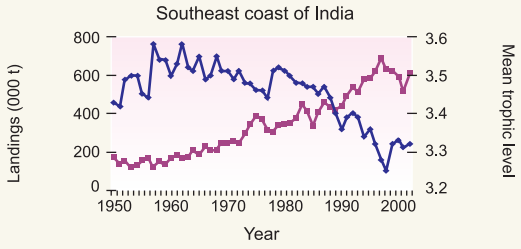
Fish Production and Processing

Marine Sector

Estimation of marine fish production: The marine fish production in India during 2004 has been estimated as 2.54 million tonnes, with a decrease of 1.9% compared to the previous year. The pelagic finfishes constituted 54%, demersal fishes 26%, crustaceans 15% and molluscs 5% of the total landings. The estimate of region-wise production showed that the north-east region, comprising West Bengal and Orissa coasts contributed 10.8% to the total production. South-east region consisting of Andhra Pradesh, Tamil Nadu and Pondicherry coasts contributed 24.1%. The north-west region comprising Maharashtra and Gujarat coasts contributed 30.0% of the total, and south-west region comprising Kerala, Karnataka and Goa coasts recorded a maximum of 35.2%. Of the total landings, 68% was from mechanized sector, 25% from motorized and the rest 7% artisanal sector during the year 2004. Among the commercially important groups, oil sardine contributed 15% of the total landings during 2004, followed by penaeid prawns (7%), Indian Mackerel (6%), threadfin breams, croakers,ribbonfishes and non-penaeid prawns (5% each). Analysis of trophic level of 707 species of commercially exploited marine fish and shellfish revealed that the production level is declining due to intense fishing and large predatory fishes are being replaced by small sized fish on the south-east coast of India. This result underlines the need for a shift toward ecosystem-based marine fisheries management.

Marine Fisheries Census, 2005: The first phase of the national marine fisheries census under the scheme "Strengthening of Database and Information Network for the Fisheries Sector" of the Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, in all coastal States except Tamil Nadu, was successfully completed. Information was collected on the number of fishing villages, landing centres, fishermen population, active fishermen, fishing crafts and gears including the infrastructure facilities for planning development programmes in different maritime states of India. The census was also focused on getting information on characteristics of the fisherfolk including their community, educational and occupational status, membership in co-operative societies, etc. besides their holdings of craft and gears.

- National Fisheries Census (except Tamil Nadu) completed
- Fiberglass reinforced plastic carp hatchery was developed
- Breeding technologies developed for yellow catfish and cat fish pabda
- Captive breeding of spiny eel was successfully done
- Cages were found useful for *in-situ* stocking
- Fishery survey of high attitude lakes of Ladakh was completed
- Molecular characterization of Indian strain of white muscle disease virus was completed
- Nested RT-PCR diagnostic kit developed for *Microbrachium rosenbergii* noda virus
- National musssle seed calendar was developed
- Low cost feeds for ornamental fish, golden mahseer and mud carb, were developed
- Check list of macro-fauna and flora of Gulf of Mannar a Marine Biosphere Reserve completed
- Genetic characterization of golden mahaseer and rohu through microsatellite was completed
- FRP boats provided to help fishermen in the wake of the destruction caused by tsunami



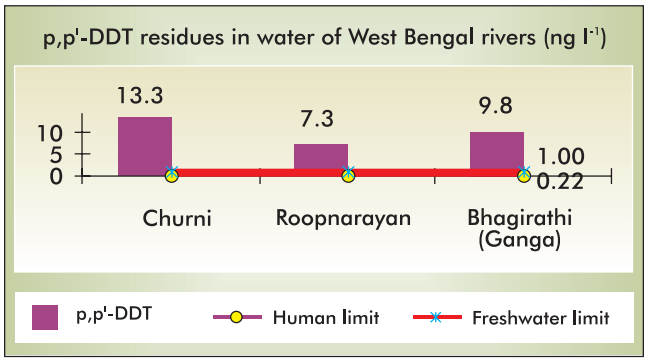
Inland Sector

Development of river and reservoir database management module system: A software was developed to store river and reservoir database. This software contains sub-modules, viz. data entry module for adding new records; modification module to modify the wrong entry; deletion module for dropping the record; and report generation module. Each sub-module has the provision to store, retrieve and manipulate different sets of parameters like sediment, water quality, biological and fishery data systematically. The modules in this software are useful for retrieving any data of river/reservoir for comparison and further analysis to suggest management actions for reservoir fishery management.

Status of ecology and fisheries in reservoirs of Karnataka, Tamil Nadu and Uttar Pradesh: Investigations were conducted on the ecology and fisheries of Dandhroul, Chandraprabha, Tanola and Hinauti reservoirs located in Gangetic basin and Kabini and Mettur reservoirs of the Cauvery basin. All the reservoirs located in Uttar Pradesh are productive and their fishery is dominated by the major carps. Kabini reservoir was medium productive, and its fishery was dominated by catfishes (*Ompok bimaculatus*, *Mystus cavasius*) and the exotic fishes (*Tilapia mossambicus*). Most of the reservoirs located in Karnataka except Varati and Chakra are medium productive and the fish yield in these reservoirs was around 40kg/ha/year.

Metals and pesticide contamination level in Rivers Churni, Roopnarayan, and Bhagirathi: The DDT concentrations in waters of Rivers Churni, Roopnarayan and Bhagirathi were higher than permissible limits (0.22 ng /l, EPA) specified for aquatic organisms and their consumers. The level of DDT concentration in fish flesh was much below the permissible limits suggested for human consumption. The mean Cu, Zn, Cd and Pb contents in the fish flesh of Churni river were within the permissible limit for human consumption.

The impact of pollutants were also evaluated in *Rita rita* and *Labeo rohita* in river Churni. In the test fishes, elevated levels of creatinine, bilirubin, triglyceride and cortisol were evident in blood.



Fisheries of Hooghly and Mahanadi estuarine ecosystems: An estimated fish catch of 64,645.7 metric tonnes was recorded during the current year at Hooghly estuary, which was 22.5% lower than that of the previous year. The fish catch in the freshwater tidal zone of the estuary registered an increase by 11.5% over previous year. Similarly, juvenile of hilsa (*Tenulosailisha*) showed an increase of 117% from the level recorded in the previous year.

In catch composition of the Mahanadi estuarine ecosystem, dominance of miscellaneous fish group (46.0%) was observed. Amongst the various fish species, contribution of *Mugil cephalus* was highest (18.4%), followed by *Liza parsia* (15.3%), *L. calcarifer* (10.6%) and *Tenulosa ilisha* (9.7%).

SUCCESS STORY

Institution Village Linkage Programme (IVLP) for Technology Assessment and Refinement in the Coastal Agro Ecosystem of Ernakulam in Kerala

Sylvi Figerado, a farmer has succeeded in improving the farm productivity of his 2-acre pond with training imparted on scientific farming on monoculture of juvenile crabs under IVL. He has earned a profit of Rs 49,500 and Rs 50,000 from a single harvest in the first and second year respectively. Presently, apart from the monoculture of juvenile crabs, he is rearing the high-yielding variety of Kuttanad ducks and getting around 40-50 eggs a day at Rs 2.50/egg. He says to other farmers that, "Now whenever I am in need of money, I just sell the crabs and earn the required amount in no time."

Freshwater aquaculture

Portable FRP carp hatchery for carp seed production: An eco-hatchery for carp breeding made of fiberglass reinforced plastics (FRP) was developed. It is suitable for breeding 10–12 kg of carps in field conditions. The hatching tank is cylindrical and can hold the net egg incubation volume of 1,200 litres. The eggs hatch in 14–18 hr and remain in the tank for 72 hr. The spawn is collected through PVC hose pipes in portable carp hatchery unit spawn collection tank. It has a capacity of hatching 12 lakh eggs. The egg/spawn collection tank is a rectangular tank with a capacity of 250 litres. The system is light weight, easy to transport and it can be connected and dismantled easily. The cost of the complete FRP hatchery unit is approximately Rs 70,000 and can be operated easily by small fish farmers.

Seed production of yellow catfish: Success has been achieved in breeding of an endangered yellow catfish, *Horabagrus brachysoma* under captive conditions. The per cent fertilization and hatching of eggs were 67±10.21 and 38±6.48, respectively. The fry were reared

Portable fish carp hatchery

for fingerling production and fed with completely compound diet, and they grew to 746±32.48 mg in weight in 30 days.

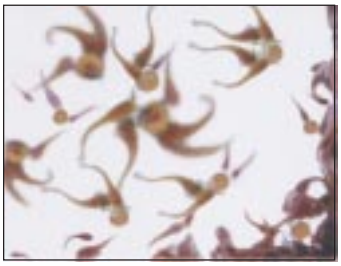
Horabagrus brachysoma fingerlings

***Breeding and culture technology of* Ompok pabda:** The breeding and culture technology of an endangered catfish pabda (*Ompok pabda*) was developed. Marketable size fish can be produced within 3 months.

Captive breeding of spiny eel: Successful attempts were made to breed spiny eel, *Mastacembelus aculeatus* under captive conditions. The per cent fertilization and hatching of *M. aculeatus* eggs were 71±12.76 and 51±12.19, respectively. The growth trend from larvae to fry was 37±212 mg during 30 days rearing while fry to fingerling was 200±16.55 mg during a 45 days rearing.

Larval feed for baby magur: To meet the nutritional requirements of magur larvae, a palatable weaning feed "Starter-M" for baby magur was developed. Starter-M is a highly nutritious feed which contains a minimum of 33% crude protein and 8% fat. The feed is also enriched with vitamins and minerals, ensuring faster growth with high survivability of larvae.

Carp seed production in cages: Fingerlings of rohu, *Labeo rohita* (62.9 mm in length and 6.12 g in weight) were reared at different stocking densities, i.e. 1,000 and 2,000 each in 10 m^2 size cages in Krishna reservoir. After 80 days, growth and survival were assessed to be 195.4 mm/68.25 g in 1,000 stocking density and 173.8 mm/55.5 g in 2,000 stocking density, with respective average increments of 1.09 and 0.87 g/day. The juvenile fishes from cages were stocked in Krishna reservoir near Praksam Barrage. The survival was 88.4% in the former and 80.5% in the latter, showing ample scope for utilizing cages for *in-situ* stocking of open water bodies.



Magur larvae on active feeding of Starter-M

Aeromonasis in carps: The pathogenesis and pathology of the disease, *Aeromonas* septicaemia in major and minor carps showed clinical *septicaemia* with dropsy, haemolytic and blood coagulation disorders, increased blood glucose, cortisol, chloride and triglyceride levels. *A. hydrophila* isolates from disease condition were highly virulent and pathogenic compared to isolates from healthy fish and better quality of water.

Coldwater fish and fishery resources of Uttaranchal: The perimeter and area of open water bodies of Kumaon region of Uttaranchal were ascertained by using GIS. Based on satellite imageries the lakes Bhimtal, Nainital, Sattal, Naukuchiatal and Garurtal have an area of 45.13, 54.29, 48.9 and 5.7 ha, respectively, with the perimeters of 4.3, 4.6, 6.2, 3.1 and 1.3 km, respectively.

Development of database of upland fishes of India: Computerized database on coldwater fishes of India was designed to compile the wealth of these fishes and make available to the researchers and anglers, along with details of principal game fishes, role of sport fishery in development of tourism and principal fishing sites in different riverine ecosystems. The generation of database on the biological wealth of various upland ecosystems would ultimately help in developing strategies for the proper management and conservation of native fish germplasm.

Data on 45 coldwater fish species inhabiting Himalayan waters, belonging to different sub-families like Cyprininae (*Carassius*, *Ctenopharyngodon*, *Cyprinus*, *Labeo*, *Neolissochelius*, *Puntius*, *Tor*), Cultrinae (*Chela*, *Salmostoma*); Rasborinae (*Barilius*, *Brachydanio*, *Danio*, *Raiamas*,*Rasbora*); Schizothoracinae (*Diptychus*, *Gymnocypris*, *Ptychobarbus*, *Schizothorax*, *Schozothoraichthys*); Garrinae (*Crossochelius*, *Garra*); Balitotinae (*Balitora*, *Bhavania*); Nemacheilinae (*Nemachelius*, *Triplophya*); Botinae (*Botia*); *Sisoridae* (*Bagarius*, *Exostoma*, *Glytosternum*, *Glyptosternum*); Salmonidae (*Onchorhyncus*, *Salmo trutta*) along with details of available game fishes, principal fishing sites of Uttaranchal have been computerized as a database.

SUCCESS STORY

Pen and Cage culture in Wetland and small Reservoirs

The Central Institute of Fisheries Research Institute, Barrackpore has successfully developed package of practices to raise the carp and freshwater prawn seed and to grow them to table size in enclosures, *viz*. pens and cages installed in small reservoirs and wetlands. In Assam, 100 pens ranging from 37.5 to 1,100 m^2. covering 2.73 ha were installed in beels, viz. Shankar, Goruchora, Samaguri, Charan, Kumri, Haribhanga, 46 Morakollang, Rowmari, Borghuli and Dek in the districts of Golaghat, Nagoan, Morigaon and Goalpara of Assam. This technology was used to raise the right size of fish seed to stock the beel for improving its fish yield. In the pens, different species of carps, viz. *Labeo rohita, Catla catla, Cirrhinus mrigala*, *Labeogonius* registered a maximum individual growth of 295 g, 265 g, 110 g and 75 g, respectively, in 3–5 months. The beels were managed by the cooperative societies. In Assam, pen culture of carps in beels was promoted for micro-financing. This technology has been adopted in small reservoirs and wetlands in West Bengal, Assam, Karnataka and Tamil Nadu with encouraging results.

SUCCESS STORY

Fibreglass Canoes for Traditional Fishing

At the Central Institute of Fisheries Technology, Cochin, a small size fibreglass reinforced plastic (FRP)(length- 5.78 m breadth (middle): 0.82 m; depth (middle) : 0.385 m) canoes was designed, developed and constructed, which is suitable for use in backwaters, near-shore waters and beels. A 40-day long training-cum-demonstration programme was carried out in Assam to provide hands-on training in the fabrication of FRP canoes. Three different types of canoes, which are commonly used in Assam, particularly in beel fishing, were fabricated after taking out a mould of the original wooden canoes. With these moulds, any number of canoes can be fabricated at a cost of Rs 23,000. This breakthrough has attracted the attention of other state governments in the region. The canoes are maintenance-free, long-lasting and affordable. The State Government of Assam is proposing to make 100 canoes using this technology.

Limnology and fishery of high altitude lakes of Ladakh: A survey was conducted on high altitude lakes, located between 3,500–5,000 m above mean sea level, Tso Morari and Pangong of Ladakh and Tsomgo, Memencho, Kupup Tso, Manjula of Sikkim, to generate a baseline data on their limnology and fishery. These lakes are either oligotrophic or ultra-oligotrophic and normally remain ice-bound for 4–5 months in a year. No indigenous fish fauna was recorded from these lakes.

Development of broodstock of rainbow trout: Culture of eyed ova of the rainbow trout, *Onchorynchus mykiss* was taken up at Champawat fish farm at a raised temperature of 28ºC. The fish stocked in January, 2005 has shown a remarkable growth i.e. 200 mm in length and 60–70 g in weight during 10 months.

Feed for golden mahseer: Feeding trials with formulated diets having 40% dietary protein gave better growth performance and feed efficiency in golden mahseer as compared to conventional feed and commercial feeds. Food consumption and growth increased with increase in the number of meals per day up to 3 meals/day. The polycarboxylic organic acid and citric acid found in citrus group of fruits was a safe feed stimulant for mahseer.

***Improved traditional culture of tiger shrimp* Penaeus monodon:** Experiments on the culture of tiger shrimp, *Penaeus monodon* were conducted in 3 tide-fed ponds having area of 1,620 m^2, 3,750 m^2 and 1,840 m^2, with hatchery seed stocked @ 10, 6, 10/m^2.

Rainbow trout showed remarkable growth at Champawat fish farm

The shrimps were harvested at the end of 118–131 days of culture and the production obtained varied from 1,150 to 1,965 kg/ha/crop.

Pond culture of Kuruma shrimp: Culture of kuruma shrimp, *Marsupenaeus japonicus* was attempted in a 0.9 ha pond at Sirkazhi, Tamil Nadu. The shrimps reached average final size of 12.5g in 113 days and registered a survival rate of 83%. The total quantity of shrimps harvested was 916.3 kg and the production worked out to be 1,018.1 kg/ ha/crop.

Fin and shellfish resources of brackishwater Vembanad lake: Vembanad Lake is the largest brackishwater lake along the south-west coast of India, spreading over a distance of nearly 100 km,with an area of approximately 256 sq. km. The rivers - Achankovil, Manimala, Pampa, Meenachil and Muvattupuzha release their water to southern part of the lake and the rivers—Periyar and Chalakkudy, join the lake in the northern end. The lake was identified as one of the "Ramsar Sites" in 2002. The lake is the most productive brackishwater body along this part of the country and the annual fish landings from Vembanad are around 20,000 metric tonnes, dominated by penaeids, freshwater prawns, crabs, mullets, pearl spot and clams. The finfish and shellfish resources of this lake were documented,comprising 169 species.

Molecular characterization and diagnosis of the Indian strain of white muscle disease virus: The white muscle disease virus was purified from white muscle disease-infected larvae of the giant freshwater prawn, *Macrobrachium rosenbergii*. Viral bands were collected and PCR reaction was performed, which gave 859 bp product, corresponding to the *Mr*NV. The sequence had 100% match with the 2.8 kb *Mr*NV genome available in the gene bank indicating the genetic similarity of the Indian and French West Indies strain.

Development of a nested RT-PCR diagnostic kit for* Macrobrachium rosenbergii *nodavirus: A nested RT-PCR

diagnostic kit to detect white muscle disease in giant freshwater prawn *Macrobrachium rosenbergii* was developed. PCR screening of broodstock of *M. rosenbergii* can significantly reduce the risk of crop failure due to white tail disease (WTD) or white muscle disease (WMD) in culture systems.

Introduction of automation in mussel farming: A low cost mussel seeder for seeding mussels and mussel harvester to strip the mussels from the culture ropes was designed and developed. The efficiency of mussel seeder and mussel harvester were successfully demonstrated to farmers.

National mussel seed calendar developed: A national mussel seed calendar and seed distribution were prepared on a GIS platform as a guide to entrepreneurs on suitability of areas, farming and seasons of mussel spat fall.

Pellet feed for mud crab fattening: *Scylla Pushti*, a formulated pellet diet, with 47% crude protein, 10% lipid, 18% crude ash and 17.8 MJ/kg gross energy was developed with indigenous raw materials, and additives for fattening mud crabs in coastal saline ponds. The pellet feed is economically viable, eco-friendly, easy to transport, store and dispense. The feed has been successfully used as a substitute for the traditional feeds for fattening.

Development of LOA aluminium boat for reservoirs and rivers: A 5.22m LOA aluminium boat for fishing and related activities in reservoirs and rivers has been developed. This new boat is corrosion-resistant and light in weight.

Standardization of process parameters for curing jelly fish: The process parameters for curing jelly fish by treating with varying concentrations of salt and alum were standardised. Yield of the finished product was 6–7%. The product is of high demand in Japan, Indonesia and Singapore.

Scylla Pushti is an economical pellet feed for mud crab

Mussel harvester was developed

Development of fish tunnel dryer: A fish tunnel dryer using solar energy was developed, that uses forced convection system, and is superior to natural convection type dryers because of reduced risk of spoilage and increased capacity. The advantages

Prototype of the 5.20 m LoA alumimium alloy craft developed at the CIFT

SUCCESS STORY

Utilisation of Prawn Shell Waste

At the Central Institute of Fisheries Technology, Cochin, a technology for production of chitin, chitosan and glucosamine hydrochloride from prawn shell waste was developed. The chitin, chitosan and glucosamine hydrochloride are used as a dietary supplement for controlling obesity and arthritis, as a polymer flocculent, dye fixing and water treatment. The technology has been transferred to private sector in India and abroad. A patent has already been filed for production of high bulk density chitosan and high purity glucosamine hydrochloride from shrimp shell waste.

of this dryer are—hygienic drying conditions; protection against dust, insects, birds, rodents and climatic conditions; reduction of drying time; minimum mass loss; operation without fuel consumption, improved quality and low operation cost.

Processing of Jelly fish

The eco-friendly tunnel fish dryer

Biodiversity of the Gulf of Manner: A checklist of macro-fauna and flora containing 139 families and 3,065 species of the Gulf of Mannar a Marine Biosphere Reserve was completed.The checklist includes diversity of sea grass (13), sea weeds (131), sponges (275), gorgonids (22), corals (128), sea anemones (117), crustaceans (351), molluscs (771), echinoderms (70), other echinoderms (194), cephalocordata (6), urochordata (59), hemichordata (1), fishes (580), sea turtles (5), sea snakes (20) and marine mammals (11).

Database of fishes in computer disk: The database of the different aspects has been prepared in CD form.

Bioenriched feed for ornamental fish

A compound fish feed using indigenous ingredients supplemented with a fermented product was formulated for the marine aquarium fishes. Bioenrichment of the ingredients was done by using food grade microbes. The feed in the size range 1 mm to 3 mm to suit the different growing stages and species is manufactured using extrusion process in a twin-screw extruder with perfect finish. Twin-screw extrusion technology improves the texture, digestibility, stability as also the shelf-life of the feed because of reduced microbial load. This cost-effective feed was successfully used for rearing of clown fish from fry to broodstock.

Clown fish

Bioenriched ornamental fish feed

- Ornamental fishes—information on their classification, distribution, habitat, morphological features, fishing sites, seasons, etc.
- Sport fishes of India—information on 34 species covering distribution, fishing season, angling sites, size, colouration, morphology, habit and habitat, state, water body and localities. Out of 34 species, 26 are freshwater game fishes whereas 8 are estuarine and sea game fishes
- Exotic food fishes—information on their classification, distribution, habitat, morphological features, fishing sites, etc.
- Alien fishes and quarantine information system' (AFQIS)
- Bibliographic database on aquatic species introductions (BIDASI -2005)
- Fish chromosome world—containing cytogenetic and other information

A user-friendly computer software, named, 'Fish Chromosome Search Software' was developed by incorporating information on 126 fin-fish species belonging to 34 families under nine orders.

Development of fish germplasm bank: Specimens (1,007) of 17 fish species were collected from aquatic habitats of the North-east region and added to the NE regional live genebank. In Assam 11 fish collection stations were identified for collecting targeted threatened fish species to be added to the bank. Of the 115 fish species of the NE region considered exclusively as ornamental fishes, 70 species were identified and documented with images.

Genetic characterization of golden mahseer: Mahaseer was genetically profiled for their population structure in their natural range of distribution. Distinct genetic structure was observed in different natural populations of golden mahseer, *Tor putitora*. Further, genetic profiling of genus *Tor* revealed that *T. putitora* and *T. tor* were genetically closer to each other, whereas, *T. khudree* and *T. mussallah* had greater genetic differences.

Gene banking: Fish species (26) including 2 endangered, 18 riverine stocks and 6 hatchery stocks were maintained at the NBFGR live fish genebank at Lucknow. Breeding trials were conducted for *Channa marulius*, *Labeo dyocheilus*, *Labeo rohita* and *Notopterus notopterus*.

Fish disease and quarantine: Studies were conducted on isolation and detection of monogenian parasites of freshwater exotic fishes, using molecular techniques. Nucleic acid of exotic bacterial pathogens, i.e. *Aeromonas salmonicida* and *Yersinia ruckeri*, affecting the ornamental fishes, was obtained from referral laboratories for their use in polymerase chain reaction as positive controls. A PCR was also standardized for bacterial pathogens, viz. *Aeromonas hydrophila* and *Edwardsiella tarda*, of ornamental fishes, by using the isolates maintained in the microbiology laboratory.

Genetic characterization of* Tenualosa ilisha *using molecular markers: The RAPD technique was applied to delineate the hilsa stocks migrating to the Ganga-Padma and Hooghly-Matlah estuary. The UPGMA dendrogram clusters indicate that the migrating population of *Tenualosa ilisha* of Ganga-Padma and Hooghly-Matlah ecosystems belong to two different populations.

SUCCESS STORY

Ready-to-serve Fish Curry in Flexible Pouches

At the Central Institute of Fisheries Technology, Cochin, the process of production of fish curry in retortabale flexible pouch using over pressure autoclave was successfully developed and standardised. The flexible pouch can perform the packaging function equally well as metal cans, and is free from the disadvantages met within them. The technical guidance on production of retort pouch products has been given by the Institute to private sector for commercial exploitation.

Rohu microsatellite markers developed: Polymorphic microsatellite markers (12) have been isolated and characterized from rohu genome. Most of the loci exhibited cross-species amplification in bata, kalbasu, mrigal, catla, common carp, grass carp.The genetic differentiation in *Labeo bata* is being addressed using some of these microsatellites.

Survey of fish fauna in river and lakes of Arunachal Pradesh

The fish fauna of river and streams of the Deopani, Epipani, Diha, Enjupani, Dibang of Arunachal Pradesh was documented. Among the surveyed streams, 26 fish species dominated by *Tor putitora T. progenies*, *Neolissochilus hexagonolepis*, *N. hexastichus*, *Schizothorax richardsonii*. *Schizothoraichthys progastus* and *Labeo dyocheilus* were recorded. These water bodies are having abundant stock of chacolate mahseer and minor carps.

Demonstration of cage culture in NEH states

Fish rearing 10 m^2 cuboid shape cages made of conduit pipes were installed in Nongmahir reservoir (90 ha area) in Meghalaya in May 2005. Each cage is kept within a floating bamboo catwalk for easy management and handling of cages during the culture period. The catwalk is buoyed up with the help of closed and airtight HDP barrels (100 litre capacity). The entire cage complex is anchored in mid-water.

The cages were stocked @ of 300/m^2 for fingerling raising and 30/m^2 for grow out phase with carp fingerlings. Fry of catla, rohu, mrigal, kalbasu and silver barbs showed a survival rate of 50% with a growth of 15–20 g in 60 days. In the grow out phase, the production was estimated at 8 kg/ m^2.