

HERBAL SECTOR IN INDIA: DEMAND-SIDE NEEDS AND PRIORITIES

a compilation for the workshop on 'Management of the Herbal Wealth of India'

According to WHO, over 80% of the total world population depend on traditional medicines, mostly plant based, for their primary health care needs. Medicinal plants not only provide access to affordable medicine for the poor people; they also generate income, employment and foreign exchange for the developing countries. In recent years, increasing popularity of alternative medicine and herbal products has rapidly increased the demand for Medicinal and Aromatic Plants (MAPs) in the global market. Estimates by the EXIM Bank show that international trade of medicinal plants and its allied sectors is presently placed at US\$ 60 billion per year and still growing at a rate of 7% annually. Domestic sales are growing by 20% per annum.

The medicinal plants sector has traditionally occupied an important position in the socio-cultural, spiritual and medicinal background of rural and tribal lives of India. The medicinal plants comprise of approximately 8000 species and account for about 50% of all the higher flowering plant species in India. Besides meeting national demands, India caters to 12% of the global trade in herbal sector. In recent years, trade in herbal-based products has quantum leaped, particularly with respect to the volume of plant materials traded within and outside the country. Although India possesses one among the 12-mega biodiversity hotspots, the growing demand for medicinal plants is undoubtedly putting heavy strain on the existing resources, causing a number of species to become rare, threatened or endangered. Some rapid assessment of the threat status of medicinal plants using the IUCN-designed CAMP methodology has revealed that about 112 species in Southern India, 74 species in Northern and Central India and 42 species in the high altitudes of the Himalayas are threatened in the wild. Every year thousands of tonnes of these plant resources are being exploited from the natural habitat either legally or illegally, while very little of the benefits flow back to the local communities.

Post harvest processing:

Traditionally, the herbal medicines were produced manually in small quantities by the practitioners / traditional healers themselves. With the introduction of commercial production of herbal drugs, processing efficiencies have improved considerably. Indian drug manufacturers are producing vitalisers, geriatric tonics, cycle correctives for women, growth promoters for children, digestives, liver tonics and laxatives, and also working on formulations for treatment of anti-diabetes, anti-inflammatory, anti-arthritis, cardiovascular, CNS, dermatology, respiratory and urology segments, using medicinal plant extracts.

The value added herbal products are of two types:

- Extracts/concentrates (particularly in the form of retail packaging such as capsules)
- Preparations (mixed formulations)

The medicinal plants and plant parts undergo various processes to get the best out of them. They are generally chopped after collection. Threshing is done for removing and

separating unwanted and damaged or immature material. Cleaning of crop is done before drying and again before packaging to ensure that the medicinal product is of the best quality and will obtain the correct price. This is followed by drying of the plant parts in the sun or in shade as required. The aim is to reduce the moisture content of the product from actively growing in the field to a level that prevents deterioration of the product and allows storage in a stable condition.

When they are ready for mixing, the plant parts are combined carefully according to the formulae mentioned in the traditional texts. These texts describe accurately which part of the plant is to be used, when and how should the plants be collected, how they should be dried, prepared and compounded, the exact proportions of each ingredient and other details. The final products are pills, powders, decoctions, medicinal pastes, ointments, medicinal baths, inhalations, enemas, etc., designed to have little or no side effects. The traditional medicines for internal use prepared in the traditional manner involve simple methods such as hot or cold-water extraction, extraction of juice after crushing, powdering of dried material, formulation of powder into pastes using water, oil or honey, and even fermentation after adding some sugar source.

There is a need for an infrastructure to provide quality storage, both on-farm and off-farm, with cool stores and warehousing facilities for post-harvest crop management. Quality of medicinal and aromatic plants and spices deteriorate rapidly in adverse conditions. It is also essential that the crops attain a safe moisture level prior to storage. The storehouses or storage places should be damp resistant, vermin and birds or rat proof and wherever possible have controlled ventilation facility and devices to regulate temperature and moisture conditions.

Measures of primary processing depend on individual materials. These processes need to be carried out in conformity with national and regional quality standards, regulations and norms. In some cases, purchasers may require certain specific protocols to be followed. These should also comply with national and regional regulatory requirements that apply to the manufacturer and the purchaser countries. All medicinal plant materials should be inspected and any substandard products or foreign matter should be eliminated. All processed materials should be protected from contamination and decomposition.

Establishing processing and semi-processing units in form of small cottage industries at the village level in inaccessible, remote and far-flung areas would ensure better profits to the primary growers or collectors by reducing the transportation expenses of raw materials, upgradation and value addition of collected materials and would also provide opportunity for employment generation. This will enhance the price and improve the quality of the materials. The small processing units can provide viable returns to the community in short and long-term basis.

A study conducted by CECI (2002) indicated that from a single district of Pitthoragarh in Uttarakhand state, more than 1300 tons of MAPs are collected and traded annually, most of them illegally. The collection, processing and trading of medicinal plants contribute significantly to the income of the poor and the women. As the price paid to the collectors tends to be very low, they often "mine" the plants, for increasing their income. Setting up MAP- based local micro-enterprises can bridge the gap between demand and supply while also promoting social harmonization and sound environment conservation.

Quality Assurance:

Despite the wealth of medicinal and aromatic plants, the herbal sector has not developed due to the absence of suitable standardization, quality control and efficacy of drugs. It needs to organize marketing and trade and turn itself into a formal sector for integrating the development of medicinal plants from production to consumption to boost export of herbal formulations.

The production of traditional medicines for local uses does not have stringent standards, but the control of the quality of the raw materials, finished products and of processes is an absolute necessity and stringent in terms of content of active principles and toxic materials for world market and modern medicines. In India, a major disadvantage is inadequacy of standards to verify the quality by modern instrumentation methods. Even with the best of intentions, no system of medicine can achieve any degree of credibility and mass acceptance unless some quality control practice or quality assurance is maintained.

WHO has released a few guidelines regarding good agricultural and collection practices for medicinal plants in 2004 to ensure that production of herbal medicines is of good quality, safe, sustainable and poses no threat to either people or the environment. It covers a spectrum of issues including cultivation and collection methods, site selection, climate and soil considerations, identification of seeds and plants, main post-harvest operations and relevant laws on quality standards, patenting and benefits sharing. The legal situations regarding herbal preparations vary from country to country. In some countries, phyto-medicines are well established, whereas in others they are regarded as food products and therapeutic claims are not allowed. India has a large number of traditionally used herbal medicines and remarkable traditional knowledge, but no significant steps have been taken yet to identify these traditionally used herbal medicines as part of the drug legislation.

Quality has to be built into the whole process starting from selection of propagation material to the final product that reaches to the consumer. The quality of medicinal plants depends on the agro-climatic conditions, time and stage of growth when collection has been done, and the different stages for post harvest handling. The collections in most cases are done by village-tribals residing in the vicinity of the forests. The plant parts are collected without knowledge of the stage of maturity, dried haphazardly and stored for long periods under unsuitable conditions. Thus the quality of the collected material is often degraded.

Quality control and implementation of standards in medicinal and aromatic plants sector constitute an area where policy making is still '*work in progress*'. The Medicinal Plants Board was set up to be responsible for coordination of all the matters relating to medicinal plants, including formulation of policies and strategies for conservation, cost-effective cultivation, research and development, processing, marketing of raw material - in order to promote and develop this sector. Government of India has also set up pharmacopoeia committees for Ayurveda, Siddha, Unani and Homeopathy systems. The Pharmacopoeial Laboratory for Indian Medicines (PLIM) and the Homeopathy Pharmacopoeial Laboratory (HPL) are providing the necessary technical back up to these committees. The pharmacopoeia committee has published two volumes of Ayurvedic Formularies of India consisting of 635 formulations. The siddha pharmacopoeia

committee has brought out seven volumes containing standards of 910 drugs. The Unani pharmacopoeia committee has published one national formulary of 441 formulations of Unani medicines. The Homeopathy pharmacopoeia committee has brought out 7 volumes containing standards of 910 drugs. More works relate to this are in progress. There are about 7483 drug-manufacturing units of Ayurveda, Siddha & Unani (ASU) Systems of Medicine in the country. For quality assurance there is a need of public test houses as well as statutory State Drug Testing Laboratories for these medicines. It is necessary to set up, renovate and upgrade the existing State Drug Testing Laboratories. Presently there are only a couple of laboratories in the country, which can perform only few basic tests.

The crude drugs (processed medicinal plants), of standard quality need to be identified and preserved as the reference standard along with herbarium specimen, chemical finger print profiles, anatomical slides, supporting literatures-and a collection of living plants. This repository can then become the official certification centre (OCC) for raw materials. The next important stage is the quality control during processing and manufacturing. The labels should depict all the relevant details and specifications.

There is a necessity to speed up the standardization process. The processes, which are used for the production of plant-based drugs vary widely and there is variation in quality of the same product produced by different process. Therefore, it is necessary to standardize the in-process quality control. Industrial processes have to be properly and strictly controlled to produce the desired quality products. The elements of Total Quality Management (TQM) have to be introduced in the industrial projects. The requirements for ISO 9000 certification and Good Manufacturing Practices (GMP) needs to be introduced and eco-audit procedures (according to ISO 14000) leading to eco-labeling will be required for safeguarding the environmental damage.

The plant-based drugs are considered to be comparatively safer, but some of the drugs are toxic especially when these are not properly processed and used judiciously. Although majority of the plant-based drugs are time tested, clinical validation is also necessary for confirming the efficacy. At present there is no centre for safety evaluation of the plant-based drugs. It is necessary to assign a safety evaluation centre to facilitate the acceptance of the drugs at a global level.

It is an issue of great concern that our country does not fetch good prices or exports orders due to the lack of standardization/certification. Also, India's share in the international trade of medicinal plants is very low for the same reason. There is an impending need to develop quality standards and certification mechanisms with special attention towards:

- An appropriate pricing regime to encourage cultivation and reduce pressure on the natural resources.
- Establishing quality standards with respect of norms related to toxicity and heavy metal contents.
- Identifying and creating an independent national agency for quality assurance and certification of seeds, planting material and raw drugs.

Certification:

Quality assurance is an important factor for consumer confidence and certification schemes for quality control have been in existence for decades. Likewise, certification programmes are evolving worldwide with the objectives of ecological, social and economic sustainability. No independent third-party certification of medicinal plants for ecological, organic, social or quality standards has been reported in India, with the exception of a very few which are mainly of fair trade and organic certification, primarily for products usually associated with mainstream food and beverages that are destined to export.

Many medicinal plant species in India occur in forest areas and along with other non-timber forest products (NTFP), fall within the scope of certification schemes aimed at "sustainable forest management". One of the best-known certification schemes for sustainable forest management is that of the Forest Stewardship Council (FSC). FSC certification supports environmentally appropriate, socially beneficial and economically viable management of the world's forests and promotes responsible resource management and plays an important role to sustainably collect medicinal herbs and other NTFPs and to enhance their marketing.

Other prominent types of certification schemes relevant to medicinal plants relate to ensuring organic, fair trade and quality standards and are applied both to raw materials and production methods. Organic certification may be applicable to both cultivated and wild-harvested medicinal plants and has most frequently been applied to plants used in food and beverages, such as herbal teas, herbs and spices. The International Federation of Organic Agriculture Movements (IFOAM), an NGO, and regional and national governments such as those of the European Union, the USA and Japan are among the major players globally in organic certification. Fair trade certification aims to achieve social goals, e.g. to improve the position of poor and marginalized producers in the developing world. Fair-trade Labeling Organizations International (FLO), an NGO, is the main international body developing and certifying compliance with "fair trade" criteria.

In India also focus has been laid on development of organic agriculture quality products. Ministry of Commerce and Industry, Govt. of India launched a National programme on Organic Production in 2004. APEDA is the agency that looks after the norms and certification of organic products.

The Medicinal Plants Unit of Indian Council for Medical Research has announced that it would shortly release Quality Standards for 32 Indian Medicinal Plants, based on research conducted at four national research institutions. These standards will provide guidelines for herbal drugs manufacturers, practitioners, academicians, researchers as well as regulatory bodies. There are several government certification schemes focusing on product quality, environmentally friendly and organic production. The Bureau of Indian Standards has certified over 1100 products for quality standards. Certification for quality management and environmental management according to ISO has also been adopted. Progress in certifying products under India's only eco-labeling programme 'Ecomark' has been painfully slow.

Experts have suggested that the certification scheme should be "umbrella standard",

taking into consideration all ecological, social, institutional and economic issues, and having a holistic approach, should be based on international standards and before setting up a national certification programme, it should be assessed how acceptable this would be from a market perspective, since global experience showed that this could be very difficult.

The informal nature of the herbal trade sector results in problems beyond its impacts on biodiversity.

Authentication and quality assurance of plant material is currently based on physical parameters assessed purely through observation. This has always caused variation in drug potency, but has lately begun resulting in adulteration as well, as availability in the wild has shrunk. This is also likely to affect the product credibility and market size in times to come.

Marketing & Promotion:

Trade in medicinal plants, plays only a small part in the Indian economy, although this is now an expanding private sector in the country. Trade in medicinal plants consists of a large variety of commodities, which range from raw plant material, such as root or bark to processed commodities such as extracts or finished pharmaceutical drugs. Growing popularity of herbal medicines in health care systems and the trend of increase in their export demand are quite evident. Estimated figures reflect 15-20% growth of Indian pharmaceutical concerns per year. Further, the figures foretelling global trade in medicinal plant species indicate a steep upward trend in near future.

Marketing of medicinal plants in India till date is inefficient, informal, secretive and opportunistic. As a result, the raw material supply situation is shaky, unsustainable and exploitative. This results in depletion of the resource base, exploitation of rural people (who are the real stewards of the resource), adulteration and non-availability of quality herbal drugs for domestic consumption as well as for exports. The medicinal plants sector has a number of stakeholders having divergent interests. Unless coordinated efforts are made, the sector will not develop. The various players involved in the marketing of Medicinal and Aromatic Plants Sector are:

- Small and Large Scale farmers,
- Retailers,
- Health authorities,
- Conservation authorities,
- Forestry authorities,
- Policy makers at all levels of Government,
- Communities and Individuals who own or have access to medicinal plant resources.

The three main groups of stakeholders are:

- The Industrialists
- The Consumers
- The Primary Producers (Cultivators) or Collectors of raw materials.

Around 90% of the medicinal plants used by the Indian Pharmacies today are collected from the wild/natural sources. Less than 20 species of plants are under commercial

cultivation and many of these have their uses for other purposes like perfumery/condiments/spices. The bigger supply of the raw material is procured by pharmacies from the drug dealers in the markets of metro cities and many small cities of the country. These drug dealers of the cities in-turn procure them from the so-called unknown sources (as it forms a part of their trade secret). 90% of them ultimately come from natural sources of various parts of the country collected by unskilled forest dwelling communities and are purchased at a nominal price. Several medicinal plants have now been assessed as endangered, vulnerable and threatened due to over harvesting or unskillful harvesting in the wild. Habitat destruction in the form of deforestation is an added danger. The Government of India has put 29 species, threatened in the wild, in the negative list of export. The unsustainable ways of harvesting and unrestricted marketing have led to reduction in population of some of the high demand medicinal plants leading to sudden escalation in prices of these crude drugs in the market.

List of medicinal plants banned for export:

1. *Cycas beddomei* (Beddomes cycad)
2. *Vanda coerulea* (Blue Vanda)
3. *Saussurea costus* (Kuth)
4. *Paphiopedilium* spp. (Lady's Slipper Orchids)
5. *Nepenthes khasiana* (Pitcher plant)
6. *Ranathera imschootiana* (Red Vanda)
7. *Rauwolfia serpentina* (Sarpagandha)
8. *Ceropegia* spp. (Ceropegia burbosa Roxb.)
9. *Frerea indica* (Shindal Mankundi)
10. *Podophyllum hexandrum* (emodi) (Indian Podophyllum)
11. *Cyatheaceae* spp. (Tree Ferns)
12. *Cycadaceae* spp. (*Cycas circinalis* Linn.)
13. *Dioscorea deltoidea* (Elephant's foot)
14. *Euphorbia* spp. (Euphorbias)
15. *Orchidaceae* spp. (Orchids)
16. *Pterocarpus santalinus* (Red Sanders)
17. *Taxus wallichiana* (Common Yew or Birmi leaves) (*T. baccata*)
18. *Aquilaria malaccensis* (Agarwood)
19. *Aconitum* spp.
20. *Coptis teeta*
21. *Coscinium fenestratum* (Calumba wood)
22. *Dactylorhiza hatagirea*
23. *Gentiana kurroo* (Kuru, Kutki)
24. *Gnetum species* (Gnetummontanum Markgraf)
25. *Kaempferia galanga*
26. *Nardostachys grandiflora* (Jatamansi)
27. *Panax pseudoginseng*
28. *Picrorhiza kurroo*
29. *Swertia chirayta* (Chirayata)

The number of actors in the supply chain is large. These include: the primary collectors and producers, local contractors, local middlemen, regional wholesalers, markets in large city centres and specialized suppliers.

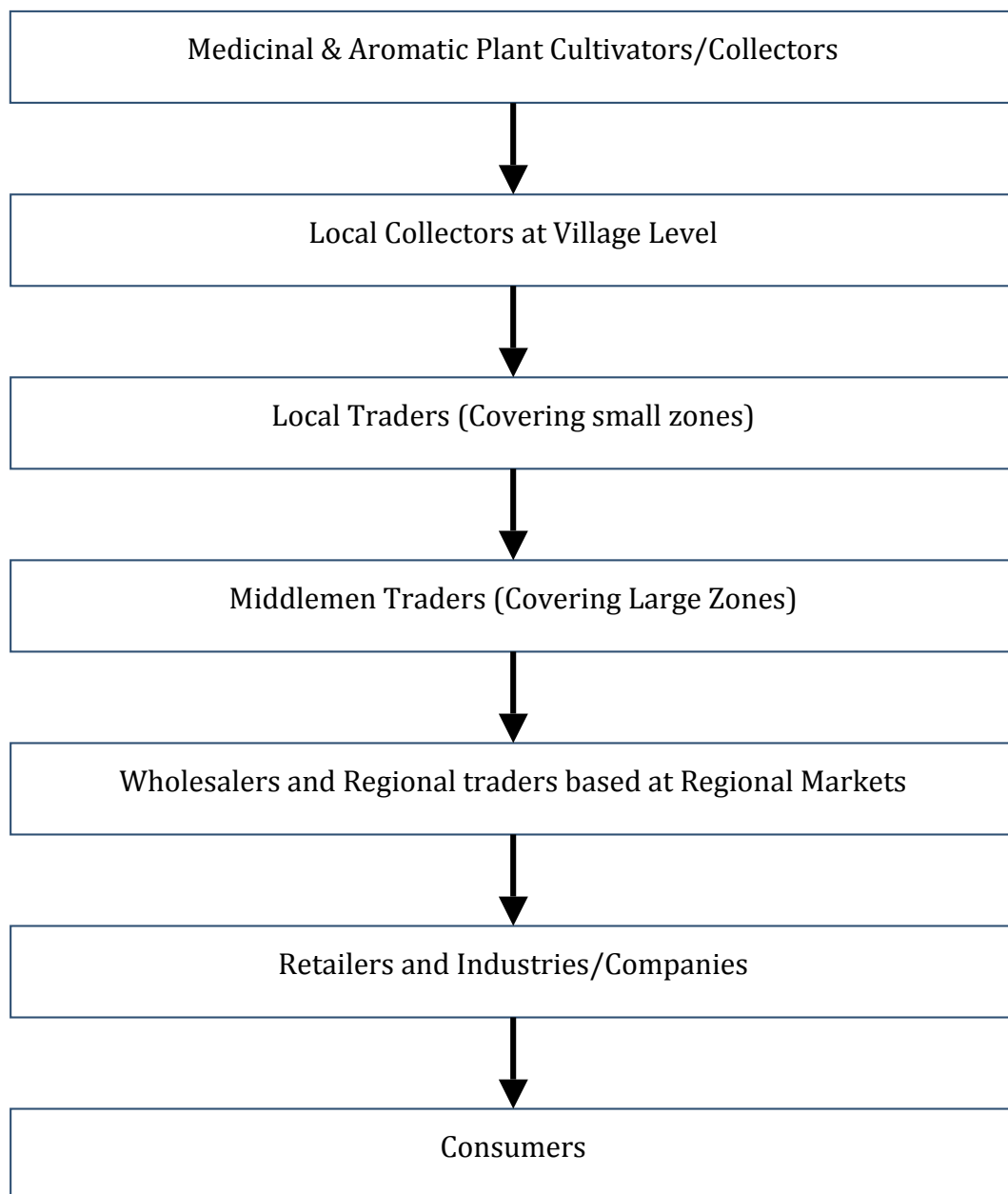


Fig. Market channels of Medicinal Plants

This supply chain often extends to more than 3-4 tiers without much value addition but increase in sales price at each level. There is, on an average, 70 to 100% increase in sale price of crude drugs from primary collectors level to pharmacy level. Often the same crude drug is available in various grades with major traders having considerable differences in price.

It is obvious that we need to develop the export of crude drugs and Ayurvedic products while scientifically harnessing our unique biodiversity and preserving the time tested scientific knowledge of natural remedies. Simultaneously, the areas of weakness and threats need to be appropriately managed to avoid any adverse impact. As identified by

NMPB, some of the constraints, which result in reducing their competitiveness in the global market are:

- poor agricultural practices.
- poor harvesting (indiscriminate) and post-harvest treatment practices
- lack of research on development of high-yielding varieties, domestication etc.
- poor propagation methods
- inefficient processing techniques leading to low yields and poor quality products
- poor quality control procedures
- high energy losses due to processing
- lack of current good manufacturing practices
- lack of R&D on product and process development
- difficulties in marketing
- lack of local market for primary processed products
- lack of trained personnel and equipments
- lack of facilities to fabricate equipment locally
- lack of access to latest technologies and market information

The estimated annual turnover of three of the major Indian systems of medicine, i.e., Ayurveda, Unani and Siddha is more than half a billion dollars. The current gap between demand and supply is estimated to be around 40,000 - 2,00,000 tons, which is expected to rise to 152,000 - 400,000 tons by 2005 (Planning Commission, 2000 & CRPA, 2001). Unfortunately, while demand rises, inequitable trade practices allow only a small margin of the profits to trickle down to the collectors and harvesters.

Import:

All the raw materials that are used by the Pharmacies are not of indigenous origin. Considerable supplies are received from the neighbouring countries of Nepal, Bhutan, Bangladesh, Pakistan, Afganistan, and also from Singapore, etc. and often through informal routes. For example, most of the 'Chirayta' and other Himalayan medicinal plant crude drugs come from Nepal and Bhutan, 'Oleoresin gugul' of best quality is obtained from Pakistan, 'Liquorice' from Afganistan and good quality 'Banshalochan' from Singapore. According to the data received from CHEMEXCIL, out of the total estimated annual demand of 31,780 tons of raw herbal material of pharmaceutical industries, 7,180 tonnes is met through import.

Export:

Apart from requirement of medicinal plants for domestic sector, India is one of the major exporters of crude drugs to six developed countries, viz. USA, Germany, France, Switzerland, UK and Japan. India's export of medicinal plants are mainly in the form of crude drugs and extracts which account for nearly 70% of the total medicinal plant product exports. The remaining 30% are exported as finished products.

Export opportunities of natural products are fabulous as the present world market is looking towards natural sources for the purpose of therapeutic use as well as nutritional and dietary supplements. The global market for herbal remedies can be classified into five strategic areas:

- i) Phyto-Pharmaceuticals - the plant derived drugs
- ii) Medicinal Botanicals / Botanical Extracts / Herbal or Dietary Supplements
- iii) Nutraceuticals - foods containing supplements from natural (botanical) sources
- iv) Cosmeceuticals - cosmetic products of botanical origin
- v) Herbal raw materials

The largest international markets for MAPs are China, France, Germany, Italy, Japan, Spain, the UK and the US. Japan has the highest per capita consumption of botanical medicines in the world. According to Lange (2002), India is placed in 2nd rank after China, amongst the 12 leading countries, which are the major exporters of MAP in the world (Table:1).

Table 1

Country of Export	Volume (tonnes)	Value (1000 US\$)
China	1,39,750	2,98,650
India	36,750	57,400
Germany	15,050	72,400
USA	11,950	1,14,450
Chile	11,850	29,100
Egypt	11,350	13,700
Singapore	11,250	59,850
Mexico	10,600	10,050
Bulgaria	10,150	14,850
Pakistan	8,100	5,300
Albania	7,350	14,050
Morocco	7,250	13,200
Total	2,81,550	6,43,200

Source: UNCTAD COMTRADE database, United Nations Statistics Division, New York

The economic challenges faced by the herbal sector are:

- Lack of product patent protection, which is responsible for very little investment by Indian companies.
- Inability of the small innovators, herbal practitioners and herbal healers to generate resources, links and avenues for commercializing their knowledge.
- Lack of funds to develop high quality medicinal plant varieties through introduction of biotechnology or develop cheap propagation methods.
- Availability of cheap alternatives from the wild.
- Poor returns to the grassroots collectors and institutions because of long distribution channels and unfair pricing.

The other challenges include inability to mobilize essential budgetary and non-budgetary resources from national and international sources for ensuring conservation, sustainable extraction, value addition and marketing by both the organized and the unorganized (informal) associations.

Unsustainable ways of harvesting and unrestricted marketing have led to the destruction of some of the high demand medicinal plants species leading to sudden escalation in prices of these crude drugs in the market. Recognizing the trend, many larger pharmacies have started promoting contract farming of medicinal plants to meet their demand. These modern pharmaceutical industries who specialize in production of a few specialist drugs/chemicals from plant sources, enter into buy-back arrangements with the growers and employ modern product standardization techniques. Established traders of crude

drugs should feel that promotion of cultivation of medicinal plants is a required step in right direction.

Responsible trade and responsible supply is the need of the hour to address the sustainability issues of the sector. The Responsible Trade Network should help to build the linkages and arrange for buy-back arrangement for the producers, stimulate cooperation between importing and exporting countries to ensure that trade is conducted in a legal and sustainable manner, facilitate training in quality management and packaging to reduce wastage and derive higher earnings and improve the quality of herbal products. Manufacturers and buyers should be a part of the Responsible Trade Network and exhibit their corporate social responsibility credentials.

Research & Development:

Drug discovery and ethno botany have long been fundamental to medicinal plant research. With new uses for medicinal plants being discovered, sustainability has increasingly become an issue; concern over the growth in bio-piracy goes hand in hand with the critical need for conservation of both species and habitat.

According to NMPB, development of medicinal plant sector in the country is suffering from unorganized and inadequate research on various crucial aspects. The research outcomes need to be consolidated, the gaps are to be identified and new initiatives to be taken to address the research requirements including those related to management of medicinal plants and their handling. A seminar on the State of the Art of Medicinal Plant Research and Business Opportunities at UPLB identified the R&D priorities as:

I. Validation

- Identification and morphological characterization
- Chemical characterization
- Conservation

II. Production

- Mass propagation
- Effect of agroclimatic conditions
- Crop protection
- Controlled growing
- Crop nutrition
- Seed generation/ physiology
- Floral biology

III. Processing

- Drying methods
- Storage
- Fabrication of machines
- Type of packaging materials

IV. Marketing

- Other uses of medicinal plants (veterinary uses)
- Development of standards both for export and local markets
- Product market assessment

V. Policy Issues

An NMPB Task Force (2000) identified that research is particularly needed in relation to:

- Good harvesting practices, post harvest handling and storage techniques.
- Good agricultural practices with emphasis on organic cultivation.
- Variations in morphotypes, genotypes, chemotypes etc.
- Traceability of raw drugs from harvesting to consumption level.
- Germination and seed treatment protocols and certification.
- Pilot trials on sustainable harvest of animal parts.

In order to convert the potential of our medicinal plants into economic wealth, an active R&D programme is essential. In terms of modern research endeavours, drug development from plants must imply a multi-disciplinary approach. The medicinal species can be categorized into: (a) those which are of proven medicinal value as per scientific parameters, (b) those on which sufficient leads are available, and (c) those on which much work is required to be done.

The emphasis of R&D should be on the following:

- Development of technology for bulk production of medicinal products;
- Development of quality control standards for the starting materials as well as for the finished products;
- Development of new formulations and dosage forms specially suited to the prevailing climatic conditions and adapted to locally available raw materials;
- Assimilation of acquired technology and its continuous improvement to make the products competitive;
- Bioequivalence, bioavailability and pharmacokinetic studies on the developed dosage forms;
- Search for new plant sources for known drug and for new drugs from locally available plants.

Many organizations, both governmental and non-governmental, are working in the herbal sector. Huge funds are being invested to develop the herbs sector and enhance the economic status of the community involved in this sector. However, all the efforts are in isolation. There is a need to organize the isolated efforts for a better result. The *Medicinal and Aromatic Plants Programme* in Asia (MAPPA) was initiated in 1998 with support from the Ford Foundation and builds on the experiences and research results of IMPN for strategic research, networking, and collaboration, to comprehensively address critical research issues related to - sustainable and equitable use of medicinal and aromatic plants and to formulate programmes which will complement and build on related research and development activities in the region. The International Plant Genetic Resources Institute (IPGRI) is an independent international scientific organization that seeks to advance the conservation and use of plant genetic diversity for the well being of present and future generations. More such coordinated efforts are required in similar directions at various levels.

A diverse field like this calls for a range of interdisciplinary perspectives to be represented in a coordinated research agenda. Most of the current research needs are essentially the gaps in knowledge, such as:

- Identification of viable incentives for sustainable harvesting.
- Assessment, monitoring, and regulatory systems for managing sustainable harvesting system.
- Evaluation of conservation measures that may be effective in ensuring the

- maintenance of genetic diversity, both *in situ* and *ex situ*.
- Inventorisation of national medicinal plant stocks.
- Agro-technology trials for priority species.
- Support for tissue culture protocols on medicinal plants.
- Dedicated research centres for different bio-climatic regions.
- Social research (e.g. the contribution to sustainable resource use of women-oriented medicinal plant enterprise programmes).
- Economic research (e.g. studies on enterprise development; trade studies, microeconomics of community level use and trade with respect to their impact on patterns of use and sustainability).
- Ecological studies (e.g. extent of harvesting, red listed areas, red data book species, volume of harvest, capacity of ecosystems, estimates on viability of the species under current and projected harvest rates).

It is necessary to prioritize the thrust areas to obtain the output of research efforts and other resources. Several issues help in determining the priorities such as, the distribution of flora, national or regional disease pattern, availability of modern health care, global precedence in developing new drugs for a good financial return. It is desirable to have a need-based approach for research on medicinal plants. Research efforts could thus be aimed at diseases for which suitable drugs are not available in the modern system of medicine and where herbal drugs have a possibility of offering new drugs. Focused R&D along with inter-disciplinary approach to research is the crux for the accelerated development of this sector.

Conclusion:

Medicinal plants constitute an enormous, undocumented and over-exploited economic resource. They are the principal health care resource for the majority of the underprivileged. Escalating demand for herbal medicines has led to significant modification in traditional patterns of medicinal plants trade. The bulk of the material trade still turns up from wild sources and only a very small number of species are cultivated. The conservation and management of MAPs in their natural habitat will require active involvement of local communities at every step. A holistic management action plan is essential for assessment and management of the reserves, promoting the finest harvesting and processing practices; dealing with the trade issues and aspects of intellectual property rights on the traditional medicines, preservation and application of traditional knowledge; and development of appropriate conservation, cultivation, harvesting strategies.

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