RESEARCH NEEDS AND PRIORITIES FOR CONSERVATION OF INDIAN MEDICINAL FLORA

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Introduction

Among the countries of the world, the Indian region has a historical past of using plant resource for myriad of diseases dating to 5,000 - 4,000 BC. As for the cultivation of plants of great significance to mankind, it could be traced back during the late Mesolithic to early Neolithic age (10,000 BC), principally for items of food to sustain life. As per an estimate 80,000 species out of nearly 2,50,000 occurring globally bear medicinal and aromatic values. South-East Asia, Africa, Latin America and Eastern Europe provide nearly 90 per cent of raw materials for medicinal exploitation. It is revealed that there are actually 121 plants that are used in prescription drugs (Farnsworth and Soejarto, 1988) as a result of the study of about 35,000 species of plants. Out of a very rich diversity among the medicinal and aromatic flora about 5,000 species are considered to have been examined thoroughly for the active principles. It is reported by Myers (1983) that only 41 species generate commercial sales to the tune of US$ 40 billion per year. Non formulation drugs as adjuncts account for US$ 50-60 billion.

Indian Medicinal Flora

The Indian region, endowed with nearly 20,000 species of plants, highlight 75 major species of medicinal flora out of which at least 25 were most sought after during the last decade. During that period, Germany alone imported 40,000 tonnes of plant dry material from India. Biswas *et al.* (2000) mention that out of about 80,000 tonnes of medicinal plants imported by western countries, India tops the list of exporters for USA and Europe with a share of over 10,000 tonnes.

Our country is amongst the most important medicinal plant resources collection centres of the world. Over 500 million people receive the benefits of traditional knowledge of well-documented and standardized systems of medicines including Siddha, Unani, Ayurveda etc. There are 460,000 practitioners of the traditional systems of medicines in India as per an estimate (Anon., 1999), out of this 271,000 are registered and 7,843 licensed manufactures of traditional drugs.

Medicinal and aromatic flora of the country is widely distributed in different parts of the region. They have specific phyto-geographical and biogeographical entities. Several of these are still remaining unexplored and have not been inventoried. Such areas fall under various endemic centres of plant diversity in the Himalayas,

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Western and Eastern Ghats, oceanic islands and Northeeastern India. As compared to the South Asian countries nearly 3,600 species of documented medicinal flora, 540 find major use as herbal drugs (about 200 of these are used in bulk quantities and are of commercial importance).

During the past over five decades, numerous species of medicinal value have been discovered, inventoried, documented, screened and commercialized. Although explorations were made in *terra incognito* but the medicinal properties of species have not been well studied. This has been largely due to lack of information from the dependants on such species, besides need for scientific scrutiny and screening of efficacy of the principles. The species that led to application of newer methods of inventorization, characterization and multiplication enjoyed maximum attention for sustainable utilization. Medicinal and aromatic flora were improved through *ex-situ* and *in-vitro* measures of conservation. In the drug industry, the following plants with active component mentioned in parenthesis were notable. For example, *Adhatoda vasica* (Vasicine), *Atropa belladona* (Atropine), *Catharanthus roseus* (Vincristine, Vinblastine), *Cinchona* spp. (Quinine), *Dioscorea* spp. (Diosgenin), *Solanum* (Solasodine). Other species are Ginseng, Ipecac, Digitalis, Liquorice, Psyllium, Senna, Margosa tree, *Mishmi teeta*, *Taxus* etc.

While the attention has to be focussed on the wild relatives of well known to over exploited species of medicinal flora, there is an emergent need for the conservation of rare and threatened germplasm of various species of useful elements. Certain plant groups as specified by the families have been identified to possess active principles and analogs of compounds in development. These families as per Myers' work on anti-cancer drug yielding plants (1983) are as follows : Apocynaceae, Celastraceae, Compositae (Asteraceae), Simaroubaceae, Rutaceae, Thymelaeaceae, Magnoliaceae, Annonaceae, Boraginaceae, Leguminosae (Fabaceae), Liliaceae, Rubiaceae, Gymnosperms (Cephalotaxaceae).

Studies reveal that at least 70 per cent of the 3,000 plant species worldwide possess anti-cancer properties. Region-wise, 4.8 per cent of Indian flora has anti-cancer properties (Myers, 1983).

The levels of exploitation of medicinal flora have reached an all time high. This has resulted in the decline of potential species and infra-specific forms. For example, to produce one kilogram of Vincristine from rosy anti-cancer (Lymphocytic leukaemia) drug, as much as 530 MT of plant material is needed to be exploited. One kg of product costs over US$ 1 million. *Taxus baccata* providing anti-cancer 10-deacity baccation III (DAB) from its needles and bark sells between US$ 0.1-0.13 million per kg, whereas present demand exceeds US$ 100 million per year (Biswas, 1988, 1990, 1991, 1991a, 2001, Biswas *et al.*, 2000). The extraction of bark causes the death of the tree. Similar are the cases with other medicinal herbs where the whole plants are removed indiscriminately before they could reach phenological maturity and vegetative regenerating capacity. Several of such plants are distributed throughout the country.

Botanical-cum-phytogeographical region-wise, the following species are

notable (the species need attention for various conservation measures) :

1. ***The Western Himalayas*** :

Aconitum heterophyllum (ativisa, atis), *Angelica glauca* (Chora, grandrayan, Chipi), *Atropa acuminata* (angur sefa, sagangur), *Bunium persicum* (siah zira), *Colchicum luteum* (suranjan siri), *Dactylorhiza hatazirea, Orchis habernarioides* (salam panja, salab, hathajari), *Frillaria roylei* and *Lilium polyphyllum* (Kakoli, Kshir-Kakoli), *Gentiana kurroo* (Karu), *Hedychium spicata* (Kapur Kachri, Kachur), *Jurinea* spp. (dhup, guggal), *Nardostachys jatamansi* and *N. grandiflora* (mansi, jatamansi), *Onosoma bracteata* and *Macrotomia benthami* (gaujuban and ratanjot), *Podophyllum emodi* and *P. hexandrum* (ben-kakri), *Picrorhiza kurroa* (Kutki, Karu), *Rheum australe* and other species (dolu, revanda chini), *Saussurea costus, S. lappa* (Kuth, quest-e-sirin), *Swertia chirata* (Chirayata), *Valeriana wallichii* or *V. jatamansi* (asarun, tagar, sugandhbala), *Viola odorata, V. canescens* and *V. serpens* (ban-a-fsha, gulbanafsha).

2. ***Eastern Himalayas*** :

Coptis teeta (mamira, mishmiteeta, golden thread) *Gaultheria fragatissima* (Indian wintergreen), *Panax pseudoginseng* (tapmare), *Dioscorea prazeri*. Biswas *et al.* (2000) have enumerated 250 species of medicinal plants typical of this phytogeographical region.

3. ***Gangetic and Indus Plains, hilltops and desert*** :

Commiphora wightii or *C. mukul* (guggal), *Curcuma caesia* (Kalihaldi, narak-chur), *Gymnema sylvestre* (gurmar), *Salvadora persica* (peeloo), *Calotropis procera, C. gigantea* (arka, madar), *Euphorbia neriifolia* (Sehund, thunner), *Peganum harmala* (harmal), *Emblica officinalis* (aonla), *Terminalia arjuna* (arjun), *T. bellirica* (bahera), *T. chebula* (Harar), *Phyllanthus* complex (*P. fraternus, P. nirurii).*

4. ***Deccan*** :

Coscinium fenestratum (marmanjil - used in place of *Berberis* sp.), *Pterocarpus santalinus* (lalchandan - red chips of stem used in Ayurvedic system of medicine), *Trachycarpus zeylanicus, Strychnos nuxvomica, S. potatorum*

Several of the potential species of medicinal value have been patented for their active principles in some developed countries. Some of such species are *Phyllanthus niruri* (Hepatitis A to Z), *Emblica officinalis* (Aids, Flu etc.), etc.

The medicinal flora of India is needed to be categorized according to the IUCN categories given here. It deserves a specific mention that several of the species which have come out of danger (Category O), not evaluated in terms of the extent of occurrence and the area of occupancy (Category NE), dependent on the improvement in reproductive compatibility (Category REP) etc., are needed to be assessed and accordingly categorized worked out.

The categories and definitions of threats as per IUCN Red Data List to be used for the rare and threatened medicinal and aromatic flora of the country are as follows :

Extinct (Ex) : A taxon is extinct when there is no reasonable doubt that the last individual has died.

Extinct in the Wild (EW) : A taxon is extinct in the wild when it is known only to survive in cultivation or as naturalized population (or populations) well outside the past range of historical distribution.

Critically endangered (CR) : A taxon is critically endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.

Endangered (EN) : A taxon is endangered when it is not critically endangered but is facing a very high risk of extinction in the wild in the near future.

Vulnerable (VU) : A taxon is vulnerable when it is not critically endangered or endangered but is facing a high risk of extinction in the wild in the medium-term future.

Lower Risk (LR) : A taxon is lower risk when it has been evaluated and does not satisfy the criteria for any of the categories critically endangered, endangered, or vulnerable. Taxa included in the lower risk category can be separated into three subcategories.

(i) *Conservation Dependent (CDS)* : Taxa that are the focus of a continuing taxon-specific or habitat-specific conservation program targeted toward the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years.

(ii) *Near Threatened (NT)* : Taxa which do not qualify for conservation dependent, but which are close to qualifying for vulnerable.

(iii) *Least Concern (LC)* : Taxa which do not qualify for conservation dependent or near threatened.

Data Deficient (DD) : A taxon is data deficient when there is inadequate information to make a direct or indirect assessment of its risk of extinction based on its distribution and/or population status.

Not Evaluated (NE) : A taxon is not evaluated when it has not yet been assessed aginst the criteria.

Threatened (T) : Used in the conservation context for species which are in one of the three categories, namely Critically endangered, Endangered and Vulnerable. Some species are marked as threatened where it is known that they are Endangered, Vulnerable or Rare, but there is not enough information to say which of the three categories is appropriate.

Rare (R) : Taxa with small world populations that are not at present endangered or vulnerable, but are at risk. These elements are usually localized within restricted geographical areas or habitats or are thinly scattered over a more extensive range.

Indeterminate (I) : Insufficient information is currently available as regards to any of the categories (Rare, Endangered, Vulnerable) the taxon falls.

Reproduction Constraints (REP) : Taxon with diagnostic features on the reproductive parts influencing the survival.

Out of danger (O) : Taxa formerly included in one of the categories, but which are now considered relatively secure because effective conservation measures have been taken or the

previous threat to its survival has been removed.

Conservation Needs

With the impact of various influencing factors the medicinal flora of the country is on the decline in terms of *biological*, (physiological, phenological, regeneration) ecological (habitat-genepool, modification and alteration, hotspots, phytogeography) and conservation aspects (*ex-situ, in-situ, in-vitro*). With regards to this significant group of plants adequate research and development (R & D) support using recent techniques of scientific and technological advances (S & T) is required. Following provides the various aspects and priorities.

1. ***Inventorization and Characterization***

- Development of baseline database on species and genetic diversity of specific sites.
- Taxonomic characterization using recent trends (biochemical, DNA, RFLP, PCR, etc. Cytological, Palynological tools).
- Manpower (capacity building).
- Funding mechanism (collaborative)

2. ***Monitoring and Assessment***

- Development of cost effective methodology for quantitative assessment of specific site.
- Application of remote sensing (RS) and GIS (Geographic Information System) technology in identifying critical habitats at landscape level. Conforming RS and GIS database with ground truthing.

3. ***Ex-situ Conservation***

- Development of nursery and planting technology for rare and threatened taxa.
- Development of gene bank (field oriented) on targer species.
- Networking for coordination and collaboration at inter disciplinary and inter institutional levels.
- Application of cost effective ways of conserving biological parts of medicinal flora (possibly through innovations and inventions at grassroots level).

4. ***In-situ Conservation***

- Development of microhabitats, endemic centres, hotspots. A separate Working Plan Circle in Forest Department may be constituted.
- Application of recent trends in the field of biodiversity conservation to the existing preservation plots, sacred groves and specific sites falling under various other key area of conservation, for example, 86 National Parks (NPs) and 480 Wildlife Sanctuaries (WLS) of the country.

While the conservation needs are being prioritized and new techniques developed to improve upon the various aspects of medicinal flora, the lacunae or the 'dark clouds' of other spheres of the subject are not being delved into and worked out. These mainly concern the rights of communities, region and the country over the intellectual property.

Indigenous knowledge systems are similar to general scientific information as they are part of public knowledge.

Intellectual Property Rights (IPRs) have so far been applied to novel and discreet intellectual goods rather than to public goods such as knowledge systems. The usual criteria for recognizing IPRs – novelty and non-obviousness – generally tend to ignore the knowledge systems of rural and tribal families, although they are often characterized by a high degree of inventiveness. While the knowledge itself may not be patentable, the product of the knowledge, namely 'folk' varieties, land races and genetic diversity at the intraspecific level, provide the basic raw material for modern plant breeding and biotechnology (Swaminthan, 1994).

Since the convention on Biological Diversity signed at the Rio summit in 1992 only raffirmed the sovereign rights of the governments over their plant genetic resources but remained silent on the contentious issue of proprietary control over the products developed from these resources, the multinational drug industry is using the long arm of the WTO (World Trade Organization) to maintain its global monopoly. The initiatives of WTO over the control of markets may jeopardize the existing medicinal plant based health care systems, which are traditionally followed in the country. A pro-active approach on the issue of intellectual property control over medicinal plants could have protected the national interests as well as provided an economic handle to dictate the global market in herbal medicines. It is true that a dilemma prevails about how to provide patents to formultations and products, which have been developed over hundreds of years (Shah, 1997). It remains a fact that hundreds of patents are being taken out on traditional medicines the world over.

It is no more a hidden fact that conservation needs and application of technological advances now by and large should depend upon attention being paid to the patenting aspects as cited above as the top priority issue or else the efforts of R & D go waste, as the product we obtain already gets patented in a developed country.

SUMMARY

South-East Asia, Africa, Latin America and Eastern Europe provide nearly 90 per cent of raw materials for medicinal exploitation. It is revealed that there are actually 121 plants that yielded prescription drugs as a result of the study on 35,000 species of plants. About 5,000 species world over are considered to have been examined throughly for the active principles. Only 41 species generate commercial sales to the tune of US$ 40 billion per year with non-formulation drugs as adjuncts claiming nearly US$ 60 billion. The Indian region endowed with nearly 20,000 species of plants highlight 75 major species of medicinal flora, out of which at least 25 were most sought after during the last decade. Nearly 3600 species of documented medicinal flora 540 find major use as herbal drugs (about 200 of these are used in bulk quantities and are of commercial potential). The families of plants such as Apocynaceae, Celastraceae, Compositae (Asteraceae), Simaroubaceae, Rutaceae, Thymelaeaceae, Magnoliaceae, Annonaceae, Boraginaceae, Leguminosae (Fabaceae), Liliaceae, Rubiaceae, Gymnosperms (Cephalotaxaceae) have anti-cancer drug yielding species. The paper provides botanical-cum-phytogeographical regions of the country with specific elements of medicinal flora. The need for categorizing the rare and threatened medicinal and aromatic flora as per IUCN Red Data enlisting norms has been emphasized in the paper. Research need and priorities targeting different activities on the aspects of (i) Inventorization and Characterization, (ii) Monitoring and Assessment, (iii) *Ex-situ* Conservation, (iv) *In-situ* Conservation and (v) Utilization have been outlined in the paper.

भारतीय औषधीय पेड़ पौधों का संरक्षण करने के लिए खोज जरूरतें और प्राथमिकताएं

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सारांश

दक्षिणपूर्व एशिया, अफ्रीका, लातिन अमेरिका और पूर्वी योरोप औषधीय समुपयोजन के लिए लगभग 90 प्रतिशत कच्चा माल उपलब्ध कराते हैं । पता चला है कि वास्तव में 35,000 जातियों पर किए गए अध्ययन के परिणाम स्वरूप 121 पादपों से ही नुस्खों में बताई दवाइयां प्राप्त हुई । सक्रिय तत्व ज्ञात करने के लिए माना जाता है कि पूरे विश्वभर में लगभग 5000 पादप जातियों का ही परीक्षण किया गया है । केवल 41 पादप जातियों से ही व्यापारिक स्तर पर 40 बिलियन अमेरिकी डालर वार्षिक मूल्य की औषधियां बनाई जाती है जिनके साथ कुछ नुस्खेतर औषधियां भी रहती है जिनसे लगभग 60 बिलियन अमेरिकी डालर मूल्य प्राप्त होता है । भारतीय क्षेत्र में लगभग 20,000 ऐसी पादप जातियां है जिनमें औषध पादपों की लगभग 75 बड़ी जातियां प्रसिद्ध हैं जिनमें से 25 पादप जतियों की पिछले दशक में सबसे ज्यादा मांग रही । प्रलेखित औषधीय पेड़-पौधों की लगभग 3600 जातियों में से 540 का दवाइयां बनाने में अधिक उपयोग किया जाता है (इनमें से लगभग 200 का उपयोग अधिक मात्राओं में किया जाता है तथा ये व्यापारिक संभावनाओं वाली है) । करवीर कुल (एपोसायनेसी), मालकंगनी कुल (सेलास्ट्रेसी), संग्रथित कुल (कम्पोजिटी एस्टेरेसी), देवनिम्ब कुल (सीमारूबेसी), निम्ब कुल (रूटेसी), पर्णसी कुल (थाईमेलियेसी), चम्पक कुल (मैग्नोलियेसी), सीताफल कुल (एग्नोनेसी), श्रीहस्तिनी कुल (बोराजिनेसी), शिम्बी कुल (लेग्युमिनोसी), (पृथुशिम्बि कुल = फैबेसी), नलिनी कुल (लिलियेसी), मंजिष्ठा कुल (रूबियेसी), नग्नबीजा: (उद्धनुर्वृक्ष कुल = सेफालोटैक्सेसी) जैसे पादप कुलों में कैंसर विरोधी दवाइयां उपलब्ध कराने वाली जातियां मिली है । इस अभिपत्र में देश के वनस्पति एवं पादप भौगोलिक क्षेत्र और वहां के औषधीय पेड़ पौधों के विशिष्ट अंग बताए गए हैं । औषधीय और सौरभिक पेड़ पौधों को, जो दुर्लभ या संकटापन्न हैं, आई यू सी एन लाल सूची के अनुसार उनके सामान्य आधार बताते हुए, श्रेणीकृत बनाने की आवश्यकता पर भी अभिपत्र में जोर दिया गया है : 1- तालिकाकरण और लक्षणलेखन, 2 - जांचपडतालना और मूल्यांकन, 3 - मूलस्थान बाह्य संरक्षण 4 - मूलप्रदेश में संरक्षण, तथा 5 - उपयोजन पक्षों पर की जाने वाली विभिन्न कार्रवाइयों को लक्ष्य बनाकर अंनुसन्धान की ज़रूरतों और प्राथमिकताओं की रूपरेखा भी अभिपत्र में प्रस्तुत की गई हैं ।

References

Anon (1999). Report in *Hindustan Times* 27th April.

Biswas, Sas. (1988). Rare and threatened taxa in the forest flora of Tehri Garhwal Himalaya and the strategy for their conservation. *Ind. J. For.,* **11** (3): 233-237.

Biswas, Sas. (1990). Ethnobotanical studies on North-Eastern region of India with particular emphasis on conservation of biological diversity. *Proc. 2nd International Congress of Etnobiology, "The Challenges of Ethnobiology in the 21st Century"* held at Kumming, China, Oct. 22-26. Symposium session 5 (Abs.) :128.

Biswas, Sas. (1991). Rare and endangered flora eastern Himalaya and the measures for its conservation. *Advances in Himalayan Ecology* (G.S. Rajwar, ed.). Today & Tomorrows Printers and Publishers, New Delhi. **6**:267-273.

Biswas, Sas. (1991a). Rare and endangered plants of economic value - *Coptis teeta* Wall. *MFP News.*

Biswas, Sas. (2001). Conservation needs and techniques of medicinal plants. Paper presented in a Training Programme on "*Cultivation and Utilization of Medicinal Plants*" for the Senior Forest Officers of Uttar Pradesh, 8-12 Jan. Organized by NWFP Division, Forest Research Institute, Dehra Dun. Extended Abstracts, pp. 3.

Biswas, Sas., S.S. Jain and Sumer Chandra (2000). Some rare and threatened medicinal plants of Himalayan and North Eastern regions of India and strategies for this conservation. *J. Non Timber Forest Products,* **7**(1&2):101-111.

Farnsworth, N.R. and D.D. Soejarto (1991). Global importance of medicinal plants. *The Conservation of Medicinal Plants – Proc. International Consultation*, 21-27 March, Chiang Mai University, Thailand (Akerley, O., V. Heywood and H. Synge, eds.). Cambridge Univ. Press, Cambridge, U.K. pp. 25-51.

Myers, N. (1983). Plants as sources of anticancer drugs. *A Wealth of Wild species - storehouse for human welfare*. Colorado : 105.

Shah, N.C. (1997). Conservation of wild medicinal plants : need for a comprehensive strategy. *Sem on Endangered species*, Dec. 15-17 Kurukshetra.

Swaminathan, M.S. (1994). Inaugural address: *Fourth International Congress of Ethnobiology*, Lucknow, Nov. 17.