How to protect our valuable riverine fish species from multiple stressors?

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Most of the Indian rivers are over-exploited to fulfil the ever-increasing demand for power, agriculture, industrial and municipal sectors[1]. Damming of rivers or tributaries is the root cause of severe modifications and perturbations to the river flow, velocity, depth, substratum, pools, ecology and fish habitats[2]. The Himalayan rivers are the preferred choice for hydro-power developers because of assured perennial flow, steep gradients and gorges with stable rocky banks. Owing to these attributes, the rivers and their ecological assets in the mountain states of Uttarakhand, Jammu & Kashmir, Himachal and Arunachal Pradesh, including fisheries resources are under severe threat.

The river Ganga along with its major tributaries is dammed or proposed at about 70 sites in its upper stretch for the purpose of hydroelectric projects. As a result, the downstream ecosystem, fishery and benefits of the dependent populace are at stake. The series of dams cause complete alteration of the river hydrology and habitats. The river Ganga along with its vast and varied tributaries, reportedly harbour copious fish species. A few recent studies listed 143 species from main trunk of river Ganga[3], 112 from Yamuna[4], 89 from Ken and 81 in Betwa[5] and 89 species from the river Sone[1].

Large scale river modifications, abstraction, excessive drawing of riparian groundwater; over-exploitation and wanton destruction of fishery resources in the rivers cause depletion in the sensitive fish species and appearance of exotic fishes[1,2,5–8]. In many instances, the Himalayan rivers are also being obstructed under cascade regimes with meagre intermittent free flow; causing the destruction of feeding and breeding grounds of fishes, obstruction of migratory routes and nutrients dispersal. The obstructions have also blocked migratory routes of important Himalayan fishes like mahseer and snowtrouts. These fishes have inherent migratory habit of over-wintering, particularly to overcome severe cold conditions during winters. Other important migratory fishes of the plains severely affected by river abstractions are *Hilsa ilisha* and *Bagarius bagarius*. Further, owing to complete change of the river habitat from fluviatile system to lentic, obstruction of the continuous flow and meagre downstream flow (sometimes zero flow) there is complete change in downstream hydrology, ecology, fish diversity and compositions. As a result, there is a massive shift in fish diversity and fishery of the systems in the potamon zone[1–6] linked with drastic change in physico-chemical features. If the exploitation continues in the present momentum, the Indian rivers will probably lose valuable fish germplasms, which are required for sustenance of ecological balance and will also lose their medicinal and ornamental values, sport, food values and germplasm for posterity.

The Ganga river system is known as the original abode of a number of fish species including Indian major carps. Owing to habitat alteration and over-exploitation, a number of flagship species like *Tor putitora*, *Tor tor*, *Schizothorax richardsonii* in the upper stretches, Indian major, minor carps and major catfishes in the middle stretch are under severe depletion. Likewise, hilsa fishery is almost exterminated from the middle stretch of the river[2,9] (Figure 1).

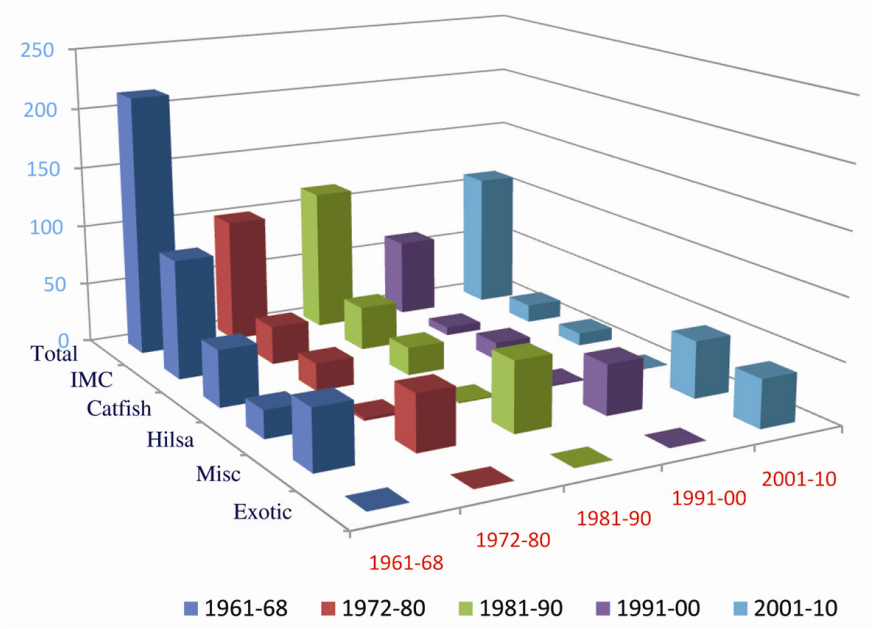

Figure 1. Decadal changes in total fish yield (t) including different groups, from the rivers at Allahabad (Modified after Jha and Joshi[10]) during 1961–2010.

Our rivers hold towering potential to generate green energy and irrigation of agricultural lands for production of food grains for the increasing human population. As a result, developmental activities pertaining to rivers are spreading throughout the length and breadth of the country affecting ecological conditions of most rivers. Hence, besides implementation of strict regulations for release of environmental flow from all dams and barrages under construction or proposed, there is an urgent need to protect some very important rivers, which are natural habitats for our valuable fish biota, from rapidly spreading developmental activities. I think it is high time to look for some effective options for managing the finite riverine fishery resources. The existing management of forests and wild life is an excellent example for protection of resources. For conservation of our forest and wildlife, a total of 160,901.77 km^2, i.e. about 4.89% of the

total geographical area of the country, is being protected in different agro-climatic regions under national parks, wildlife sanctuaries, community reserves, conservation, and protected areas (ENVIS centre on wildlife and protected areas, wild life institute of India). Similar steps need to be initiated for protection of our riverine resources including valuable native fisheries with selection of sizeable stretches in different geographical regions and declaration of the areas as protected or aquatic reserves. In this process, some stretches, tributaries and streams of major rivers including Indus, Ganga, Brahmaputra and rivers of East and West coasts, could be conserved for protection of valuable biotic resources including fish germplasm for sustainable use and posteriority.

1. Joshi, K. D., Jha, D. N., Alam, A., Srivastava, S. K., Kumar, V. and Sharma, A. P., *Curr. Sci.*, 2014, **107**(3), 478–488.
2. Vass, K. K., Tyagi, R. K., Singh, H. P. and Pathak, V., *Aquat. Ecosyst. Health Manage.*, 2010, **13**(4), 374–384.
3. Das, M. K., Sharma, A. P., Vass, K. K., Tyagi, R. K., Suresh, V. R., Naskar, M. and Akolkar, A. B., *Aquat. Ecosyst. Health Manage.*, 2013, **16**(4), 395–407.
4. Joshi, K. D., Alam, A., Jha, D. N., Srivastava, S. K. and Vijay Kumar, *Indian J. Anim. Sci.*, 2016, **86**(8), 957–963.
5. Joshi, K. D., Jha, D. N., Alam, M. A., Kalpana Srivastava, Srivastava, S. K., Vijay Kumar and Sharma, A. P., *Aquat. Ecosyst. Health Manage.*, 2017, doi:10.1080/14634988.2017.1261576.
6. Joshi, K. D., Jha, D. N., Alam, M. A., Das, S. C. S., Srivastava, S. K. and Vijay Kumar, *J. Inland Fish. Soc.*, 2014, **46**(1): 92–95.
7. Kolar, C. S. and Lodge, D. M., *Science*, 2002, **298**, 1233–1236; doi:10.1126/Science.1075753.
8. Aarts, B. G. W. and Nienhuis, P. H., *Hydrobiologia*, 2003, **500**, 157–178.
9. Jhingran, V. G., *Fish and Fisheries of India*, Hindustan Publishing, Delhi, 1991.
10. Jha, D. N. and Joshi, K. D., *Ganga nadee-Paristhitikee evam Matsyikee*, CIFRI Bulletin No. 181, 2012, p. 29.

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