Adaptive learning networks for improved floodplain management [1]

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ABSTRACT

Adaptive learning is a structured process of “learning by doing” that emphasises the learning process in management. Previous work on adaptive learning networks has focused on exchanges between individuals or focused on technical aspects of resource management across villages. However, co-management is increasingly being adopted in floodplain commons. In Bangladesh many community based organizations (CBOs) have been formed and left to continue managing wetlands when projects ended. Over 250 existing CBOs involved in managing floodplain natural resources were brought together into a learning network. The CBOs identified lessons and good practices and spread their adoption. They identified gaps and opportunities, and coordinated innovation to address common problems.

The adaptive learning process evolved through workshops among CBO leaders at a regional level and two-way communication between leaders and members of their CBOs. By bringing together CBOs that had before concentrated on either fishery management or water management for rice, and reviewing together constraints and opportunities, proven practices spread and new options were tested. Over three years 56% of participating CBOs acted to improve fisheries management, and 72% now have fish sanctuaries. Taking a system-based view of natural resource management encouraged a quarter of the CBOs to test dry season crops that need only about 20% of the water used by the dominant irrigated rice. The aim was to preserve more surface water for fish to survive in. Most of the alternative crops were shown by the farmers to give better financial returns than rice, and crops such as garlic are now spreading in several CBO areas.

Overall the benefits of an adaptive learning network are: more rapid and systematic learning than individual trial and error, encouraging innovation, more efficient channels for advice, and strength in numbers to face threats such as external pressure to access common water resources.

KEY WORDS

Community organisation, adaptive, co-management, fisheries, floodplain, water

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BANGLADESH CONTEXT

About 6-7% of Bangladesh is always under water, and in the monsoon 21% is deeply (>90 cm) flooded and around 35% experiences shallow inundation (FAO, 1988) – these areas form the floodplains of Bangladesh. Within this system are rivers, *haors* (deep depressions in the north-east that coalesce to form a vast inland sea in the monsoon - rainy season), *beels* (permanent freshwater depressions), *baors* (oxbow lakes), and extensive seasonally inundated floodplains.

Floodplain wetlands in Bangladesh provide local people, especially the poor, with food, most notably fish but also other aquatic animals and plants. Up to 80% of rural people and about half of rural poor households living in the floodplains catch fish and use other aquatic resources, and about 60% of animal protein consumption in Bangladesh is derived from fish (Minkin *et al*. 1997; Thompson *et al*. 2003; Muir 2003; Toufique and Gregory 2008). Wetlands are also important sources of fodder, building materials, water retention to recharge groundwater and absorb floodwaters, and means of transport. As a result, local communities have a direct interest in maintaining floodplain natural resource productivity.

However, these floodplain systems have complex property rights and management interventions. Permanent waterbodies and rivers are state property, but the majority of land in the floodplains is privately owned and cultivated with rice. When it is flooded private land becomes a seasonal commons where people catch fish and make use of a multitude of natural aquatic resources, all interlinked in an ecosystem connected through water. Bangladesh wetlands have ample water for half of the year in the wet season, but the amount and use of surface water in the dry season is the main factor determining overall floodplain productivity. In the dry season surface water is needed for agriculture, for domestic uses, and for the survival of fish. Agricultural development has largely focused on rice production. Rapid growth in rice production since the 1980s has been led by abstracting ground and surface water to irrigate high yielding varieties in the dry season (Sultana *et al.* 2008). In addition flood control and embankments have been built to drain wetlands for agricultural expansion and to protect crops from floods, but embankments have had negative impacts on fisheries (Ali 1997; Halls 1998).

Since the mid-1990s the Government of Bangladesh has undertaken several projects to improve local fisheries management and water resources management through Community Based Organizations (CBOs). In all cases these initiatives represent community based co-management. The various projects were all time bound, and the major question is over sustainability. Often the essence of a project fades out after project support finishes due to gaps in knowledge, leadership capability, funding, technology, access to resources, and unity of efforts. Floodplain resource users are either poor and weak or rich and influential. One of the main themes of community based management has been to encourage and empower the poor to take part in management and for the rich to support them. For example, use rights to public waterbodies (*jalmahals*) and ownership of water control structures have been transferred to about 300 CBOs for long term community management under government oversight. It is expected that this management and improved productivity will continue, and that poor fishing communities using these resources

are expected to continue benefiting for generations to come. Similarly ownership of water control structures commanding areas up to 1,000 ha has been handed over to CBOs that are expected to operate and maintain this infrastructure. Sustainable use requires local coordination and collective action and for this local institutions for natural resource use were embedded in newly formed CBOs. However, while the access rights of CBOs to floodplain areas were and are recognised by government after projects ended, the CBOs have been left each to fend for itself in managing those resources. This paper examines how an adaptive learning network of CBOs can address this gap.

CONCEPTUAL FRAMEWORK

Adaptive management is 'an approach based on the recognition that the management of natural resources is always experimental, that we can learn from implemented activities, and that natural resource management can be improved on the basis of what has been learned' (Borrini-Feyerabend *et al*. 2000). It could be argued that any good management should be adaptive with the managers trying to improve management and respond to changing circumstances. However, adaptive co-management is now seen as a specific management approach that incorporates a hierarchy of institutional arrangements to share management responsibilities over scales of resource and an explicit commitment to learning (Armitage *et al*. 2009).

Adaptation is about systematically using the results of management and monitoring to test assumptions (Margoluis and Salafsky 1998) and thereby improve interventions. If the intervention did not achieve the expected results, it is because either the assumptions were wrong, the interventions were poorly executed, the conditions at the intervention site had changed, the monitoring was faulty, or some combination of these problems. Adaptation involves changing the assumptions and the interventions to respond to new information obtained through monitoring. Thus Tyler (2008) argues that the key element of adaptive management is that it specifies a formal design to test resource management interventions experimentally, rather than waiting for scientific uncertainties around such actions to be resolved before acting. However, he also noted that much adaptive management is set within an existing resource management framework that does not promote wider shared learning and focuses on technical/scientific issues.

Adaptation is also possible in natural resource governance systems – if organisations and institutions are static they are less likely to survive in a dynamic world (Jentoft 2007). But this raises a new set of challenges in terms of adaptive membership and constitutions for community organisations, or forums and linkages in co-management. The institutional assessment framework developed by Ostrom (2005) and Oakerson (1992) offers a way of understanding adaptation in institutions by focusing on contextual factors (biophysical/material conditions, community attributes, and rules) and interactions.

Monitoring and assessment methods and scope are a key component of adaptive learning and assessments of co-management performance. Armitage *et al*. (2009) recommend that context, uncertainties and objectives should be considered in deciding what outcomes to monitor. However, for learning by resource managers the

process is at least as important as the information and its analysis, and participatory processes in both the choice of indicators and monitoring are vital (Garaway and Arthur 2004; Armitage *et al*. 2009). The adaptive learning presented here followed this approach, although input from the research team was needed to advise CBOs on the practicality of some proposed indicators and to help CBOs from different regions standardise on the details of measurement and methods.

In management through adaptive learning the existence of uncertainties is not only accepted but made a focus of management efforts which seek to reduce them at the same time as managing the resource. In such cases learning, and reducing uncertainties about the resource system being managed, becomes a vital and integral part of management itself. Learning is seen as a three stage process comprised of: information generation, information sharing and information utilization (Arthur and Garaway 2005). Learning is about systematically documenting the process that was followed and the results that were achieved. Armitage *et al* (2009) stress four aspects of learning related to co-management:

1. Social interaction based on trust;
2. A diversity of learning strategies particularly experiential;
3. A model of learning that accounts for social context, reflection, system thinking or interconnectedness, and a diversity of approaches to adaptation; and
4. Attention to who is learning and the linkages among learners – scaling up individual learning.

We have focused on scaling up learning across and among similar organisations, and encouraging learning within those organisations to spread beyond leaders to the wider membership. The networking process among CBOs was designed to help develop trust among peers, and learning was based largely on sharing experiences taking explicit account of the interconnections in resources and their uses in the floodplain. Resources limited the scope to directly involve many members of each CBO in learning workshops, so other mechanisms to encourage sharing of experience and lessons within CBOs were developed. These encouraged sharing between CBO leaders and general members and ensured that general members actively supported and were involved in testing lessons and piloting new options.

Social learning in adaptive co-management will also tend to involve shared learning among divergent stakeholders (individuals and organisations) with different orientations and values, and thereby may develop a collective understanding. Consequently one of the main challenges for a social learning approach is the application of participatory methods and communications skills in the face of social and political power differences (Beck and Fajber 2006; Armitage *et al*. 2008). While, as noted by Tyler (2008), social learning can foster innovation through deliberation, relationship building, better communications, shared power, and recognition of mutual interest; it can be time consuming and is vulnerable to conflicts among stakeholders. In our experience by focusing on adaptive learning among CBOs rather than links between CBOs and government stakeholders, we have sought to provide a framework favourable to social learning, and have adopted an iterative process led by the participant CBOs. By developing their collective strength this also forms a step towards poorer natural resource users/managers interacting with and being heard by government stakeholders.

Tyler (2008) also highlighted a contradiction between management that attempts to maximize natural resource production (which can increase vulnerability), and ecosystem resilience (and adaptation) which requires diversity of components, linkages, and flows. The approach reported here aimed to encourage communities that have a legacy of different objectives in their management of similar floodplain resources handed to them from past project support, to take a wider view of their natural resource systems by sharing lessons in crop, water, and fishery management, and by giving space to consider other system linkages not anticipated at the outset by the research team.

Olsson *et al*. (2006) and Fabricius *et al*. (2007) note that learning becomes even more effective when knowledge networks are formed, which enable adaptive actors working at different levels to share information, and that this can enable communities to access technologies from outside their area. Previously adaptive learning networks have been proposed between individuals (Davidson-Hunt 2006), or involved villages but focused on a more technical aspect of resource management such as culture based fisheries management in small waterbodies (Arthur and Garaway 2005). Our approach differs in having worked to help a diversity of CBOs managing floodplain resources to learn from each other's experience and experiments.

ADAPTIVE LEARNING NETWORK

Initial situation and invitation to CBOs

In Bangladesh by the mid 2000s there were already several hundred floodplain CBOs. These are people's organisations comprising of 50 to 800 or more member households, mostly poor, and each covering several villages that depend on a defined floodplain or waterbody. They were formed to manage natural resources (water or fish) by government projects with facilitation from NGOs. They have graduated from those projects and are registered as independent legal entities with recognised rights and responsibilities to their resources. Each CBO already tried to do the best it could, based on its experience, but did this in isolation.

From early 2007 with support from IDRC and later from DFID's Research Into Use programme we attempted to scale up learning, by linking up CBOs. The isolation and local experience base of each of these CBOs limited their scope for adaptive management and learning. The solution attempted has been learning among a network of CBOs, addressing issues identified by those CBOs. In terms of research we investigated how CBOs can improve their management by sharing lessons, good practices and problems, and jointly testing new ideas and practices. This covered resource management practices, information generation and monitoring, CBO governance, and the policy implications of the lessons. It was expected that the adaptive learning network process would improve on existing practices through:

- the multiplier effect of shared learning based on experience;
- identifying common constraints and gaps in knowledge of what works; and

- coordinated piloting of innovations and good practices that address a wider range of interlinked floodplain resource management issues than sectoral projects have usually addressed.

CBOs formed under different completed projects that had “graduated” from project support, were still active, managed floodplain resources, and were interested to improve their activities were invited to participate. There was an enthusiastic response among the CBOs who saw the potential for a forum where they could come together, share their problems and opportunities, learn about innovations, try and adapt innovations in their area, and jointly influence practices and policies in favour of their communities. Initially 154 CBOs joined in, a number limited by the resources available to the team (Table 1 indicates the project origins of those CBOs). In 2008 this was expanded to about 250 CBOs, but quantitative results in this paper focus on the initial CBOs since they have participated in the network for longer. A very small number dropped out at early stages, mainly as their leaders were not prepared to adopt transparent processes in managing their funds or planning resource management piloting.

Table 1 CBOs managing floodplain resources and involvement in the adaptive learning network

Project	Donor	Ended	CBO formed	Network CBOs
Aquaculture Development Project	IFAD	2005	9	6
Community Based Fisheries Management projects	Ford Foundation/ UK/DFID/ IFAD	2007	107	58
Fourth Fisheries Project	World Bank and UK DFID	2006	46	31
Management of Aquatic Ecosystems through Community Husbandry project	USAID	2007	16	10
Oxbow Lakes Project phase II	Danida and IFAD.	1997	22	8
Small-Scale Water Resources Development Sector Project	ADB and Dutch govt.	2003	462	41
Total			662	154

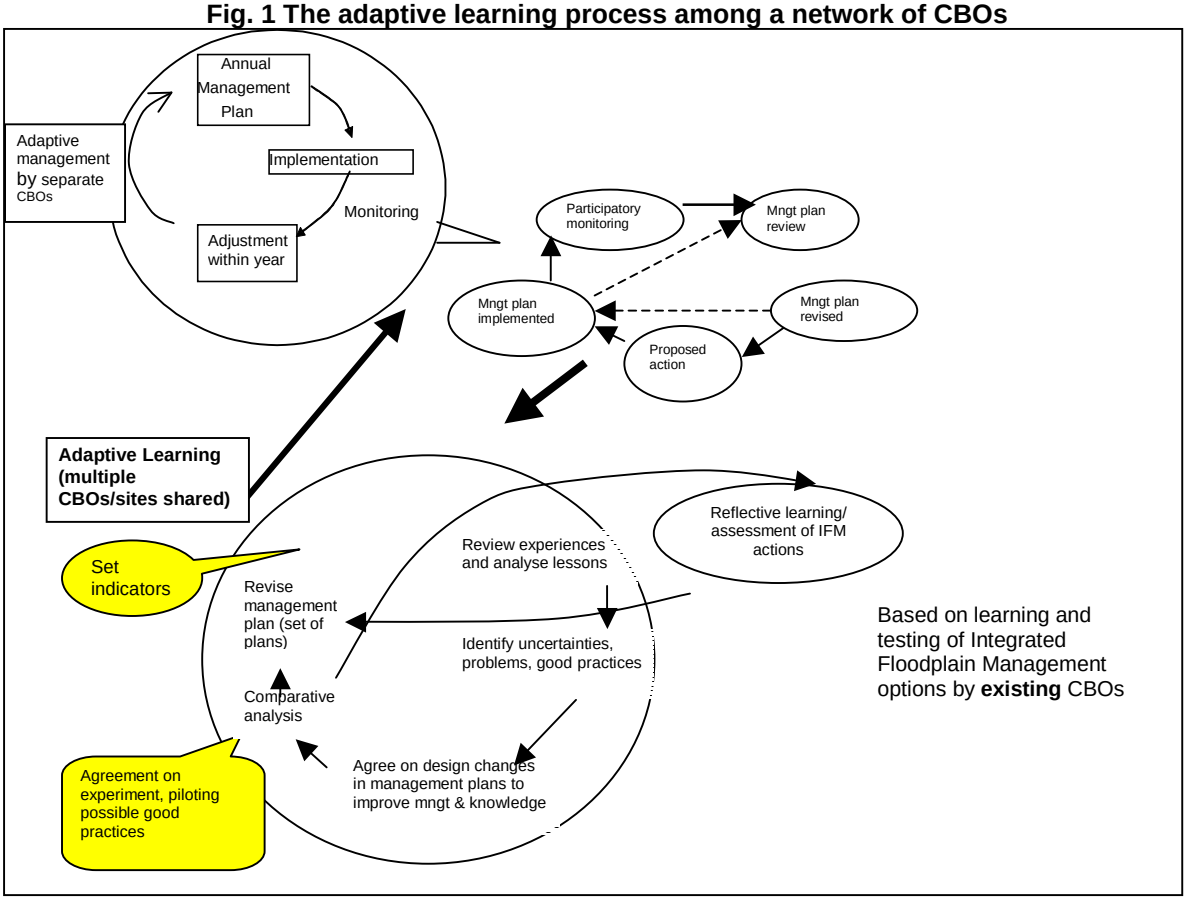
Developing an effective adaptive learning network

Typically each CBO has an executive committee of leaders representing the whole organisation, and these leaders made a management plan. Sometimes the leaders discussed the plan with the general members or wider community through a meeting or workshop, but the planning process was most often not well structured. Every year the CBOs made their management plan with some informal review of their own past experiences, but there was no sharing between CBOs (the top left closed circle in Fig. 1). The concept of an adaptive learning network was to enhance this practice through the multiplier effect of sharing learning across CBOs. Collectively the CBOs would share experience, identify constraints and gaps in knowledge, coordinate piloting and changes in practice to address a wide range of interlinked floodplain resource management issues, and monitor and assess these changes.

Facilitation and resources were needed to bring scattered CBOs together. Initial workshops with small groups of CBOs from a given environment and region were held to discuss how the process could function and understand how CBOs’

management plans have evolved and what expectations CBOs had. However, smaller workshops did not offer a forum where lessons could be more widely shared, and it was rather expensive to hold many small workshops. As originally conceived, adaptive learning among a network of CBOs was expected to function through annual workshops among CBOs. But 150 or more CBOs are too many to hold meaningful sessions in one place. Meeting only once in a year was found to give insufficient impetus to the process – it was too easy for CBOs to be swamped with their own issues and there was a long delay before CBOs could give feedback between one another.

Fig. 1 The adaptive learning process among a network of CBOs



The adaptive learning network process that evolved is shown in Fig. 1. In each of three regions each CBO sends a representative to two larger workshops in a year covering the cycle of activities in the large bottom circle. The CBOs identify common issues and uncertainties; solutions already proven by some CBOs; opportunities and potential changes in their draft management plans; and other aspects of their decision making and resource management that they want to improve or experiment with. The individual CBOs started to make more systematic management plans and could see room for changing their decisions on the basis of combined experience. Options are fed back by CBO leaders to their members and changes to plans and actions are finalised by the executive committees of each individual CBO (top right open circle). These plans are coordinated by the network of CBOs so that alternative views can be tested in the form of experimental designs where appropriate. In the workshops the CBOs also develop a set of common indicators for each initiative they try. This process has allowed the networked CBOs to compare and assess impacts

using their own monitoring. Subsequently the CBOs trying the same types of initiatives wanted to meet and explore why and how options worked or did not work. This has been added as local reflective learning workshops.

In the first year of the project the CBOs agreed to formalize their network through three regional committees. In January 2008 all 13 members of each regional networking committee (39 CBO leaders) met and agreed to register a federation of all the CBOs and formed an ad hoc central committee. This central committee finalised a constitution, and succeeded in obtaining registration as a legal entity – the "Society for Water Resources Management" – under the Society Registration Act, 1860. All of the participating CBOs have become members of this federation, which has held regular meetings and in 2010 an annual general meeting of all CBOs.

AREAS IDENTIFIED BY CBOS FOR ADAPTIVE LEARNING

In the early workshops the CBOs identified a range of lessons that they could already share and issues and options that they wished to test (Table 2). These formed the basis for piloting and lesson sharing during the subsequent two years, although as the process progressed a few additional ideas were raised by CBOs, while some of the areas identified proved difficult to assess in a structured way or to reach conclusions for the CBOs themselves and even with additional support from the research team

Table 2 Examples of lessons/gaps and areas that CBOs proposed for adaptive learning trials

Lessons and gaps in knowledge	Proposed trials and comparisons
Fish sanctuaries to increase fish population and diversity	Test sanctuaries in sites that lack them, assess the effect of sanctuaries on the local fish catches and species diversity.
Use of different (indigenous) materials to repair old sanctuaries attracts more fish	Test use of materials that are better for fish aggregation (Hijol, Gab, Shawra) where available.
Bigger sanctuaries give better results than the same area in a few small sanctuaries	Compare sites by size of sanctuary. Test new bigger sanctuaries and compare with waterbodies with small ones.
Rare fish can be re-established	Test re-introducing fish that once occurred in waterbodies.
Tree plantations reduce soil erosion	Test different species in different wetland locations.
Bee-keeping could generate income for fishers to reduce fishing pressure	Test where there are abundant flowering crops in right season.
Opportunity to cultivate fish in the dry season where water is isolated in a section of river	Test stocking fish in small enclosures of bamboo net (pens) or in closed *khals* (canals).
Farming ducks could add an income from waterbodies	Test by CBOs in closed beels and khals in floodplains.
Re-establishing aquatic plants can diversify returns	Test planting of Paniphal and other plants that bear fruit.
Integrated floodplain management enhances overall productivity	Test less water demanding crops to restore dry season water for fish in the canals and ditches, composting water hyacinth, alternative jute retting, etc.
Eco-tourism can add an income when attractive aquatic resources are conserved (e.g.	Test conserving wildlife and promoting eco-tourism.

Lessons and gaps in knowledge	Proposed trials and comparisons
waterbirds, plants)	tourism.
Selection or election of CBO leaders is better	Compare accountability of leaders, extent of participation in decision making, etc. between CBOs.
Education level of CBO leaders affects their effectiveness	Comparison of governance and resource impacts of CBOs with educated leaders and illiterate leaders in the executive.
It is bad for the management of CBOs to change leader frequently	Compare outcomes against duration that leaders have been in post.

BENEFITS OF ADAPTIVE LEARNING

The strength of the adaptive learning network, compared with experiential learning, is that only the implementation stage of the learning cycle is isolated within each CBO. The other stages are modified to involve coordinated sharing and planning of responses among the CBOs. This has resulted in improvements in community based floodplain resource management that would not otherwise have happened so fast, and generalization of key findings.

Institutional strengthening

Annual assessments of CBO performance using a structured format and conducted by the research team through discussions with CBO members and review of CBO records, indicate that CBOs have improved their performance during this process. About 70% of CBOs involved the poor more in their activities and also improved natural resource management; and about half of the CBOs enhanced the role of women in their organisation and the organisations' functioning.

The CBO network and project team followed a system whereby CBO leaders presented potential interventions in front of their peers for feedback and endorsement, and CBOs discussed plans with their members and reached a general agreement on piloting including their own contributions, before in-kind support was provided. Through this the capacity of CBOs has also been strengthened by the process of preparing scheme proposals and receiving small grants to test innovations. This results in bottom up planning, enhanced debate and decision making within CBOs, and greater transparency and accountability; only a small number of CBOs did not engage in this process and consequently did not fully participate in adaptive learning or even dropped out of the process.

In 2008 the CBO network or federation was formally registered as the "Society for Water Resources Management" (SWRM). One of the potential advantages of networking seen as an attraction early on by CBOs was not so much the learning process as the potential for solidarity of numbers in a federation with over 30,000 members in 153 CBOs and representing over 300,000 households. Jointly they believe they have a better chance of resisting the many dormant and active threats to waterbody access rights held by CBOs. The CBOs developed a better understanding of how to access government services. By joining forces they are more confident to bargain and demand better services; also some government

agencies, such as agricultural extension, find it easier to provide a service through a CBO.

The CBOs within a region have helped one another resolve local conflicts. For example, in Dhalna Beel in southwest Bangladesh, the CBO leaders broke the CBO's rules and sold all the fish from their fish sanctuary. The general members complained about this to two neighbouring CBOs which mobilised seven other CBOs from the area who together called and facilitated a meeting where the Dhalna community decided to expel those leaders and form a new committee. The nine other CBOs helped this CBO to reform their committee and start working again.

Similarly, in 2009 a politically backed group tried to grab the well established right of a CBO to manage and use a waterbody - Beel Gawha in northwest Bangladesh. The CBO consulted with the federation for advice, and then wrote to the district administration. When there was no response it and other CBOs in that region mobilized their members (comprising over a thousand people) to hold a public demonstration and human chain against the illegal threat. Subsequently the outside group offered to negotiate for a share of the benefits, but with its renewed strength the CBO held out for the political group only participating if it invested with them in the fishery and to the extent of any such investment. More generally the CBO federation has raised the collective negotiating power of the CBOs, it has raised with senior government officials key problems such as the need to maintain their security of access to waterbodies in the face of recent policy changes, and the adverse impacts of pollution on wetland and fisheries.

The most significant impacts came from bringing together CBOs that previously had different focuses, for example CBOs that before had only concentrated on stocking carps learned about conservation and management of wild fish, and thereby enhanced their returns. Likewise, CBOs that had just managed water for rice production learned about alternative crops that could make more efficient use of limited dry season water resources and about how they could through simple measures restore valuable local fisheries.

Fisheries

At the CBO level, resource management has consequently changed. Some CBOs had no idea about fish sanctuary. During adaptive learning workshops they learned from other CBOs that establishing sanctuaries can restore the diversity and increase the catch of valuable wild fish. The CBO leaders went back and discussed the idea with their members, and then made plans to create sanctuaries. Some CBOs who already had sanctuaries established more or larger ones, and some reintroduced locally rare native fish. All of the CBOs now have a fair idea of appropriate sanctuary materials and size, and by 2009 75% of CBOs that managed areas holding dry season water had fish sanctuaries (compared with 66% earlier). Those CBOs that had no sanctuary before reported up to a five-fold increase in their wild fish catch – as Fig. 2 shows catches from individual fishing by the poor more than doubled in some oxbow lakes within a year of creating the first sanctuaries. Some CBOs also adopted a range of related actions to improve fisheries (Table 3)

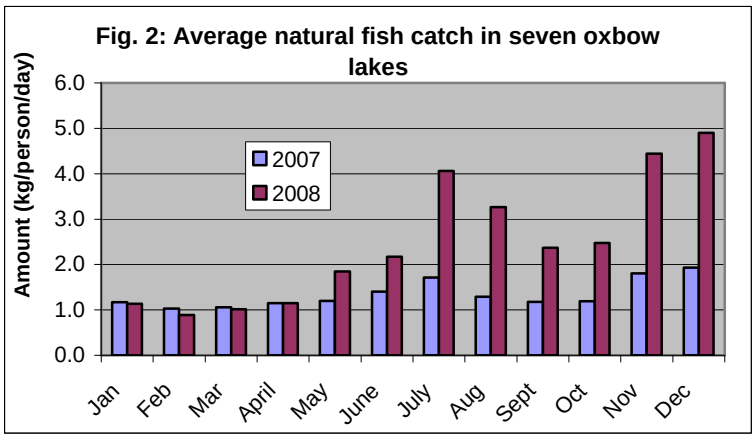


Table 3 Fishery related interventions taken up through the adaptive learning process 2007-2009 (out of 153 CBOs)

Actions tested by CBOs	No. of CBOs
Any fishery action	87
Sanctuary (new)	28
Sanctuary (improvement)	44
Excavate habitat	2
Fish re-introduction	6
Boat to improve guarding	12
Pen/nursery for cultured fish	7
Fish culture (native species)	4

However, despite considerable participatory monitoring of fishing and fish catches by many of the CBOs the results of this were unable overall to measure and attribute changes in biodiversity and productivity to changes associated with learning. This is because many factors affect catches (both internal to management by CBOs and external such as annual variation in water levels and volumes), and this action research covered a relatively short period compared with this inherent variability and the time needed to fully restore fisheries.

Agriculture

As part of an approach that we have termed “Integrated Floodplain Management” (Sultana and Thompson 2009), CBOs through sharing of experiences and lessons considered the implications of management interventions for the overall productivity and linkages within their floodplain systems. Alternative dry season crops (that are less water demanding than irrigated rice) have been tested by many of the CBOs and are now well accepted by those communities. The CBOs observed that cultivating new crops can save water for fish in the dry season. Farmers found the crops to be profitable. Table 4 summarises the returns achieved by farmer piloting of alternative crops and the implications for water use – all of the crops tested averaged better returns to cash costs and to water use than irrigated rice, and only two give lower net returns per hectare. Consequently after initial demonstrations organised by the CBOs and with advice and help accessing seeds from the research team, more farmers are increasingly adopting these crops from their own interest. For example, 21 CBO members from six CBOs tried no-tillage garlic in 2007, and by the start of

2010 this had expanded to 50 members, with the area per farmer also increasing. With dry seasons becoming drier in recent years, possibly linked with climate change, increasing numbers of farmers in CBO areas, particularly in floodplains in the southwest region, are interested to cultivate crops with low water demand.

Table 4 Returns from low water demand crops taken up by CBOs compared with irrigated rice in 2008-09 dry season.

Crop	Water demand (mm)[a]	No. of farms	Net return as % of HYV rice	Benefit – cost ratio	Net return (US$/100 mm water/ha)
Grasspea	90-100	10	168	4.6	485
Garlic	150	45	323	3.4	625
Mustard	160	38	122	2.9	221
Wheat	200	5	58	2.2	85
Maize	240	29	62	2.7	74
Sunflower	300	29	249	3.7	240
Potato	350	13	558	2.4	462
HYV rice	835-1000	9	100	2.1	8

[a] Biswas and Mandal (1993) quoted in Shankar et al. (2004)

Networking has also provided a forum where new problems have been raised and unexpected solutions have been tested. For example, members of CBOs in the northwest region (particularly women) complained that some seasonal vegetables and fruits were not setting fruit, and some CBOs came up with the idea of trying bee keeping. Through the network ten CBOs have tried bee keeping. Bee hives are moved from homesteads where fruit trees flower to mustard plots in the winter. These CBOs also planted jujube and mango trees which flower after mustard. This has added some additional income from honey for six CBOs that have expanded this operation, and brings environmental and indirect benefits (for example pesticide use among farmers in participating CBO areas has fallen), although it depends on the skills of CBO members and did not sustain with four piloting CBOs in areas with high pesticide use and colder winters.

Other similar initiatives were taken by CBOs to integrate production systems and make use of local opportunities – for example adding duck rearing to enhance returns from common waterbodies, and changing jute processing to improve the quality of common surface water. Jute retting (to separate jute fibre) is traditionally done in open waterbodies during the early-mid monsoon. However, retting de-oxygenates the water, and when monsoon water levels are low or waterbodies become isolated by infrastructure this causes skin disease and fish kills. Links between CBOs and government agencies were facilitated as the latter offered a simple alternative processing method ("ribbon retting") that minimises loss of water quality[3]. The benefit to fisheries of better water quality was an incentive to try this process. The project arranged training for interested CBOs that faced this problem, and examples of a very simple equipment for stripping jute fibre without soaking (retting) the fresh jute stalks.

[3] This is based on stripping fibre when green off freshly cut jute stalks and then soaking it in small water containers, rather than the traditional method of soaking the stalks in openwaters and then stripping the fibre off after it has softened and part decayed.

CHALLENGES FOR EFFECTIVE NETWORKING

Although there are institutional and productivity benefits for the communities represented by CBOs from adaptive learning through a network, there are also challenges to this process.

The dispersed nature of CBOs

CBOs are widely dispersed so it is hard for them to make the network function and take up issues at higher levels. Close coordination needs frequent interactions for which face-to-face meetings, workshops and visits are more effective. When CBOs are scattered this requires more funds than the CBOs can contribute. Moreover to function effectively the federation should have an annual convention but the costs of this are beyond the resources of the member CBOs.

Nevertheless, CBOs within a region can more easily share lessons and cooperate for conflict resolution. Also although they are scattered, CBOs do spend time and resources communicating with each other and with regional committees when facing problems. The rapid expansion and falling costs of mobile phone ownership in rural Bangladesh has facilitated networking.

Aspirations and vision

Each CBO inherits a certain idea of its objectives from the parent project and sponsoring agency. Taking up new ideas takes time to understand and trust other CBOs' lessons and to then change management plans.

There is a gap between the aspirations of the CBO network to raise their problems and views on government policies and practices, and their ability to access policy makers and organise by themselves suitable events. The project addressed this to some extent by developing a steering committee where CBO regional committee members sit with government officials to review progress and where CBOs through their committees could bring issues to the notice of officials, and this is also true of workshops organised by the project team. But government itself is unlikely to sponsor such events, especially as the CBOs may raise issues regarding government policies and services.

CONCLUSIONS AND RECOMMENDATIONS

This experience indicates that adaptive learning networks among CBOs are effective and worthwhile, and we believe the approach can be adapted to other types of CBO.

However, adaptive learning networks among scattered CBOs composed mostly of poor people require more resources than the CBOs can themselves mobilise. Networks of CBOs are a cost effective way for government agencies to link with communities with mutual benefits. Agencies can deliver services and messages to many people through CBOs, so funding from those agencies is one way that the costs of communication and networking among CBOs could be sponsored. Ideally

access to a pool fund for small one time grants or subsidies would better enable CBOs to continue testing further innovations, and might enable the federation to employ a fund raiser and facilitator. One option for sustaining this process would be to develop an endowment fund that could support a basic level of networking and interaction among CBOs beyond the very modest contributions that they can make from their own resources.

With a network now functioning, it could be made more effective in the future by focusing on links between CBOs and with government agencies at the district level and by developing valued services for members. For example, advocating that CBO network representatives become formal members of the government committees that decide on fishing rights at district level. Helping communities access science and new technologies (such as alternate jute retting) and establishing a lesson bank to be referred to by the CBOs (and others).

This project took a bounded view of adaptive learning in floodplain governance and institutions. CBOs did compare their governance systems, and some adopted good governance practices that they had previously ignored, or expanded membership to include under-represented stakeholders, such as women. However, substantial change in the forums where government stakeholders interact with CBOs was beyond our scope.

Hence this project has focused on a horizontal process of learning between entities (CBOs) that are considered largely comparable in status but have a diversity of experiences and resource bases within the common frame of floodplain resources. “Bridging organizations” such as those in co-management, that can strengthen social capital particularly trust across a hierarchy of levels or scales of different types of organizations (Berkes *et al*. 2003) are important to the future of the CBOs. However, we believe this can only be effective when poorer grass-roots stakeholders already have achieved a sufficient level of “bonding” social capital. In establishing community based co-management we consider that initial emphasis should be placed on helping the poor to organise and develop community organisations, understanding, trust and a common platform and voice (such as a network) before they are thrown into the frame of formally interacting with traditionally more powerful actors (government and local elites).

Similarly in adaptive learning networks associated with co-management, we consider that the initial focus needs to be on facilitating communities or CBOs to share and learn between one another, and to organise their network. This minimises the potential risk raised by Adger *et al.* (2005) that powerful stakeholders could use information from cross-scale learning to undermine trust and reinforce their own authority. A learning network among CBOs forms a much stronger basis for then interacting with other knowledge and management stakeholders in not only sharing information but also seeking to inform and influence practice and policy in favour of local community interests, particularly those of disadvantaged groups such as fishers and poor aquatic resource users in Bangladesh.

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