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Agrobiodiversity Hotspots and Access and Benefit Sharing

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ABSTRACTS

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BIOLOGICAL DIVERSITY ACT, 2002

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Introduction

Biodiversity encompasses the variety of all life on earth. India is one of the 17-mega diverse countries of the world. With only 2.5% of the land area, India already accounts for 7.8% of the global recorded species. India is also rich in traditional and indigenous knowledge, both coded and informal.

India is a Party to the Convention on Biological Diversity (CBD) (1992). Recognizing the sovereign rights of States to use their own biological resources, the Convention expects the Parties to facilitate access to genetic resources by other Parties subject to national legislation and on mutually agreed upon terms (Article 3 and 15 of CBD). Article 8(j) of the Convention on Biological Diversity recognizes contributions of local and indigenous communities to the conservation and sustainable utilization of biological resources through traditional knowledge, practices and innovations and provides for equitable sharing of benefits with such people arising from the utilization of their knowledge, practices and innovations.

Biodiversity is a multi-disciplinary subject involving diverse activities and actions. The stakeholders in biological diversity include the Central Government, State Governments, institutions of local self-governmental organizations, industry, etc. One of the major challenges before India lies in adopting an instrument, which helps to realise the objectives of equitable sharing of benefits enshrined in the Convention on Biological Diversity.

Salient Features of the Biological Diversity Act – 2002

- After an extensive and intensive consultation process involving the stakeholders, the Govt. of India has brought Biological Diversity Act, 2002.

- To regulate access to biological resources of the country equitable share in benefits arising out of the use of biological resources.
- To conserve and sustainable use of biological diversity.
- Setting up of National Biodiversity Authority (NBA), State Biodiversity Board (SBB) and Biodiversity Management Committee's. (BMC's).
- NBA and SBB are required to consult BMCs in decisions relating to bioresource / related knowledge within their Jurisdiction.
- To respect and protect knowledge of local communities traditional knowledge related to biodiversity.
- To secure sharing of benefits with local people as conservers of biological resources and holders of knowledge and information relating to the use of biological resources.
- All foreign nationals / organizations require prior approval of NBA for obtaining biological resources and / or associated knowledge for use.
- Indian scientists / individuals require approval of NBA for transferring results of research to foreign nationals / organizations.

- Conservation and development of areas of importance from the standpoint of biological diversity by declaring them as biological diversity heritage sites.
- Protection and rehabilitation of threatened species.
- Involvement of institutions of State Government in the broad scheme of the implementation of the Biological Diversity Act through constitution of committees.
- Protect India's rich biodiversity and associated knowledge against their use by foreign individuals and organizations without sharing benefits arising out of such use and check Biopiracy.
- Indian Industry needs prior intimation to SBB to obtain bioresource. SBB has right to restrict if found to violate conservation and sustainable use and benefit sharing.
- Provisions for notifying heritage sites by State Government in consultation with local body.
- Creation of National, State and Local Biodiversity Fund and its use for conservation of biodiversity.
- Prior approval is needed from NBA for IPRs in any invention in India or outside India on Bioresource

Biodiversity

Biological Diversity means the variability among living organisms from all sources, including interalia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part and this includes diversity within species, between species and of ecosystems. Biodiversity is defined as the variety and variability among living organisms and the ecological complexes in which they occur is measured at three levels *viz*., genes, species and ecosystem.

Convention on Biological Diversity

The Convention on Biological Diversity (CBD) is a landmark in the environment and development field, as it takes for the first time a comprehensive rather than a sectoral approach to the conservation of Earth's biodiversity and sustainable use of biological resources. It was in the year 1984 that the needs to have in place a global convention on biological diversity started gaining momentum. In response, the United Nations Environment Programme (UNEP) in the year (1987) recognized the need to streamline international efforts to protect biodiversity. It therefore established an ad hoc working group to investigate "the desirability and possible form of an umbrella convention to rationalize current activities in the field. This group by 1988 concluded that a) the existing treaties were inadequate to address the issue of conservation and sustainable use and b) a new global treaty on biological diversity was urgently needed. Organisations such as the World Conservation Union (IUCN) and the Food and Agricultural Organisation (FAO) contributed draft articles in addition to specific studies commissioned by the UNEP. The UNEP Secretariat prepared the first draft and the formal negotiating process was started in 1991. The Inter-governmental Negotiating Committee for a Convention on Biological Diversity (INC) was given the task of ensuring the adoption of the Convention. On May 22, 1992 the nations of the world adopted the CBD in Nairobi and on June 5, 1992 the CBD was tabled at the UN Conference on Environment and Development in Rio de Janeiro where a record 150 countries signed the Convention.

The Convention on Biological Diversity (CBD) was negotiated and signed by nations at the UNCED Earth Summit at Rio de Janeiro in Brazil in June 1992. The Convention came into force on December 29, 1993. India became a Party to the Convention in 1994. At present, there are 175 Parties to this Convention.

The main objectives of the Convention are:

- Conservation of biological diversity;
- Sustainable use of the components of biodiversity;
- Fair and equitable sharing of benefits arising out of the utilisation of genetic resources.

Re-affirming the sovereign rights of Parties over their own biodiversity, the Convention balances conservation with sustainable utilisation and access to and use of biological resources and associated knowledge with equitable sharing of benefits arising out of such use. The CBD offers opportunities to India to realise benefits from its rich biological resources and associated traditional knowledge.

The CBD stipulates that the parties, even though having sovereign rights over their biological resources, would facilitate access to the genetic resources by other parties subject to national legislation and on mutually agreed terms. The CBD also provides for equitable sharing of benefits arising from the utilisation of traditional knowledge and practices, with holders of such knowledge. This has made it necessary for a legislation to be put in place, which lays down the framework for providing access, for determining the term of such access and for ensuring the equitable sharing of benefits.

Summary of Biological Diversity Act, 2002

- 12 Chapters
- 65 Sections and many subsections
- Notified Notifications and Rules
- Chapter – I : Preliminary – Terminologies
- Chapter – II : Regulations of access to Biological Diversity
- Chapter – III : National Biodiversity Authority
- Chapter – IV : Functions and Powers of National Biodiversity Authority
- Chapter – V : Approval by the National Biodiversity Authority
- Chapter – VI : State Biodiversity Board
- Chapter – VII : Finance, Accounts and Audit of National Biodiversity Authority
- Chapter – VIII : Finance, Accounts and Audit of State Biodiversity Authority
- Chapter – IX : Duties of the Central and State Governments

- Chapter – X : Biodiversity Management Committees
- Chapter – XI : Local Biodiversity Fund
- Chapter – XII : Miscellaneous

Management structure of Biodiversity Act

A three tiered structure at the national, state and local level is envisaged.

National Biodiversity Authority (NBA)

All matters relating to requests for access by foreign individuals, institutions or companies, and all matters relating to transfer of results of research to any foreigner will be dealt with by the National Biodiversity Authority.

State Biodiversity Boards (SBB)

All matters relating to access by Indians for commercial purposes will be under the purview of the State Biodiversity Boards (SBB). The Indian industry will be required to provide prior intimation to the concerned SBB about the use of biological resource. The State Board will have the power to restrict any such activity, which violates the objectives of conservation, sustainable use and equitable sharing of benefits.

Biodiversity Management Committess (BMCs)

Institutions of local state government will be required to set up biodiversity management Committees in their respective areas for conservation, sustainable use, documentation of biodiversity and chronicling of knowledge relating to biodiversity.

NBA and SBBs are required to consult the concerned BMCs on matters related to use of biological resources and associated knowledge within their jurisdiction.

People's Biodiversity Register (PBR)

- Many of our local people or ecosystem people possess valuable knowledge of uses of biodiversity such as herbal remedies and vegetable dyes, much of the knowledge of the status and dynamics of biodiversity also resides with the people at grassroots
- The tremendous valuation from place to place in the distribution and uses of biodiversity, the documentation has to be highly location specific and time specific
- The PBR is a complex process involving a series of activities linked to each other in many different ways.

National Biodiversity Authority (NBA)

- Establishment of NBA.
- The head office of the NBA is established at Chennai.
- NBA consists of the following members.

Members of NBA

- A Chairperson who shall be an eminent person having adequate knowledge on conservation and sustainable use of biological diversity.
- Three ex-officio members appointed by the Central Government. One representing the Ministry dealing with Tribal affairs.Two representing the Ministry dealing with Environment and Forests of whom one shall be the Additional Director General of Forests.
- Seven ex-officio members appointed by the Central Government to represent respectively the Ministries of the Central Government dealing with
    - Agricultural Research and Education
    - Biotechnology
    - Ocean Development
    - Agriculture and Cooperation
    - Indian Systems of Medicine and Homeopathy
    - Science and Technology
    - Scientific and Industrial Research
- Five non-official members appointed amongst specialists and scientists, representatives of industry, conservers, creators and knowledge holders of biological resources.

Functions and Powers of NBA

- Regulate activities, approve and advice the government of India on research, commercial, bio-survey and bio-utilization.
- Grant approval to Section 3,4 and 6.
- Certain persons not to undertake Biodiversity related activities without approval of National Biodiversity Authority (Section 3).
- Results of research not to be transferred to certain persons without approval of National Biodiversity Authority (Section 4).
- Application for IPR rights not to be made without approval of National Biodiversity Authority (Section 6).
- Perform such other functions as may be necessary to carry out the provisions of this act.

Approvals by NBA

- Any person who intends to access or apply for a patent or any other form of IPR protection whether in India or outside India referred to sub-section (1) of Section 6 may make an application prescribed by NBA.
- Any person who intends to transfer any biological resource or knowledge associated thereto referred to sub-section (1) of Section 3 shall make an application in such form and in such manner as may be prescribed to the National Biodiversity Authority.
- Determination of equitable benefit sharing by National Biodiversity Authority.

State Biodiversity Board (SBB)

- Establishment of State Biodiversity Board in every State.
- State Government may by notification in the Gazette can establish the SBB in their State name e.g Tamil Nadu Biodiversity Board.

- No State Biodiversity Board shall be constituted for a Union Territory and in relation to Union Territory, the National Biodiversity Authority shall exercise the powers and perform the functions of a SBB for the Union territory.

Collaborative Research

Collaborative research projects involving transfer or exchange of biological resources between government sponsored institutions and similar institutions in other countries will be exempted from this regulation.

Intellectual Property Rights

Intellectual Property Rights relating to biological resources must be defined in order to ensure that the benefits derived from their use are equitably shared. Section 6 of the Act underlines this principle. In case of persons intending to apply for any form of Intellectual Property Right in or outside India for any invention based on any research or information on a biological resource found in India, prior permission of the NBA is required. The NBA may impose benefit sharing fee or royalty or conditions on the financial benefits arising out of commercial utilization of such right while granting permission. Section 21 provides for the determination of "equitable benefit sharing" which is also one of the objectives of the Act. NBA in consultation with local bodies can impose terms and conditions for securing equitable sharing of benefits.

National Biodiversity Fund

A National Biodiversity Fund is being constituted for this purpose. The NBA will ensure that equitable benefit sharing is made during the utilization of biological resources and the knowledge relating to them. The amount of benefit sharing will be deposited in the National Biodiversity Fund and the amount shall be paid directly to such individuals or groups of individuals or organizations in accordance with the terms of any agreement in such manner as decided by the NBA. On behalf of the Central government, the NBA will take all measures to oppose Intellectual Property Rights granted outside India on any biological resource or associated knowledge originating from India.

Penalties

Whoever contravenes or attempts to contravene or abets the contravention of the provisions of **section 3 on section 4 or section 6 shall be punishable with imprisonment for a term which may extend to five years, or with fine which may extend to ten lakh**

rupees and where the damage caused exceeds ten lakh rupees such fine may commensurate with the damage caused, or with both.[Sec.55(1)]

Whoever contravenes or attempts to contravene or abets the contravention of the provisions of section 7 or any order made under sub-section (2) of section 24 shall be **punishable with imprisonment for a term which may extend to three years, or with fine which may extend to five lakh rupees, or with both. .[Sec.55(2)]**

Enforcement

The section dealt with under chapter XII provides for enforcement in general and deals with penalty, cognizance of offences, offences by companies, appeal etc in particular. Section 58 provides that the offences under the Act shall be cognizable and non-bailable.

Any person, aggrieved by any determination of benefit sharing or order of the Authority under this Act may file an appeal to the High Court. The time allowed to prefer an appeal is 30 days from the date of communication to the aggrieved person of the Order of the Authority.(Sec.52)

If any person contravenes any direction given or order made by the Central Government, the State Government, the National Biodiversity Authority or the State Biodiversity Board for which no punishment has been separately provided under the Act the person shall be punished with a fine which may extend to one lakh rupees and in case of a subsequent offence the fine may extend to two lakh rupees and in case of continuous contravention with additional fine which may extend to two lakh rupees everyday which the default continues.(Sec.56)

Biopiracy

To check biopiracy, the proposed legislation provides that access to biological resources and associated knowledge is subject to terms and conditions, which secure equitable sharing of benefits. Further, it would be required to obtain the approval of the National Biodiversity Authority before seeking and IPR based on biological material and associated knowledge obtained from India.

Exemptions provided in the Act

The Biological Act, 2002 provides for the following exemptions:

- Exemption to local people and community of the area for free access to use biological resources within India.
- Exemption to growers and cultivators of biodiversity and to *Vaids* and *Hakims* to use biological resources.
- Exemption through notification of normally traded commodities from the purview of the Act.

- Exemption for collaborative research through government sponsored or government approved institutions subject to overall policy guidelines and approval of the Central Government.

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AGRO BIODIVERSITY HOT-SPOTS

S. Nagarajan, S. Kannaiyan, S. P. Yadav, A. K. Singh, R. K. Trivedi, Suresh Pal

Plants are essential for human survival and well being. And agriculture in India is atlealst 5,000 to 7,000 year old industry. Crop husbandry is an important agricultural activity and in that process farmers have picket-up new variations in the plant material handled by them. In this process an enormous amount of agricultural bio-diversity got generated in the Indian subcontinent. It can be generalized that world-wide, there are 2, 34,000 endemic species of plants. And India possesses a rich flora of flowering plants. Most of it is in Western Himalaya, Eastern Himalaya, Indo-Myanmar belt and in the Western Ghats region. The Indian sub-continent has about 25,000 species of flowering plants of which 12,000 species are endemic or present few in number (Nayar, 1996). Table-1, gives an idea on the number of flowering plants occurring in different countries of South Asia.

Table-1: Flowering Plants of South Asia (after Nayar, 1996).

Country	**No. of Plants**	**No. endemic**	**Cause**
India	17,000	5725	Economic and development activity
Pakistan	4,938	203	
Srilanka	2,900	850	
Nepal	7,000		
Bhutan	3,500		
Bangladesh	4,500	-	

There are over 53 million tribal people in India belonging to 550 communities and almost two thirds of the community is distributed in Central India (MP, Gujarat, Rajasthan, Chattisgarh, Orissa and Jharkhand). Over 79% of the total tribal population live in the NE Indian states of Meghalaya, Nagaland, Mizoram and Arunachal Pradesh (Nayar, 1996). The rich tradition, proximity to nature and their keen observation has enriched these biodiversity hot spots with plant forms and variations that are of economic interest to man.

With the Intellectual Property Right becoming as a major socio-political issue of concern under 'Trade Related' discussions and access to benefit sharing becoming a monologue, it has become necessary to develop a home grown procedure to recognize rural communities and/or farmers for protecting and sustaining the valuable agro-biodiversity. Logically, it has become necessary to understand the intentions, provisions and actions suggested in various Acts and the legal instruments that are now in place.

1 Hot spots and Heritage sites

1.1 **Peoples' concern:** The consumers of agricultural products, the urban middle class population and the rural populace are concerned about the quality of their produce. They are also anxious to ensure that the environment and the agro biodiversity are not destroyed in the process of increasing agricultural productivity. This mutual appreciation on the need of agro biodiversity should be understood and should be stressed upon.

1.2 **About hot spots:** 'Hot spots' are earth's biologically richest places with high number of species found no wherelse. Loss of diversity in these shrinking hot spots are gradually reaching a threatening level and is likely to affect agriculture, by reducing the availability of diverse genes for crop improvement activities. Access to rich and diverse genes is essential for a continuing plant breeding programme.

Mittermeier (1988) developed a concept to prioritize biological diversity conservation action covering diverse living organisms. This subsequently led to the identification of seventeen ‘Biologically wealthiest nations’ of which India is one. The Western Ghats and the Himalayas are the two biologically rich areas identified at global level.

1.3 Reserves and heritage sites:

The regions of ‘Biosphere Reserve’ are protected from human interference and are nature’s play ground wherein, dynamic evolution of organisms are kept undisturbed. The natural competition in such reserves through struggle for existence promotes the evolution of new variation and death of the unfit combinations. There are twelve declared Biosphere Reserve in India, where the evolutionary factory of all kinds is kept at work. In these sites, natural biological diversity is at work, rather than the economic plant diversity set in motion by human intervention.

Under the ‘World Heritage Sites’ a ‘Gene Sanctuary’ for preserving Citrus and Musa species has been established by the MoEF in the Tura Range in Gora Hills of Meghalaya. Similarly, for Rhododendron and orchids there exists a Gene Sanctuary in Sikkim. The ‘Heritage Sites’ and the ‘Gene sanctuary’ are concepts and action plan in naturally conserving the biodiversity of certain species where they occur in adequate number and in diversity. These sites conserve and enable natural evolution of the protected species.

2.0 Biodiversity

Biodiversity includes all organisms, species and populations; the genetic variation amongst these; and all their complex assemblages of communities and ecosystems. ‘Biodiversity hot spots’ are areas that support natural ecosystems that are largely intact and where native species and communities associated with these ecosystems are well represented. Biodiversity hot spots are areas that are unusually rich in species, most of which are endemic and are under constant threat of being over exploited.

The term biodiversity also refers to the inter-relatedness of genes, species and ecosystems and their interaction with the environment. In other words there are three clear strata of diversity namely:-

- Ecosystem Diversity
- Species Diversity
- Genetic Diversity

The Agro-biodiversity as we understand is more relevant to the genetic diversity.

2.1 The ecosystem diversity:

This is a mega variation concept perceived taking larger global issues in mind. Twelve mega biodiversity regions have been identified world wide, cover Brazil, Peru, Equator, Columbia (South America), Mexico (North America), Zaire, Madagascar (Africa), India, China, Malaysia, Indonesia (Asia) and Australia. Except Australia none of the highly industrialized nations come under the endowed group. Logically, the developed world is not keen to meet the cost of sustaining this resource. Global effort by the poor and bio-endowed nations in arriving at a 'Treaty' to conserve and sustain biodiversity fell through and the Rio Declaration has left it to the sovereign nations to take care of their respective biodiversity. However, the developed world have retained the profit making clauses of 'patenting' genes, live forms and novel products from biological diversity as this rightly suits their industrial interests. The diversity of life enriches the quality of life in ways that are not easy to quantify. Narrowing down of diversity by way of loss of individuals, populations and species decrease the variety of genes needed for crop improvement activities for huge harvest and protecting against climate change.

Agro biodiversity is an essential component of the FAO propelled International Treaty on Plant Genetic Resources for Food and Agriculture. The pluralistic cultural society that India is, and the diverse climatic conditions occurring in India has endowed it as a center of origin of a wide range of species of plants. Therefore, it is all the more necessary to properly take care of the valuable resources that the country is endowed with.

2.2 Biographic grouping in India

Based on agroclimatic conditions and species variability a biographic classification of India has been proposed by Rodgers and Panwar (1988) which is as follows:-

- Trans-Himalayas-An extension of the Tibetan plateau, harboring high-altitude cold desert in Laddakh (J&K) and Lahaul Spiti (H.P) comprising 5.7% of the country's landmass.
- Himalayas-The entire mountain chain running from north-western to north eastern India, comprising a diverse range of biotic provinces and biomes, 7.2% of the country's landmass.
- Desert-The extremely arid area west of the Aravalli hill range, comprising both the salty desert of Gujarat and the sand desert of Rajasthan 6.9% of the country's landmass.
- Semi-arid-The zone between the desert and the Deccan plateau, including the Aravalli hill range accounts for 15.6% of the country's landmass.
- Western ghats-The hill ranges and plains running along the western coastline, south of the Tapti river, covering an extremely diverse range of biotic provinces and biomes and represents 5.8% of the country's landmass.
- Deccan peninsula-The largest of the zones covering much of the southern and south central plateau with predominantly deciduous vegetation amounting to 4.3% of the country's landmass.
- Gangetic plain-Defined by the Ganges river system, these plains are relatively homogenous and cover 11% of the country's landmass.
- North-East India-The plains and non-Himalayan hill ranges of northeastern India, with a wide variation of vegetation and is 5.2% of the country's landmass.

- Islands-The Andaman and Nicobar Islands in the Bay of Bengal, with a highly diverse set of biomes and is 0.03% of the country's landmass.
- Coasts-A large coastline, distributed both to the west and east, with distinct differences between the two; Lakshadweep islands are included in this with the percent area being negligible.

2.3 Endemicity of plant species

Based on the endemicity of species, climatic and topographic features Nayar (1996) has identified twenty phytogeographical divisions covering the entire country.

1. Andaman Group of Islands
2. Nicobar group of Islands
3. Southern W. Ghats
4. Northern W. Ghats
5. Leeward Deccan Plateau
6. Southern E. Ghats
7. Northern E. Ghats
8. Chotanagpur, Malwa Vindhya Plateau
9. Western Himalaya
10. Central Himalaya
11. Eastern Himalaya
12. North eastern India
13. Assam plains
14. Indo-gangetic plains
15. Aravalli hills
16. Aridzone (W. Rajasthan)
17. Semi arid zone (Kathiawar & Kutch)
18. Coastal zone
19. Mangroves
20. Lakshadeep islands

2.4 Centers of origin of crop plants

Based on the evolutionary trend of plants and the associated systems, eight main centers of origin of domesticated plants have been identified by N.I. Vavilov in 1926. India figures as a major center of evolution of crop plants. The evolutionary centers of crop plants and the twelve biodiversity centers identified world wide overlap with each other but they are not exactly identical. South Asia is a center of origin or diversity for several crops such as:

- Rice, Sugarcane
- Yam, Taro, bread fruit, several types of bean
- Bamboo, lemon grass, nutmeg, clove, beetelnut, sandal wood, ginger, cardamom, turmeric
- Coconut, Arecanut, Pinus spp.
- Maize, mango, coffee, sweet potato, cassava and several other crops as diploid, cotton etc.

But what is of great economic significance is the domesticated diversity of plant species made by farmers in these evolutionary centers that are rich in agro biodiversity. The long farming tradition, soil features, topography and rainfall variation have permitted the development of diverse agricultural ecosystems and enormous biodiversity in the region.

3.0 Agro biodiversity

3.1 Agro biodiversity can be niche specific

Diversity of cultivated taxa is distinct from diversity of wild taxa and is now increasingly termed as Agribiodiversity to distinguish it from general biodiversity. Agro biodiversity can be broadly defined as 'that part of biodiversity which nurtures people and which is nurtured by people (Vcichow, 1998; Krishnamurthy 2003). Agro biodiversity has a wide connotation. It covers a wide range of variety and variability of plants, animals and micro organisms at genetic, species and ecosystem level. The agro biodiversity is actively managed by farmers by maintaining inter species and intra species diversity in a dynamic farming system back drop. They sustain the biological yield by supporting micro organisms that enhance the functioning of various plant parts. The capacity to manage a dynamic agricultural production system varies between communities, the ethnic groups, social order and customs. Farming communities located in centers of plant genetic diversity have been managing agro biodiversity for centuries without any extraneous input of capital or knowledge. Therefore, they have selections for local adaptation, preferences and the small market. Naturally, the produce they harvest are the ones with very high uniformity but meet the needs of nutrition, taste and abiotic stress.

3.2 Agro biodiversity and global relevance

By the time population of India stabilizes by 2020, number of botanical species that form the wealth of India will be on their way out or would have become extinct. Logically priority of the PPV&FRA is to identify the agro biodiversity hot spots, area that fall under this, and institutionalize a mechanism that would on an annual basis identify communities that have over years kept the agro biodiversity alive for possible varietal development usages.

While dealing with agricultural biodiversity and elimination of hunger and poverty under the 'UN Millennium Development Goals'- The Chennai platform of action (Balaravi et al., 2005) has said that

- Agricultural biodiversity offers that crucial raw material for improving in perpetuity the productivity and quality of crops.
- Agricultural biodiversity provides uncommon opportunities for developing decentralized and locale specific community food security system.
- The Agricultural biodiversity and cultural diversity have feed back relationship are closely intecover with customs, traditions and beliefs.

3.3 Agro biodiversity hot spots

Since agro-biodiversity relates to areas where plants and animals concerned with man's economic interest are densely prevalent and such areas can be delineated. Obviously, these agro-biodiversity areas will not account for all plants connected with man's needs but would cover the important ones and a substantial amount of it.

In subsistence and shifting agriculture production systems, microbes interact with plant communities, in a symbiotic and parasitic mode. The slash and burn practice or the Jhum system of cultivation common in North east India influences with both the aerial and below ground parts of crop plants raised in that patch of land. The slash down practice, choice of the field/soil type, cropping pattern of the farmer etc., all decide the type of agro biodiversity that is to be sustained. It is also to be understood that such agro-biodiversity areas in India cover vast stretch of land, cutting across state boundaries, habitation of different communities, ecological and climatic conditions. Therefore, wherever farmers/farming communities have conserved, shared and sustained these valuable resources at their own initiative for a larger cause, there all, they can be recognized and rewarded for their efforts.

In order to do this, certain agro-biodiversity hot spots are to be identified as shared vision with general acceptance. The following can be considered as agro-biodiversity hot spot areas.

1 Travancore/Malabar area
2 Konkan coast
3 Gulfs of Gujarat (Rann) and Kathiawar
4 Leeward Deccan Plateau
5 North Gujarat/Mewar
6 Arid Jodhpur-Bikaner belt
7 NW temperate Himalaya and Ladakh
8 Sikkim Hills and Arunachal Himalaya
9 Hills of Meghalaya
10 Nagaland/Manipur/Tripura/Mizoram
11 Brahmaputra part of Assam
12 Lower Ganges system
13 Gangetic Delta
14 Triveni-Allahabad belt
15 Koraput region
16 Bastar and adjoining area
17 Cauvery system
18 Andaman islands & Lakshdweep

With in the agro-biodiversity areas in India, these eighteen hot-spots locations can be examined as potential agro-biodiversity hot spots. The above agro-biodiversity hot spots are shown in Figure 1. To begin with, these eighteen agro-biodiversity hot spots can be considered for purposes of the provisions under Gene Fund of the PPV&FR Act, 2001.

Periodically the identified areas can be re-examined to ensure that all such hot-spots are covered for purposes of the PPV&FRA.

4.0 The Indian Laws:

Emphasis given for the conservation and sustainable use of genetic resources in the PPV&FR Act, 2001 and Rules there under is to be viewed in the above discussed context. Rule 70 of the PPV&FRR, 2003 allows the Authority to pay the amount of benefit sharing compensation required for use of genetic resources involved in the development of new or essentially derived variety. It has to be tailored in a manner that it meets the expenditure incurred in the conservation and sustainable use of genetic resources. There is also a provision for framing schemes related to benefit sharing, from out of the Gene Fund (Section 45 of the Act). The 'Gene Fund' under the PPV&FR Act is meant to support tribal and rural communities for their efforts in the conservation, improvement and preservation of genetic resources and their wild relatives of plants that have economic implications, particularly in areas identified as agro-biodiversity hot spots. The question is whether the 'Agro-biodiversity hot spots' is different from the other such ones under the Biological Diversity Act, 2002 and other environment related rules. The agro biodiversity hot spots it appears, is only a sub system under the over all umbrella of biodiversity hot spots.

4.1 Suggested line of action

Various districts that fall under these eighteen agro biodiversity hot spots and the important crops that are more common in these spots have been listed (Table-2). The Agricultural Universities can conduct systematic mapping of the area, document and create an inventory of the agro biodiversity and species diversity retention there is a code them in a manner scientific and retrievable. Once done, care can be bestowed to ensure that these wealth of 'Indian Agriculture' are augmented in an appropriate manner. The various governmental agencies can then focus their action plan covering these areas in a more coordinated manner. The PPV&FR Authority considers this common vision of eighteen 'agro biodiversity hot spot' as a step forward to implement the provision under the PPV&FR Act, 2001 and the rules thereunder.

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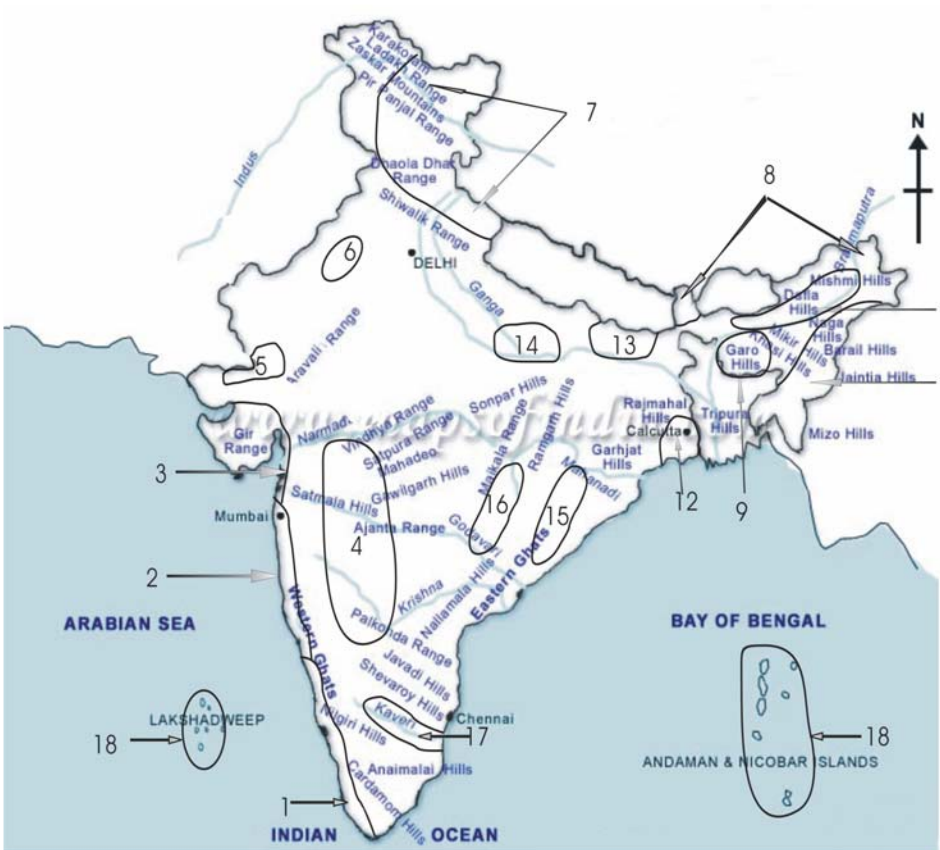

Figure -1 The proposed eighteen agro-biodiversity hot spot location in India

TECHNICAL SESSION: I

AGROBIODIVERSITY HOT SPOTS – ACCESS AND BENEFIT SHARING

<u>CEREAL CROPS</u>

Chairman: **Dr. M. Mahadevappa** Date: **19-07-2007**

Co- Chairman: **Dr. A. K. Das**

Venue: **University Guest House Conference Hall.**

Rapporteurs: **Dr S. Leena Kumary**
Dr. S. Murugan

Time: **11.30 AM**

Time	Abstract	Names
11.30-12.00 Noon	Farmers variety, Folk varieties, land races and varieties of common knowledge in the content of Plant variety Protection	**S. Nagarajan** PPV&FRA New Delhi
12.00-12.10 PM	Collection, Documentation and Conservation of Indigenous Scented and Medicinal Rice Germplasm of Kerala	**S. Leena Kumary** Rice Research Station, Alleppey
12.10-12.20 PM	Wild Rice Biodiversity hotspots and benefits	**M. Subramanian** TNAU, Coimbatore
12.20.12.30 PM	Biodiversity of Indigenous Rice varieties and their conservation	**V. Muralidharan** TRRI, Aduthurai.
12.30-12.40 PM	Sorghum Diversity in India	**M. Elangovan, A.Vilas, Tonapi, B. V. S Reddy and N. Seetharama.** NRCS, Hyderabd
12.40-12.50 PM	Valuing on-farm conservation and linking pearl millet diversity through farmers' innovations and community participation	**I. S. Khairwal,** Pearl Millet IP ICAR, Jodhpur
12.50-1.00 PM	Eastern India – A Region of Rich diversity for wild Rice germplasm	**S. R. Dhua B. C. Patra, B. C. Marndi, P. K. Nayak and M. P. Pandey.** CRRI, Cuttack
1.00-1.10 PM	Biodiversity of Landraces in Rainfed Tracts of Tamil Nadu	**G. Meenakshi** CPBG, TNAU, Coimbatore

1.10-1.30 PM **Open discussion**

1.30- 2.15 PM **Lunch**

TECHNICAL SESSION: II

AGROBIODIVERSITY HOT SPOTS – ACCESS AND BENEFIT SHARING

AGROBIODIVERSITY HOT SPOTS

Chairman: **Dr. M. P. Nayar**

Date: 19-07-2007

Co- Chairman: Dr. **Satyabrata Maiti**

Venue: University Guest House Conference Hall.

Rapporteurs: **Dr. K. N. Nair**
Dr. Akshat Medakker

Time: 2.30 PM

2.30-3.50 PM	Biodiversity and Biodiversity Hot Spots	**S. Kannaiyan** NBA, Chennai
2.50-3.10 PM	Agrobiodiversity hot spots in India and their Paradigm in relation to Biodiversity Hot Spots	**M. P. Nayar,** Environmental Resources Research Centre, Trivandram
3.10-3.30 PM	An overview on the Agrobiodiversity hotspots Southern and Peninsular India	**M.Unnikrishnan** CTCRI, Trivandram

TECHNICAL SESSION: III

AGROBIODIVERSITY HOT SPOTS – ACCESS AND BENEFIT SHARING

Sugarcane, Cotton and Oil Seeds

Chairman: **Dr. P. Tandon**

Date: 19-07-2007

Co- Chairman: **Dr. H. S. Chawla**

Venue: University Guest House Conference Hall.

Rapporteurs: **Dr. Meenakshi Ganesan**
Dr. K. Anjani

Time: 3.30-4.30 PM

3.30-3.40 PM	Collection of Land Race *Cernuum* of *Gossypium* arboretum Linn From North Eastern Hill Region of India	**V.V. Punit Mohan, Singh and K.N. Gururajan.** CITR, Nagpur.
3.40-3.50 PM	Biodiversity of Cotton Genetic Resources in India (*Gossypium Spp.)*	**K. N. Gururajan, S. Manickam, V.V Singh & N. Gopalakrishnan,** CICR, Nagpur
3.50-4.00 PM	Biodiversity in Indigenous Castor (*Ricinus communis* L.)	**Anjani, K. & D. M. Hegde** DOR, Hydrabad
4.00-4.10 PM	Indigenous Safflower and its wild species	**Anjani, K., & D. M. Hegde.** DOR, Hydrabad
4.10-4.20 PM	Oilseed Brassica Germplasm: Status, Hot Spots and Priorities	**Arvind Kumar & A. K. Mishra** NRC Rapeseed-Mustard, Bhartpur.
4.20-4.30 PM	Wild sugarcane diversity in North-east India	**Amalraj, V. A. & N. Vijayan Nair.** SBI (ICAR), Coimbatore

4.30-4.45 PM: Tea Break

TECHNICAL SESSION: IV

AGROBIODIVERSITY HOT SPOTS – ACCESS AND BENEFIT SHARING

Horticultural Crops

Chairman: **Prof. S. Kannaiyan**

Date: 19-07-2007

Co- Chairman: **Dr.V. A. Parthasarathy**

Venue: University Guest House Conference Hall.

Rapporteurs: **Dr. K. N. Shiva** **Time: 4.45 PM**
Dr. K. Manivannan

4.45-5.00 PM	Biodiversity Act, 2002 and Agro Biodiversity	**S. Kannaiyan** NBA, Chennai
5.00-5.10 PM	Diversity of Piper Species In India	**V. A. Parthasarthy, Utpala, P, Saji, K. V., & Shiva K. N.** IISR, Kozhikode.
5.10-5.20 PM	Current Concern of Bio-diversity of Medicinal Plants in India	**Satyabrata Maiti & K.A. Geetha** NRCMAP, Anand
5.20-5.30 PM	Diversity in Tuber Crops and Wild Relatives	**S. Edison** CTCRI, Trivandram
5.30-5.40 PM	Biodiversity in Medicinal Plants	**K. Manivannan** Annamalai Univ., Annamalai Nagar.
5.40-5.50 PM	Plant genetic resource management in vegetable crops	**Mathura Rai & Major Singh.** IIVR, Varanasi.
5.50-6.00 PM	Studies on genetic diversity in naturally distributed populations of Gamboge Tree (*Garcinia gummi-gutta* L.) of Central Kerala.	**S. Thirugnana Kumar, K.A. Inasi, M. Prakash, S. Murugan.** Annamalai Univ., Annamalai Nagar.
6.00-6.10 PM	Western Ghats: a megadiversity hot spot in India for horticultural crops	**P. E. Rajasekharan** IIHR, Bangalore.
6.10-6.20 PM	Land races in Horticulture Crops	**S. Sambandamoorthi** Puducherry
6.20-6.30 PM	Biodiversity of Calocybe, Volvariella and Pleurotus	**T. Marimuthu, A.S. Krishnamoorty & S. Nakkeeran** TNAU, Coimbatore.
6.30-6.40 PM	Bio-diversity of Vegetable Crops in Kulluvalley in North Western Himalayas	**P.R. Kumar & S. R. Sharma.** IARI, New Delhi

7. 30 PM – Visit to Natarajar Temple, Chidambaram.
8.30 PM - Dinner

TECHNICAL SESSION: V

AGROBIODIVERSITY HOT SPOTS – ACCESS AND BENEFIT SHARING

Plant Genetic Resources and Traditional Knowledge

Chairman: **Dr. Anishetty Murthy** **Date: 20-07-2007**

Co- Chairman: **Dr. S. P. Khanuja**

Venue: University Guest House Conference Hall.

Rapporteurs: **Dr. M. Unnikrishnan**
Dr. M. Geetha Rani

Time: 9.00 AM

9.00-9.20 AM	Agrobiodiversity Hotspots in Eastern Ghats – Issues and challenges	**K. S.Varaprasad S.R. Pandravada, N. Sivaraj & S. K. Sharma** NBPGR, Hydrabad
9.20-9.30 AM	Biodiversity of Crop plants in Haryana	**R. S. Waldia & S.K. Sethi.** HAU, Hisar.
9.30-940 AM	Biodiversity and Plant Breeding	**Raveendran T.S., & C. Vanniarajan** TNAU, Coimbatore
9.40-50 AM	Status of Biodiversity in Punjab	**R.C.Sharma, Monika A. Joshi & Navraj K. Sarao** PAU, Ludhiana
9.50-10.00 AM	Development of Stress Tolerant traits in Regional Cultivars	**Akshat Medakker** Sathguru Management, Hydrabad.

TECHNICAL SESSION: VI

AGROBIODIVERSITY HOT SPOTS – ACCESS AND BENEFIT SHARING

Access and Benefit Sharing

Chairman: **Dr. S. Nagarajan**

Date: 20-07-2007

Co- Chairman**: Dr. S. Edison**

Venue: University Guest House Conference Hall.

Rapporteurs: **Dr. V. Arivudai Nambi**
Dr. M. Chinnadurai

Time : 10.00 AM

10.00-10.30 AM	Access and Benefit Sharing	**Suresh Pal** NCAP, New delhi
10.30-11.00 AM	National Biodiversity Authority and Access and Benefit Sharing	**K.Venkataraman.** NBA, Chennai.
11.00-11.15 AM	Access and benefit sharing of agriculture related traditional knowledge	**Ganeshan, S./ Rajasekaran** TBGRI, Trivandram
11.15-11.30 AM	Traditional Knowledge and Agro-biodiversity Hotspots	**V. Arivudai Nambi.** MSSRF, Chennai
11.30-11.45 AM	Issues in optimal use of bio-resources and benefit sharing.	**M. Chinnadurai.** TNAU, Coimbatore.
11.45-12.00 NOON	Agrobiodiversity Hotspots Management and Procedures for Access and Benefit Sharing	**Geetha Rani. M., & M.S. Swaminathan** MSSRF, Chennai
12.00-12.15 PM	Use of traditional knowledge of Plant Genetic Resources in agro-biotechnological innovations and sharing of benefits	**B.C.Virakthamath, N, Shobha Rani & R.M. Sundaram.** DRR, Hydrabad.

12.15-1.30 PM: Open Discussion

1.30-2.15 PM Lunch

CONCLUDING SESSION

AGROBIODIVERSITY HOT SPOTS – ACCESS AND BENEFIT SHARING

Date: 20-07-2007.

Venue: University Guest House
Conference Hall.

Time : 2.30 PM

Technical Session out come **:** Summary report of each session by the Rapporteurs

Chairman: Dr.S.Nagarajan

Remarks: Prof. S. Kannaiyan
Prof. P. Tandon
Dr R. Mahadevappa

Recommandations: **Dr. S. Edison / Dr. S. Kalpana Sastry**

Feedback from the Workshop Participants:

1. **Mr. Vijayaraghavan**
2. **Dr. S. Sambandamoorthi**
3. **Mr. Mukundan**
4. **Mrs. Madhavi Char**
5. **Dr. M. Geetha Rani**

Vote of thanks: Dr K. Venkataraman

TECHNICAL SESSION – I

COLLECTION, DOCUMENTATION AND CONSERVATION OF INDIGENOUS SCENTED AND MEDICINAL RICE GERMPLASM OF KERALA

S. Leena Kumary
Associate Professor, Rice Research Station, Alleppey Dt- 688 503,

Exploration trips covering the various ecological niches of Kerala were conducted during the period 1999-2004 to collect and conserve the rich genetic diversity in the specialty rice of Kerala viz., the fragrant rice and the medicinal rice and to document the associated traditional knowledge. Twelve accessions belonging to six indigenous aromatic rice varieties and thirty two accessions belonging to seven medicinal rice varieties were collected in this mission and deposited in the National Gene bank for national accessioning. The indigenous aromatic rice varieties collected are *Gandhasala, Jeerakasala, Pookkilathari, Neycheera, Kothampalarikkayama and Kunjikayama.* Characterization and evaluation of the indigenous scented rices revealed wide variation among the varieties with respect to morphology, photosensitivity and grain characters and the varieties differed from the scented 'Basmathi rice with respect to growth habits as well as physico-chemical properties of the grains. The medicinal rices included varieties like *Njavara, Chennellu, Kunjinellu, Erumakkari (Aruvakkari), Varinellu, Karuthachampavu, and Kavunginpoothala* .While Njavara, the unique medicinal rice of Kerala was found to be grown in almost all the districts of Kerala on a small scale, the other medicinal rices were restricted to certain pockets and were almost on the point of extinction The traditional knowledge associated with these varieties substantiate their use either as medicine or as ingredient in medicinal preparations, but the clinical validation of the traditional knowledge is essential to prove the medicinal property of these rice varieties.

WILD RICE DIVERSITY, HOT SPOTS AND BENEFITS

M. Subramanian
Director of Research (Retd.) (TNAU), Coimbatore

The wild species of *oryza* are useful not only to improve the cultivated rice, but also to under stand their phylogenetic relationship of many species in the genus oryza found almost exclusively with in the boundaries of the tropic cultivated rice, about 22 wild rices were reported to be present in Himalayan foot hills, Asian river deltas, Tropical Carribiean island, Swamplands of southern and West Africa as well as temporary pools of the arid Savannas of the tropics. India is rich in wild rice variability. The wild species like *O. Officinalis, O. nivara, O. rufipogon, O. granulate* and *Portersia coarctata* found in Western, Northern Central Eastern India and Coastal areas have striking variability.

In India *O. officianlis* and *O. granulate* are growing in ever green and semi green forest vegetation up to elevation of 2500 and *O. nivara* and *O. rufipogon* occur in marshy areas, shallow ditches and particularly inundated areas both in hills and plains. A tetraploid form of *oryza* found in Kerala was named as *O. malamphuzhaensis* and later identified as *O. officinalis* sp *malamphuzhaensis*. *O. spontanea* the wild species closest to the cultivated rice is also of common occurrence in Kerala. *O. nivera* and *O. officinalis* were also collected from Western India. In addition *O. officinalis, O. granulata, O. rufipogon, O. nivara* and *O. spontanea* were collected with high variability. Samples of the aforesaid wild species were collected from Orissa, Bihar, West Bengal and Madhya Pradesh. The wild species are threatened with extinction. The National Plant Genetic resources in India collected more variabilities of wild species from Bihar, Uttar Pradesh, Haryana, Andhra Pradesh, Kerala, West Bengal & North Eastern India.

These germplasm need specific location and environment to grow well and attain maturity to produce quality seeds. Many wild species are found in swampy marshy forest areas, they should be preserved on *in-situ* basis. Infrastructure facilities for storing wild species should be improved, use of biotechnological tools, proper documentation free exchange of wild rice species, well documentation of IPR, and declaring wild rices growing zone as protected area are some of the immediate needs to conserve them.

BIO-DIVERSITY OF INDIGENOUS RICE VARIETIES AND THEIR CONSERVATION

V. Muralidharan
Tamil Nadu Rice Research Institute, Aduthurai,

Biodiversity is defined as 'the variability among living organisms. Conservation and sustainable use of biodiversity is fundamental to ecologically sustainable development. India ranks tenth in the world and fourth in Asia in plant diversity. There are thousands of paddy varieties that are grown widely in India and all over the world. Most indigenous varieties are hardier and resistant to pests. Many varieties fulfill specific nutritional and other dietary needs. Besides this, indigenous varieties provide the basic genetic material for developing any other variety in future. *Njavara (Oryza sativa),* a unique type of medicinal rice indigenous to Kerala, is famous for its curative properties in circulatory, respiratory and digestive ailments. In the alkaline soils of Tamil Nadu an indigenous variety of paddy called "Kalarpalai" alone can be cultivated. Local landraces *viz.,* Nootripathu, Kallurundaikar, Mattaikar, Poongar, Kuzhiadichan, Varappukudainchan, Vadan Samba, Kattu Samba, Puzhuthi Samba, Puzhuthikkar and Sornavari are tolerant to drought. Local landrace Pokkali is tolerant to salinity condition.

Habitat destruction, over exploitation, pollution, and species introduction are the major causes of biodiversity loss in India. Biodiversity hotspots are areas that are unusually rich in species. Among the 18 hot spots in the world, two are found in India. These are the Eastern Himalayas and the Western Ghats. Indigenous varieties adapted to the local environmental conditions are fast disappearing. Conservation of crop diversity is the need of the hour. Agricultural Research Station at Dacca (eastern India) and the Paddy Breeding Station at Coimbatore (southern India), Indian Council of Agricultural Research (ICAR) at New Delhi, Central Rice Research Institute (CRRI) at Cuttack and National Bureau of Plant Genetic Resources, New Delhi are involving in collecting and conserving the Indigenous rice cultivars. In addition to spectacular variability in its traditional cultivars, India is also rich in genetic diversity of wild *Oryza* species, particularly *O. nivara, O. rufipogon, O. officinalis, O. granulata* and *Porteresia coarctata.*

SORGHUM DIVERSITY IN INDIA

M. Elangovan, Vilas A. Tonapi, B. V. S. Reddy[1] and N. Seetharama
National Research Centre for Sorghum (NRCS), Hyderabad–500030,
International Crops Research Inst. for the Semi-Arid Tropics, Patancheru–502324

Sorghum [S*orghum bicolor* (L.)] Moench) is one of the most important cereals of the semi-arid tropics in the world. It ranks fourth in importance as food grain in India after rice, wheat and maize, but ranks first for fodder. India is endowed with a very rich contribution to the wealth of world's biodiversity. The classification of centres of origin and biodiversity hotspots into mega, major, minor, micro, and nuclear for crop plant diversity by eminent scientists in the past, clearly indicates that the emphasis was to demarcate the crop boundaries encompassing network of crops. India's geography was invariably covered by the classification of various workers in relation to centre of origin. In fact, Indian sub-continent is the secondary centre of origin of sorghum, with evidence for early cereal cultivation being discovered at an archeological site in western parts of Rojdi (Saurashtra) dating back to about 4500 years from present (Vavilov, 1992; Damania, 2002).

Being a secondary centre of origin, sorghum accessions from Indian exhibit significant variability. Most of the Indian germplasm belongs to durra (3235), followed by guinea (781), bicolor (343), durra-bicolor (491), caudatum (212), durra-caudatum (371), caudatum-bicolor (129) races including other botanical types and 804 are unclassified accessions. The genebank at International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) currently conserves 36774 accessions belonging to ninety countries covering durra, caudatum and guinea races representing 21.8, 20.9 and 13.4% of the total collection respectively (Reddy et al 2002). Out of the 674 collections maintained at National Research Center for Sorghum (NRCS) 52.8% belongs to durra followed by durra-caudatum (24.0%), durra-bicolor (14.0%), bicolor (6.0%) and guinea (3.0%) races. Wild sorghums that are found in India belong to *drummomdii* and *halepense* species. Eastern India is one of the native centres of *Sorghum halepense*, a perennial plant with well developed, creeping rhizomes, and has been introduced as a weed to all warm temperate areas of the world (de Wet, 1978). *Sorghum propinquum.*

Durra race is prominent in Andhra Pradesh, Karnataka, Maharashtra, Madhya Pradesh and Uttar Pradesh and bicolor in Tamil Nadu and Rajasthan. Similar observations by Appa Rao et al. (1999) has indicated that all the 5 basic and 10 intermediate sorghum races are found in India, though durra are predominant. The race durra was selected from early bicolor that had moved into India some 3,000 years ago (House, 1995). It is the dominant race in India today. Agronomically, the caudatum race is one of the most desirable races; and provides high yield and excellent seed quality and has become one of the most important sources of germplasm in modern breeding programmes (Dahlberg, 1995).

Exploration by NRCS in Khammam district of Andhra region could document and collect six races indicate the presence of maximum diversity of races in the state of Andhra Pradesh. Appa Rao et al. (1999) have also reported higher racial diversity in the state of Andhra Pradesh followed by Maharashtra.

VALUING ON-FARM CONSERVATION AND LINKING PEARL MILLET DIVERSITY THROUGH FARMERS' INNOVATIONS AND COMMUNITY PARTICIPATION

I. S. Khairwal
All India Coordinated Pearl Millet Improvement Project (ICAR), Jodhpur - 04

Large scale use of genetically uniform hybrids is considered an inevitable consequence of stagnation and growth in productivity in pearl millet. Despite all the assumed advantage of cultivating genetically diverse local landraces, long term studies on-farm state of diversity in various parts of India and more specifically in Rajasthan have demonstrated an unprecedented rate of erosion of native pearl millet within a short span of a hybrid era since 1965. For example the seed of 'Jakharana' landrace having 1.0 M panicles is no more available in pure form. The dependence on fewer genetically uniform hybrids for meeting food and nutritional security is obviously not sustainable. Templed for hybrid cultivars, it is not pragmatic to assume that farmers will continue to maintain optimal varietal diversity without any institutional and national policy support. To identify the feasibility of using various market and non-market based incentives for promoting on farm conservation of pearl millet research programme was undertaken by AICPMIP in collaboration with IPBGRI, IICRISAT, NBPGR and SAUs from 2000 to 2004. Several innovative attempts have been made to explore the variability of both the demand and supply side incentives for landraces conservation.

We recognize at the national level, the role of farmers breeders and innovators play in not just the conservation but also augmentation of pearl millet landraces. The AICPMIP has recognized contributions of; many such farmers breeders scouted from Rajasthan, Gujarat and Haryana. The Protection of Plant Varieties and Farmers' Rights Authority (PPV&FRA) is seized of the responsibility and the challenge of recognizing and rewarding the contribution of such farmers as well as local communities playing pivotal role in conservation of pearl millet diversity. Like-wise private sector entrepreneurs may also see new opportunities in characterization and on-farm conservation of pearl millet diversity for developing niche processed food products as well as nutraceuticals.

EASTERN INDIA –A REGION OF RICH DIVERSITY FOR WILD RICE GERMPLASM

S. R. Dhua, B. C. Patra, B. C. Marndi, P. K. Nayak and M. P. Pandey
CRRI, Cuttack – 753 006

O. nivara and O. rufipogon are the two predominant 'AA' genome wild relatives of cultivated species widely distributed throughout the eastern India. *O. nivara* is the annual species with short stature plants found in seasonal ditches, road side swampy areas and along the bunds of small canals etc. It flowers in the month of September-October. On the other hand *O. rufipogon* is perennial, with long stem, procumbent habit and/or floating species found in the fringes of ponds, lakes and other perennial water bodies. It flowers during October end to November. Such populations of plants are eroding fast with the construction of roads and expansion of industry in these regions.

Hence, during the period 1999 to 2003 a total of 17 explorations were undertaken for collecting wild rice germplasm from the eastern India comprising of the states of Orissa and West Bengal which lie approximately between 18^{O} N to 26^{O} N latitude and 82^{O} E to 90^{O} E longitude. Each exploration site was thoroughly explored and the samples were collected either in the form of seed or stubbles wherever available. These trips resulted in collection of 483 accessions consisting of 250 samples of *O. nivara* populations and 233 samples of *O. rufipogon* populations.

Morpho agronomic characterization on the basis of replicated experimentation on these accessions revealed a very high degree of significant inter-accessional variability within these species. Further evaluation of these accessions against stress of drought it was observed that a few *O. nivara* accessions like IC-330470 and IC-330611 had very strong degree of tolerance to drought. The cross verification of passport data further revealed that the habitat of these accessions were from dry upland regions of the districts of Bankura and Murshidabad. Evaluation under artificial epiphytotic condition for Bacterial Leaf Blight (Blb) resulted in identification of at least 17 accessions of *O. nivara* and 7 accessions of *O. rufipogon* with resistance to Blb. Such accessions are being used in the crop improvement programmes.

BIODIVERSITY OF LANDRACES IN RAINFED TRACTS OF TAMIL NADU

N. Meenakshi Ganesan
CPBG, TNAU, Coimbatore

In Tamil Nadu, a number of long duration land races are still under cultivation in large areas of rainfed tracts particularly, when the rainfall received during single monsoon season is inconsistent to support a successful crop. These land races are very popular in sorghum and groundnut which have the special character of utilizing both the monsoon rains (South West and North East) and they possess the dormant growth stage at the end of southwest monsoon and show resurrection in growth, when they receive North East monsoon rains.

Some of the important land races, which show such special character and widely cultivated in sorghum are Periamanjal cholam (long duration yellow grain sorghum) in Coimbatore and Erode districts, Thalaivirichan cholam (open panicle type) in Dharmapuri, Krishnagiri, Salem and Vellore districts and Makkattai cholam in Trichy and Perambalur districts. In groundnut, Trichengodu local, which is a spreading type shows similar resurrection in growth. Although the grain yield of these landraces are inferior than that of the improved varieties, they give almost cent percent assured yield with flexible sowing dates, depending upon the early or late arrival of monsoon rains. The seed production and distribution in these landraces are wholly dependent on the exchange of seed among farmers.

Apart from the landraces, which are cultivated using bimodal rainfall, there are also a number of other landraces in rice, sorghum (redgrain Murungapattai local, Theni local, Chinna manjal cholam (short duration yellow grains), Irungu and Kakka cholam); in small millet crops, *viz*, foxtail millet, little millet, kodo millet, proso millet and barnyard millets in specific areas; in pulses *viz.*, black gram, green gram, cowpea and field bean; in oilseeds *viz.*, groundnut and sesamum. These landraces are grown for their very specific attributes in the location of their cultivation and in general possess very high drought tolerance and pests and diseases resistance.

Although, collection of such landraces have been carried out by public sector institutions and organizations, they have not been effectively used in breeding programmes for the development of varieties for rainfed tracts. Further breeding programmes in these crops, targeting rainfed locations will have to utilize these landraces and they need to be protected from genetic erosion by registering them as farmer's varieties after purification for proper access and benefit sharing.

TECHNICAL SESSION – II

BIODIVERISTY AND BIODIVERSITY HOTSPOTS

Prof S. Kannaiyan
Chairman, National Biodiversity Authority, Chennai – 600 041

Diversity is the hallmark of life on earth. Each organism during the course of evolution has developed suitable structure and adaptations to live in a specific geographical region or habitat in the biosphere. The genetic changes particularly those in tune with environment are mainly responsible for the creation of new species. Wild species provide much important and unique genetic material and the wild relatives of plants and domestic animals will form essential components for ensuring food security. A variety of new plants / crops / organisms with high productivity as well as with pest(s) disease(s) / drought tolerance / resistance have been produced with genes from the wild stock. Biodiversity is not distributed uniformly on the earth and some areas particularly along the tropics are rich in species. Species richness refers to the number of different species within a region and many species in these areas are threatened with extinction. The two major criteria for designating an area as hotspots are i) Richness in endemic species ii) Impact by human activities.

Endemic species are those restricted certain localized areas of the earth. Evolutionary history has endowed species with ecological characteristics that respond to the environment. However, most species are rare and restricted because of their ecological requirements are only met over by a small area and because they are not capable of dispersing great distances to other suitable habitats. Plant diversity is the biological basis for hotspot designation. To qualify a hotspot, a region must support 1500 endemic plant species, 0.5% of the global total. Existing primary vegetation is the basis for assessing human impact in a region. Further to qualify as a hotspot a region must have lost more than 70% of its original habitat. Identification of hotspots would help to pin point priority areas for conservation. According to the classification of Norman Myers there are 25 hotspots scattered in different parts of world. Eventhough the 25 biodiversity land area, they contain 44% of all plant species and 35% of all terrestrial vertebrate species in the world. Each of the hotspots is under severe pressure due to anthropogenic interventions and already lost atleast 70% of its original natural vegetation. Of late conservationists nine new “Biodiversity Hotspots” making the total to 34 hotspots which also include the Himalayas.

AGROBIODIVERSITY HOT SPOTS IN INDIA AND THEIR PARADIGM IN RELATION TO BIODIVERSITY HOT SPOTS

M. P. Nayar
Environmental Resources Research Centre, Thiruvananthapuram

At present the most serious environmental problem facing human race is the irretrievable loss of biodiversity leading to extinction of plant and animal species and erosion of genetic resources (Ehrlich and Ehlrich, 1981; Myers, 1991). The major constituents of agro-biodiversity are as follows: (i.) The harvested crop varieties, progenitors of cultivated plants, livestock breeds and their non-domesticated species; (ii) Non-harvested species including micro-organisms, pollinators which support agro-sylvo-ecosystems. (iii) Non-harvested species in the environment, which support functioning of food production ecosystem. The Agricultural biodiversity is the result of the interaction of culturally diverse ethnic groups over time and space on the progenitors of cultivated species. It includes the variety and variability of plants, animals and micro-organisms which help the functioning and sustaining the key functions of the agro-ecosystems including its structure and processes, assuring the food production and food security (FAO, 1998). On the basis of the above criteria, it is proposed to designate areas rich in progenitors of cultivated plants and associated weedy species with vast array of varieties and variability in farm lands, grasslands and woodlands, which have evolved under various environmental stresses and co-adapted through man's interventions as "Agro-biodiversity Hot spot areas". The major criteria are the occurrence of genetic resources useful to man, heterogeneity of landscape, extreme climatic, edaphic and altitudinal stresses which usually function as driving forces for evolutionary adaptations in plants and animals. The Indian gene center posssess about 17000 species flowring plants of which 33% are endemic to India (Nayar, 1996). Of these 3000—3500 species are of economic value. In India there are about 166 species (Zeven and de Wet, 1982), which are of direct genetic resource value. The genetic resources of indirect value is about 320 specie and they are distributed in eight agro-ecological zones (Arora and Nayar,1884). India is a primary centre of diversity of crop plants like rice, black gram, moth bean, cucurbits, (Luffa), jute (capsularis), jack fruit, banana, sugar cane, mango, large cardamom, black pepper, several minor millets, several medicinal plants like *Rauvolvia serpentine, Strychnos nuxvomica, Cymbopogon, Saussaurea, Vetiveria*. India is also the secondary centre of African crops like finger millet, sorghum, pigeon pea, cowpea, cluster bean, sesame, niger, safflower and tropical American crops like maize, tomato, pumpkin, cucurbits, chillies and Amaranth. India is in the diversity belt of South Asian and East Asian crops like ginger, turmeric, tuber crops, taros, yams, bamboos, citrus, rice bean, mung bean, sword bean, small cardamom, sugar cane (Arora, 1988). It is considered that the important criteria for considering an area of agro-biodiversity importance is the rich presence of progenitors of cultivated plants which have evolved in time and space with varied landscape ecology and terrestrial heterogeneity along with the ethnic communities, According to Hawkes (1983) the genetic resources consists of i. landraces or primitive cultivars, ii. Wild or weedy relatives of domesticated species, iii. Wild species used by man, iv. Wild species of potential use for man and v. Obsolete or advanced cultivars. Extremes of climatic fluxes like dry aridity or cold aridity and tropical systems of high rain fall also play an important role as driving force for phenotypic adaptability. (Nayar, 2004). On the above parameters it is possible to evaluate the area as a rich agro-biodiversity through apportioning value numbers giving equal priority. In a white paper on "Agro-biodiveristy hot spots" circulated at the National level consultation held in Shillong, Nagarajan (2007) has tentatively proposed twenty agro-biodiversity hot-spots situated in the major agro-biodiversity zones of India . The hotspots proposed by Nagarajan(2007) largely fits into the parameters which was proposed here excepting Maliabad area of UP (Mango & fruits.) and Southern Gangetic Delta of Bengal. On the basis of Nagarajan's proposal with two deletions, the following 19 agro-biodiversity hot spots are suggested based on the above parameters. The semi arid Deccan belt is divided into the northern Black cotton soil tract of Marathwada –Satpura ranges and southern red soil belt of semiarid southern Deccan.

AN OVERVIEW ON THE AGROBIODIVERSITY HOTSPOTS OF SOUTHERN AND PENINSULAR INDIA

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The southern region of Indian continent represents agro biodiversity hotspots of like Western Ghats and the Andaman & Nicobar Islands. A total of 5000 angeospermic species have been reported from Western Ghats of which 2000 species are endemic (swengel. 1991). The Andaman & Nicobar flora include 2000 indigenous and several non- indigenous angeospermic species, besides many cryptogamic species in three important natural ecosystems viz. the forest ecosystem, the marine ecosystem and interface between the two, the mangrove ecosystem. (Hajra. *et. al*. 1990) (Botanical Survey of India). Besides possessing rich biodiversity of the cereals (mainly rice and minor millets), pulses, oil seeds and spices, these areas are veritable source of root and tuber species belonging to the families Araceae, Dioscoreaceae and Zingiberaceae.

Germplasm exploration trips conducted by CTCRI, Trivandrum, over the past twenty years in these areas in association with the National Bureau of Plant Genetic Resources, New Delhi have helped in collecting information not only on the floral diversity but also on the tribal people who are the stake holders of this natural wealth and the benefit sharers of the related indigenous knowledge. Overexploitation of forest resources is threatening their *in situ* conservation. External interventions by settlers, bioprospectors and even some of the developmental activities like road construction and hydal power stations have lead to distruction of their habitats leading to extinction.

A brief survey of the agrobiodiversity of some of the areas studied are presented and discussed along with the problems and prospects of access and benefit sharing in relation to the areas studied.

TECHNICAL SESSION – III

COLLECTION OF LAND RACE *Cernuum of Gossypium arborcum* LINN FROM NORTH EASTERN HILL REGION OF INDIA

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A National Germplasm Exploration and Expedition Programme of the West Garo Hills in Meghalaya of North Eastern Hill Region of India was organized jointly by the Central Institute for Cotton Research, Nagpur (Maharashtra) and National Bureau of Plant Genetic Resources, Regional Station, Barapani in collaboration with the ICAR Research Complex for NETT Region, Barapani, Shillong, Meghalaya, North East Indian State, Meghalaya, also known as the "Abode of Clouds' is situated in the North Eastern Hill Region, between 25° 5 N and 26° 10 N latitudes and 89° 47 E and 92° 47 E longitudes. Meghalaya is bound on the North and East sides by Assam and partly by Bangladesh. The western parts of the Meghalaya, i.e., the Garo Hills are highly dissected area with an average height of about 600 meters from sea level. The Garo Hills are basically named after the tribes 'Garo' residing in this area. Meghalaya has a variety of natural vegetation ranging from tropical mixed forest to pureforest which reflects the variations in physiography, soils and climatic conditions within the state. The annual area of cotton grown in Garo Hills of Meghalaya is very small, as cotton is cultivated by the aboriginal hill tribes with primitive methods of cultivation is isolated patches under 'Jhoom ' or 'Tungya' (Shifting cultivation). About 80% of the total area under cotton is confined to the Garo Hills. However, exploration and collection of cotton germplasm was made from selected areas where there was no introduction of improved cotton varieties/commercial hybrids.

The Garo tribals are maintaining primitive land race *cernuum* of *Gossypium arboretum* L., from ancient time from generation to generation. The main cotton growing areas are the hills which offer proper drainage of soil and allow crop to thrive even with a high rainfall of 3750 mm or more per annum. The collected germplasm accessions were having very specific morphological characters, viz., long petiole, deeply palmate leaves, long broad bracts, elongated pointed apex capsules and high boll weight (7 g). They also possessed high ginning outturn (40%), short staple (18-22 mm) and coarse fibre with white glean. Generally, arboretum cottons have poor locule retentivity and high locule shedding character. However, 33 collected germplasm accessions were endowed the source of high locule holding capacity and fully burst elongated capsule (605 inches long) of cotton can resist high wind velocity with minimum locule shedding.

The above material can be used in breeding programmes for genetic improvement of *arboretum* cotton in terms of locule retention capacity, boll size, and ginning outturn.

BIODIVERSITY OF COTTON GENETIC RESOURCES IN INDIA *(GOSSYPIUM* SPP.)

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Cotton, Gossypium spp. is grown as a source of fibre, cattle feed and edible oil. Presently 49 species constitute this genus. Of this, four are cultivated, *G.hirsutum* and *G.barbadense* which are tetraploid and *G.arboreum* and *G.herbaceum* which are diploid. *G.hirsutum* is by for the most widely cultivated. All the species of cotton have an aggregate geography range that encompasses most tropical and sub tropical regions of the world (Percival *et al*.,1999). Among the eight Vavilovian centres of origin, the Indian gene centre occupies the central stage as regards the origin of diploid cultivated cotton Viz., *G.arboreum* and possibly *G.herbaceum* too are concerned. The four cultivated species embody considerable genetic diversity as they are acclimatized to coastal (Fryxell 1979 and 1992) as well as desert eco system. (Steward 1995and Craven *et al* ., 1995).

Genetic diversity provides a buffer against adverse effects of biotic and abiotic environments. It is only through discovering or creating new variability that progress in breeding can be achieved. Incorporating variability from wild cottons and related species should remain a priority so that new variability is available for future generations.

Under the National Agricultural Technological Project, ten surveys were made during 1999-2003 in seven Zones and covering ten States. The regions explored were Saurashtra, Malwa, Vidarbha, Jharkhand, Meghalaya, Mizoram and Assam in the Central belt and Karnataka, Telengana, Rayalseema, Coastal AnhdraPradesh and Orissa in the Southern belt.

The genetic diversity of diploid cotton in their natural habitat of South East Asia is under threat, where increase in agricultural and Indistrial activities are causing enormous habitat disturbances. Against the drastic erosion of Tribal habitat due to various socio economic reasons, several land races belonging to both *G.arboreum* and *G.herbaceum* could be collected in areas like Megalaya, Mizoram and Assam. Primitive cultivars of both *G.arboreum* and *G.herbaceum* were collected at an altitude of 1200 metres and above at Mizoram in North eastern India. Collection of salt tolerant lines of *G.herbaceum* in the coastal salt affected regions of Saurashtra is a notable feature during the exploration. *G.barbadense* type plants but without petal spot were also collected from Orissa and Assam. In Malwa tract in Central India, big boll and hairy types of *G.hirsutum* were collected.

Five hundred and twenty two accessions were collected during the survey which belonged to all the four cultivated species. Three wild type collections were also made. As many as 305 collections were under the Farmers' field and 118 collections were from village back yards. All the collections made under the NATP through exploration will be evaluated, conserved and made available to the breeders for their utilization in their breeding programme.

BIODIVERSITY IN INDIGENOUS CASTOR

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Castor *(Rican's communis* L,) is native to India. It is found growing in wild and semi-wild states across the country at altitudes rang mg from sea level to 1800m. The Directorans of Oilseeds Research, Hyderabad currently maintains 3011 indigenous cassor accessions collected through nine castor germplasm, explorations in Andaman and Nicobar Islands, Tamil Nadu, Kerala, Andhra Pradesh, Maharashtra, Bundelkand region, Uttar Pradesh, Bihar, Jharkhand, Assam, Manipur, Meghalaya, Mizorana, Nagaland, Jammu and Kashmir, Haryana, Himachal Pradesh, Rajasthan, Punjab and Gujarat.

The location-specific unique morphotypes such 3S purple colour castor from Assam and Nagaland, different co1oured capsules and feeds from Tamil Nadu, Jammu and Kashmir, Bihar, Utter Pradesh. Maharashtra and Gujarat, very big leaf (50-60 cm diameter) type from Bihar, very small capsule (lcm circumference) type from Punjab and Himachal Pradesh, very tall (>4m), big capsule (3-4 cm circumference) type from Bihar, North Eastern States Bundelkhand region and Tamil Nadu, and very long spikes (60-70 cm) and heavy seed (86g/100 seeds) from Bihar were collected. All these monotype are being utilized in castor improvement progmnmes as genetic markers.

The major yield reducing biotic factors in castor are *Fusarium* wilt, *Macrophomina* root not. nematode, *Botrytis* grey mold, capsule borer, leafhopper, *Spodoptera,* thrips and whitefly. These can cause 40-80% yield loss. Several indigenous germplasm accessions were identified as stable source of resistance to these biotic stresses. Resistance source to salinity was found among wild collections from Andaman and Nicobar Islands. Sources to moisture stress were identified among Tamil Nadu, Bihar and Assam col1ections. In addition to these resistance sources, germplasm possessing desirable traits like early and medium maturity, high seed yield and yield traits, high oil, pistillate type and dwarf stature were also identified. The Indigenous phenotypic and genotypic diversity in castor was characterized, evaluated, documented and conserved. High rainfall areas in Karnataka, Lakshdweep Islands, Madhya Pradesh and Orissa are identified for future explorations in collaboration with National Bureau of Plant Genetic Resources, New Delhi.

So far more than 8000 samples were supplied to various researchers in the country. Seven disease and insect resistant accessions were registered with Plant Germplasm Registration Committee, ICAR. Thirteen varieties and 12 hybrids were developed in castor utilizing indigenous germplasm.

INDIGENOUS SAFFLOWER AND ITS WILD SPECIES

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Safflower *(Carthamus tintortus* L.) is an ancient crop in India. It has potential to establish under various crop growing conditions. Currently 4842 indigenous accessions are being maintained at the Directorate of Oilseeds Research, Hyderabad. The indigenous collection includes the landraces maintained by farmers in foot Himalayan region and the local types maintained by traditional safflower farmers in Maharashtra, Uttar Pradesh, Madhya Pradesh, Orissa, West Bengal and Karnataka. Four explorations were conducted in Madhya Pradesh, Orissa, West Bengal, Punjab, Haryana, Rajasthan, Himachal Pradesh and Jammu and Kashmir.

Specific morphotypes like d1in, partial arid striped hull types, large capitula, non-spiny, appressed and semi-appressed types and spreading plant type were collected. Several accessions were identified as sources of resistance/tolerance to the major biotic stresses like aphid. *Fusarium* wilt and *Alternaria* leaf spot Ecotypes suitable to different safflower growing locations and conditions like early *rabi,* late sowing in rice fallows, minimal irrigation in black soils and salt affected soils are identified among indigenous accessions.

The phenotype and genotypic diversity in indigenous safflower was characterized. Evaluated, documented and conserved. Eleven catalogues have been brought out. So far, 64351 samples of different germplasm accessions were supplied to various researchers. Nine safflower varieties and one hybrid were developed utilizing indigenous germplasm.

For safflower wild species viz., C. *oxyacantha* and C. *lanatus*, explorations were conducted at altitudes ranging from 170-3300 m in Haryana, Punjab, Rajasthan, Himachal Pradesh and Jammu and Kashmir. The ecological niches of C. *lanatus* were identified at altitudes ranging from 1600-1700 m in saffron fields and temperate fruit orchards in Srinagar valley C. *oxyacantha w*as found growing on settled sand dunes in Rajasthan and on waste lands, field bunds and road sides in Punjab and Haryana. Fifty nine accessions of *C. oxyacantha* and two of *C. lanatus* were collected from diverse ecological niches. One of the indigenous accessions of C. *oxyacantha* served as a source of sterile cytoplasm in cytoplasmic-genetic male sterility system developed in safflower at the Directorate.

C. lanatus' and *C.* oxyacantha were identified as sources of resistance to wilt and *alternaria* Resistance to *Alternaria* is not available in cultivated safflower genepool. It was introgressed from these wild species into the cultivated species. Wilt resistance was diversified utilizing these species in introgression breeding programme.

OILSEED BRASSICA GERMPLASM: STATUS, HOT SPOTS AND PRIORITIES

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In India, working germplasm collections of rapeseed - mustard is over 14,000. Of these, 5,909 accessions are available at NRCRM, Bharatpur. Out of these, 80% of the available genetic resources are characterized for various agro-morphological traits. During last five years, this genetic resource wealth further been enriched by collecting around 800 land races and wild species in ten explorations trips, spreading all over the country covering 64 districts of 11 states. These collections include yellow seeded toria, white flower yellow sarson, dwarf Indian mustard, broad leaf toria and Indian mustard from Nagaland, etc. During this period, over 450 exotic accessions of rapeseed- mustard were acquired from Australia, Canada, China, Germany, Japan, Russia, and Iraq etc.

So far in India, 169 varieties of rapeseed- mustard have been recommended/ notified for release, of these eighty-two are of *Brassica juncea* (Indian mustard). As many as 63 varieties have been directly selected from local germplasm or using these local cultivars as one of the parent. Thirteen varieties have been released by using exotic material. Promising donors have also been identified for useful traits such as, tolerance to Alternaria blight, White rust, downy mildew, low erucic acid (single low), low glucosinolates, double low, early duration, salt tolerance, yellow seeded, tetra-locular, high oil content and apetalous trait. In addition to these 35 lines with some novel traits has been registered so far.

In India, the most common species amongst the oilseed brassica is *B juncea*, which is cultivated in approximately 80% of cropped area. Earlier, *B rapa* was prominently grown in India, specially yellow sarson. The origin of *B. juncea* (the oldest cultivated amphidiploid of *B. rapa* x *B. nigra*) is somewhere in Middle East from there it travelled to Iran, Afghanistan, China and to India through NEH region. The secondary centre of origin is NEH region of India. The origin of Asian group of *B. rapa* is Sino- Indian, again confined to NEH region. Thus, the hotspot of variability for *Brassica* group may be considered the NEH region. Where the various kind of morphological variants such as, broad leaf, dwarf, small siliquae, various siliqua arrangements, white seeded, etc., especially in *B. rapa* are still prevalent. The wild relatives in *Brassica* are not documented in India. The other hotspots are as follows:

Therefore there is a need to broaden the genetic base and the regions of higher diversity should be explored. The exploration and collection from unexplored areas / hotspots are extensively needed. Multi-location evaluation/ characterization of germplasm, and subsequently their proper documentation are required to be strengthened. The modern analytical/biochemical tools for germplasm characterization and classification is needed for effective utilization.

WILD SUGARCANE DIVERSITY IN NORTH-EAST INDIA

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India is one of the major center of diversity for the members of '*Saccharum* complex' germplasm. According to Mukherjee (1957), '*Saccharum* complex' (*Saccharum, Erianthus, Narenga, Sclerostachya*) has originated most probably in the region of common frontiers of India, Burma and China. It is a fact that north-east India comprising of seven states (Assam, Arunachal pradesh, Nagaland, Mizoram, Meghalaya, Manipur and Tripura) is extremely rich in floral biodiversity with several endemic species. The region is also rich in diversity and variability for many important cultivated crop plants such as rice, maize, citrus, mango and banana. Wild sugarcane (*Saccharum spontaneum* L.) and related wild genera such as *Erianthus*, *Narenga* and *Sclerostachya* occur frequently or abundantly in this region. It is needless to mention that wild relatives are a source of desirable genes needed for the genetic improvement of crops especially for pest/disease resistance and tolerance to abiotic stresses. Several explorations have been conducted by Sugarcane Breeding Institute in these seven states in 1984, 1985, 1989, 1990, 2004, 2005, 2006 and a large number of variable collections belonging to *Saccharum*, *Erianthus*, *Narenga* and *Sclerostachya* have been assembled at Coimbatore.   The collections are being conserved and characterized for their use in sugarcane breeding.

TECHNICAL SESSION – IV

AGROBIODIVERSITY AND ACCESS AND BENEFIT SHARING

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The Indian economy is predominantly agriculture based with nearly two third of its population engaged in Agricultural sector and one-fourth of the Gross Domestic Product (GDP) being contributed by agriculture. The Green Revolution has been one of the most striking success of the sixties in India. Green revolution also was an era of "self sufficiency" in food production and rural prosperity. However, Green Revolution also taught the Nation some valuable lesions due to the excessive application of chemical inputs like fertilizers and pesticides which affected the soil system and environment as well as the ecosystem considerably and adversely affected the soil health and sustainability. There has also been considerable erosion of agro biodiversity in the agro-ecosystem including that of genetic resources of plants, animals, fish, insects and soil microorganisms. At present large number of high yielding varieties, hybrids and farm technologies are available and at the same time "Technology Transfer" also should address the issues of "ecofriendly", "farmer friendly" "agro biodiversity friendly" in conserving and maintaining local farmers varieties and land races for the welfare of our further generations.

Cultivated plants in India belong to two categories, viz; (i) indigenous, and (ii) introduced; the latter may be further sub-grouped according to the geo-political areas from where these were introduced, i.e., from Western Asia, Africa, China, Southeast Asia and Pacific Islands, the New World and the Europe. National Bureau of Plant Genetic Resources (NBPGR) have shown a preponderance of variable land race forms/primitive types belonging to different crops of cereals, millets, legumes, vegetables, fruits, forages, fibers, sugar yielding types, spices, condiments, medicinal and aromatic plants and others grown in the diverse phytogeographical and agro-ecological regions of India. Concentration of genetic diversity comprising native species and landraces occurs more in Western Ghats, Northern Himalayas, Southern plateau, Central India and Northwestern Himalayas.

DIVERSITY OF PIPER SPECIES IN INDIA

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The institute maintains 2199 collections of Piper nigrum and related species at its repository in Peruvunnamuzhi and the AICRP centres maintain 461 accessions of Piper nigrum in the various centres. Western Ghats is the home of *Piper nigrum* (Black pepper). There are about 16 species of *Piper* available in Western ghats. The Indian Institute of Spices Research, Calicut maintains the world's largest germplasm collection of *Piper.* The institute maintains 2199 collections of *Piper nigrum* and related species at its repository in Peruvunnamuzhi and the AICRP centres maintain 461 accessions of *P. nigrum* in the various centres.

In order to understand their genetic diversity, Geographical Information System (GIS) was used to surveys various locations in Kerala and different species of *Piper* were collected. These were mapped using specialised DIVA-GIS software for plant genetic resources. The data collected were subjected to species richness of *Piper*. In a study using DIVA-GIS, the first of its kind in *Piper* research, Utpala et al (2007) reported tha species richness is clearly not homogenously distributed within the districts in Kerala. *Piper nigrum* and some of the related species has originated in Kerala. Based on the distribution and species richness, the areas where *Piper* species may be available for further surveys has been predicted. DIVA-GIS was also used to predict the possible distribution of *Piper* species in other parts of India. Based on these prediction distribution maps, it is expected that most areas of North east India, coastal Andhra Pradesh, Orissa and West Bengal are also likely to have many *Piper* species. The chances of distribution of *Piper* species in other parts of the country are remote. The ideal annual rainfall distribution for these *Piper* species range between 2200 to 2700 mm and the frequency of distribution of the *Piper* species under study is very high in these ranges even though *Piper* species do occur in areas receiving rainfall from 1500 to 3500 mm. The distribution of *Piper* species at different altitudes was also studied and mapped using DIVA-GIS. Interestingly, all these species occur in silent valley of Western *Ghats*, thereby, confirm earlier reports. The analyzed map with species of collection shows that climate and soil has impact on the distribution of wild *Piper*.

CURRENT CONCERN OF BIO-DIVERSITY OF MEDICINAL PLANTS IN INDIA

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Throughout the world, increasing interest is being expressed on conservation and utilization of biodiversity in a sustainable manner. India is also not an exceptional. India is blessed with two mega centers of biodiversity in plant species (North eastern Himalayan region and Western ghats). Indian forests possess wide range of medicinal plants that takes care the treatment of almost all variety of diseases affecting human. Traditional Indian System of Medicine has been evolved and flourished, perhaps due to this richness of diversity. Interest on local health traditions and demand for herbal products are in increasing trend in Western countries. This trend has resulted over exploitation of our natural resources causing some important medicinal plant species to become either extinct or endangered. Therefore current concern must be to address the protection of species from over exploitation and also enriching the biodiversity by creating proper environment. To achieve these goals, we need to focus on the following

1. Characterization of MP intra and inter species biodiversity;
2. Assessing magnitude and distribution of MP diversity in different states;
3. Assessment of loss of MP diversity;
4. Maintenance of inventory of MP diversity and its monitoring;
5. Effective information management and communications;
6. Assessment of economic values of MP biodiversity;
7. Measures for conservation and sustainable use of its components.

DIVERSITY IN UNDER EXPLOITED MEDICINAL PLANTS OF POTENTIAL USES

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There are twenty five global hotspots identified for their exceptional concentration of endemic species. Two of these hot spots are the Indo-Myanmar and Western Ghats/ Srilanka regions. India is the primary centre of diversity for medicinal plants. All known types of agroclimatic, ecologic and edaphic condition are met within India. The classic systems of medicines like Ayurveda, Siddha and Unani make use of only about 2000 plants in various formulations. Within our Tamil Nadu there are potential hot spots where we can explore and identify the diverse eco types of under exploited medicinal plants for their potential, uses in various healing systems of Indian medicine. To mention a few, Gymnema (*Gymnema sylvestre*), *Abutilon indicum*, *Hybanthus eneospermous*, *Leptodenia reticulata, Aloe vera, Coleus veteiveroidus*, *Wedelia chinensis*, *Tinospora cordifolia,* etc. are some of the important and potential medicinal plants of various uses, which find a place in different hot spots of importance in terms of biodiversity. The Kolli hills, Pachamalai, Anamalais, Kalvarayan and Karumanthurai are the rich sources of exploration and collection of the important under exploited medicinal plants in Tami Nadu. Efforts were made to collected and assemble the various ecotypes of those medicinal plants for their further utilization

PLANT GENETIC RESOURCE MANAGEMENT IN VEGETABLE CROPS

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About 400 species constitute the global diversity in vegetable crops. This diversity is mainly distributed in seven eight geographical regions, which represent the centres of origin and/or diversity as well. Among these, the regions possessing maximum diversity are the tropical Americin, Tropical Asian and the Mediterranean. In the tropical Asian region, both India and China hold maximum diversity. The geographic centres of origin and diversity vary from eight to twelve in number and lie between 20^0 to 45^0 latitude, north and south, and are superimposed over world's major vegetation formations/biomes/floristic zones (Good, 1953). Vavilov (1926) identified eight centres with three sub-centres of origin of crop plants where agriculture development took place independently, based on the diversity. He further recognized secondary centres of origin and pointed out that valuable forms are available from its area of domestication. A good example is tomato which is a native of South America and Mexico whereas domestication took place in Mexico (Baswell, 1949). However, Zhukovsky (1965), a close associate of Vavilov, proposed 12 megagene centres of crop plant diversity. The new areas added to Vivilov's eight centres were Australia, whole Africa and Siberia followed by revision of boundries to make 12 centres. The global genetic wealth comprising about 3000 cultivated taxa, which mainly include both primitive/native cultivars and their wild and weedy species is distributed to these twelve primary centres of diversity (Zeven and Zhukovsky, 1975). They have dealt elaborately in the Dictionary of cultivated plants and their centres of diversity, listing species for different megacentres and the range and extent of distribution of genetic/varietal/specific diversity etc. This includes centres of origin and distribution of diversity in 218 vegetable crop species in different regions of diversity viz., Chinese-Japanese (56), Indo-Chinese Indonasian-(31), Australian (1), Hindustani (11), Near Eastern (4), Mediterranean (24), African (36), European-Siberian (29), South American (18), Central American and Mexican (6) and North American (2) (Arora 1985). During the process of domestication of vegetable crops other than the centres of origin/diversity, the primitive species moved to other areas during ancient past and due to continuous mutations, crossing with the related species, evolution, and selection by man and nature would have resulted in development of the secondary centre of diversity. The primary centre of origin and domestication and secondary centres of diversity of some of the important vegetable crops (Zeven and Zhukovsky, 1975) forms important place for collection of genetic diversity.

The Indian Gene centre, holds a prominent position among the eight Vavilovian centres of the crop plant origin. Rich genetic diversity occur in about 166 crop plants including vegetables species and their wild relatives of about 320 species in the different regions of the country. A number of vegetable crops said to be originated in this region and assigned primary centre of Variability viz., eggplant (*Solanum melongena*), lablab bean (*Lablab perpurius*), cucumber (*Cucumis sativus*), ridge gourd (*Luffa acutangula*), sponge gourd (*Luffa cylindrical*), wax gourd (*Banincasa hispida*), pointed gourd (*Trichosanthes dioca*). This region is also secondary centre of diversity, for crops like *Vigna unguiculata*, *Abelmoschus esculentus*, *Capsicum annuum*, *Citrullus lanatus* and *Amaranthus* species. A number of vegetable crops introduced in ancient past which has developed variability in different parts of the country due to its domestication and diversification. Other species, which have been identified as having wide distribution in India and *Allium, Cucurbita, Coccinia*, and *Canavalia* etc. In addition, a number of introduced vegetable crops have also developed variability due to long history of domestication in climatic conditions. This group includes early, mid and mid late group of cauliflower, bottle gourd, pumpkins, French bean, carrot, onion etc.

On the basis of distribution of flora, the Indian sub-continent is divided into 8 to 10 regions wherein the entire diversity in plant genetic resources is distributed. Chatterjee (1939) suggested 8 sub-region, whereas, the Planning Commission of India has demarcated the country into 15 agro-climatic zones (Sehgal et al., 1990). Based on the physiographic, climatic and cultural features, the ICAR recognized 8 agro-climatic regions (Murthy and Pandey, 1978) which more or less superimpose with the phytogeographical regions of Chatterjee (1939).

Wild plants have often played an important role in many diets due to their higher nutritional value than cultivated species. Wild species and putative ancestral forms of vegetable crops contain valuable genes that are of immense importance in crop improvement programme using conventional methods or modern biotechnology. These genetic resources can be utilized in the development of new cultivars, strains and hybrids and also in restructuring of the existing ones that lack one or the other attribute. The distributional pattern of the wild plant genetic resources in different botanical/ phyto geographical regions and the areas of their concentration where rich diversity of wild species still continues to perpetuate, are of special significance for undertaking programmes on collection as well as for *in situ* conservation of biodiversity. The important families possessing wild genetic diversity are Brassicaceae (*Brassica*), Malvaceae (*Abelmoschus*), Leguminoceae (*Canavalia*, *Lablab, Trigonella, Vigna*), Cucurbitaceae (*Citrullus, Coccinia, Luffa, Momordica, Neoluffa, Trichosanthes*), Solanaceae (*Solanum*), Amaranthaceae (*Amaranthus*), Dioscoreaceae (*Dioscorea*), Amaryllidaceae (*Allium*), Araceae (*Alocasia*, *Amorphophallus*, *Colocasia*). The bulb of greater galangal (*Alpinia galangal* family Zingiberaceae) can also be eaten raw. In the Garwhal areas, *Cornus capitata* and *Cornus controversa* (family Cornaceae) are eaten raw. In Rajasthana, the whole plant of *Gisekia pharnaceoide* (family Mulluginaceae) is widely consumed during food shortage but in the South and West (Deccan Region) the leaves are used as greens, as are the leaves of *Glinus trianthemoides*.

Collection characterization, evaluation and conservation of germplasm is most important activities as it is eroding fast due to introduction of modern high yielding varieties/hybrids, shrinking natural resources, urbanization/industriliazation, change of cropping pattern and climate. In the past large number of germplasm have been collected from different agroclimatic zones of the country. Hence there is urgent need to identify the unexplored areas for collection of valuable germplasm of different vegetable crops for their use and conservation.

Several exotic germplasms of vegetable crops have been utilized directly as promising varieties in India. The assembled germplasm were evaluated and promising ones identified and further tried with the best local checks available and the outstanding ones were released for direct cultivation. Wild species of genus *Lycopercicon*, such as *L.*

pimpinellifoium. L. hirsutum, L. hirsutum f glabratum and L. peruvianum have been used to develop diseases and pest resistance varieties. However, there is still scope to use these species against different traits and some more species not only for stress resistance, but also for incorporation of quality and yield traits, because they offer rich variability for different desired characteristics. The vegetable production scenario in this country is undergoing several changes and the demand for fresh vegetables is increasing mainly from middle income segment of the population chiefly from urban and semi-urban areas of the country. Such market demands to adopt off-season production of vegetables, even under unfavorable conditions with lower yield but higher market price for better return. Seasonality in vegetable production, availability and consumption is fast disappearing. Hence genetic resources in vegetables have to be sought not only for increased production, disease and pest tolerance but also for tackling abiotic factors like heat or cold tolerance, rain fed and semiarid conditions etc. Besides, there is growing awareness of the advantages of healthy food habits, like increased vegetable consumption and the intake of important nutrients like proteins, vitamins and minerals is facilitated by enhanced vegetable consumption.

IIVR is the National Active Germplasm Site for PGR Management of vegetable crops in India designated by NBPGR, New Delhi. Accordingly a total of 6700 germplasm including 1250 in tomato, 620 in brinjal, 340 in chili, 760 in okra, 210 in cauliflower, 425 in pea, 267 in bitter gourd, 215 in pointed gourd, 190 in bottle gourd, 124 in pumpkin, 210 in cucumber, 360 in dolichos and more than 1500 in other vegetable crops are being maintained. In addition rich genetic resources of underutilized vegetable have been collected which includes, 221 in ash gourd, 65 in spine gourd 32 in sweet gourd, 57 in cho-cho, 109 in chenopod, 36 in basella, 168 in curry leaf, 21 in leak, 46 in lettuce, 13 in mellow, 105 in kale, 199 in drumstick, 546 in dolichos, 128 in faba bean, 17 in asparagus, 261 in Amaranth. These germplasm have been characterized for a set of agro- morphological characters and resistance to biotic stresses. In process the resistant lines in tomato, chilli, brinjal, okra, snap melon have been identified for important biotic stresses. Efforts have also been made for development of RILs for ToLCV resistance, early blight resistance, Lycopene content, fruit characters, drought resistance and heat tolerance in tomato, Chilli virus resistance and fruit traits in chili, downey mildew resistance and fruit traits in melon. The details have been discussed in the text

STUDIES ON GENETIC DIVERSITY IN NATURALLY DISTRIBUTED POPULATIONS OF GAMBOGE TREE (*Garcinia gummi-gutta* L.) OF CENTRAL KERALA

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Gamboge tree (*Garcinia gummi-gutta* L. Syn: *G. Cambogia* Desv) belongs to the family Clusiaceae. It is typical cross pollinating tree crop. It has commercial medicinal and industrial value. Hydroxyl citric acid is obtained form the fruit rind. It is used as a medicine against obesity based cardiac problems and fetches high foreign exchange. It is a potential under – exploited crop. Studies on genetic diversity is very meager in this fruit tree crop.

Two thousand one-parent families of Gamboge tree, which are naturally distributed in the altitudes ranging from 0.00 M mean sea level to 2000 M mean sea level (Central Kerala), forms the base population of the present investigation. These 2000 one – parent familes were evaluated for single tree fruit yield. One hundred and twenty one parent families (plus trees), which has a single tree fruit yield of more than population mean +2SE were selected. This 120 one – parent families constituted the experimental material for the present investigation. These 120 one-parent families are distributed in 32 panchayats of three important districts of central Kerala (40 in each district) viz., Kottayam (151 M above MSL), Pathanamthitta (20 M to 150 M above MSL) and Alapuzha (0 to 20 M above MSL). Observations were recorded on 15 fruit characters including hydroxyl citric acid content. The D^2 estimates were made following Mahalonobis (1936), as described by Rao (1952). Clusters were prepared following Tocher method (Rao, 1952). The study was conducted during 2000 - 2001.

It was found out that the genotypes hailing from the same panchayat and altitudes were grouped into different clusters and the genotypes hailing from different panchayat and altitudes were grouped into the same cluster. Genotypes hailing from Pathanamthitta and Alapuzha districts exhibited wide range of diversity. Hydroxy citric acid content contributed maximum towards genetic diversity.

WESTERN GHATS: A MEGADIVERSITY HOT SPOT IN INDIA FOR HORTICULTURAL CROPS

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Western Ghats one of the 34 biodiversity hot spots of the world, cover an area of about 160,000 km² and stretch for 1,600 kilometers from the country's southern tip to Gujarat in the north, interrupted only by the 30 kilometers Palghat Gap. The wide variation of rainfall patterns in the Western Ghats, coupled with the region's complex geography, produces a great variety of vegetation types. These include scrub forests in the low-lying rain shadow areas and the plains, deciduous and tropical rainforests up to about 1,500 meters, and a unique mosaic of montane forests and rolling grasslands above 1,500 meters.

The Western Ghats, with a latitudinal range of more than 10 degrees, lies more or less parallel to west coast of India. Its forests are one of the best representatives of non-equatorial tropical forests in the world. The Indian region is one of the world's eight centres of crop plant origin and diversity. In horticultural crops, genetic diversity is well represented in India with the occurrence of 190 species of economic importance in fruits (109), vegetables (54) and spices and condiments (27). These includes turmeric, ginger, pepper, banana, bitter gourd, brinjal, okra, coconut, cardamom, jack fruit, taro, indigo, amaranthus, mango, and gooseberries. Species, which may have originated exclusively in India, include mango, taro, cucumber, pigeonpea, pepper, eggplant, and cardamom. While the species diversity among Indian crops is significant, what is truly mind-boggling is the genetic diversity within each of these species. One species of mango (*Mangifera indica*) has yielded over 1000 varieties, ranging from the size of a peanut to a muskmelon. Other crops with rich diversity in India include, legumes, okra, eggplant, banana, and jackfruit, *jamun*, ginger, turmeric, pepper, cinnamon, cardamom, sweet potato, yam, kidney beans, and velvet bean, coconut. In Western Ghats the following horticultural crops rich diversity is found: cowpea, *Dolichos* bean, sword bean Okra, eggplant, cucumber, chilli/ *Capsicum,* Taros, yams, elephant-foot yam, Jackfruit, banana, lime/lemon, orange, *jamun*/Syzygium black pepper, turmeric, ginger, coconut, arecanut, IIHR carried out exploration, missions for collecting the diversity in our mandate horticultural crops from western ghat region. The diversity collected has been used to breed better genotypes. Our experience in terms of the diversity collected in these crops will be discussed in this paper.

BIODIVERSITY OF CALOCYBE, VOLVARIELLA AND PLEUROTUS

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Globally 41,000 mushroom species have been reported; about 850 species are known to occur in India. The genera *Calocybe*, *Volvariella*, and *Pleurotus* show wide variation in their geographical distribution, substrate preference, colour and shape. They represent 25-28% of world mushroom production. Biodiversity of these fungi offer greater scope for pharmaceutical, nutriceutical and biopesticidal molecules for human welfare.

Calocybe is a grassland fungi and has approximately 20 species described worldwide (Singer, 1986; Pegler, 1983). *Calocybe indica* P &C is native to India and was first reported by Purkayastha and Chandra (1974). Krishnamoorthy *et al* (1998) from Coimbatore, India released the world's first commercial milky mushroom variety APK2. *C. gambosum*, *C. eborina*, *C. cyanocephala*, *C. cyanea*, *C. onychina*, *C. rubra*, *C. cyanello* *C. bipigmentata*, *C. alneti*, *C. coniceps*, *C. atropapillata*, *C. cyanocephala* are some of the *Calocybe* spp reported from different regions of the world. Erode, Namakkal, Coimbatore, Salem districts of Tamil Nadu are hot spots of this genus and more than 25 wild isolates have been collected.

The genus Volvariella has more than 100 species distributed world-wide. In India, 13 species of *Volvariella* have been recorded. However, *V. volvacea, V. dipasia* and *V. esculenta* are common species under cultivation.

Pleurotus was described first by Fries (1874-1878). Based on the species diversity Singer (1975) classified the genus in to five categories *viz*., *Lepiotarii*, *Pleurotus*, *Calyptrati*, *Lentodiellum* and *Tuber regium* which includes many of the *Pleurotus* spp. In India *P. cornucopiae*; *P. flabellatus*; *P. eous*; *P. opuntiae*; *P. fossulatus* have been reported to occur in different geographical locations with diverse host preference. *P. platypus* (Marimuthu *et al*.,1991); *P. citrinopileatus* var.CO1 and *P. djamor* var.MDU 1 (Sivaprakasam *et al*.,1986;1995); *P. salmoneostramineus* var.*roseus* Corner (Krishnamoorthy *et al.*, 1997); *P. eous* var.APK1 (Muthusamy *et al.*,1998) and *P.ostreatus* var.Ooty 1 (Mohan *et al.*, 2000) collected from Western-Ghats of TN have been commercially exploited.

BIO-DIVERSITY OF VEGETABLE CROPS IN KULLUVALLEY IN NORTH WESTERN HIMALAYA

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Himalayan ranges are home to a wide array of plants, wild as well as cultivated species, their land races, farmers varieties Kullu valley located at altitudes of 1000-4000m which has a temperate monsoonal climate exhibits a rich repository of vegetable crops in addition to medicinal and field crops. If exploited properly they may serve as gifted source of varied genes including those for resistance to biotic and a biotic resources.

Several species of *Allium* including *A. ascalonicum*, *A. ampeloprassum*. *A. Schoenoprassum* besides the cultivated varieties of *A. cepa* and *A. Sativum* are observed growing in wild. Similarly a number of species belonging to genus *Amaranthus* viz., *A. caudanis A. Cruentis A. Spinpsus. A. blium* and *A. tricolor* have been found growing on sporadic locations in the valley. Plants of *Chenopodium album* and *C. opulifolium* grow in the cultivated fields as weeds. A rich diversity of *Phaseolus vulgaris. P. lunaaus. P. aconitifolitam* and *P. grandis* exists in various parts of the valley. Some varieties of which are established and recognized landraces maintained by farmers through generations. Wild relatives of *Spinacea oleraceu* are found growing on heights in wilderness. *Brassica cumpestris* var *rapa* is generally grown as root crop. Its wild relatives are grown widely in the villages of consumption as leafy vegetable. There are also reports of wild relatives of *Dancus carota* growing as weeds. There species of *Fugopyrum* & Several belonging to genus *Solanum* are observed growing in abundance as weeds. The richness in case of medicinal and aromatic plants is endless. In a similar fashion several farmers varieties and landraces of maize, barley, rice and millets are bring maintained by the farming community of the valley.

There have been sporadic and non-concerted efforts in the past to explore and documents the naturally occurring diversity in the valley. A substantive project for this purpose will do a lot to unearth the rare genes present in this treasure of biodiversity.

TECHNICAL SESSION – V

AGROBIODIVERSITY HOTSPOTS IN EASTERN GHATS – ISSUES AND CHALLENGES

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Eastern Ghats are located between 77^0 22' & 85^0 20' E and 11^0 30' & 21^0 0' N and spread over 75,000 Km^2 in 38 districts of 6 states. At least 54 tribal communities are aborigines of Eastern Ghats ecosystem harnessing biodiversity for their livelihood. Several eminent botanists (Haines, Gamble, Fischer, Ellis, Mathew, Seshagiri Rao, Subba Rao, Pullaiah etc.) recorded the floristic wealth of over 2600 flowering plant species occurring in the region. National Bureau of Plant Genetic Resources conducted over 100 exploration missions in the region for the past two decades collecting, conserving and documenting about 15,000 landraces/ accessions of agrobiodiversity.

Eastern Ghats are perceived differently by foresters (ever green, deciduous, savannah, scrub etc.), ecologists (wet land, dry land, plains, high altitude), tribes (forest products for food, health and money, shifting cultivability etc.) and agriculturists (rainfed, irrigated). The new dimension emerged of late is the legal angle to protect the plant varieties, biodiversity and environment largely at the national level. Landraces/ germplasm/ extant varieties are the basic building blocks exploited by plant breeders (as defined in Plant Varieties Protection and Farmers Rights Act) to develop and/or commercialize modern plant varieties.

Landraces evolve over thousands of years in ecosystems designed/ modified through a selection pressure operated by the native communities. Invasion of culture and advancements in agriculture often with tribal development as a motive interfered with the natural evolutionary process of landrace development. In view of the importance of the landraces, global awareness on biodiversity, environment and plant variety rights on commercial exploitation, it has become necessary to identify natural ecosystems, hotspots and heritage sites etc of agrobiodiversity for effective conservation and utilization. The issues involved in the process have social, economic, legal and scientific dimensions. Cultural traditions, food preferences, life style & habitats, available income options, influence of leadership, connectivity (transport and information technology) etc pertaining to tribal communities, naturally occurring populations of plant species & their wild relatives, associated organisms including microbes and pollinators need to be taken in to consideration while identifying agrobiodiverstiy hotspots. Selection criteria might vary in different ecosystems and in different crops, which primarily depends upon the breeding system involved.

Our experience in eastern ghats indicate occurrence of hotspots for landraces of paddy, sorghum, minor millets, red gram, cowpea, green gram, black gram, horse gram, castor, niger, pongamia, mahua, brinjal, chillies, okra, cucumber, gourds, beans, tuber crops, leafy vegetables, mango, banana, custard apple, wood apple, bael, tamarind, jamun, turmeric, ginger, curry leaf and pillipesara etc..

There are several challenges in identifying and conserving agrobiodiversity hotspots with the objectives of facilitating natural co-evolution of landraces, protecting the interests of dependent communities and the country rights at large acquired and being implemented through Biological Diversity Act, PVPFRA, Environmental Protection Act etc.. The issues and challenges in this context are discussed citing examples from Eastern Ghats.

BIODIVERSITY OF CROP PLANTS IN HARYANA

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Agricultural Biosecurity for crops, trees is of great importance since it relates to the work and income security of very large section (about 65 percent) of the population, and food and trade security of the state. Haryana has a considerable heritage of biodiversity in its different agro-climatic zones. Haryana is a small state having two well defined zones i.e. North-Eastern (sub humid & high rainfall) and South-West Haryana (Arid to semiarid region). Based on agro climatic conditions different fruit crops and germplasm occupies different niches. Shivalik foot hills (Ambala, Panchkula, Yamunanagar, Jagadhari, Karnal, Panipat) of eastern region are rich in different fruit crops like Mango, Peach, Plum, Pear, Litchi, Sapota and Loquat. Alluvial plains (Kurukshetra, Faridabad, Gurgaon, Karnal, Sonepat, Panipat, Kaithal) of this zone are rich for Guava, Aonla, Peach, Jamun, Mulberry, Grapes. In the Western Zone Aluvial plains (Hisar, Rohtak, Bhiwani, Jhajjar, Mahendergarh) are famous for Citrus, Grapes, Phalsa, Guava, Aonla, Jamun, Pomegranate, Phalsa, Bael and Ber, while sand dunes areas (Sirsa, Hisar, Bhiwani, Rewari, Mahendergarh) have abundance of Citrus, Ber, Aonla, Phalsa, Karonda and Pomegranate.

Shivalik foot hills of North Eastern region are also rich in natural vegetation of Medicinal and Aromatic Plants like Khair, Amaltas, Chid, Toon, Harar, Bahera, Kathal, Barna (tree spp.) Vasaka, Karounda Euphorbia, Wooddfordia and Murray spp (shrubs) and Dioscorea, Vetiver and various aromatic grasses. The South-West part mainly comprising Aravali Hill areas are rich in tropical thorn forests spp. of Teant/Kair, *Prosopis cineraria* (Jandeli), Jal, Sagargota, *Acacia* sps, *Cactus* sps. Guggal Guarpatha, Lasora, Karonda and Maha neem.

The locally available germplasm can be collected by farmers and para-professional in agriculture and conserved in situ. Above mentioned areas can be explored for the conservation of land races of various crops which are rich in agro biodiversity in different regions of the state. Hence we can prevent some of our genetic treasurer becoming ‘hotspots’ from the point of view of threat to biodiversity.

BIODIVERSITY AND PLANT BREEDING

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Conservation of biodiversity in the wake of depleting natural resources has assumed considerable significance and worldwide importance. Biological diversity, particularly genetic diversity in crop plants comprising land races, primitive cultivars and related wild taxa has always played an important and very vital role in crop improvement ever since man and woman began domesticating wild plants well over a millennium ago. The prevalence of genetic diversity provides greater opportunities for crop improvement today and in distant future when confronting situations would demand reconstruction of new cultivars and hybrids for sustaining higher production and productivity. It is now widely recognized that these genetic resources are under considerable threat as a result of destruction of ecosystems habitats, changes in land use patterns, and modern agricultural practices that have already replaced many of the local varieties and land races with modern varieties / hybrids and clones with much restricted genetic diversity. The reduction in the genetic diversity is a serious danger to future plant breeding programme. Thus the conservation of plant genetic wealth is of considerable importance to the progress and useful application of new emergent techniques of molecular biology and genetic engineering.

In this connection, twenty four explorations were conducted to different places in the Tamil Nadu to collect the land races and wild species of field crops during 2001 - 2004. The total number germplasm collected were 333 comprising of different field and horticultural crops. The characterisation was made according to the NBPGR descriptor. The genetic variability was more in rice accessions. It was followed bysorghum, ragi, cumbu. The horsegram and field bean have enough variability and are concentrated in Dharmapuri district. The seeds of the collected accessions were sent to long term conservation to NBPGR, New Delhi. The passport data of all the collected accessions were documented and placed in the data base. Based upon the needs, the materials are being utilized in crop improvement program.

STATUS OF BIODIVERSITY IN PUNJAB

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Punjab is located between 29° and 32' N latitude and 74° 77' E longitude. Phsiographically, it is situated in the NW part of India between rivers Ghaggar and Ravi. The state has 85% area under agriculture and about 6% area under forests. Thus, the cropland ecosystem is the dominant ecosystem in the state. The state was known to harbour great genetic variability amongst crop plants. However, over the years, the change in cropping pattern has resulted in emphasis on monoculture farming, resulting in a loss of domesticated biodiversity.

Though large scale bio-diversity studies have not been carried out in the state, however, a large number of flora and fauna have been recorded from the forest areas and wetlands. Gymnosperms and angiosperms account for 32.8% and 12.9% of species in Punjab with reference to India. As far as domesticated plant biodiversity in Punjab is concerned, the number of pre- and post-green revolution varieties are 41 and 37 for wheat, 31 and 18 for rice, 4 and 18 for maize, 18 and 34 for pulses and 8 and 27 for oilseeds. Thus, the state has considerable genetic diversity for a given crop species. However, the varieties in active commerce for these crops are very low, thereby resulting in a gradual depletion of diversity.

For vegetable crops like muskmelon; Amritsar, Gurdaspur, Hoshiarpur, Ropar and Mansa districts have been identified as potential areas of diversity. Varieties of chilli like Shahkoti, Jaaun Mirch, Sanauri, Sathi Mirch and Launi are endemic to Jallandhar, Ropar, Patiala, Amritsar and Gurdaspur districts, respectively. For other vegetables like cucumber, radish, garlic, carrot, onion, okra and spinach, only one or two varieties are cultivated throughout the state, thus, resulting in narrowing down of the genetic base.

Hence, due to monoculture, our crop ecosystems are facing problems of over-exploitation and degradation. However, the state has many botanical gardens which can play an important role in the protection of the plant species. Also, the establishment of Punjab Biodiversity Board in December, 2004 as a statutory body under the Biological Diversity Act, would go a long way in conserving the states' biodiversity and regulating the commercial utilization of biological resources by industrial and commercial entities so that local communities get an adequate share of economic benefits arising from the use of these resources.

DEVELOPMENT OF STRESS TOLERANT TRAITS IN REGIONAL CULTIVARS

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India is an agrarian country with 65% of its population depending on it as a main income and employment source. As one of the oldest civilizations practicing agriculture, India has a rich resource of traditional biodiversity preserved and practiced by local communities. Over the last couple of decades, with the beginning of the Green Revolution, the seeds of the high yielding varieties of crops (HYVs) have appeared as a great new hope for the farmers, however, with a high demand of irrigation and chemical fertilizers leading to an emerging agro-ecological crisis.

One of the major reasons for the shift from regional or more appropriately traditional cultivars is due to the impact of emerging markets, which insist on supply chain and packaging friendly varieties, colour, size and shelf life; and insist more on consumer preferences in terms of the above parameters.

The demand for regional crop varieties has taken a back seat due to the impact of such markets; leading to neglect of the different properties of the regional cultivars like disease and pest susceptibility, climate tolerance, yield, flavour, aroma, etc

The Agricultural Biotechnology Support Project II is a project that focuses on the safe and effective development and commercialization of bio-engineered crops as a complement to traditional agricultural approaches to boost food security, economic growth, nutrition and environmental quality. One of its missions in the project is the development of pro-poor regional cultivars with stress tolerant traits for sustaining and popularizing those neglected biodiversity important varieties; thereby promoting their access to the market and benefiting the local farming communities involved in preserving such varieties.

An important factor influencing the biodiversity flow is global collaborations, wherein, certain sturdy trait genes are identified and introduced into specific national varieties. Although conservation of national biodiversity is of paramount importance, scientists need to be open to breeding plant varieties with minimum restrictions with respect to germplasm flow across borders to address issues on global food security.

TECHNICAL SESSION – VI

NATIONAL BIODIVERSITY AUTHORITY AND ACCESS AND BENEFIT SHARING

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The Biodiversity Act - 2002 primarily addresses access to genetic resources and associated knowledge by foreign individuals, institutions or companies, to ensure equitable sharing of benefits arising out of the use of these resources and knowledge to the country and the people. Section 3 and 4 are the important sections for access of bioresources, traditional knowledge as well as transfer of research results (Technology) on biodiversity of India.

To regulate the access of biodiversity a three tier structure at the national, state and local level is established under the Biological Diversity Act, 2002. National Biodiversity Authority (NBA) deals with all matters relating to requests for access by foreign individuals, institutions or companies, and all matters relating to transfer of results of research to any foreigner and approval for IPR related bioresources. State Biodiversity Boards (SBB) deals with all matters relating to access by Indians for commercial purposes. The Indian industries are required to provide prior intimation to the concerned SBB about the use of biological resource. The SBBs have the power to restrict any such activity, which violates the objectives of conservation, sustainable use and equitable sharing of benefits. The Biodiversity Management Committees (BMCs) are set up by the State Biodiversity Boards at local level in every Panchayat in their respective areas for conservation, sustainable use, documentation of biodiversity and chronicling of knowledge relating to biodiversity in People’s Biodiversity Register (PBR). Any person referred to in sub section (2) of section 3 of the Biodiversity Act, 2002, who intends to obtain any biological resource occurring in India or knowledge associated thereto for research or for commercial utilization or for bio survey and bio utilization or transfer the results of any research relating to biological resources occurring in, or obtained from, India, shall make application to the National Biodiversity Authority. The NBA and SBBs are required to consult the concerned BMCs on matters related to use of biological resources and associated knowledge within their jurisdiction. Also to check bio piracy, the Biodiversity Act, 2002 provides that access to biological resources and associated knowledge is subject to terms and conditions by way of agreements between the access applicant and NBA, which secures equitable sharing of benefits to the local community through National Biodiversity Fund (NBF).

The National Biodiversity Authority while granting approvals under Section 19 or Section 20 ensures that the terms and conditions subject to which approval is granted secures equitable sharing of benefits arising out of the use of accessed biological resources, their by products, innovations and practices associated with their use and applications and knowledge relating thereto in accordance with mutually agreed terms and conditions between the person applying for such approval, local bodies concerned and the benefit claimers. Fair and equitable share of benefit is governed by section 21 and Rule 20 of Biological Diversity Rules, 2004 on case by case basis. The share of benefit sharing out of the use of bioresources shall be decided by NBA in consultation with the local bodies. The benefit claimers are conservers of biological resources, creators and holders of knowledge and information relating to the uses of biological resources. While granting approvals, NBA will impose conditions, for securing equitable share in the benefits arising out of the use of biological resources occurring in India or knowledge relating to them. These benefits includes monetary gains, grant of joint ownership of Intellectual Property Rights, transfer of technology, association of Indian Scientists in Research and Development, setting up of venture capital fund etc. The present paper will discuss the process of implementing Access and Benefit sharing of bioresources of India by NBA as per the Biodiversity Act, 2002.

ACCESS & BENEFIT SHARING OF AGRICULTURE RELATED TRADITIONAL KNOWLEDGE

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INDIA being a country with rich traditional knowledge in agricultural practices, there is an urgent need to systematically collect and document the same and create a database which could be used across the country and derive maximum benefits to the farming community. Benefit sharing is defined as sharing of knowledge derived profits in an equitable manner arising out of the use of accessed biological resources, their by-products, innovations & practices associated with their use and applications & knowledge relating thereto, in accordance with mutually agreed terms and conditions between and among the stakeholders.

TBGRI in consultation with the tribal community has worked out a benefit sharing model. According to this arrangement, the TBGRI has agreed to share 50% of the license fee and royalty with a tribal community. A team of scientists undertook an ethnobotanical field study in the tribal inhabited Western Ghat region of Kerala. During this study they came across an interesting ethnomedical information on a wild plant known as *Trichophus zeylanicus*, locally called as “Arogyapacha”.

The scientists observed that the tribals accompanying them frequently ate some fruits which kept them energetic and agile. When asked about the source of the fruits, they were initially reluctant to reveal the information. The team convinced and assured the tribals that the information provided by them would not be misused and that, they would carry out scientific investigation. If any marketable drugs/products get developed, the benefits accrued would be equally shared with the tribal community. The tribe then showed the plant from which the fruit was obtained. The plant was identified as *Trichophus zeylanicus.* The presentation will discuss further updates on the model.

TRADITIONAL KNOWLEDGE AND AGRO-BIODIVERSITY HOTSPOTS

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Research on Biodiversity Hotspots has served the purpose of providing guiding principles for conservation investments. Diversity of vascular plants, non-fish vertebrate diversity notably birds, mammals, reptiles, amphibians and endemism are the key criteria used in fixing a biodiversity hotspot according to Mittermeier *et. al. (2001).* Nagarajan (2007) has suggested that agrobiodiversity hotspots may be treated as a sub-system within the biodiversity hotspots framework. The paper attempts to view Agrobiodiversity Hotspots in the light of the centre of origin and dispersal of crop plants outlined by Harlan (1992) and the recommendation by the Task Force on application of Agricultural Biotechnology, (2004) calling for setting aside important centres of origin and diversity as "Agrobidiversity Sanctuaries". The author suggests two independent pathways of action: i) Use of a Gene-ecological Approach for identification and operationalization of Agrobiodiversity Hotspots and ii) People based pathway for dealing with non descript breeds of cattle, sheep, goats, ducks and other livestock and number of cop varieties held by farmers that cannot be "fixed" to certain locations but are certainly of value in the long run. The NBA could substantially aid the effort through the People's Biodiversity Registers (PBRs) and providing recognition and reward to individual conservers of novel genetic resources and supporting a network of such individuals at the district or regional level.

ISSUES IN OPTIMAL USE OF BIO-RESOURCES AND BENEFIT SHARING

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Biological diversity is fundamental to agriculture and contributes for feeding the millions of population of the world. Due to climate change, increase in population, urbanization, changes in life styles and food habits, globalization of production systems and trade biodiversity is declining at a rapid pace. Access to biological resources and associated traditional knowledge, innovations and practices, and the sharing of benefits from the use of these resources rests on the concepts which are complex, multifaceted, dynamic subject to changing realities and interpretations and thus hard to define unequivocally.

The issue of access and benefit sharing involving bio-resources and traditional knowledge has however become a rather contentious subject of wide ranging discussions and debates at various national and international forums. The existing inequities in the existing framework and the disproportionate distribution of biodiversity and biotechnologies across the world have been the major impediments for implementing a dynamic and transparent mechanism for regulating and monitoring access, benefit sharing, technology transfers and IPR protection and other relevant activities related to bio-resources and associated traditional knowledge. Following are some of the issues concerning the access and benefit sharing mechanism of bio-resources use and benefit sharing.

- Considering all the stakeholders involved in the process of access and benefit sharing in terms of their role, functions, strength and weaknesses.
- Recognizing the existing system of governing the bio-resources access and associated knowledge, innovations and practices.
- Role of bio-resources in sustaining the local livelihood systems.
- Protection of common resources and knowledge
- Method of evaluation of bio-resources use - both tangible and intangible
- Equitable share of benefits
- Awareness among the stakeholders
- Demarcation of responsibilities of various agencies/ organizations / institutions.
- Empowering the institutions involved
- Co-ordination among the departments / institutions
- Ensuring the common goal

AGROBIODIVERSITY HOTSPOTS MANAGEMENT AND PROCEDURES FOR ACCESS AND BENEFIT SHARING

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This paper briefly describes MSSRF experiences in dealing with conservation and sustainable use of agrobiodiversity, which include the major issue of access and benefit sharing. The cases are drawn from three agrobiodiversity hot spots of India – (i) the Jeypore tracts of Orissa, (ii) Kolli Hills in Tamil Nadu and (iii) Wayanad districts from Kerala. Agrobiodiversity hospot is defined as the area, which holds especially high numbers of traditionally cultivated and domesticated varieties and breeds, their wild relatives, but faces extreme threats with extreme loss of genetic diversity, traditional land use and crop management practices.

For example, MSSRF study shows rice in Jeypore tracts of Orissa, rice, pepper, roots, tubers and medicinal plants in Wayanad and small millets in Kolli Hills are being experienced complex survival issues at *onfarm* level because of a number of reasons. So is the case of traditional land use and land cover management practices that are design more pro-nature. The paper highlights MSSRF's initiatives in arresting the rapid loss of such diversity and revitalizing the conservation traditions of the local communities. The different systems of conservation, farmers' varieties involved, the institutions involved in preserving conservation traditions and the steps undertaken for access and benefit sharing are discussed in detail. MSSRF's experience shows benefit of conservation is a value, which people assign to goods and services, including those provided by nature as well as those created and improved through human efforts. Benefits have social, spatial and temporal dimensions and include diverse items such as socio-cultural, ecological and technological benefits. Benefits can be both direct i.e. used directly in consumption or production (crops, livestock) or indirect i.e. benefits arising from the ecosystems and habitats.

USE OF TRADITIONAL KNOWLEDGE OF PLANT GENETIC RESOURCES IN AGRO-BIOTECHNOLOGICAL INNOVATIONS AND SHARING OF BENEFITS

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The Convention on Biological Diversity and the National Biodiversity Act, 2002 and various international treaties that have become binding to the contracting parties have conservation and sustainable use of plant genetic resources for food and agriculture along with fair and equitable share of benefits arising out of their use as core objectives. Access and benefit sharing (ABS) are thus important, despite being complex and contentious issues with the mechanisms for operation being prior informed consent, mutually agreed terms and benefit sharing agreements. The US patent on basmati rice was in certain ways a blatant infringement of accessing the basmati germplasm conserved by the farmers of northwest India for centuries, deploying them in product development, patent and commercialization with no regard to benefit sharing. Basmati case was a classic study of IPR issues and a curtain raiser for India to accelerate its efforts in enacting and implementing its laws for protection of the native and new agri-biodiversity of the country. Sharing of benefits with the *Kanis,* the tribal community in Kerala, by the Tropical Botanical Garden and Research Institute (TBGRI) has been acclaimed as finest example of validating the indigenous knowledge associated with *Trichopus zelanicus* in developing anti-fatigue herbal drug – *Jeevani.* While the scientific community and the policy makers are thus engaged in developing model agreements for ABS components, the access to technology as well as its utility and commercialization is much more complex in the frontier areas of research like biotechnology. To deliberate on the issue of ABS further, three case studies related to rice biotechnology are summarized below.

The subject of the first case study is intellectual property rights and benefit sharing arrangements associated with the cloned gene *Xa21*, which was isolated from a wild rice of Mali (Africa) called *Oryza longistaminata*. *Oryza longistaminata* is generally considered a weed but the Bela community had observed that it never contracts any diseases, which normally affect cultivated rice. A specimen of *O. longistaminata* was originally accessed in Mali and transferred to Central Rice Research Institute, Cuttack where Dr S. Devadath observed its resistance to bacterial leaf blight (BLB), which is one of the most serious rice diseases. The blight resistant specimen was transferred to International Rice Research Institute (IRRI), in the Philippines. At IRRI, it was determined that the resistance was encoded by a single locus/gene called *Xa21* and bred a near isogenic line of IR 24 called IRBB 21 with high BLB resistance through convential methods under the guidance of Dr GS Khush. Later Dr Pamela Ronald, Professor, University of California, Davis, USA found the precise chromosomal location of *Xa21* on chromosome 11 through fine mapping strategy and cloned the gene and secured a patent on the gene. After the grant of the patent, since all this research was pursued utilizing grants from public sector, Dr. Pamela Ronald set up a Genetic Resource Recognition Fund (GRRF) to share the benefits arising from the commercial utilization of the patented gene with the stakeholders in Mali and other developing countries. It was also determined that the fund shall be used to provide fellowships to agriculture students and researchers from Mali, the Philippines and other countries where the wild rice is found, so as to build capacity in the donor country. *Xa21* is an excellent example where a transgenic technology was developed through public sector funding and benefits are shared rightfully with all the stakeholders.

Golden rice technology is another example to study the access and benefit sharing arrangements critically. Golden rice refers to the transgenic rice possessing genes for biosynthesis and accumulation of β carotene in the endosperm. Normal rice endosperm is devoid of β carotene in its milled form. Realizing the fact that consumption of milled rice by poor rice consumers is one of the primary reasons for Vitamin A deficiency is many developing countries, Prof. Ingo Potrykus (Switzerland) and Prof. Peter Beyer (Germany) together transferred genes from Daffodil and a soil bacterium into rice and developed prototype version of Golden rice in the year 2000 in the genetic background of Taipei 309, a Japonica rice variety. The funding for development of Golden rice came from public sector (Rockefeller Foundation). In order to ensure the smooth flow of the technology to developing countries, the inventors formed a non-profit consortium called 'Golden rice humanitarian board' (GRHB) and transferred the licensing rights of Golden rice to the multinational company AG Novartis (which later became Syngenta). It was also announced that any farmer can cultivate Golden rice freely provided his income from the sale of crops he cultivates does not exceed US$ 10000. Three more versions of golden rice have been developed through collaborative work between Syngenta and GRHB and the latest version called SGR 2 possesses 32 µg of carotenoids per g of endosperm. Seeds of SGR2 were received by IARI, New Delhi in 2006 and it is anticipated that homozygous lines of Golden rice lines in the genetic background of Indian rice varieties would be available for cultivation only by 2011-12 after completion of regulatory procedures. Golden rice represents a technology which can benefit the poor rice consumers nutritionally with an established mechanism of benefit sharing between the developers and farmers. But the access to the benefits of golden rice is getting delayed due to the delay in technology refinement process.

The third example is the development of transgenic rice capable of tolerating drought and salinity. The technology involves introduction of transgenes for production of high levels of Trehalose in rice. It was primarily developed by Cornell University (Prof. Ray Wu) using public funds. Realizing the long term benefits of the technology, Cornell University obtained patent rights for the transgene constructs and developed a framework for technology transfer to developing countries including India under the aegis of USAID so that the transgene constructs could be deployed in high yielding rice varieties by public sector laboratories. Genetic transformation work is in progress in different laboratories in India and it is expected that stable, homozygous lines will be available in another 3-4 years for testing, evaluation and eventually commercial release. Thus, the Trehalose rice technology is an example of public to public partnership wherein access has been given to the public sector for R & D work, with an established agreement with respect to benefit sharing by all the stakeholders.