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These are short and medium term storage for a range of crops, woody species, fruit trees and horticulture species using tissue culture techniques.

The crop species diversity has declined with the onset of modern agriculture techniques, which will give severe implication to food security of the planet given environmental degradation, pests, epidemics and climate change.

Seed gene banks are the easiest way to store germplasm of wild and cultivated plants at low temperature in cold rooms.

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- A Russian scientist N. I. Vavilov pioneered plant genetic collections (1887-1943). He and his students collected more than 2,50,000 plant accessions around the world.

- The N. I. Vavilov Institute of plant Industry in St. Petersburg, Russia houses one of the most important gene banks in the world.

- FAO & World Information and Early Warning Systems on plant genetic resources (WIEWS) lists 1,308 gene banks world wide, which conserve about 6.1 million accessions.

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- Kew botanical gardens in London has stored plant material since the 1850's and has developed a project to establish the millennium seed banks.

- The International Plant Genetic Resources Institute (IPGRI) Rome, Italy is the world's largest organization and conserve the agricultural biodiversity.

- For storing the seeds in gene banks, the seeds are cleaned and dehydrated prior to storage. Then cooled to $20^{o}C$ (cooling lowers the metabolic rate and allows the seeds to be stored for a longer period of time)

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In-Vitro gene banks:

- Tissue culture systems allow the propagation of plants with high multiplication rates in an aseptic environment.
- The cells are grown on a gel and fed with suitable nutrients and hormones to give rise to entire plants.
- 38,000 accessions are conserved worldwide using the in vitro culture techniques (FAO, 1996)

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What is Genome Project?

- It is a non profit organization to create a database of health, genealogy and genome data.
- First started in 2001, by the government of the Republic of Estonia, "The Estonian Genome Project Foundation"
- First tissue samples were taken from gene donors in October 2002
- The database will make it to carry out research in links between genes, environmental factors and common diseases and to apply the information gained from research in making new discoveries in genomics and epidemiology which lead to increasing the efficiency of health care.

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How is the Gene Bank created?

- Phenotype & genotype data of voluntary gene donors are collected into the Gene Bank.
- A person contact GP introduce to GP
- Sign in gene donor consent form.

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Genome Technology in Prawn

- The Institute of Marine Studies of the Chinese Academy of Sciences (CAS) cooperated with the genome information centre of CAS to test Expression sequence tags (ESTS)
- Scientist found 10,000 ESTs and sorted out more than 3,000 new prawn sequences
- These new genomes may be directly related to the growth rate of prawns, their resistance to diseases and sex control (Xiang Jianhai)

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Genome Studies on marine organisms

- Zebra fish: 2 species of *Brachydanio frankei* and *B. rerio,* diploid and triplod hybrids between *B.frankei* and *B.rerio* have been induced and studied, and establishing a homozygous transgenic (GFP) Zebra fish pure line has been developed well.

- Salmon and Clown fish: Transgenic fish produced, sperm from salmon and egg from clown fish collected and produced transgenic fish by nuclear transplantation.

- Fish molecular population genetics: Establishment of molecular genetic markers and micro evolution in different strains of carp, with techniques of mitochondrial DNA. RFLP (Restriction Fragment Length Polymorphism) isozyme and nuclear DNA RAPD (Random Amplified Polymorphic DNA), the genetic population of 5 strains of carp were studied.

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- The cellular and molecular mechanisms of gynogenetic fish: The diploid and triploid hybrids between carp and crucian carp were induced.

- By other methods: Cell culture, chromosome banding, DNA sequencing, gel electrophoresis, PCR, RAPD, genomic mapping DNA fingerprinting, gene cloning, SEM & TEM.

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Development of fish germplasm bank in India:

- 1,007 specimens of 17 fish species were collected from aquatic habitats of the North east region and added to the NE regional live gene bank.
- 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 NE region considered exclusively as ornamental fishes 70 species were identified and documented with images.

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Gene Banking:

- 26 fish species including 2 endangered, 18 riverine stocks and 6 hatchery stocks were maintained at the NBFGR live fish gene bank at Lucknow.

- Breeding trials were conducted for *Channa marulius, Labeo dyocheilus, L.rohita* and *Notopterus notopterus*.

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The NBFGR has emerged as a Centre of Excellence for research on fish genetic resource management and has made significant contributions in its mandated research areas, as follows:

Developed database on fish diversity of India containing information about 2953 finfish species.

Developed database on Freshwater Fishes of Northeast and Western Ghats, and fish diversity checklists for eight states and three ecosystems (Western Ghats, Gulf of Mannar and Vembanad Lake).

Developed four online databases-Fish Barcode Information System, Fish Karyome, Fish and Shellfish Microsatellite Database, and Fish Mitogenome Resource.

Extensively explored different rivers basins and two important hotspots viz. Western Ghats and Northeastern States for documentation of fish diversity.

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Discovered forty three new fish species during explorations of ecologically diverse habitats in India during last 10 years, in collaboration with other partner organizations.

Developed genomic resources including expressed sequence tags and gene associated markers in Indian catfish, Clarias magur and Tenualosa ilisha.

Phylogenetic relationships of fishes belonging to important groups and genera studied through molecular markers. Initiation of whole genome sequencing of two commercially important fish species, Labeo rohita and Clarias magur in collaborative mode.

Molecular markers for 35 finfish species identified. Genomic libraries for 6 fish species constructed for microsatellite identification.

Produced quality seed of IMCs for supply to state fisheries department and farmers of Uttar Pradesh and adjacent areas.

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Population genetic structure of 26 finfish and shellfish species studied across the native distribution range in Indian waters which would help in management strategies, stock-specific conservation and river ranching programmes.

Complete mitochondrial DNA sequenced in eight fish species.

Species-specific DNA profiles of 11 Harmful Algal Blooms species (8 Dinoflagellates and 3 cyanobacteria) from Indian seas developed for their accurate and timely identification.

DNA Barcoding of over 600 Indian marine and freshwater finfish and shellfish species completed. Species-specific molecular signatures of commercially important finfish and shellfish species generated to resolve taxonomic ambiguity and for accurate documentation of species diversity

Captive breeding protocols developed for 15 ornamental fishes in collaboration with other partner organizations including College of Fisheries, Panangad. Also developed breeding protocols for six endangered fish species for conservation and sustainable utilization.

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Three legal disputes resolved based on the DNA barcoding, viz., forensic identification of pomphret (*Pampus chinensis*), endangered and wildlife protected whale shark (Rhyncodon typus) and sea cow (*Dugong dugong*).

Developed sperm cryopreservation protocols for 30 fish species, which can provide support to captive breeding technology in the propagation assisted rehabilitation of the target species in its natural habitat.

Ranching of endangered yellow catfish, Horabagrus brachysoma and Malabar labeo, Labeo dussumieri in Vembanad Lake and adjacent rivers in collaboration with RARS, Kumarakom, Kerala resulted in increased landings.

Developed in vivo and in vitro assay system for evaluation and assessment of genotoxicity of aquatic pollutants in fishes.

Fluorescence in situ hybridization technique utilized for assessment of genetic diversity in 20 fish species.

Completed cytogenetic profiling of 70 endangered and endemic freshwater fish species.

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Assessment of impacts of exotic fish species viz. *Oreochromis niloticus*, *Clarias gariepinus*, *Pangasianodon sutchi* and *Piaractus brachypomus* on indigenous fish biodiversity carried out.

Developed pluripotent embryonic stem cell lines derived from Indian catfish, *Heteropneustes fossilis* and *Labeo rohita* embryos.

Developed rapid DNA based diagnostic assays utilizing PCR for *Gyrodactylus salaris*, *G. elegans*, *Dactylogyrus intermedius*, *Myxobolus cerebralis* and *M. clarii*.

Promoted a new concept of 'State Fish', which led to declaration of 14 fish species as State Fish by 17 States.

Coordinating the implementation of DAHDF and NFDB supported National Surveillance Programme for Aquatic Animal Diseases in the country, carried out in 14 selected states of aquaculture importance, with involvement of 22 partner organizations.

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Developed diagnostic capability for OIE-listed pathogens of finfishes as well as shellfishes.

Developed monoclonal antibodies against serum immunoglobulins of *Channa striatus*, *Clarias magur* and *Catla catla*, which have application in sero-surveillance and evaluating efficacy of vaccines.

Developed cell lines from 16 commercially important food and ornamental fish species, which will have application in disease diagnosis. Also developed macrophage cell lines from catla and rohu which can be used as in vitro models for evaluation of immunomodulators.

Established National Repository of Fish Cell Lines possessing 50 fish cell lines with financial support of Government of India.

Contributed to the preparation of several policy documents for conservation and sustainable utilization of fish genetic resources, in collaboration with other institutes/agencies, viz., Guidelines for Germplasm Exchange; National Strategic Plan on Aquatic Exotics and Quarantine; National Exotics and Quarantine Guidelines; Guidelines for Green Certification for Freshwater Ornamental Fishes and Model guidelines for Fish and Shellfish Seed Certification in India.