer comments on open day trials
viii. Some issues to consider in group meetings

G. Annual Reports

i. First Annual Report, 1997
ii. Second Annual Report, 1998
iii. Third Annual Report, 1999
iv. GVT Aquaculture Research Progress Report 1996-2000
v. GVT Aquaculture Development Progress Report 1996-2000

H. Back to Office Reports

i. Back to Office Report, Malene Felsing, December 1998
ii. Back to Office Report, Graham Haylor, June 1999
iii. Back to Office Report, Graham Haylor, August 1999
iv. Back to Office Report, Malene Felsing, August 1999
v. Back to Office Report, Malene Felsing, January 2000
vi. Back to Office Report, Malene Felsing, March 2000
vii. Back to Office Report, Malene Felsing, July 2000
viii. Back to Office Report, Dave Little, September 2000
ix. Back to Office Report, John Beeching, September 2000

I. Further Information on Project Activities, by Output

J. Final Project Inventory