

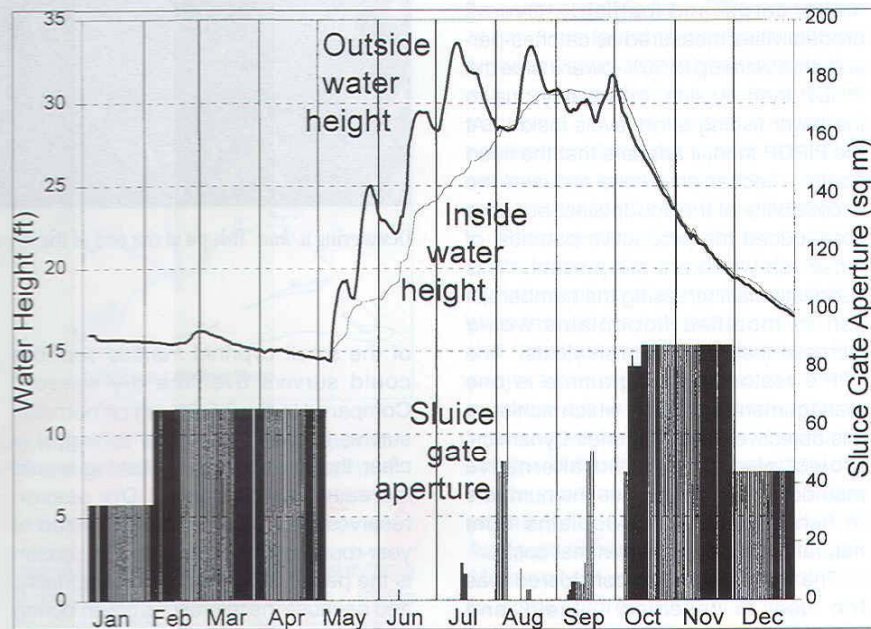
Restocking the Floodplains ... from Natural Sources

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The last issue of Aquaculture News reported the results of the DFID/World Bank-funded Third Fisheries Project (TFP) in Bangladesh, under an article entitled 'Restocking the Floodplains'. Following reported declines in the major carp fisheries in Bangladesh, and the impoundment of large areas of floodplains in flood control schemes, the TFP was designed to enhance the catches of major carps by stocking carp fingerlings at the start of the annual flood cycle. The project was successful in producing good returns from stocked fish in some years. The large numbers of fish required for stocking were produced by a backyard fry-production industry which grew rapidly in response to the project. Further work is now starting to find ways of privately financing such 'fish ranching' in what is largely an open access fishery.

The TFP and similar projects arose from concerns that flood control schemes in Bangladesh are largely responsible for the reported declines in its inland fish production. These concerns have recently been investigated by a research project 'Fisheries Dynamics of Modified Floodplains' funded by the DFID's Fisheries Management Science Programme. This project was set up to investigate the detailed mechanisms by which flood control schemes affect fish behaviour and productivity, and to see if any cheaper, natural methods could be used, as alternatives to stocking, to conserve and enhance catches from these resources. Sampling programmes on fish catch production rates were thus supported by detailed studies on the migration behaviour of fish, and their growth, reproduction and survival inside and outside a flood control scheme. The impact studies were designed to show whether flood control impoundments are actually accessible to migrating fish, and whether differences in flood levels inside



Sluice gate apertures at the PIRDP Talimnagar regulator, and water heights inside and outside the gate in 1995.

the schemes actually change the inherent productive capacity of those fish present.

The project was located at a study site in NW Bangladesh, straddling the boundary of the Pabna Irrigation and Rural Development Project (PIRDP). This 1,845km² flood control scheme was constructed during the early 1970s to protect Pabna communities from flooding and provide controlled irrigation for agriculture. Internal water levels are kept at safe levels by two pumping stations and fifteen sluice gates evenly spaced around the high perimeter embankment. Management of these sluice gates and pumps is guided by a committee of water engineers and farmers, and the gates are only opened to let in water (and fish) when this will not threaten crops. The gates are sometimes opened during the flood season, but were kept closed during most of the 1995 season, due to high levels of local rainfall. Water levels

inside such modified floodplains are therefore lower than outside, but significant flooding does still occur.

The project investigated the biological characteristics of six key species, the major carp *Catla catla*, the small cyprinid *Puntius sophore*, the silurid catfish *Wallago attu*, the climbing perch *Anabas testudineus*, the goby *Glossogobius giurus*, and the snakehead *Channa striatus*. All these species proved to be very fast growing, with 'wallago' even reaching 50-60cm in one year. All but 'catla' also proved capable of spawning at their first birthday. Mortality rates, however, were found to be extremely high, with only 0.5-2% of fish surviving beyond the age of 12 months. Wild floodplain fish stocks in Bangladesh are clearly supported mainly by the small handful of fish which survive both the fishery and the dry season conditions to spawn at the end of their first year.

Surprisingly, it was found that the PIRDP flood control scheme had *no negative impacts* on the growth, reproduction and survival potential of *individual fish* of any of these key species. Growth rates were actually *higher* inside the PIRDP than outside for four of the six species: this was explained though, by the fact that fish densities were lower inside the PIRDP. Species compositions were also different inside and out, with fewer species found inside, and particular reductions in the numbers of the large major carps and catfish. Overall productivities measured as catches-per-unit-area were up to 50% lower inside the PIRDP than outside, only partly due to the lower fishing effort levels inside. At the PIRDP then, it appears that the flood control mechanisms *have* reduced the accessibility of the floodplains, but *have not* reduced the productive potential of those fish which are still present. This suggests that increasing the numbers of fish in modified floodplains *would* increase their potential fish yields. The TFP's restocking programme is one management approach which achieves this objective. The 'Fisheries Dynamics' project also considered alternative methods which could raise the numbers of fish in modified floodplains from natural sources and at minimal costs.

The main approach considered was the use of reserves. Field and experimental studies both showed that when fishing was restricted, natural mortality levels were such that up to 37%



Dewatering a 'kua' fish pit at the end of the dry season.

of the small cyprinid *Puntius sophore* could survive over the dry season. Compared to the 0.5-2% which normally survive in the presence of fishing, it is clear that restrictions on fishing would increase fish numbers. Dry season reserves were recommended instead of year-round ones because the dry season is the period of highest fishing mortality, and because the migrations of fish during the flood season would expose them to capture whenever they ventured outside their reserve. Restrictions on fishing at

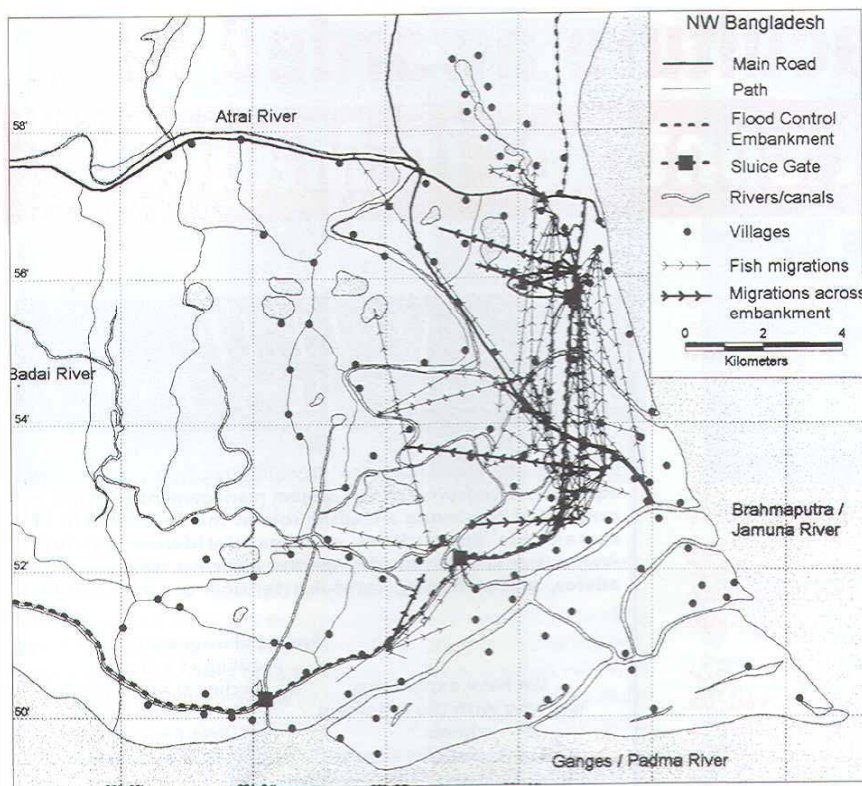
the end of the dry season (after the largest catches have been taken) would reduce the total catches by only a few kilogrammes in each waterbody. However, even such a minimal restraint could be enough to double the spawning stocks which produce the hatchlings for the next year.

Dry season fishing in Bangladesh presently includes the use of brushpile traps and dewatering by diesel pumps. Pumping out the waterbodies at the height of the dry season is particularly disastrous for fish stocks. Thankfully, some waterbodies are too big to pump dry, and these were shown to be where most fish presently survive the dry season. Encouraging restraint on dry season fishing in more of these waterbodies would mainly impact the richer leaseholders and their employees who fish them at this time, but could produce many more fish for everybody next year. Achieving such dry season restraint will no doubt pose a challenge for NGOs and social developers, but the small financial losses of the leaseholders may also be balanced by gains in their respect and status among the poorer community members.

The migratory behaviour of the key fish species was studied by a mark, release and recapture programme using small, highly visible, numbered plastic tags. With excellent collaboration by the local fishing community, up to 51% of the tagged and released fish were returned



'Katha' brushpile fishing in the early dry season.



The PIRD floodplain study site at the Jamuna/Padma confluence. The arrowed lines connect the release and recapture points of tagged *catla* carps showing their migrations between the waters of different village communities.

to the project by fishermen. From a total of 1,389 recaptures, 23 fish were found to have migrated through the sluice gates into the PIRD, and another 12 to have migrated out of the PIRD. Only tagged *C. catla*, *C. striatus* and *W. attu* were found to have passed through the sluice gates, but the other smaller species were also found in the catches at the sluice gates and some of these fish may well also have penetrated the gates without being returned. Fish migrated passively in to the PIRD at the start of the flood, and the large major carps and catfish were also seen to migrate actively into the PIRD against the flow when waters started to fall in September. This positive attraction for flowing water at this time would normally put fish further up the catchment for spawning so that the released eggs would flow back down to the floodplain feeding grounds. This behavioural trait could be used to attract fish into flood control schemes such as the PIRD to increase their fish catches.

Collaborative studies with the Bangladesh Agricultural University (BAU), Mymensingh suggested that the bulk of fish production in impounded waters

derives from the progeny of fish surviving in their dry season waterbodies. Some species of fish do not survive in these waters, though, and biodiversity is maintained by fish migrating in through the sluice gates from outside. When the sluice gates were regularly opened during the 1996 flooding due to the low water levels inside, catches were relatively better than when they were mostly closed in 1995. It was thus proposed that sluice gates should be opened whenever agricultural conditions permit to maximise the entry of fish. As a first step, it would clearly also be useful to have a representative of the fishing community on the sluice gate management committees who could advise when many small fish fry were being caught in the waters outside the gates.

Strong fish movements were seen for all of the six species studied with *Wallago attu* migrating up to 9km and even the small *Puntius sophore* moving up to 5km. These distances were enough to move the fish between the fishing waters of many of the 100 or so different villages at the Pabna study site. Such migrations

clearly increase the incentives of fishermen to catch as many fish as possible while they are in their local vicinity. Unilateral restraints on dry season fishing by one village may therefore be resisted if a community perceived that the rewards from their sacrifices were also going to other adjacent communities. To minimise such concerns it was suggested that each and every community could contribute to the breeding stock survival with their own dry season reserve, in a policy of 'local action for national gain in fish'. Different species of fish were found to survive in different types of waterbody, with some preferring still waters and others preferring river sections. The most important requirement for a dry season floodplain reserve, however, is simply that it retains some water for the whole dry season!

This project has thus shown that flood control schemes may reduce fish catches by interrupting the migrations of fish, even though the inherent productivity of the floodplains is not reduced. The project has also demonstrated two simple ways in which catches may be maintained or enhanced at minimal costs. Both dry season reserves and sluice gate management hold strong potential for increasing the numbers of fish in impounded flood control schemes. Management of sluice gates is restricted to some degree by rainfall levels and farming needs, though some small changes could easily be made to benefit fish stocks without risking agricultural production.

These largely biological insights were discussed at a final project workshop at BAU, Mymensingh in April 1997. The workshop participants included representatives from the Department of Fisheries, the NGO community, international funding agencies and the academic community. Reflecting on the study, the participants concluded that dry season reserves and sluice gate management approaches both offered viable and attractive solutions for the observed negative impacts on Bangladesh's impounded floodplains. The challenge now is for an integrated approach to the management of floodplain fisheries, where biologists, social scientists, NGOs and community stakeholders all work together and play active roles in the management process from the earliest possible stages.