Sustainable Management and Biodiversity Conservation

Atul Batra* and R.S.Katiyar
CSIR-National Botanical Research Institute,
Rana Pratap Marg, Lucknow-226001
*Email : batul3@rediffmail.com

Introduction

The variety of life on Earth and its biological diversity is commonly referred to as biodiversity. The number of species of plants, animals and microorganisms, the enormous diversity of genes in these species; the different ecosystems on the planet such as deserts, rainforests and coral reefs are all part of a biologically diverse Earth. Biological diversity means the variability among all living organisms from all sources including inter alias, terrestrial, marine and other aquatic ecosystems and biological diversity within a species and of ecosystems. *Biodiversity is the degree of variety in nature and not nature itself.* Indian cosmology estimates 84 lakh species of living organisms in the entire universe.

Biodiversity of India

Out of the 1.4 million known species of living organisms only about 2,50,000 are higher plants and 1.03 million are animal (WWF, 1989). According to another estimate, worldwide there are 2,70,000 known species of vascular plants.

Estimated number of known species worldwide

S. No.	Taxonomic Group	Number of Species
1.	Blue Green Algae	1700
2.	Bacteria	3600
3.	Fungi	46983
4.	Bryophytes	1700
5.	Gymnosperms	750
6.	Angiosperms	2,50,000

India is a mega diverse nation, housing around 10% of world's species. India also has a rich cultural heritage going back thousands of years. Much of Indian biodiversity is intricately related to the socio-cultural practices of the land. Unfortunately, due to population explosion, climate change and lax implementation of environmental policies, several species are facing the threat of extinction. Not only does this affect the food chain, but also the livelihood and the culture of millions of Indians who depend on local biodiversity. Nature has endowed India with a rich biological diversity, which includes over 40,000 species of plants and 75,000 species of animals. India has about 12% of the global plant wealth amongst which there are nearly 3,000 tree species.

Estimated number of plant species in India

S. No.	Taxon Group	Number of Species	Percentage
1.	Bacteria	850	1.87
2.	Fungi	23000	50.79
3.	Algae	2500	5.52
4.	Bryophytes	2843	6.2
5.	Pteridophytes	1022	2.25
6.	Gymnosperms	0.64	0.14
7.	Angiosperms	15000	33.1

(Source: BSI, 1994)

Salient Features of Indian Flora

Amongst the various families of flowering plants in Indian the dominant are –

Orchidaceas, Leguminanceae, Gramineae, Rubiaceae, Euphorbiaceae, Acanthaceae, Compositae, Cyperaceae, Labiatae and Urticaceae. Amongst the families, Labiatae and Compositae are

more abundant in the temperate regions while the rest are largely tropical in distribution. One interesting feature of the Indian flora is that Composite, which is the richest family of flowering plants in the world, has a relatively low position in Indian flora. There are hundreds of species of grasses, over 100 species of Bamboos and more than 25 species of conifers in India.

Endemic Flora in India

S.no.	Dicots	Total number
1.	Species	11124
2.	Genera1	1813

Due to Green revolution in India, India become self sufficient in food production but now a days the productivity of most of the food crops- paddy ,wheat, sorghum, pearlmillet, soyabean, sugarcane etc. is stagnant or declined in spite of heavy input cost. Today, more food is produced per person than ever before in earth's history. This success however has come with the costs of the sustainability of agriculture and biodiversity.

Loss of Crop and Genetic Diversity

Crop diversity has declined on most of farms over the last century due to mechanization because mechanization requires farms to have uniform crop types, structure and management practices. For example, traditional farm includes grains, pulses, vegetables, spices, medicinal plants, livestock and trees. In contrast, most modern farms are monocultures – one crop species planted over a large area. The genetic diversity of crops has declined with industrial agriculture. Although hundred of edible plant species have been important in traditional crop systems, today only three crops- Rice (Paddy), Wheat and Maize provide 60% of our plant based diet worldwide.

Agricultural Biodiversity

Agricultural Biodiversity includes all components of biological diversity of relevance to food and agriculture. The variety and variability of plants, animals and micro-organisms at genetic, species and ecosystem level which are necessary to sustain key functions in the agro-ecosystem.

Agriculture Biodiversity includes:-

- Higher plants, wild plants harvested and managed for food, tree on farm, pasture and rangeland species
- Higher animals-domestic animals, wild animals hunted for foods, wild and farm fish
- Arthropods- mostly insets including pollinators e.g. bees, butterflies, pest (beetles, wasps) and insect involved in the soil cycle (termite)
- Micro-organisms (rhizobia, fungi, disease producing pathogens)
- Other macro-organisms e.g. earthworms

Agricultural biodiversity is essential to the world for the following functions:

- Wider ecological services provided by agro-ecosystems, such as landscape protection, soil protection and health, water cycle and quality, and air quality.
- Sustainable production of food and other agricultural products, including providing the building blocks for the evolution or deliberate breeding of useful new crop varieties.
- Biological support to production via, for example, soil biota, pollinators and predators.

Components of Agricultural Biodiversity

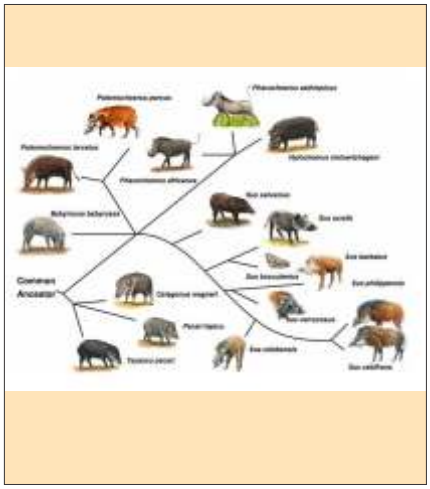
Wild Plant Biodiversity:

Foods from wild species from an integral part of the daily diets of many poor rural households. They are important source of vitamins, minerals and other nutrients and also represent ready sources of income for cash-poor households.

Crop Diversity:

Of the 2,70,000 species of higher plants, about 7000 species are used in agriculture but only three (Wheat, Rice and Maize) provide half of the world's plant-derived calorie intake. Genetic diversity is vital for the evolution of agricultural species and their adaptation to particular environments through a mixture of natural and human selection. In crop agriculture, for some species, this selection has led to the development of many thousands of landraces or farmer's varieties.

Aquatic Diversity:



Live stock Diversity:

Arthropod Biodiversity:

Aquatic Diversity:

Fish and other aquatic species are integral parts of several important farming systems.

Live stock Diversity:

Of about 50000 known mammal and bird species, only about 40 have been domesticated. These species provide people not only with food but also clothing, fertilizer and fuel (from manure) and draught power. From these species farmers and breeders have developed about 5000 identified breeds to fit local environment conditions and to meet specific needs.

Below-Ground Biodiversity:

In tropical systems, the contribution of roots to soil organic matter is proportionately larger than from above-ground inputs. The effect of roots on soil biophysical properties is particularly critical in impoverished farming system where crop residues are at a premium for fuel and fodder.

Arthropod Biodiversity:

It is well known that insects, spiders and other arthropods often act as natural enemies of crop pets. Insects and arthropods are also important pollinators of many crops. Bees and other pollinating insects are essential agents for the production of many crops.

Microbial Diversity:

Microbes contribute a wealth of gene pools that could be a source of material for transfer to plants to achieve traits such as stress tolerance and pest resistance and large scale production of plant metabolites.

Conservation and Enhancement of Agricultural Biodiversity

To achieve such transformations for the conservation and enhancement of Agricultural biodiversity, the following strategic principles are as follows:

- Conservation of plant and animal genetic resources-especially in situ efforts- help protect biodiversity for current livelihood security as well as future needs and ecosystem functions.
- Application of agro ecological principles helps conserve uses and enhance biodiversity on farms and can increase sustainable productivity and intensification, which avoids extensification, thereby reducing pressure on off-farm biodiversity.
- Adaptation of methods to local agro ecological and socio-economic conditions, building upon existing successful methods and local knowledge, is essential to link biodiversity and agriculture and to meet livelihood needs
- Conservation of plant and animal genetic resources-especially in situ efforts- help protect biodiversity for current livelihood security as well as future needs and ecosystem functions
- Reforming genetic research and breeding

programs for agricultural biodiversity enhancement is essential and can also have production benefit.

- Creating a supportive policy environment-including eliminating incentives for uniform varieties and for pesticides and implementing policies for secure tenure and local rights to plant genetic resources-is vital for agricultural biodiversity enhancement and for food security.
- Participation and empowerment of farmers and indigenous peoples and protection of their rights are important means of conserving agricultural biodiversity in research and development.
- Practices for soil fertility/health and nutrient recycling also make use of agricultural biodiversity. Example,
    1. Intercropping and cover crops, particularly legumes, which add nutrients, fix nitrogen and pump nutrients to the soil surface.
    2. Use of mulch and green manures (through collection and spread of crop residues, litter from surrounding areas and organic materials).
    3. Elimination or reduction of agro-chemicals-especially toxic nematicides-that destroy diverse soil biota, organic material and valuable soil organism.
    4. Compost from crop residues, tree litter and other plant /organic residues.
    5. Integration of earthworms (vermiculture) or other beneficial organisms and biota into the soil to enhance fertility, organic matter and nutrient recycling.

Conclusion

It is vital that the common man is made aware of the domino effect of species loss and what we stand to lose. *Project Brahma* aims to create such awareness, by increasing participation of the people in biodiversity documentation and conservation. In addition, there are several organizations carrying out notable conservation work in India. The aim is to create a central resource where such organizations can access all kinds of knowledge about Indian biodiversity.