

USE OF TRADITIONAL KNOWLEDGE AND BIOTECHNOLOGICAL INTERVENTIONS FOR SUSTAINABLE DEVELOPMENT

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Parallel to its rich agroclimatic diversity, India is equally rich in biodiversity. These biological resources have provided useful gene pool to humankind since time immemorial. However, a number of such biological resources have been lost due to over-exploitation on the one hand, and immense selection and domestication of fewer species on the other. Thus in the context of the present demand and future needs, the major global concern is for the conservation and sustainable utilization of our genetic resources for sustainable growth. The Convention of Biological Diversity was formulated during the UNCED Earth Summit held at Rio de Janeiro in Brazil in June 1992 to achieve these goals. While the technologically rich developed countries lack genetic resources, most of the developing countries including India, have not been able to get full benefit from its biological riches due to lack of sound technologies. It is, therefore, important to strengthen our technologies and rise to the much desired status of technologically and genetic resources rich nation. It becomes mandatory to bioprospect, document and conserve the valuable gene pool. It may also involve adequately compensating the indigenous communities that have conserved the biological resources through centuries, and have also generated valuable knowledge regarding their use. There is a need for using traditional knowledge and biotechnological interventions for sustainable utilization of plant genetic resources. This paper highlights an urgent need for systematic programme of bioprospecting of India's rich biodiversity using molecular and biochemical approaches. Such a systematic study would enable identification of new genes and molecules that may be useful in agriculture, medicine and other cognate disciplines.

Key words · Biodiversity, indigenous knowledge, biotechnology, bioprospecting, benefit sharing

India commands a unique phytogeographical and agroecological diversity. With only 2.4 per cent of the total land area of the world, it contributes a significant 8 per cent to the known global biodiversity. It is one of the twelve mega biodiversity centres in the world. India holds tenth position in the world in terms of mammalian species and eleventh in terms of the endemic species of higher vertebrates. It ranks tenth in the world and fourth in Asia with respect to

plant diversity and stands seventh in the world for the number of species contributing to agriculture and animal husbandary.

Out of the 18 hotspots in the world, two are located in India; the eastern Himalayas and the western ghats, both of which have rich genetic diversity. Approximately 1.7 million species have been described so far, out of this 1,26,188 have been recorded in India. Based on about 70 per cent of the total geographical area surveyed so

far, 49,000 plant species and 81,000 animal species have been recorded by the Botanical Survey of India and Zoological Survey of India, respectively (MoEF, 1997).

The existing biodiversity has been a result of billions of years of co-evolution of plants, animals and human beings. During this evolutionary process, the effect of human interference were minimal. However, during subsequent generations, mankind have continuously selected and domesticated fewer species for their specific requirements. While the earth had about 2,50,000 plant species, man has utilized only about 3000 plant species and the present day agriculture is confined to only about 150 species (Rana, 1995). Out of this, 20 crop species provide 90 per cent of the calories to the entire mankind, and rice, wheat and maize supply almost 60 per cent of the calories and protein derived from plants (Zimmerman, 1996).

Some newer varieties have evolved as a continuous process of evolution and selection, however, a wide range of biological resources have been lost which could serve as an invaluable genepool for future generations. Immense selection and domestication of fewer species on one hand, phenomenal population growth and unsustainable harvest on the other, coupled with unmindful exploitation of natural resources due to unplanned developmental activities, have altogether resulted in habitat degradation and loss of precious biological resources.

The Convention on Biological Diversity

In order to reverse the trend of continued loss of biodiversity and to ensure sustainable utilization for growth and development, the major global concerns have been reflected in the form of the Convention on Biological Diversity (CBD), that was formulated during the United Nations Conference on Environment and Development held at Rio de Janeiro in June 1992. The

Convention entered into force on 29 December 1993 and at present 169 countries including India are Parties to the Convention. India ratified the Convention on 18 February 1994, and thus the CBD has come into force for India on 19 May 1994 (MoEF, 1997).

The three principle objectives of the Convention are; the conservation of biological diversity, the sustainable use of the components of biodiversity, and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. Therefore, the CBD emphasizes the need of sharing in a fair and equitable way, the results of research and development, and the benefits arising from the commercial and other utilization of the genetic resources, with the contracting parties providing the genetic resources.

Access to germplasm, technology transfer and Benefit sharing

The Article 15 of the CBD, while dealing with the issue of Access to genetic resources emphasizes the need of sharing in a fair and equitable way, the results of research and development and the benefits arising from the commercial and other utilization of genetic resources with the contracting party providing such resources. The Article 16 of the CBD dealing with access to and transfer of technology, requires that the countries which provide genetic resources are provided access to and transfer of technology, which makes use of those resources, on mutually agreed terms, including technology protected by patents and other IPRs. The countries rich in genetic resources are expected to create conditions to facilitate access to genetic resources for environmentally sound uses by other contracting parties subject to prior informed consent (PIC) of the contracting party providing such resources. But in its present form, CBD does not provide a blue print of the mechanism to be followed by the contracting parties/collaborating groups for

access to genetic resources (Maurice, 1996).

So far, there has been a regular flow of germplasm from the gene-rich technologically poor countries to the gene poor, technologically rich countries. However, an appropriate and proportionate flow of technologies to the genetic resource rich countries has, unfortunately, not been witnessed (Khoshoo 1995). A lot of precious germplasm was transferred from the developing (biological resource rich) countries to the developed (biological resource poor) countries due to free-flow of germplasm between nations prior to the signing of CBD. Many of the developed countries are thus holding vast biological resources in *ex situ* collections. The germplasm that has been transferred before the convention is now under the trusteeship of FAO and cannot be patented as such. The FAO global network of *ex situ* collections prohibit the centres and all subsequent recipients of the material from taking out intellectual property protection on the designated material itself, however, it does not preclude a recipient from filing IPR on breeding/biotechnological products derived from such material (Hawtin, 1996). Thus in the event of a product arising out of its use, it is not clear whether the benefits would go to the country(ies) who provided this germplasm, and may not have it anymore in *in situ*, or to the *ex situ* collections situated outside the country of origin.

The CBD, in its present form, does not provide a model agreement to guarantee fair and equitable compensation to the countries providing the germplasm. Since it also does not provide or propose a IPR like patent on genetic resources, it is not clear what kind of or what percentage of benefit has to be shared between the country/countries of origin/countries supplying germplasm from *ex situ* collections not originating in that country, but acquired from other countries prior to the proposed CBD and now used for commercial gains. Thus there is a need to evolve

a model agreement for guaranteeing fair and equitable compensation to the countries providing the germplasm.

Traditional knowledge, Bioprospecting and Benefit sharing

India's vast and varied climatic conditions are matched with equally diverse and rich plant based preparations. However, much of the knowledge of the beneficial properties of the biological resources is held by traditional communities and this variability has not been systematically documented. Along with the loss of the valuable biological diversity, there has been a continued erosion of valuable knowledge about their usage. This has mainly been due to the lack of scientifically proved and authenticated records about the use of herbal preparations, and a shift in the mindsets of the people towards newer forms of medicines.

Most of the invaluable diversity found in our country has remained unutilized due to a lack of systematic approach to bioprospecting. Now in order to harness the benefits, biotechnological interventions are urgently required to bioprospect, evaluate and characterize the unique wealth of our country. The characterization can be achieved through morphological, cytological, biochemical or molecular markers. This provides useful information about the diversity and usefulness of the germplasm, such as tolerance to biotic and abiotic stresses, special nutritive quality, therapeutic potential etc.

Molecular markers such as species-specific probes, RAPD, AFLP would be helpful in fingerprinting of diverse germplasm with far reaching benefits for utilization as well as protection of our country's genetic resources in view of the CBD and IPR regulations. DNA based markers can also be utilized to assess diversity at all taxonomic levels for molecular breeding. Genetic fingerprinting and gene cloning can help

to identify useful genes such as those responsible for biotic/abiotic stress tolerance. The genetic engineering could be utilized to transfer the genes of interest to the desired species across the compatibility barrier.

Phytochemical characterization of plants with secondary metabolites having insecticidal, pesticidal, special nutritive quality or therapeutic potential will be valuable in characterizing the biochemical diversity. The selected plants having higher active ingredients can be selectively micropropagated to raise need based plantations for reducing pressure on natural populations. The rare and endangered plant species can be clonally propagated through tissue culture techniques to be reintroduced into their natural habitat.

Apart from the need to evolve a model mechanism for access to genetic resources and transfer of technology, it is also necessary to evolve a model for access to traditional knowledge and sharing of benefits arising out of its use. Therefore, it becomes mandatory to include the details of country/countries of origin, proof of prior informed consent, and the knowledge of indigenous people in the patent applications arising out of the use of biological resources. While at global level, it is important to share the benefits between the nations that provide the germplasm/knowledge regarding their use, at national level, it is necessary to share this benefit with the indigenous communities that have evolved and conserved these genetic resources and holds the knowledge for their use.

Keeping this in view, a simple mechanism (modified and based on Khoshoo 1996, Gadgil *et al.* 1996, TERI 1998) is hereby proposed that emphasizes the need to develop a National Biodiversity Resources and Information Data Bank based on monitoring, bioprospecting, and documentation of the valuable genetic resources along with their usage based on indigenous knowledge (Fig. 1). A National Biodiversity

Conservation and Utilization Board may be set up to over look the functioning of the Data Bank and the National Biodiversity Funds being generated through its use. The national industries and multinational companies, utilizing the resource and information from the data bank would contribute to the National Biodiversity Fund in the form of fees and royalty payments. This fund in turn should be effectively utilized for capacity building, *in situ* and *ex situ* conservation, biodiversity monitoring and bioprospecting. A part of this fund should be used for rewarding the indigenous communities. Since many communities and generations have been involved in evolving this diversity and knowledge, it may be difficult to pinpoint a particular persons/persons for the reward. Thus the money could be utilized for social upliftment of such communities and for specific development programmes suited to their requirements.

The indigenous communities have practically been the custodians of the vast biological diversity, have selected and conserved the biological resources since centuries and have also evolved a valuable knowledge base regarding their various usage. Prioritization for bioprospecting of the genetic resources can be based on the available indigenous knowledge regarding their use. The resulting value addition of biological resources, alongwith sharing of the benefits with the indigenous communities, would go a long way towards sustainable development.

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