Biodiversity-A scientific approach : Agenda for the 21st Century

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The North-Eastern Hill University (NEHU), Shillong hosted the 72nd Annual Session of the National Academy of Sciences, India (NASI) and the National Symposium on `Biodiversity–A Scientific Approach : *Agenda for the* 21st *Century*' during October 25–27, 2002. Bharat Ratna Dr. A.P.J. Abdul Kalam, His Excellency the President of India inaugurated these events on October 25, 2002. Inaugurating the Symposium, Dr. Kalam mentioned that biodiversity is a gift of nature and it should not be allowed to get destroyed with man's greed. Biodiversity by its nature wants to give a lot for the benefit of human kind. He mentioned that it is essential for Central and State governments to ensure that biodiversity is not destroyed and at the same time it is used as a friendly economic entity. Dr. Kalam opined that Northeastern states should be considered as biodiversity-dense region and there has to be integrated mission to harness it. Scientific research and technological advancement has to go together. The researches in pharmaceutical industries have to gear up to provide cost effective herbal drugs to common man. He congratulated the organizers of the Symposium for their timely action.

Professor S. K. Joshi, President, NASI delivered the Presidential Address. The scientific sessions were held in two sections : Physical Sciences and Biological Sciences. The Physical Sciences section was presided over by Professor A. K. Sood, Indian Institute of Science, Bangalore and the Biological Sciences section by Dr. Vijayalakshmi Ravindranath, National Brain Research Centre, Gurgaon. A galaxy of eminent scientists and researchers from leading research institutions were invited to deliver talks at the Symposium and the scientific sessions. These events provided a unique platform for scientists from all over the country to present their research findings in frontier areas of science, and a golden opportunity for meaningful scientific interactions among 450 scientists who attended these meetings. Special efforts were made to encourage participation by younger scientists, research scholars and those from northeastern region. The NASI Swarna Jayanti Puraskars were presented to young scientists presenting the best research paper each in the Sections of Physical and Biological Sciences. Both these Sections had lectures by Invited Speakers, as also presentation of papers. These oral and poster presentations highlighted the current research findings of active scientists from different parts of the country.

*(Convenor of the Symposium and General Secretary, National Academy of Sciences, India).

About the symposium :

India possesses a rich diversity of plants, animals and microbes. This is also true for the diversity of ecosystems, species and the genetic pool within the species. Rated as one amongst the world's twelve 'mega diversity' countries, India has Eastern Himalayas and Western Ghats as the important 'hot spots' of biodiversity. The conservation, sustainable utilization and management of diversity are the key to the survival and economic well being of the Indian populace.

Eminent scientists, planners and policy makers were invited to deliberate on various facets of biodiversity. Considering the importance of biodiversity in the north-eastern region, and the scientific approach for its conservation, the Symposium was aimed at discussing diverse aspects pertaining to Plants and Crops, Animals, Microbes, Ecosystems, Remote Sensing, Germplasm Characteri-zation, IPR issues, Bioinformatics, Conservation and Sustainable Utilization, Industry, Policy Issues and Regulatory Framework.

The Symposium provided a platform for in-depth discussions, deliberations and formulation of recommendations. The recommendations will provide action plans for conservation and sustainable utilization of Indian Biodiversity for socio-economic development, and focus on our strength, expertise and ability to meet new challenges in the 21st Century. The lectures delivered by 26 eminent scientists at the Symposium are being published in the form of a book, which could prove to be of immense value and as a useful treatise on this subject. The symposium was organized under the able guidance of Dr. Manju Sharma.

Professor A. K. Sharma (University of Calcutta) delivered the keynote address at the Symposium. He mentioned that the study of biodiversity needs an understanding of its origin and of advent as well. He emphasized the different conservation measures, the limitations and the need for continuous monitoring. The basic studies on molecular documentations provide tools in understanding the trend in evolution. Other than biosphere reserves, sanctuaries and germplasm banks, and conservation of specific ecological niches in stress zones were recommended. He further stressed the necessity of enrichment of genetic diversity in medicinal and other economic species. Professor Mrinal Miri, Vice-Chancellor, NEHU delivered a lecture on 'Understanding Cultural Diversity'.

Session I. Plants and crops :

Dr. P. Pushpangadhan of NBRI, Lucknow informed that medicinal plants constitute an important component of plant resource spectrum of Meghalaya. Out of the estimated 3000 species of flowering plants in Meghalaya, over 450 species are reported to have high medicinal values. The local communities use about 1500 plant species for various primary health care needs. He emphasized the need for developing the indigenous knowledge systems of the state for sustainable use and bio prospecting. He further stressed the importance of pursuing bio prospecting for capacity building, managing and prospecting intellectual property rights related to biodiversity and bio-industrial enterprises.

Prof. B. N. Dhawan (Lucknow), highlighted biodiversity as a source of new chemical entities (NCE). He mentioned that several industries, particularly the pharmaceutical industry, are continuously pros-

pecting for NCE. Mentioning the major sources as synthetic compounds and natural products, he opined that the latter offer a more diverse spectrum of molecules and are a renewable resource. He recommended careful management of this resource so that it can meet not only the current needs but can also take care of future requirements.

Prof. Asis Datta of National Centre For Plant Genome Research, New Delhi emphasized the need for studies on nutritional genomic for increase in productivity. He enumerated the objectives of plant genomic research for revolutionizing agricultural research for improvement of nutritional quality and technology innovation chain and its commercialization. Citing the example of GM Potato where an increase of 4-6 folds in the tuber yield is possible using genomic studies, he informed that GM plants could also be used in health care. He mentioned that the WHO urges the acceptance of GM food.

Dr. S. Nagarajan of IARI, New Delhi mentioned that in Eastern India farm productivity is quite low and agriculture is mainly practiced at subsistence level. Due to scattered marginal holdings and narrow land terraces, agriculture has been a formidable and difficult task. The low yields and lack of inputs have failed in bringing economic security to the people of this region. He emphasized the need for sustainable agricultural development through a farming system approach towards enhancing biological productivity with considerations to the economic needs and aspirations of the people.

Session II. Livestock and microbes :

Dr. J. R. B. Alfred of Zoological Survey of India, Kolkata gave an elaborate account of known faunal resources of India, which presently account for about 7.28% of the global animal diversity and include about 70,000 insect species in Insecta as the largest group. Signifying the endemicity in vertebrates with 222 species of fishes, 134 species of Amphibia, 176 species of Aves and an important species of primate-Hollock Gibbon, Dr. Alfred mentioned that the number of endemic species that is the highest in Amphibia (64.11%) differs distinctly in different groups of Animal Kingdom. Interestingly, about 172 species of globally threatened animals are known to occur in India. The talk also referred to protected area networks, biosphere reserves and biodiversity policies. He laid special attention on loss of biodiversity because of undesirable use of animals and their parts namely of mammals, birds, reptiles, amphibians and butterflies. His recommendations included preparation of an exhaustive national inventory of animal resources with special emphasis on micro-organisms and ecosystem diversity, preparation of suitable database, identification of conservation spots, conservation measures, community based conservation programs, recognition of dominant resource areas, attention on butterfly farming, general awareness and different aspects of sustainable development of faunal diversity of India.

Dr. Amit Ghosh of Institute of Microbial Technology, Chandigarh indicated general importance of microbial diversity and its role in producing value added products. The paper highlighted increase in knowledge of microbial diversity with availability of higher resolution techniques. Microbes provide about 80 references of pharmaceutically active compounds and this can be potentially enhanced with more

studies. He informed that inventory of micro-flora is currently being undertaken in five zones in India as multi-institutional project. A collaborative programme between 22 universities/ institutes has been undertaken to study fungal wealth of India and attempts are on to provide information on bioactive molecules in relation to diseases. He highlighted the need for cloning the meta-genome, adequate attention on nitro-aromatic compounds and their bio-remediation. He strongly recommended exploitation of vast potential of microbial diversity with particular attention to still unexplored and uncultivated diversity.

Session III. Conservation and germplasm characterization :

Dr. G. M. Nair of Tropical Botanic Garden and Research Institute, Thiruvananthapuram spoke on mega biodiversity region of Western Ghat. He dealt with the floristic diversity of the region with beautiful pictorial presentation. Out of 4000 species reported from the region, 1500 species are endemic. Five orchids have been rediscovered in this region. He mentioned that a major initiative has been taken in the area of biotechnology of these plants at his Institute and a DBT-funded National Gene Bank for medicinal and aromatic plants has been developed in about 75 acres of land. Bioprospecting of medicinal and aromatics plants of the Western Ghats is another venture of the Institute. He also mentioned the activities on mushroom cultivation undertaken by the division of Microbiology.

Prof. Pramod Tandon of NEHU, Shillong highlighted the significance of rich biodiversity of Northeastern region through beautiful pictures and expressed concern about deforestation and serious depletion of plant wealth. He described the research work carried out by his group on *in-vitro* conservation of rare and endangered plants of the region and emphasized the need for concerted efforts for *in-situ* and *ex-situ* conservation of the rich plant diversity for sustainable utilization. He emphasized that biotechnology will become an integral part of all aspects of germplasm acquisition, characterization, inventorization, conserva-tion, exchange and genetic resource management.

Prof. S. N. Raina of University of Delhi talked about DNA-fingerprinting as useful genetic marker for analysis of genetic diversity in Himalayan endangered species. He showed similar pattern of karyomorphology of different *Podophyllum* species collected from different places. With the help of fluorescence plus Giemsa staining techniques he explained the position of ribosomal-DNA, which is exactly the same in all these plants. However, by using random amplified polymorphic DNA fingerprinting in *Podophyllum* species he demonstrated 54% polymorphism. Both RAPD and AFLP marker systems are useful to study the genetic diversity.

Dr. Malathi Lakshmikumaran of Tata Energy Research Institute, New Delhi presented her data on fingerprinting of some medicinal plants particularly Neem from different areas. Using AFLP analysis, she reported that Indian Neem has large diversity. With the help of beautiful autoradiograms she established that Neem is an out crossed species since the fingerprints of progeny and their mother are unmatched. However, tissue culture mediated plants showed same pattern as that of the mother plants. She

recommended mapping of genetic diversity of medicinal plants for conserving genetic resources.

Session IV. Policy issues and regulatory framework :

Dr. Manju Sharma Secretary, DBT in her eloquent address highlighted various international and national policies related to biodiversity. Specifically highlighting areas where national policy and regulatory framework are absent in the context of international treatise and the emerging Indian scenario vis-à-vis biotechnology. She emphasized the need for revision of some of the relevant extant laws. Starting from the Budapest agreement, India realized the necessity of framing a broad policy document covering the entire spectrum of biodiversity related issues including the emerging field of biotechnology and transgenics. She mentioned that towards this end an expert panel prepared a vision statement/ document. This document contains regulatory framework on many new emerging disciplines and includes regulatory mechanisms covering areas such as :

(i) Biosafety protocols and guidelines- including safe use of recombinant DNA and transgenics as revised in 1998;

(ii) Ethical policies and human genetics;

(iii) CBD; (iv) Patent act 1970 as revised in 1999; (v) Stem cell research; (vi) PVR etc.

Dr. Sharma elaborated on some aspects of transgenics, such as application, use and regulatory mechanisms. Keeping in view these emerging fields, expert committees have been constituted to come up with policy and regulatory frameworks, she added. Some of the relevant extant laws need to be amended keeping our international commitments and the emerging global scenario on trade etc. She highlighted the importance of (i) Environmental protection Act 1986-1989; (ii) IBSc; (iii) RCGM; (iv) GEAC; (v) MEC and State level biotech committees; (vi) Transgenic plants, GM food and other recombinant products.

Dr. Sharma further mentioned the problems related to the pharmaceutical sector especially aspects related to drug-development and recombinant products, the difficulty faced by the industry while applying for registration of patents due to the cumbersome bureaucracy, resulting in loss of time, money etc. The suggestion of a single-window portal for expediting these processes was recommended so that the industry can be more competitive at the international arena. She concluded by emphasizing the need of networking between national laboratories, universities and industries, assigning specific task to designated labs for scientific validation and awareness programs on patent issues, IPR, and the various policies and regulations that come up from time to time.

Dr. B. S. Dhillon of NBPGR, New Delhi provided an expanded exposition of the importance of plants genetic resources. Some of the points highlighted by him were:

(i) Reduction in pressure on resources,

(ii) Genes that have been exploited and search for newer ones,

(iii) 'Rights to Access' covered under different regimes such as IUPGR, CBD, Multilateral System, and Biological Diversity Bill, International treaty/ conventions like WTO, TRIPS, and UPOV etc.,

(iv) Regulatory activities that are mandatory-dealing with (a) Transgenics (b) Introduction of new crops and (c) International Treaties on Plant Genetic Resources under FAO.

He further elaborated on Multilateral System (MS) for access and benefit sharing, and highlighted some of the provisions therein. Lastly he described the Biological Diversity Bill, its conformity to CBD and the relevant structures like the National Biodiversity Authority, State Biodiversity Board, etc. in India containing provisions like: Permission for commercial utilization; Exchange of germplasm; and Quarantine arrangements.

Session V. Bioinformatics, remote sensing and cosystems :

Dr. Manju Bansal of Indian Institute of Science, Bangalore mentioned the various initiatives that are underway worldwide, including India to develop databases as well as novel tools specific for handling biodiversity data. The talk provided a brief summary of these projects and highlighted some of the common methodologies used in analysis of diversity data. To describe and classify all the surviving species of the world is a daunting task and needs a concerted effort, comparable to the Human Genome Project (HGP). In particular, biodiversity informatics harnesses the power of computational and information technologies to organize and analyze biological data from research collections, experiments, remote sensing, modeling, database searches and instrumentation and delivers them to users.

Prof. Alok Bhattacharya of Jawaharlal Nehru University, New Delhi gave a lucid talk on bioinformatics approach for study of biodiversity. He stressed on the need for documentation and digitization. A large pool of information on biodiversity is being generated and computational and bioinformatics tools are essential to effectively utilize this vast information through development of biodiversity specific database.

Dr. J. Nagaraju of Centre for DNA Finger Printing and Diagnostics, Hyderabad spoke on the conservation of biodiversity in the age of genomics. He highlighted the complexity of the systems and suggested specialized requirements in the area. The role of molecular markers and genomics in biodiversity conservation were discussed.

Prof. P.S. Roy of Indian Institute of Remote Sensing, Dehradun mentioned that the satellite remote sensing has enabled to map and monitor vegetation resources in varying scale and time. The geographic information system enables to organize data sets for analysis and decision-making. Under a national scientific initiative, India has developed comprehensive database on vegetation types, fragmentation, disturbance regimes and biological richness at landscape level in the important eco regions. Remote sensing from space has facilitated systematic and hierarchical approach of biodiversity assessment and it's monitoring.

Prof. R. S. Tripathi of NEHU, Shillong provided a comprehensive account of forest ecosystem diversity in Northeast India. He emphasized on the need for conservation of entire ecosystem in order to conserve the life forms.

Dr. H. A. Nagarajaram of Centre for DNA Fingerprinting and Diagnostics, Hyderabad provided a detailed insight into frontiers in bioinformatics research. He mentioned that biodiversity studies are now

supported by powerful technological developments in the area of information technology involving database management and modeling. He stressed on the need of networking of various groups working in the area of biodiversity and preparation of a national database through bioinformatics.

Session VI. Industry :

Dr. S. R. Nair of Biotech Consortium India Ltd., New Delhi spoke on the role of industry in the sustainable utilization of biodiversity. He mentioned that industry apparently has not been an active participant in the biodiversity discussion, but it is expected that with the increasing realization of the benefits of sustainable development, the corporate sector would play a key and active role in biodiversity conservation. He attempted to identify the areas of major adverse of industry on biodiversity and suggested the steps to be taken by the industry as well as other agencies to minimize their impact, in the light of the experience and thinking of national and international agencies.

Dr. M.C. Gopinathan of E.I.D. Parry (India) Ltd., Bangalore highlighted the significance of alternative health care systems in the present day scenario of new threats such as resistance to drugs and AIDS/HIV. He recommended the integration of various discipline of science with traditional medicine for creating new opportunities and challenges. India with its rich biodiversity and traditions of Ayurveda, Sidda and Unani has the opportunity to capture the emerging market through sustainable utilization of bioresources. A "Biovalley" strategy integrating various disciplines of traditional and modern health care systems with collaboration, co-operation and networking of various stakeholders will provide much needed export growth, domestic health and prosperity and biodiversity conservation.

Point-wise recommendations

1. Diversity of Earth's plant life is under threat as never before. Therefore, Conservation, sustainable utilization and management of biodiversity are becoming increasingly important. Biodiversity will be the key to the survival and economic well being of human kind in the 21st century.
2. More biosphere reserves, sanctuaries, and germplasm banks need to be established. Conservation of specific ecological niches in stress zones is needed and community based conservation programmes should be taken up.
3. Need for integration of indigenous and community knowledge systems related to biodiversity to mainstream knowledge systems.
4. Documentation of biodiversity using molecular markers; computer aided storage and retrieval systems of biodiversity for developing technology packages for conservation and ensuring exchange of information.
5. Remote sensing from space for biodiversity assessment and its monitoring
6. Biodiversity of medicinal and aromatic plants; bioprospecting of compounds, genes and species to meet the needs of industry.
7. Utilization of vast potential of microbial diversity with particular attention to unexplored and uncultivated diversity.
8. Safe guards against bio-piracy; preparation of databases on biodiversity; establishment of patenting cells in

different parts of the country Biotechnology Information System (BTIS) of DBT to play an important role.

9. Check on further erosion of biodiversity with the availability of FAO's world information and early warning system.

10. Need to conserve much wider spectrum of germplasm in view of serious threat to agri-diversity by replacement of traditional land races by high yielding crop varieties and moving over to cash crops.

11. Need for sustainable agricultural development towards enhancing biological productivity with considerations to the economic needs and aspirations of the people.

12. Agriculture Universities in India to act as 'Genetic Enhancement Centres'.

13. Conservation biotechnology programme with a long-term perspective be initiated including all aspects of germplasm acquisition, characterization, inventorization, conservation, exchange and genetic resource management.

14. Universities' participation in location specific problems related to biodiversity conservation and development of biological resources.

15. Introduction of a course on Biodiversity Conservation at under graduate level; preparation of text material in biodiversity for students, researchers, and common man.

16. Enhanced funding for R&D in the area of biodiversity; active involvement of State Governments in management of biodiversity.

17, Close linkage between universities - research institutions – industry towards scientific approach concerning issues related to biodiversity.

18. Use of 'Information Technology Revolution', particularly bioinformatics aimed at distance learning and electronic networking for and targeted at biodiversity conservation and sustainable utilization programmes.

19. Intellectual Property Rights issues and exchange of germplasm–need for strict national legislation.

20. Special need for national policies and regulatory framework covering the entire spectrum of biodiversity related issues.

21. Need for simplification of procedures for utilization of biodiversity for commercial gains.

22. Establishment of at least one major Botanical Garden and Zoological Park with gene banks in Northeast India as this region harbours 50% of Indian flora and fauna with allocation of sufficient funds for R&D activities for conservation of biodiversity and development of bioresources of the region.

Expected outcome :

India with her vast biodiversity can be a big bargaining power among Nations in the 21st century. Accomplishment of this objective will also require continued public and scientific interest and political support.