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Biodiversity and strategies for conservation of rare, endangered and threatened medicinal plants

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ABSTRACT

Biodiversity refers to the numbers, variety and variability of living organisms and ecosystem. India is one of the world's top 12 mega diversity countries with 10 bio geographic regions. India alone includes two among the world's eight biodiversity hotspots. The climatic and altitudinal variations, coupled with varied ecological habitats of this country, have contributed to the development of immensely rich vegetation with a unique diversity in medicinal plants which provides an important source of medicinal raw materials for traditional medicine systems, as well as for pharmaceutical industries in the country and abroad.World Health Organization has listed over 21000 plant species used around the world for medicinal purpose. In India, about 2500 plant species are being used in indigenous system of medicine. The red data book lists 427 Indian Medicinal plant entries on endangered species, of which 28 are considered extinct, 124 endangered, 81 rare and 34 insufficiently known.The dedicated medicinal plants are used by various tribal's and local people to cure different ailments ranging from simple injuries, wounds, cuts, fever, diarrhoea, ulcers, swelling, bone fractures, potency, antidote, skin care, night blindness, toothache, asthma, cough & cold. Medicinal plants occupy a vital sector of health care system in India and represent a major national resource. Hence, there is an immense need for conservation of diversity of medicinal plant wealth for the present and fore coming generations, by adapting the suitable strategy with most appropriate method of conservation.

INTRODUCTION

The World Health Organisation (WHO) estimated that 80% of the population of developing countries rely on traditional medicines, mostly plant drugs, for their primary health care needs. Also, modern pharmacopoeia still contains at least 25% drugs derived from plants and many others which are synthetic analogues built on prototype compounds isolated from plants. Demand for medicinal plant is increasing in both developing and developed countries due to growing recognition of natural products, being non-narcotic, having no side-effects, easily available at affordable prices and sometime the only source of health care available to the poor. Medicinal plant sector has traditionally occupied an important position in the socio cultural, spiritual and medicinal arena of rural and tribal lives of India [1].

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Medicinal plants as a group comprise approximately 8000 species and account for around 50% of all the higher flowering plant species of India. Millions of rural households use medicinal plants in a self-help mode. Over one and a half million practitioners of the Indian System of Medicine in the oral and codified streams use medicinal plants in preventive, promotive and curative applications. There are estimated to be over 7800 manufacturing units in India. In recent years, the growing demand for herbal product has led to a quantum jump l volume of plant materials traded within and across the countries.

An estimate of the EXIM Ban puts the international market of medicinal plants related trade at US$ 60 billion per year growing at the rate of 7% only. Though India has a rich biodiversity, the growing demand is putting a heavy strain on the existing resources while the demand for medicinal plants is growing; some of them are increasingly being threatened in their natural habitat. For meeting the future needs cultivation of medicinal plants as to be encouraged.

According to an all India ethno-biological survey carried out by the Ministry of Environment & Forests, Government of India, there are over 8000 species of plants being used by the people of India.

Medical Plants as Part of Culture

It is evident that the Indian people have tremendous passion for medicinal plants and used them for wide range of health related applications from a common cold to memory improvement and treatment of poisonous snake bites to a cure for muscular dystrophy and the enhancement of body's general immunity. In the oral traditions local communities in every ecosystem from the trans-Himalayas down to the coastal plains have discovered the medical uses of thousands of plants found locally in their ecosystem. India has one of the richest plant medical cultures in the world. It is a culture that is of tremendous contemporary relevance because it can on one handen sure health security to millions of people and on the other hand it can provide new and safe herbal drugs to the entire world. There are estimated to be around 25000 effective plant based formulations used in folk medicine and known to rural communities all over India and around10000 designed formulations are available in the indigenous medical texts.

Distribution of Medicinal Plants

Macro analysis of the distribution of medicinal plants shows that they are distributed across diverse habitats and landscape elements. Around 70% of India's medicinal plants are found in tropical areas mostly in the various forest types spread across the Western and Eastern Ghats, the Vindhyas, Chotta Nagpur plateau, Aravalis & Himalayas. Although less the30% of the medicinal plants is found in the temperate and alpine areas and higher altitudesthey include species of high medicinal value. Macro studies show that a larger percentage of the known medicinal plant occur in the dry and most deciduous vegetation as compared to the evergreen or temperate habitats.

Analysis of habits of medicinal plants indicates that they are distributed across various habitats. One third is trees and equal portion shrubs and the remaining one third herbs, grasses and climbers. A very small proportion of the medicinal plants are lower plants like lichens, fern algae, etc. Majority of the medicinal plants are higher flowering plants.

Biodiversity

Biodiversity is taken in its holistic sense, to encompass all levels of biodiversity, ecological and evolutionary process, including:Natural ecosystems, Wild species & varieties, Agricultural ecosystems, Domesticated species & varieties

BIODIVERSITY IN INDIA

Almost all known types of agro climatic& edaphic conditions are found in India, from the coldest Nubra valley, dry cold of Ladakh, temperate and alpine region of Kashmir Himalaya, highest rainfall in the world Meghalaya, to the Desert habitats of Rajasthan.

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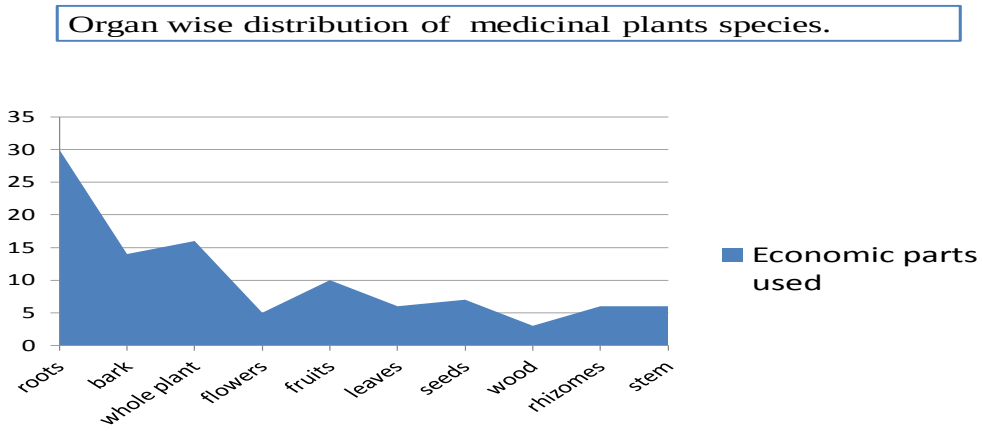
Table 1: Biogeographical zones of India

Sr no	Biogeographicalzone	No. of known medicinal plants
1	Trans Himalayan	700
2	Himalayan	2900
3	Desert	500
4	Semi arid	1000
5	Western ghat	2000
6	Deccan peninsula	3000
7	Gangetic plains	1000
8	North east India	2000
9	Andaman and Nicobar	1000
10	Coastal lands	500

Habitat diversity in India: 10 Vegetation Zones, 25 biotic provenances and 426 Biomes

Bio diversity in Karnataka: In Karnataka according to the study of the BSI there are 3924 species belonging to 1323 genera and 199 families in the forests, of which 1493 species are of medicinal value.

- These belong to 808 genera and 108 families. They occur in different vegetation types across the Western Ghats.
- Karnataka State Medicinal Plants Authority (KaMPA) was established in the year 2002 with an objective of conservation, utilization and development of the medicinal plants sector in the state.
- The main activity of KaMPA consists of implementation of the National Medicinal Plants Board (NMPB), Government of India, schemes through different institutions in the state.



Endangered Medicinal Plants in India (Plants are categorized as endangered according to the Convention on International Trade in Endangered Species (CITIES).

Table 2: Endangered Medicinal Plants in India

Botanical name	Family	Sanskrit name
Aquilariamalaccesis Lam.	Thymelaeaceae	agaru, aguru
Cibotiumbarometz (L.)	Cyatheaceae	Not available
Dendrobiumnobile Lindl.	Orchidaceae	Not available
Dioscoreadeltoidea WallexKunth.	Dioscoreaceae	Not available
Nardostachysgrandiflora DC.	Valerianaceae	jatamansi, jatamamsi
Picrorhizakurrooa Benth.	Scrophulariaceae	katuka, katuki
Podophyllumhexandrum Royle	Berberidaceae	laghapattra, vakra
Pterocarpussantalinus L.f.	Fabaceae	raktachandana, tilaparni
Rauvolfiaserpentina (L.)	Apocynaceae	sarpagandha, nakuli
Saussureacostus (Falc.)	Asteraceae	kustha, vapya
Taxuswallichiana Zucc.	Taxaceae	talisapatra, barahmi

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Table 3: Major plant drugs for which no synthetic substitute.

Sr. no	Plant	Drug	Use
1	*Catharanthusroseus*	Vinblastine, vincristine	Anticancer
2	*Rauvolfia serpentine*	Reserpine, resinnamine	Tranquilizer
3	*Cinchona ledgeriana*	Quinine	Antimalarial
4	*Erithroxylem coca*	Cocaine	Anaesthethe
5	*Papaversomniferum*	Morphine, codeine	Pain killer, anti cough
6	*Glysyrrhiziaglabra*	Glycyrrhizine	Antiulcer
7	*Coleus forskohli*	Forskohline	Hypotensive
8	*Plumbagoindica*	Plumbagine	Antibacterial
9	*Celastruspaniculata*	Pristimerine	Antimalarial
10	*Digitalis sp*	Cardiac glycosides	Heart failure

Conservation of Medicinal & Aromatic Plants

Conservation strategy (IUCW, UNEP & WWF, 1980) defines conservation as "the management of human use of the biodiversity so that it may yield the greatest sustainable benefit to present generation while maintaining its potential to meet the needs and aspirations of future generations".

Strategies & Priorities

The primary goals of biodiversity conservation as envisaged in the World Conservation Strategy can be summarized as follows:

– Maintenance of essential ecological processes and life support systems on which human survival and economic activities depend.
– Preservation of species and genetic diversity andSustainable use of species and ecosystems which support millions of rural communities as well as major industries.

Strategies for conservation of medicinal plants

- The conservation of the wild medicinal plants or any other such threatened species can be tackled by scientific techniques as well as social actions.
- There are basically two scientific techniques of conservation of genetic diversity of these plants.
  1. Legislation
  2. *In-situ* conservation
  3. *Ex-situ* conservation

Conservation of medicinal plants: Strategies

- **Legislation**

There are no separate policies or regulations for conserving medicinal plants growing in forests in India. There conservation is covered under existing laws pertaining to forestry. Following are the laws formulated by government of India for conservation of forests which directly or indirectly protects the wild herbal flora.

- ❖ Forest Act, 1927
- ❖ Wildlife (Protection) Act 1972 and Wildlife (Protection) Amendment Act 1991
- ❖ Forest (Conservation) Act, 1980
- ❖ Environment Protection Act, 1986
- ❖ National forest policy, 1988
- ❖ National biodiversity act, 2002

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- ❖ The scheduled tribes and other traditional forest dwellers act, 2006

- *In-situ* conservation

  - ❖ Conservation of a given species in its natural habitat or in the area where it grows naturally is known as in-situ conservation.
  - ❖ It includes Gene bank / Gene sanction, Biosphere reserves, national parks, sacred sites, Sacred grooves etc.
  - ❖ It is only in nature that plant diversity at the genetic, species and eco-system level can be conserved on long-term basis
  - ❖ It is necessary to conserve in distinct, representative biogeographic zones inter and intra-specific genetic variation.

It is cost-effective way of protecting the existing biological and genetic diversity is the 'in-situ' or on the site conservation wherein a wild species or stock of a biological community is protected and preserved in its natural habitat. The prospect of such a 'ecocentric', rather than a species centred approach is that it should prevent species from becoming endangered by human activities and reduce the need for human intervention to prevent premature extinctions. Establishment of biosphere reserves, national parks, wild life sanctuaries, sacred groves and other protected areas forms examples of 'in-situ' methods of conservation. The idea of establishing protected area network has taken a central place in all policy decision process related to biodiversity conservation at national, international and global level.

Table 4: Biosphere Reserves in India

Sl no	Biosphere reserves	State
1.	Nokrek	Meghalaya
2.	Nilgiri	Karnataka, Kerala, Tamil Nadu
3.	Namdapha	Arunachal Pradesh
4.	Nanda Devi	Uttar Pradesh
5.	Sundarbans	West Bengal
6.	Great Nicobar	Andaman & Nicobar Islands
7.	Gulf of Mannnar	Tamil Nadu

However, experiences have amply demonstrated that in a densely populated developing country like India, where a sizeable population are living in close proximity to forests, declaring protected areas will not entirely be sufficient to ensure conservation on the fast eroding biological diversity. The success of any conservation programme vests solely on the efficient management of protected areas. The involvement of local communities in conservation activities has now been increasingly realised. A people nature-oriented approach thus becomes highly imperative. This will help to generate a sense of responsibility among the local people about the values of biodiversity and the need to use it sustainably for their own prosperity and the maintenance of ecosystem resilience.

In-situ conservation of medicinal plants in India can be accomplished through the active support and participation of people who dwell in or near and around the protected forest areas. Involving the local mass in all phases of conservation programmes, such as planning, policy decision process, implementation etc. will be a.

- *SACRED GROVES*

Sacred groves are small or large patches of vegetation protected on the basis of cultural and traditional practices on the religious background.

Sl.no	Vernacular names	State
1	Devbhumi	Uttarakhand
2	Oran	Rajasthan
3	Kovilkadu	Tamil nadu
4	Deo van	Himachal pradesh
5	Devarakadu	Karnataka

Harish Singh et.al [2]

Table 5:- Sacred groves of India

States	No. of Documented Groves
Andhra Pradesh	750
Arunachal Pradesh	58
Assam	40
Chhattisgarh	600
Gujarat	29
Haryana	248
Himachal Pradesh	5,000
Jharkhand	21
Karnataka	1,424
Kerala	2,000
Maharashtra	1,600
Manipur	365
Meghalaya	79
Orissa	322
Rajasthan	9
Sikkim	56
Tamil Nadu	448
Uttaranchal	1
West Bengal	670
Total	13,720

Significant component in achieving efficient management and utilization of medicinal plant resources. A few such in-situ conservation areas have been marked and declared as medicinal plant in-situ conservation areas on the forests of three Southern States of Kerala, Tamilnadu and Karnataka by the joint efforts of the forest departments of these States and FRLHT, Bangalore.

Outlines for in-situ management

- The Parks Department should prepare a policy at national level on the conservation and utilization of medicinal plants in protected areas.
- The policy should include:
  - Identifying which of the protected areas are most important for medicinal plants;
  - Targets and techniques for recording and monitoring medicinal plants in protected areas;
  - Techniques and procedures for collection of medicinal plants within protected areas.
- The Parks Department should assess the extent to which the protected areas system covers the medicinal plants of the country. It should then create new protected areas and extend existing ones to ensure that all the medicinal plants of the country are conserved.

- The Parks Department should devise economic and social incentives for maintaining natural habitats and wild species.
- Park managers should ensure that the conservation and exploitation of medicinal plants are incorporated into site management plans.
- Species that are heavily depleted by over-collection should be re-introduced into areas where they once grew wild.

Ex-Situ Conservation: Conservation of medicinal plants can be accomplished by the ex-situ i.e. outside natural habitat by cultivating and maintaining plants in botanic gardens parks, other suitable sites, andthrough long term preservation of plant propagules in gene banks (seed bank, pollen bank,DNA libraries, etc.) and in plant tissue culture repositories and by cryopreservation).

Botanical gardens can play a key role in ex-situ conservation of plants, especially thosefacing imminent threat of extinction. Several gardens in the world are specialised in cultivationand study of medicinal plants, while some contain a special medicinal plant garden or harbourspecial collection of medicinal plants.

India has a network of about 140 botanical gardens which include 33 botanical gardensattached to 33 universities botany departments. But hardly 30 botanical gardens have anyactive programme on conservation. Tropical Botanical Gardens & Research Institute (TGBRI),located in a degraded forest region of Western GhatMountains in Kerala has an excellentexample in ex-situ conservation of plant diversity in India. The field gene bank programmelaunched by TBGRI from 1992-1999 is now well acclaimed as a very effective method ofconservation of medicinal and aromatic plant genetic resources. This field gene bank ofmedicinal and aromatic plants at TBGRI, Thiruvananthapuram is essentially a blend of the exsituand in-situ situations [3].

TO CONSERVE POPULATIONS OF MEDICINAL PLANT SPECIES*EX- SITU*

- ✓ The primary purpose of this is as an insurance policy. But it also has the advantage that it is usually easier to supply plant material for propagation, for re-introduction, for agronomic improvement, for research and for education purposes from *ex situ* collections than from *in situ* reserves.
- ✓ The disadvantages of *ex situ* conservation are that the sample of the species conserved *ex situ* may represent a narrower range of genetic variation than that which occurs in the wild.
- ✓ Species conserved *ex situ* can also suffer genetic erosion and depend on continued human care. For this reason, *ex situ* conservation must not replace, but should complement, *in situ* conservation.

A. Ethno-medicinal plant gardens: Creation of a network of regional and sub-regional ethno-medicinal plant gardens which should contain accessions of all the medicinal plants known to the various ethnic communities in different regions of India.

- This chain of gardens will act as regional repositories of our cultural and ethno medicinal history and embody the living traditions of our societies knowledge of medicinal plants.

Current status

- There are estimated to be around 50 such gardens in the country ranging from 20 acre to 40 acres some of them were set up by an All India Health Network.
- More recently networks of 15 such gardens have been set up in 3 states of South India with the initiative of FRLHT. One of the gardens is located in TBGRI, (Tropical botanical garden research institute) Palode at Thiruvananthapuram.

B. Gene banks

- The precautionary principles would suggest that an immediate and country-wide exercise be taken up to deposit seeds of wild medicinal plants with a first priority to known Red listed species and endemic species.

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Current status

- The department of bio-technology, Government of India has recently taken the initiative to establish 3 gene banks in the country.
- One is with ICAR at the NBPGR (National Bureau of plant genetic Resources) Campus, the second is with CIMAPs, (Central Institute of Medicinal and Aromatic plants) Lucknow and the third with TBFRI in Thiruvananthapuram.
- TBGRI has established the field gene bank of medicinal and aromatic plants under the G-15-GBMAP sponsored by DBT, Government of India, TBGRI experience now provide ample opportunity to repeat the same elsewhere in the country.
- The field gene bank of TBGRI has covered 30,000 accessions of 250 medicinal andaromatic plant species which include 100 endemic, rare and endangered medicinal andaromatic plants of the tropical region of India.

C. Nursery network

- The most urgent and primary task in order to ensure immediate availability of plants and planting materials to various user groups is to promote a nationwide network of medicinal plant nurseries, which will multiply all the regional specific plants that are used in the current practice of traditional medicine.
- These nurseries should become the primary sources of supply of plants and seed material that can be subsequently multiplied by the various users.

Current status

- Planting material for 40 odd species of medicinal and aromatic plants is reportedly available in the ICAR and CSIR (CIMAP) network.
- In South India FRLHT has recently set up a network of 55 supply nurseries.

D. Cultivation

- Figures projecting demand and trade in medicinal plant species globally indicate a step upward trend in the near future.
- One estimate puts the figure of world trade in medicinal plants and related products at US $ 5 trillion by A.D. 2050 (World Bank report, 1996).
- The demand so far has been met mainly from wild sources.
- This can't go on for much longer; policy intervention is urgently needed to encourage and facilitate investments into commercial cultivation of medicinal plants.

Current status

In the Govt. sector agro-technology of 40 odd species has been developed by ICAR- Agricultural University System and CSIR (CIMAOs & RRL, Jammu and Jorhat).

- ❖ In recent years industries like Dabur, Zandu, Indian Herbs, AryaVaidyaShala, and AryaVaidya Pharmacy and others have made some symbolic efforts to initiate cultivation.
- ❖ Since 1984 NABARD (National Bank of Agricultural and Rural Development) has formulated schemes for financing cultivation and processing of medicinal plants.

E. Community based enterprises

- A strong case exists for promotion of community level enterprises for value addition to medicinal plants through simple, on site techniques like drying, cleaning, crushing, powdering, grading, packaging etc.

Current status

- Three community based enterprises are known in south India, one in Gandhigram Trust, (Dindigul), Preemade development Society (Peermade) Kerala and the third by VGKK in B.R.Hills, Mysore.

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Guidelines for Ex-situ conservation from IUCN

- Each country should have at least one functioning botanic garden
- Botanic garden(s) should set up seed banks for the native medicinal plants and those cultivated in the country.
- Botanic gardens should set up alternative means of ex situ conservation for those species which cannot be stored in seed banks.

CONCLUSION

Medicinal plants occupy a vital sector of health care system in India and represent a major national resource. The dedicated medicinal plants are used by various tribal's and local people to cure different ailments ranging from simple injuries, wounds, cuts, fever, diarrhoea, ulcers, swelling, bone fractures, potency, antidote, skin care, night blindness, toothache, asthma, cough & cold. Hence, there is an immense need for conservation of diversity of medicinal plant wealth for the present and fore coming generations, by adapting the suitable strategy with most appropriate method of conservation.

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