

## The systems approach to research and extension in the Bangladesh floodplains

by Julian Barr

The dynamic between land and water in the Bangladesh floodplains means that agriculture and fisheries are intimately associated: the annual flood results in a constant interplay between terrestrial and aquatic production activities.

Single-focus interventions can negatively affect other parts of the floodplain system: increased production of foodgrains has been achieved at the expense of floodplain fisheries; and stocking of carp in floodplain water bodies has reduced the diversity of small indigenous species which are significant in the diets of poor people.

A systemic approach to needs identification, research and extension is needed.

Bangladesh is largely floodplain, with much of the land being inundated by flood water during the monsoon. This dynamic between land and water means that agriculture and fisheries are intimately associated activities that feature in floodplain dwellers' livelihood strategies according to their access to terrestrial and aquatic resources. Nonetheless, interventions on the floodplains have tended to concentrate on only parts of the 'floodplain system', often those parts operated by wealthier sectors of the community, sometimes at the expense of the poorer sectors. The use of a 'soft systems' approach in agricultural and fisheries research and extension can elucidate the full range of user perspectives on floodplain resources, and develop more acceptable system improvements.

Bangladesh is dominated by the multiple deltas of the Ganges, Brahmaputra, and Meghna rivers, and thus 80 percent of its area is classed as floodplain. During the monsoon most floodplain land is inundated for some period. Bangladesh has a population of approximately 120 million, of these some 80 percent live in rural areas, and more than 50 percent are classed as functionally landless (owning less than 0.2 ha of land for cultivation), with 11 percent not even owning sufficient land for a homestead (Karim, 1994).

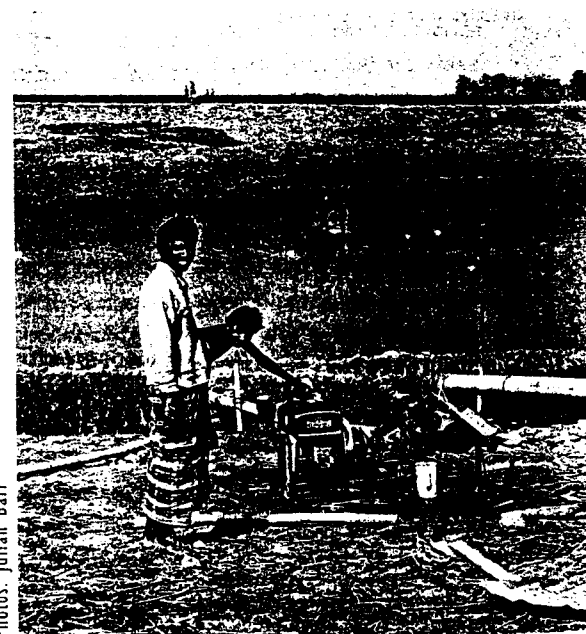
As in many developing countries, agriculture is important to the economy, accounting for 65 percent of labour employment and 35 percent of GDP. Nonetheless, it is estimated that 73 percent of the population also engage in part-time fishing, and more than 8 percent depend upon it as their principal livelihood. The dynamics of the annual flood result in a constant interplay between terrestrial and aquatic production activities that can be difficult to incorporate into research agendas and extension strategies.

In general, the poorer sections of the community, who have too little land to produce a subsistence crop, rely more heavily on fishing-related livelihood strategies (though leasing arrangements can affect access to common property water bodies). Nonetheless, the Ministry of Agriculture in Bangladesh recognises that their 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.

Bangladesh is now achieving near self-sufficiency in production of food grains. This resulted from concerted efforts to improve rice production by both increasing the amount of irrigated dry season rice (boro) grown, and through flood control to increase the area of cultivable land. This has facilitated a shift from lower yielding local varieties of broadcast deep-water monsoon season rice (aman) to more productive transplanted High Yielding Varieties (HYV) of aman in shallower water. However these yield benefits have been achieved at the expense of floodplain fisheries. Flood control has converted seasonal wetlands to drier cultivable land, leading to loss of fish habitat. It has reduced the migration and recruitment of floodplain fish and reduced species diversity. The overall impact has been reported to be a 70 percent reduction in floodplain fisheries (NEMAP, 1995).

Single-focus interventions (in this case on rice production) can thus negatively affect other parts of the floodplain system, impacting resource users with divergent livelihood strategies. Other single-focus interventions, such as stocking carps in floodplain water bodies have also been found to have negative impacts, in this case on other users of the same resource. Research by Minkin et al (1997) has found that floodplain stocking reduces diversity of floodplain fish, especially small indigenous or 'non-economic' species, which they found to be significant in the diets of poor people, especially women and chil-



Photos: Julian Barr

**Farming Systems Research and Extension (FSRE) identifies constraints and develops site-specific solutions; it has been successful in bringing together biological, economic and social perspectives.**

**But FSRE focuses on individual farm decision-making: in the floodplain, management approaches to common property are important.**

**A soft systems approach views the floodplain environment as a fabric of interwoven 'human activity systems' based on different farmers' or fishers' worldviews and livelihood strategies.**

Riverbank-planted rice (below) and two sets of users of water – for irrigation and for fishing (left). Interventions which fail to consider competing uses of the water resource are likely to have 'zero-sum' outcomes.

dren. A more systemic approach to needs identification, research and extension is therefore required.

There are indications that responses to the need for a systemic approach to natural resources research and development are starting to emerge in Bangladesh. Karim (1994) has argued for a broad systems approach to resource management and sustainable agriculture by the National Agricultural Research System (NARS) in Bangladesh. There has been a grassroots reaction against the agriculturally biased flood control approach of the Flood Action Plan (FAP), articulated by environmental NGOs in Bangladesh (Haggart, 1994). The New Agricultural Extension Policy 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). Technologies relating to integrated systems of production such as the rice-fish (paddy aquaculture) technology are being widely promoted by the NGO CARE (Kamp et al, 1996) and taken up by farmers. That systems approaches are gaining currency in Bangladesh is significant, given the intertwined nature of terrestrial and aquatic production on the floodplain.

Nonetheless, systems research and extension can operate on a number of scales. The established approach for Farming Systems Research and Extension (FSRE), in Bangladesh as elsewhere, is to target groups of farmers with sufficient homogeneity that they form a Recommendation Domain (RD). Such targeting allows multidisciplinary FSRE teams to identify constraints and develop site and RD specific solutions. This approach has achieved some

notable successes, and is also seen as appropriate to small-scale fisheries research and development, particularly as it brings together biological, economic and social perspectives in a multidisciplinary manner (Veach, 1996). However, the greater significance of common property issues in fisheries than agriculture is highlighted by Veach. FSRE is typically confined to individual farm level decision making rather than co-management approaches at the community level. It is the community level which is appropriate to Bangladesh floodplains, since there is so much seasonal interaction and overlap between land and water based production systems and between common property and private resource use.

FSRE is being taken forward from 'research into farming systems' towards 'systems research about farming' (Bawden, 1995). A significant element of this distinction is the recognition by soft systems researchers that any complex situation, i.e. one involving people, will expose a range of different perspectives according to the goals and worldviews of the different actors in the situation.

FSRE has tended to conceive of farming systems as 'hard' objectively definable entities. The 'soft' systems approach recognises that a system is subjective; a personal construct defined by social factors, goals, experiences, indigenous knowledge, etc. The approach treats complex situations as learning systems, in which mutual learning by different actors in the system about each others' varied and often divergent views is promoted. By appreciation of the multiple worldviews, the actors in the 'system' can move towards consensus in goal setting and system change/improvement. This concept ties in strongly with the use of participatory methods in FSRE.

The floodplain is exactly one such complex or messy situation, and one with very many actors. Given the history of interventions on floodplains having negative impacts on non-target groups, i.e. zero-sum interventions, an approach which considers all resource users may result in more positive improvements in overall productivity.

The floodplain environment may be seen from the physical standpoint as a catchment or similar hard system, however the soft systems approach sees it as a fabric of interwoven 'human activity systems' each relating to a different perspective. Thus what constitutes 'improvement' or 'sustainability' will depend on the worldview and resulting livelihood



The soft systems concept ties in strongly with participatory methods of exploring indigenous knowledge and complex resource management situations.

Two current projects are aiming to enhance understanding of the complexity of floodplain livelihood strategies.

A hoped-for outcome is positive sum (win-win) rather than zero-sum (win-lose) floodplain management options.

An institutional constraint is that in Bangladesh extension activities and research all follow vertically-integrated or commodity-based approaches.

strategy of the farmer or fisher in question. Techniques such as Rapid Appraisal of Agricultural Knowledge Systems (RAAKS) (Engel & Salomon, 1997) have developed to capture and synthesise multiple perspective in agricultural production systems. Little work has been recorded in mixed fishing/farming communities however.

Two projects, funded by the UK Department for International Development (DFID), and implemented by the Universities of Newcastle, Durham and Stirling together with several Bangladesh collaborators, are currently underway in the Bangladesh floodplain environment, specifically trying to address just these problems of understanding the complexity and multiple perspectives in floodplain livelihood strategies. The projects are studying the matrix of overlapping strategies by different socio-economic groups who make differential use of terrestrial and aquatic resources across the seasons. The indigenous knowledge (IK) of these groups is also being investigated to develop methodologies for routinely incorporating IK into natural resources research. IK can help in the understanding of complex resource management situations, and in the development of acceptable system improvements. One aim is to develop more sustainable and equitable floodplain management options, i.e. options which, considering the whole floodplain, are closer to positive sum (win-win) rather than zero-sum games.

### Implementing a Systems Approach

A systems approach, wherein the perspectives of all floodplain users are considered, in order to achieve both sustainable and more equitable increases in production, is not simple to implement.

Approaches which consider systems issues within narrowly defined recommendation domains, can often yield technological packages that are easier to deliver to the target audience, but may improve productivity in one area only at the expense of another. Thus 'systems' at natural resources system scale (i.e. interacting multi-user systems like the Bangladesh floodplains) are inherently more complex to deal with.

Soft systems approaches are important at both the initial stages of natural resources development and the later development of systems improvements. Initial activities are required to express the 'problem situation' and explore different perceptions of the floodplain system. Activities such as Farmer Information Needs

Assessment (FINA) (Ministry of Agriculture, 1997) and problem census (Bhuiyan & Walker, 1996) can then take place to define desirable changes to the system. Debate on desirable changes to the system should only occur once research and extension organisations have obtained at least outline understanding of the pattern of relationships between different floodplain livelihood strategies through participation with floodplain stakeholders.

### Changes that ignore the systems perspective

Without the initial 'whole systems' evaluation, problem census might, for example, identify lack of irrigation as a constraint to boro rice production, leading to research to develop a low-cost technology to use surface water in small water bodies for irrigation. However this would miss the perspective of other floodplain resource users (fishers) who use this water for the mainstay of their livelihood (capture fisheries). A systems approach might yield a management strategy for more balanced use of this water resource, or identify the need for improved water use efficiency in cropping systems as a better technological development.

At a simpler level, Pretty (1995) offers the example of different and conflicting perspectives between neighbouring farmers. Both farmers grow HYV rice using high levels of inputs, including non-selective pesticides. One farmer introduces IPM to his system, but his pesticides kill the predators beneficial to the IPM farmer's system. Such a scenario may occur in Bangladesh where one farmer practices rice-fish co-production, and a neighbour uses piscitoxic pesticides that flow in surface water into the fish-stocked paddy with disastrous effects.

This use of the soft systems model is heuristic, helping to identify where there is a system weakness. This weakness may be strengthened by single discipline research and extension, but the approach ensures relevance by setting problem definition, research, and extension of solutions in a systems framework. It should thus be noted that a systems approach does not preclude specialist research and extension, but instead helps to target it.

There are a number of institutional problems that relate to this approach. Extension activities and research all follow vertically integrated approaches in Bangladesh. The commodity-based remit of the NARS institutes can result in a lack of co-ordination of research on different commodities within the same produc-

**Incorporating systems approaches into natural resources R&D involves the hard task of managing interdisciplinary and cross-sectoral activities, and may result in slower progress.**

**But the advantages are greater stakeholder involvement and more sustainable improvements.**

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tion system (Karim, 1994). Extension is provided by bodies such as Department of Fisheries, Bangladesh Agricultural Development Corporation and many NGOs, in addition to the Department of Agricultural Extension. The New Agricultural Extension Policy has made significant progress towards creating structures for interdisciplinary and farmer-centred approaches in extension. However the focus is still the farm unit, rather than the floodplain ecosystem with its multiple users. Initiatives are now needed by agricultural service providers to tackle multiple perspectives, especially where agriculture-fisheries interactions are important.

The drawbacks of incorporating such systems approaches into natural resources R&D are the increased difficulty in managing interdisciplinary and cross-sectoral activities, and the slower progress that can result from the extra complexity. The advantages are greater stakeholder involvement, an increased user perspective, and more sustainable improvements. In particular it allows the views of fishers to be heard by farmers, and those of the landless by the landed.

There is a risk of diffusion of effort through trying to address the plurality of multiple stakeholders' perspectives. However the process whereby different views can be accommodated is an essential part of the development process. Röling (1996) has proposed a platform for taking account of the social and biophysical issues in natural resources management, leading to mutual learning and jointly evolved systems improvements. This platform involves accommodating individual interests, negotiating, and resolving conflicts that result from multiple perspectives, thereby losing some diversity in the system, but resulting in consensus for collective action.

Central to this and other similar systems developments is the formation of stakeholder groups to act as a collective agency in natural resources management. This may involve facilitation by outsiders (researchers, extension agents), who may form stakeholder-facilitator groups for soft systems analysis. In the Bangladesh floodplains case, this might involve wealthy and poor farmers, fishers, agricultural and fisheries extensionists and researchers working together in problem identification and developing complementary rather than conflicting solutions. Under such high population density, the resource limited conditions of the floodplain have often meant that one user group can improve production only at the

expense of another. The soft systems approach develops negotiated actions for improved productivity and reduces the risk of promoting win-lose scenarios.

Julian Barr is a Lecturer in the interdisciplinary Centre for Land Use and Water Resources Research (CLUWRR) at Newcastle University, UK. (j.j.f.barr@ncl.ac.uk)

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## Delivering fish, tackling poverty

Aquaculture – the farming of fish and other aquatic products – is of key importance in meeting human food needs as catches of wild fish decline. Potentially a highly efficient user of space, of agricultural by-products (including animal wastes) and of under-utilised water resources, aquaculture is being promoted in countries of the South by national governments, by aid donors and by NGOs. But is the experience of the 'green revolution' about to be repeated, so that, in aquaculture as in foodgrain production, it will be the farmers with most resources who benefit most from the opportunities offered by aquaculture research and development?

If aquaculture is to reach its full potential, then it needs to be adopted widely by resource-poor and low-income people, including – crucially – those who work in risk-prone environments far removed from on-station research. Articles in this issue of The REB report on experiences with aquaculture development and extension in both Asia and Africa. They also highlight some key themes which are emerging from this experience – among them the importance of a systems approach to understanding aquaculture's place in complex livelihood systems; and the vital contribution which participatory research can make to R&D.

The University of Reading Agricultural Extension and Rural Development Department