Freshwater Fish Diversity Information System as a Basis for Sustainable Fishery

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Abstract

Our freshwater fish diversity is poorly studied. There is no proper documentation on freshwater fish resources of India. Due to irrational fishing practices, environmental aberrations like reduction in water volume, increased sedimentation, water abstraction, and pollution over the years this diversity is on a decline. The paper highlights some features and impacts of erosion of this biodiversity. To save this diversity and to develop a sustainable fishery practice in the country proper documentation leading to Freshwater Fish Diversity Information System is an urgent need. Some components of databases for information system development and documentation have been suggested. For standing up to this negative phenomenon a coordinated effort is needed.

Introduction

India is one of the 12-mega biodiversity countries having two biodiversity hotspots, namely the Western Ghats and the Eastern Himalayas that are included amongst the top eight most important hotspots in the world. It also has rich freshwater (rivers, irrigation canals, tanks, lakes, reservoirs) fish diversity. This diversity is being eroded each day mainly because of unending anthropogenic stress. This diversity is not only the wealth of India and the world but it also has serious implications on fishery. Thus there is an urgent need for proper inventorisation and documentation of this fish diversity in order to

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develop a fresh water fish diversity information system having both bioinformatics and georeferenced databases of fish and fish habitat.

Fresh water fish diversity

The country is endowed with vast and varied resources possessing river ecological heritage and rich biodiversity. Freshwater fishery sites are varied like 45,000 Km. of rivers, 1,26,334 Km. of canals, ponds and tanks 2.36 million hectares and 2.05 million hectares of reservoirs[1]. The assessment of fresh water fishes is done mainly on the basis of 6 drainage systems in the country. These are Indus river system, Upland cold-water bodies, Gangetic river system, Bramhaputra river system, East flowing river system and West flowing river system.

About 21,730 species of fishes have been recorded in the world; of which, about 11.7% are found in Indian waters. Out of the 2546 species so far listed[2], 73 (3.32%) belong to the cold freshwater regime, 544 (24.73%) to the warm fresh waters domain, 143 (6.50%) to the brackish waters and 1440 (65.45%) to the marine ecosystem. The Indian fish fauna is divided into two classes, viz., Chondrichthyes(cartilage fishes) and Osteichthyes(bony fishes). The endemic fish families form 2.21 per cent of the total bony fish families of the Indian region. 223 endemic fish species are found in India, representing 8.75 per cent of the total fish species known from the Indian region. The Western Ghats is the richest region in India with respect to endemic freshwater fishes. Northeastern India, which has a very high diversity among freshwater fish, does not have many endemic species within India because of its jagged political boundary. There are about 450 families of freshwater fishes globally. Roughly 40 are represented in India (warm freshwater species). About 25 of these families contain commercially important species. Number of endemic species in

warm water is about 544. Freshwater fishes are a poorly studied group since information regarding distribution, population dynamics and threats is incomplete, and most of the information available is from a few well-studied locations only[3].

Erosion of fish diversity

The freshwaters of India have been viewed from a single perspective: that of economic production. They are to be sources of irrigation or urban-industrial water supply or of hydel power; they are to receive sewage and industrial waste; they may produce edible fish. In this strictly utilitarian framework, there is no space to conserve the rich heritage of freshwater fish diversity of the country.

All over India, freshwater fish diversity is on a decline. Many of them have been lost forever Few studies have been carried out so far regarding this aspect. They mainly identified three major forces driving extinction which are; over –harvesting, competition by newly introduced exotic fishes and pollution. According to a workshop estimate hosted out by National Bureau Fish Genetic Resources a total of 227 Indian freshwater fishes are threatened based on the IUCN Red list Categories of 1994. The species that suffered much are Indian long fin eel (*Anguilla bengalensis*), the redfinned Mahseer, the catfish (*Rita pervimentata*), Chitala (*Notoptrus chitala*), smaller fishes like Indian Hatchet fish (*Chela laubuca*), Scarletbanded Barb (*Puntis amphibious*), Indian Tiger Barb (*Puntis filamentous*) to name a few.

Some other factors are also contributing towards this biodiversity erosion. In the irrigation canal when water is stopped in the canals, they are trapped near the gate and fished out. The nets used for the fishing often have very small mesh and so everything is

caught. The shallow streams and pools, such as those at the base of waterfalls, fall victim to the easy availability of dynamite ever since quarrying and road construction began on a grand scale in the country. The shock waves of the blast destroy all fish in the vicinity. Sewage, industrial effluents, chemical fertilizers and pesticides are polluting India's freshwaters. Several carps and barbs as well as fresh water prawns are being susceptible to pollution.

The drastic modification of freshwater habitats by damming streams and rivers siltation leading to reduction in their depth has also profoundly affected many fish species like the Indian shad (*Hilsa ilisha*), the carps (*Labeo calbasu*), the catfish (*Bagarius bagarius*) etc. Due to changed habitat, the life cycles of these species have been seriously disrupted. Moreover exotic species like Tilapia, the silver carps, the grass carps, the African catfishes proved catastrophic for native species. Its prolific breeding nature simply crowd out its native competitors. The overall deterioration of habitat has rendered many fishes susceptible to diseases. One of the most serious is epizootic ulcerative syndrome disease that brought mass mortalities and extinction of some species in Indian freshwater fishes[4].

Impacts of Erosion

There are many impacts of freshwater fish diversity erosion. Some of the important impacts are:

1.Though the food grain production in India has increased many times but the production of pulses still remain stagnant. Pulses are the basic source of vegetable protein for poor people. With the increasing prices, the poor are able to access less and less pulses over the years. Fish caught from streams and lakes was their other important protein source. Freshwaters fish diversity erosion denied them this animal protein source also. It is true

that freshwater aquaculture for Indian Major carps (Rohu, Catla, Mrigala, Silver carp, Grass carp, Cyprinus carp) have achieved considerable growth but these are produced in the commercial mode and channelised to urban markets, poorer people cannot access them through subsistence fishing. Thus it is surely important to protect and sustainably harvest natural populations of freshwater fish to meet the protein needs of these people[5].

2. Mindless harvesting of native freshwater fishes have reduced a considerable number of species. The important riverine fishery of Indian major carps has either collapsed or is at the threshold of collapse, as the average yield had declined from 26.62 to 2.55 kg/ha/yr during last four decades in river Ganga. Biologically and economically desirable fish species have started giving way to low value species.

3. Aquaculture is mainly done for economically important species but the roles of other non-target species have been ignored over the years that have disturbed the aquatic ecosystem.

4. Conservation of fish genetic diversity is not only important for sustainable fishery but it also helps in national development. Many freshwater fish species contain bioactive substances having properties as medicine, food preservatives and other chemicals that may fetch many patents inside and outside the country. India as a signatory of WTO (World Trade Organization) is compelled to comply with TRIPs (Trade Related Aspects of Intellectual Property Rights). According to the article 27.3(b) of TRIPs member countries have the option not to grant patents for animals and in Indian Patent Act (1970) animals are non-patentable subject. But the chemicals derived from them are patentable

provided that fulfilled the three basic criteria (novelty, inventive steps and utility) for granting patents. Thus many freshwater fishes could bring patents for us but because of this erosion of diversity we would no more be able to know their properties.

5. Being primary source of original fish germplasm, role of riverine fisheries and lakes is crucial for conservation of biodiversity. Many transnational companies and agencies of developed countries are involved here in bioprospecting for sources of new products in biodiversity rich aquatic habitats of our country that also contributed towards this biodiversity erosion. These bioprospectors- cum- biopirates may get patents on our resources and this is very unfortunate for us.

6. In many places in India freshwater fishes are worshipped and are a part of the traditional knowledge of indigenous people, which is also at stake due to this biodiversity loss.

Why Documentation and information system

Those nations (India is a member) that have ratified the Convention on Biological Diversity (CBD) are required to inventorise and monitor their own biodiversity and biological resources[6]. This is an onerous task, given that only a small fraction of freshwater fishes living in India have so far been documented properly. No fish is listed in the schedules of protected species in the Wildlife Protection Act, 1972. The Fisheries Act of India of 1897 zeroed exclusively on management of edible fishes.

It is not only sufficient to observe, identify and classify fishes present in rivers and other freshwater environment but also it is essential to record their physical and chemical properties in order to help define ecosystem that led to a sustainable fishery in the country. Poorly studied freshwater fish species of India must be studied and documented properly immediately so that we do not loose any of them anymore. This documentation will serve the national fish germplasm resource centre (like national bureau of fish genetic resources) for further research and development activities. The documented information of fresh water fishes will also help us to understand, conserve, and exploit it for sustainable fishery. This documentation can be acted as a fisheries management tool for resource manager. A nationally approved document on the various physical and chemical properties of freshwater fishes can be a great help for opposition and revocation of a patent granted to multinational companies on our fish resources in other countries. Similarly it can be a tool for further research for granting a patent to our researchers and research agencies leading to our national development and forex earning. Our many laboratories of research agencies like CSIR, ICAR are working on transgenic fishes and this documentation can be a great resource for them. It may be helpful for arrangement of access and benefit sharing with traditional fisherman communities for providing the biogenetic information to the researchers. It is not enough to inventorise the fish resources but it needs regular monitoring as the world at present is in a state of pervasive change, with changes in habitats, pollution and biological introductions and probably in climate. The need for regular monitoring of sensitive areas and species is possibly even greater than the immediate need for identification of all species, because it gives warning of changes that may lead to shifts in populations, extinctions or population explosion.

All these data and information should be integrated into a nationwide Freshwater Fish Diversity Information System that would be updated regularly for its proper effectiveness and utility. This information system is an urgent need for overall development of sustainable fishery and above all to conserve our rich freshwater fish diversity. Such an information system would serve a variety of important purposes too. It would generate the necessary understanding regarding freshwater fishes and fishery and that information could also be used to effectively deploy freshwater resources to promote the conservation and sustenance of freshwater resources.

Information system development

This will be a mission oriented information system having distributed partitioned databases. Like general information system, it essentially comprises a combinations of various functions, including facilities for collection and analysis of data, is storage and retrieval and its dissemination to users. The process of documentation should be organized in bottom up fashion. In the process of data acquisition and data upgradation for the development of databases, active participation of traditional fisherman communities must be involved to make the data most effective at the ground level. Otherwise the basic aim of the information system will fail. The various databases of the information system should be linked to constitute countrywide network and for this purpose various RDBMS (Relational Database Management System) software can be employed.

Freshwater Fish Diversity Information System may contain mainly three types of databases. These are as:

Spatial databases

Bioinformatics databases

Economic databases

Spatial databases

It is basically georeferenced databases that contain spatial analyzed data of freshwater streams, lakes, reservoirs etc collected with the help of remote sensing and GIS (geographical information system) tools. It would contain all the important data regarding fish habitat and fish like:

-length, breath, depth, origin of the freshwater resources

-turbidity, planktons(zooplanktons and phytoplankton), chlorophyll concentration etc

-site selection for better fishing

-land use pattern

-siltation, physical and chemical properties of water

- stream direction of flow and possible direction change

-fish movement, distribution and concentration of fish schools and breeding zone

All these data will help to built a biologically sustainable Potentially Fishing zone (PFZ) maps and data will be upgraded everyday with the satellite sent data, image and information.

Bioinformatics databases

These databases will contain all biological data that are collected by *in –situ* verification.

It may contain the following data:

-fish morphology

-identification and special features if any

-biogeography

-lifecycle

-competitor species in terms of food and habitat

-systematics

-diseases

-fish ethology

-feeding habits

-population status(if endangered , threatened, extinct, vulnerable etc)

-genetic structure

-chemical properties and contain bioactive substance if any

Economic databases

These databases may contain the following data regarding the concerned fish and these are follows

-target species/economically important species or not

-area of fishing, time of fishing, concerned fishermen communities etc

-overharvested or not

-yield/ha/yr

-export

-traditional knowledge if any regarding its uses

-patent if any

-reseachers and research agencies working on it inside and outside the country

For a Better Tomorrow

For a better tomorrow we must keep a strong monitoring on the changing environment. Sustainable fishery is not about fishing for economic purposes only it has also a great concern to save the fish habitat or aquatic environment. It is not only necessary to save freshwater resources but save the whole aquatic environment including fishes and other aquatic organisms to keep the ecosystem undisturbed as far as possible. These freshwater resources are also our life supporting system that cannot be exploited any more for economic purposes only. Maximum sustainable yield should be changed according to the changing environment and it must commensurate with fish population of a particular species. Any deviation would lead to further erosion of biodiversity that would be detrimental for fisheries and environment as a whole. Right information at right time can save this biodiversity. So to alter the trends of biodiversity in positive direction the role of right information input and information technology as a tool is quite inevitable.

There are a number of different initiatives in progress at present, all approaching the need to inventory, documentation and monitor freshwater fish diversity from different points of view. However, these are not sufficient. A collective effort to determine the priorities, and to concentrate the available resources on these is surely an essential precondition for a better tomorrow.

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