

Demand and Supply of Medicinal Plants in India

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FOREWORD

There is a global resurgence in the traditional and alternative health care systems. We in India are fortunate to have systems of medicines which date back to more than 3000 years and have deep rooted societal acceptance. Ayurveda, Unani, Sidha and Homeopathy systems of medicines which offer health care solutions to a large segment of our populations including those living in remote and interior areas.

The growth and acceptability of the traditional systems requires a robust infrastructure of hospitals, dispensaries, pharmacies and manufacturing units so as to manufacture and dispense quality medicines. The country has more than 9000 manufacturing units for Ayurveda, Sidha, Unani and Homeopathy medicines. However, the quality of the medicines produced by these units critically depends upon the manufacturing processes followed as well as the quality of raw material. The Government has made it mandatory for all manufacturing units to adhere to the Good Manufacturing Practices (GMP) as notified under Schedule 'T' of the Drugs and Cosmetics Act 1940. However, since more than 90% of the formulations under these systems are plant based, what is critical is to ensure sustained availability of quality raw material.

The National Medicinal Plants Board (NMPB) has the primary mandate of supporting programmes relating to conservation and development of medicinal plants. The key to any conservation and development effort is the assessment of consumption and supply of medicinal plants and thereafter launch management interventions. A lacunae in the medicinal plants sector has been the absence of authentic data on consumption and the sourcing of the raw material by industries and an understanding of the supply chain, which is often quite complex. It is with a view to unravel the trade dynamics and to assess the quantum of domestic supply and demand that the NMPB launched this study through the Foundation for Revitalization of Local Health Traditions (FRLHT) Bangalore.

I would like to compliment the NMPB for this initiative, particularly at a time when the 11th Plan has just begun and when the medicinal plants sector is poised for a

quantum jump both in terms of the range and scale. The team of professionals from the FRLHT also deserve appreciation for accomplishing the challenging task. It would be important to identify the salient points emerging from the report and take follow up action in a time bound manner by identifying key partners for synergistic action.

I hope that this report will generate interest among those concerned with the conservation and development of medicinal Plants and their role in promoting better health care to our people.

Anita Das
(Anita Das)

New Delhi,
26th December 2007.



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मुख्य कार्यकारी अधिकारी
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Message

The world today is witnessing a resurgence of interest in herbal drugs, herbal cosmetics and herbal food supplements. A vast diversity of herbal ingredients, major proportion of which is derived from wild, provide the resource base to the herbal industry. More than 6,000 plant species are known and used in Indian Systems of Medicine in our country. The commercial demand for the botanical raw drugs has put the medicinal plant resources under great stress. Whereas many of the wild medicinal plant species are facing serious threat of extinction, the supply of cultivated species is not able to match the rising demand. It has become imperative to strengthen the medicinal plant resource base in the country. The irony, however, is that no reliable estimates of demand and supply are available in the country to guide the resource augmentation efforts.

It is against this scenario that the National Medicinal Plants Board (NMPB) commissioned this survey-cum-study through the Foundation for Revitalization of Local Health Traditions (FRLHT).


This study has highlighted the fact that although the data from the published records in Ayurveda, Siddha, Unani, Swa-rigpa, Homoeopathy and ethno-botanical literature estimates the total number of species used in Indian Systems of Medicine at around 6000, only 960 of these have been recorded in trade. A significant suggestion of this report is that in the next few years the priorities for conservation efforts and cultivation should be sharply focused on 178 of these 960 species, which are traded in high volumes in quantities exceeding 100 MT per year.

A unique feature of this report is that it has, for the first time, in the context of a study on demand assessment, drawn attention to the non-commercial demand of medicinal plant resources by the rural households. Interestingly enough, the assessment of this non-commercial consumption of medicinal plants suggests that it may account for more than 25% of the overall consumption of botanical raw drugs in the country. This estimated non-commercial consumption will require framing socially relevant strategies for fulfilling the non-commercial consumption needs though activities like promotion of home, community and school herbal gardens.

Equally importantly the study has identified the species in high volume trade that are currently almost wholly sourced from the wild and also those that are being obtained largely from cultivation. In respect of wild collections it has further distinguished 93 species sourced mainly from the forests and 46 species sourced from roadsides, wastelands and farm bunds. This latter wild source, which nature freely offers, is often overlooked.

I am confident that this study can guide operational strategies for management of medicinal plant resources in the country. I, however, believe that such studies need to be conducted periodically and more extensively. While there is certainly scope for further improvements, the basic foundations for demand and supply studies, relating to the medicinal plants, have been laid by this pioneering study.

Yours sincerely


(B.S. Sajwan)
27.12.07

Demand and Supply of Medicinal Plants in India

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Preface

The industrial demand on medicinal plant resources is poised to increase owing to the worldwide buoyancy in the herbal sector engaged in production of herbal health care formulations; herbal based cosmetic products and herbal nutritional supplements. In India, nearly 9,500 registered herbal industries and a multitude of unregistered cottage-level herbal units depend upon the continuous supply of medicinal plants for manufacture of herbal medical formulations based on Indian Systems of Medicine. In addition to the industrial consumption, significant quantities of medicinal plant resources are consumed in the country under its traditional health care practices at the household level, by traditional healers and by practitioners of Indian Systems of Medicine. An idea about the richness and diversity of these health care practices in India can be had from the diversity of plant species used in these systems. It is estimated that more than 6,000 higher plant species forming about 40% of the higher plant diversity of the country are used in its codified and folk healthcare traditions.

The sheer magnitude of the people using plants for health care (about 70% of country's population) and the diversity of plant species used in these practices make the assessment of demand and supply of medicinal plants in the country a complex affair. The complexity starts with the nomenclature and identification of plants. Since the plant material is sourced from different regions of the country, it quite often happens that one plant entity is known by different names in different regions of the country and similarly, in many cases diverse plant material is known by the same or similar names across different regions. This complexity is further compounded by the fact that at the consumption end most of the plant entities are recognised and consumed by their trade names or classical sanskritized names making it all the more difficult to correlate the botanical material to its authentic botanical identity by its local/ trade or classical name. Obviously, sorting out the complexity in the nomenclature correlation is a first step for assessing the actual consumption and profiling the demand & supply of medicinal plants. When we, at the Foundation for Revitalisation of Local Health Traditions (FRLHT), took up the National Medicinal Plants Board (NMPB) sponsored short-term study to estimate the quantum of demand and supply of medicinal plants in the country we first prepared a ready to use dictionary which linked trade names to botanical names.

The relative opacity of the medicinal plant trade at the level of gatherers, traders and the industry makes the assessment of demand and supply of medicinal plants a complicated affair. Lack of any mechanism for maintenance and consolidation of information related to supply, trade and consumption of botanicals at the national and state level adds to the difficulty in making demand and supply estimation for the country.

Preliminary literature review revealed a general lack of national level studies on the subject. The CERPA study (Anon. 2002), the only previous effort where national level assessment of the demand and supply of medicinal plants has been carried out on the basis of primary data collection, had arrived at the national demand and supply figures on the basis of study of only 162 plant species. Besides the limited number of species worked upon, the study has some other limitations too, viz. (a) the basis for selection of these 162 species has not been elucidated in the report and these species do not fall in any single category e.g. species with

high annual demand, high domestic production, high price per kg, threat status and the like, (b) the nomenclature issues as highlighted above have not been addressed, and (c) the methodology for arriving at various demand and supply figures and their extrapolation has not been adequately explained.

It is in the backdrop of these gaps that the effort, method and results of this short-term study need to be appreciated. Within the time constraints, we carried out comprehensive literature review and undertook extensive and rigorous fieldwork for data collection and better understanding of the intricacies of the sector. Data was collected from herbal manufacturing units, household consumers, raw drug markets, dealers in foreign trade, government departments and production centres. FRLHT's years of experience on nomenclature correlation linking vernacular names of plant materials with the scientific names of the plant sources, systematically stored into a well structured electronic database, came in very handy to deal with the complex nomenclature issues. Our repository of botanicals having samples collected directly from natural habitats by our in-house team of botanists, as well as samples collected from various raw drug markets, also helped in resolving identification of plant sources of a number of plant raw drugs.

This publication presents the results and outcomes of this short-term study. It is unique in many ways. Firstly, it presents a well-researched comprehensive list of 960 medicinal plant taxa in trade in the country with each such entity supported with proper author citation. Further, a priority list of 176 medicinal plant species in high trade i.e. species with annual trade of >100 MT each, has been drawn to focus attention for their management. Various identity, nomenclature and trade issues have been highlighted through information given in boxes. Results of a pilot survey aimed at quantitative estimation of botanicals consumed at the rural household level and its implication on demand and supply are also included. To arrive at more realistic demand estimates, the estimation has been arrived at on the basis of sample data relating to reported consumption of botanicals by different consumer segments. We have also made recommendations based on this analysis.

The book has been laid out in ten chapters devoted to distinct thematic areas. The first two chapters provide introduction to the subject, literature review and method and scope of study. Chapters 3 to 9 present theme-wise information with independent conclusions drawn for each thematic area. Conclusions from Chapters 3 to 9 have been consolidated and synthesised in Chapter 10 that also includes recommendations for further initiatives. The text is laced with graphic presentation of results and provides substantial supporting information in the form of boxes.

We hope that the publication results in creating better understanding on the subject and acts as a trigger to initiate further action on sustainable management of medicinal plant resources of the country.

D.K. Ved
G.S. Goraya

Acknowledgements

This multi-faceted study where field data was required to be gathered from the industry, from the raw drug markets, from state forest departments, from rural households and from exporters would not have been possible without the determined effort put in by FRLHT's project team, for which we are grateful to them. We would especially like to express our deep gratitude to Mr. G A Kinhal for organising the collection of production and supply data from the various state forest departments and in providing critical inputs during data analysis and report compilation. We would also like to express our special gratitude to Dr. K Ravikumar, Dr. Vijaya Sankar and Ms. Noorunnisa Begum for fieldwork and meticulously handling the nomenclature issues, sifting the data and updating the botanical nomenclature in respect of traded medicinal plant species. Our acknowledgement is also due to Mr. B S Somashekhar, Dr. G Gangadharan, Dr. Venugopal, Mr. Vijay Barve, Dr. C R Jawahar and Mr. Abdul Kareem for gathering data from herbal industries, raw drug markets and rural households. Handling and consolidation of the vast data generated during the study needed great devotion and mental strength that was willingly provided by Ms. Kavitha for which we are grateful to her. We would also like to acknowledge the consistently efficient secretarial service provided by Ms. V P Mangala. We are grateful to Ms. Suma and Ms. Tabassum for their help in compilation and checking of the data.

Mr. Darshan Shankar, Director, FRLHT, has been a constant source of encouragement and moral support during the course of this study. The structure and layout of the report has greatly benefited from the time-to-time critical comments and untiring editing support provided by him. We express our deep gratitude to him.

Our heartfelt thanks are also due to Dr. D R Nag, Dr. Tilak Raj Gujrani, Dr. Thirunarayanan, Dr Usman Ali, Dr. Narsimhan, Ms. Chandrakala, Dr. Jarial and Mr. Khotele for their dedicated efforts to undertake field survey of herbal manufacturing units, raw drug markets and medicinal plant production centres on behalf of FRLHT and gathering useful data.

We would have been still groping in the dark about the realistic demand of the botanicals but for the whole-hearted participation in the survey by a small but forward looking group of herbal manufacturers and traders. Their readiness to share their trade information with FRLHT, for the purpose of this study, is gratefully acknowledged. We hope that after seeing this report, the ones who have failed to participate in the present survey would see reason to participate in the future studies on the subject.

We are obliged to the National Medicinal Plants Board, New Delhi for accepting FRLHT's proposal and honouring it with this study. Mr. B S Sajwan, Chief Executive Officer, NMPB has been a motivating force all through the course of this study and took initiative in facilitating access to various herbal units. We place our gratitude to him on record. We would also like to express our sincere gratitude to Ms. Anita Das, Secretary, AYUSH and Mr. Shiv Basant, Joint Secretary, AYUSH, who have been keenly following the progress of the study and who have prompted the highlighting of many issues related to the sector in this report.

We would like to express our gratitude to Mr. Ranjit Puranik, Dr. N B Brindabanam and Dr. S. Maiti for painstakingly going through the draft report. The critical comments provided by them have helped us in improving the draft.

October 2007

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G S Goraya

EXECUTIVE SUMMARY

The industrial demand for the medicinal plant resources has been on the rise due to the worldwide buoyancy in the herbal sector engaged in production of herbal health care formulations; herbal based cosmetic products and herbal nutritional supplements. In India, nearly 9,500 registered herbal industries and a multitude of unregistered cottage-level herbal units depend upon the continuous supply of medicinal plants for manufacture of herbal medical formulations based on Indian Systems of Medicine. In addition to the industrial consumption, significant quantities of medicinal plant resources are consumed in the country under its traditional health care practices at the household level, by traditional healers and by practitioners of Indian Systems of Medicine. Whereas, more than 6,000 higher plant species are estimated to be used in the codified and folk healthcare traditions in the country, the quantum of their consumption has remained a matter of guesstimate. The fallout of the lack of reliable species-wise demand estimates - so very important for sustainable management of medicinal plant resources - has been an inadequate focus on the management of medicinal plants in the country. In fact, wild populations of many a medicinal plant species, forming the major resource base for the herbal industry, are reported to be facing a serious threat of extinction due to indiscriminate harvesting.

It is in this context that the National Medicinal Plants Board (NMPB), Department of AYUSH, Government of India, during 2006-07, constituted a nation-wide study to assess the demand and supply of medicinal plants in India. The Foundation for Revitalisation of Local Health Traditions (FRLHT), Bangalore undertook this study from August 2006 to February 2007.

This publication presents the basis and the results of this study. Highlights of the study are presented below:

1. Comprehensive Listing of Medicinal Plant Species in Trade:

A list of 960 medicinal plant species forming source of 1289 botanical raw drugs in trade in the country has been worked out from the (a) literature and (b) data collected during the study on (i) consumption of botanicals by the herbal manufacturing units, and (ii) the plant raw drugs traded in the Mandis (raw drug trading centres).

This list includes the known equivalent species, substitutes, and the adulterants in trade for major botanical raw drugs. Species that are harvested in large quantities from the wild, whether or not recorded during the survey of herbal industry or the raw drug markets, have also been included in this list.

The list attempts to correlate the trade/ popular vernacular names with updated botanical nomenclature, including valid author citations. The popular botanical synonyms have also been incorporated in the list for ease of reference.

2. Estimation of Annual Demand of Botanical Raw Drugs in the Country:

The annual demand of botanical raw drugs in the country has been estimated at **3,19,500 MT** for the year 2005-06. This estimate reflects synthesis of data related to estimates of

consumption of botanicals by the domestic herbal industry, the rural households and the volume of botanicals recorded in the export during the year 2004-05.

Estimated Annual Demand of Botanical Raw Drugs* (Dry Wt. in MT) for 2005-06			
Herbal Industry	Rural Households	Exports**	Total
1,77,000	86,000	56,500	3,19,500

* The demand estimates pertain to botanical entities that are exclusively traded as 'herbal raw drugs' and do not include demand on account of entities that have their major usage as spices, fruits, vegetables and cereals.

** Data pertains to the year 2004-05.

The demand estimates in respect of the domestic herbal industry have been prepared based on the compilation and analysis of data on 'consumption' of botanical raw drugs provided by 188 herbal manufacturing units.

The demand estimates in respect of rural households of the country have been prepared based on analysis of sample survey of 1223 rural households located in 5 states. This first-ever quantitative estimation of demand on medicinal plant resources for non-commercial but competitive use, by rural households, will help in design of more holistic strategies for management of medicinal plants in the country.

Whereas 'Amla' (*Emblica officinalis*) is the highest consumed botanical raw drug by the domestic herbal industry, exports of Isabgol (Psyllium husk), Senna (leaves and pods), Henna (leaves and powder) and Myrobalans account for nearly 70% of total exports of plant raw drugs by volume.

3. Estimation of Annual Trade Value of Botanical Raw Drugs in the Country:

An annual trade value corresponding to the trade of 3,19,500 MT of botanical raw drugs in the country works out to **Rs. 1,0691,058.90 crores** for the year 2005-06. This reflects a synthesis of trade values worked out separately for each of the three consumption sectors.

Estimated Annual Trade Value of Botanical Raw Drugs (Rs. in Crores) for 2005-06			
Herbal Industry ¹	Rural Households ²	Exports ³	Total
627.90	86.00	354.80	1068.70

1. **The aggregated procurement costs reported by four major manufacturing units (Dabur, Charak, Sami and Zandu) have been utilized for estimating the procurement value of 1,77,000 MT of raw drugs.**

2. Trade value of material consumed by the rural households has been estimated using a notional rate of Rs.10 per kg of dry material.

3. Actual value as per DGCIS data.

4. Estimation of Annual Domestic Turnover of Herbal Industry in the Country:

The **annual** turnover of the herbal industry in the country, for the year 2005-06, has been **industry** estimated at ~~more than~~ **Rs. 8,800 crores!** This estimation is based on a correlation between the trade value ~~in respect~~ of botanical raw drugs (excluding spices, cereals, fruits etc.) consumed by ~~a the~~ manufacturing units and ~~its total~~ their **annual** turnover. Analysis of data obtained from the herbal industries has revealed that the **annual** procurement costs of botanical raw drugs account for about 7% of the **annual** turnover of the herbal manufacturing

units. The total annual turnover of the domestic herbal industry has been estimated by employing this correlation to the ~~entire herbal industry in the country, it comes out that for the~~ total procurement costs of Rs. 627.90 ~~19.50~~ crores, pertaining to ~~in respect of the~~ botanical raw drugs, consumed by this sector. ~~domestic herbal industry for the year 2005-06;~~

5. Estimation of Annual Production and Supply of Botanical Raw Drugs:

Estimation of domestic production and supply of botanical raw material from (a) **wild harvests** (from forests as well as other land use categories like roadsides, wastelands, farm bunds, etc.), (b) **cultivation**, and (c) **imports** has been found to be a major grey area as adequate record keeping mechanism is not in place. Consolidation of species-wise data in respect of raw drugs harvested from wild (forest areas) obtained from 9 states, representing more than 52% of the forest area of the country, adds up to **1,20,000 MT** of botanicals per annum. Whereas some of the remaining states do not have any system for recording such data, the records in respect of some states were too old to be incorporated in the analysis. In respect of wild botanical raw drugs harvested from other land use categories, no records are available.

Similarly, no national level statistics on the species-wise cultivation of medicinal plants and production of botanical raw material from such cultivated sources is available. On the basis of field visits ~~made~~ to the areas ~~reported known~~ to be under ~~sizeable~~ medicinal plant cultivation, data in respect of six species (Isabgol, Senna, Jojoba, Henna, Aswagandha & Milk thistle), ~~being under~~ almost exclusively ~~obtained from~~ cultivation, was ~~collected~~ ~~compiled~~. These species, cultivated over an area of nearly 1,18,000 hectares, have an estimated annual production of **1,21,400 MT**. Consumption estimates in respect of another set of 30 species consumed/ traded in high volumes, and obtained largely from cultivations, have been compiled from literature and add up to **24,000 MT**, broadly correlating to a cultivation area of 24,000 hectares.

~~T2004-05 was also computed and~~ the quantity of imported botanicals ~~raw drugs~~ for the year 2004-05 ~~added up for the year has been assessed to be~~ 37,483 MT, of which the import of 'Gum Arabic' and 'Pepper Long' constituted more than 58% of the total imports. However, the current Harmonized System of data management in respect of entities in foreign trade does not allow the linking of all the imported plant raw drugs to their botanical identities as many such entities are clubbed as "others" for the purpose of record maintenance.

6. Medicinal Plant Species Traded in High Volumes (≥ 100 MT/year):

Of the 960 traded medicinal plant species, 178 species are consumed in volumes exceeding 100 MT per year, with their consolidated consumption accounting for about 80% of the total industrial demand of all botanicals in the country. Analysis of these 178 species by their major sources of supply reveals that 21 species (12%) are obtained from temperate forests, 70 species (40%) are obtained from tropical forests, 36 species (20%) are obtained largely or wholly from cultivations/plantations, 46 species (25%) are obtained largely from road sides and other degraded land use elements and the remaining 5 species (3%) are imported from other countries.

21 Medicinal Plant Species in High Trade sourced from Temperate Forests

Abies spectabilis (Brahmi talish), *Aconitum ferox* (Vachnag), *Aconitum heterophyllum* (Atis), *Berberis aristata* (Daruahaldi), *Bergenia ciliata* (Pashanbheda), *Cedrus deodara* (Devdar), *Cinnamomum tamala* (Tejpatra), *Ephedra Gerardiana* (Somlata), *Juniperus communis* (Hauber), *Jurinea macrocephala* (Dhoop), *Nardostachys grandiflora* (Jatamansi), *Onosma hispidum* (Ratanjot), *Parmelia perlata* (Chadila), *Picrorhiza kurroa* (Kutaki), *Pistacia integerrima* (Kakarsingi), *Rheum australe* (Revandchini), *Rhododendron anthopogon* (Talish patra), *Swertia chirayita* (Chirata), *Taxus wallichiana* (Talish), *Valeriana jatamansi* (Mushakbala), *Viola pilosa* (Banafasha).

70 Medicinal Plant Species in High Trade sourced from Tropical Forests*

Acacia catechu (Katha), *Acacia nilotica* (Babool), *Acacia sinuata* (Shikakai), *Aegle marmelos* (Bael), *Albizia amara* (Cheroola), *Alstonia scholaris* (Saptaparni), *Anogeissus latifolia* (Dhawada), *Asparagus racemosus* (Shatavari), *Baliospermum montanum* (Dantimool), *Bombax ceiba* (Simal), *Boswellia serrata* (Salai guggul), *Buchania lanzan* (Chironji), *Butea monosperma* (Tesu phool), *Careya arborea* (Vaai kumbha), *Cassia fistula* (Amaltas), *Celastrus paniculatus* (Malkangani), *Chlorophytum tuberosum* (Safed musali), *Cinnamomum sulphuratum* (Dalchini), *Clerodendrum phlomidis* (Arnimool), *Coscinium fenestratum* (Maramanjil), *Cyclea peltata* (Paadu kizhangu), *Decalepis hamiltonii* (Magali), *Desmodium gangeticum* (Salparni), *Embelia tsjerium-cottam* (Vai-vidang), *Emblica officinalis* (Amla), *Garcinia indica* (Kokam), *Gardenia resinifera* (Dikamali), *Gmelina arborea* (Gambar Chhal), *Gymnema sylvestre* (Gudmar), *Helicteres isora* (Marod phali), *Holarrhena pubescens* (Kutja), *Holoptelea integrifolia* (Aavithali), *Holostemma ada-kodien* (Jeevanti), *Ipomoea mauritiana* (Palmudhukkan kizhangu), *Ixora coccinea* (Thechippoovu), *Lannea coromandelica* (Jhinganjingini), *Litsea glutinosa* (Maida chhal), *Lobelia nicotianaefolia* (Lobelia leaves), *Madhuca indica* (Madhuka), *Messua ferrea* (Nagakesar), *Mimusops elengi* (Bakul), *Morinda pubescens* (Manjanathi), *Mucuna puriens* (Kaunch beej), *Nilgiriianthus ciliatus* (Kurinji), *Operculina turpethum* (Nishoth), *Oroxylum indicum* (Tetu chhal), *Premna serratifolia* (Arnimool), *Pterocarpus marsupium* (Vijaysaar), *Pterocarpus santalinus* (Rakta chandan), *Rauwolfia serpentina* (Sarpagandha), *Rubia cordifolia* (Manjishtha), *Santalum album* (Chandan), *Sapindus mukorossi* (Reetha), *Saraca asoca* (Ashoka Chhal), *Schrebera swietenoides* (Ghanti phool), *Semecarpus anacardium* (Balave), *Shorea robusta* (Raal), *Smilax glabra* (Chopchini), *Soyimida febrifuga* (Rohan), *Sterculia urens* (Karaya), *Stereospermum chelonoides* (Patala), *Strychnos nux-vomica* (Kuchla), *Strychnos potatorum* (Nirmali), *Symplocos racemosus* (Lodh pathani), *Terminalia arjuna* (Arjan), *Terminalia bellirica* (Behra), *Terminalia chebula* (Harda), *Vateria indica* (Manda dhoopa), *Wrightia tinctoria* (Inderjau), *Ziziphus xylocarpus* (Ghonta phala)

**Commiphora nigritii* (guggul) and *Aquilaria agallocha* (agar), largely sourced through imports at present, are also native tropical species and need special management focus.

Whereas all the above-mentioned 93 medicinal plant species sourced from forests (including 'guggul' and 'agar') need appropriate attention, the temperate and alpine herbs and the tropical trees form the most vulnerable group of species that needs immediate management focus.

As regards the following 36 species sourced wholly or largely from cultivation, it needs to be appreciated that cultivation of these species has already stabilised and got firmly incorporated into the local agricultural systems and does not need any promotional incentives. Instead, the focus in relation to these species would need to be on developing better cultivars/ varieties and making their germplasm available to the growers in adequate quantities for enhancing their income.

36 Medicinal Plant Species in High Trade sourced largely from Cultivation

Abelmoschus moschatus (Muskdana), *Acorus calamus* (Bach), *Adhatoda zeylanica* (Adusa), *Aloe barbedensis* (Kumari), *Alpinia calcarata* (Chittartha), *Azadirachta indica* (Neem), *Caesalpinia sappan* (Pathimugam), *Cassia angustifolia* (Sonamukhi), *Catharanthus roseus* (Sadabahar), *Cichorium intybus* (Kasani), *Croton tiglium* (Jamalghota), *Curcuma angustifolia* (Tikhur), *Curcuma zerumbet* (Kachur), *Ficus benghalensis* (Vada Chhal), *Ficus religiosa* (Arali chakkiLakh-Pippal), *Gloriosa superba* (Kalihari), *Indigofera tinctoria* (NiliAkika), *Inula racemosa* (Pushkarmool), *Jatropha curcas* (Nepalam seed), *Kaempferia galanga* (Kacholumra), *Lawsonia inermis* (Henna), *Lepidium sativum* (HalimKurassani), *Ocimum basilicum* (Sweet basil), *Ocimum tenuiflorum* (Tulasi), *Piper longum* (Pippali), *Plantago ovata* (Isabgol), *Plectranthus barbatus* (Gandhira), *Pongamia pinnata* (Karani), *Prunus armeniaca* (Chuli), *Saussurea costus* (Kuth), *Silybum marianum* (Milk thistle), *Simmondsia chinensis* (Jojoba), *Trachyspermum ammi* (Ajwain), *Vitex negundo* (Neergundi), *Withania somnifera* (Ashvagandha), *Ziziphus jujuba* (Ber)

Raw material pertaining to the following five species is largely obtained through imports. Two of these five species, namely *Aquilaria agallocha* (Agar) and *Commiphora wightii* (Guggual), do occur in tropical India, but their wild populations are able to meet only a fraction of the total domestic requirement. Efforts need to be taken up to build up wild populations of these two species.

5 Medicinal Plant Species in High Trade sourced largely through Imports

Aquilaria agallocha (Agar), *Commiphora wightii* (Guggual), *Glycyrrhiza glabra* (Mulethi), *Piper chaba* (GajpippalChavak) and *Quercus infectoria* (Majuphal)

The following 46 species are found growing wild in abundance in wastelands including farm bunds, fallow lands, roadsides, shrubberies, etc. and their domestic supplies are largely obtained from wastelands. As such, these species may not require immediate management focus as far as their wild populations are concerned. Some of these species may, however, need cultivation to conform to quality standards, especially in cases where more than one equivalent species are freely traded as one botanical.

46 Medicinal Plant Species in High Trade sourced mainly from Wastelands, etc.

Abrus precatorius (Gunja), *Achyranthes aspera* (Upmarga), *Aerva lanata* (Cheroola), *Andrographis paniculata* (Kalmegh), *Bacopa monnieri* (Brahmi), *Boerhavia diffusa* (Punarnava), *Cardiospermum halicacabum* (Mudakkatham), *Cassia absus* (Chaksoo), *Cassia tora* (Chakoda beeja), *Centella asiatica* (Brahmi booti), *Centratherum anthelminticum* (Kali zeeri), *Citrullus colocynthis* (Indrayan), *Convolvulus microphyllus* (Shankhapushpi), *Curculigo orchioides* (Kali musli), *Cynodon dactylon* (Durva), *Cyperus esculentus* (Musta), *Cyperus rotundus* (Nagar motha), *Datura metel* (Dhatura), *Eclipta prostrata* (Bhringraj), *Fumaria indica* (Shatara), *Hedyotis corymbosa* (Pitpapra), *Hemidesmus indicus* (Anatmool), *Hygrophylla schulli* (Tal makhana), *Ipomoea nil* (Kaladana), *Merremia tridentata* (Prasarani), *Ocimum americanum* (Ban tulsii), *Peganum harmala* (Harmal), *Phyllanthus amarus* (Bhumiamla), *Pluchea lanceolata* (Rasna), *Plumbago zeylanica* (Chitrak), *Pseudarthria viscida* (Moovila), *Psoralea corylifolia* (Bawachi), *Sida rhombifolia* (Bala), *Sisymbrium irio* (Khubkalan), *Solanum anguivi* (Katheli badi), *Solanum nigrum* (Makoi), *Solanum virginianum* (Kateli), *Sphaeranthus indicus* (Gorakh mundi), *Tephrosia purpurea* (Sarpankha), *Tinospora cordifolia* (Giloy), *Tragia involucrata* (Kodithoova), *Tribulus terrestris* (Gokshura), *Trichosanthes cucumerina* (Patol panchang), *Vetiveria zizanioides* (Lavanha), *Withania coagulens* (Panir dodi), *Woodfordia fruticosa* (Dhatki).

This list of 178 medicinal plant species in high volume trade would need to be suitably modified in view of the region-specific 'alternate' or 'equivalent' species that are

harvested and freely traded as source of popular raw drugs like 'bala', 'gokhru', etc. Footnotes on the use of such alternate or equivalent species have been added to the list in the main publication. Similarly, some species that might have been left out of the survey due to limitations of the sampling size might need to be included in this list of species in high volume trade.

7. **Supply of Medicinal Plant Species through Mandis and Price Analysis:**

Survey of 3 'Large (National level) Mandis', 4 'Regional Mandis' and 13 'Intermediate Mandis' has been conducted and major raw drugs traded in these mandis with annual trade volumes and prevailing market prices have been recorded. This survey has also resulted in understanding of the trade peculiarities and the trade-web in as far as it relates to botanical raw drugs.

Analysis of the price related data reveals the difficulties in arriving at any 'common annual price' for the botanicals in trade, as trade complexities on account of seasonality of trade, distance from production centres, quantum of production, quality, size of procurement order, etc. had a large impact on the price. It was also found to be non-feasible to work out species-wise prices for medicinal plants in trade as most of the plants were being traded by parts and not as a whole and that different plant parts in trade commanded different prices.

8. **Recommendations:**

The study, in view of the growing interest in herbal products, emphasizes upon the need for periodic assessment of such demand and supply studies, so that resource management strategies and policy interventions could be suitably modified in view of any changes in the demand pattern. A triennial national level assessment of demand and supply and a template for such periodic studies has also been suggested. Other key recommendations are:

- High priority to be accorded to *in-situ* conservation as well as resource augmentation of medicinal plant species in high volume trade, being obtained wholly or largely from the forests and the state forest departments be supported to undertake these tasks.
- Immediate assessment of the status of wild populations of medicinal plant species in high consumption, which are also of high conservation concern, and appropriate management interventions for building up populations of such species be worked out.
- A system of backward linkage of the raw material consumed by the herbal manufacturing units to their source of production be developed and put in place.
- The existing system of coding of botanicals in foreign trade (HS codes) be critically evaluated and improved to establish clear linkage of traded materials with their plant sources.
- Support studies for reviewing the plant identities in respect of raw drugs obtained from more than one/ controversial plant sources.

- Support the setting up of 1 national and 4-5 regional Repositories of Plant Raw Drugs in Trade to act as reference centres for authentication of raw drugs in trade and consumption.
- Review and rationalize current schemes for incentive based promotion of commercial cultivation so that the species of conservation concern and facing acute supply shortage could be accorded needed focus.

Abbreviations/ Terms

A. Abbreviations		
	AJORP	Association of Rajasthan Jojoba Plantation and Research Project
	AYUSH	Department of Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homeopathy. Ministry of Health and Family Welfare. Govt. of India. (Formerly Department of ISM & H)
	CAMP	Conservation Assessment & Management Prioritisation
	CAZRI	Central Arid Zone Research Institute
	CERPA	Centre for Research, Planning and Action, New Delhi
	CG	Chhatisgarh
	DGCIS	Director General of Commercial Intelligence and Statistics
	EXIM Bank	Export-Import Bank of India
	FRLHT	Foundation for Revitalisation of Local Health Traditions, Bangalore
	GCC	Girijan Cooperative Corporation, Andhra Pradesh
	GMP	Good Manufacturing Practice
	ha	Hectare
	IUCN	World Conservation Union
	KAR	Karnataka
	KER	Kerala
	Kg	Kilogram
	Mah	Maharashtra
	MP	Madhya Pradesh
	MT	Metric Tonnes
	NMPB	National Medicinal Plants Board, New Delhi
	SFD	State Forest Department
	TN	Tamil Nadu

B. Terms		
1	Botanicals	Plant based raw material used in herbal industry making classical formulations.
2	Mandi	Raw Drug Market
3	Red Listed	Plant species that are threatened and have been assessed to be Critically Endangered, Endangered and Vulnerable.
4	Taxa	Taxonomically distinct plant entity at species/ sub-species/ varieties level.