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FINAL TECHNICAL REPORT

DFID Project number

R 6756

Project title

Investigation of Livelihood Strategies and Resource Use Patterns
in Floodplain Production Systems in Bangladesh

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Glossary of abbreviations, acronyms and Bengali terms

Ail	Earthen wall between paddies (see *bundh)*
Aman	Rice grown during the monsoon and harvested after the monsoon.
B. Aman	a crop of *aman*, sown by broadcasting the seed. Normally local varieties and more flood tolerant.
Aus	Rice planted before the monsoon and harvested during the monsoon.
AEZ	Agro-Ecological Zone
Bari	Household unit - those living in one compound
Bazar	Weekly market
Beel	Shallow floodplain depression with an ephemeral or perennial waterbody
Bigha	local land units - 1/3 of an acre
Boro	Rice cultivated in the dry season; usually an irrigated crop.
Bundh	Earthen wall between paddies (see *ail)*
CAQDAS	Computer-Assisted Qualitative Data Analysis Software
CBFM	Community Based Fisheries Management
CEGIS	Centre for Environment and Geographic Information Services
CEMARE	Centre for the Economics and Management of Aquatic Resource (University of Portsmouth)
CGIAR	Consultative Group on International Agricultural Research
CNRS	Center for Natural Resources Studies (NGO)
CPR	Common Property Resource / Common Pool Resource
CRF	Competitive Research Facility
Decimal	an hundredth of an acre
DFID	Department for International Development (formerly ODA)
DoF	Department of Fisheries
FAP	Flood Action Plan
FCD	Flood Control and Drainage
FCD/I	Flood Control and Drainage/Irrigation
FemCom	Bangladesh communications NGO
GIS	Geographic Information System
GoB	Government of Bangladesh
Hat	small / village market – usually daily
HYV	High Yielding Variety
ICLARM	International Centre for Living Aquatic Resources Management
IK	Indigenous Knowledge (see LK)
IRRI	International rice Research Institute
Karta	Head of household
Khal	Channel or canal, often connecting a *beel* to a river
Khana	Household unit - those who share a cooking pot
Kharif	the wet season. Sufficient soil moisture from rain and flooding to support non-irrigated agriculture
Khas	Land (and waterbodies) owned by Government, usually leased out
Kua	Excavated area (sump) in a waterbody, used for aggregating fish
LK	Local Knowledge (See IK)
LWI	Land / Water Interface
Mouza	the smallest administrative unit in Bangladesh
NARS	National Agricultural Research System
NGO	Non-Governmental Organisation
NR	Natural Resources
NRM	Natural Resources Management
NRSP	Natural Resources Systems Programme
ODA	Overseas Development Administration (now DFID)
OVI	Objectively Verifiable Indicators

PRA	Participatory Rural Appraisal
R6383	previous LWI funded scooping project on Bangladesh floodplains
R6756	this project
R6744	associated and concurrent project funded under SEM – “Methodological research into the incorporation of indigenous knowledge into natural resources research on Bangladesh floodplain production systems”
Rabi	the dry season. Crops depend on moisture stored in the soil from the monsoon, or on irrigation.
RSS	Reconnaissance Social Survey
Sharia	Quranic law
SEM	Socio-Economic Methodologies
SL	Sustainable Livelihoods (approach)
SYMO	Systems Management Office
T. Aman	a crop of *aman*, sown by transplanting seedlings. Normally HYV varieties and less flood tolerant.
Thana	Administrative unit between a Union and a District

Preface

This report is the formal Final Technical Report (FTR) of DFID research project R6756, funded under the Land/Water Interface (LWI) production system of the Natural Resources Systems Programme (NRSP). It is presented in the format prescribed by the research contract and follows DFID guidelines on content[1]. As such, it presents the original justification for, and aims of, the research. It then provides a summary of the research process and the products of that process, with some reflection on whether the planned outputs were achieved. Finally, it demonstrates how the research has been able to contribute towards DFID's development goals.

This prescribed format is not appropriate to detailed reporting of the research methods and results. Therefore, to provide a comprehensive report on the research, this report includes a number of appendices and annexes. The appendices are supplementary to the FTR, providing supporting documentation for statements made in the report. The annexes are stand-alone outputs: research products in their own right. They include a detailed overall research report, detailed reports on specific elements of the research, a literature review on floodplain fisheries, a geographic information system (GIS) of the project study sites on CD-ROM, together with copies of book chapters and journal and conference papers produced under the auspices of the project. The project worked in parallel with NRSP Socio-Economic Methodologies project R6744[2], which produced indigenous knowledge data that were shared with this project; the R6744 FTR is therefore also appendicised for cross-reference [Appendix A.].

[1] SYMO (January 1998). *Guidance Notes for Project Leaders*. SYMO, NRSP, DFID, London.
[2] R6744: "Methodological research into the incorporation of indigenous knowledge into natural resources research on Bangladesh floodplain production systems."

Executive Summary

Title: Investigation of Livelihood Strategies and Resource Use Patterns in Floodplain Production Systems Based on Rice and Fish in Bangladesh

The Purpose of this project was:

> *"Interrelationships between competing commodity production systems on floodplains understood and incorporated into system management strategies"*

To achieve this it undertook field survey and of the resource base available to floodplain producers and developed agro-ecosystem maps in a geographic information system (GIS). The bio-physical starting point was soils and land survey and water resources audit. The exploitation of these resources was been determined by monitoring crop production and fishing activities. Resource users were characterised using social survey and triangulating participatory techniques, and households were classified into seven socio-economic strata. The resource use patterns of these seven groups were monitored over the annual cycle. An integrated bio-physical and socio-economic modelling framework for floodplain production systems was developed, and complementarity and conflict between different groups' resource use strategies examined. This systems framework could make explicit the potential trade-offs, side-effects and points of tension resulting from single sector or narrowly focused interventions. This project was associated with an indigenous knowledge project that provided supporting information on local interpretation of natural resources management and decision making by the different producer groups.

In addition to field-based natural resources research, and computer-based data interpretation, plus indigenous knowledge investigation, the project also undertook a stream of action research. This set of activities involved working with the socio-economic groups separately and together to learn about production constraints from their perspective. This participatory planning exercise assisted them, using systems approaches, in identifying solutions that minimise undesired side-effects and frictions in the floodplain production system. Through mutual learning about each others' natural resources management strategies, it was possible to progress towards local interventions for better resource use, such as co-management. By exploring individual group's production constraints and perspective on the system as a whole, these activities also served to validate the systems model based on the field research.

The projects outputs have been taken up by two further research projects and by bilateral and multilateral development projects.

2. Background

2.1 The nature and importance of the researchable constraint

As can be seen from the project Purpose below (Section 3.), the underlying premise of the project is that there are competing commodity production systems on floodplains, which are poorly understood. Taken at their most basic level, these competing production systems are agriculture (crop production) and open-water fisheries. Understanding the interaction between these two systems is complicated by both the seasonal dynamic of the floodplain natural resources, and the complex of factors (social, cultural, institutional, political, economic) that influence access to these resources. In Sustainable Livelihoods (SL) terms these two sets of factors relate to the interplay between natural capital and transforming structures and processes. (Bebbington, 1999).

Floodplain natural resources production systems can be characterised as below (Table 1). The overall production system switches within the annual cycle between agricultural production on private land and fisheries in open-water (which is a regulated common property). The developmental problem, and thence researchable constraint which this project targets, emerges from this scenario once socio-economic and poverty dimensions are introduced.

Table 1. Characteristics of the principal floodplain production systems

Terrestrial production systems	Aquatic production systems
Agriculture	Fisheries
Private land	Common property
Mainly held by wealthier households	More important for poorer households
Access widened through sharecropping	Access restricted through leasing
Dominant for ~8 months/year	Dominant for ~4 months/year

Nationally, the population is approximately 80% rural, with more than 50% are classed as 'functionally landless' (owning less than 0.2 ha[3]). With population growth of 1.8% per annum, a population estimated to reach 170 million by 2020 (World Bank, 1998a), and sub-division of land parcels through a *sharia* inheritance system, landlessness continues to increase. Unable to be self-sufficient in food, poor rural families' livelihoods thus depend increasingly on share-cropping, agricultural wage labour, fishing, non-agricultural labouring, and paid urban employment.

As shown by Rahman *et al* (1998), 52% of rural households subsist below the poverty threshold, while another 23% are likely to move into poverty and are classed as 'tomorrow's poor'. For the 52% already below the poverty threshold, who are the project's target beneficiaries, a large proportion of time is allocated to 'expenditure saving strategies'. These include collection of food (fish, fruit, vegetables), fuel, fodder and house building material from 'ecological reserves'. Ecological reserves include homestead forestry, product (crop) residues and common property resources (CPRs). Therefore, for the rural poor, CPRs are either an important livelihood safety-net, an "employer of last resort"[4], or for professional fishing households who fish for 10-12 months/year, the main-stay of their livelihood portfolio[5].

[3] This amount of land (originally formulated as ½ an acre) is considered the threshold for subsistence producers to be food grain self-sufficient, however it does not mean that landless households (<½ acre) are non-agricultural. In addition to cropping their small quantity of land, they access further land by through share-cropping arrangements or mortgaging in others' land.

[4] DFID - Bangladesh's Fisheries and Aquatic Resources Sector Strategy (FARSS)

[5] FAP 17 distinguished between professional, seasonal and subsistence fishing. There are 1.5 million full-time and 11 million part-time fishers, and approximately 80% of rural households (64 million people) have some participation in the floodplain fishery.

Nonetheless, on Bangladesh floodplains the trend has been for agriculture and infrastructure oriented development that has reduced the extent of wetlands and common property resources. Since poorer people disproportionately depend on these resources for their livelihoods, notably through fishing, the needs of marginal and landless farmers and fishers have been poorly addressed by much development intervention. Intervention that has failed to take account of the complex bio-physical and socio-economic interactions in floodplain production systems, due to a poor understanding of the system, and a failure to appreciate the systems perspective. The project has therefore aimed to develop a systems understanding of land and water resource use and resource users.

2.2 Impacts of the researchable constraint

Systems interactions in floodplain production are both ecological and socio-economic, but such interactions have not featured as priority considerations in the majority of interventions. In relation to NR research, the problem is one of a commodity-focused national research programme, driven by top-down concerns. The NARS has thus tended to neglect low resource-level producers and their livelihood systems and has made little progress on elucidating the knowledge base for farmers' decision making. Government intervention has demonstrated a similarly poor comprehension of, and applicability of its programmes to, subsistence livelihood systems and cross-sectoral issues. The Ministry of Agriculture recognises that past extension efforts tended to focus on wealthier medium and large land-ownership groups of farmers (Ministry of Agriculture, 1997), rather than landless rural communities. Extension may therefore be considered to not have taken an holistic or 'systems' view of floodplain production.

There have been two main development themes in floodplain development in the post-independence period. One has been the massive growth in small scale irrigation provision and the associated shift to irrigated dry-season rice from rain-fed monsoon season rice crops. This has improved crop production and has spread the labour demand, diminishing the importance of the traditional January – May lean season (Rahman *et al*, 1998). The other theme has been an infrastructure approach to floodplain modification, with the aim of reducing the worst effects of large floods and reducing the depth and duration of normal monsoon flooding. Much of this infrastructure development has, in the 1980s and 1990s, been co-ordinated under the Flood Action Plan (FAP). The constraints resulting from a lack of a systems understanding of floodplain production are illustrated by impact appraisals of various infrastructure approaches to flood control.

Most flood control and drainage (FCD) or flood control and drainage/irrigation (FCD/I) schemes have achieved their hydrological objectives, and thereby their main aim to increase the yields and security of rain-fed and irrigated agriculture (Khan, 1994; FAP 12, 1992). They have tended to result in increasingly rice-based cropping patterns. The key positive aspects of FCD/Is have been: a shift from *Aus*/*Aman* and B. *Aman* rice crops to T. *Aman* and HYV T. *Aman* with associated increases in rice production; improved land capability; reduction in crop damage losses; improved dry season cropping due to provision of irrigation; and improved potential for culture-based fisheries, *beel* stocking, and aquaculture.

However, flood control interventions have almost invariably damaged inland open-water capture fisheries (FAP 12, *ibid*). FAP 12 stated that: "*in regularly inundated floodplains…the magnitude of these [fishery] losses in most cases appears to be substantially greater than has been previously estimated, and in some case to be sufficient to severely reduce the economic performance of projects which appear viable on agricultural performance alone. …The absence of* ***integrated flood control and fisheries planning*** *has led in some cases to acute social conflicts between fishermen and farmers*." (Emphasis added).

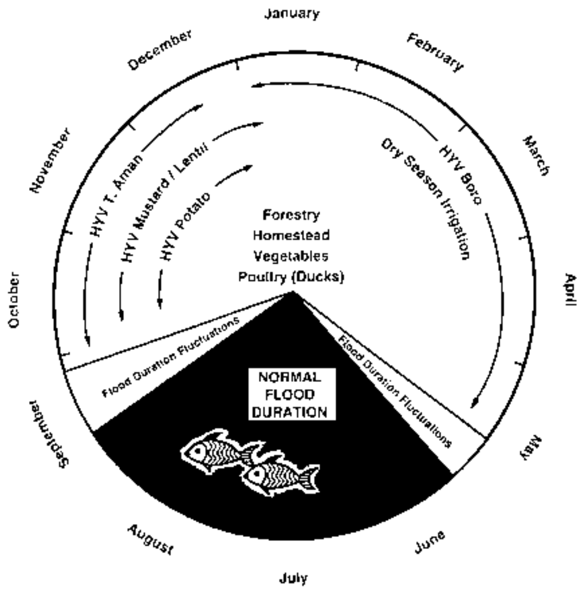
The negative impacts of FCD/I include: reduction in extent of inundated floodplains and perennial beels; loss of floodplain habitats and fishery; increased pressure on river fisheries; blockage of fish migration routes; absence of integrated flood control and fisheries planning; acute social conflicts between fishermen and farmers; the livelihoods of landowners, particularly the larger ones, have improved at the expense of capture fishermen; reduction in free common access to subsistence floodplain fisheries in the flood season; increase in full-time fishers seeking other work on a part-time basis; fishers losing their livelihoods, or diverting to river fishing – resulting in overfishing in rivers; increase in other landless people participating in part-time fishing for the first time; reduction in crop diversity; and prevention of annual addition of nutrient-rich sediment to soil (Boyce, 1990; Thompson, 1990; FAP 12, 1992; FAP 16, 1992, 1993; FAP 17, 1994a, 1995; Rasid & Mallik, 1995). Although increasing the agricultural production in the dry season may lead to a marginal increase in landless household's labouring income, it does not mitigate loss of access to, and income from, the floodplain fisheries in the monsoon season. Therefore, flood control interventions have met their principal aim of increasing food-grain self-sufficiency, but only at the expense of impeding fish migration and reducing fish production, thereby particularly affecting the landless.

A further example of the type of unplanned consequence of intervention that systems analysis can help avoid is given by Minkin & Boyce (1994) and Minkin *et al* (1997). They showed that enhancing floodplain fisheries by stocking waterbodies with major carp reduces diversity of fish species, especially small indigenous or 'non-economic' species. These species were found to be significant in the diets of poor people, especially women and children. Thus stocking preferential improved commercial fishing as the expense of the nutrition of disadvantaged members of the community. These, and other planned interventions can have side-effects, and pressures on the system due to unintended consequences of development, and the implications of these on livelihoods have not been fully explored (Rahman *et al*, 1998). Developments in one sector, e.g. agriculture, can, and have, adversely affected the resources in another sector, e.g. fisheries[6] and forestry (Viju Ipe, 1995). A systems framework offers the potential to understand the possible trade-offs and knock-on effects of given interventions.

2.3 Previous research

Previous research on floodplain production can be largely divided along disciplinary lines into agricultural research and fisheries research, with some limited degree of overlap at the margins. Though there is a robust track record of farming systems research (FSR) in Bangladesh (Hossain, 1990; Chowdhury *et al*, 1993; Siddique *et al*, 1994; Roy, 1996), the focus has been the farm unit (Barr, 1998 [Annex 10.3]), and thus only those activities located within that unit, i.e. crop, homestead, and livestock production plus aquaculture, have tended to be included. Therefore this research has mainly been 'research into farming systems' rather than 'systems research about farming' (Bawden, 1995). This resource focus has been true of most previous research, and livelihoods research centred on all the dimensions of an individual's or rural household's 'making a living' - i.e. systems research about livelihoods - has yet to permeate into the research system. Typical outputs from FSR studies are descriptions of different combinations of production components in the farm unit (eg. Hossain *et al*, 1998), and models of the cropping patterns in these systems, related to prevailing rainfall or flood distribution (eg. Brammer, 1997: 14). These may attempt to distinguish the farming systems of farmers of different classes of land-holding size, or as in Figure 1., often do not.

[6] For example, in the Chandpur Irrigation and Flood Control area, fish production in open waters declined by 35% during the first two years after project completion (BARC, 1987).



After BARC (1990)

Figure 1 **Model of the annual production cycle on Bangladesh floodplains**

Fishing is included on this model, albeit as a discrete and time-bound activity in the cropping cycle. Yet poverty-focused floodplain development will inevitably include fishers, who tend to be the poorest members of the communities who directly use wetland resources. The World Bank (1998b) has shown that 60% of the rural landless and marginal landowners are very poor, whereas those households who own >1 ha enjoy 43% greater per capita consumption than landless households. Nonetheless, it is estimated that 73% of all households have some involvement in floodplain fisheries (DOF, 1990). This often quoted statistic masks the heterogeneity of who fishes, when, for how long, with what intensity, with what gear, and importantly how these factors relate to the households' other production activities (such as agriculture).

The FAP 17 study (the fisheries FAP) devised a schema with three categories of participant in floodplain fishing: subsistence, seasonal and professional, though the distinctions are blurred at the margins (FAP 17, 1995) (Figure 2.). Subsistence fishers are opportunistic according to floodplain conditions, and catch mainly for the pot using small gears. This group include landless labourers, small farmers, and even women and children. Although they evidently do fish and some of the catch may be sold, this group do not class themselves as 'fishers' (*jele*), which carries adverse social connotations. Seasonal fishers are a group which has expanded recently in response to crises and pressures for land and because more intensive approaches to fishing in the monsoon season can fit well with agricultural production, which requires most inputs in the dry season. This group may be landless and marginal farmers or even small and some medium land owners in the case of more profitable fisheries, who may have faced up to the stigma of fishing in order to intensively exploit the seasonal floodplain fishery. For this group, fishing has become an important component of their livelihoods. Professional fishers were traditionally Hindus using larger gears in *beels* and rivers. This group has declined due to competition and out-migration, and Muslim agriculturalists have increasingly entered this part of the fishery (FAP 17, 1995).

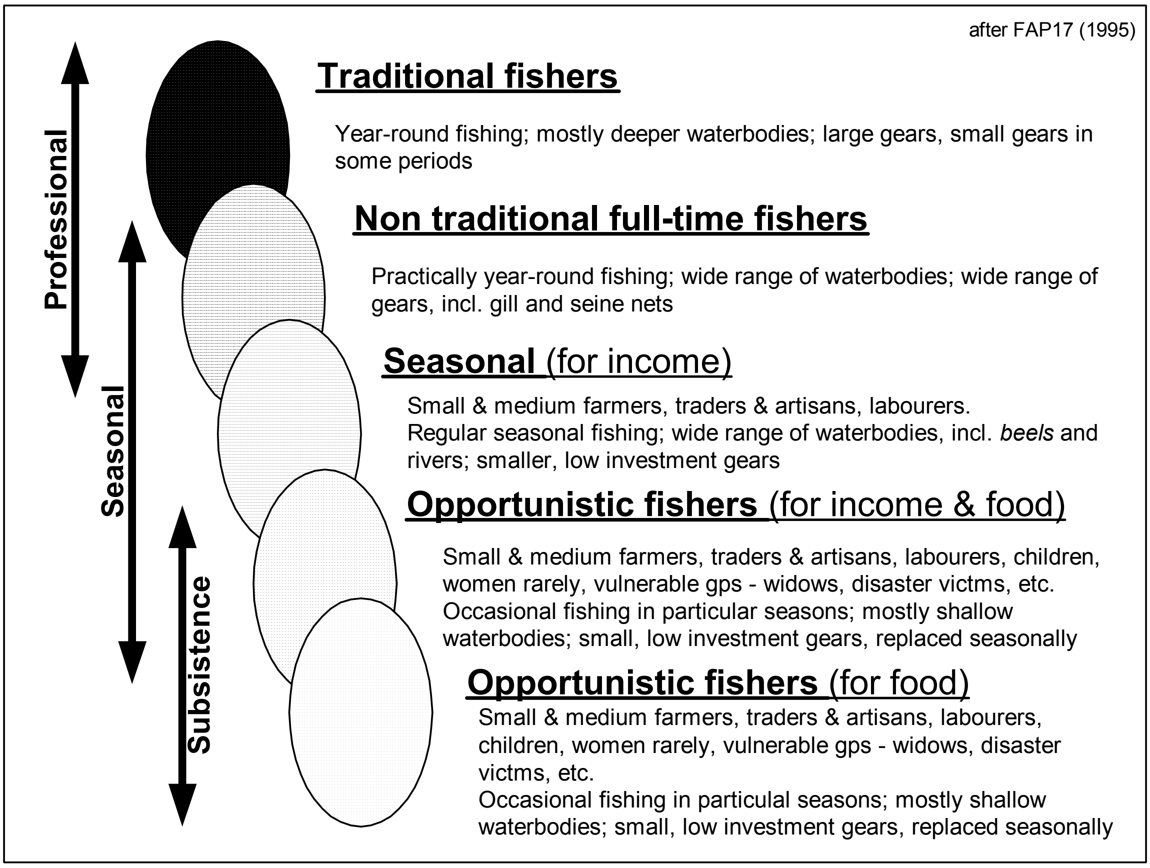
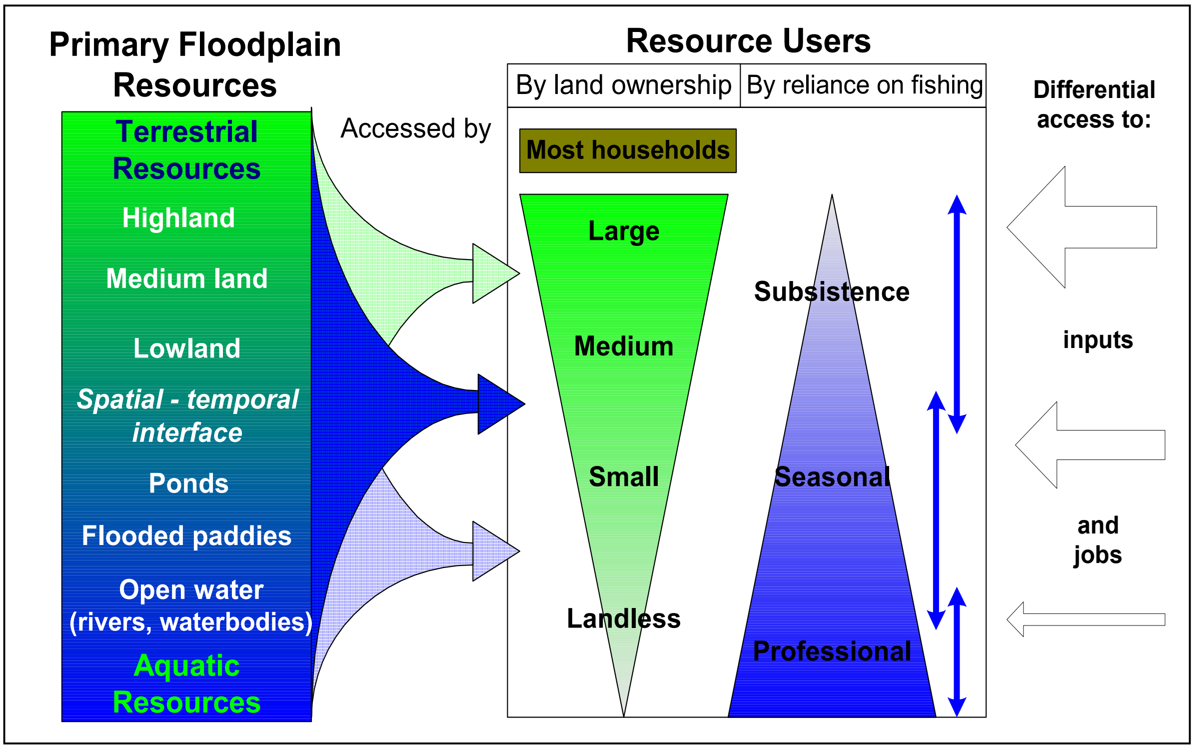


Figure 2 Model of types of participation in floodplain fisheries

This FAP 17 framework is a useful model for understanding involvement in the floodplain fishery. However it does not indicate how these different strategies for aquatic production relate to agricultural production strategies. Thus, under a previous NRSP-LWI project (R6383), a model was advanced which tried to bring these two dimensions together (Figure 3). The R6383 model combined the fishing type model with households' land ownership types (a proxy for wealthy), and the type of natural resources that these households predominantly depend upon for their NR-based livelihoods. The current project has explored this model further and provides more detail on this differential access to resources. The debate on conflict and complimentarity in use of floodplain natural resources has tended to accept the simplistic model represented in Table 1 – a bipolar model of agriculture versus fishing. This approach tends place greater consideration on conflict, particularly conflict between the extremes - large land owners and professional fishers. However there is a very large constituency of landless, marginal, small and medium farmers who depend on a mixed portfolio of activities that includes both agriculture and fishing, that they fit with the seasonal cycle of the floodplain. The present research attempts to investigate complementarities between the poles, and to better understand the complex of activities pursued by that the large group of stakeholders in the middle.

Figure 3 Model of floodplain resource use from project R6383



2.4 The demand for the research

Demand for this research project was identified at three levels:

- by a prior project (R6383)
- by the ODA Aid Management Office - Dhaka (AMOD as was, now DFID - Bangladesh)
- from Government of Bangladesh (GoB)

<u>R6383</u>

Prior to R6756, NRSP-LWI funded a short duration project R6383: "*Preliminary Investigation of Agricultural Diversification and Farmers' Practices in Bangladesh Floodplain Production Systems Involving Rice-Fish Production - a Whole Farm System Approach*" (Barr *et al*, 1996). This project grew out of the programme's need for a scoping study which would define the appropriate types of floodplain production system to research in Bangladesh, the nature of the land/water interface in those systems, and the principle researchable constraints which producers and institutions faced. R6383 identified particular systems constraints and a clear demand for research which aimed to understand and improve the sustainability of farmers' livelihood systems in representative floodplain sites. The systems constraints that farmers attributed to causing declining productivity from crop production and fishing included biomass shortage and associated soil fertility decline, loss of diversity in production systems, and water management problems including sudden flood, drought, flood control, siltation and reduction in volume of rivers and water bodies.

It was also clear from R6383 that demand-driven, systems-based field research was novel for many of the local researchers involved, who have traditionally been commodity-focused and driven by top-down concerns. R6383 was well received by the intermediate beneficiaries, and R6756 aimed to meet their continuing demand for systems-based knowledge and methods.

<u>ODA – AMOD; DFID</u>

The ODA Bangladesh Country Strategy Paper for Natural Resources in operation when R6756 was designed stated that: "ODA gives the highest priority to support for integrated development of the whole farm system", and went on to indicate that the strategy recognised that opportunities exist for activities which integrate land and water based activities within the farm. This supported the need for a systems project that understood the interaction between land and water use. However it also inferred that activities 'within the farm' are the main focus. This overlooks the fact that many of the poorest of the rural population do not have farms as such. R6756 has taken a broader focus, studying landscape-scale interactions between different farms rather than within single units, and between private land and common property water resources. The ODA strategy paper identified a demand for a systems approach to floodplain NR development, stating that the country programme should adopt: "a farming system-wide approach and seek to strengthen local capacity for conduct of such work".

Since the project commenced, two notable development themes have emerged, especially within DFID. These are a poverty focus, as evidenced in the goals laid out in the White Paper on International Development (DFID, 1998), and a livelihoods approach, as evidenced, *inter alia*, by the establishment of the DFID Rural Livelihoods Department from the previous Natural Resources Policy and Advisory Department and the Natural Resources Research Department, and from the web site (http://www.ids.ac.uk/livelihoods/) and publications of the DFID Rural Livelihoods Support Office (Carney, 1998; DFID, 1999; Ashley & Carney, 1999). This project addresses both poverty concerns and livelihood issues. The ultimately beneficiaries are "*small, marginal and landless farmers and fishers producing a livelihood on Bangladesh floodplains, especially those whose livelihood strategy is dependent on production of both rice and fish*". A socially differentiated approach has been used to ensure that the livelihoods of poorer groups can be distinguished. The project was conceived of as a 'livelihoods' project as indicated in its title "*Investigation of Livelihood Strategies and Resource Use Patterns in Floodplain Production Systems in Bangladesh*". In this regard, the DFID sustainable livelihoods (SL) framework has been used to appraise stakeholders' livelihood (Barr & Haylor, *forthcoming* [Annex 10.8]). However the SL framework as it now appears did not exist when the project was designed, thus the project does not address all aspects of the current SL framework. In that the project is an NRSP project, it was designed to focus mainly on the floodplain NR elements of people's livelihoods, especially agriculture and fisheries at a landscape scale.

<u>GoB</u>

The Government of Bangladesh in its Fourth Five Year Plan (FFYP) has as a major objective to "ensure sustained agricultural growth through more efficient and balanced utilisation of the country's land, water and other natural resources." Such balance in resource utilisation requires an understanding of how different resource use systems interact with each other. GoB has also made explicit calls for promotion of systems approaches. Z. Karim (Chairman - Bangladesh Agricultural Research Council (BARC), and ex-Director General Bangladesh Rice Research Institute (BRRI)) has argued for a broad systems approach to resource management and sustainable agriculture by the National Agricultural Research System (NARS) in Bangladesh (Karim, 1994). This has been manifest in examples such as the New Agricultural Extension Policy (NAEP), drafted with the World Bank/DFID Agricultural Support Service Project (ASSP), which calls for training of extension officers to "*impart an understanding of the interaction of each particular discipline with other disciplines in the context of on-farm management*" (Ministry of Agriculture, 1997).

Furthermore, the World Bank (1999) has stated that GoB needs to address water resources issues in a comprehensive manner. The Bangladesh Water and Flood Management Strategy (FPCO, 1995 [cited by the World Bank]) has highlighted the problems associated with *ad hoc* approaches, which could be avoided by increased inter-dependence among the sub-sectors, ministries, and departments in charge of surface irrigation, groundwater irrigation, fisheries, public health, environment, municipal water supply, power, and navigation, most of which at present are acting independently of each other.

3. Project Purpose

The project Purpose as defined in the logical framework was:

> "*Interrelationships between competing commodity production systems on floodplains understood and incorporated into system management strategies*."

To achieve this Purpose, the project aimed to develop a systems understanding of the resource base and resource use patterns in floodplain production systems. This would encompass both environmental and socio-economic components, and lead to the development of system management strategies for increased productivity, diversity of resource use, equitability and sustainability in floodplain systems.

With this objective, the project aimed to address the need for improved management of floodplain resources and thence improve floodplain livelihoods, through development of a systems framework that could make explicit the potential trade-offs, side-effects and points of tension in the system. The intention being that by investigating in detail two specific floodplain systems, general rules of resource interaction and socio-economic relationships could be derived. Thus such a framework could offer a planning and evaluation matrix that could be used to assess the actual and potential benefits and disadvantages of any given floodplain intervention.

In developing such a systems framework, the bio-physical starting point has been to assess what terrestrial and aquatic resources are available to producers in the study areas through soils and land survey and water resources audit. The exploitation of these resources has been determined by monitoring crop production and fishing activities. The socio-economic starting point has been a full census of the villages around the study sites (*beels*) and selection of representative households across the whole spectrum of socio-economic and occupational stakeholder groups. This has been supported by project anthropologists who have studied local interpretation of natural resources management and decision making by different producer groups. The product of this research, a detailed analysis of floodplain production systems, stratified by stakeholder group, identifies how and when resource use strategies compete and complement each other, and addresses the Purpose.

This delivers an understanding of the overlapping matrix of livelihood strategies and differential use of floodplain resources by different producer groups. To enable target institutions to take this forward, the research has identified over-exploited and under-used resources, which translate into points of conflict and complementarity. This analysis has also been undertaken in a participatory planning exercise with the stakeholder groups. Through mutual learning about each others natural resources management strategies, it has been possible to progress towards local actions for better resource use, such as co-management.

The objectively verifiable indicators (OVIs) for the project Purpose were:

- Floodplain natural and agro-ecosystem resources mapped, quantified and inventoried.
- Impacts of resource exploitation and livelihood strategies identified and understood.
- Effective and sustainable systems for participatory needs assessment and information transfer adopted by appropriate target institutes.

Although not strictly compliant with logframe guidelines, it is possible to demonstrate how the project has delivered against the Purpose. This may also indicate a lack of clear hierarchical distinction between Purpose and Outputs in the original logframe design.

Firstly, the project GIS (Annex 3.) stands as a map and quantitative inventory of the natural and agro-ecosystem resources of the study sites. Secondly, interpretation of the quantitative data and problem census results have enabled the project to identify and understand the livelihood strategies of key floodplain stakeholder group, as evidenced in the paper by Barr and Haylor (Annex 10.8). Finally, the problem census and systems-based workshop methodology (Annex 2) has proved to be a practical tool for participatory needs assessment , and has been strongly taken up by the local NGO CNRS (see Section 6.3.3. and Appendix E).

4. Research Activities

The project was conceived of as interdisciplinary research, with researchers from a number of disciplines developing an understanding of the resource base and patterns of exploitation of those resources from their own disciplinary perspective. A systems understanding has emerged from bringing together and sharing the knowledge gained from these different perspectives. Knowledge gained through scientific study of resource use systems has been triangulated against that gained through ethnographic enquiry by field anthropologists working under R6744.

The project activities have functioned as three parallel streams:

i) quantitative assessment of the natural resource base and resource use patterns
ii) qualitative ethnographic investigation of indigenous knowledge on natural resources management
iii) participatory and socio-economic studies and systems-based workshops

Figure 4 presents a detailed flow chart of the main project activities in these streams, with time progressing from top to bottom. To maintain clarity of presentation, cross-linkages are not included in the flow chart, however linkage and triangulation occurred between the streams.

The principal disciplines involved were:

- Farming systems / Agronomy
- Soil science
- Fisheries management
- Aquaculture
- Anthropology
- Environmental science / Botany

The anthropologists were responsible for the ethnographic stream, whilst the other disciplines undertook specific survey and monitoring activities in the quantitative assessment stream. The third stream and the analytical stages were combined efforts.

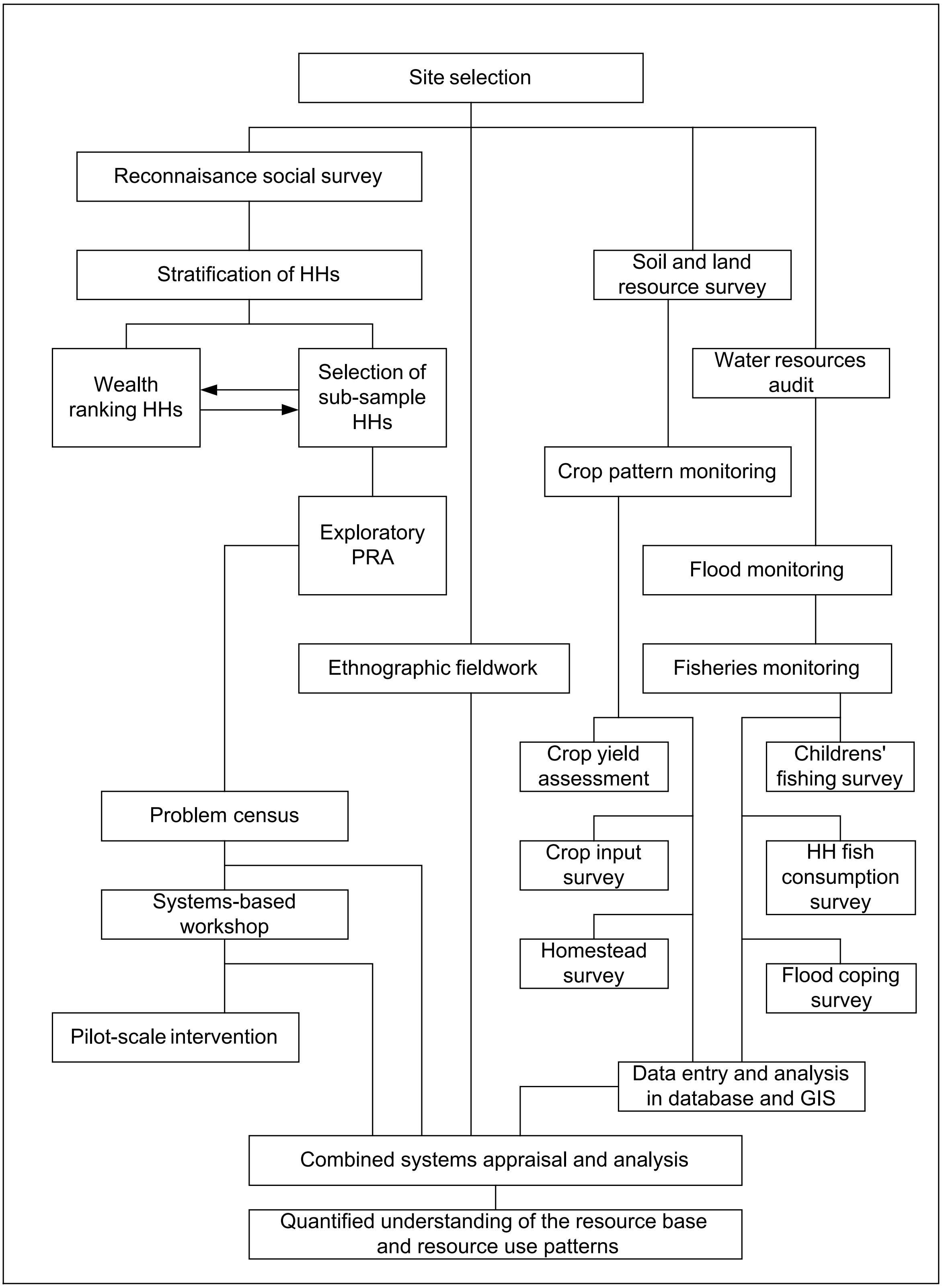


Figure 4 Flow chart of project activities

The main research activities are described below:

4.1 Scoping - Site selection, site maps and field bases

The project aimed to develop an understanding of the resource use issues in floodplain areas where the 'land/water interface' is important, i.e where the seasonal expansion and recession of floodwater occurs over a spatially broad zone, and an interaction between fishing in aquatic commons and cultivation of private land occurs during these seasonal fluctuations. It was decided that such circumstances occur in the expansion areas around perennial *beels* and in riverine floodplains, and that a site should be selected on each of the Ganges (Padma) and Brahmaputra (Jamuna) floodplains. *Beels* and *beel* communities were also selected as the focus of the research sites because they are representative of social and natural resource conditions for large areas of the floodplain. *Beel* communities are primarily agrarian communities located around ephemeral or perennial *beels*, whose arable land experiences extensive monsoon inundation. The settlements are normally located on higher land on ridges or levees around these waterbodies or along elevated roads. The arable land is lower in the landscape, between the settlements and the perennial water, but at a position where much of it becomes seasonally flooded.

Examination of the FAO Agro-Ecological Zone reports (FAO/UNDP, 1988), the soil memoir of the area, and flooding pattern information, and discussions with EGIS[7] and CNRS[8] revealed that Tangail District offered several possible *beel* locations for a Jamuna floodplain site. Charan, Elasin and Bathuli *beels* were visited, with Charan *beel* offering the best potential for a study site as it encompasses more land of medium height than Elasin and Bathuli, and thus the land/water interface is a more distinctive and important feature of the resource base here. The sites lies at intersection of Agro-Ecological Zones (AEZs) no. 8 and no. 9 - Young Brahmaputra and Jamuna Floodplains and Old Brahmaputra Floodplain respectively.

In the Padma floodplain, the aim was similarly to identify a *beel*-type waterbody of sufficient size and depth to provide perennial water, and thus a dynamic year-round interaction between terrestrial and aquatic production systems. One of the studies in R6383 was in a *beel* in Mohanpur *thana* in Rajshahi district, however minimal fishing was found to occur here due to the increasing ephemerality of the *beel*, so the site did not provide the interaction between competing production systems required for the present project. Other sites in the NW region were scoped including *beels* stocked under Third Fisheries Project, Kumari *beel* on the Shib river, Churi *beel* in the Mohananda floodplain, and Shuti *beel* and Goalkandi *beel* in Bagmara *thana*, but these were also discounted for various reasons. Eventually it was decided that Padma *beel* and the *beel* linked to it, Choto *beel* in Durgapur *thana* would be the most suitable project site. The site offered an appropriate land/water-scape, is reasonably accessible, and of a size amenable to study and modelling of resource use patterns. The soil memoir for the region showed it was a true floodplain site, with its major soil series comprising soils that are intermittently and seasonally flooded non-calcareous loams clay loams and clays, occupying nearly level to gently undulating ridges and basins on the oldest Ganges alluvial meander floodplain. Flooding occurs between to 1 - 2 feet for 2 - 3 months and 2 - 10 feet for 2 to 5 months, and the soil is unsaturated for about 5 to 7 months during the dry season.

The location of the sites is shown in Figure 5., and a summary of them is given below in Table 2.

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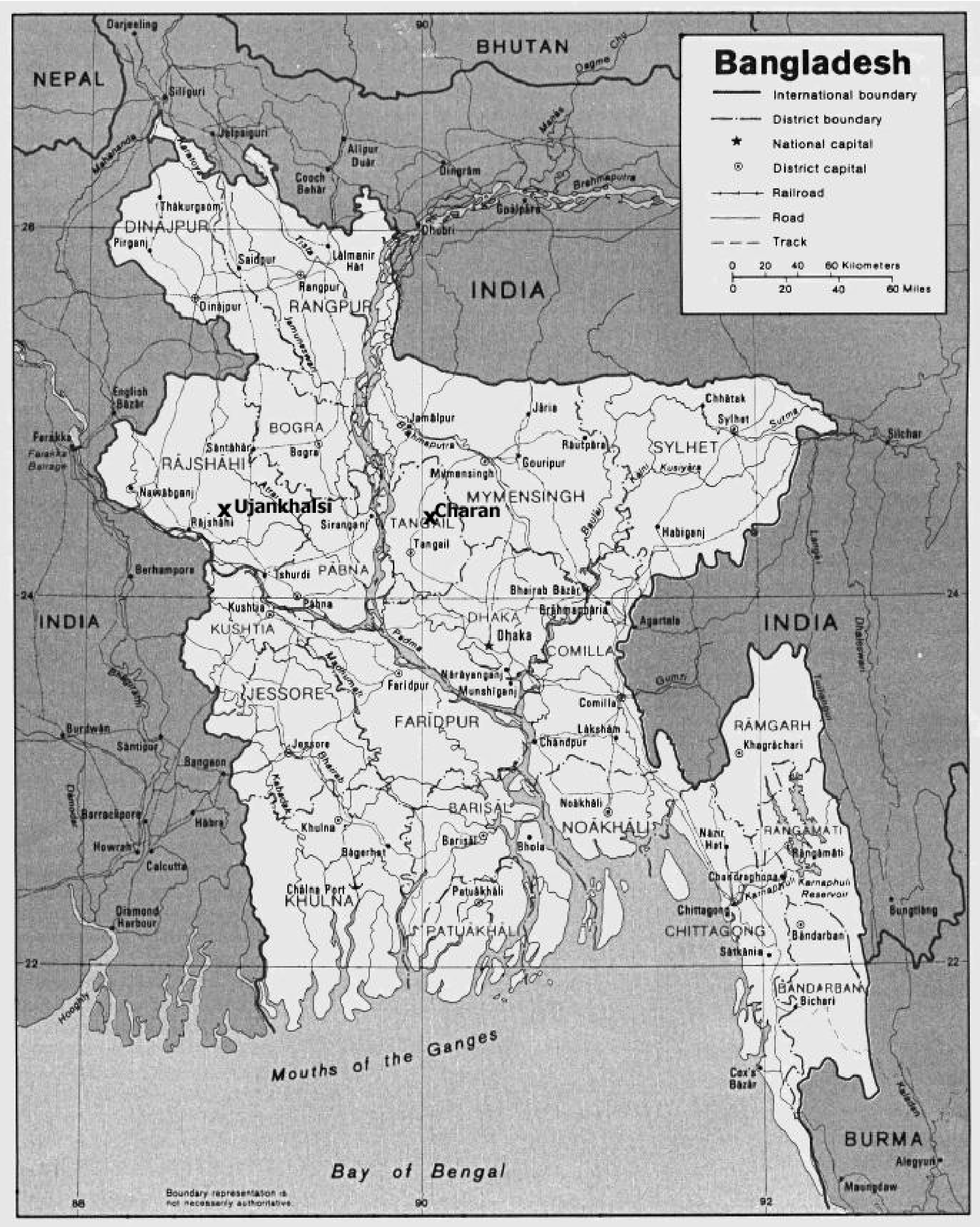
[7] EGIS - Environmental and GIS Support Project for Water Sector Planning. A project in the Ministry of Water Resources, funded by the Netherlands. Encompasses previous FAP 16 and FAP 19 activities.

[8] CNRS - Centre for Natural Resources Studies.



Source: http://www.virtualbangladesh.com/

Figure 5 Location of project field sites.

Base maps

The project planned to use GIS as an integration domain for geo-referenced data on the terrestrial resource base, agricultural production and flooding. The base maps for spatial data and the GIS were the *mouza*[9] maps of the study areas, which were purchased from the District Land Revenue office in Rajshahi (Padma *beel* site) and *thana* headquarters at Kalihati (Charan *beel* site). These are cadastral maps used for land tax purposes; they are at a 16” : 1 mile (1 : 3960) scale. These maps distinguish individual paddies and were digitised for use as the project base maps.

[9] The *mouza* is the smallest administrative unit in Bangladesh, approximating to a parish in Britain. Several mouzas make up a union, which is administered by a union council - the Union Parisad.

Table 2. Research sites

Site	Charan *beel*	Padma and Choto beels
Location	24º 21' N, 90º 01' E	24º 30' N, 88º 48' E
Description	Medium size *beel*, 16km west of the Jamuna river, lying between a major distributary of the Jamuna and a river draining the slightly uplifted Madhupur Tract to the east.	Two beels, one of which is ephemeral and the other has an area of perennial water; part of a complex of small beels.
Perennial waterbody (ha)	538	45
Seasonal floodplain (ha)	92	7
Study villages	AgCharan, Joynabari, PashCharan	Ratugaon, Ujankhalsi
Union	Kokdahara	Kismat Gankur
Thana	Kalihati (*thana* no. 287)	Durgapur (*thana* no. 120)
District	Tangail (District no. 44).	Rajshahi (District no. 16).
AEZ No.	No. 9, just east of boundary between 8 and 9	No. 11[10]
AEZ Name	Old Brahmaputra Floodplain; Young Brahmaputra and Jamuna Floodplains	High Ganges River Floodplain

Field bases

Since both R6756 and R6744 aimed to obtain in-depth information about floodplain production, field bases for the projects' joint use were established at each site. This enabled researchers to spend more extended periods in the field to build a better rapport with the farming and fishing communities of the study areas, to collect better quality data, to have longer periods in which to collect more reliable data, and to interact with each other as an interdisciplinary team. To this end, houses were rented in a village adjacent to each of the two study beels for the duration of the projects.

4.2 Sample selection, wealth ranking and stratification

Once field sites were established, field work commenced with a reconnaissance social survey (RSS). This was a very brief, ten question questionnaire that was conducted with all households in all the villages around the study *beels*. It was designed as a basic mini-census to provide a social overview of the resource users of the areas and to provide a basis for socio-economic stratification, which could then be used as a framework for sub-sampling households for in-depth studies. The household was used as the unit of study, with the head of household as the reference point for each household. The household is an accepted indigenous social unit that has a foundation in normative Islamic-Bengali culture (Herbon, 1994). Households are production and consumption units, represented by the head of the household (*karta*), who takes the perspective of the household as a whole. Demarcating the precise extent of the production and consumption unit is difficult, as it may extend beyond kin relationships, and may vary over the year (Ghosh, 2000). The smallest unit is the *khana* (those who share a cooking pot), but in practice the survey unit normally extends to the *bari* (those living in one compound).

The RSS was undertaken in five villages around Charan *beel* and three villages around Padma and Choto *beels,* covering 1907 and 930 households and approximate populations of 8,640 and 4,254 respectively. From these the villages of AgCharan, Joynabari, and PashCharan, representing 942 households, were selected at the Charan *beel* site, and Ujankhalsi and Ratugaon villages, representing 818 households, were selected at the Padma *beel* site.

This sample of households was then ranked according to the area of land owned by the households. The ranked list of households was then stratified into seven strata using an *a priori*

[10] (Office of Field Services, 1993).

stratification system based on the categories used by the Bangladesh Bureau of Statistics (BBS). In general, BBS classifies size of landholding according to three classes (Hossain, 1991):

small	0.05 - 2.49 acres
medium	2.50 - 7.49 acres
large	>7.50 acres.

However, finer divisions are recognised, as are three categories of landlessness. Thus the project stratified households as follows according to the scheme in Table 3. The distribution of households between these strata is shown in Figure 6. The rural population is a socio-economic pyramid, with a large number of landless and marginal households and a small number of larger farmers. Though few in number, the wealthier three strata own most of the land.

Statistical advice was taken on the size of the final sub-sample to be used for most of the NR data collection. Rather than take households from each strata in proportion to their prevalence in the population, which would have given a very small number of households in strata 6 and 7, equal numbers were selected from each stratum. Therefore, where numbers permitted, 30 households were selected from each stratum, giving a research sub-sample of 30 x 7 = 210 households per site.

Table 3. Stratification schema for project households

Group	Land owned		Socio-economic category
1.	<0.049	acres[11]	landless - Categories I & II
2.	0.05 - 0.49	acres	landless - Category III
3.	0.5 - 0.99	acres	marginal
4.	1.0 - 2.49	acres	small
5.	2.5 - 4.99	acres	medium – I
6.	5.0 - 7.49	acres	medium – II
7.	>7.5	acres	large

Stratification on the basis of landholding may be criticised on the basis of applying a single, externally selected criterion (Scoones, 1995). However, Bangladesh research has shown that from a range of sixteen health, demographic and socio-economic criteria, landholding has the most significant relationship with wealth ranks allocated by villagers themselves (Adams *et al*, 1997). Since stratification was to play a key role in undertaking a socially differentiated appraisal of resource use and livelihood strategies, a wealth ranking exercise was carried out at each site to triangulate the above stratification procedure. This was based on the Grandin methodology (Grandin, 1988) and yielded a unit-less 'wealth rank score'. At both sites the results showed good agreement between households placement into land-holding based strata and wealth rank score (Figure 7.). This showed that landholding is a good proxy for wealth and socio-economic status.

[11] Units. In Bangladesh, official documents give land area in acres, agricultural research results are published in metric or imperial units, and farmers report land area in either *decimals* or *bighas*. Decimals are units of 100th of an acre. *Bighas* are units of 1/3 of an acre (though this can vary with location).

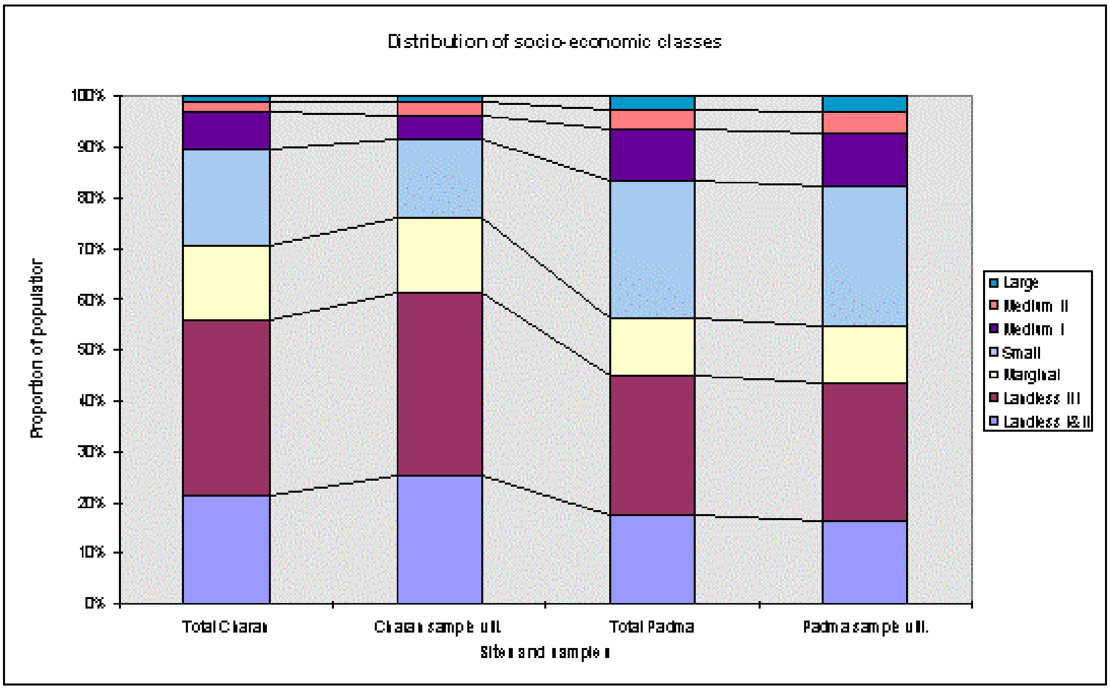


Figure 6 Proportion of households in each stratum

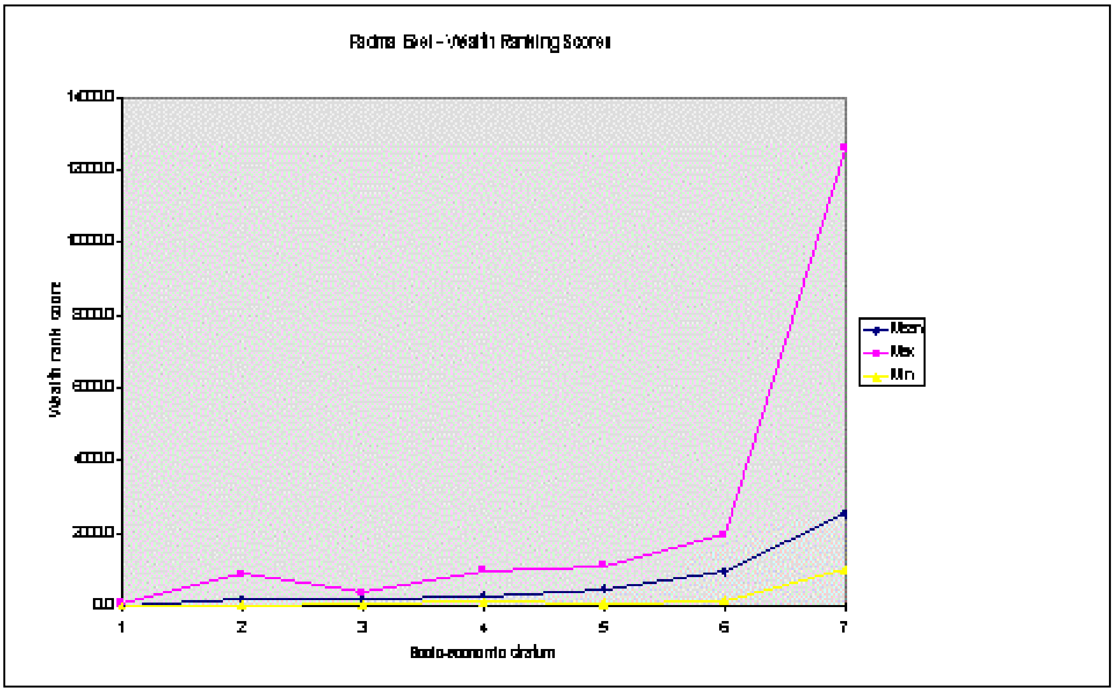


Figure 7 Padma *beel* - Wealth rank score vs. Strata

PRA

Following the RSS, sub-sample household selection and wealth ranking, an exploratory PRA was conducted at each site. The aim of the PRA was twofold:

- to act as a ground-breaking and rapport-building function with the households who would be involved in the research
- to provide initial insights into what producers say about their production. This could be contrasted with what monitoring shows they actually do.

The PRA proved to be useful to rapidly brief the field researchers about the basic production systems being practised at the two sites, but lacked detail for the type of systems analysis which the research aimed to perform subsequently. It did not provide the depth of information that was required on either the complexity of the land/water floodplain environment or the subtleties of the Bengali socio-political system that influences much of what people do in rural Bangladesh. It is considered that PRA is often done rather mechanistically in Bangladesh, and does not supply either the richness of data required for research or promise of peoples' empowerment that NGOs are seeking.

4.3 Natural resources field data collection

The following major types of field data collection were employed:

1. Water resource audit
2. Flood spread and depth measurement
3. Soil and land survey
4. Crop pattern monitoring
5. Crop yield sampling
6. Fisheries catch and effort monitoring
7. Fish marketing, fish consumption surveys
8. Homestead production/consumption surveys

Water resource audit

This activity involved creating an inventory of all water resources in the study areas, including *beels*, rivers*, khals*, seasonal and perennial ponds, ponds in paddies, wells, deep and shallow tubewells, pumps and other water bodies. These were located on the GIS. Where appropriate to the type of waterbody, their ownership, management regime, uses and users were recorded through interview. The size and depth were measured where possible. Concerted efforts were made to monitor on a monthly basis the water quality of ponds, so as to determine their potential for aquaculture development. At the Ujankhalsi site, this involved the use of a Hach portable water quality test kit. At the Charan *beel* site, an agreement was reached with the Faculty of Fisheries at BAU to analyse water samples. Both sites also made field measurements such as temperature and Secchi disk observations. Water quality measurements were abandoned at both sites; at Ujankhalsi it was not possible to get reliable data due to both deterioration of reagents and operator error; at Charan it was not possible to get the samples processed promptly, so the data that were eventually obtained were on samples that had degraded in storage.

Flood spread and depth measurement

It was necessary to obtain data on the spatial extent (spread) of the flood on the floodplain over the course of the annual cycle, particularly as it related to inundation of arable land. In addition to flood spread, data was also required on flood depth over different parts of the floodplain, as this would affect different locations' suitability for various land uses. These measurements were needed on a monthly frequency.

Three options were available to record flood spread:

- use of a surveyor's plane table and stadia rod (staff)
- use of GPS to record way-point around the *beel* shoreline
- manually plotting the *beel* shoreline on hard copy *mouza* maps

GPS was ruled out as expensive, inaccurate at the project's operational scale (1:3960) without a costly differential base unit, and overly technical for the application. From the water quality experience it was decided to use low/appropriate technologies where ever possible. Once field staff became familiar with the area and the location of plots on the *mouza* maps, this proved the simplest method to use, and the plane table was abandoned. Thus each month the field staff walked around the shoreline of the *beel* / flood, marking its location on the plot map. The 'edge' of the flood was the outer boundary of each paddy that had an inner *bundh* or *ail* (mud wall) under water, and an outer one standing proud of the flood water. These 'flood contours' were then transferred to the GIS (Figure 8).

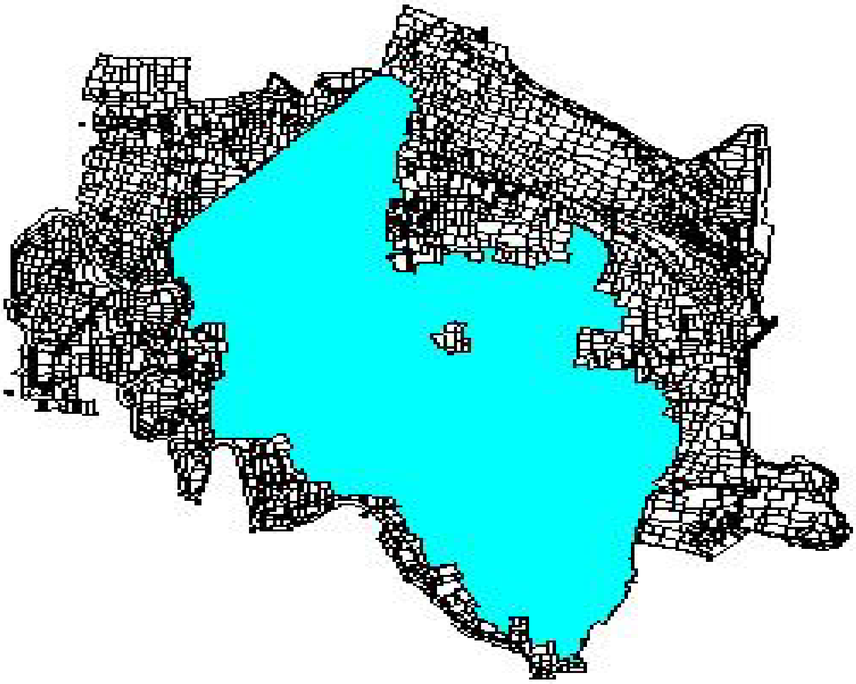


Figure 8 Charan *Beel* – Maximum flood spread (September 1998)

Flood depth was established using a staff gauge located near the deepest part of the perennial *beel*. Absolute depth was recorded on this on fortnightly intervals. For a number of purposes notional sampling transects were established across the *beel* and floodplain at each site between fixed and obviously visible end-points, such as a white mosque and a bridge. At a point in time as close as possible to the height of the annual flood, water depths were sounded from a boat along these transects on 50m intervals. These depths were interpolated in the GIS to approximate bottom contours across the whole study site. Water depth at any point in the *beel*, at any time, can be estimated in the GIS using the absolute water deep at that time, as recorded on the staff gauge.

Soil and land survey

The terrestrial resource base was surveyed using two stages of soil and land resource survey, plus a farm walk together with the R6744 field anthropologists. Initially a reconnaissance survey was undertaken to determine broad soil patterns in relation to landscape position and flood depth in and around the *beels*. This used a shallow pit and auger method following up to six transects across each site. The output from this survey was a provisional soil map legend, based on the 1:50,000 scale Government of Bangladesh soil memoirs for the Districts in which the sites were located. A detailed soil and land resource survey was then undertaken, following free survey methods with full soil profile descriptions for each series and intensive augering to establish soil series boundaries. Soil distribution was described in relation to landfrom, elevation, seasonal flood depth, land use and predicted management constraints. Soil samples were taken from each series for chemical and physical analysis in the laboratory. These were done at the Bangladesh Rice Research Institute (BRRI), with check samples analysed at

Newcastle University. The output from this stage was a 1:3,960 scale soil map and soil survey report for each site (Annex 6). The maps were digitised into the GIS (Figure 9).

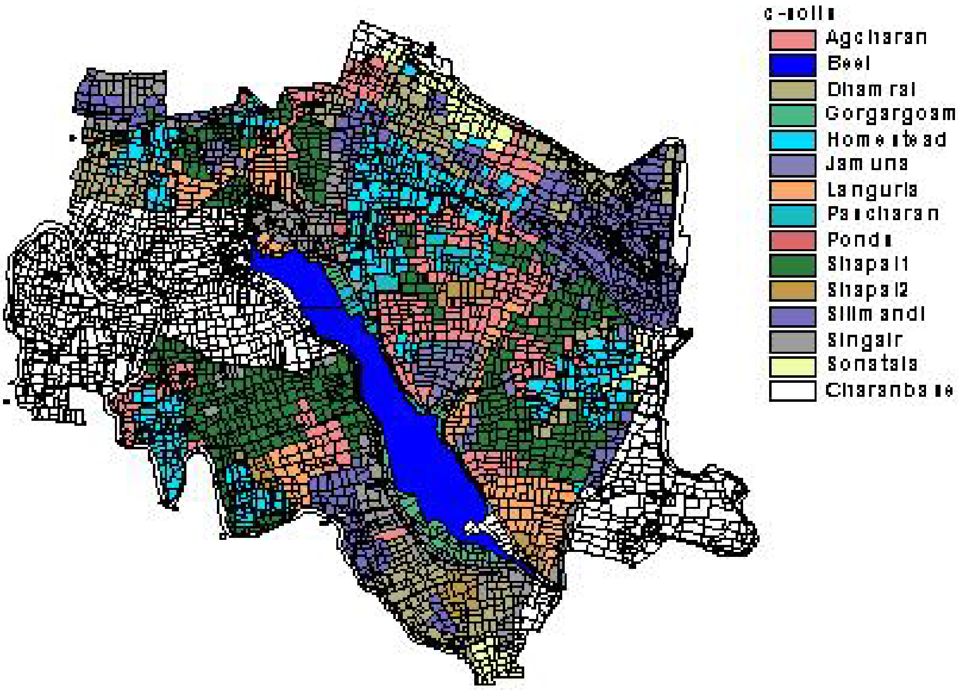


Figure 9 Detailed soil map – Charan *beel*

<u>Crop pattern monitoring</u>

Rather than use a PRA approach to obtain general crop rotations used over the annual cycle, the aim was to observe and monitor how what crops were being grown in a sample of fields/plots each month of the year. It was hoped that this would be able to detect subtle differences in cropping pattern according to land heights or cultivators' socio-economic status or livelihood system. Initially the plots lying on the transects established for water depth measurement were monitored. However this was too small a sample size, so at Ujankhalsi, the sample was extended to all the plots lying within the Padma *beel* micro-catchment. In practice this ended up being the plots in the micro catchment in Ujankhalsi *mouza*. The crop type being grown in each plot was recorded each month, together with some basic data on variety and growth stage, where available. These were entered into the GIS (Figure 10).

In order to be able to link the crop pattern data to the socio-economic data from the RSS, a survey was undertaken to confirm the identity of the owner of each plot, and if it was sharecropped, who the sharecropper was. At Charan *beel*, due to the much large size of the site, an alternative approach was taken to extending the sample. Rather than selecting an area and then finding out about the owners and cultivators of those plots, the owners were selected, and their plots monitored. Thus the plots belonging to the approximately 210 households from the RSS sub-sample were monitored, and the identity of their sharecroppers was also established where applicable.

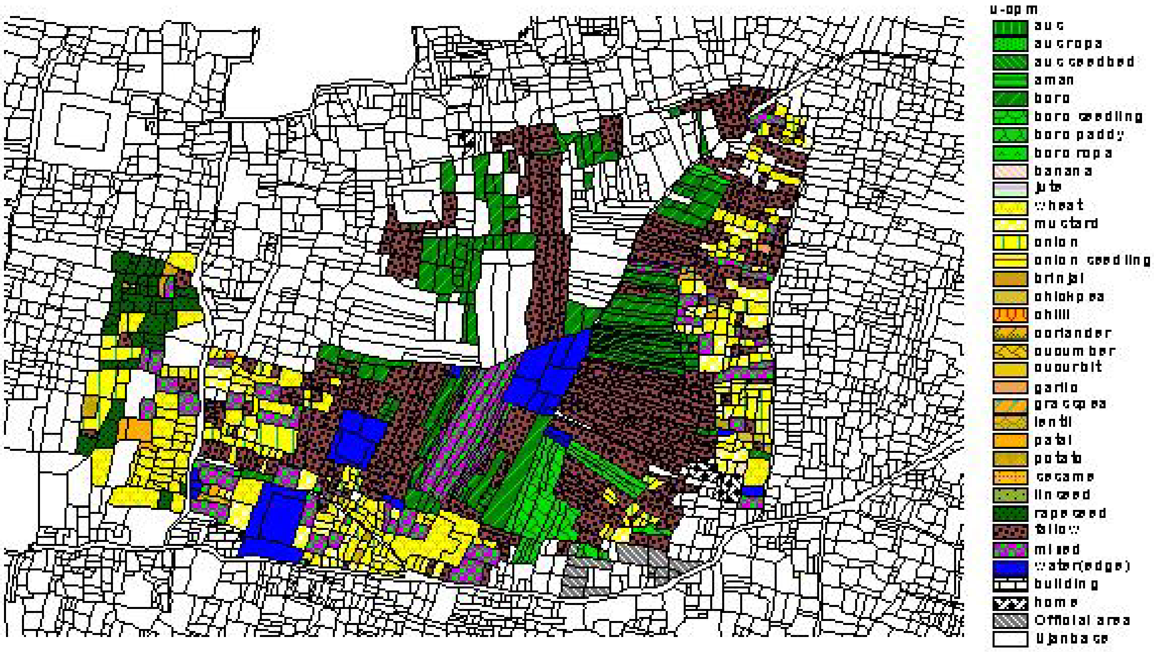


Figure 10 Cropping pattern at Padma *beel* (January 1998)

Crop yield sampling

Direct yield sampling was undertaken on a small sample of plots for each of the major rice crops at both sites. Thus for each of the *aus*, *aman*¸ and *boro* crops, five plots being cultivated by each of the seven socio-economic strata were identified (i.e. 5 replicates x seven strata [treatments] = 35 plots). A 3.5m x 3.5m quadrat was laid out in each plot just prior to harvest and the sample of crop from the quadrat harvested and the yield of straw and grain weighed. This method has a large degree of inherent error and is thus not particularly useful for establishing absolute yields. It can however be useful for comparing relative yields between socio-economic groups.

Fisheries catch and effort monitoring

The aim of this activity was to record the fishing strategies of households described as fishers in the different socio-economic groups in the study areas. The output would be a database of fishing activities in each *beel* for each socio-economic class. The database would include details of fishing availability (i.e. leasing, pond or *kua* ownership), employment (i.e. full-time, part-time or employed), species exploitation and stock assessment. It was not possible to record the precise location of where fishing took place, so this data was not included in the GIS.

The original aim was to monitor sub-sample of ten fishers from each socio-economic stratum, but since most fishers were in the poorer strata, in practice all fishers were monitored. Initially a detailed profile of each fisher household was established, including details of name, area of land owned and cultivated, ownership of pond areas (including their sizes) and *kuas* (numbers, location), and leasing of rivers and *beels* (total area owned or leased and plot numbers). Thereafter, each fisher was visited monthly and information collected on the time spent fishing, the gear used, the fishing location, the catch composition (including details of species (fish and invertebrates) and size), the weight of catch and the value of the catch during that month. Additional information regarding the employment of other the fisher people was collected. A further one-off survey was done on children's involvement in fishing, especially their effort, types of gear, species caught and reasons for fishing.

Fish marketing and fish consumption surveys

Researchers monitored the marketing of fish in the local daily (*hat*) and weekly (*bazar*) markets. They measured size of a sample of fish being offered for sale, and recorded species for sale and their price at each market.

Homestead production/consumption surveys

In addition to fish catch and marketing effort, a further survey of household consumption of fish, and other protein sources, was also undertaken. Monthly monitoring was carried out over a year with five to six households from each of the seven strata. For a sample five day period each month, the following data were collected by 'resident monitors' – usually local village women given some training:

> weight, size and species of fish consumed at each of up to three daily meals, other protein consumed, sources of fish (caught or bought), if caught – where and by whom, fishing activity patterns in the family.

A one-off inventory of homestead natural resources (livestock, trees, etc.) was also undertaken, as was a record of household expenditure and income for a sub-sample of households at Ujankhalsi. Due to the amount of data coming from the 'field' studies (as opposed to homestead studies), and due to the project focus being on land and water interactions, these activities were given less importance. A MSc student undertook a project on fuel use and nutrient cycling at Charan *beel.* This involved sampling fuel types, ash and dung and analysing them for NPK, and recording types of fuel used and measuring quantities used. Recycling of ash and dung back to the field was assessed, and household nutrient budgets calculated. Annual fuel source charts were also created from interview data (Harvey, 1998 [see Section 6.1 – list of Outputs]).

4.4 Indigenous knowledge studies

An in-depth study of the indigenous knowledge (IK) was undertaken under the auspices of the sister project (R6744) funded under the Socio-economic Methodologies (SEM) programme. This aimed to provide the NR scientists in R6756 with information on two sets of factors:

- IK of floodplain society and the social and cultural factors that influence NR management
- IK of natural resources and their management

This activity was mainly the responsibility of two field-based RAs under R6744. They used standard ethnographic techniques (long stay, participant-observation, informal interviews, 'snowballing', everyday conversation and participation) to gather information on topics including:

- institutional and informal structure of political relations in the villages
- village social organisation
- composition of kinship groups
- dispute resolution
- local history
- seasons and climate

- land classes/topography, soil type names and classification, terms for soil properties/characterisitics, soil management
- cropping practices, social issues informing cultivation decisions, cultivation practices, crop consumption, pest management
- homestead production
- wild food sources
- waterbody types, water plants and animals, waterbody management, water spirits and rituals
- fishing practices, social issues informing fishing, access to water and fishing rights - open water *beel* fisheries and ponds, labour arrangements in fishing, fish classification, fisheries management, consumption, technology and fishing methods

Their data was made available as reports from the field, chapters from their MPhil/PhD theses, and as English translations of raw transcripts of interviews in the field. These transcripts were entered into a type of qualitative database package known as computer-assisted qualitative data analysis software (CAQDAS). The specific package used was QSR NUD*IST (Qualitative Solutions and Research's Non-numerical Unstructured Data Indexing, Searching and Theorizing). This package is a tool for managing data such as interview texts, searching the data, coding sections (words, sentences, paragraphs, etc) of text, developing coding structures, and querying coded data to elucidate concepts emerging from the data. Text is coded in two ways, factually on the respondent (gender, age, location, education, etc), and by reference to what is being said (topic, attitude, etc). Thus, for example, text can be coded according to various NR topics – soil fertility, manure, moisture retention, erosion, and then the full database of up to hundreds of interviews can be searched to see if there is a coherent theme in what, say, women between 15 and 30 think about tree planting and erosion. This technique is covered in more detail in Barr (1998) [Annex 10.9], Barr *et al* (forthcoming) [Annex 10.14], and Barr (1999) [conference paper at the Institute of Education, February 1999]. NUD*IST was used in the production of the outputs by Blyth (1998) and (Barr et al, 1999) [Annex 10.13].

In addition IK was collected in the course of NR studies. Soil survey is normally a hybrid technique relying partly on direct observation by the expert, partly on measurement, and partly on discussion with farmers and other land users. Some IK of NRM resulted from this process. Specific studies of IK on NRM were made by NR scientists undertaking MSc projects at University of Newcastle (see Sections 6.1 and 6.6 – lists of dissemination outputs): Cannon (1997) on IK in soil survey, and Harvey (1998), which used a combination of quantitative and qualitative data collection processes to investigate fuel use and nutrient cycling.

4.5 Data integration and interpretation

The project used various types of computer database as integration domains for the different types of data collected, and to manipulate the data into formats appropriate for analysis and interpretation (Figure 11).

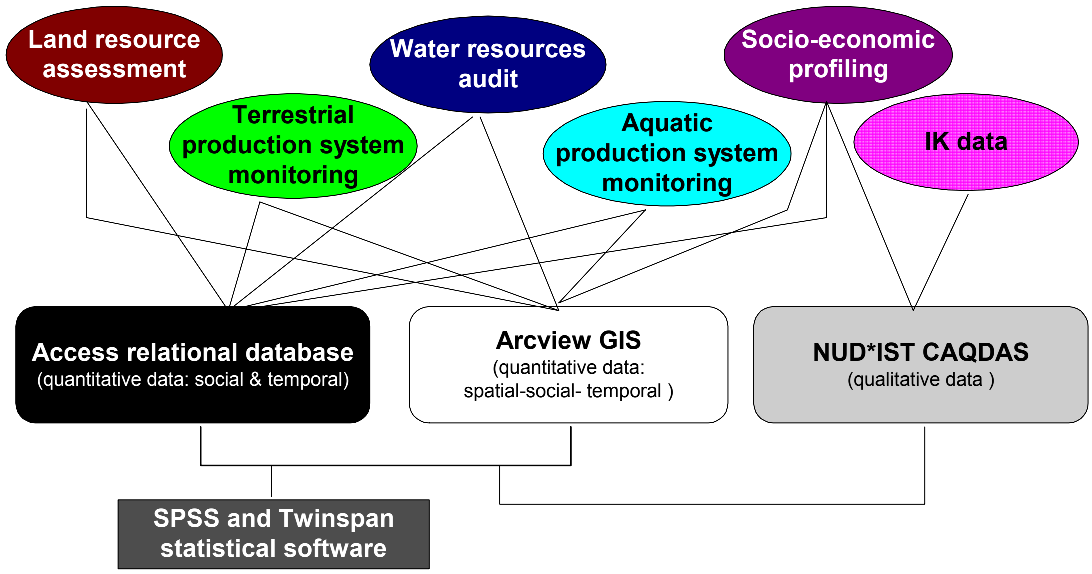


Figure 11 Data integration scheme

This system depended on field data being entered in PCs in Bangladesh, and then being e-mailed to the UK, where they were re-checked and added to the appropriate databases. The project leader ran a data archive, maintained a meta-database of field data, and acted as a clearing house, directing disciplinary data to the appropriate researchers. This scheme was implemented as above, however the initial entry of raw data was not always consistent or in a format where the month–by–month monitoring data could easily be appended to the databases. Consequently quite a large amount of time had to be invested in data clean and formatting. This reduced the time available to interrogate the integrated and compiled databases.

4.6 Problem census and systems-based workshop

This set of activities is reported more fully elsewhere – Section 5, Output 4, and Annex 2. It was a two-stage process:

- An initial identification of different stakeholder groups' main production constraints through a problem census (Crouch, 1991; DAE, 1995; Bhuiyan & Walker, 1996) with individual stakeholder groups.

- A four to six day village-based workshop that facilitated a detailed analysis by primary stakeholder groups of options to resolve the priority production or resource management constraints identified from the problem census. The workshop process facilitated systems learning by stakeholder groups about each other's production systems.

4.7 Administrative and logistical activities

The project was staffed by a large team:

In the UK

- Newcastle University - Centre for Land Use & Water Resources Research and Department of Agricultural and Environmental Science
- Stirling University - Institute of Aquaculture
- Durham University - Department of Anthropology

At the Ujankhalsi site

- Rajshahi University - Centre for Environmental Research
- Gono Bishwabydhalay (People's University) - Centre for Environmental Research
- Centre for Environment and Development (NGO)

At the Charan *beel* site

- Bangladesh Rice Research Institute - Rice Farming Systems Division
- Bangladesh Agricultural University - Farming Systems and Environmental Studies
- Bangabandhu Agricultural University (formerly Institute for Post-graduate Studies in Agriculture) - Department of Agronomy and Agroforestry

At both sites, especially Charan *beel*

- Center for Natural Resources Studies

Senior researchers and research assistants were involved from these institutions. The Bangladeshi institutions provided a number of junior staff to undertake the field activities (Section 4.3), usually involving them in at least one week per month at the field sites. In addition, local enumerators were employed from the village sites. Co-ordinating such a large team relied upon a UK project leader (Barr) and a site co-ordinator for each site (Zuberi and Naseem). Managing large, *ad hoc* multi-site, multi-institution, multi-discipline teams has been described as an "administrative challenge" or a "research administrator's puzzle" (Chubin *et al*, 1986). The task was only made possible by providing the site co-ordinators with e-mail, but the project was nonetheless ambitious in its scope.

In addition to e-mail communication, the full UK project team aimed to meet together on a six-monthly basis. It was decided at project initiation that UK staff field visits to Bangladesh would be in series rather than parallel, to maximise the period of time during which there was a UK researcher in the field. It may have been better for interdisciplinarity and information sharing if the visits had occurred as a team instead of a series of individuals.

In order to improve uptake of research products by target institutes, a project consultative group was formed from a selection of NGO, government, donor and academic institutions in Dhaka. It was not possible to maintain the initial momentum of this group throughout the project, partly due to difficulties of maintaining contact with a large and diverse group from a UK base. The group were interested in the research and did therefore form the basis of the audience for the end of project symposium.

Evidence of other administrative activities such as meetings, workshops and minor presentations is provided in Section 6.2.

5. Outputs

The project aimed to achieve the following logframe Outputs:

1. A survey and analysis of the resource base available to floodplains producers[12] produced, leading to agro-ecosystem maps and modelling outputs validated by the producers.

2. A conceptual model of floodplain production systems created (based on a *beel* and a small riverine floodplain), and a robust, diversified and integrated strategy for floodplain production developed.

3. The environmental impact and socio-economic acceptability of Output 2 assessed.

4. A methodology for accessing of indigenous knowledge and its transfer to NR researchers, together with traditional and other effective mechanisms for identifying farmers' researchable problems, in concert with a related SEM project. (This Output will be generated by activities in collaboration with the SEM sister project.)

Output 1.

"A survey and analysis of the resource base available to floodplains producers produced, leading to agro-ecosystem maps and modelling outputs validated by the producers."

This output was achieved through the various land and water and agriculture and fisheries survey activities conducted during the project. The survey results were inputted into databases for structuring, inter-relating and analysis. Those results with a temporal and/or socio-economic reference were inputted into an Access relational database, those with a spatial and temporal or socio-economic reference were inputted into an ArcView geographical information system (GIS) (Section 4.5). The Access database and ArcView GIS address the objectively verifiable indicators (OVIs) for this output: "By mid project-year three, resources and resource use patterns mapped, inventoried and quantified in two key floodplain systems." Thus by layering the different agro-ecosystem maps generated through the disciplinary NR studies (Section 4.2 and Figures 8, 9, and 10) and combining these with a layer socio-economic data, novel analyses of the type of natural resource available to different types of household can be generated (Figure 12.). The socio-economic layers were derived by combining social survey data with geo-referenced information about the identity of plot owners and sharecroppers.

The database and GIS have been further developed as a distributable CD-ROM, in a user-friendly format, with a tutorial and exemplar data interrogations. Validation did not occur as had been originally envisaged, by taking computer maps and modelling outputs back to the village for feedback and comment; time and resources limited the options for doing this. Also, it was uncertain whether it would be possible to design and manage a validation/evaluation process of sufficient scope to match the socio-economic and natural resource scope of the outputs generated by the database and GIS. Therefore, validation occurred partly through triangulation of the quantitative results with the qualitative findings from the IK studies, and partly through the systems based workshop (Annex 2).

[12] In this context 'floodplains producers' mean those who make productive use of the natural resources of the floodplain, and is taken to include farmers, fishermen, and those who depend on both farming and fishing.

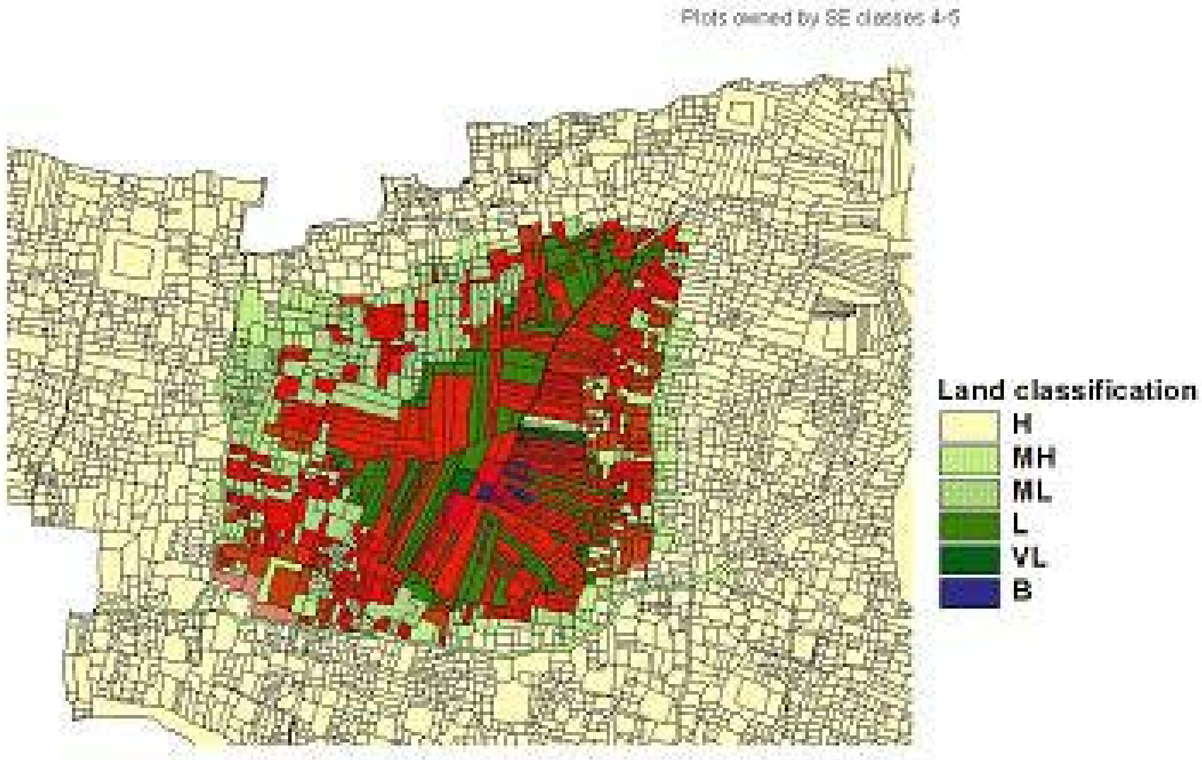


Figure 12 Plots owned by households in strata 4 and 5 – Padma *beel*

Output 2.

"A conceptual model of floodplain production systems created (based on a *beel* and a small riverine floodplain), and a robust, diversified and integrated strategy for floodplain production developed."

The aim of this output was to develop a model that progressed beyond that produced in project R6383 (Figure 3). The R6383 model lacked explicit spatial and temporal dimensions, and addressed an axis of social differentiation only in broad terms. This framework for the model therefore incorporates all these dimension, to characterise production systems in relation to their defining spatial, temporal and socio-economic factors (Figure 13). The framework allows multiple layers of different types of data to be queried, linking them according to points in time or space or socio-economic status. However the complexity of interaction between these three determinants of production, does not permit a simple 'floodplain production system model' to be presented, and a schematic is not available. The disciplinary studies have each developed an in- depth understanding of their component of the system, but interdisciplinary analyses have only been possible towards the latter part of the project, when some project staff had departed. Nonetheless there is now a good understanding of the functioning of the floodplain system both at the level of its parts, and as a whole (or system). However, the conceptual model of floodplain production systems is best illustrated through specific cases.

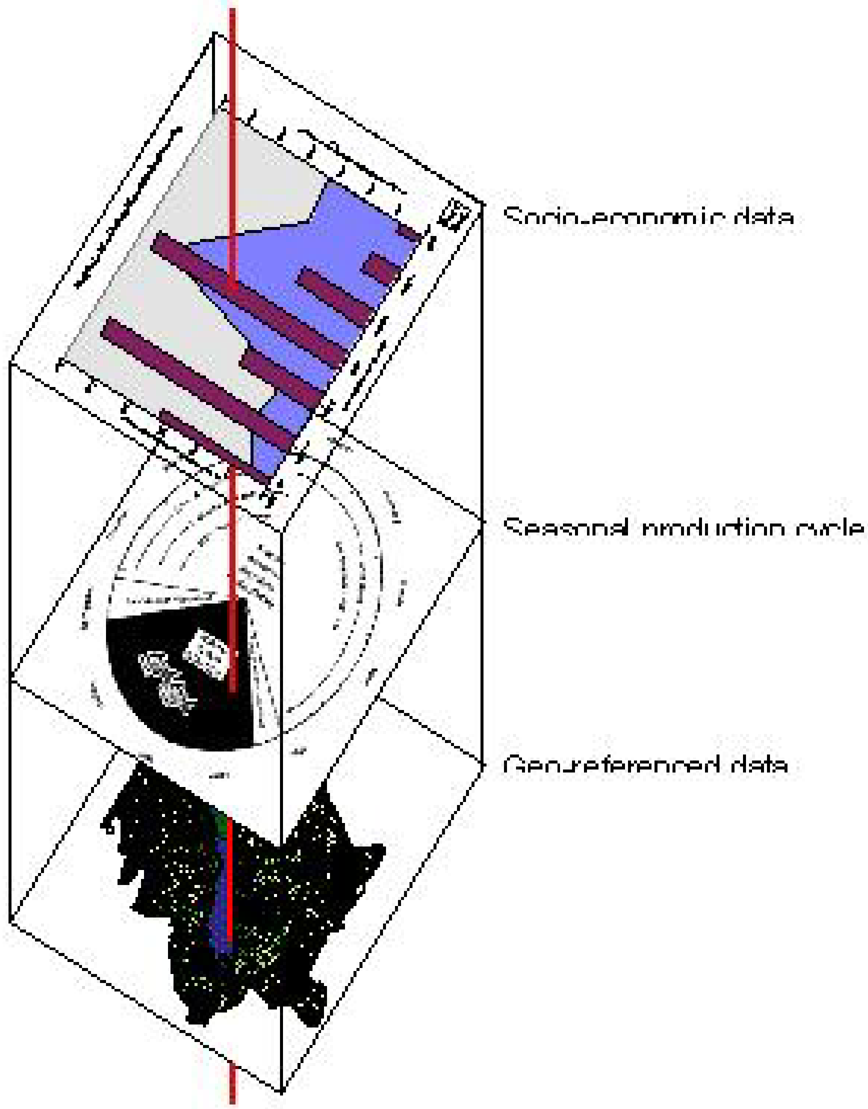


Figure 13 Systems framework for modelling floodplain resource use

From the appraisal of the resource base (Annex 6) and IK studies on natural resources management (R6744), is became clear that though farmers appreciate soil properties, they do not have a large impact on the cropping pattern. This is controlled mainly by the flooding regime at any given part of the landscape. Thus the annual flooding cycle is the a key determinant of production strategies. Therefore flooding can be related to aquatic production (fishing effort) and terrestrial production (areas of different crops), to assess potential conflict and complementarity (Figure 14). At Padma *Beel*, Fishing effort by fishers in socio-economic strata 1 to 5 followed a similar pattern, with peaks in August and November, and troughs in December, February and April. This complements well the dry season agricultural pattern, which has peaks of labour demand for cultivation and planting *boro* and onions, in December, weeding in February and harvest in May and June. Therefore, at this site, the newer irrigation based cropping system has matched production strategies. When poorer household's income from fisheries declines after November, there is a compensating demand for agricultural day labour.

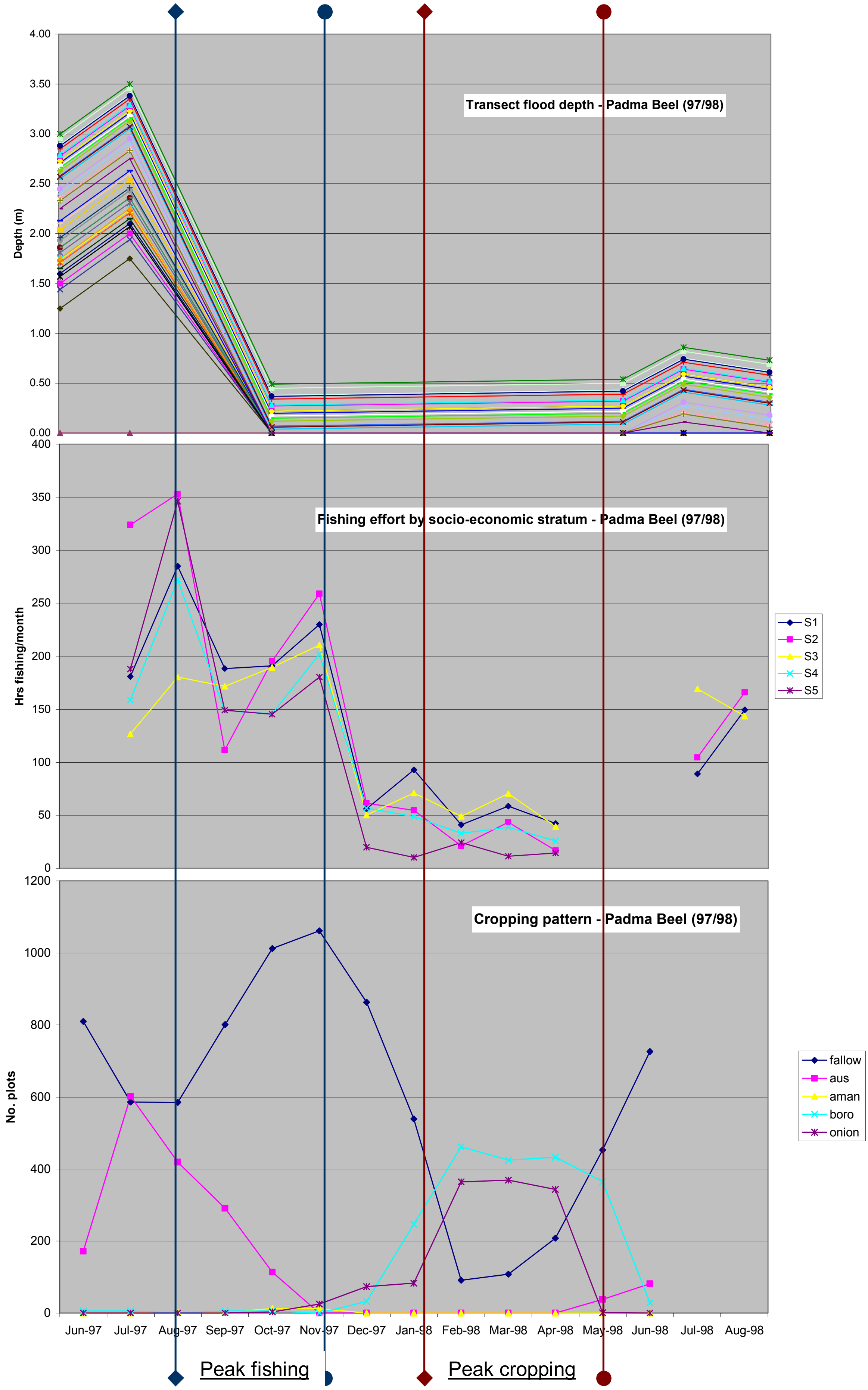
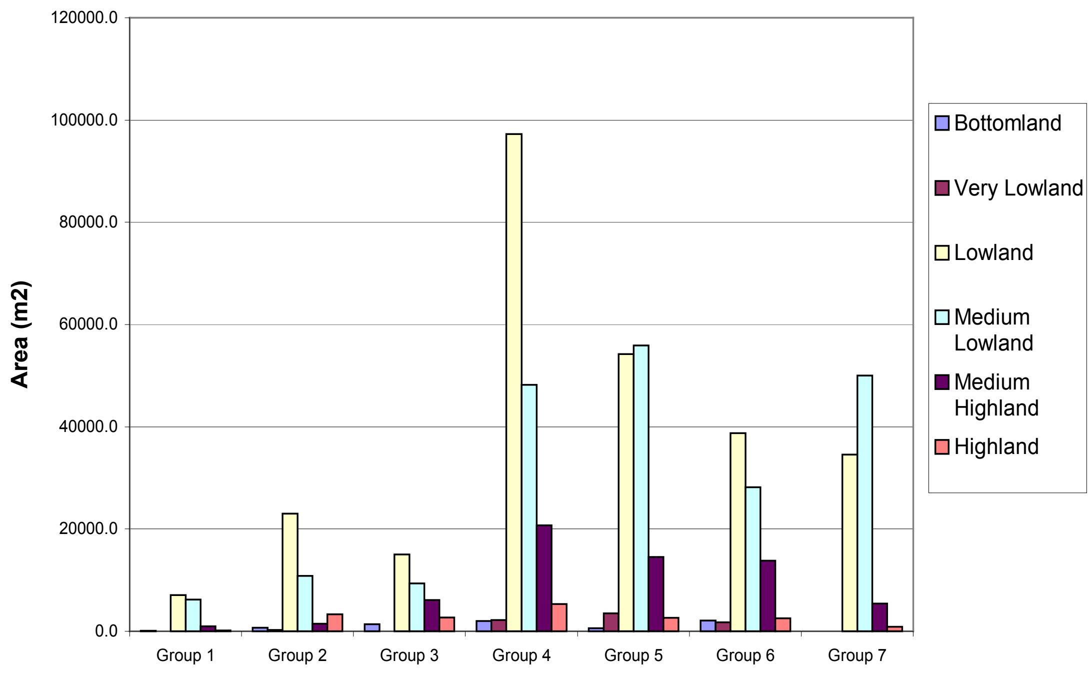


Figure 14 **Resource base and resource use profile – Padma Beel**

The *aus* crop may compete with fisheries for labour in August and September. September and October are the traditional lean season (*mara Kartik*), but it can be seen the with fishing efforts of 5 to 6 hours a day, even by households with more than 2.5 acres of land, diverting effort into fisheries can to some extent offset this. This demonstrates the need for a systems appraisal. Interventions that negatively affect fisheries at this time off year have a wide-ranging social impact. From the extent of the fallow area during this period, it can be seen that there are very few compensating agricultural options.

This analysis can be taken deeper, for example by determining who is growing the crops recorded in Figure 14. The poorer types of household hold their land at lowland and medium lowland landscape positions, whereas the less flood-prone land which has a wider range of cropping options is held disproportionately by households of medium and upper medium socio-economic status (Figure 15). Most low-lying land becomes too deeply flooded for *aus* cultivation, resulting in poorer households needing to produce the bulk of their food grains from the high input requirement *boro* crop. The land available to different households is not limited to that owned by them; there is a sophisticated sharecropping system in practice (Figure 16). Contrary to what might be expected Socio-economic stratum one, that group with the least land, do not sharecrop the most land. It appears that they do not have enough resources to overcome the barriers to entry into sharecropping (such as being able to purchase fertiliser). Their only asset is the sale of their labour. Thus a socio-economic model that emerges from the systems analysis highlights the key role played by entrepreneurial small farmers. This can be seen from the analysis of who at Padma *beel* is cultivating onions (Figure 17). Onions are a recent introduction to the area, replacing *boro* from some cropping patterns. This cash crop is more profitable than *boro*, but it is input and labour intensive. Small farmers were found to be sharecropping in land from labour-poor wealth households and buying in agricultural day labour from land-poor landless households. In this way they minimise their fixed costs, yet had flexible control over their variable costs (labour) if this rapidly fluctuating market declined.

Land Height Categories within Total Area of Land Owned by Groups 1 - 7 Study Site, Ujankhalsi



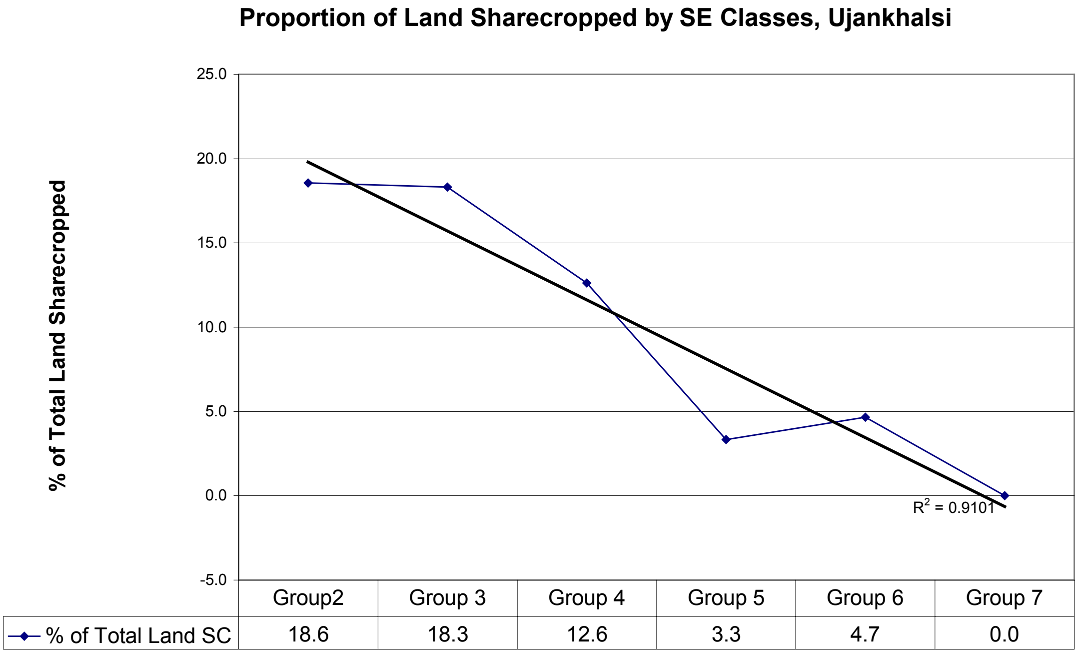


Figure 15 **Distribution of land height by socio-economic group – Padma Beel**

Figure 16 **Relationship between sharecropping and socio-economic group – Padma Beel**

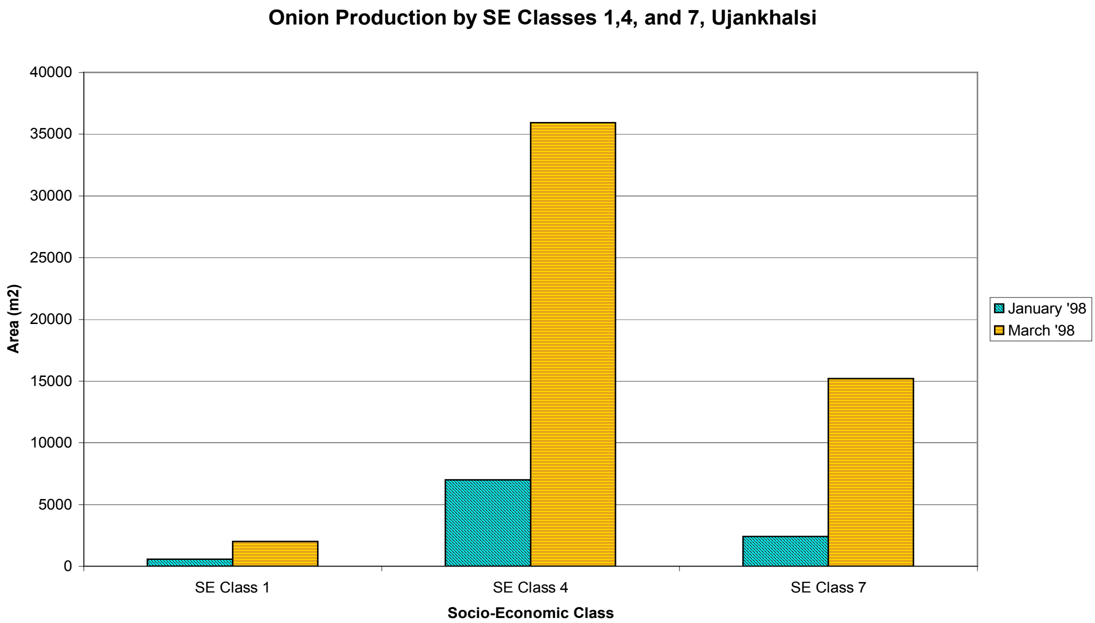
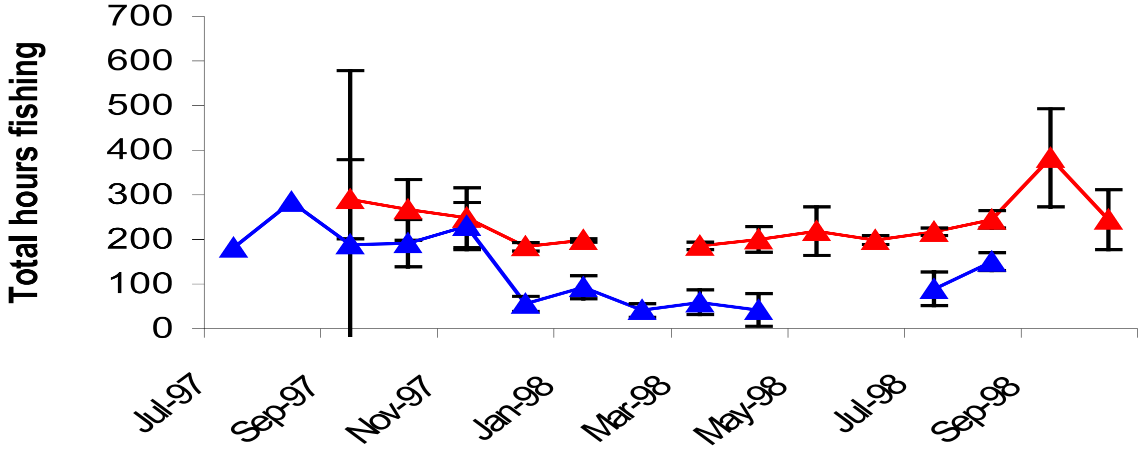


Figure 17 **Onion production by different socio-economic groups – Padma Beel**

The above illustration of the use of the systems data refers to the situation at Padma *beel*. Opportunities for extrapolation appears to depend on the flood regime and topography of other areas. For example, the large and more perennial waterbody at Charan *beel* allows the larger fishing community to maintain a more intensive year-round fishing effort (Figure 18). The cropping pattern at Charan is also biased towards irrigated dry season cropping. Thus there is



conflict in the dry season over use of *beel* water for irrigation and maintaining the waterbody as a fish habitat.

Figure 18 **Total number of hours spent fishing per month at Ujankhalsi (blue) and Charan (red) by social category one fishers. (Monthly means ±95%CL)**

In addition to a quantitatively based model, outputs from analysis of the problems census (Section Output 4.2 and Annex 2) by Barr & Haylor (Annex 10.8) and outputs from the system-based workshop (Annex 2), together with information from the IK studies (Section 5 - Output 4.1) have all contributed to the conceptual model of floodplain production systems and its validation. Thus, for example, Barr & Haylor's analysis shows how different groups' livelihood constraints map on to the Sustainable Livelihoods (SL) framework (Table 4). This demonstrates that fishers and landless and marginal farmers do not see their lack of natural resources *per* se as their most important problem, is the local institutions and social norms that limit access to the resource base are more important. As might be expected from an increasingly single rice crop system, landless farmers are badly affected by trends related to seasonality, especially low commodity prices at harvest. Another example of contribution to the conceptual model is the social mapping as a component of the systems-based workshops, that demonstrated how different social and occupation stakeholder groups conceive of their livelihoods in relation to other groups, and thus who are the key group that can affect their livelihoods (Figure 19).

Table 4 Categorisation of transformed problem census data according to the SL framework

	Vulnerability context			Assets (deficiency of)					Structures		Processes			Σ
Stakeholder group	Trends	Shocks	Seasonality	Natural	Social	Physical	Human	Financial	Public	Private*	Intra-Household	Local institutions & 'culture'	Formal governance	Points
1. Landless	2		23	15	6	5	3	4	8	5		32		100
2. Sharecroppers	10	1	8	11			10	12	15	23		10		100
3. Medium /large land owners	9	2	4	6		26	7	8	13	15		6	4	100
4. Seasonal fishermen	41		6					20				13	20	100
5. Traditional fishermen	44				7			16				33		100
6. Poor women	1	8	19	33		2	1	14	1	8	1	10	5	100
7. Wealthy women		8	6	13	5	3	14	9	14	2	6	22		100

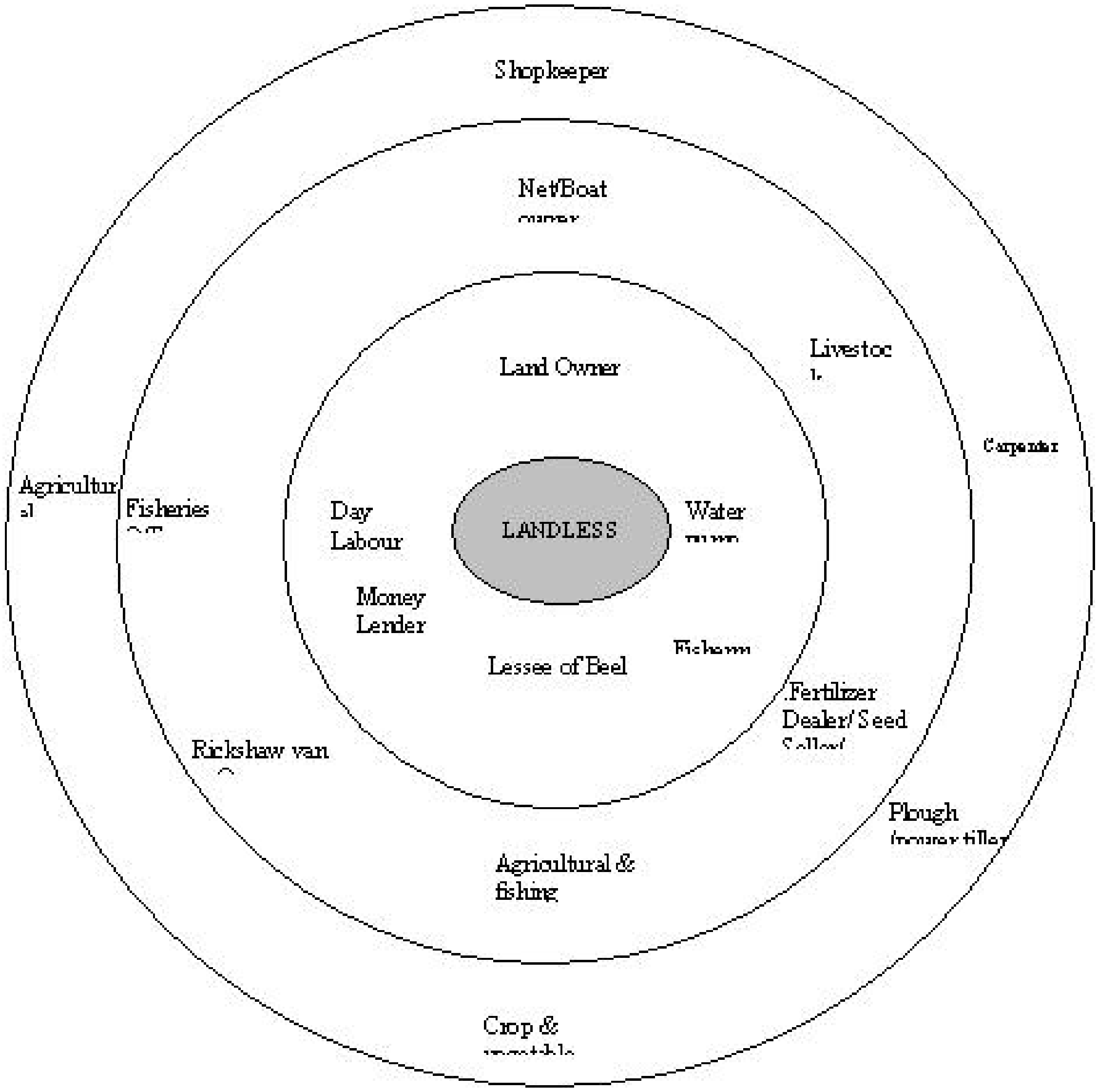


Figure 19 **Social map – Landless households , Charan *Beel***

Primarily due to time constraints on the analysis, it has not been possible to use the systems modelling framework to develop a "*robust, diversified and integrated strategy for floodplain production*". However, now that the research has provide an understanding of the bio-physical, socio-economic, institutional, cultural and political complexity of the floodplain system, it is apparent how vastly over-ambitious this objective was when it was written into the logframe, aiming as it did to be verified on the strength of having produced "*a sustainable production strategy for floodplains*". Nonetheless particular development options that would contribute to a strategy for better floodplain management have been explored by the project, largely through the village workshops (Output 4.2 and Annex 2).

Output 3.

"The environmental impact and socio-economic acceptability of Output 2 assessed."

This Output represented the opportunity to undertake an intervention that would take into consideration systems impacts, impacts in both the bio-physical floodplain system and the socio-economic system. That is, an intervention that would avoid in zero-sum (win-lose) outcomes.

Output 3.1 - Interventions

This Output was only partially achieved. The aim was to undertake a pilot-scale intervention at each site, and to monitor impact on the bio-physical environment, and use participatory tools to assess acceptability. The intervention to undertake at each site was, as outlined above (Output 2), also identified through a participatory process that addressed a priority NR problem for the - *beel* communities (Output 4.2). A necessary precursor to this process was deriving an understanding of the structure and functioning local communities and their NRM. This level of understanding was not achieved until a sufficient quantity of data had been synthesised. Thus the participatory problem identification process (Output 4 and Annex 3), was undertaken over a period spanning the end of project year 2 and the early part of project year 3. Potential interventions were identified, but project staff expressed doubts about the project itself implementing these interventions. The reasons for this were: the project was funded as a research project, and the resources would not stretch to fund an involved intervention of the type identified; the project was a research project and thus probably was not the most appropriate vehicle for implementing what could be viewed as a mini development project; and with only about one year of the project to run, could a sustainable intervention really be achieved in the available time, or might the intervention just end up being massaged to serve the immediate goal of the project, but not leave any more permanent impact on the village?[13] Two solutions were taken to this problem, neither of which fully addressed the Output, but both of which did result in at least limited local benefit.

At the Ujankhalsi site, the village workshop process was not able to arrive at consensus on the problem that was identified as the highest priority at a community level - this was management of water levels in the *beel*. Wealthier farmers wanted to manage water levels by digging a canal to drain the *beel*, whilst poorer households considered that this would detrimentally affect the *beel* fishery. Therefore it was decided to step back in the process and undertake some of the less ambitious interventions that specifically targeted production constraints identified by the poorer and disadvantaged members of the community in the problem census. The community as a whole had identified soil fertility decline as its second ranked problem, after management of *beel* water levels. Additionally, landless heads of households identified problems including lack of paid employment in the lean season (monsoon period), together with poor women, they identified a problem of poor knowledge of livestock husbandry. Women also specified fuel and fodder scarcity as a problem. Nearly all the poorer households identified lack of income earning opportunities as a problem. The project therefore undertook to address a number of these problems by acting as a broker, putting target groups in contact with service providers who were better placed than the project to make interventions, and as a catalyst, providing a micro-fund for training and materials. The success of the training was monitored by the resident IK RA. The training involved 24 farmers who attended a four day training on soil fertility management, conducted by the *Thana* Agricultural Officer and *Thana* Agricultural Extension Officer; 16

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[13] This raised an interesting issue in relation to uptake pathways and beneficiaries. To what extent should an aim of research projects be to have a direct but very localised positive impact on the type ultimate beneficiary (the poor and disadvantaged) who live at the research site, or is wider impact through the 'A - H continuum' more appropriate? This also raises the issue of expectations. Despite briefings to the contrary when field sites were established, during the course of the research, and prior to the problem census workshops, the mere presence of a research project inevitably raises expectations regarding the local benefits that a project brings. Rural people understand the term 'project', but do not differentiate between a development/implementation project and a research project. There does therefore tend to be a driver to undertake some type of intervention that will result in direct local benefit.

female participants who attended a three day training on duck rearing, conducted by the *Thana* Livestock Officer and *Thana* Veterinary Officer; seven female participants who attended a three day training on establishing tree nurseries, conducted by the NGO TRINAMOOL. Two people were assisted in trying to establish *Colocasia* rafts in village waterbodies.

At the Charan site, it was possible to reach a consensus on a community focused intervention. This addressed a similar problem to the Ujankhalsi site - both fishing and agricultural producers recognised that accumulated silt in the *beel* and access *khal* had negatively affected their livelihoods, and that some form of excavation would probably improve this. This was less contentious at Charan due to the area of *khas* land/water underlying the perennial area of the *beel*. This appeared to give different stakeholder groups room to manoeuvre compared to the entirely private land situation at in Padma *beel*, where the stakes were higher. However, the intervention that was selected as the most acceptable to all stakeholder groups was excavation of an area of the floor of the *beel*. This would provide a refuge for fish, and could be demarcated as a seasonal protected area, it would also act as a sump to speed the recession of the flood from agricultural land. It was realised that *beel* excavation was not going to be possible within the project time frame or budget. In this regard, this was an illuminating example of participatory or people-first processes in action. The research team had not approached the exercise with a technology in hand, but equally were not practically able to offer an immediate solution to the problem that did arise.

Nonetheless, it was decided to try to pursue this a solution to the problem that the stakeholder groups did identify. The main problem was the cost of excavating this area which, at a generous estimate, could be as much as Tk 40,000,000 (£50, 000), which was clearly far more than the project could afford. Two avenues were identified as possible to achieve the *beel* excavation: i) fund the excavation from a bilateral project, ii) approach the Food for Work programme to undertake the work on a FFW basis. Both options were to be pursued by CNRS, who, as a very active NGO in wetland and fisheries management in Bangladesh, were also involved in a number of similar initiatives. Amongst these was the Community Based Fisheries Management (CBFM) projects14 I and II. CNRS had undertaken community-based *khal* excavation under the Ford Foundation funded CBFM-I, and under DFID funded CBFM-II, was planning to undertake fisheries habitat restoration work on a network of *beels* in the Tangail District, including Charan. They aim to test fish refugia and protected areas, so the excavated area would fit well with this approach.It was therefore decided that the intervention would be taken forwards by CNRS by its inclusion in their component of CBFM-II. The extra time would ensure a real rather than forced consensus had been reached at the workshop. A committee would be formed to cover the detail of the institutional arrangements, technical issues, authorities and agreements that would be needed to go ahead. Originally, CBFM-II had been planned to start in October 1999, which would have been good timing to dove-tail the excavation intervention identified under R6756 into CBFM-II. Unfortunately, due to budgeting problems in DFID - Bangladesh for the 1999/2000 financial year, the start of CBFM-II was delayed, with its preparatory phase not commencing until February 2000. Thus there has been a break in taking the intervention forward, but at the time of writing it appears that CBFM-II will be going ahead in the 2000/2001 financial year. It is the loss of momentum on the intervention at this site will be picked up again when CBFM-II does receive its funding.

Output 3.2 – Predictive assessment

Despite problems with implementing the interventions that prevented concurrent assessment of the environmental and socio-economic impacts of intensification or diversification of the production system, the project was able to undertake some predictive assessment.

[14] See Section 6.3 on uptake of R6756 concepts in development projects.

Output 3.2.1 Predictive assessment - GIS

Within the project GIS (Annex 3), Arcview has been customised using Avenue script language to produce two tools to manipulate the temporal attributes of the data layers. The first of these custom tools, a date slider (Figure 20), can be used to time-step through the annual cycle, showing for example the flood spread and crop pattern in each month. However, the second tool de-couples the flood data (Figure 21), allowing the analyst to lag or advance the flood in relation to the terrestrial production activities. In this way it is possible to simulate the impacts of, for example, an early onset of flooding due to excavation of a connecting canal or more fish-oriented sluice gate management (Figure 22). Because the GIS has a socio-economic layer, this simulation can also determine if the impact is felt differentially by different types of land owner (Figure 23).

Figure 20 The date slider tool from the project GIS

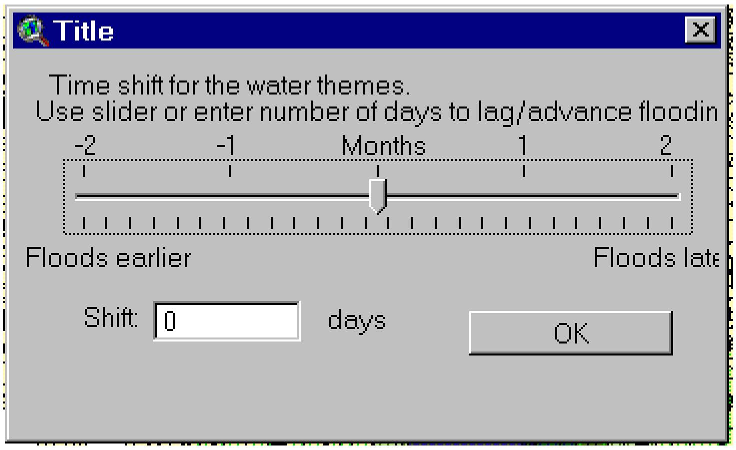

Figure 21The time shift tool from the project GIS

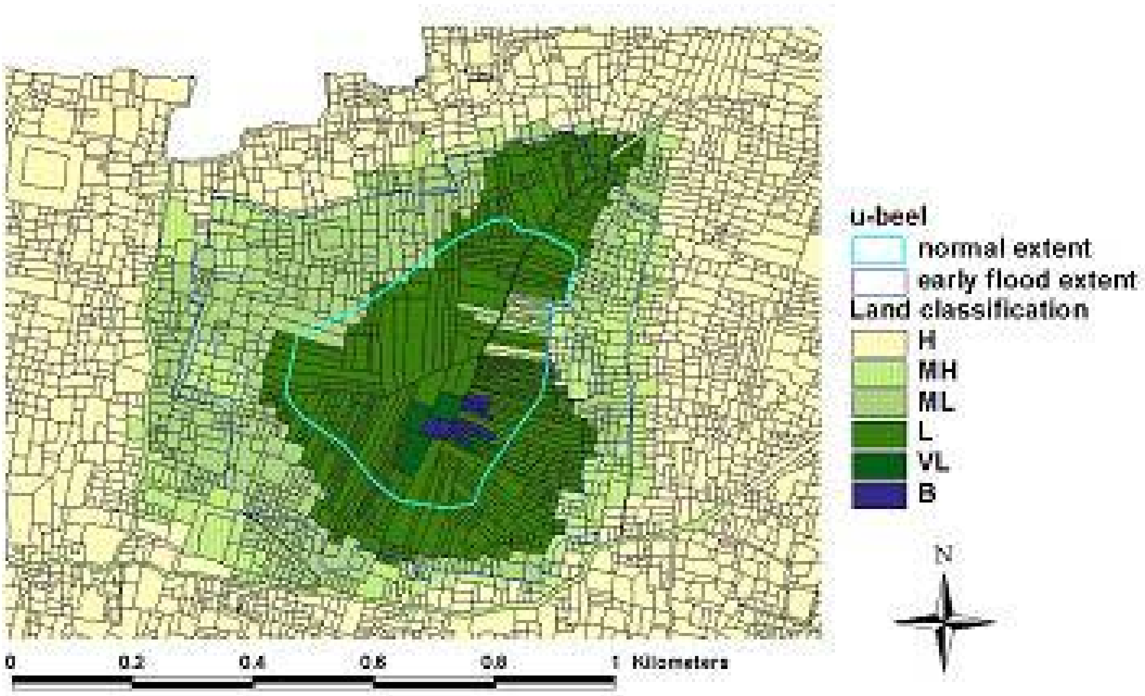

Figure 21 Areal extent of normal and early flooding at 1st July 1997 – Padma *Beel*

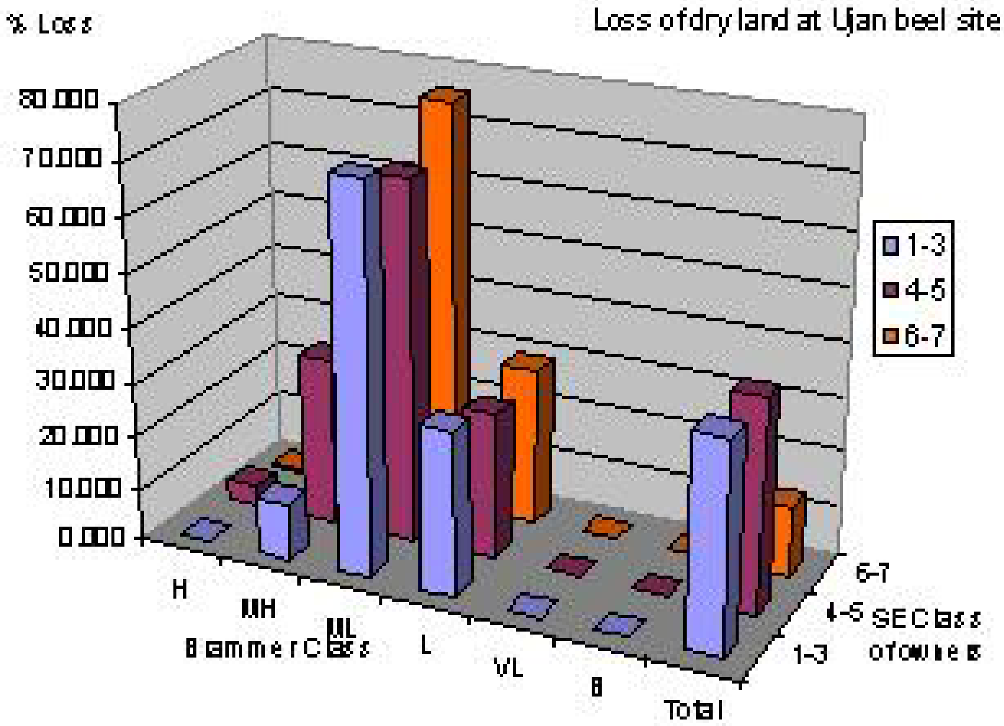

Figure 22 Loss of dry land due to early flood in July, classified by socio-economic class and land height – Padma *Beel*

Output 3.2.2 Predictive assessment – Village workshops

The village workshops (Output 4.2 and Annex 2) involved a stage of asking each stakeholder group to undertake a STEPS analysis to predict the Social, Technical, Environmental, Political and Sustainability impacts of different interventions (Tables 5 and 6). When the prediction of the different groups was compared, this was activity was also informative about each group's perspective on floodplain resource management, and provided another layer of support to the conceptual model of floodplain production systems.

Table 5 STEPS analysis by large and medium farmers at Charan *Beel*, 27.01.99, in relation to the constraint "Drainage congestion causing crop damage".

Solution	Desilt 20-30 Acres area of *beel*	Desiltation of canal from South side of the *beel* (Plot no. 2079) to Balla Sluice gate (0.5 Km long)
Purposes	• *Beel* would be perennial • Fish production would be increased • Fish sanctuary will be established • Rainwater will drain out and threat on *Boro* crop (in low lying area) would be removed	• Water can ingress and outgress without obstacle which will reduce water logging problem in the *beel* & floodplain • HYV *Boro* lands will be increased • Fish fry/egg/spawn can enter in the *beel* directly in early monsoon • Direction of Sapai River would be changed which will reduce sand & silt deposition. • Threat would be reduced on *Kharip* 1&2 crops (*Aus, Aman* & Jute)
Sustainability	See Table 6	See Table 6
Technical issues	• *Beel* water would be pumped/drained out prior to desilt	• There are enough space to keep disposed soil • Width and depth of the canal would be

	• Sticky and clayey soil- difficult and expensive to excavate/ After dried up soil become hard. • Depth would be 6-8 feet more from existing level	30 ft and 15 ft respectively
Impacts on Environment	• Underground stream flow will be restarted. • Increase of bio-diversity.	• Flora and Fauna would be increased in Charan *beel*
Political (institutional) issues	• 24 *Acres* of land in the *Beel* (plot no. 586) has been leased out temporarily by the Government • 35 *Acres* of land in the *Beel* (Plot no. 2086, total area 96 *Acres*) have been leased out by the government • Required government approval	• Part of the canal located in different *mouza*, need to be discussed with the nearest villagers • Part of the canal is encroached • Government approval is required
Sustainability issues	• *Beel* would be functioning several years without any maintenance	• Sand deposition rate at 8/9 points would be high and sand has to be clear 2/3 times a year for proper functioning of the sluice gate

Table 6 Social impact analysis (ref Table 5)

Stakeholders	+ ve	- ve	=	Remarks
1. Seed supplier	+			Seed market would be enhanced
2. Plough/Power Tiller Owner	+			Increase of agricultural lands.
3. Water pump owner	+			Do
4. Rice Mill Owner	+			Profit will be more.
5. Transport Owner	+			Do
6. Bank/Money Lender	+			Return of credit + More profit
7. Revenue Department	+			Tax collection will be regularized.
8. BADC			=	
9. Crop Buyer	+			More profit
10. Stockiest	+			Do
11. Threshing Machine Holder	+			Do
12. Pesticide supplier	+			Do
13. Fertilizer Seller	+			Do
14. Land owner	+			more crop yield
15. Share cropper	+			Increase of cropping fields.
16. Agricultural labourers	+			Increase of labour cost
17. Engine Mechanic (pump & tiller)	+			
18. Carpenter	+			
19. Fishermen	(+)	-		Migration of hatchling, increase production.

Output 4.

"A methodology for accessing of indigenous knowledge and its transfer to NR researchers, together with traditional and other effective mechanisms for identifying farmers' researchable problems, in concert with a related SEM project. (This Output will be generated by activities in collaboration with the SEM sister project - R6744.)"

This Output was achieved in two ways:

Output 4.1 – IK methodology

The methodology for incorporating IK into NR research was developed through close association between natural scientists (essentially operating under R6756) and anthropologists (essentially operating under R6744). This methodology has been written up and delivered under R6744, as has always been the intention. These two projects were designed to have this link, and indeed, the LWI programme part funded R6744 in recognition of this. This deliverable addressed the OVI for this Output "*By end of project-year three, methodology for incorporation of farmers' needs, knowledge and research into studies of NR constraints investigated*."

The methodology is in three parts:

i) A definition of IK, review of IK in the context of the participation movement, and justification for incorporating IK in development programmes

ii) a consideration of the practical issues and trade-offs in design and management of projects that incorporate IK (this provides the main link to R6756)

iii) a toolbox of methods and techniques for collection IK

The second part characterises NR projects that aim to incorporate IK according to the time and resources available for the IK component, and its scope (systems-wide IK or narrow, technically focused IK). Each of these factors defines a set of possible inputs (such as staff) and tools that can be used in the IK methodology. For example a project with limited resources and of limited IK scope, but abundant time could employ a post-graduate anthropologist, who would use ethnographic methods. However, the trade offs might include lack of expertise in the culture of the project area and lack of familiarity with the relevant NR topics. This assessment is presented in a series of SWOT matrices.

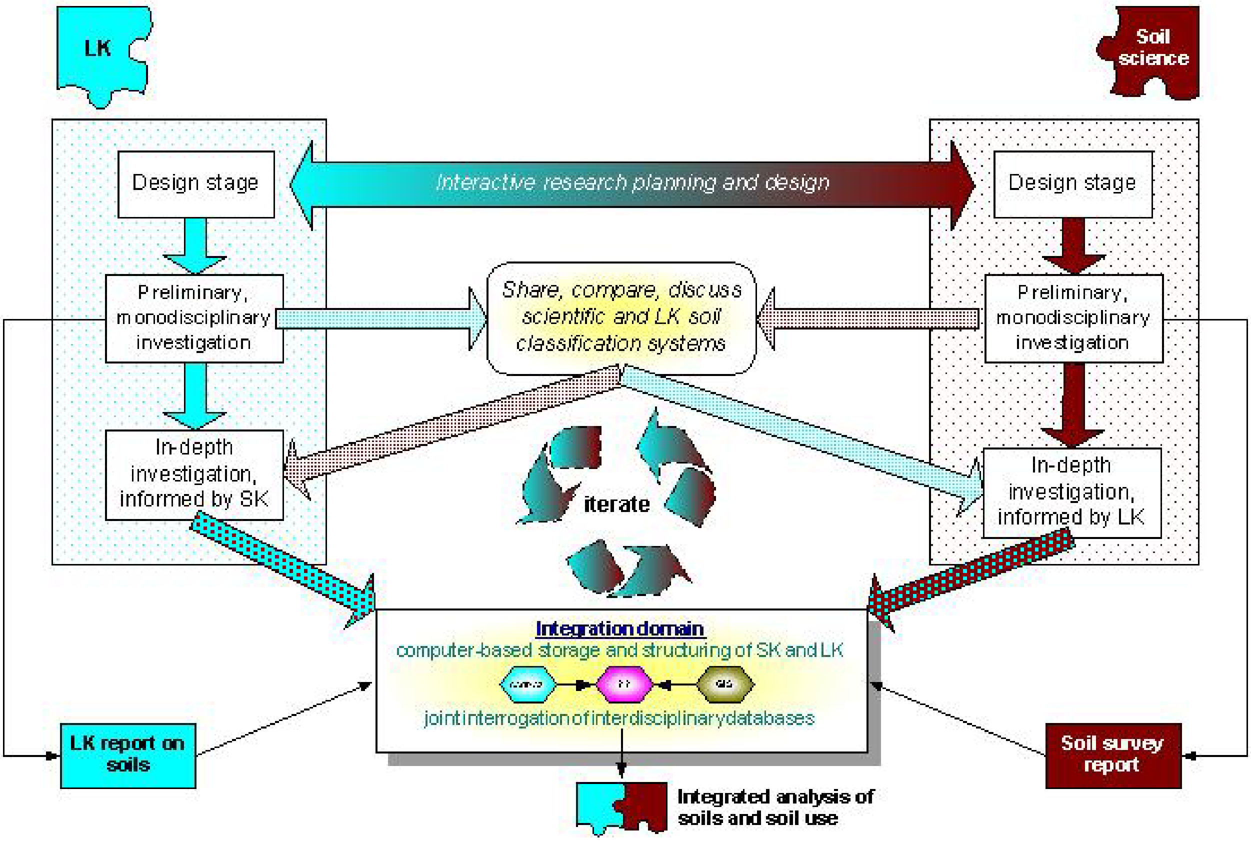

Figure 23 **Idealised methodology for integrating scientific and local knowledge of soil resources**

Related to the above methodology report are a number of in-depth appraisals of specific areas of IK – NR interactions. The utility of CAQDAS software (Section 4.4) for making IK accessible to NR scientists has been assessed in the following papers: Barr (1998) [Annex 10.9], Barr *et al* (forthcoming) [Annex 10.14], and Barr (1999) [conference paper at the Institute of Education, February 1999]. The more general problems of interdisciplinary research involving both natural scientists and social scientists have been discussed in Sillitoe *et al* (1998) [Annex 10.10], Dixon *et al* (1998) [Annex 10.11], Barr and Dixon (1999) [Annex 10.12] and Dixon *et al* (*in press*) [Annex 10.15]. Though conceived in relation to the interaction between soil scientists and anthropologists in the context of combined NR – IK study of soils and land use, the modality of interaction between the disciplines was considered in Barr *et al*, (1999) [Annex 10.13] (Figure 24).

Output 4.2 – village workshops

A methodology for "…*other effective mechanisms for identifying farmers' researchable problems*" has been delivered by the problem census - systems-based workshop process devised and tested by R6756. This methodology has been well adopted by one of the project target institutions (CNRS) - see Section 6.3 below, and Annex 3 for a full report on the methodology.

This methodology involves two stages: a Problem Census and a systems-based stakeholder workshop (Section 4.6). The problem census is a technique now becoming widely used in Bangladesh to identify and prioritise the key production constraints of fairly homogenous groups of producers. The systems-based workshop draws on the problem structuring method known as 'soft systems methodology' (SSM), developed for use in business management (Checkland & Scholes, 1990), the RAAKS methodology developed at Wageningen University (Engel & Salomon, 1997), and on 'Future Search' and participatory decision making techniques (The New Economics Foundation, 1999). It also resonates with stakeholder approaches (Grimble & Wellard, 1997). SSM recognises that different actors or stakeholders do not perceive of and understand situations from the same, objective perspective and thus different actors will inevitably have different, subjective, perspectives which depend on their particular social factors, goals, and values.

The three objectives of the systems workshop activity were:

1. To explore the different perspectives of primary stakeholder groups on the floodplain, and thereby develop a better understanding of their own conceptualisation of the 'floodplain production system'. This served as a validation of the external conceptualisation from the quantitative NR research.

2. To develop a deliberative, inclusive and participatory process for stakeholders to identify and agree better natural resource management options on a community-wide basis.

3. To identify, agree on, and implement an intervention to achieve more sustainable and equitable natural resource management

The precursor step to the process is identification of social and occupational stakeholder groups (Section 4.2). Then, by working initially with homogenous groups in the problem census, participants felt that in a peer environment they were relatively free to express the constraints on their production system. These constraints were then fed through a filter to select problems that fitted with donor goals, environmental and poverty objectives, and were considered to have researchable solutions (Figure 25). From a selection of different stakeholders' constraints, priority constraints for the community were identified in plenary, and with input from outside experts, possible solutions put forward. Stakeholder groups were then reformed, and the causes and effects of the problem and the impacts of different possible solutions were again appraised in a peer environment. The outputs from these appraisals were then discussed in a further plenary. This facilitated different stakeholder groups to appreciate the varied management options available and their non-uniform impacts on different floodplain users. The process is deliberative, inclusive, and participatory. It is also recognises that there are other (secondary/external) stakeholders who have an interest in floodplain natural resource use and its potential impacts and that these interests also need to be taken into account. The progression through two cycles of peer stakeholders meetings and plenary meeting optimises the balance between expression of participants' views and whole group discussion and awareness of issues. This process will be further developed and fined in R7562 (Section 6.3.3), and is further elucidated in the project's documentary video (Section 6.3.1 and Annex 4.), where specific characters are taken to represent certain stakeholder groups (Figure 26).

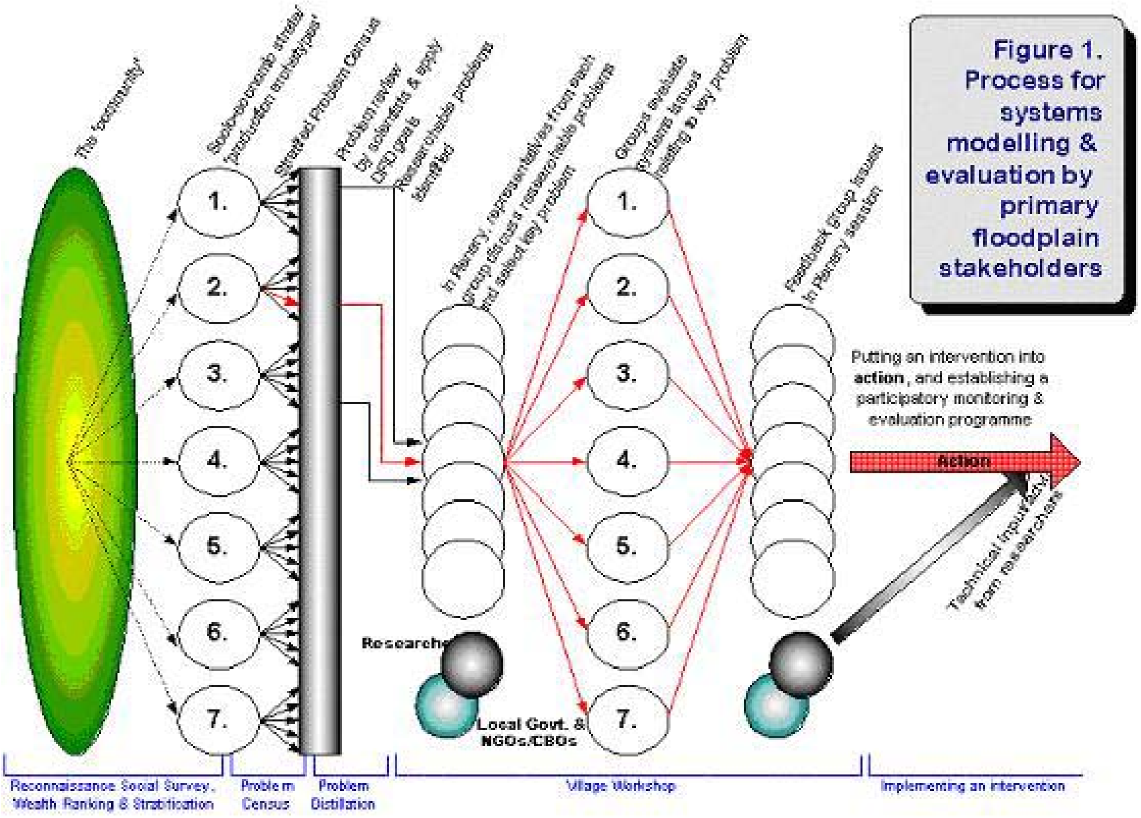

Figure 24 Flow chart of the problem census and systems-based workshop process

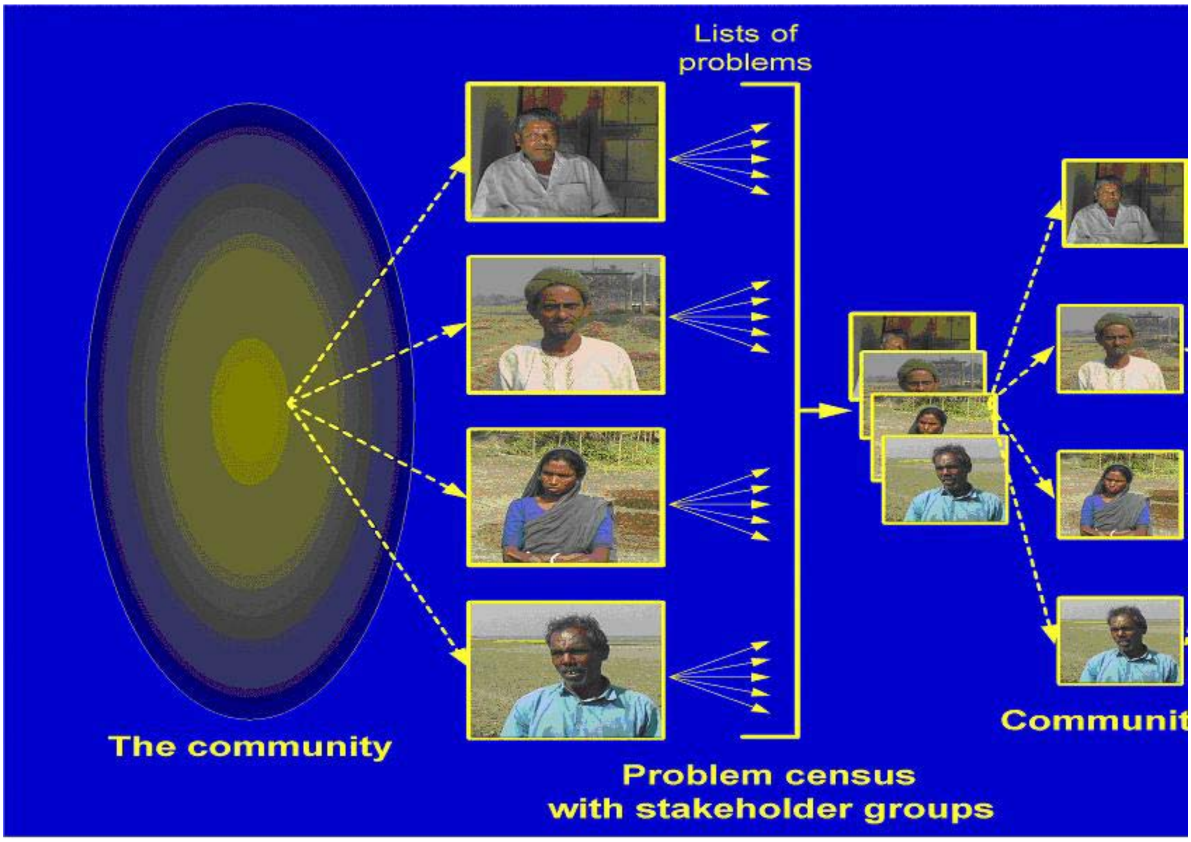

Figure 25 **The problem census / village workshop process as present in the project documentary**

6. Contribution of Outputs

6.1 List of Dissemination Outputs - R6756

Bean, C.W. (1997) Fisheries Management. *Aquaculture News*, 23, 35.

Haylor, G. S. and Stewart, A. (1997). Aquaculture Systems Research. *Aquaculture News*, 23, 18 - 20.

Barr, J.J.F. and Bean, C.W. (1998). Systems Approaches to Understanding Floodplain Livelihoods. *DFID Fisheries in Bangladesh*, 2, 12.

Barr, J.J.F. (1998). The Systems Approach to Research and Extension on Bangladesh Floodplains. *Rural Extension Bulletin*, 12, 44-47. ISSN 0906-6350.

Barr, J.J.F. and Gowing, J.G. (1998) Rice Production in Floodplains: Issues for Water Management in Bangladesh. Poster presented at: International Commission on Irrigation and Drainage - 1st ICID Inter-regional Conference on Environment-Water: "*Innovative Issues in Irrigation and Environment*", 16th - 18th September 1998, Lisbon.

Harvey, D. (1998). *Fuel Use, Biomass Cycling and Sustainability Issues in a Bengali Village*. Unpublished MSc thesis. Department of Agricultural & Environmental Science, University of Newcastle.

Barr, J.J.F. (1998) Investigation of Livelihood Strategies and Resource Use Patterns in Floodplain Production Systems in Bangladesh (R6756). *WorldWide Web pages*. URL: http://www.cluwrr.ncl.ac.uk/lwi/R6756/lwiR6756.html

Barr J.J.F. (1998). Investigation of Livelihood Strategies and Resource Use Patterns in Bangladesh Floodplain Production Systems. pp. 994-1003. In: Proceedings of "*Rural livelihoods, empowerment and the environment: Going beyond the farm boundary*" - 15th International Symposium of Association for Farming Systems Research & Extension, 29th Nov - 4th Dec 1998, Pretoria.

Barr, J.J.F. and Gowing, J.G. (1998) Rice Production in Floodplains: Issues for Water Management in Bangladesh. pp 308-317. In: Pereira, L.S. and Gowing, J.G. (eds.). *Water and the Environment. Innovative issues in irrigation and drainage*. E & FN Spon, an imprint of Routledge, London. ISBN 0-419-23710-0.

Anna Lawrence, Julian Barr, Graham Haylor (1999). Stakeholder approaches to planning participatory research by multi-institution groups. Paper No. 91, *Agricultural Research & Extension Network* (AgREN), ODI, London. ISBN 085003 422 1; ISSN 0951-1865.

Quin, F.M. and Barr, J.J.F. (1999). Improved Livelihoods and Greater Productivity – a Complex Relationship. Presentation at DFID symposium "*Eliminating Poverty: the Value of Science to Rural Poverty*" at the Royal Horticultural Halls, London, 9th December 1999.

University of Newcastle (1999). Tackling poverty on the Bangladeshi floodplains. p5. Issue 63, *University of Newcastle upon Tyne Newsletter*.

University of Newcastle (1999). Managing the floodplains. p5. *University of Newcastle upon Tyne Annual Report, 1998-99.*

Bean, C.W., Deverill, J., Felsing, M. and Barr, J.J.F. (MS - 2000). *Review of floodplain fisheries in Bangladesh*. Project report - R6756. Institute of Aquaculture, University of Stirling and Centre for Land Use and Water Resources Research, University of Newcastle.

Barr, J.J.F., M.I. Zuberi, S.B. Naseem, Craig, J.F., McGlynn, A.A., Shirley, M.D.F., Dixon, P-J. and Payton, R.W. (2000). Livelihood Strategies and Resource Use Patterns on the Floodplains – Who Does What, Where, When? Paper at symposium "*Peoples' Livelihoods at the Land-Water Interface – Emerging Perspectives on Interactions between People and the Floodplain Environment.*" held at LGED Bhaban, Agargaon, Dhaka, 18th January 2000.

Barr, J.J.F. and Haylor, G.S. (*submitted*) Experiences of Applying the Sustainable Livelihoods Framework on Bangladesh Floodplains. *World Development*.

Barr, J.J.F., Dixon, P-J., M.M. Rahman, A. Islam, M.I. Zuberi, McGlynn, A.A. and G.P. Ghosh. (2000*). Report on a participatory, systems-based, process for identification of improved natural resources management for better floodplain livelihoods*. Project report - R6756. Centre for Land Use & Water Resources Research, University of Newcastle.

Barr, J.J.F., Dixon, P-J, and Rose, D. (2000). *Machte, Bhate, Bangali: Understanding Rural Livelihoods on Bangladesh Floodplains.* Documentary video. Centre for Land Use & Water Resources Research, University of Newcastle.

Johnson, D.M.L., McGlynn, A.A., Barr, J.J.F. and Nirupama, with M.I. Zuberi, G.P. Ghosh, S.B. Naseem, Rezaul Karim, Mahbub Alam, Rana Hossain, R.W. Payton and G.S. Haylor, (2000). *The Land/Water Interface. Investigation of Livelihood Strategies and Resource Use Patterns in Floodplain Production Systems in Bangladesh.* GIS Application and Data Distribution CD-ROM. Centre for Land Use & Water Resources Research, University of Newcastle.

Dixon, P-J., Md. Mokhlesur Rahman, Md. Anisul, Islam (2000). *Report of a survey of household coping strategies in response to the 1998 floods in Bangladesh*. Centre for Land Use and Water Resources Research, University of Newcastle and Durham and Center for Natural resources Studies, Dhaka

Barr, J.J.F., *et* al (2000). *Livelihood Strategies and Resource Use Patterns on Bangladesh Floodplains.* Project research report - R6756. Centre for Land Use & Water Resources Research, University of Newcastle.

Soussan, J., Barr, J,.J.F., Chadwick, M. and Dixon, P-J. (2000) Summary report on "*Peoples' Livelihoods at the Land-Water Interface – Emerging Perspectives on Interactions between People and the Floodplain Environment*" symposium held at LGED Bhaban, Agargaon, Dhaka, 18th January 2000. http://www.bcas.net/features/200002/leeds.htm

Chadwick, M. and Barr, J.J.F. (eds.) (*forthcoming*) "*Peoples' Livelihoods at the Land-Water Interface – Emerging Perspectives on Interactions between People and the Floodplain Environment.*" Proceedings of symposium held at LGED Bhaban, Agargaon, Dhaka, 18th January 2000.

Julian Barr, Peter Dixon, Matthew Chadwick, John Soussan, Md. Mokhlesur Rahman, Anisul Islam, Sardar Shafiqul Alam and Dwijen Lal Mallick (*abstract submitted*) Integrated floodplain management in Bangladesh - managing land and water resources from a people-centred perspective. British Hydrological Society, 7th National Hydrology Symposium "*Balancing Water and Land Developments with Human and Environmental Concerns*"; Sub-theme: *Making the decision - incorporating human and environmental concerns.* University of Newcastle, September 2000.

6.2 List of Internal Reports

<u>Back to office reports:</u>

- J Barr: Dec 96, Jan/Feb 97, May/Jun 97, Sept 97, Mar/Apr 98, May 98, Nov/Dec 98, Jan/Feb 99
- G Haylor: Nov 97
- C. Bean: May 97
- R Payton: Jan 98

with R6744 [SEM]:

- PJ Dixon: Jan/Feb 97, May 97, Sept 98, Sept 99
- P Sillitoe: Jan 97, May 97, Jan/Feb 98

<u>Presentations:</u>

- Presentation to Aquaculture Research Programme workshop: '*Participatory Research in Aquatic Resources in South & South East Asia - Methodological Lessons Learnt*'. (Feb 98)
- Presentation and briefing for workshop at Leeds University on DFID research in Bangladesh (March 1998)
- Presentation to LWI mini-PAC (March 1999)

<u>Other documents:</u>

- Various authors. (1997). *Manual of terms of reference and methodologies for field studies*.
- J.J.F. Barr and G.S. Haylor (1997). *Report on Participatory Research Methods Workshop*; Rajshahi, 12th - 15th May 1997. [Appendix B.]
- Site Co-ordinators Handbook (1997).
- Briefing note for project consultative group (1997).

<u>Reports to Programme Manager:</u>
Quarterly Reports
Annual Reports: 96/97, 97/98, 98/99

<u>Minutes:</u>

- Minutes of project team meetings: Stirling Jan 97; Rajshahi, May 97, Newcastle, Jun 97; Durham Jul 98; Dhaka Sept 98; Newcastle Oct 98; Newcastle Apr 98; Stirling Apr 98.
- Minutes of project consultative group meeting Sept 97.

<u>Micro reports from the field:</u>
These are reports submitted from the field and have been distinguished from the large quantity of raw field data collected.

Naseem, S.B and Alam, M. (1997). *Local institutions and power bases.*
Zuberi, M.I. and Ghosh, G.P. (1997). *Analysis of Power-Base: Institutions in Ujankhalsi*
Zuberi, M.I. (1997). *Report on fisheries monitoring.*
Zuberi, M.I. (1997). *Report on yield sampling Aus.*
Alam, M. (1997). *Report on Powerbases (Part II).*
Dewan, S. (1998). *Fish marketing.*
Zuberi, M.I. (1998). *Report on paddy cultivation and share cropping.*
Zuberi, M.I. (1998). *Report on beel leasing.*
Zuberi, M.I. (1998). *Report on fishing and fish marketing.*
Alam, M. (1998). *Report on an anthropologist working with NR scientists.*
Mizan (1998). *Leasing system of the beel.*
Zuberi, M.I. (1998). *Fish catch and marketing.*

6.3 Dissemination Pathways

Dissemination pathways for many of the above outputs are self-evident; for example conferences papers and articles. However, certain of them require additional comment. This project was identified to represent the Faculty of Agricultural and Biological Sciences in the University's Annual Report, and thus two short articles appeared in the 1999 University Newsletter and Annual Report respectively. This might not be considered to have very great developmental impact, but both publications have a circulation of approximately 19,000, including all the Northern MPs and MEPs as well as 13,000 alumni worldwide - some of whom now hold senior and influential positions[15]. The Quin and Barr (1999) presentation at DFID's "Eliminating Poverty: the Value of Science to Rural Poverty" symposium was well received by DFID, and was given to an audience of foreign Embassy representatives, NGOs, DFID staff and academics[16].

A number of the outputs have only become available near the end of the project, and it has not been possible to disseminate them widely during the life of the project, though dissemination will clearly continue after project completion. Four outputs particularly fall into this category and require special mention:

6.3.1 Documentary video

The Purpose of this project is "*Interrelationships between competing commodity production systems on floodplains understood and incorporated into system management strategies*." Thus the aim is to generate understanding of a natural resources production system, to inform system management strategies. It was considered that the outputs or research products from this type of systems research are not always easily grasped, because the research which does not aim to produce a new device or technology. What has become evident form the research is that many of the developmental problems which the research aims to address stem from non-systemic views and approaches to managing floodplain natural resources. Thus to inform better management strategies, one of the aims of the research has been to develop and promote a systems approach and systems understanding of the floodplain production system. It was considered that the high degree of complexity in the floodplain system might be most clearly put across using a visual medium, and therefore it was decided to make a short documentary distilling the key elements of the research on floodplain livelihoods. Furthermore, given present concerns that research outputs are made accessible[17], it was hoped that a documentary would met these 'public understanding of science' goals.

To ensure circulation of the documentary to an appropriate audience, three dissemination activities have been set in train for continuation post-project:

i) the documentary was previewed at the R6755 / R6755 symposium in Dhaka in January 2000, and a list of names of those people interested in receiving a copy of the video was taken

ii) a Bangladesh NGO specialising in development video and communications, who also maintain a development video library, has been approached. This NGO is called FemCom, and they have agreed to take a master copy of the documentary, which they will copy free of charge to interested parties on request

iii) one of the project partners, CNRS will be given a stock of the documentary to show and distribute to interest parties as appropriate.

[15] Note from University's Public Affairs Office attached - Appendix C.

[16] Note from Dr. Tarbit attached - Appendix D.

[17] For example: Andrew Bennett, Closing address. DFID Symposium 'Eliminating Poverty: The Value of Science to Rural Livelihoods'. December, 1999.

6.3.2 CD-ROM database and GIS

The project collected a large quantity of data on the natural resource base, agricultural and fisheries production activities and the socio-economic characteristics of households involved in this production. The temporal and socio-economic data were compiled into an Access database and the spatially referenced data were complied into an Arcview Geographic Information System (GIS). The objective of compiling these data from different disciplinary studies into a single resource was to enable interdisciplinary (or systems) interrogation of the data by the project scientists. However, it was realised that with some additional input, the data sets could be tidied-up and made more accessible or 'user-friendly'. This could then be placed in the public domain and would reduce the chance that the data languish on a shelf after the conclusion of the research. It would make this potentially useful resource easily available to further researchers or projects working in this field.

Therefore the project's quantitative data set has been made available as a CD-ROM package. This package includes both the Access and GIS databases, together with supporting graphics. The package can be run from the CD or installed as a piece of software on to users' hard disks. The data is then fully interrogable by users have have Access and/or Arcview on their machines. For those without Arcview, the CD is bundled with ESRI's Arc Explorer, which is a free software application for reading Arcview files. It lacks Arcview's functionality, but does allow novices to make some exploration of the data. Copies of this CD-ROM will be sent out to a number of organisations in Bangladesh, including the Centre for Environment and Geographic Information Services (CEGIS). We are planning to make the data set available for download from the R6756 web page.

6.3.3 Stakeholder and systems-based methodology

The project developed a methodology to identify different stakeholder groups' priority concerns and community-based approaches to identifying their solution. This was piloted at the two project sites, and has been written up as a report: "*Report on a participatory, systems-based, process for identification of improved natural resources management for better floodplain livelihoods"* (Barr, Dixon *et al*, 2000). This work has received only limited dissemination in this report format. However this component of the project has probably had the greatest development impact despite the formal write-up occurring late in the life of the project. It has been a lesson to the investigators on the very immediate demand of 'development' and development professionals for information and tools from research projects. Whereas we might conceive of a normal research and dissemination process akin to the project cycle (Figure 27), the lesson has been that development must take actions based on partial information, thus the methodology and lessons from piloting the methodology were taken up in several ways during the lifetime of the project, prior to the dissemination stage being reached.

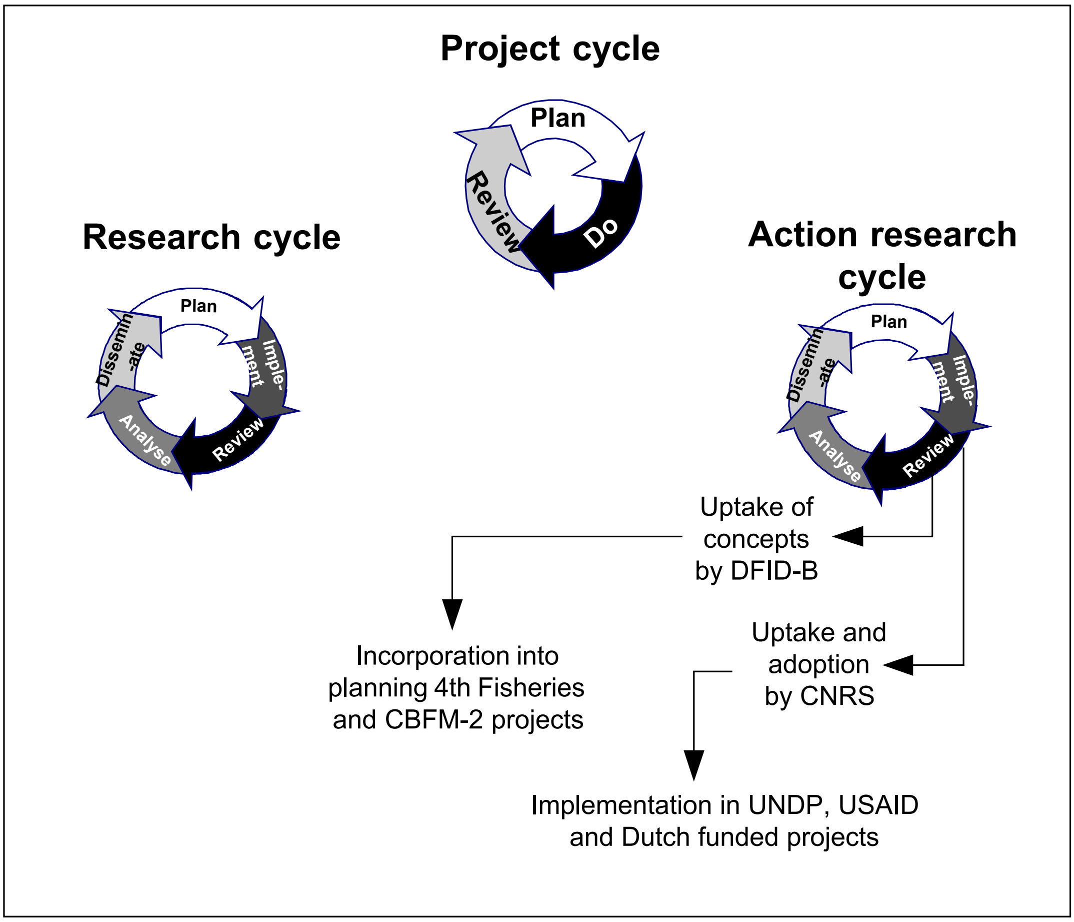

Figure 26 The research project cycle, and uptake of R6756 research products.

Thus the NGO the Center for Natural Resources Studies (CNRS), with whom the project developed the methodology, recognised its utility at the stage of pilot testing it. They have gone on to refine the process and have adopted it as one of their principle tools in several participatory natural resource planning and management projects in which they are currently involved. They have thus conducted up to five of these workshop processes in each of the following projects and locations (Figure 28). This is an example of research leap-frogging up the A-H continuum[18] from a pre-A stage to E, with, as described below, the intention to take this forward to H under project R7562.

[18] The DFID A-H uptake pathway for assessing progress of research towards developmental impact:
A - Generation of relevant research results (R project outputs delivered)
B - Formal agreement with target institutions (TIs)
C - Development of appropriate research-based products through adaptation/ packaging
D - Promotion of products to TIs
E - Adoption of products by TIs
F - Application and replication of results in TIs
G - Promotion of technology or behavioural change among end-users by TIs
H - Adoption of technology by end-users and generation of economic benefits - developmental impact (R project purpose delivered)

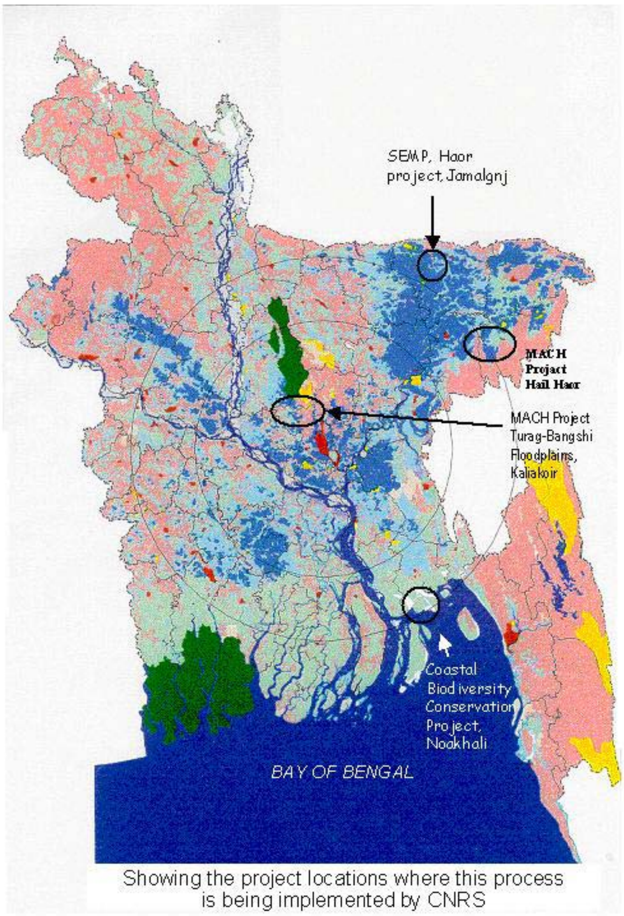

Figure 27 **Project locations where CNRS have conducted problem census / systems-based workshops.** (**see Appendix E. for full-size map**)

- Sustainable Environmental Management Project (SEMP), Haor component, located at Jamalganj. This project is the implementation of the National Environmental Management Action Plan (NEMAP). It is funded by UNDP, with management by IUCN. CNRS are implementing the Haor component.
- Management of Aquatic resources and Community Husbandry (MACH). Haor and floodplain components. Located at Hail Haor and Kaliakoir on the Turag-Bangshi floodplains respectively. This project is funded by USAID and managed by Winrock International. CNRS are implementing these components in association with other NGOs.
- Coastal Biodiversity Conservation Project. This project is funded by the Dutch Embassy.

This method is considered to be appropriate to community-based issues of resource management in general. The concepts and initial presentations of the process were reported to both DFID-Bangladesh (Fisheries and Aquatic Resources Adviser) and ICLARM-Bangladesh (Officer in Charge). DFID-Bangladesh have reported that these ideas were reflected in drafting the project memorandum for the World Bank/DFID Fourth Fisheries Project[19], and reference is made to the work in the project memorandum of the forthcoming DFID-Bangladesh funded Community-Based Fisheries Management project - 2 (CBFM-2), to be implemented by ICLARM.

Seeing an opportunity for further developing this methodology with ICLARM, using CBFM-2 as an action research test bench, a concept note was submitted to NRSP in

[19] Note from DFID-Bangladesh Fisheries and Aquatic Resources Adviser attached - Appendix F.

response to the last 1999 call for projects on consensus building methods for management of common property resources. This proposal, incorporating additional inputs from CEMARE at Portsmouth University was accepted. Thus the method piloted in R6756 will be further tested, improved, evaluated, and promoted in project R7562.

6.3.4 Symposium

The project held a symposium in Dhaka in January 2000 to promote its findings to a wide audience of representatives form target institutions in Bangladesh. In order to generate a critical mass of information and ensure the symposium was significant enough to draw a large and representative audience, the symposium was held jointly with the University of Leeds (project R6755) and the Bangladesh Centre for Advanced Studies. The symposium was designed to show that there is a large body of new thinking about integrated management of floodplain natural resources, and thus the presentations went beyond on the R6755 and R6756 research, but included presentations from NGOs undertaking integrated NRM projects and policy-level organisations and donors[20]. It was not possible to draw together and edit the many contributions within the lifetime of the project. Therefore the proceedings of the symposium, will be published and disseminated soon after the project is completed. The symposium was reported in the Bangladesh press, and a summary is now available at:
http://www.bcas.net/features/200002/leeds.htm .

6.4 Other contributions to development goals

As discussed above (Section 2.4), the project has been guided by poverty concerns, particularly trying to develop an understanding of poorer households resource use strategies. The outputs from this area of the research have been absorbed into DFID thinking about natural resource management on the floodplains (Tollervey, *pers. comm.*- project video [Annex 4], and Robertson, Appendix F.). The project has taken a livelihoods approach, albeit an NR-centred one. Livelihoods analysis of production constraints had yielded suggestions for entry point for floodplain development (Barr & Haylor {Annex 10.8). It has also contributed to the debate on how to undertake SL analysis. Evidence for this comes from positive feedback from the Dr Brown, Natural Resources Adviser, and Dr Montgomery, Social Development Adviser, DFID – Bangladesh on the draft SL analysis [Annex 10.8]. Dr Brown has expressed interest in using the approach in forthcoming work on *charland* development. This document has also been used and cited in re-aligning a stagnating bilateral power-tillers project along SL lines (report by C. Turton, 2000; Brown, *pers. comm.*).

At a more general level, the project has contributed to development through provision of training in research methods and research management, supporting inter-institute collaboration and networking within Bangladesh, and advocacy of systems approaches to NR planning and management.

6.5 Further stages needed to develop the Outputs

The project Outputs are already being further developed as follows:

- The two stage problem census and village-based workshop process (Annex 2) is being refined and tested in a further NRSP-LWI project, R7562. R7562 commenced in February 2000, and is led by Newcastle University, with partners at the University of Durham, CEMARE (University of Portsmouth), ICLARM, CNRS and two other Bangladesh NGOS,

[20] The symposium programme, attendance list and a summary of the symposium are attached – Appendix G.

Banchte Shekha and CARITAS. The project aims to develop a method for consensus building for improved management of common property resources. The DFID bilateral project Community Based Fisheries Management – II, co-ordinated by ICLARM, will host the project. The R6756 method will be the kernel of this project; it will be developed, tested, and evaluated with the three NGOs in CBFM-II waterbodies.

- Two elements of the research have been taken up and will be further developed by a project led by IRRI. This project, funded under DFID's CRF programme with CGIAR institutes, involves IRRI, ICLARM and Newcastle University. It aims to investigate the potential of an area of coastal Vietnam protected from coastal salinity, and determine the impacts of this intervention on different types of terrestrial and aquatic producers' livelihoods. The project will further develop the R6756 approach and techniques whereby bio-physical and socio-economic data were integrated in a GIS. These techniques will be the basis of identifying resource management domains. The Sustainable Livelihoods analysis of problem census data will also be further developed as a tool to explore different stakeholder groups' livelihood constraints.

- The project's review of the literature on floodplain fisheries in Bangladesh (Annex 5.) will be upgrade to a standard publishable in a peer-reviewed fisheries journal. This is being funded by NRSP (ref PD83), and will involve Dr J.F. Craig (ex-ICLARM) and Dr A.S. Halls (MRAG). The aim is to take a grey project report, and make it widely available to the development community. 100 reprints of the review will be ordered from the journal and disseminated to the development community in Bangladesh.

It is also the intention to further develop the Outputs as follows:

- To follow-up the proposal made by Dr. Huq (BCAS) at the end of project symposium to establish a forum for organisations and individuals interested in integrated floodplain resource use and management.

- To promote the uptake of project Outputs through contacts in Bangladesh, such as CEGIS, through dialogue with the DFID-Bangladesh bilateral programme and by maintaining the project web site, including making the project GIS available over the web, and registering the project web site with search engines

- To co-operate with NRSP-LWI and its contractors in relation to comparing and integrating Outputs from this project with Outputs from NRSP and other floodplains research. In this manner to strengthen the validation of the results against other findings, and to pursue further analyses. This may be possible through further projects under NRSP-LWI.

- To target further funding opportunities that would enable further interrogation of the integrated databases, and integration of the NR and IK data. One avenue may be to identify post-graduate students to sue the databases for their research.

6.6 List of Dissemination Outputs - with project R6744

In addition to Outputs under R6756, the project has jointly produced the following dissemination outputs with R6744. Their contribution to development goals is discussed in the R6744 FTR [Appendix A.].

Cannon, D. (1997). *Scientific and Indigenous Assessment of Soil / Land Resources: a Case Study from the Floodplains of Bangladesh*. Unpublished MSc thesis. Department of Agricultural & Environmental Science, University of Newcastle.

Barr, J.J.F. (1998) Use of Indigenous Knowledge by Natural Resources Scientists: Issues in Theory and Practice. Paper presented at National Workshop on "*The State of Indigenous Knowledge in Bangladesh*". Held by Bangladesh Resource Centre for Indigenous Knowledge (BARCIK); Dhaka, 6th - 7th May 1998.

Sillitoe, P., Dixon, P-J., and Barr, J.J.F. (1998). Indigenous Knowledge Research on the Floodplains of Bangladesh: The Search for a Methodology. *Grassroots Voice*, 1 (1). ISSN 1560-358X

Blyth, R.E. (1998). *An Ethnographical Description of the Fish and Fisheries of Two Floodplain Sites in Rural Bangladesh*. Unpublished MSc thesis. Institute of Aquaculture, University of Stirling.

Barr, J.J.F., Sillitoe, P. and Dixon, P-J. (1988). Methodological issues in incorporating local knowledge into natural resources research and development. Paper presented at "*Development's Demand for Indigenous Knowledge*" workshop at the 12th Biennial Conference of European Association of Social Anthropologists, Frankfurt, 4 - 6 September 1998.

Barr, J.J.F. and Dixon, P-J. (1998). Using Farmers' Knowledge in Natural Resources Research in Bangladesh Floodplains. Paper presented at *Tropical Agriculture Association meeting*, 26th September 1998, Durham.

Dixon, P-J., Barr, J.J.F., and Sillitoe, P. (1998). Methodological Issues in Incorporating Local Knowledge into Natural Resources Research and Development. In: Proceedings of "*Rural livelihoods, empowerment and the environment: Going beyond the farm boundary*" - 15th International Symposium of the Association for Farming Systems Research & Extension, 29th Nov - 4th Dec 1998, Pretoria.

Barr, J.J.F. and Dixon, P-J. (1999). Incorporating Farmers' and Fishers' Knowledge into Natural Resources Systems Research on the Bangladesh Floodplains. *Tropical Agriculture Association Newsletter*. ISSN 0954-6790.

Barr, J.J.F. (1999). Can QSR NUD*IST translate in the babel of multi-site, interdisciplinary, cross-cultural research? Paper presented at conference "*Strategies in Qualitative Research: QSR NUD*IST software and methodological issues*" held at Institute of Education, University of London, 24th February 1999.

Barr, J.J.F., Payton, R.W., Sillitoe, P., Martin, A.M., Gowing, J.W. and McGlynn, A.A. (1999). Methodological Lessons from Contrasting Approaches to Integrating Indigenous Knowledge and Scientific Resource Survey. Poster presented at "*Agroecology and Soil/Crop Management Among Indigenous Cultures*" Symposium at "*Science Serving Agriculture and*

Natural Resources: Present and Future". The 1999 Annual Meetings of the American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America; Salt Lake City, Utah. 31st October - 4th November 1999.

Barr, J.J.F. and Sillitoe, P. (*in press*) Databases, indigenous knowledge and interdisciplinary research. In P. Sillitoe (ed.) *Indigenous knowledge development in Bangladesh: Present and future*. Intermediate Technology Publications, London and & University Press Ltd., Dhaka.

Dixon, P-J, Barr, J.J.F. and Sillitoe, P. (*in press*) Actors and rural livelihoods: interdisciplinary research integrating local knowledge. In P. Sillitoe (ed.) *Indigenous knowledge development in Bangladesh: Present and future*. Intermediate Technology Publications, London and & University Press Ltd., Dhaka.

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Ashley, C. and Carney, D. (1999). *Sustainable Livelihoods: Lessons from early experience.* Department for International Development, London.

BARC (1987). *National Conservation Strategy for Bangladesh*. Draft prospectus (phase I). Bangladesh Agricultural Research Council (BARC) and International Union for Conservation of Natural Resources (IUCN), Dhaka. Cited in Viju Ipe (1995).

BARC (1990). *Floodplain Agriculture*. Policy Brief, Bangladesh Agricultural Research Council, Dhaka.

Barr, J.J.F., Payton, R.W., Sillitoe, P. and Haylor, G.S. (1996). *Preliminary Investigation of Agricultural Diversification and Farmers' Practices in Bangladesh Floodplain Production Systems Involving Rice-Fish Production - a Whole Farm System Approach*. pp. 254. Project Research Report. ODA Land/Water Interface project R6383, University of Newcastle.

Bawden, R. (1995). On the Systems Dimension in FSR. *J. for Farming Sys. Research-Extension*, 5 (2), 1-18.

Bebbington, A. (1999). Capitals and Capabilities: A Framework for Analysing Peasant Viability, Rural Livelihoods and Poverty. *World Development*, 27 (12), 2021-2044.

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List of Appendices – Supporting reports and documents

A. **Final Technical Report For NRSP Socio-Economic Methodologies Project R6744. (2000). Department of Anthropology, University of Durham.**

B. **J.J.F. Barr and G.S. Haylor (1997).** ***Report on Participatory Research Methods Workshop*****; Rajshahi, 12th - 15th May 1997.**

C. **Note from Mr. M. Warwicker, Public Relations Officer, University of Newcastle. 7th January 2000.**

D. **Note from Dr. J. Tarbit, Research Section, Rural Livelihoods Department, DFID. 14th December 1999.**

E. **Map of project locations where CNRS have conducted problem census / systems-based workshops.**

F. **Note from Mr. T. Robertson, First Secretary, Fisheries and Aquatic Resources Adviser, DFID – Bangladesh. 3rd January 2000.**

G. **Summary report, programme, and attendance list for a combined R6756, R6755 and BCAS symposium: "*****Peoples' Livelihoods at the Land-Water Interface – Emerging Perspectives on Interactions between People and the Floodplain Environment*****." Held at LGED Bhaban, Agargaon, Dhaka, 18th January 2000.**

H. **Response to reviewers' comments on the final technical report:** R6756 - in***vestigation of livelihood strategies and resource use patterns in floodplain production systems in Bangladesh***

List of Annexes – Major Outputs

1. Livelihood Strategies and Resource Use Patterns on Bangladesh Floodplains.

Barr, J.J.F., *et* al (2000). *Livelihood Strategies and Resource Use Patterns on Bangladesh Floodplains.* Project research report - R6756. Centre for Land Use & Water Resources Research, University of Newcastle.

2. Stakeholder and systems-based methodology.

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3. CD-ROM database distribution and GIS application.

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4. Documentary video.

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7. Flood coping strategy report.

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8. Household fish consumption survey report.

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9. World Wide Web sites.

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10. Conference papers, presentations, posters.

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10.2 Barr, J.J.F. (1998). The Systems Approach to Research and Extension on Bangladesh Floodplains. *Rural Extension Bulletin*, 12, 44-47. ISSN 0906-6350.

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