Ex Situ Conservation and Sustainable Utilization of Plant Genetic Resources of India : The Role of Botanic Gardens in the New Millennium

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The ever-increasing lust for civilization and ruthless exploitation of natural resources have destabilized the ecological balance. Demographic pressure, urbanization, industrialization, environmental pollution and deforestation have resulted in the loss of considerable biodiversity. The net loss of forests due to human interference since they first began felling trees accounts to 15-20% of the world's forest cover. More factually, we are losing tropical forest at a rate of 50 hectare/ minute and as a result one plant species is becoming extinct every day on an average (Anonymous, 1984; Myers, 1988). IUCN Red List of Threatened Plants suggests that 34,000 (10-12% of the world's flora) are facing extinction. In the United Nations Conference on Environment and Development (UNCED)-the 'Earth Summit' in Rio de Janeiro, Brazil in 1992 an international law was formulated which emphasizes the need for the preservation of global diversity (Jackson, 1997). A total of 153 countries have already signed and ratified this new law and have agreed to work for promoting its implementation.

Plant Genetic Resource: The genetic resources may be defined as the genetic material of plants, animals and other organisms which determines their characteristics and hence their ability to adopt and survive (Anonymous, 1999). The Plant Genetic Resources (PGR) are often classified into – cultivated varieties (cultivars), including elite and developing breeder lines folk varieties (land races) wild and weedy species genetic stocks (eg. aneuploid and polyploid lines; morphological/biochemical mutants. Conservation of PGR, their sustainable utilization and benefit sharing is a topic of debate. PGR have received world-wide attention by the plant conservationist as the restriction has been laid down for the free flow of PGR by the enforcement of Trade Relate Aspects of Intellectual Property Rights (TRIPS), charter of World Trade Organisation's (WTO's) Agreement, Convention on Biological Diversity (CBD) and FAO's International Undertaking on Plant Genetic Resource (IUPGR). These recent enactments necessitated in depth study and formulation of effective legislation so that the rights of the PGRs rest with respective countries besides their conversation and sustainable utilization.

India has been designated as one of the 12 mega gene centres in the world. Flora of Indian sub-continent is very rich in diversity and endemism largely due to the varied agro-climate conditions. For understanding vegetation diversity, India has been divided into 10 biogeographic zones and each zone has its own unique characteristic natural vegetation (Rodgers and Panwar, 1988). Within these zones, there are two 'hotspots' of biodiversity – Western Ghat and Eastern Himalayas. These areas are not only rich in biodiversity but also in endemic species. It is estimated that over 45,000 species of plants are available in India representing 11% of the known plant species of the world and are distributed into groups namely, Angiosperms (15,000), Gymnosperms (64), Pteridophytes (1,022), Fungi (23,000), Aglae – 2,500, and Bacteria – 850 (Rao, 1997). Further, the flowering plants of India represent 6% of the world's known flowering plants (Nayar, 1977). Aside, half of the world's a aquatic flowering plants exist in India (Lavania *et al.*, 1990). The plant species endemic to India are nearly 5,500 and about 1,500 are threatened species. But status of conservation for such vast floristic diversity is doomsday. As a result, 10 – 15% of the Indian flowering plants are under various degrees of threat. Nevertheless, 25% will become rare by the turn of the century (Jain, 1981).

Conservation methods and sustainability: The term 'conservation' may be defined as 'the management of human use of the biosphere so that it may yield greatest sustainable benefits to present generation while maintaining its potential to meet the needs and aspirations of the future generations. Thus, conservation is positive, embracing preservation, maintenance, sustainable utilization, restoration and enhancement of the natural environment. Before advocating any conservation measures for a threatened plant species, it is recommended that the critical assessment of the causes of threat is

made. Flood, landslide, drought and technological development are the natural factors which disturb ecological balance resulting in long range effect beside loss of vegetational cover. The qualitative assessment of threat is based on the field observation, a visual decline of species, lesser frequency of occurrence and long-spaced collection (Jain, 1981). Conservation has three specific objectives: to maintain a balance between essential ecological process and life support system; to preserve genetic diversity; to ensure sustainable utilization of natural resources.

There are two main approaches of conservation as follows:

In situ or on site: This refers to conservation of the plant species in its natural habitat within the community of which it is a part so that it has potential for continued evolution. Botanic Gardens should also participate in the environment planning and conservation biology research of the respective country to conserve as much as possible the world's plants in *in situ.*

Ex situ: It refers to maintenance of organisms outside or away from their natural habitat, such as in botanic garden, field genebank or by storage in the form of seed, vegetative propagules, tissue or cell culture. The commonest form of conservation is botanic garden. The purpose of *ex situ* conservation is to provide protective custody. It should be considered as part of an overall, integrated programme. *Ex situ* and *in situ* should be seen as complementary and mutually reinforcing approaches.

Plant species having economic importance should be identified for their use in commercial horticulture, forestry and agriculture. Access to the PGRs for the purpose of benefit sharing is also an important aspect. About 4 million accessions are currently held by the botanic gardens world-wide. These should be shared for various research and development purposes.

Role of Botanic Gardens: A Botanic garden is an institution holding documented collection of living plants for the purpose of scientific research, conservation, display and education (Jackson, 1999). They serve as a repository of germplasm collection specially rare and endangered ones of indigenous and exotic origin (Sharma and Goel 1994). Botanic Garden Conservation International (BGCI), an international organization with its headquarter in London, was established in 1987 for global co-operation and monitoring the conservation programmes of the botanic gardens. BGCI has 500 member botanic gardens in 111 countries all over the world (Jackson, 2000). There are about 1,846 Botanic Gardens world-wide as per BGCI database. The Botanic Garden Conservation Strategy was worked out jointly by BGCI, IUCN, WWF in 1989 which provides the guidelines for every botanic garden in the world. In the recent past, the new International Agenda for the BGCI has been launched in 2000 at the 1st World Botanic Garden Congress in Asheville, USA. This outlines why involvement of botanic gardens is an essential element in the conservation for sustainable development. The other tasks of the botanic garden should also be taken up on priority basis. The role of the botanic gardens in the new millennium should be as follows (Crane, 2001, Jackson, 2000).

- *Ex-situ* conservation of plants specially rare and endangered ones. This emphasizes improvement in the germplasm collection management, establishment of seed bank, management and maintenance of gene pool. New links have been developed with the International Crop Genetic Resources Conservation sector, marked by the recognition of the role of botanic gardens and their collections in FAO Global Plan of Action.
- To study the habitat requirement, distributional range, biology and reproductive potential of the plant species so as to provide the required micro-climate, essential for the plant growth.
- Introduction of newer species through exchange programme from other botanic gardens, arboreta located in the iso-climate zones of the world for enrichment of germplasm collection and their subsequent utilization for the benefit of the people.
- To increase the basic knowledge of plant diversity.
- To build public understanding through educational programme.
- To play an active role in the conservation and sustainable utilization of plant resources.
- Public awareness with educational programme highlighting the importance of plant conservation and sustainable utilization, control of environmental pollution is one of the important role of the botanic garden in the 21st century. They should encourage visits of the students from school and universities.
- Sharing of the surplus propagules with the other botanic gardens, arboreta and research institutions to increase the survival chances and to avoid the

catastrophic loss of genetic material at one centre resulting in total extinction of the species.

- Networking of the botanic gardens specially within the country in order to have the first hand information on the existing genetic resources, status of the rare and endangered plant species so that the species which needs conservation measures are identified and ultimately identifying plant material for exchange. A national inventory of threatened, endangered or rare plants should be prepared.
- A significant number of plant species are grown in public parks along national highways, school and college campus and private gardens. Botanic gardens should also list such collection or individual specimen besides providing facilities for propagation of such species.
- Multiplied species are to be reintroduced in the wild as a measure to replenish the dwindling population.
- The new international agenda advocates much broader role to be played by the botanic gardens in other discipline, involving much greater integration of tools, methodologies and tasks.

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Genetic-Diversity of Medicinal and Aromatic Plants of Himalayan Region (Himachal Pradesh) and its Conservation

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India in general and Himalayas in particular are the reservoir of genetic wealth, ranging from tropical, sub-tropical, sub-temperate to temperate including dry temperate and cold deserts, culminating into alpine-both dry and moist, covering a great variety of flora and fauna. But these genetic resources are threatened by the exploding human and cattle population, unsustainable resource extraction and unfriendly waste dumping. Many species have already disappeared or are in the process of extinction and are designated as endangered species. Such disappearance of genetic resources is related to the extinction of innumerable species with which it is intrinsically linked through food webs and food chains. This has also lead to serious ecological consequences with an eventual bearing on productivity, which is affecting the basic life support system and livelihoods