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Raw Drug Trade Record of Medicinal and Aromatic Plants in Foothills of North-Western Himalayas

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Authors' contributions

This work was carried out in collaboration between all the authors. Moreover, the first and the second authors were supervisors of the work. All the authors read and approved the final manuscript.

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ABSTRACT

Trade of medicinal and aromatic plant species (MAPs) is age old practice throughout the world to increase household income. Over harvesting decreased their populations and a number of species became threatened in natural habitat. Survey was conducted on trade of important MAPs from wild in Jammu and Srinagar districts of J&K State, India. Information was collected on MAPs, by directly interviewing the people involved in the trade of medicinal and aromatic plants in mandis of two districts. Trade record was also collected from LOC at two locations I,e. Poonch and Uri. Even after ban on commercial exploitation of some MAPs, trade continued through illegal ways. The highest trade was recorded for *Curcuma longa*, *Punica granatum*, followed by *Phyllanthus emblica* in Jammu district. But in Srinagar it was found that *Phoenix dactylifera*, *Lawsonia inermis* and *Rauwolfia serpentina* recorded maximum trade. In this paper we have given the present status of herbal medicines, their quantity, per kg cost & part traded.

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1. INTRODUCTION

Medicinal and aromatic plants (MAPs) are produced and offered in a wide variety of products, from crude materials to processed and packaged products like pharmaceuticals, herbal remedies, teas, spirits, cosmetics, sweets, dietary supplements, varnishes and insecticides [1]. An estimated number of 70,000 plant species are used in folk medicine worldwide [2], a figure that has recently been confirmed by lange and Schippmann, 1997. As a consequence, there is an enormous demand in botanicals – for domestic use and for commercial trade –resulting in a huge trade on local, regional, national and international level. Demand of herbal medicine is increasing throughout the world. Annual turn over of herbal medicine in India is estimated 1,77,000 MT for which 960 plant species are inactive trade [3]. Such increased demand creates a pressure on natural population, due to which many species declined in their number and abundance and entire into various degrees of threat [4]. Medicinal plants constitute an important natural wealth of a country. They play a significant role in providing primary health care services to rural people [5]. They serve therapeutic agents as well as important raw materials for the manufacture of traditional and modern medicine. Substantial amount of foreign exchange can be earned by exporting medicinal plants to other countries. In this way indigenous medicinal plants play significant role of an economy of a country. Past century there has been a rapid extension of the allopathic system of medical treatment in India. It generated commercial demand for pharmacopieial drugs and their products in India. Efforts have been made to introduce many of these drug plants to farmers. Several research institutes have undertaken studies on the trade record of medicinal plants, which were found suitable and remunerative for commercial cultivation [6]. The rich plant diversity of Jammu and Kashmir has provided an initial advantage to the local people for scrutinizing various plant species for the purpose of food, medicine, perfumes and spices. Over the years, they have accumulated a great deal of knowledge on the use of plant species. There are areas in the remote hills where people still practice traditional way of life and hence use nearby plant species for curing diseases and other purposes. But data related to trade of these traditionally important species is almost lacking in India including Jammu and Kashmir. This paper is focusing on aspects associated with the trade in medicinal and aromatic plant material, in particular on aspects of trade streams, trade structure, trade volumes and trade values.

1.1 Theoretical Background

Traditional systems of medicine continued to be used in India even during the British era when western system was promoted due to outbreaks of epidemic diseases such as cholera, smallpox and Malaria. Overtime many of the ancient as well as the more recent introductions have become vital components of traditional medicine systems, India has over the Millions primarily relied on her own indigenous plant diversity in this regard. The Botanical Survey of India records over 15,000 plant species occurring in the country, of which at least 7,500 species have been used for medicinal purposes [7].

The forests of Himachal Pradesh, said to have been the birthplace of Ayurveda, are known to supply a very large proportion of the medicinal plant requirements of India, with one estimates quoting figures as high as 80 percent of all Ayurvedic drugs, 46% of all Unani drugs and 33% of all allopathic drugs developed in India [8].

The use of plants for medicinal purposes and human sustenance has been in practice in India since the Vedic age. The earliest mention of the medicinal use of the plants is found in the Rigveda, 1500-400 BC, Athurveda 1500 BC, Upnishada 1000-600 BC. India is one of the major contributors to the world in terms of herbal drugs and its raw materials [9].

India is of course an active participant in the global medicinal plants market having been for some time the world's largest supplier of raw materials. Medicinal plants are one of the most important components of the non-wood forest products sector which supplies over 80% of India's net forest annual export earnings [10].

Medicinal plants have been used for centuries in traditional health care systems and numerous cultures around the world still rely on plants for their primary health care. With the recent advancements in plant sciences, there has been a tremendous increase in the use of plant based health products in developing as well as developed countries. About 70-80% people

around the globe rely on medicinal plants for primary health care [11].

Purohit and Vyas in 2005 have also focused that there is huge demand for herbal products in global market. But India's share in global trade of Medicinal and Herbal plant is less than 1%.

Non-timber forest products (NTFPs) are biological materials other than timber, which are extracted from forests for human use. NTFPs have a long history of being used by rural communities in the tropics for their subsistence and trade [12].

The Indian Himalayan region supports the tropical, sub-tropical, temperate and sub alpine vegetation and it has a rich flora of medicinal and aromatic plants and so far 1748 species have been reported medicinally important [13]. Medicinal plants are of great concern throughout the Himalayan region, because they are important for traditional health care and in large scale collection for trade. Himalayan plants have huge market potential but due to overexploitation and many other anthropogenic and environmental factors their growth is restricted only to protected areas and reserves [14].

People are using herbal medicines from centuries for safety, efficacy, cultural acceptability and lesser side effects. Plant and plant products have utilized with varying success to cure and prevent diseases throughout history [15]. Written records about medicinal plants date back at least 5000 years to the Sumerians and ancient records are suggested earlier use of medicinal plants. Due to side effects of synthetic products, herbal products are gaining popularity in the world market. In spite of well-practiced knowledge of herbal medicine and occurrence of a large number of medicinal plants, the share of India in the global market is not up to the mark [16].

Plants are one of the most important sources of medicines. The application of plants as medicines date back to prehistoric period. In India the references to the curative properties of some herbs in the Rig-veda seems to be the earliest records of use of plants in medicines. The medicinal plants are extensively utilized throughout the world in two distinct areas of health management; traditional system of medicine and modern system of medicine. The traditional system of medicine mainly functions through two distinct streams (1) Local or folk or tribal stream and, (2) Codified and organized Indian system of medicines like Ayurveda Siddha and Unannietc [17].

2. MATERIALS AND METHODS

2.1 Study Area

The Jammu and Kashmir state is located in the northern part of Indian Sub-continent in the vicinity of korakoram and western most Himalayan mountain ranges. The vast majority of the state's territory is mountainous, and the physiography is divided into seven zones that are closely associated with the structural components of the western Himalayas. From southwest to northeast those zones consist of the plains, the foothills, the Pir Panjal Range, the Vale of Kashmir, the Great Himalayas zone, the upper Indus River valley, and the Karakoram Range. The climate varies from alpine in the northeast to subtropical in the southwest. The flora of Himalayan Kashmir comprises about 3054 species. About 650 species are found in Kashmir valley and 506 species found in Jammu. These figures only include the angiosperms, gymnosperms and pteridophytes. The plants of western Himalayas are well known for their medicinal properties. This area is store house of medicinal and aromatic plants which are used in pharmaceutical and perfume industries. The list includes 55 species of important medicinal and aromatic plants. There are 11 medicinal plants in temperate, cold arid regions of J&K. Several medicinal plants grow wild in temperate and alpine habitats. Jammu and Kashmir has the unique distinction of being one of the richest repositories of medicinal and aromatic plants, which pave a way for reaping the green gold. Owing to its characteristic climate, altitudinal variations and conducive growing environment, the region is endowed with rich and spectacular diversity of medicinal and aromatic herbs of promising health and economic benefits. Since time immemorial plants have been used by man for relieving sufferings and curing ailments through various traditional healthcare systems. The Hakeems of Kashmir (the native physicians) attribute some property to every plant. Similarly 'Amchi system of medicine' (Tibetan traditional medical system) has been one of the most important traditional healthcare system in Ladakh and other Trans-Himalayan regions, which involves skillful use of various Himalayan plants to cure different diseases.

The important medicinal plants (with vernacular name) of Kashmir region like

Aconitum heterophyllum (Patris), *Arnebia benthamii* (Kah-Zaban), *Artemisia absinthium* (Thethwan), *Datura stramonium* (Datur), *Picrorhiza kurrooa* (Koad), *Podophyllum hexandrum* (Wan Wangun*), Saussurea costus* (Kuth), *Taraxacum officinali* (Haend) *Trillium govanianum* (Tre-patri) etc., once found in plenty, have now become threatened due to unscientific harvesting and due to other reasons. Most of the medicinal herbs available in the market are reported to originate from the wild, and are extracted through destructive harvesting practices.

Owing to their growing recognition in pharmaceutical, perfumery, cosmetic, agricultural and food industry, they are in high demand that opens up new avenues for higher level of gains to farmers with a significant scope for boosting rural economy. Increased consumer demand for herbal products may be attributed to rising awareness about health side effects of synthetic drugs fuelled by soaring prices of prescription drugs.

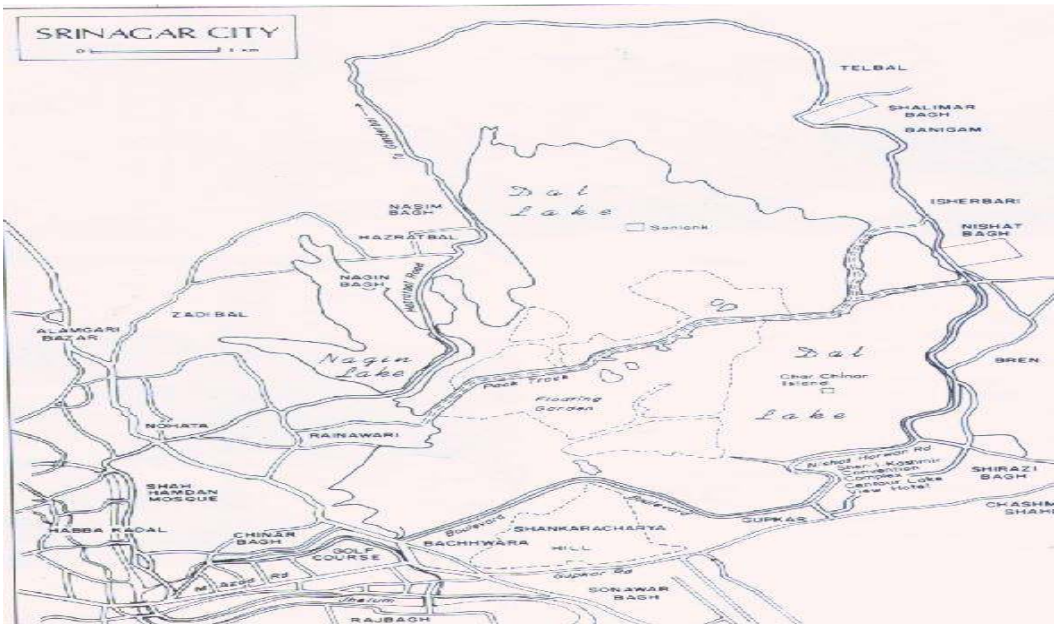
The present study was carried out in two districts (Jammu and Srinagar) of Jammu and Kashmir State. The two districts were surveyed to collect information regarding plant raw drug trade of medicinal and aromatic plants in the region. The Srinagar and Jammu are the capital cities of the state and trade mandis are only here. The data was collected from traders who are in direct trade of medicinal and aromatic Plants. Data was also collected from two points along LOC (Poonch and Uri) to know the actual export and import of medicinal and aromatic plants in the State.

Jammu is the most populous district in the Indian state of Jammu and Kashmir and is home to the winter capital of Jammu and Kashmir. Jammu is located at 32°44′N74°52′E32.73°N 74.87°E. It has an average elevation of 327 m (1,073 ft). Jammu city lies at uneven ridges of low heights at the Shivalik hills. It is surrounded by Shivalik range to the north, east and southeast while the Trikuta Range surrounds it in the north-west. It is approximately 600 kilometres (370 miles) from the national capital, New Delhi. Jammu, like the rest of north-western India, features a humid subtropical climate with extreme summer highs reaching 46°C (115°F) and temperatures in the winter months occasionally falling below freezing. June is the hottest month with average highs of 40.6°C (105.1°F), while January is the coldest month with average lows reaching 7°C (45°F). Average yearly precipitation is about 42 inches (1,100 mm) with the bulk of the rainfall in the months from June to September.

Srinagar is the second most populous district in the Indian state of Jammu and Kashmir, after Jammu District and is home to the summer capital (Srinagar) of Jammu and Kashmir (The capital moves to Jammu city in the winter). Srinagar has a humid subtropical climate, much cooler than what is found in much of the rest of India, due to its moderately high elevation and northerly position. The valley is surrounded by the Himalayas on all sides. Winters are cool, with daytime a January average of 2.5°C (36.5°F), and temperatures below freezing at night. Moderate to heavy snowfall occurs in winter and the only road that connects Srinagar with the rest of India may get blocked for a few days due to avalanches. Summers are warm with a July daytime average of 24.1°C (75.4°F). The average annual rainfall is around 720 millimetres (28 inches). Spring is the wettest season while autumn is the driest.

2.2 Methods

The selected districts were visited frequently during 2015-16 to collect the required data. The respondents were interviewed and primary data was tabulated. Information's were collected on MAPs trade from all the mandis of two selected districts. There was a stark difference in trade of MAPs from site to site. These differences directly influenced cost and number of species traded along with trade pattern from each site. A number of MAP species were in trade from study areas. List of important MAPs with their trade name, botanical name, economically useful part with source of collection is presented. The traders of MAPs employed local agent (local traders), who made contact with collectors. Collectors dig out MAPs from nature, supplied them to local traders (sometime directly to traders). Local traders supplied MAPs to traders. Local traders were often money lenders or local merchants of household requirements. The collectors were mostly local inhabitants but sometimes persons hired by the local traders which extracted plants destructively. Collectors dug out material from nature, dried it partially or completely and carried the produce to local trader's house. The produce further moved to other channels accordingly. Study reveals that volume of collected MAPs varied from site to site depending on availability of species. The data of MAP's traded through LOC was also recorded by consulting forest department officials.



Map 1. Srinagar District Map

Map 2. Jammu District Map

3. RESULTS AND DISCUSSION

The use of medicinal and aromatic plants (MAPs) in India for cosmetic, medicinal, colouring and aromatic purposes has a long tradition. MAPs are also used in herbal teas, food supplements, liquors, bitters, insecticides, fungicides, essential oil products, perfumes, flavouring liquids, varnishes and cleaning products. In India, at least 2,000 MAP taxa are used commercially, 1,200-1,300 of which are native to India. The people of Jammu and Srinagar are among the most important export regions for medicinal and aromatic plants in Jammu and Kashmir. During

the 01990s, no less than 8% of the total Indian MAP export volume were exported from Jammu and Srinagar districts of J & K. Traditionally, wild-harvesting of MAPs predominates in this region. Trade of MAPs is age-old practice and believed to be 5000 year old. However, number of species traded fluctuated regularly. Before 1994, Trade of MAPs in Jammu and Kashmir was made by licensed contractor with payment of royalty to forest department and sale through district level cooperative societies [18]. Later on some of the plants categorized as threatened and their collection was banned from natural habitats. Many people in Jammu and Kashmir are involved in trade of MAP's. The harvesting and trade of MAPs in the both the districts has atleast three equally important dimensions: the ecological, the social and the economic issues. For a sustainable development of MAP harvesting, all three dimensions have to be considered. As a result of over-harvesting, land conversion, erosion and other factors, the populations of some MAP species traditionally collected in the region have declined considerably; some species have become rare, threatened or vulnerable. This development endangers not only the plant species and their ecosystems but also the economic livelihood of people involved in MAP collection and trade. Most harvesters belong to poorer or under-privileged groups in society and quite often depend on the additional income generated by wild-harvesting of MAPs. This study will concentrate on trade of MAP in two districts of Jammu and Kashmir State (Jammu and Srinagar). It will provide current data and investigate the amount of MAP raw material collected in and traded from or within these two districts and especially consider MAP traded through LOC in order to find out whether there is potential to use part of the revenue to conserve the rare and endangered species of MAPs in the region. This study will only give a rough overview of the current situation and practices in the marketing and trade of MAPs in selected districts and will try to find evidence for the potential for using sustainable trade to provide financial support to traders. The Plant Raw Drug Trade Record in Jammu and Srinagar districts of the Jammu and Kashmir state is presented in Table 1 and 2. Study reveals that volume of traded MAPs varied from site to site depending on availability of species. The estimated annual quantity along with cost per kg, part used and source of collection is also given. The highest trade was recorded for *Curcuma longa* (Haldi), *Punica granatum* (Anardana), followed by *Phyllanthus emblica* (Aonla) in Jammu district. But in Srinagar it was found that *Phoenix dactylifera* (Dates), *Lawsonia inermis* (Henna) and *Rauolfia serpentina* (Sarpagandha) recorded highest values. Same results were recorded by Larsen and Olsen in 2007.*Curcuma longa* finds use in antiseptic industry besides used as cooking ingredient, this the the reason that its trade has recorded highest in the region. *Punica granatum* and *Phyllanthus emblica* is found abundantly in the region particularly in outskirts of Jammu district. Both the species locally find numerous usages especially as chatini (blended aonla and anardana) rich in Vitamin C and K. The highest trade of *Phoenix dactylifera* is related to Muslim majority in Srinagar where its consumption is considered sacred. Income from MAPs is integral part in the socio-economy of the people settled in hilly areas of Jammu and Kashmir. Apart from healthcare, medicinal plants are mainly alternative income generating source of underprivileged community [19], therefore, strengthening of this sector may benefit and improve the living standard of poor people [20]. The total quantity of MAP's traded through LOC was also recorded by consulting Forest department officials and is presented in Table 3. The highest traded species was *Acorus calamus* (Buch), followed by *Trillium gavanianum* (Nagchatri) and *Podophyllum hexandrum* (Bankakri). The LOC trade between Jammu and Kashmir and other countries remained suspended for more than three decades mainly due to tension in the state, therefore effecting trade of medicinal and aromatic drug traders. In 2004, the trade ties between India and Pakistan improved creating opportunities for trade across the boarder. In 2015-16, the trade of medicinal and aromatic raw drugs through LOC reached highest crossing over 3 lakh kilograms. A total of 15 species were traded across the LOC through Uri sector of Baramulla, Srinagar and Pounch sector of Jammu region. Both these Border districts are now a days main cross points of LOC trade in Jammu and Kashmir. *Acorus calamus* being the highest traded species on the LOC is exported to Iraq, Iran and other Middle east countries because of its high demand for antioxidant and antibacterial use. Most of the drug dealers export this particular species to different pharmaceutical companies from Muzafarabad, POK to middle east countries. *Phoenix dactylifera* is imported from these countries to Jammu and Kashmir for use in enhancing human vigor and vitality. Most of the trade of *Phoenix dactylifera* is done in the month of Ramazan, the holy month of Muslims.

The use of plant medicinal raw drugs are used traditionally in both the regions in enormous quantities. The fields of usage are Ayurveda, Sidhi and Panchkarma. The latest technologies combined with traditional knowledge has given rise to new era of medical science. The trade of plant medicinal raw drugs has found good attention in the state and can create employment opportunities for people especially young generation. More research work should be done in this field to compile all the data related to trade of medicinal and aromatic plants in the state of Jammu and Kashmir.

Table 1. Plant raw drug trade record in Jammu District of the Jammu and Kashmir State (2015-16)

S. no.	Trade name (S)	Botanical name	Part (S) Used	Estimated annual Quantity in trade (kg)	Rate (Rs/kg)	Source (Wild/collection/ import)
1	Dhoop	*Jurinea dolominea*	Root	900	220	Import
2	Tulsi	*Ocimum tenuiflorum*	Leaves	870	240	Import
3	Kodakuti	*Picrorriza kurroa*	Roots	300	350	Import
4	Aonla	*Emblica officinalis*	Fruit	2090	90	Cultivation
5	Atees	*Aconitum heterophyllum*	Root	500	1600	Import
6	Nag chatri	*Trillium govanianum*	Root	250	800	Import
7	Harad	*Terminalia chebula*	Fruit	1500	60	Cultivation
8	Shatavari	*Asparagus racemoses*	Root	600	310	Import
9	Anardana	*Punica granatum*	Fruit	2800	550	Local
10	Rasount	*Berberis lyceum*	Root	980	140	Import
11	Katha	*Acacia catechu*	Wood	160	270	Import
12	Ratanjot	*Arnebia benthamii*	Root	400	250	Import
13	Bhojpathar	*Betula utilis*	Bark	790	260	Import
14	Haldi	*Curcuma longa*	Root	9000	250	Import
15	Mushakbala	*Valeriana spp.*	Root	570	260	Import

Table 2. Plant raw drug trade record in Srinagar District of the Jammu and Kashmir State (2015-16)

S. no.	Trade name (S)	Botanical name	Part (S) used	Estimated annual quantity in trade (kg)	Rate (Rs/kg)	Source (Wild/collection/ import)
1	Tethwan	*Artimesia absentium*	Roots	505	100	Wild
2	Banafsha	*Voila odorata*	Flower	208	80	Import
3	Harad	*Terminalia chebula*	Fruit	406	260	Import
4	Shanger		Wood	300	110	Import
5	Guchies	*Morchella esculenta*	Fungi	325	900	Wild
6	Dates	*Phoenix dactylifera*	Fruit	8000	200	Import
7	Khubani	*Prunus armenica*	Fruit	1095	410	Cultivation
8	Belladona	*Atropa belladonna*	Root	370	210	Import
9	Hand	*Taraxicum officinale*	Grass	550	150	Wild
10	Neem	*Azadiracta indica*	Leaves	890	100	Import
11	Henna	*Lawsonia inermis*	Leaves	2100	100	Import
12	Ashwagandha	*Withinia somnifera*	Fruit	900	400	Import
13	Sarpgandha	*Rauolfia serpentine*	Fruit	1500	1600	Import
14	Bhojpathar	*Betula utilis*	Bark	200	255	Import
15	Datura	*Datura stromonium*	Seeds	285	55	Wild

Table 3. Record of LOC trade of plant raw drug in J & K during 2015-16

S. no	Botanical name	Local name	Part traded	Quantity traded (Kgs)
1	*Morchella esculenta*	Guchies	Fungus/Mycelium	4369
2	*Zizypus jujube*	Anab	Barry /Fruit	768
3	*Punica granatum*	Anarchilka	Fruit	6000
4	*Punica granatum*	Anardana	Dried fruit	8817
5	*Ficus carica*	Anjeer	Fruit	150
6	*Aconitum heterophyllum*	Atees /Patees	Tuber /Root	4114
7	*Centaurea behan*	Bavan	Root	15168
8	*Viola odorata*	Banafsha	Flower	6015
9	*Podophyllum hexandrum*	Bankakri	Root	16663
10	*Trillium gavanianum*	Nag chatri	Root	19070
11	*Betula utilis*	Bhojpather	Bark	7658
12	*Eclipta protrata*	Bringraj	Seed	558
13	*Central islandica*	Charela	Lichen	16031
14	*Acorus calamus*	Buch	Roots /Rhizome	138200
15	*Phoenix dactylifera*	Dates	Fruit	2000

4. CONCLUSION

The last three decades have seen substantial growth in herb and herbal product markets across the world. Rapidly rising exports of medicinal and aromatic plants during the past decade attests to worldwide interest in these products as well as in traditional health systems. According to the Secretariat of the Convention on Biological Diversity, global sales of herbal products totalled an estimated US$60 000 million in 2002 At present, 80 percent of the population in developing countries rely largely on plantbased drugs for their health care needs, and the WHO has estimated that in coming decades a similar percentage of the world population may well rely on plant-based medicines. Thirty percent of the drugs sold worldwide contain compounds derived from plant material. Trade of medicinal and aromatic plants is age old practice but it is also fact that our resources are depleting. The people involved in trade should be educated with respect to collection, harvesting and illegal trade. Trade of medicinal plants raises a number of complex environmental and social issues that must be addressed locally on a case-by case basis. The traders should be given free access for inter boarder trade that will help in easy accessibility of some rare species. The Loc trade will help in reduction of price of medicinal and aromatic plant drugs.

5. RECOMMENDATIONS

1. People living close to forest areas should be educated about the use of medicinal and aromatic plants, so that proper income is generated by collection of valuable species.
2. Collectors should be provided list of threatened species to restrain them from collecting these rare species.
3. Promotion of cross border trade of medicinal and aromatic plants should be acknowledged for their importance in international markets and subsequently more research should be done for cultivation of critically threatened species.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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