BIO-DIVERSITY, CONSERVATION AND MANAGEMENT OF FISHERIES RESOURCES IN INDIA

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Accepted on August 10, 2020

Fish and Fisheries are an integral part of most societies and make important contributions to economic and social health and well being in many countries and areas. It has been estimated that approximately 13.0 million people are employed in fishery related activities, and in recent years global production from capture fisheries has tended to vary between approximately 90-92 million tonnes.

Despite this enormous importance and value, or more correctly, because of these attributes, the world's fish resources are suffering the combined effects of heavy exploitation and in some cases, environmental degradation.

Asia has overwhelmingly contributed to the world's inland capture fisheries production. The inland capture fisheries provide an important source of food and livelihood for many people in rural areas. Inland fisheries resources provide not only the material basis for maintaining capture fisheries production, but also serve as a reservoir of aquatic bio-diversity. However, over the past few decades inland fisheries resources have come under increasing pressure from over fishing, use of destructive fishing gear / methodologies, water engineering projects, pollution and environment changes and have shown a clear declining trend. This has been well demonstrated by the disappearance of some traditionally important fish species and a general reduction in the catch of high valued species.

Fisheries resource enhancement and conservation measure have long been adopted in many Asian countries for sustaining capture fish production, conserving aquatic biodiversity, rescuing endangered species, improving environmental conditions and upgrading recreational fisheries by offsetting the adverse impacts of human activities on inland fisheries resources. The contributions of inland fisheries resource enhancement and conservation to sustained inland capture fisheries and conservation of aquatic biodiversity as well as to nutritional security and improved rural livelihood has been commonly recognized. On the other hand, external interventions to the aquatic ecosystem from fisheries resource enhancement and conservation activities may have had adverse impacts on the ecosystem and wild fish community, especially when such activities are carried out without a strong scientific basis or adequate evaluation and monitoring mechanisms.

2. MAJOR PRACTICES OF ENHANCEMENT AND CONSERVATION

2.1 Capture, culture based fisheries and enhancement

Rivers, ponds, lakes, reservoirs and flood plain wetlands are the rich natural resources. Inland fish production in the country can be summed up as the capture fisheries of rivers, estuaries, lagoons and lakes, aquaculture in ponds and various forms of enhancement (mainly culture based fisheries and stock enhancement), being practiced in the reservoirs, lakes and flood plain wetlands. Catch from the rivers and estuaries are on the decline due to the negative impact of human activities on the aquatic environment. And also the information on the fisheries activities in the upland lakes is scarcity. The details of fish production in Mangrooves are not available and they are protected areas where in fishing is either prohibited or done on a subsistence basis.

The strategies for inland fisheries development should focus on sustainability and sustainable development which should be environmentally non degrading, technically viable and socially acceptable. But the sustainability of fish production systems is inversely proportional to intensification as tabulated below.

Open water fishery resources on India and their mode of fishery management.

Sl. No.	Resource	Resource size	Common mode of management
1.	Rivers (km)	2900	Capture fisheries
2.	Mangroves (ha)	35600	Subsistence
3.	Estuaries (ha)	300000	Capture fisheries
4.	Estuarine wetland bheries (ha)	39600	Aquaculture
5.	Back waters / lagoons (ha)	190500	Capture fisheries
6.	Large & medium reservoirs (ha)	1667809	Stock and species enhancement
7.	Small reservoirs	1485557	Culture based fisheries
8.	Floodplain wetlands	354213	Culture based fisheries
9.	Upland lakes	720000	Not known.

Hyper intensive culture systems are not environmentally sustainable and many times these work against social equity by affecting access to resources by many stakeholders. Therefore in order to meet the national targets for future production, a right balance needs to be stuck between intensive aquaculture and fisheries management.

2.1.1. Capture fisheries:

Rich biodiversity is noticed in the Indian rivers, lake and wetlands. Hamilton (1822) & Hora (1929) reported about 265 and 272 fish species, respectively from river Ganga and its tributaries alone. More recently Payne et al (2004) reported 140 freshwater fish species and NBFGR reported 143 fish species from Ganga River basin. Inland waters of India can boast of 765 freshwater and 113 brackish water fish species (NBFGR, 2009). These include the culturable Indo Gangatic carp (catla, L. rohita, Mrigala) species and other commercially important fish species such as other carps

(C.cirrhosa, L. fimbriatus, L. calbasu, L. bata) Peminsular carp (Puntius pulchellus), pearl spot (Etroplus suratensis), mullets (Liza parsia, Mugil caphalus), golden masher (Tor putitora) other mahseers (T. tor, T. mussulah, T. Khudree), chocolate mahseer, catfishes (Pangasius pangasius, A. aor, A. seenghala, silonia silondia, Mystus punctatus), sno trouts, murrels (C. punctatus, C. marulius), climbring perch (Anabas), magur and singhi.

The important prawn and shrimp species that are regularly caught are giant freshwater prawns (Macrobrachium rosenbergii, M. malcolmsonii, Penaeus monodon are P. indicus). The commercially important molluscs are edible oyster and mussels.

2.1.2. Species for enhancement:

In culture based fisheries, the most common species are the Indian major carps (C. catla, L. rohita and C. mrigala). Among the three, C. catla is the most preferred species due to its faster growth and catchability. Indian water bodies are rich in plankton and the plankton feeding habit of C. catla enables it to achieve quick growth. In some of the Reservoirs in south India, catla is reported to grow up to 1-1.5 kg during the first year of stocking. Rohu (L. rohita), known for its browsing habits, can effectively utilize periphyton and C. mrigala a bottom feeder, is very suitable for stocking in floodplain wetlands with heavy detritus loads. In some parts of the country, especially the northeast and uplands, common carp (Cyprinus carpio) is preferred for stocking the Reservoirs. Freshwater prawn (M. rosenbergii) has been tried as a candidate species for culture based fisheries in some of the Reservoirs.

So Reservoirs and floodplain wetlands form the enhancement practice where as in capture fisheries the rivers, estuaries, lagoons etc, the main emphasis lies on conserving the habitat and extracting fish stock from the wild on a sustainable basis.

2.1.3. Culture based fisheries:

In India the culture based fisheries is practiced in small reservoirs and closed floodplain wetlands. Floodplain wetlands (beels) are located mainly in states of Assam, West Bengal, Uttar Pradesh and Bihar (Sugunan et al., 2000, Sugunan & Bhattacharya, 2000 and Pathak et al, 2004 for details): These water bodies allow relatively easy recapture of stocked fish and are suitable for culture based fisheries. Conversely the 180 medium and 56 large reservoirs are relatively deeper where recapture of stocked fishes is rather uncertain. These water bodies are not considered suitable for culture based fisheries and are not considered suitable for culture based fisheries and are managed on the basis of stock and species enhancement. The key management parameters are estimation of fish yield potential, selection of fish species for stocking, stocking rate and size, period of growth and size at harvesting (Yadava & Sugunan, 2009. Sugunan et al., 2000; Sugunan and Bhattacharya, 2000). Ownership of stock, access to fishing and sharing of profit under a culture based fishery very considerably across and within the states of India.

2.1.4. Species for enhancement:

Since 1970, after the advent of carp seed production technology, most of the Indian states have a flourishing carp seed industry in the private sector, producing seed of C. catla, L. rohita and C. mrigala. Consequently the culture based fisheries of small reservoirs and floodplain wetlands in India largely centers around these three species. The Indian major carps have an impressive growth and their feeding habits are suitable for utilization of various food niches. Even the striped cat fish Pangasisanodon hypophthalmus also invaded culture area but next to caps only. Presently the state government is promoting the Tilapia species in large scale.

2.2 Marine capture fisheries in India:

Marine fish production of India was only 0.5 million t in 1950, increased to 3.07 million t in 2010 (ICAR, 2011), contributing 38% of the total fish production and 79% of the capture fish production. Marine fishery potential of the Indian Exclusive Eonomic Zoe (EEZ) is estimated at about 3.93 million t (Anon, 2000). About 58% of the resources is available at a death of 0.50 m, 35% at 50-200 m and 7% from beyond 200 m depth. The present catch is largely derived from the intensively fished shelf waters. About 1,94,490 fishing crafts of various sizes and classes are under operation in marine fisheries, consisting of 72,559 mechanized; 71,313 motorized and 50,618 non mechanized fishing vessel (CMFRI, 2012). Shelf resources are subjected to highest intensity of fishing pressure and are exploited at levels close to or exceeding optimum sustainable limit. Problems of juvenile finfish mortality and by catch discards increased with the intensification of shrimp trawling. Plateuing of catches from Mid 1990 s economic and growth overfishing at several centers, and inter sectoral conflicts in the Coastal belt have highlighted the need for regulation of fishing capacity, adoption of responsible fishing practices and causation in Marine capture fisheries development. Over fishing and fishing down effect is evident in Indian fisheries (Vivekanadan et al., 2005; Bhathal and Pauly, 2008). Removal of excess fishing capacity and adoption of responsible fishing gear and practices and a conducive fisheries management regime would contribute to the long term sustainability of the resources, minimize negative environmental impacts, protect biodiversity and facilitate rebuilding of the depleted marine fish stocks.

3. BIODIVERSITY CONSERVATION:

Overfishing and irresponsible fishing practices have long been recognized as leading causes that have reduced aquatic bio-diversity, along with other causes such as pollution, habitat destruction and fragmentation, non native species, invasions and climate change. The FAO code of conduct for responsible fisheries and the international instruments pertaining to fisheries and bio-diversity conservation, stress the need for developing selective and eco-friendly fishing gears in order to conserve resources, protect non targeted resources and endangered species like sea turtles and minimize environmental impacts of fishing. Various types of

bycatch reduction technologies have been developed in the fishing industry around the world in order to minimize the impact of fishing on non target resources. These devices have been developed taking into consideration variation in the size, and differential behavior pattern of shrimp and other animals inside the net. Semi pelagic trawl system has been developed as an alternative to shrimp trawling in the small scale mechanized trawlers operating in the tropical waters. Sources of pollution from fishing operations which affects fisheries environment include emissions of green house gases (GHGs) and plastic debris originating from abandoned, lost and abandoned fishing gears. Enforcement of bycatch reduction technologies, promotion of low impact and fuel efficient fishing systems and smart trawling techniques, along with regulation on total fishing effort at sustainable levels and maintenance of Marine protected areas will facilities protection and restoration of bio-diversity and enhance the resilience of the fish stock to fishing pressure.

3.1 Legislatives for Aquatic biodiversity

The government of India has various acts, rules and regulations to conserve the fish and aquatic diversity and judiciously utilize it for the well being of the nation. The major legislatives are 1. Indian Fisheries Act of 1987, 2) Wild Life (protection) Act, 1972. 3) Forest (Conservation) Act 1980, 4) The Environment (Protection) Act 1986, 5) Biological Diversity Act. 2002, 6) Coastal Aquaculture Act. 2005 and 7) National Biodiversity Action Plan 2008. The policies and strategies directly relevant to biodiversity include national conservation strategy and policy statement for environment and sustainable development, comprehensive marine fisheries policy 2004, Ministry of Agriculture, National Fisheries Policy, National Biodiversity policy, Environmental Action Plan, National Lake Conservation Plan and National River Conservation Plan. The National Environment Policy 2006 seeks to achieve balance and harmony between conservation of national resources and development processes and also forms the basic frame work for the national biodiversity action plan and similarly the national Ganaga River Basin Authority 2009 also.

3.2 Role of Marine Bio-diversity and its effect on fish production:

a. Through the ocean is vast, marine living resources are not inexhaustible and are bound to be vulnerable to destructive fishing and increase fishing pressure.

b. Since there is no selective fishing in trawling, exclusively for the harvest of shrimp or any particular fish, the bio-diversity in the fishing grounds is very badly effected, leading to collapse of fisheries.

c. The contribution of discards in traveling is the real destruction of bio-diversity of a potential fishing ground. It has been proved that no commercial fishery can service and be sustained without balance in harvesting a particular resource of the ecosystem. The preservation of ecosystem integrity with several communities of commercial and non commercial importance, is essential for sustainable productivity and harvest of fish and fishery resource.

d. Pollution due to discharge of fossil fuels, hydrocarbons, fly ash, pesticide, domestic sewage, coconut retting etc, affect the communities of the ocean ecosystem impairing immune system, delayed embryonic development, developmental aberrations, disrupted liver functions, tissue damage, behavioural changes etc. (Murugasan et al 2000).

e. The release of Chloro Fluro Carbon (CFC) cause damage to the plankton including larval stages of fishes.

f. Release of heated effluent from power stations descript the normal functioning of the ecosystems.

g. Petrochemical industries such as SPIC discharge urea, DAP, aluminium floride, ammonia, Co2 and hydro flouoro silicic acid.

h. Operations of coral and sand mining cause severe damage to be environment and life of the sea.

The vast stretches of 29000 km long rivers, 3.15 million ha reservoirs, 0.2 million ha floodplain wetlands and 0.72 million ha uplands lakes, besides 0.3 million ha estuaries and 0.9 million ha backwaters and lagoons have been providing a diverse inland open waters for the country, which contribute about 1.0 million tones of fish at presents. The 14 major rivers, 44 medium rivers and innumerable small rivers provide rich fish faumistic resources of 877 freshwater tropical and temperate species. Available information indicates that maximum number of endemic freshwater finfish species (27.8% of the native fish fauna) occur in India followed by China, Indonesia and Myanmar. Among the four biodiversity hotspot regions in the country, the water bodies along the Western Ghats posses highest (69%) finfish endemcity followed by the north eastern regions (62%). Endowed with a coastline of 8,120 km, 2.02. million Km2 of Exclusive Economic Zone (EEZ) and 0.5 million Km2 of continental staff, India has a catchable annual marine fishery potential of 4.2 million tones. The marine fish landings of the country have shown a steady increase since last six decades and the present production of 3.2 million tones shows proximity with catchable annual marine fishery potential, thereby limiting scope for much increase in production from the sector.

4. THREATS TO FISH DIVERSITY:

The cold water and warm water of fresh water fish diversity, brackish water fish diversity and the marine fish diversity and the ecosystem stability are expressing serious threats. Several strategies and priorities are in force to solve this crisis. The threats are either man made or natural or in combination. They are wide

ranging including habitat alterations, over exploitation of resource, reduction of natural habitat area, construction of dams, diversion or reclamation of river beds for urbanization reducing water discharge in rivers, siltation, over fishing, pollution of water bodies, introduction / entry of non-native species and global climatic variations etc. The occurrence of destructive natural events such as floods, cyclones, earthquakes, tsunamis, disease out breaks also greatly affect the aquatic ecosystems, causing severe threat to living beings. Organizations such and IUCN, World Wide Fund for Nature (WWF), Conservation International and the United Nations Environment Programme (UNEP) have been warning of the increasing rate of species extinctions for many years. Marine bio-diversity loss is increasingly impairing the oceans capacity in providing ford, maintain water quality and recover from perturbations. Overfishing, irresponsible and destructive fishing practices, and illegal, unreported and unregulated (IUU) fishing is the leading cause for reduced biodiversity and imbalance / modified ecosystem function (FAO, 1995; Bochlart, 1996; Jackson et al 2001, Lotze et al, 2006; Worm et al, 2006, FAO, 2010b).

5. CONCLUSION / RECOMMENDATIONS

The changes in any of the biological, chemical, geological or physical components of the ecosystem will have impact on the resource population and community. The responsibility for declining stocks and falling economic returns and employment opportunities in fisheries must be shared among fishers, fisheries management authorities, fishery scientists and those involved in environment degradation. Resilient ecosystem that are able to with stand occasional shocks are to be maintained. Account for evolutionary changes caused by fishing, which tends to remove large and order fish. And also include the actions of humans and their social and economic systems in all ecological equations.

In regard to inland fisheries, the strategy is to accelerate carp seed production, establish new fish seed farms and augment fish production in reservoir and tanks. Seed rearing infrastructure has to be developed for enhancement and ranching. Cage and pen culture practices should be encouraged as cluster approaches. The government should act as facilitator to encourage, empower and facilitate the community to do stocking and manage the stock. Appropriate tools are to be developed to collect resource and catch data on inland fisheries and to create stronger databases to enable better planning. Putting up of an integrated river management regions to plan and implement water resource development projects. Appropriate environmental flow models have to be developed to suit the Indian condition and the provisions of environmental flow needs. Further adequate marketing chemical and marketing infrastructure including facilities for value addition are to be developed.

The marine resources according to the FAO (2000) estimated that, in 1999, 47% of the 441 stocks for which some information on status was available were fully exploited, 18% overexploited, 9% depleted and 1% recovering. In marine sector to achieve higher production targets, is to establish new fishing harbors expand the mechanized fishing fleet for coastal fishing; introduce more deep sea trawlers, diversify fishing techniques, assist traditional fisher man by providing subsidies for fish craft, nylon twine and implements.

In view of the biodiversity conservation, the adoption of ecosystem based fisheries management which incorporated responsible fishing practices, along with strict regulation of fishing capacity at sustainable levels and establishment of Marine Protected Areas (MPAs). Which would facilitate production and restoration of biodiversity and enhance the resilience of the fish stocks and ecosystem services. In conserving the inland aquatic habitats the major initiatives like 1) In situ conservation, 2) Ranching with endangered species like Hilsa ilisha, T. khudree, T. putitora, L. Dussumieri, Ompokpabda, O. Malabarisus, Anabas testudineus and Chitala chitala, Nandus nandus, 3) A new conservation approach "State Fish" adoption, 4) Fish sperm and embryos cryopreservation, 5) Tissue banking, 6) Live gene bank, 7) Environmental impact assessments for river water development project and 8) River Ganga action plan has to be focused. In the marine sector, the Bicatch Reduction Devices (BRD's) and Turtle Excluder Devices (TEDs) need to be adopted and enforced legally, under a participatory management regime, in order to protect biodiversity and prevent trawling can be promoted as an alternative to shrimp trawling in small mechanized trawl sector in India to minimize environmental impacts. Ecofriendly practices are to be promoted in purse seining, gill netting, lining and trap operations, to minimize the impact on non target species and environment. Technologies and procedure for minimizing of GHG emissions from fishing fleet need to be promoted. The plastic waste origination from articles abandoned also should to taken care. Lastly the strict compliance regulation for safe disposal of MARPOL of garbage, oil, oily mixtures and other residues from fishery vessel operations, need to be promoted and implemented for protecting the health of aquatic environment and consumers. The government of India has enacted National Bio-diversity Action Plan in 2008 and created a National Biodiversity Board.

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