



Fish Biodiversity of Uttar Pradesh: Issues of Livelihood Security, Threats and Conservation

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India is one of the mega biodiversity hot spots contributing 11.72% of globe fish biodiversity. Fisheries sector in India has shown outstanding growth and ranks third in the world in total fish production and contributes around 1.07 % of the countries Gross Domestic Products (GDP) and 5.34% of the agricultural GDP. Shrinking resource of agriculture, mounting pressure on land is making us to look for new avenues of producing food and ensure adequate nutrition to the masses. India is one of the 17 mega biodiversity hot spots contributing 60-70% of the world's biological resources. With third position in fisheries and second in aquaculture, the country has high potentials in the sector for rural development, domestic nutritional security, employment generation, gender mainstreaming as well as export earnings, that only few other activities can provide. Uttar Pradesh is one of the largest states in India, located between 23°52'-31°28'N latitude and 77°04'-84°38'E longitude. The state has vast potential of aquatic bioresources and offers considerable scope of inland fisheries development and aquaculture. Fishery resources are available in the form of rivers and their tributaries, reservoirs, wetlands, lakes, ponds and tanks exhibited a rich genetic diversity. However, owing to ever increasing demand of water in this region, these bioresources are experiencing serious threats to both biodiversity and ecosystem stability and a number of fishes are disappearing due to several factors anthropogenic factors. In view of the significance to improve socio-economic condition fisherman community and to achieve sustainable utilization of resources for fisheries development, optimum production of fish from water bodies, employment generation, availability of protein rich food,

appropriate planning for conservation and management strategies are of utmost importance. To respond to new challenges and developments, Govt. of India has legislated the Biological Diversity Act 2002 (BDA, 2002) and the Biological Diversity Rules (2004), which aims at conservation of our natural heritage and ensures the sharing of benefits of the utilization of biological resources in an equitable manner. The present communication highlights various issues related to biodiversity of the native fishes in U.P. with aspects on resources, livelihood security, threats and conservation issues.

Fishery resources of Uttar Pradesh

Uttar Pradesh being a land locked state having vast freshwater resources such and river, lakes, reservoirs, ponds and tanks. The freshwater aquaculture resources in the country comprises 2.25 million hectares of ponds and tanks out of which Uttar Pradesh has 1,61,372 ha, 1.3 million ha of bheels and derelict water, 2.09 million ha of laes and has 2,70,652 ha and 1.2 lakh km irrigational canal and channels. The state has 7, 20,000 ha where rivers occupy 28500 km and a few lakh hectares of paddy fields, a portion of which is amenable to fish farming. Different types of water resources available in the state and their extent are given in table 1.

Riverine resources:

The extensive network of rivers constitutes one of the major fishery resources of the state. The drainage pattern is dominated and controlled by river Ganga system recognized as the master stream of the state. Its total length is about 2,525 kms of which 1450

**Table 1. Different categories of water bodies in Uttar Pradesh.**

Water resource	Area (Lakh/ha)	Area under utilization (Lakh/ha)	Utilization (%) (Lakh/ha)
Rivers and canals	7.20	–	–
Large & medium Reservoirs	1.38	1.25	90.50
Lakes	1.33	0.05	3.70
Ponds	1.61	1.09	67.70

kms is in U.P. and Uttaranchal. The most important tributaries are Yamuna on the right side and Ram Ganga, Gomti and Ghagra on the left side. Yamuna is 1376 Sq. km long basin, covering an area of 320 lakh Sq. km of which 61750 Sq. Km. lies in U.P. The important tributaries of Yamuna are Chambal, Sind, Betwa, Dhasan, Baghin and Ken. These rivers contribute 79 billion cubic m of water every year into the main stream. The Gomti has its length of 940 Km and contributes 7.39 billion cu m of water per year to main river Ganga. The Ghaghra contributes the largest amount of water per annum to the entire Ganga basin, (94.4 billion cu m.). Its total area is 1, 27,950 sq km of which 49,750 sq km lie in Uttar Pradesh. Its other important tributaries are Saryu, Rapti and Gandak.

Reservoir, wetland and pond resources:

In Uttar Pradesh sixty reservoirs, with an area of 1, 18,103 ha, are distributed among 15 districts. The four large reservoirs viz., Rihand, Matatila, Kalagarh and Sardasagar occupy 71, 196 ha. Sonebhadra district with 52, 000 ha has the largest area under reservoirs on account of the imposing presence of Rihand reservoir.

Uttar Pradesh is one of the prominent zones of wetland resources of the country. River borne and river fed wetlands are concentrated mostly in riverine and flood prone belt where as the man made wetlands are scattered in the southern plateau region of the state. Natural wetlands are ox-bow lakes, deep pools, water logged depressions, marshes and swamps. These wetlands are extremely diversified in their size, shape,

depth, gaseous contents, nutrient status, biotic diversity, aquatic weed infestation and production status. Total pond area in Uttar Pradesh is about 1.61 lakh ha. These ponds are scattered all over the state in the interior regions. Fish farming in these ponds has shown very impressive growth as a result of financial, technical and extension support by FFDAs.

Diversity of fish:

Figure 1 represents fish species diversity and distribution of the major rivers in U.P. Total fish biodiversity of U.P. contributes approximately 14.68% of the national fish biodiversity. Some authors have documented the fish biodiversity in Uttar Pradesh. According to a report as occurrence of 87 species from eastern part of U.P while 111 fish species have been recorded from U.P. and Bihar described 30 fish species in Allahabad stretches of river Ganga. Under protected area network, a study revealed that the fish fauna of Samaspur Bird Sanctuary, Uttar Pradesh and recorded a total of 46 species represented by 7 orders, 19 families and 33 genera. In Katarniaghat Wild Life Sanctuary located in river Gerua, 87 species belonging to 22 families and 52 genera were reported. More recently, 92 fish species belonging to 58 genera and 24 families were recorded by NBFGR from river Ganga in Uttar Pradesh. Another report reveals 56 species belonging to 42 genera, 20 families and 7 orders from river Gomti. About 123 fish species have been listed by NBFGR. Evaluation of the utilization pattern in U.P., it appears that out of 123 species about 33% are considered as ornamental fishes, nearly 87% are

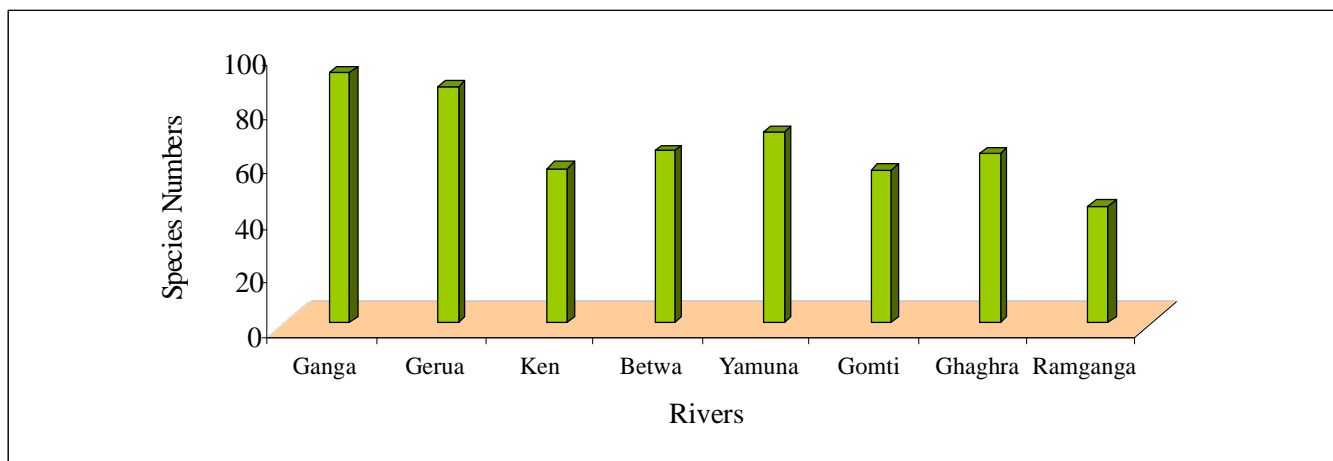


Fig. 1 Fish diversity in different rivers of Uttar Pradesh. Source: NBFGR

potential food fishes and 10% are listed under potential sport fishes.

Recent studies indicate changing pattern of fish biodiversity of river Ganga and tributaries in U.P. and other states. In the stretch of Allahabad, a constant decline of all economic species from 1972 onwards (major carps from 424.91 in 1961-68 to 38.58 in 2001-06 and cat fishes 201.35 in 1961-68 to 40.56 in 2001-06) have been reported with dominance (223.41 kg km⁻¹) of miscellaneous fish species like *Salmostoma bacilia* (34.39%), *Puntius ticto* (6.72%) and the clupeids *Gudusia chapra* (8.3%). In a recent study of NBFGR seven exotic species viz., *C. gariepinus*, *C. idella*, *C. carpio*, *H. nobilis*, *H. molitrix*, *O. mossambicus* and *O. niloticus niloticus* were recorded from river Ganga in U.P. with dominance of *C. carpio*. The low fish production of the major fish groups in the river Ganga is the recruitment failure of the young ones due to degradation (decreased runoff, changes in flow, turbidity) of the natural spawning habitat and climate change.

Out of the total fish diversity reported from Uttar Pradesh, about 57 fishes may be categorized as small indigenous groups which grow to size of 25-30cm in mature or adult stage of their lifecycle. Many of the fishes under small indigenous groups also highly important for food and nutrition, and important source of various products of pharmaceutical and other commercial value and sustain other trades like

ornamental fishes. It is reported that *Amblypharyngodon mola* (a small indigenous fish) contains 3 times more calcium and 50 times more Vitamin-A than that of silver carp and *L. rohita*. However, indigenous knowledge about these fishes and their benefits has been poorly documented in many states including U.P.

Livelihood security:

Uttar Pradesh with 166 million people, it is home to one-sixth of the nation's population and almost one-fifth of the country's poor, and ranks below the national average in respect of economic and social indicators. Increase in state income was zero as against 3.5 percent national average during 1997-2004. Agriculture is the dominant economic sector of the state, employing 78% of the labour force and contributing 36% to state GDP. This sector exhibits weak and uneven growth, averaging only 2.2% annually over the last decade, and just 1.2% annually over the last five years. Fish is high class protein rich edible commodity and its farming and production is capable of generating means of employment besides supply of protein rich food. It has been reported that nearly 55% of the fishing community is engaged in capture fisheries. In U.P. fisheries contribution in rural prosperity is great and place a very important role especially in the upliftment of socio-economic conditions of members of fishermen community living



below poverty line. The state has been achieving significant progress in fish production and ranks forth in the country. So far, fish productivity is concerned; it was only 600 kg/ha/yr before the establishment of FFDA's and is now reached to 2,605 kg/ha/yr indicating great enhancing potential in aquaculture sector. The utilization of compound water resource is 2.3 lakhs ha. which is only about 54 per cent and therefore fish production can be doubled if the water resources are utilised to the maximum extent. In Uttar Pradesh, many fisher communities are highly dependent on the indigenous fish species for their livelihoods. The species mostly exploited by them are *S. aor*, *S. seenghala*, *M. cavasius* among the cat fishes, *L. calbasu*, *L. rohita*, *C. catla*, *C. mrigala*, *L. bata* among the carps and *C. marulius* and *C. striatus* among the snake heads. Other important exploited species are *E. vacha*, *O. pabda*, *O. bimaculatus*, *C. garua*, and *Chitala chitala*. However, more awareness and motivation is required on the value of indigenous fish diversity and their conservation.

Major threats and conservation status:

The freshwater resources of U. P. are currently experiencing an alarming decline in fish biodiversity due to various anthropogenic activities. Destructive fishing methods, entry of exotic species, use of poison, habitat alteration and water diversion, poor vegetation cover in the river banks, siltation, water abstraction, and low water velocity have been affected the overall fish diversity to large extent. A series of barrages and dams have been commissioned in the upper segment of river Ganga from Rishikesh to Narora and large dam constructed in the hills of Tehri has considerably reduced the water flow and have shown detrimental effects on physical attributes and destruction of feeding, spawning, and migration routes of mahseer. Evidently, this will prove hazardous to the abundance and distribution of fish fauna in river Ganga and its tributaries. Water pollution has become a great menace to the aquatic fish fauna almost in all the major rivers. Recently, in a study by Sarkar in 2010, fish biodiversity of river Gomti has been listed as 5 fish species as Endangered (EN), 11 Vulnerable, 30 Lower risks and data on 10 species were not

available to categorize them under any threatened category. Though not much published literature is available on the threat status of fish species of U.P., yet it is fact that population of some species is constantly going down and there is an urgent need to safeguard the same. In this respect, attempts have been made by NBFGR to assess the threat status of Indian freshwater fishes for conservation at national and regional level (Lakra and Sarkar, 2006, Lakra et al 2010). According to recent conservation assessment of NBFGR, a total of 20 freshwater fishes included as threatened status of which 9 under Endangered and 11 Vulnerable. Some of the endangered freshwater fish species are *Chitala chitala*, *Tor tor*, *T. putitora*, *Sisor rhabdiformes*, *Ilisha megaloptera*, *Hemibagrus menoda*, and *Ompok pabo*.

Conservation and management of biodiversity:

Increasing pressure on aquatic resources indicate that fish conservation issues on wide variety of factors must be taken into consideration to develop a comprehensive action plan. Considerable efforts have been made by NBFGR, Lucknow to generate information that can provide holistic approach towards sustainable conservation of the biodiversity of fish. In order to conserve the threatened species, the strategies envisaged are:

In-situ conservation:

Wide ranging aspects that are covered under *in situ* conservation programme include the role of protected areas and fish sanctuaries, habitat management and life history traits of prioritized species. Research carried out by NBFGR showed more species, greater population densities with superior biological traits and larger individuals, and additionally showed higher number and densities of endangered fishes within the protected area compared to unprotected area and it may be serve as tool for aquatic biodiversity conservation. Large number of waterbodies inside these protected areas which harbors bountiful fish germplasm resources. The creation of specially targeted fish protected areas is an important step in the conservation of aquatic biodiversity. However, policies are required to create



freshwater aquatic sanctuary for maximizing protection and in- situ conservation. Habitat fingerprinting through elemental analysis of otolith is also a new innovative approach to identify and conserve the potential breeding and spawning grounds of threatened fishes. In Uttar Pradesh, about 25 sanctuaries including national parks are in existence.

Ex-situ conservation:

Gene banking and cryopreservation of gametes of the prioritized fish is a powerful ex-situ conservation tool for preserving natural genetic variability in fish. A live gene bank contributes to delisting of threatened species by captive breeding and restocking in species-specific recovery programs. Live gene bank contribute to recovery and utilization of genetic diversity and its use in conservation programs and genetic enhancement. NBFGR, Lucknow is the leading organization in India having fish gene banking programmes and this is accomplished through repository of biological material and maintaining live gene bank of high conservation species like *T. putitora*, *Barilius* spp., *Garra* spp., *Labeo dyocheilus*, *L. calbasu*, *W. attu*, *C. chitala*, *C. marulius* and *L. bata*. Success was observed in captive breeding for *C. batrachus*, *H. fossilis*, *O. bimaculatus*, *S. seenghala* and *N. notopterus*.

Sperm and embryo cryopreservation are important tools for conservation of endemic and endangered species and storing their genetic material for future use. Under experimental scale, NBFGR, Lucknow has developed species specific sperm cryopreservation protocols for threatened species like *T. putitora*, *L. dyochelius*, *C. batrachus* and *H. fossilis*. This ex-situ conservation tool has very strong application to support in-situ conservation strategies like propagation-assisted rehabilitation of endangered fish species.

Declaration and conservation of state fish :

Among current conservation efforts, an innovative approach have been adopted for the first time in the country by NBFGR, Lucknow which involves integration of the key stakeholders in the conservation exercise by the strategies of declaring a State Fish

in order to achieve the real time conservation benefits. Govt. of Uttar Pradesh has declared endangered *Chitala chitala* as a state fish and planning of conservation actions are in process.

Strategies for the conservation of fish germplasm resources in Uttar Pradesh:

The conservation of fish biodiversity is an increasingly important field of scientific endeavor. When an increasingly number of species are being reported to be endangered and threatened, an immediate need is felt to introduce and revise the strategies necessary for conservation of fish germplasm resources. Some of the proposed research and development areas are as follows:

1. Assessment of aquatic resources, prioritization of conservation sites through GIS and ground validation.
2. Updated inventory of the fish fauna, evaluation and germplasm registration.
3. Impact assessment of exotic species and disease management.
4. Identification of priority habitats, establishment of Protected Areas.
5. Ex-situ conservation and Live Gene Bank.
6. Conservation aquaculture for food and ornamental fishes.
7. Development of a state specific aquaculture and fisheries enhancement model.
8. Diversification of aqua farming.
9. Research efforts on the biodiversity, conservation biology, captive breeding.
10. Molecular genetic studies and stock identification.
11. Ranching and stock enhancement of indigenous fish yearlings.
12. Public awareness campaign including people's participation and HRD.
13. Climate change and implications in freshwater fisheries.
14. Legislative framework for fish biodiversity conservation.



Conclusion:

Conservation of fish diversity is essential to maintain ecological/nutritional and socio-economic equilibrium. Species diversity and genetic variability are necessary for the long term maintenance of stable, complex ecosystem and species. Therefore, the conservation policy should promote the management practices that maintain integrity of aquatic ecosystem, endangerment and enhance recovery of the threatened species. Many livelihoods are dependent on the fishery resources and therefore there is a need to adopt conservation strategy different from conven-

tional approaches. As the threats to the fish and aquatic biodiversity of rivers have become serious and conservation of indigenous fishes has become priority, the India's recently formed National River Ganga Basin Authority (NRGBA), Chaired by the Honorable Prime Minister of India, would certainly help to mitigate the threats and conserve the biodiversity. Fish conservation management of U.P. is possible if it is taken in a comprehensive manner, defining conservation areas, adopting ecohydrological approach, involving the wider public and different research organizations, state fisheries, biodiversity boards and other stakeholders for wider environmental benefits.
