INLAND FISHERIES

India has rich inland water resources—rivers, ponds, lakes, reservoirs and floodplain wetlands. Inland fish production systems in the country can be summed up as capture fisheries in rivers, estuaries, lagoons and lakes; aquaculture in ponds; and various forms of enhancements (mainly culture-based fisheries and stock enhancement), being practiced in reservoirs, lakes and floodplain wetlands (Table 1). Catch from rivers and estuaries, however, is falling drastically due to negative anthropogenic impacts on the aquatic environment.

Resources	Size	Mode of management
Rivers (km)	29,000	Capture fisheries
Mangroves (ha)	356,000	Subsistence
Estuaries (ha)	300,000	Capture fisheries
Freshwater ponds (ha)	2,430,000	Aquaculture
Brackish water ponds (ha)	1,140,000	Aquaculture
Secondary Saline soil areas (ha)	9,000,000	Aquaculture Potential*
Estuarine wetlands (ha)	40,000	Aquaculture
Lagoons (ha)	190,500	Capture fisheries
Large and medium reservoirs (ha)	1,667,809	Enhanced capture fisheries
Small reservoirs (ha)	1,485,557	Culture-based fisheries
Floodplain wetlands (ha)	202,213	Culture-based fisheries; enhanced capture fisheries
Upland Lakes (ha)	720,000	Capture fisheries

Source: Ayyappan, S., and Sugunan, V. V. (2009), 'Fishery resources in the context of nutritional security in India', Indian Farming, 59:7, 29-35;* ICAR, 2006

Table 1: Inland fisheries resources of India and their modes of management.

In a typical capture fishery, the wild untended stock of organisms is harvested with little human intervention on either habitat variables or the biotic communities, while in a culture fishery (aquaculture), the production process is based on captive stocks with a high degree of effective human control over the water quality and other habitat variables. Fish production systems (Fig 2) that are intermediate to capture and culture are collectively called 'enhancement'.

Freshwater aquaculture

Freshwater aquaculture contributes 3 million tonnes (S Ayyappan, et.al., 2009, 'Eco-friendly fish production systems', Indian Farming) of fish annually, at a utilisation level of 40 per cent of the potential water area of 2.4 million ha, leaving sufficient scope for vertical and horizontal expansion. At present, the three Indian major carps viz., catla (Catla catla), rohu (Labeo rohita) and mrigal (Cirrhinus mrigala) constitute 87 per cent of freshwater aquaculture production. Culture systems with different combinations of carps have been standardised to suit varying ecosystems and input levels, as also

integrated with other farming practices, which assure profit of Rs 50,000 – 90,000 per ha annually (ibid.).

While two important technologies viz., induced fish breeding and composite carp culture triggered the growth of carp culture in the 1970s, two developments in recent years have opened up new possibilities in freshwater aquaculture—the development of improved rohu (Jayanti) with 70 per cent higher growth, developed through a selection programme; and, multiple and off-season breeding of carps that enabled seed availability at different times of the year. With the adoption of technology of composite carp culture, the mean yield in Fish Farmers' Development Agency (FFDA) ponds across the country has gone up to over 2.9 tonnes/ha/year (DAHD&F, 2011), while several farmers are achieving much higher production levels of 8-10 tonnes/ha/year. Apart from culture of Indian major carps, there are opportunities for developing culture of catfish, especially magur (Clarias batrachus), which has a high market demand. Coldwater fisheries and aquaculture, with high valued species like trout and mahseers in hill states like Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim and Arunachal Pradesh are also being accorded high priority in India's R&D efforts.

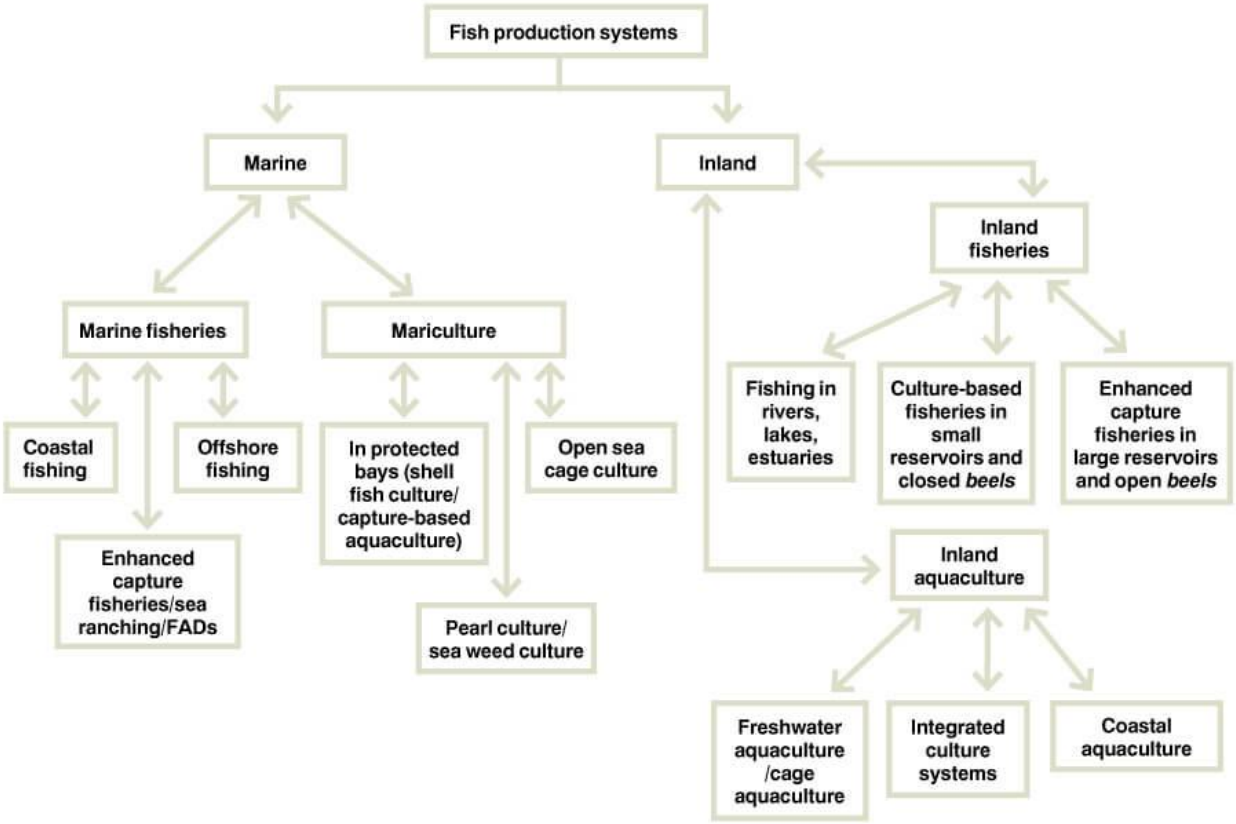

Fig. 2: Fish production systems in India.

Seed is the most critical input in aquaculture. The private enterprise in carp seed production in the country is fast growing with over 700 hatcheries producing over 35 billion fry annually. With an investment of about Rs 70,000, the newly devised portable carp hatchery can produce over 2 crore of seed in 20 batches in three months from July-September. Further, the net profit in raising carp fry in two crops of 15-20 days, is about Rs 90,000/ha. Recent technological innovations, such as multiple carp breeding; portable hatcheries; improved

intensive carp culture; and so on have augured well for the development of freshwater aquaculture.

Despite development there is still a shortage of fish seed in the country and an adequate number of hatcheries is required to be established in different regions to obviate the need for long distance transportation. There is also a need to create sufficient rearing space to ensure uninterrupted supply of fingerlings. Feed is another major component in the aquaculture segment, the quality and cost of which determine the success of an aquaculture enterprise. Considering the projected horizontal and vertical expansion of freshwater aquaculture, the feed requirement in the next 10 years is estimated at 10 million tonnes, 30 per cent of which would be commercial pelleted feed. Also aquaculture suffers from a lack of species diversification. At least 15-20 species of finfish and shellfish including giant freshwater prawn, catfishes and ornamental fishes are lined up for commercial production to meet the demand from domestic and international markets. In order to facilitate species diversification in freshwater aquaculture, research institutes in the country have launched major efforts on seed production of selected species at the national level, by setting up model production units. Other major issues

are the need for appropriate leasing policies for public water bodies and effective post-harvest and marketing infrastructure including cold chains. Major R&D efforts on the anvil are related to breed improvement, fish genomics, transgenics, bio-remediation and vaccines. In view of the shrinking freshwater availability and increased wastewater generation, production technologies with minimum water requirement and wastewater recycling are also getting research attention. Further, in view of the emerging market for organic farmed fish, emphasis is being laid on wider adoption of organic farming practices and certification systems so that these contribute to at least 10 per cent of the total aquaculture production for meeting the niche market.

Integrated Farming Systems:

Integrated farming systems entail synergising different components of agriculture such as field crops, animals, poultry and fish to conserve resources and optimise resource use and outputs. Often, by-products and wastes from one segment act as inputs for another—thereby cutting down production costs drastically. By recycling the organic wastes, integrated farming systems become an instrument to achieve sustainability and reduce risks of

environmental degradation. Rice-fish farming is a traditional integrated farming practice, followed in many parts of India for centuries. Recent technological upgradations have made these systems a more economical and an attractive proposition. A sizable portion of the 18 million ha of canal-irrigated, 6 million ha of low and rainfed, 3 million ha of deep water and 1 million ha of coastal wetland rice culture systems are suitable for rice-fish cultivation, particularly in the eastern India, which accounts for more than 60 per cent of such resources. Fish and shellfish species suitable for freshwater rice ecosystems are Indian major carps (catla, rohu, mrigal), catfishes (magur and singhi), medium carps (bata and kalbasu), minor carps (mola and barbs), snakeheads (murrels) and perches (koi and gourami). Mullets and tiger shrimps are grown in coastal saline areas along with salt tolerant, lowland rice; while in irrigated shallow waters, fish and prawn seed rearing can be combined with rice cultivation under favourable situations (20-30 cm water depth).

Capture fisheries:

Rivers: The river systems of the country comprise 14 major rivers, 44 medium rivers and innumerable small

rivers and desert streams—providing one of the richest fish genetic resources in the world. The Gangetic system alone harbours not less than 265 species of fish. Similarly, 126 species belonging to 26 families have been recorded from the Brahmaputra system and 76 species from the peninsular rivers. The rivers, however, present a complex mix of artisanal, subsistence and traditional fisheries with highly dispersed and unorganised marketing system, which frustrates all attempts to collect regular data on fish yield. A firm database on fish production trends of rivers is still elusive. Based on the information collected by CIFRI on selected stretches of the rivers Ganga, Brahmaputra, Narmada, Tapti, Godavari, and Krishna, fish yield from these rivers vary from 0.64 to 1.64 tonnes per km, with an average of 1 tonne per km.

The catch statistics over the years indicate some disturbing trends in the riverine fisheries especially the Ganga (M Sinha et al., 1998, 'The Ganga–Environment and fishery,' CIFRI). A sharp decline in fish production from five stretches of the Ganga—Kanpur, Allahabad, Buxar, Patna and Bhagalpur, is testimony to the deleterious effects of environmental changes on fish output. Average fish production from Ganga at Allahabad used to be around 205 tonnes during the period between

1958-59 and 1965-66, which had declined to 59 tonnes during 1996-97. More marked is the fall in the production rate of prized Indian major carps, which declined from 91.35 in the 1950s to an abysmal 4.9 tonnes in 1996-97. Similar decline in catches are reported from Brahmaputra, Godavari and other rivers. Decline of fish populations in rivers is universal phenomenon due to a variety of factors including destruction of habitat, effluent discharge and cascading effect of dams and other obstructions.

Upland lakes: Information on the fisheries activities in the upland lakes is scanty as natural lakes have not been studied for their fishery potential. However, on account of their limnological characteristics these are suitable for developing coldwater fisheries. Upland lakes support a lucrative indigenous and exotic fish fauna comprising schizotharcids, mahseers, trout, tench, Crucian carps and the mirror carp. The yield rates, based on our 2001 study, from Himalayan lakes range from 8-22.5 kg/ha in Dal lake, 10-28.5 kg/ha in Anchar, 15-45 kg/ha in Wular, 2 to 6 kg/ha in Manasbal and 5 to 15 kg/ha in Sivalik lakes. The catches in most of these lakes are dominated by C. carpio with sizeable contribution to schizothoracids and mahseers in northern lakes and Oreochromis mossambicus in Deccan lakes.

Management norms for these upland lakes are virtually non-existent. Also some of the lakes in Kashmir are experiencing a disturbing trend with schizothoracids are giving way to the common carp. The common carp introduced into the Kashmir valley now contributes 65-78 per cent of the total fish landings. A parallel situation has been observed in case of the mahseers in Kumaon and Sivalik lakes. In Bhimtal Lake, the common carp constitutes a significant portion of the catch marking decline of the Tor putitora population. On account of their remoteness and the low temperature regime, drastic increase in yield and production are not expected from these water bodies.

Estuarine fisheries, lagoons and backwaters: Various estuarine systems form an important component of the fisheries resources of India. The average yield is estimated to vary from 45 to 75 kg/ha (V G Jhingran, 1991, 'Fish and fisheries of India', Hindustan Publishing Corporation). Presently a continuous monitoring of the fisheries is being done only in the Hooghly-Matlah estuarine system—the largest estuarine complex in India. However, river course modifications have had a negative impact on the estuarine fish populations. Mahanadi estuary is characterised by poor tidal oscillations and

flood discharge due to sand bar formation in the sea mouth affecting fish yields. The fisheries of Godavari estuary too have been seriously affected by sand bar formations. Fisheries potential of Tapti estuary drastically declined after commissioning of the Ukai dam as also mushrooming industries on the banks of Mahi that pose a serious pollution problem in the estuary.

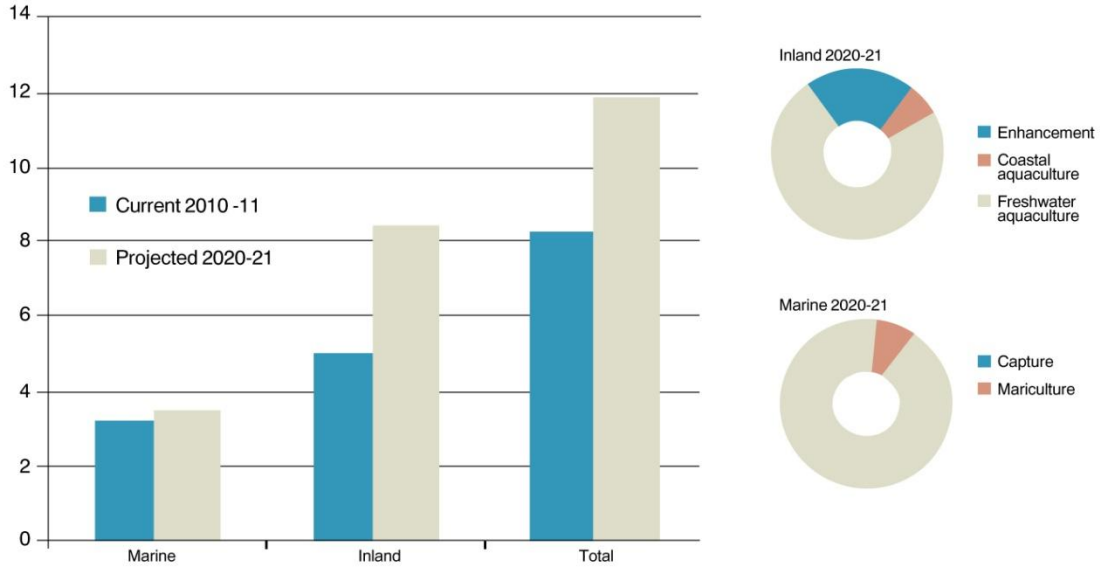

Fig. 4: Current and projected fish production in India (in million tonnes)

Lagoons and backwaters associated with estuaries constitute an important inland capture fishery resource. Chilka and Pulicat Lake in the east coast and the Vembanad lagoon in the west coast are the major brackish water lakes in India. Regulated discharge through incoming rivers, siltation and anthropogenic pressure has

made considerable negative impact on the fishery of Chilka Lake. As fish catch from Pulicat lagoon is dependent on the ingress of fish and prawn seed from the sea, the sand bar formed at the mouth adversely affects recruitment. In Vembanad backwaters, marked decline in prawn catches, both from impoundments and open waters has been reported due to human intervention, mainly pollution and over fishing (N N Menon et al., 2000, 'Hydrobiology of the Cochin backwater system- a review', Hydrobiologia).

Mangroves and estuarine impoundments (bheries): Mangroves are sensitive ecosystems, which play a vital role in breeding and nursery phases of many riverine and marine organisms of commercial value, besides contributing through its own fishery. However, since mangroves are protected areas where fishing is either prohibited or done on a subsistence basis, details of fish production in these water bodies are not available. Nearly 85 per cent of the Indian mangroves are situated in the Sundarban, which is under severe climatic and anthropogenic pressure.

Contribution of inland capture fisheries from rivers, estuaries, lagoons and lakes is fast decreasing, which is

presently estimated at 20 per cent. A substantial increase in production is not expected from these water bodies and therefore the focus should be on conservation of the existing resources and restoration of some of the degraded habitats aiming at fish germplasm conservation. The inland fisheries sector is highly dispersed and unorganised. Appropriate tools need to be developed to create good database to enable better planning. It is envisaged that the national policy on inland fisheries should strike a balance between aquaculture and various enhancement practices to achieve higher fish productivity, environmental sustainability and social equity. Stocking should receive national priority. The government should also shed the 'revenue approach' in favour of 'development approach' while leasing out water bodies. Cooperative societies, SHGs and other groups should be encouraged to manage culture-based fisheries in reservoir with long leasing terms for 5-10 years.

Also an integrated river management regime should be in place to plan and implement water resource development projects that recognise all tangible and intangible benefits of riverine resources. At present, many ecosystem services including that arise from fisheries are grossly undervalued while planning water resource development.

Most of environmental flow models available today have been developed for meeting the specific conditions of small, rhithronic, head water streams in the temperate countries and Australia. New tools for estimation operation of environmental flows need to be developed for Indian/Asian conditions.

Moreover there is a need to create adequate marketing channels and marketing infrastructure including value addition apart from setting up a national quality standard that is at par with the standards of international buyers. This will not only raise the reputation of the country as a responsible exporter, but also ensure the health of domestic consumers.