

Study Methodology and Strategy

Assessment of demand and supply of medicinal plants for India's complex herbal sector consisting of more than 8600 licensed domestic herbal units and thousands of cottage level unregulated herbal units; thousands of folk healers; millions of households using thousands of herbal raw drugs procured from various supply sources, is equally complex. Since the medicinal plant sector is on a path of continuous growth, it is assumed that all the different categories of users of medicinal plants are getting required supplies of the herbal raw drugs. Thus, demand and supply of herbal raw drugs in the country is equated to their annual consumption by different categories of resource users. Different statistical sampling techniques have been employed to estimate consumption by different user groups. The Director General of Commercial Intelligence and Statistics's (DGCIS) database has been used in respect of foreign trade (export & import) of herbal raw drugs. Data in respect of commercial trade and supplies of herbal raw drugs has been collected by making visits to herbal raw drug mandis. The major medicinal plant wild harvest and cultivation sites have also been visited and movement of this material along trade chain documented.

2.1. INTRODUCTION

India's herbal sector is represented by 8610 licensed herbal units, thousands of cottage-level unregulated herbal units and millions of folk healers and household level users of thousands of herbal raw drugs on one hand and a complex trade web on the other that channels the herbal raw drugs from various supply sources to the end users. The canvas portraying demand and supply of medicinal plants in the country is, thus, quite complex. Any effort to assess demand and supply of medicinal plants in these diverse arenas has to be a challenge. This challenge to assess demand and supply of medicinal plants in the country has been attempted to be addressed by employing a comprehensive sampling technique and technical rigour to understand and bring out the dynamics of demand and supply of medicinal plants in the prevailing legal and administrative environment in the country.

2.2. IDENTIFICATION OF KEY ISSUES

It is important for a country-wide study of this dimension to identify key issues that are needed to be understood and addressed for arriving at worthwhile inferences in the available time frame. In view of the complexity of the subject and the expected outcomes of the study, an Inception Workshop of the entire project team was organised at Dehradun on 08 May 2015 to familiarise the team members with the subject, to identify key issues and to develop strategy for comprehensive coverage of the entire ambit of study arenas in a uniform and efficient manner. The workshop resulted in bringing out the following key issues that need to be studied to arrive at holistic understanding of the subject:

- the diversity of herbal raw drugs that are routinely used by the local communities under folk health care practices; by the registered ISM practitioners; and by the domestic herbal industry for making ready-to-use ASU formulations, along with the estimated annual quantum of use of these raw drugs.
- the diversity and annual quantum of medicinal plant species in foreign trade, both export and import.
- the sources of supply of herbal raw drugs, viz. wild harvested, cultivated, and imported to develop strategies for sustainable supplies.
- the existing and potential trade/ marketing of these medicinal plant resources, especially from the wild and cultivation, for optimising benefits to the local communities; and
- the legal and administrative environment in so far as it relates to the medicinal plants harvest, trade and use in the country.

2.3. STUDY STRATEGY

Increasing reliance upon the herbal based pharmaceutical, nutraceutical and cosmeceutical products has caused considerable growth of herbal sector in the country. However, the herbal sector still remains largely unorganized with little documentation of the herbal resource available. It is especially true in respect of supply from the wild and the cultivated sources, these sources being very wide spread and involving millions of households across the country.

For the purpose of this study the complex herbal sector in the country was broadly categorized

into two operational arenas, i.e. the one linked to the consumption (demand) of raw material and the other linked to supply of raw material. The consumption of herbal raw material has been taken to include use by industry engaged in making herbal formulations, practitioners of Indian health care practices who prepare and dispense their own formulations, local communities that use plant



Inception Workshop (08 May 2015) to identify Key Issues and Finalise Strategy

material for their bona-fide household remedies, and for exports. Similarly, three known supply sources of medicinal plants i.e. wild, cultivations and imports have been considered for this study. The movement of herbal raw drugs from different supply sources to the end users has also been studied.

There is an acute deficiency in data availability in respect of consumption, supplies and trade of herbal raw drugs. On the consumption side, some data about annual consumption by the licensed domestic herbal industry has started becoming available pursuant to the introduction of section 157 (A) in the Drug and Cosmetics Act, 1945. Similarly, consolidated year-wise data in respect of exports is also available in the form of compilation by DGCIS. It is, however, difficult to decipher this data at the entity level due to the inadequacies of the present foreign trade classification system. In as far as the supplies from wild harvests are concerned most of the state forest departments have stopped maintaining data base on supplies from the wild after passing on the regulatory mechanisms to the local communities under different legislations.

In the absence of any reliable data sources on demand and supply of herbal raw drugs in the country, the annual demand of herbal raw drugs has been assumed to be equivalent to the annual consumption of herbal raw drugs by various resource users for the purpose of this study. Major reliance of this study has, therefore, been on estimating the annual consumption of herbal raw material, as comprehensively as possible, by the herbal industry, by the households and folk practitioners and on account of exports. The supplies of herbal raw drugs from all sources i.e. wild, cultivation and imports have been taken as equal to the demand as computed on the basis of consumption by all categories of users.

The annual estimated demand of herbal raw drugs has been functionally integrated with the supply sources in testing validity of the estimates and projections of demand and supply and to make a fair assessment of gaps (shortfalls) in supply and resultant pressure on the natural medicinal plant resource base.

2.4. REVIEW OF LITERATURE AND DATA SOURCES

The understanding of the status of knowledge on the subject and limitations of the previous studies as developed from the review of literature and available reports has been used in

developing study methodology. Some key data sources consulted to gather background information on various aspects pertaining to the study include the following:

- Previous reports on the subject, mainly the reports by Ved & Goraya (2008), EXIM Bank (2003), CERPA (2002), and Task Force of Planning Commission (Anon., 2000). These reports helped in developing perspective on the subject, helped in fine tuning the methodology, and acted as benchmark reference material for the study.
- The website of the Department of AYUSH giving ISM stream-wise and state-wise detail of the licensed herbal units in the country. The information, corroborated with the one obtained from some of the State Drug Controllers, formed the base on which domestic herbal industry has been stratified for this study.
- The annual 'Foreign Trade Statistics' published by the Director General of Commercial Intelligence and Statistics (DGCIS), Ministry of Commerce and Industry to get information about import and export of botanical raw drugs for the last 10 years, i.e. from 2005-06 onwards.
- Annual statements submitted by the domestic herbal industry in respect of species-wise plant material consumed by them to NMPB and State Drug Controllers in pursuance of amendment to the Section 157A of the Drug and Cosmetics Act, 1945.
- Records of the State Forest Departments to gather information about the diversity and quantum of wild harvest of medicinal plants and to understand the chain of custody in respect of important species. The information received from this data source was, however, very weak.
- Literature pertaining to ethno-medicinal studies carried out in the districts selected by using a multistage sampling strategy (with random selection of units at each stage) for household survey was referred to cross check the botanical correlations of the local names documented during the survey with their botanical nomenclature.

2.5. COMPUTATION OF ANNUAL DEMAND OF MEDICINAL PLANTS

As already brought out above, the total estimated annual demand of the herbal raw drugs has been assumed to be equal to the total estimated annual consumption of herbal raw drugs by various user categories as depicted in the equation below:

$$f_n D \simeq \sum_{j=1}^m R_{uij} + \sum_{j=1}^n R_{utj} + \sum_{j=1}^o R_{ue_k} + (\sum RHw)$$

Where,

- R_{ui} = Estimated consumption by the domestic herbal industry
- R_{ut} = Estimated consumption by the household level users
- R_{ue} = Computed exports
- RHw = Estimated resource wastage during handling
- f_nD = Estimated demand (quantity in MT/ year)

While working out the consumption estimates, quantities of various raw drug entities consumed

by various consumer groups have been converted to their equivalent 'dry weight'. Thus, in case of entities like 'amla' (*Phyllanthus emblica*), where a sizeable quantity of fresh fruits is also used, the quantities of fresh fruits consumed annually have been converted into equivalent dry weight by applying a factor of 5:1 (fresh fruit weight : dry weight). Similarly, in case of 'extracts' consumed by the domestic herbal industry, a common factor of 1:8 (extract: dry weight of raw drug) has been employed to work out the equivalent dry weight of concerned raw drugs. The weight of 'extracts' in foreign trade as computed from the DGCIS data has, however, not been converted into equivalent 'dry weight' to maintain compatibility with the DGCIS data.

In view of the diversity of the user categories, different strategies and different sampling designs as detailed below were employed to gather consumption data.

2.5.1. Estimation of Consumption by the Domestic Herbal Industry

The herbal raw drugs in India are used by domestic herbal industry in making health care formulations, as well as in the manufacture of cosmeceuticals and nutraceuticals. Some of the botanicals, used in herbal pharmaceutical formulations, have major use as cereals (rice, barley, etc.); spices (viz. black pepper, nutmeg, cinnamon, bay leaves, cumin, fenugreek, etc); fruits (mango, papaya, etc.); and vegetables (bitter gourd, bhindi, etc.). Many of these items do not route through the traditional raw drug mandis. Any effort at assessing demand of the botanicals based on raw drug market survey, therefore, has to factor in the competitive uses various botanicals are put to, which is a very complex exercise. The following assumptions were, therefore, made to develop a sampling design for comprehensive gathering of data on consumption of herbal raw drugs by the domestic herbal industry:

- that the annual consumption of raw drugs by volume, including those that are usually categorized as spices, by a herbal unit is a fair indicator of its annual turnover.
- that the quantum of resource use is largely independent of the different ISM streams.
- that even though the number of traded herbal raw drugs is fairly large, only a limited number of entities are traded in large quantities i.e. >100 MT/ year.
- that irrespective of their current operational status, all licensed small and very small manufacturing units were taken to be operational. It was done to offset the impact on the total demand of herbal raw drugs consumed by a large number of cottage scale unlicensed units using herbal raw material for health care products.

The Ministry of AYUSH, Government of India recognizes the existence of 8610 licensed manufacturing units registered under Indian System of Medicine (ISM) in the year 2011 (AYUSH, 2011). The Department of AYUSH has also categorized the herbal industry into four size-wise classes on the basis of annual turnover i.e. Large (annual turnover > ₹ 50 crore), Medium (annual turnover between ₹ 5-50 crore), Small (annual turnover between ₹ 1-5 crore), and Very Small (annual turnover < ₹ 1 crore) and has used this categorization to classify 7000 herbal units (Anon. 2002). The same broad categorization has been followed in stratifying the 8610 licensed herbal units into four size-wise strata (table 2.1). Since the annual turnover for all licensed herbal units was not available, an equation to correlate the size-wise categories of herbal units with their annual consumption of herbal raw drugs including spices was developed and used to work out the categories (table 2.1).

Table 2.1. Categories of Domestic Herbal Units based on Annual Turnover and Annual Consumption of Herbal Raw Drugs including Spices

Unit Size	Based on Annual Turnover		Based on Annual Consumption of Herbal Raw Drugs	
	Annual turnover (₹ in Crore)	Apprx. number of units	Annual Consumption of Herbal Raw Drugs (MT)	Apprx. number of units
Large	> 50	20	>500	50
Medium	5-50	50	50-500	200
Small	1-5	2000	10-50	2000
Very Small	< 1	6540	<10	6360
Total		8610		8610

The equation to correlate the size-wise categories of herbal units with their annual consumption of herbal raw drugs including spices has been based on the percentage of the cost of herbal raw drugs including spices vis-a-vis the annual turnover of the unit. A sample analysis of such data in respect of herbal units reveals that the cost of herbal raw drugs including spices makes about 10% of the total turnover of the herbal units. Similarly, the cost of the herbal raw drugs including spices has been worked out to be a shade above ₹ 100 per kg. However, the rate has been rounded off to ₹ 100 per kg for the ease of calculations. Based on these calculations, a herbal unit with annual turnover of ₹ 1 crore consumes herbal raw drugs including spices for a value of ₹ 10 lakh, which at a rate of ₹ 100 per kg works out to 10000 kg or 10 MT. For the purpose of working out sampling design under this study, the category-wise classification based on annual consumption of herbal raw drugs by the industry was used.

A Stratified Random Sample with proportional allocation of sampling units (domestic herbal units) based on stratification variables including, a) their annual turnover so as to proportionally cover industries of large, medium and small sizes; b) geographical occurrence of units so as to cover variations in resource use across the country; and c) Indian Systems of Medicine used as base for manufacturing herbal formulations to cover the sector in its entirety has been employed to gather consumption data through direct survey of the herbal industry. The herbal industry's categorization based on annual consumption of herbal raw drugs, has been adopted for stratification of herbal industry for the purpose of data gathering. Details of the sample size planned are given in the table 2.2.

Table 2.2. Category-wise Detail of the Domestic Herbal Units Planned to be Sampled

Unit Size	Apprx. number of units based on annual consumption of herbal raw drugs	Planned sample size	No. of units planned to be sampled
Large	50	50%	25
Medium	200	40%	80
Small	2000	5%	100
V. Small	6360	3%	191
Total	8610	-	396

Data on consumption of botanicals by domestic herbal units has been obtained (a) from the formats submitted by these units under Section 157 (A) of the Drug and Cosmetics Rules, 1945 to the State Drug Controllers and to the NMPB, and (b) by direct visits to the selected herbal units

with a special focus to understand and validate the botanical correlations of the herbal entities in use by them.

2.5.2. Estimation of Consumption by Households and Folk Practitioners

A detailed multistage sampling with region, state, district and villages in successive stages and household as sampling unit has been followed to gather information on consumption of medicinal plants by rural households from across the country. As per this design, survey was to be carried out in randomly selected 13 states across 6 eco-geographical regions, 39 districts (@ 3 districts per selected state) and 195 villages (@ 5 villages per district). At village level, information was to be collected from 15 households from every selected village, irrespective of the size of the village. Thus, in all data from 2925 households was planned to be collected under this survey. Some deviation from this sampling design was necessitated due to Panchayat election in one state, and insurgency problems in other. Data was thus collected from 2450 households spread over 15 states. Information on both quantitative and qualitative parameters in respect of use of botanicals was gathered at the household level.

As far as folk healers and registered practitioners of different streams of codified health care systems are concerned, the folk healers from the selected villages were identified by using *a priori* information.

The information from the households and the folk healers was recorded as per pre-tested semi-structured questionnaires on specially designed formats. The plants used by the communities and the folk healers were identified with the help of local floras, by consulting experts, and by comparing the local names with the ones recorded in the ethno-medicinal survey literature.

2.5.3. Computation of Exports

DGCIS data on exports for the years 2005-06 to 2014-15 was obtained and analysed to compute export of medicinal plants, and to work out export trends of top traded species. Efforts were made to decipher ITC (HS) codes to arrive at the level of species under export. The species-wise export data has been validated through consultations with the various agencies involved in export of botanicals including 'Exporters', 'Export Regulating Agencies' and 'Export related Data Management Agencies'.

2.6. ASSESSMENT OF SUPPLY OF MEDICINAL PLANTS

Data sources on supplies of medicinal plants are very weak. Therefore, it was assumed that all different categories of users of herbal raw drugs were able to meet their annual requirement and the supplies were, therefore, assumed to be equivalent to demand. Efforts were made to collate as much information as possible from different supply sources.

2.6.1. Estimation of Supplies from Wild Resources

The wild resources include forests and habitats outside forests (viz. farm lands, road/ rail sides, canal banks, ponds and lakes, waste lands, etc.) with the major supply of raw drugs of wild origin coming from forests. The State Forest Departments, custodians of the forest lands, and the MFP Federations, Corporations and Cooperatives were approached to provide information on the annual quantum of removals of medicinal plants from the forests. However, data received from these organisations was generally weak. Field visits were made to sites in different States to document wild harvest and the trade chain. Information was also sought from local gatherers/

agents on the subject and it was of immense help in understanding the lines of harvest and trade (both quantitative and qualitative).

2.6.2. Estimation of Supplies from Cultivation

Cultivation of medicinal plants has become an important source of supplies over the years. However, there is no data source where species-wise information on cultivation at national level is maintained. In the absence of data sources, information on cultivation is usually based on inferences drawn from the resource use side. In cases where the species is sourced only from cultivation, e.g. 'isabgol', 'mentha', or 'senna', the use figures (domestic and export) provide a fairly good idea of total production. However, such estimation in respect of species that are partly sourced from the wild and are also cultivated or imported is complex and needs critical studies. The following strategy was employed to gather information on the subject:

- Information about the source of material (wild/ cultivated) was recorded during market survey.
- Information about any cultivation under buy-back arrangements was recorded during industry visits.
- Information about cultivation of medicinal plants already available in literature and with ICFRE/ FRLHT was reviewed.

Field visits were made to known medicinal plant cultivation sites to document the size of cultivation and activities along trade chain. Various issues related to cultivation were also directly discussed with randomly selected farmers.



Consultation with farmers and wild gatherers of medicinal plants

2.6.3. Computation of Imports

DGCIS data on imports for the years 2005-06 to 2014-15 was obtained and analysed to compute import of medicinal plants, and to work out import trends of top traded species. Efforts were made to decipher ITC (HS) codes to arrive at the level of species under import. The species-wise import data has been validated through consultations with the various agencies involved in import of botanicals including 'Importers', 'Import Regulating Agencies' and 'Import related Data Management Agencies'.

2.7. STUDY OF RAW DRUG MARKETS

Most of the botanical raw material, except the one cultivated under buy back arrangements between farmers and the industry, passes through raw drug markets of various sizes across the

country. Study of these markets is very important to understand the dynamics of movement of botanical raw material from production centres to the consumption centres. The trading of medicinal plants currently happens through the Conventional Herbal Raw Drug Mandis of various sizes; the Krishi Upaj Mandis; the MFP Federations/ Corporations/ Cooperatives; Specialised Herbal Mandis; and under Buy-back Arrangements.

Visits were made to more than 40 herbal raw drug mandis of different types and information generated in respect of -

- the diversity of botanical entities under trade for medicinal purposes along with their trade names and prices.
- species in significant trade, say >100 MT/ year, along with supply chain/ trade web of important species.
- species that are Red-Listed and are of high Conservation Concern, irrespective of their annual trade volumes.

Basic information on the points given above was compiled from the FRLHT's database and other recent publications, and market and price bulletins published by different states and agencies.

Data was also collected from randomly selected retail shops selling botanical raw drugs and the information so gathered has been used in compiling the Comprehensive Inventory of Medicinal Plants in Commercial Trade.

2.8. ESTABLISHING BOTANICAL CORRELATION OF HERBAL RAW DRUGS

Establishing critical identity of the herbal raw drugs in trade is the biggest challenge in assessing their demand and supply. It is understood from the previous works on the subject that many raw drug entities pass on as equivalents, substitutes or adulterants of the officially accepted raw drugs. List of many such known controversial raw drug groups viz. 'shankhapushapi', 'daruharidra', 'jivanti', 'rasna', 'gokshura', 'vidari', 'vidanga', etc. were prepared before visiting the herbal raw drug mandis for the survey. This list kept the field teams vigilant about the entity actually in trade. Even as most of the traders were reluctant to share samples of the herbal raw drugs in trade, the teams were successful in procuring some samples of raw drugs from across various raw drug mandis for confirmation and future reference. These samples helped in confirming the botanical identity of some controversial raw drugs like 'jivanti', 'gurhal', 'ativisa', etc. Controversial herbal raw drugs recorded during the study have been enlisted for detailed investigation.

2.9. ASSESSMENT OF RAW DRUG WASTAGE

Some portion of the medicinal herbs collected from the wild or cultivated sources gets wasted from the time of collection to their eventual use. Major reasons for such wastage include insect or fungal attacks due to non-following of good post harvest handling methods, or during transit due to poor packaging. Such wastage has definite implications in as far as demand or supply of medicinal herbs is concerned. The percentage of such wastage is, however, not known and has, therefore, failed to get factored in the previous studies on demand or supply of medicinal herbs. Under this present study effort was made to estimate the wastage along the supply chain of selected medicinal herbs and an average wastage percentage worked out for the herbal raw drugs in trade.

2.10. ANALYSIS OF POLICIES AND REGULATORY REGIMES

The wild harvest, trade, pricing, consumption and foreign trade of medicinal plants involve various policy issues and regulatory regimes. These issues have been examined and appropriate interventions for improvements suggested. The main policy and regulatory issues analysed under the study are -

- ITC (HS) Code for Trade Classification for foreign trade.
- Transit Rules concerning trade of wild harvested and cultivated material.
- MFP Federations, Corporations and Cooperatives and trade of medicinal plants.
- Devolving rights over MFPs to local communities.
- Implications of Biological Diversity Act, 2002 on medicinal plant sector.

Available literature on the subject was reviewed and consultations with experts held to examine the issues and to arrive at appropriate recommendations.

2.11. HIGHLIGHTING RED-LISTED MEDICINAL PLANTS

Concerns about the depleting wild populations of a number of medicinal plants are being raised for quite some time. Some attempts at assessing the threat status of medicinal plants have also been made. The available reports related to assessment of threat status of medicinal plants using IUCN's Red-List Categories and Criteria were examined and the lists of red listed medicinal plant species compared with the medicinal plant species in high trade. The species facing threat have been flagged to guide conservation action in the field and to ensure sustainable supplies of these threatened species.

2.12. SYNTHESIS OF DATA AND COMPILATION OF STUDY REPORT

The study-cum-survey has generated enormous data that has been collated, cleaned, computed and analyzed separately for each study arena following appropriate analytical tools in accordance with the proposed sampling design. The qualitative information gathered for different study arenas has been appropriately grouped, correlated with the quantitative data and inferences drawn from these.

Since large number of medicinal plant species have been documented in commercial trade for the year 2014-15, data collation has been prioritized based on (a) the volume of annual trade i.e. detailed analysis has been carried out for species in high volume trade i.e. >100 MT/ year; (b) the



National Consultation Discussing Draft Report on Demand and Supply of Medicinal Plants



Presentation of Draft Final Report on Demand and Supply of Medicinal Plants

species having high monetary value, and (c) species of conservation concern, irrespective of the volume of annual trade.

The draft report was presented in the national consultation specially convened on 23 March 2016 at Dehradun to share highlights of the study with representatives of different stake holder groups and to seek their comments and inputs on different outputs of the study. The draft report was thereafter modified to incorporate views expressed by the stake holders. The highlights of the draft final report were presented to NMPB's specially convened committee with the Secretary AYUSH as chairperson and subject matter experts, representatives of herbal industry, traders and officers of the NMPB as members on 01 September 2016. The comments/ suggestions by the Secretary AYUSH and other members of the committee were duly incorporated to further refine the report and to bring it to its present form.

Based on the inferences drawn from the collated data, suggestions for further fillip to the herbal sector in the country have been made in the form of recommendations.



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