

Exploring the potential of culture-based fisheries for augmenting income of tribal beel fishers: A success story from Assam

**Simanku Borah, Birendra Kumar Bhattachariya, Pronob Das, Anil Kumar Yadav,
Basanta Kumar Das and Uttam Kumar Sarkar***

ICAR-Central Inland Fisheries Research Institute, Barrackpore, Kolkata, West Bengal 700 120

The floodplain wetlands are amenable to different forms of enhancement options including culture-based fisheries (CBF). Fish production potential of this system is very high, but realized average actual production is still on the lower side. This reflects unscientific and poor management of resources. Therefore, on-field studies were carried out in collaboration and successful adoption and implementation of CBF in beels, has led to 117% increase in total fish production, 153% increase in net annual income of tribal fishers, 64% increase in total fish production and 106% increase in net annual income of tribal fishers in Bamuni and Charan beel, respectively. Per capita fish production (kg/fisher family) and fish production per unit area (kg/ha/year) doubled in Bamuni beel, while it increased by 1.5 times in Charan beel, post implementation of CBF. Studies suggest that technology of CBF practices if expanded properly in floodplain wetlands have the potential to improve fish production, maintain sustainability and increase fishers' income.

Keywords: Culture-based fisheries, Floodplain wetland, Supplementary stocking

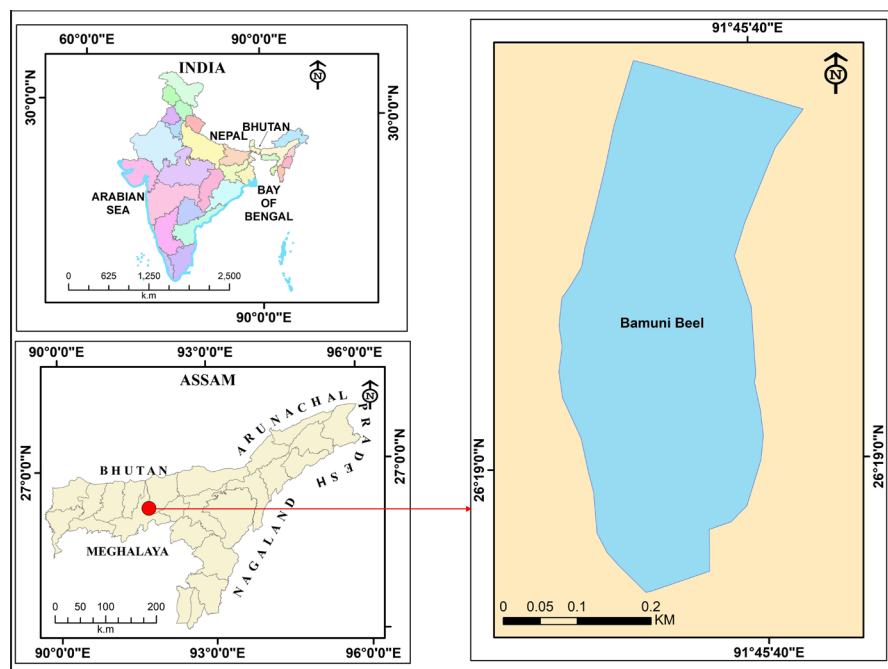
FLOODPLAIN wetlands are locally known as beel, anoa, haor, jheel, tal, maun, char, pat, dhal, charha and baor in different parts of Ganga-Brahmaputra-Irrawaddy basin. These resources provide a wide range of ecological goods, services and livelihood opportunities and are considered as kidneys of landscapes. They are rich repositories of aquatic biodiversity; breeding and nursery grounds for indigenous fish species; important ecosystems towards mitigating climate change; potential sites of carbon sequestration; facilitate ground water recharge; act as sink for floodwater; source of drinking water, water for irrigation and other daily human activities; besides providing livelihood opportunities, income, food and nutritional security to sizeable inland fisher population. Rich nutrient budget is a characteristic of these resources evident from

high fish production potential of 1000–2500 kg/ha/year. Though a series of management guidelines have been articulated over the last few decades for improving floodplain wetland fisheries, full potential of these resources has not yet been realized reflecting poor adoption of scientific management regime. Region specific management and technical guidelines are required to sustainably realize production potential of fish from such aquatic ecosystems. Fish production potential of floodplain wetlands (beel) in Assam ranges from 1000–1500 kg/ha/year, where realized average actual production is 254.3 kg/ha/year in wetlands where supplementary stocking is not practiced and 539.1 kg/ha/year in wetlands following supplementary stocking management regime (on the lower side). Possible reasons include lack of timely availability of fish seed of desired size and species

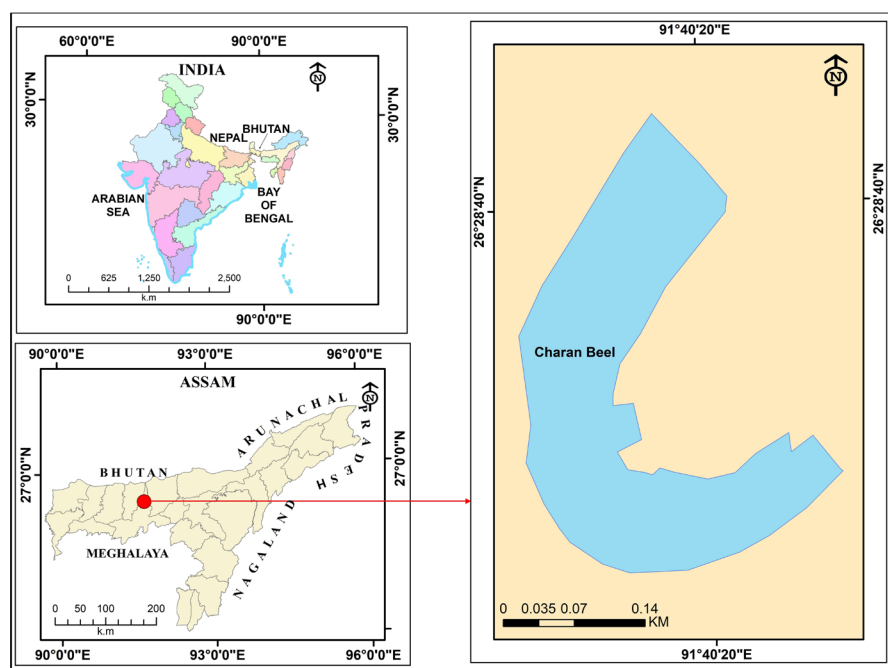
for stocking, generally crippled by difficulties in transportation over long distances, high mortality and cost. In aquatic ecosystems which cannot thrive on self-recruiting populations of fish, culture-based fishery (CBF) is a suitable management norm that can be adopted for fish production enhancement. The basic principle of CBF is stocking of fish seed and recapture after a definite period of time.

Demonstration of CBF among tribal beel fishers

ICAR-Central Inland Fisheries Research Institute, regional centre, Guwahati, Assam demonstrated CBF among tribal beel fishers of Bamuni beel (26°18'55" N and 91°45'30" E), Kamrup district and Charan beel (26°28'29" N and 91°40'13" E), Baksa district, Assam. For the purpose, advance fingerlings of Indian major carps (IMCs) and medium and



Bamuni beel, Kamrup rural, Assam



Charan beel, Baksa, Assam

minor carps comprising *Labeo gonius* and *Labeo bata* were stocked in both the beels during October–December, 2020. As per guidelines forwarded by ICAR-CIFRI for CBF in closed beels (having no riverine connectivity), fingerlings were stocked at the rate of 3000 no./ha. A total of 48,000 advance fingerlings were stocked in Bamuni beel, which has an area of 16 ha and another 33,000 advance fingerlings were stocked in Charan beel having an area of 11 ha. A total of 65 and 133 tribal fisher families depend on Bamuni and Charan beel respectively for their livelihood and nutritional security. Prior to stocking, awareness programmes were conducted by ICAR-CIFRI to sensitize the tribal beel fishers on importance of CBF in beels.

Impact of CBF on fish production and income

Little or no supplementary stocking was practiced in Bamuni beel, resulting in low fish production. During 2019–20, total fish production from the beel was reported to be 6.29 tonnes. Annual net income per fisher family during the period was (₹17,692.00). Post implementation of CBF protocols, fish production from the beel was more than doubled and a total of 13.52 tonnes of fishes were harvested during 2021–22. Annual net income per fisher family also increased to ₹44,763. During 2021–22, successful implementation of CBF in Bamuni beel led to 117% increase in total fish production and 153% increase in net income of local tribal fishers compared to 2019–20. Per capita fish production (kg/fisher family/year) increased from 96 kg in 2019–20 to 208 kg during 2021–22, while fish production per unit area doubled from 393.13 kg/ha/year to 845 kg/ha/year over the period (Table 1).

Similar to Bamuni beel, in Charan beel also supplementary stocking was not practiced in scientific manner prior to 2020–21. During 2018–19, total fish production from the beel was reported to be 3.18 tonnes. Annual net income per fisher family during 2018–19 was a meager amount of ₹3,652.00. Post-demonstration of scientific

Table 1. Impact of CBF on fish production and fishers' income in beels of Assam

Floodplain wetland	Bamuni beel		Charan beel	
Year	2019–20	2021–22	2018–19	2021–22
Area (ha)	16		11	
No. of fisher families	65	133		
Total fish production (tonnes)	6.29	13.52	3.18	5.22
Per capita fish production (kg/fisher family/year)	96	208	23.89	39.23
Per capita gross income from beel fisheries (₹/fisher family/year)	21538	47840	4779	9023
Per capita net income from beel fisheries (₹/fisher family/year)	17692	44763	3652	7519
Per unit fish production (kg/ha/year)	393.13	845	288.91	474.27



Supplementary fish seed stocking in Bamuni beel



Supplementary fish seed stocking in Charan beel



Harvest of fishes from Bamuni beel



Harvest of fishes from Charan beel

CBF protocols in the beel, fish production in beel increased more than 1.5 times to 5.22 tonnes during 2021–22. Annual net income per fisher family also increased to ₹7,519.00 during the period. During 2021–22, successful implementation of CBF in Charan beel led to 64% increase in total fish production and 106% increase in net income of local tribal fishers compared to 2018–19. Per capita fish production (kg/fisher family/year) increased from 23.89 kg in 2018–19 to 39.23 kg during 2021–22, while fish production per unit area increased more than 1.5 times from 288.91 kg/ha/year to 474.27 kg/ha/year over the period (Table 1).

Threats

In the present era, wetlands are facing the issues of habitat degradation, pollution and over-exploitation of its resources. These natural aquatic ecosystems bear the

brunt of tremendous anthropogenic pressure and are either drained or degraded through encroachment for human habitation and agriculture. Eutrophication of these aquatic resources is another major threat to its ecosystem health, biodiversity and sustainable management. Improving fish production and income through sustainable management options can be a potential solution to all major threats facing floodplain wetland fisheries.

Recommendations for sustainable beel fisheries

Floodplain wetlands are over-stocked in certain cases and under-stocked in most instances. Optimum stocking of 3000 fingerlings/ha for closed wetlands (without riverine connection) and 3600 fingerlings for open wetlands (with riverine connection) may be followed.

- Stocking with advanced

fingerling (>10cm) would result in better survival and return, and should be carried out during February–March, when there is a slight rise in temperature.

- Certain floodplain wetlands retain critically low water levels during summer and experience floods during monsoon season. In such cases in deep pools, pen culture with extendable pen walls above high flood level, late stocking and early harvesting can be an efficient management measure.
- Manual removal of aquatic macrophytes from wetlands is recommended at periodic intervals. A 5–10% macrophyte cover may be maintained, which will act as shelter for fishes particularly during summer.
- Nursery and rearing ponds in wetland periphery along with seed raising in pens and cages

in wetlands are recommended. This will help the stakeholders to overcome seed shortage of desired quality and quantity at the time of stocking and at the same time reduce input cost.

- Fishermen co-operatives and co-management regime should be promoted.
- Application of ecological modeling for devising stocking strategy and species selection and combination would help the primary managers to utilize the fish production potential of the various floodplain wetlands.
- Modern tools and techniques like remote sensing and GIS should be used in calculating the effective

average operational/water spread area. This will help in formulating appropriate stocking rates.

- Through appropriate regulations, stocking of invasive exotic fish species, which can potentially harm our indigenous biodiversity in floodplain wetlands, should be restricted and fishers should be sensitized on such issues.

SUMMARY

CBF has potential to increase fish production of beels and augment the income of tribal fishers' depend on these resources for livelihood. By adopting CBF protocols, income could be raised among tribal fishers of Charan and Bamuni beels of

Assam. Pradhan Mantri Matsya Sampada Yojana (PMMSY) initiated by government of India is giving maximum emphasis on development of fisheries sector, improving food and nutritional security and doubling fish production and fishers' income in the country. CBF protocols if implemented properly have the potential to realize these goals. At technical level, the CBF protocols needs to be demonstrated across the Assam and other parts of the country.

*Corresponding author's e-mail: uksarkar1@gmail.com

Breeding of fishes under controlled conditions

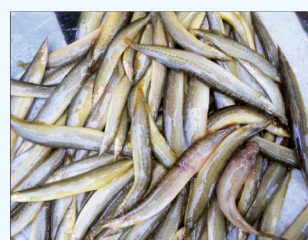
- Picnic seabream or black seabream (*Acanthopagrus berda*) is of aquaculture importance due to its high economic and recreational values, excellent meat quality and ability to tolerate wide variations in environmental parameters. Achieved its breeding and seed production by induced breeding using salmon GnRH-analogue hormone. The fishes spawned after 36 hr of inducement and the pelagic eggs hatched after 22 to 24 hr at a temperature of 28 to 30°C. Fecundity was 0.25 million per female (450 g) and 86% of the eggs hatched after 24 h. Larval rearing was carried out with various live feed organisms such as Copepods, Rotifers and *Artemia*. Metamorphosis of the larvae initiated in 24th day post-hatch (DPH) with 9% survival.
- Grey mullet (*Mugil cephalus*), a high-valued commercial brackishwater fish, was successfully bred under controlled captive conditions for the first time in the country. Captive maturation was achieved using sustained-release of LHRH and 17-MT hormone implants. Attained maturation percentage of over 80% in females with oocyte diameter > 520 µm and in males with expressible milt. Larvae were reared in captivity with the survival of ~22% on a mixture of microalgae and other conventional live feeds. Hatchery-produced mullet seeds were given to progressive farmers for further rearing.
- Barred spiny eel, *Macrogathus pancalus*, is a bottom-dwelling economically important freshwater food fish. Brood fish with the average size of 16.65±2.47 cm and 23.36±5.43 g with gonado-somatic index ranging from 8.49 to 11.4 were successfully bred naturally under captivity in rectangular FRP tanks (2 m length × 0.35 m width × 0.5 m height) using water hyacinths as the substratum for egg attachment. The sticky eggs remained attached with the root hairs of water-hyacinth by their distinct stalk. Eggs were laid normally on the inner branches of the upper part of the roots of the water hyacinth that remain 2–3 inches below the water surface. Hatching occurred in 48–60 h. Yolk sac of the larvae got fully absorbed in 2 days after hatching. The larvae produced were reared with planktons, formulated feed and chopped tubifex worms. Small, cylindrical PVC pipes were used as refuges in the rearing tanks.
- Peninsular carp (*Labeo kontius*) is endemic to the Western Ghats and is recorded from the rivers Cauvery, Bhavani and Moyar and its tributaries in Karnataka, Tamil Nadu and Kerala. Earlier it was a valuable component of capture fisheries in the Cauvery river system, but its population has declined drastically in recent years. Pond cultured *L. kontius* attained the first maturity at one and half years of age and was successfully induced bred for the first time using salmon gonadotropin-releasing hormone (sGnRH) analogue and Domperidone in both males and females. Hatching of fertilized eggs occurred in 20–24 h of incubation and the hatched-out spawn were transparent, with conspicuous yolk mass and distinct head with transparent eyes. Yolk got completely absorbed and the larvae started feeding five days post-hatching.



Picnic seabream or black seabream, *Acanthopagrus berda*



Grey mullet, *Mugil cephalus*



Spiny eel, *Macrogathus pancalus*



Peninsular carp, *Labeo kontius*

Source : ICAR Annual Report 2021-22