Wetland Fisheries Development

1. Introduction

Floodplain Wetlands are water bodies associated with major rivers systems, connected to them by some means or the other, accommodating the swelling waters and playing a great role in mitigating floods and irrigating croplands. They are also the habitat for a large number of small indigenous fish species (SIFS) which support subsistence fisheries and provide livelihood to fisher communities, besides meeting nutritional requirements of the local population.

2. Resources

India has about 8.0 lakh ha of floodplain wetlands (*beels, jheels, mauns, chaurs, pats*, etc.) spread across the numerous river basins in the country. Major wetland areas are in the States comprise – Assam: 1.10 lakh ha, West Bengal: 0.42 lakh ha, Bihar: 0.05 lakh ha, Uttar Pradesh: 1.33 lakh ha, Odisha: 1.80 lakh ha, Arunachal Pradesh: 0.42 lakh ha, Kerala: 2.43 lakh ha, Manipur: 0.04 lakh ha, J&K: 0.06 lakh ha, Gujarat: 0.12 lakh ha, Haryana: 0.10 lakh ha (Total: 7.98 lakh ha). Wetlands of Assam, West Bengal, Bihar, Uttar Pradesh, Odisha, Arunachal Pradesh and Manipur States are amongst the most important from fisheries point of view and account for 7.50 lakh ha of wetland water spread area (WSA).

3. Status and Potential

Fish yield from floodplain wetlands has been estimated at 400-800 kg/ha/yr, against the production potential of 1,500-2,500 kg/ha. Harvesting is a major problem in most of them as they are usually weed-choked, obstructing use of fishing gear. Presence of predators often results in high natural mortality of stocked fishes causing low productivity. Therefore, enclosure culture systems are adopted to augment fish production from floodplain wetlands, wherein a captive seed stock is grown to fingerlings (*in-situ* or *ex-situ*) on formulated feeds, protected from predators, stocked in the main water body or in cages and harvested in due course of time. This is referred to as *Culture Based Capture Fisheries* (CBCF).

Selecting the right combination of fish species, based on trophic structure and potential of such wetlands, stocking seed of appropriate size (80-100 mm) and releasing them at the right time are essential to fully utilize all ecological niches and optimize fish yield from wetlands. Species most suitable for stocking in wetlands/*beels* include: Indian Major Carps (improved varieties), Indigenous Minor Carps, Exotic/Chinese Carps, etc.

4. Project Location and Implementation

A. Beneficiaries: Beneficiaries include fishermen and their cooperative societies/ SHGs/ fish farmers. The overall increase in wetland fish production would in turn improve the livelihoods of fishers and fish vendors, and provide nutritional security to the surrounding rural population.

B. Criteria for Selection of Wetlands: A committee comprising of representatives from State Fisheries Department/ Fisheries Development Corporation, ICAR-CIFRI, SAU-COF/ KVK, ATMA, would identify and select wetlands/*beels* for development. NFDB would provide financial assistance to the States having wetland resources for enabling an institutional setup and development in a project-mode.

Wetlands would be selected based on the following criteria:

- Wetlands/*beels* having water spread area (WSA) 10 ha and above.
- Wetlands that are not within restricted or prohibited area.
- Both registered and unregistered perennial wetlands.
- Community-based Combination Strategy shall be adopted.
- Wetlands leased out to a Cooperative Society would be selected.
- Where wetlands/*beels* are leased out to individuals, the State Fisheries Department/ Corporation shall organize the stakeholder's community into a Cooperative Society.

5. Project Components

(i) Construction/Renovation of Wetland Embankment.
(ii) De-weeding.
(iii) Stock Enhancement.
(iv) Procuring Stocking Material:
  a) Rearing Fry in Pens
  b) Rearing Fry in Cages
  c) Rearing Fry in Ponds

(i) **Construction/Renovation of Embankment:** Most of the natural wetlands were developed 10-20 years ago and require strengthening of embankments to facilitate stock enhancement and increase fish production. Need-based renovation/construction of embankment to appropriate width and height is required to hold flood-water and prevent escape of fish stock.

(ii) **De-weeding:** Aquatic weeds, especially the floating weeds such as Water Hyacinth, build up a huge biomass on the water surface and choke the water body. Further, there is: (a) enormous water loss through transpiration; (b) impediment to water flow, causing sedimentation, flooding and soil erosion; (c) obstruction to light penetration required for photosynthesis by primary producers; (d) drastic change in the physic

detrimental effects on the biota; (e) hindrance to navigation; and (f) fishing is hampered, reducing the catch, source of food and income of local population. Weeds also cause environmental as well as public health problems, as they may create a microhabitat suitable for the breeding of many vectors of human diseases and for harbouring poisonous snakes. Therefore, removal of floating weeds is necessary to make wetlands/*beels* productive.

(iii) **Stock Enhancement:** Wetlands/ *beels* were initially connected with rivers and there was free flow of water and auto-stocking of fish during rainy season. Now, the connecting channels of most of them are either silted up or encroached upon or blocked for constructing water control devices by the Flood Control Department, all of which have prevented auto-stocking. Therefore, stock enhancement is of paramount importance in wetlands to increase fish production.

Further, wetlands/*beels* have a large number of carnivorous and uneconomical weed fishes which either eat bulk of the stocked small-sized fish or compete with them for food and space. It is practically impossible to remove all the carnivorous species. Thus, all these factors are responsible for poor growth and survival of fish and low fish production in wetlands. To overcome this problem, large-sized fingerlings (at least 100 mm) need to be stocked in these water bodies so that they can escape from carnivores and fish production and productivity can be increased significantly to attain the potential of 2,500 kg/ha/year.

(iv) **Procuring Stocking Material:** Most of the States having Wetlands are self-sufficient in fish seed (spawn/fry) production for stocking in aquaculture ponds, but there is scarcity of grownup seed (advanced fingerlings) required for stocking in wetlands/*beels*. Advanced fingerlings are not readily available at the *beel* site, and bringing them from a distant farm is uneconomical due to high mortality and transportation cost. The problem can be overcome by raising fingerlings *in-situ* in cage and pen enclosures or *ex-situ* in rearing ponds constructed in the peripheral areas of wetlands. Fish fry of 2-4 cm size are to be procured from Govt. Registered Farms only.

(a) **Rearing Fry in Pens:** Shallow peripheral area of wetlands is suitable for installing pens. Pen culture, especially for raising stocking material, offers a great scope for effective utilization of available wetland water resources for fisheries enhancement that will lead to significant improvement in the socio- economic status of poor *beel*-fishers. Different sizes of pens can be installed in *beels*, but a 0.2 ha area pen is found to be ideal. Pens may be constructed using HDPE mesh/netting or bamboo-split fence. HDPE pens last longer than bamboo pens.

(b) **Rearing Fry in Cages:** Wetlands also offer good scope for installing cages to rear fish seed to stocking size or for further culture to table fish. At least one battery consisting of six cages (each 6 x 6 x 3 m or 6 x 4 x 2 m, depending on size and depth of *beel*) can be installed at selected locations. Cages may be free floating or fixed. Floating HDPE cages with GI pipe- frame are preferred as they last longer than bamboo framed floating cages.

(c) **Rearing Fry in Ponds:** Low-lying areas of wetlands/*beel* are suitable for constructing rearing/stock ponds at a low cost. These low-lying areas are vulnerable to encroachment and it is one of the biggest threats to *beel* fisheries. Construction of rearing/ stock ponds at the low-lying peripheral areas will help to prevent encroachment as well as enhance production. Rearing pond area may be 0.20-0.50 ha with a depth of 1.0-1.5 m, so that after rearing fish fry to fingerlings, the same pond can be used for grow-out to table size fish.

6. Technical Details

Sl. No.	Component	Salient Feature
1	Construction/ Renovation of Embankments	i. Wetland embankment height 2-3 m ii. Wetland embankment top width 2 m iii. Wetland embankment slope 1:1.5
2	De-weeding	i. Floating weeds like Water Hyacinth and other dense floating and rooted weeds forming mats are removed
3	Stock Enhancement	i. Fry of freshwater fish (IMC & other permissible species) are reared to fingerling size (8-10 cm) and stocked in the Wetland @ 2,000/ha.
4	Rearing Pen	i. Rectangular Pen. ii. Area minimum 0.20 ha. iii. Pen made of either split-bamboo mats or HDPE mesh. iv. Stocking: Fry of 3-4 cm @ 6,000 nos/pen (30,000/ha); survival 40% v. Supplementary Feed: Oil Cake (ground nut/mustard) & Rice Bran in 1:1 ratio @ 7% of body weight.
5	Rearing Cage	i. GI-framed HDPE mesh Cage. ii. A battery consists of 6 Cages; minimum one battery.

Sl. No.	Component	Salient Feature
		iii. Size of each Cage 6 x 6 x 3 m (108 m^3) or 6 x 4 x 2 m (48 m^3) iv. PVC drum floats (12 nos). v. RCC sinkers/ boulders at each corner (4 nos). vi. Stocking rate of fry @ 150/m^3; survival 40%. vii. Supplementary Feed: Oil Cake & Rice Bran in 1:1 ratio @ 7% of body weight. viii. Ramp/Catwalk optional. Instead, country-boat/raft can be used for feeding & harvesting.
6	Rearing Pond	i. Construction in low-lying peripheral areas. ii. Pond size 0.2-0.5 ha. iii. Pond depth 1.0-1.5 m. iv. Pond bed slope at least 1000:1 v. Pond dyke top width 1.5-2.0 m depending on soil type. ix. Stocking rate of fry @ 30,000/ha; survival 40%. vi. Supplementary Feed: Oil Cake & Rice Bran in 1:1 ratio @ 5-7% of body weight.

7. Production Economics

Item	Amount/ Quantity
Setup Cost: Strengthening Wetland Embankment, De-weeding, Construction of Rearing Ponds (up to 0.5 ha), etc.	Rs. 6.0 lakh
Inputs Cost: Pen (0.2 ha)/ Cages (6x6x3 m); fish fry/ fingerlings; manures/fertilizers, supplementary feed; etc.	Rs. 3.0 lakh
Estimated fish Production from Wetland/ha/Cycle	2,500 kg
Estimated Returns/ha/Cycle (Rs. 100/kg fish)	Rs. 2.5 lakh
Estimated Returns/ha/Year (2 Cycles)	Rs. 5.0 lakh
Net Returns/ha/Year	Rs. 2.0 lakh
Net Returns from a 10 ha Wetland/Year	Rs. 20.0 lakh

8. Project Monitoring Unit (PMU)

The Technology Partner ICAR-CIFRI would constitute a PMU, and a PERT (Programme Evaluation Review Technique) Chart would be prepared for all the major components of the project, in terms of activities and events.

The Project Monitoring Indicators would broadly include:

- Fish escape prevention structure to be in place
- Wetland being free from floating weeds except those used as fish aggregators
- Enhancement of fish yield
- Increase in fishing days for stocked fishes
- Creation of Sustainability Fund Account
- Emergence of local level people-institutions (Cooperatives, SHGs, etc.).

- Increase in employment opportunities pertaining to fisheries
- Increase in awareness level among fishers and their capacity
- Improvement in livelihoods

9. Aqua One Center (AOC)

An 'Aqua One Center' would be established to provide technical services.

- The AOC would register fishers holding lease or fishing rights of Wetland.
- Where the beneficiaries choose to avail AOC advisory services, a sum of Rs. 1200/- will be charged per crop towards registration, monitoring water quality, growth, health, etc. If not, this amount will be released to beneficiaries as part of the input cost.
- The AOC will carry out inspection/ field visit and submit report to the Project Monitoring Unit (PMU), in the prescribed format.
- The PMU will compile and submit reports to NFDB, crop-wise separately for each Wetland.

10. Governance and Socio-Economics

Wetlands are generally under the ownership of Dept. of Fisheries of the State Govt. They are usually leased out to Fishermen Cooperative Society (FCS) for a period of 7 years. The routine activity of an FCS is managed through an executive committee under the command of the President and Secretary. Fishing is mainly carried out by means of cast net, drag net and gill net using a traditional dingy boat. Harvesting is scheduled twice a year spreading over summer and winter seasons. Summer fishing lasts for 60 days whereas in winter it is for 70 days.

Functional linkages among Fisher/Fish Farmer Interest Groups (FIGs)/ Self Help Groups (SHGs), line departments, technology partner, ATMA, KVKs, input suppliers and marketing agencies will be established for the sustainability of the Group as well as for the Project Development. Further, a Sustainability Fund for each Wetland would be created to provide financial back-up that will ultimately help the Post-Project Sustainability. Workshops, capacity building, forward & backward linkages (fish seed hatcheries, feed mill, post-harvest handling and marketing) and Sustainability Fund will ensure continuity and adoption of the technological intervention.

11. Further Reading

Bhaumik. U. 2015. Aquaculture and Culture-based Inland Fisheries Extension in the Country through PPP Mode. *In*: V.R.P. Sinha, P. Keshavanath, A.P. Sharma and B. P. Mohnaty (eds.), *Public Private Partnership in Aquaculture*. Narendra Publishing House, Delhi. 2015, pages 291-308.

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