



## Indian Agrobiodiversity System

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Agrobiodiversity occupies a distinctive place within biodiversity. It recognises that agriculture evolved from bioprospecting, selection and development of a few species from plant and animal kingdoms, to meet human needs of food, fibre and fuel. All biotic factors related to agriculture, such as, plants, animals, fish, reptiles, insects, birds and microbes are components of agrobiodiversity. The conservation, management and sustainable use of these organisms (and their wild progenitors/relatives) require specific attention. The Indian Council of Agricultural Research (ICAR) addresses the issue of management of genetic resources through its five Bureaux, namely, National Bureau of Plant Genetic Resources (ICAR-NBPGR), National Bureau of Animal Genetic Resources (ICAR-NBAGR), National Bureau of Fish Genetic Resources (ICAR-NBFGR), National Bureau of Agriculturally Important Microbes (NBAIIM) and the National Bureau of Agricultural Insect Resources (ICAR-NBAIR) to address the management of their respective genetic resource. The respective Bureaux coordinate the management involving various stakeholders in their functional areas.

Effective conservation and use of agrobiodiversity is of immense importance in the present scenario. There is an urgent need for managing genetic resources for food and agriculture in ways that promote the evolution and conservation of agrobiodiversity, and to ensure that they are available to all stakeholders for use to adapt to changing environment by developing new climate resilient varieties/breeds to ensure the food and nutritional security. Climate change will also increase the importance of minor or under-utilized crops and plant species. Therefore, it is essential that all forms of agrobiodiversity are collected through regular explorations, conserved through suitable means, characterised and evaluated using modern technologies to ensure their availability for improvement programmes of food and agriculture. Resources and activities of each of the five bureaux is presented briefly:

National Bureau of Plant Genetic Resources (ICAR-NBPGR), New Delhi was established in 1976 as a nodal institute for assembly of global diversity of plant genetic resources (PGR) that are of direct or indirect value to humans. The component activities include PGR collection through exploration, characterisation, evaluation, safe conservation using both conventional storage and biotechnological approaches for *in vitro* conservation and cryopreservation; generation and conservation of genomic resources. So far over 2,600 explorations have assembled over 2.66 lakh crop species and their wild relatives. The national Genebank houses ~0.43 million accessions of over 1800 species in seed genebank, 11,000 accessions in cryo genebank and 1,900 accessions in *in vitro* genebank. Exchange of germplasm is carried out with >100 countries and CGIAR institutes under bi- or multilateral agreements. Besides, it is a nodal institute authorized by Government of India to facilitate international exchange of germplasm for research purposes and to undertake quarantine which has resulted in the interception of over 50 pests of high economic significance. Till date, over 2.35 lakh accessions of different agri-horticultural crops have been characterised and evaluated. A mega evaluation executed in collaboration with SAUs for 21,822 accessions of wheat and 18,775 of chickpea earned its place in Limca Book of Records. DNA fingerprinting of agri-horticultural crops, conservation and use of genomic resources and GM detection are also important activities at ICAR-NBPGR. About 2300 varieties of >35 crops have been fingerprinted to safeguard against biopiracy. It is mandatory for the notification of any new variety to be registered with ICAR-NBPGR. A PGR portal, a gateway to information on PGR conserved, is hosted on ICAR-NBPGR website. The PGR information has been documented in user friendly databases. HRD including PGR Education, awarding M.Sc. and Ph.D. degrees in PGR discipline in collaboration with ICAR-IARI, are also integral components of its functioning.

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National Bureau of Animal Genetic Resources (ICAR-NBAGR) was established in 1984 at Bangalore in order to safeguard the existence of precious livestock of the country. The institute was later shifted to Karnal in 1985. It is working for the enhancement of indigenous livestock and sustainable utilisation of animal genetic resources. It is divided into three divisions: Animal Genetics, Animal Biotechnology and Animal Genetic Resources, and also work with various agencies involved in livestock improvement through a Network Programme on Animal Genetic Resources. ICAR-NBAGR has a mandate for identification, evaluation, characterisation, conservation and utilisation of livestock and poultry genetic resources and conducts systematic surveys to characterise, evaluate and catalogue farm livestock and poultry genetic resources and to establish their National database; designs methodologies for *ex situ* conservation and *in situ* management and optimal utilisation of farm animal genetic resources and undertakes studies on genetic characterisation using modern molecular biological techniques. About 1,1,30,000 cryo-preserved semen doses representing important and endangered breeds of seven species (Cattle, Buffalo, Goat, Sheep, Camel, Equine and Yak) are being maintained in the National Gene Bank. Animal Genomic Resource Bank is established which has collection of DNA samples of more than 90% of the Indian breeds of various livestock species besides some embryos.

National Bureau of Fish Genetic Resources (ICAR-NBFGR), was established in 1983 at Lucknow with the mandate of collection, classification and cataloguing of fish genetic resources of the country, maintenance and preservation of fish genetic material for conservation of endangered fish species and evaluation and valuation of indigenous and exotic fish species. The Bureau has created excellent infrastructure and expertise in several research areas including development of fish databases, genetic characterisation, gene banks, fish germplasm and habitat inventory, risks analysis of exotic species, diagnostics for OIE notified pathogens, aquatic microbes and other areas of germplasm conservation with special focus on threatened, prioritized and exotic fish species. A database on Fish Diversity of India, containing information on about 2936 indigenous fish species (936 freshwater, 113 brackish water and 1887 marine species) and 462 exotic species, has been developed. The Bureau has prepared fish diversity checklists for eight states, viz. Uttar Pradesh, Chhattisgarh, Madhya Pradesh, Rajasthan,

Kerala, Karnataka, Tamil Nadu and Maharashtra and three ecosystems such as Western Ghats, Gulf of Mannar and Vembanad lake. The Bureau has discovered forty new species during explorations from North-eastern States and Western Ghats in collaboration with other partner organizations. The cytogenetic profiling of over 70 fish species mainly from freshwater and marine systems, collected from various part of the country including biodiversity hot-spots, like North-Eastern part and Western Ghats, Kerala, has been accomplished. Using the molecular markers, especially microsatellite DNA, concerted efforts have provided description of genetic variation and population structure for 24 prioritized fish species from their major range of natural distributions. At ICAR-NBFGR, a National Repository of Fish Cell lines (NRFC) has been established where at present 50 cell lines are being maintained. ICAR-NBFGR is also coordinating the National Surveillance Programme for Aquatic Animal Diseases (NSPAAD) which is being implemented in 15 States and 2 Union Territories through 24 collaborating partners.

National Bureau of Agriculturally Important Microorganisms (ICAR-NBAIM), was established in the year 2001 at Maunath Bhanjan for cataloguing and preservation of agriculturally important microflora, which is a necessity of the present time for judicious microbial resource management, bio-prospecting and fundamental scientific research. The Bureau started functioning at ICAR-NBPGR, New Delhi and was later shifted to Maunath Bhanjan, Uttar Pradesh in 2004. ICAR-NBAIM was designated as a Recognized Repository under the National Biodiversity Act (2002) for storing microbial wealth in India. It is a premier organisation of agricultural and microbial biotechnology prioritizing its responsibilities in the area of collection, isolation, conservation, management and utilisation of agriculturally important microorganisms (AIMs) in the country. The Bureau is engaged in the multifarious activities in the area of microbial diversity, biological control, microbial genomics, preservation and maintenance of microbial cultures. Diversity analysis of northern Indo-Gangetic plains undertaken indicated that the soils do have a population of *Bacillus* isolates and fluorescent *Pseudomonas* in high numbers but the isolates/strains have lost the ability to express plant growth promoting attributes. Diversity analysis of various extreme environments has led to the development of huge database of microorganisms from extreme habitats. The Diversity

of *Bacillus* and predominant genera has been mapped and novel *cry* genes with insecticidal properties have been deciphered. The Bureau has also made significant progress in nutrient management and biocontrol and has developed bioformulations to be used as biofertilizers, biocontrol agents, abiotic stress alleviators, agricultural residue decomposers etc. DNA based diagnostic kits were developed for the identification and ecological monitoring of *Bacillus*, *Pseudomonas*, *Alternaria*, *Colletotrichum*, *Fusarium udum* and *Macrophomina phaseolina*. The Bureau established the Microbial Genomic Resource Repository (MGRR) where over 10,000 accessions of genomic DNA, clones, plasmids, vectors and gene constructs from various sources are being maintained. The Bureau is also engaged in supply of pure cultures to various research organizations and provides microbial identification services.

National Bureau of Agricultural Insect Resources (ICAR-NBAIR), Bengaluru is involved in the study of invertebrates particularly insects, spiders, mites and their associated organisms (including microbes). A radical shift in perspective in 2009 saw the institution transform itself from one devoted solely to the use of insects as biological control agents for the management of insect pests in agricultural situations to one which acknowledged the multifarious roles of insects in agroecosystems in particular and all of nature in general. While research in biocontrol would continue to be conducted at ICAR-NBAIR, it would henceforth have the responsibility of not only documenting and studying the entire agricultural insect diversity of the country but also that of the fauna of associated organisms, viz., insect pathogenic bacteria, fungi, viruses and nematodes as well as endosymbionts of insect pests and their natural enemies. ICAR-NBAIR has been undertaking surveys to document agricultural insect diversity from all agroecological regions of the country with special emphasis on the collection and documentation of insects in the biodiversity hotspots of the country. Many new taxa have been discovered and described from various parts of the country. Over 200 types in the collection of the ICAR-NBAIR have been digitized and are hosted on the ICAR-NBAIR website which is available for free access to taxonomists all over the world. ICAR-NBAIR leads other organizations in the country in the generation of barcodes of Indian insects. Over 600 barcodes have been generated for insect pests, their natural enemies, mites and nematodes of agricultural importance. Identification services for

insects of agricultural importance, including both insect pests and their natural enemies are being provided free. The insect collection in the ICAR-NBAIR museum is home to over 100,000 dry land wet specimens. In recognition of the expertise in insect taxonomy available at ICAR-NBAIR, the National Biodiversity Authority of the Government of India has designated this bureau as a National Repository for agriculturally important insects, spiders and mites.

The main threats to biodiversity as perceived and submitted to the Convention on Biological Diversity (CBD) to which India is a signatory include habitat fragmentation, degradation and loss, over-exploitation of resources, shrinking genetic diversity, invasive alien species; declining forest resource base, climate change and desertification, impact of development projects, and impact of pollution. In the backdrop of the varying socio-cultural milieu and often conflicting demands of various stakeholders, there is an urgent need for augmenting and accelerating the efforts for conservation and sustainable use of biodiversity, and for the fair and equitable sharing of benefits arising from the utilisation of genetic resources.

India has ratified all the three treaties-CBD, International Treaty for Plant Genetic Resources for Food and Agriculture (ITPGRFA) and Nagoya Protocol (NP) and also enacted its own Biological Diversity Act (BDA) in 2002 that governs the access and benefit sharing (ABS) mechanisms of genetic resources held within its political boundaries. Following the ratification of CBD, India notified the Biological Diversity Rules in 2004 to give effect to the provisions of the CBD, including those related to its ABS. India was one of the first few countries to enact such a legislation. The Act is to be implemented through a three-tiered institutional structure: National Biodiversity Authority (NBA), State Biodiversity Boards (SBBs), Biodiversity Management Committees (BMCs) at the local level, in line with the provisions for decentralized governance contained in the Constitution. The Biological Diversity Act is a path-breaking and progressive legislation which has the potential to positively impact biodiversity conservation in the country.

At a policy level, the National Policy and Macro level Action Strategy (1999) was developed that called for consolidating existing biodiversity conservation programmes and initiating new steps in conformity with the spirit of the Convention. This was followed

by implementation of a UNDP/GEF-sponsored NBSAP Project (2000-2004) that yielded micro-level action plans adequately integrating cross-cutting issues and livelihood security concerns. Besides, subsequent to the approval of the National Environment Policy (NEP) in 2006, preparation of the National Biodiversity Action Plan was taken up by revising the 1999 document in consonance with the NEP, using the NBSAP project report as one of the inputs. The National Biodiversity Action Plan (2008) defines targets, activities and associated agencies for achieving the goals, drawing upon the main principle in the NEP that human beings are at the centre of concerns of sustainable development and they are entitled to a healthy and productive life in harmony with nature.

The ICAR envisaged the Agrobiodiversity Platform to address management of genetic resources of plants, animals, fish, microbes and insects. The respective Bureaux coordinate these management functions involving other stakeholders in their functional areas from National Agricultural Research System (NARS) consisting of ICAR Institutes, All India Coordinated Research Project (AICRP) centres and State Agricultural Universities (SAUs). The objective is to suitably characterise, evaluate and conserve the genetic resources to ensure the availability of desirable trait specific

germplasm of food and agriculture for improvement programmes. In order to ensure achievement of this objective, the CRP on Agrobiodiversity of ICAR has eight sub-projects addressing management of genetic resources of plants, animals, fish, microbes, insects, veterinary type culture collections and documentation of fungal biodiversity through fungal barcoding and on island ecosystems. The project will provide long-term strategies for management and sustainable use of agro- biodiversity. Through this project there would be enhanced conservation, management and sustainable use of these genetic resources (and their wild progenitors/relatives) in the improvement programmes of different components of agrobiodiversity, namely, plants, animals, fish, microbes, insects and documentation of fungal biodiversity through fungal barcoding. During past three years, a total of 40 thousand germplasm accessions of agri-horticultural crops were multiplied, characterised and evaluated. The project would establish and strengthen the different Institutions governing genetic resources in ways that would promote the evolution and conservation of agrobiodiversity, and to ensure that they are available to be used by all regions to adapt better changing environment, as climate change is also expected to change interdependence patterns and levels.