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## SUSTAINABLE USE OF HIGH ALTITUDE MEDICINAL AND AROMATIC PLANT FOR SOCIO-ECONOMIC DEVELOPMENT IN UTTARAKHAND: A REVIEW

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### Keywords:

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**ABSTRACT:** The present paper reveals the socio-economic benefits for the peoples of the Uttarakhand state. The demand for medicinal and aromatic plants of Uttarakhand is quite inflated, and many of these plants grow only in the Himalayan states. The State has diverse agro-geo climate conditions, which is most suitable for Medicinal and aromatic plant cultivation. Uttarakhand is blessed with a variety of soils and agro-climatic conditions, ranging from Sub-Tropical to Alpine, which is a mega biodiversity hotspot for a wide range of wild and cultivated Medicinal and aromatic plants. Due to the low point of agricultural production, lack of industrial development, poverty, and unemployment, peoples migrate to exploit biodiversity to improve their socio-economy. There is a socio-economic pressure to migrate on the plain districts for better livelihood opportunities.

**INTRODUCTION:** Uttarakhand, located in the northern part of India and is located between 28 °C 43' N to 31 °C 27' N (Latitude) and 77°C 34' E to 81 °C 02' E (Longitude), is well known for plentiful biological as well as cultural diversity. Almost the entire region of Uttarakhand is covered by mountains (approximately 93%), and forests show up on about 64% of the mountains. The total geographical region of the state is 53,483 sq. Km.; it is split into 13 districts within two revenue divisions and one tribal division<sup>1</sup>. Of the total geographical region, about 19% is under permanent snow cover, glaciers and steep slopes<sup>2</sup>.

The total population of the state is 1.01 Crores (Census 2012), with over three-fourths of the total population dependent on agriculture for their livelihood<sup>3</sup>. Medicinal and Aromatic Plants constitute a major segment of the flora, which provides raw materials for use in the pharmaceuticals, cosmetics, and drug industries<sup>4</sup>.

The demand for herbal medicine is increasing throughout the world. Annual turnover of herbal medicine in India is estimated at 1.7 lakh metric tons, for which 960 plant species are in active trade<sup>5</sup>. Uttarakhand State is enriched with forest and valuable water resources. The populations of high altitude areas of Himalayan regions have limited options to earn money for their daily needs due to the uneconomic nature of cereals production *i.e.*, low returns from agricultural production<sup>6</sup>. Despite the abundance of innumerable flora and fauna, most of the people are marginalized and still live on a subsistence level.

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Due to the low point of agricultural production, lack of industrial development, poverty, and unemployment, peoples migrate to exploit biodiversity to improve their socio-economy. There is a socio-economic pressure to migrate on the plain districts for better livelihood opportunities<sup>7, 8</sup>.

Migration from rural areas in Uttarakhand is a serious problem with a comparison between 2001-2011 census data showing a very slow decadal growth of population in most of the mountain districts of the state<sup>9</sup>.

Medicinal and aromatic plants collection provides an extra source of income, which compensate for low agricultural production. Uttarakhand endows with a high diversity of Medicinal and aromatic plants<sup>10</sup>. A total of 964 species of medicinal plants are known to occur out of which 614 are herbs, 190 are shrubs, and 160 are trees<sup>11</sup>.

This paper aims at the cultivation and sustainable use of high altitude medicinal and aromatic plants for socio-economic development, which may lead to rural employment and, ultimately, the increased state economy.

The socio-economic development would provide better opportunities for industrial development and stop the falling population, specially in the hilly areas of Uttarakhand.

**Trade of Medicinal and Aromatic Grown in Uttarakhand:** The demand for Medicinal and aromatic plants of Uttarakhand is quite inflated, and many of these plants grow only in the Himalayan states. The State has diverse agro-geo climate conditions, which is most suitable for Medicinal and aromatic plant cultivation<sup>12, 13</sup>.

Uttarakhand is blessed with a variety of soils and agro-climatic conditions, ranging from Sub-Tropical to Alpine, which is a mega biodiversity hotspot for a wide range of wild and cultivated Medicinal and aromatic plants<sup>14</sup>. More than 2000 unique plants with medicinal properties are found in State.

The state has 3.66lac ha cultivable wasteland which can be utilized for the cultivation of aromatic crops. 324 Medicinal and aromatic plants attribute to approximately 200 metric tone/yr by volume is cultivated.

Most of the cultivated and off-farm Medicinal and aromatic plants are grown only in the state's provinces of Garhwal, Kumaun, and Jaunsar region<sup>15</sup>.

Many of these medicinal plants are only grown in the subsistence level and are not exploited to the commercial scale.

**TABLE 1: MISCELLANEOUS LIST OF PLANTS GROWN IN UTTARAKHAND ADVANTAGEOUS FOR TRADE<sup>16</sup>**

S. no.	Local Name	Botanical Name	Locality
1	Amla	<i>Phyllanthus emblica</i>	All Garhwal and Kumaon mandal
2	Ashagandha	<i>Withania somnifera</i>	Rudraprayag, Uttarkashi, Jaunsar
3	Ativisha	<i>Aconitum heteroplullum</i> Wall	Dehradun, Jaunsar, Chamoli, Haridwar
4	Bay Leaf/Tej patta	<i>Cinnamomum tamala</i>	Dehradun, Tehri, Almora, Haridwar
5	Bedu	<i>Ficus palmate</i>	Nainital, Pithoragarh
6	Burans	<i>Rhododendron arboretum</i>	Tehri, Uttarkashi, Chamoli
7	Deodar	<i>Cedrus deodara</i> Ber	Uttarkashi, Chamoli
8	Hisalu	<i>Rubus ellipticus</i>	Tehri, Pithoragarh, Chamoli, Almora
9	Daruharidra	<i>Berberis aristata</i>	Tehri, Pauri, Nainital, Haridwar
10	Jurinea	<i>Jurinea macrocephala</i>	All Garhwal and Kumaon mandal
11	Kafal/Kaphal	<i>Myrica esculenta</i>	Tehri, Nainital, Almora, Chamoli
12	Keeda Jadi	<i>Ophiocordyceps sinensis</i>	Chamoli, Pithoragarh
13	Khumani(Apricot)	<i>Prunus armeniaca</i>	Chamoli, Uttarkashi
14	Kilmor	<i>Ziziphus mauritiana</i>	Chamoli, Rudraprayag, tehri and Uttarkashi
15	Malta	<i>Citrus X sinensis</i>	Uttarkashi, Chamoli,
16	Patherchatta	<i>Bergenia ciliate</i>	Tehri, Pauri, Chamoli
17	Plum	<i>Prunus persica</i>	Chamoli, Uttarkashi, Tehri
18	Reetha	<i>Sapindus mukorossi</i>	Tehri. Chamoli, Uttarkashi

**TABLE 2: OVERVIEW OF MEDICINAL IMPORTANCE AND OTHER FACTS OF SOME UNIQUE PLANT SPECIES**<sup>17-19</sup>

Botanical and family	Medicinal importance	Parts in commerce and approximate annual demand in India	Sources of raw material	Method for cultivation or plantation
<i>Saussurea lappa</i> (Decne). <i>S. costus</i> (Costus roots, Kuth, Asteraceae)	Main ingredient of the medicines prepared for skin disease	Roots, annually 100-200 metric tonne.	Cultivation of the crops, roots may be produced in a hectare of land	Propagated through seeds, 2-3 years gestation period, it may be cultivated in specific locations only
<i>Picrorrhizia kurrooa</i> Royle ex Benth.( Kutki, Scrophulariaceae)	Well known hepatoprotective herbal drug and also useful in the cure of diabetes	Stolons and roots, 200-500 metric tonne	Cultivation of the crops, stolons and roots may be produced in a hectare	Propagated through vegetative methods(through cutting), 2-3 years gestation period, could be cultivated in specific locations only
<i>Sapindus mukorossi</i> .(Soap nut, Reetha or Ritha, Sapindaceae)	Motly used in herbal shampoo and soaps due to antidandruff properties. Its is also a psycho-medicinal plant.	Fruits, annual demand 200-500 metric tonne	In majority it is harvested from the trees growing in off-farm premises, some of the current supply is from existing plantation	Propagated through seeds, 1-2-year-old seedlings are planted, fruits may be harvested from 8-10 years old trees
<i>Cinnamomum tamala</i> Nees (Indian Bay leaf, Tejpat, Lauraceae)	Mainly used in spice, however, recently proved its utility in the cure diabetes. Also useful in treating cold and cough	Leaves, annual demand 500-100 metric tonne	Off-farm harvesting is in practice, majority of current supply is from existing trees and random plantation	Propagated through seeds, 2-3 years old seedlings are planted, leaves may be harvested after 7-9 years of plantation.
<i>Phyllanthus emblica</i> Aonla (Amla, Euphorbiaceae)	Mostly used in to treat fever, jaundice, anaemia and eyes diseases. Also useful in case of diabetes	Fruit and seed, annual demand 2000-5000 metric tonne	Off-farm and cultivated harvesting is in practise, majority of the current supply is from existing and new plantations.	Propagated through seeds, 1 year old seedlings are planted, fruits may be harvested after 7-8 years of plantation.
<i>Withania somnifera</i> Ashgandh(Ashvagandha, Solanaceae)	Mostly used to treat bronchial asthma, rhematic ailments, insomnia and cardiac ailments.	Roots, annual demand 500-1000 metric tonne	Cultivation of the crops, majority of the current supply is from organised plantation at different regions.	Propagation through seeds, about 35-40 days seedlings are planted, roots may be harvested after 6 months of plantation.
<i>Ophiocordyceps sinensis</i> Cordyceps mushroom (keeda jadi/ Ophiocordycipitaceae)	Mostly used to treat cancer, stress reliever, increases stamina and sperm count.	Roots and mushrooms, annual demand 170-280 metric tonne	Off farm harvesting and cultivation of crops, majority of current supply is from existing trees.	Propagation through grains, about 28-30 days seedlings are planted, roots may be harvested after 15-20 weeks.
<i>Rhododendron arboretum</i> Snow rose(burans/Ericaceae)	Mostly used to treat heart and liver diseases and act as an anti-diabetic	Flower, annual demand 1000-2000 units	Cultivation of the crop, Majority of the current supply is from subsistence farming.	Propagation through seeds, about 12-20 days seedlings are planted, flowers may be harvested after 1-2 years of plantation.
<i>Berginia ciliate</i> Pakhan	Mostly used as	Roots, annual demand	Off-farm anf	Propagation through

bhed(pashanbheda/saxifragaceae)	antipyretic, hepatoprotective, diuretic and antilithiatic etc.	200-500 metric tonne	cultivation of the crop, majority of the current supply is from existing plantations.	rhizome, about 18-20 days seedlings are planted, roots may be harvested after 6 months of plantation.
<i>Myrica esculenta</i> Bayberry(kaphal/Myricaceae)	Mostly used to cure ulcers, cancer and paralysis.	Fruit, annual demand expected to be 200-500 metric tonne	Off-farm harvesting is in practise, majority of the current supply is from wild existing plantations.	Propagation through wild seed dispersal, gestation period is variable, fruits may be harvested after 3-4 months of plantation
<i>Rubus ellipticus</i> Himalayan raspberry(hisalu/hisar/Rosaceae)	Mainly used as a renal tonic and to treat coughs, fevers, colic and sore throat.	Fruit, annual demand expected to be 200-500 metric tonne	Off-farm harvesting is in practise, majority of the current supply is from wild existing plantations.	Propagation through wild seed dispersal, gestation period is variable, fruits may be harvested after 3-4 months of plantation
<i>Prunus Armeniaca</i> Apricot(chullu/khumani/Rosaceae)	Mainly used as antioxidants, boosts eye, gut and skin health.	Fruit, annual demand expected to be 0.282 lakh metric tonne	Cultivation of harvested crops, majority of the current supply is from existing and new plantations.	Propagation through seed dispersal, about one year seedlings are planted, fruit may be harvested after 8-10 years of plantation.
<i>Citrus X sinensis</i> Sweet Orange (Malta/Rutaceae)	Mainly used to maintain cholesterol, boots Vitamin C and antioxidants	Fruit, annual demand expected to be 0.362 lakh metric toone	Cultivation of harvested crops, majority of the current supply is from existing and new plantations.	Propagation through seed dispersal, about one year seedlings are planted, fruit may be harvested after 2-3 years of plantation.
<i>Prunus persica</i> Peach(Pulam/Plum/Rosaceae)	Mainly used to strengthen immune system, anti-aging, and neurodegenerative diseases.	Fruit, annual demand expected to be 0.579 lakh metric tonne	Cultivation of harvested crops, majority of the current supply is from existing and new plantations.	Propagation through seed dispersal, about one year seedlings are planted, fruit may be harvested after 2-3 years of plantation.
<i>Swetia chirayita</i> Chirayita((Chirata /Gentians)	Mainly used for fever, constipation, loss of appetite, skin diseases and intestinal worms.	Leaves, stem, bark, annual demand 500-1000 metric tonne	Cultivation of harvested crops, majority of the current supply is from existing and new plantations.	Propagation through seed dispersal, about 25-30 seedlings are planted, leaves may be harvested after 1 years of plantation.
<i>Permelia parlata</i> Chadela(Dagad/Permelia ceae)	Mainly used as astringent, anti-inflammatory and aphrodisiac drugs.	Flowers, annual demand 1000-2000 metric tonne	Cultivation of harvested crops, the majority of the current supply is from existing plantations.	Propagation through vegetative propagation, about 25-30 seedlings are planted, flower may be harvested after 1 years of plantation.
<i>Jurinea macrocephala</i> Guggal doop(timru/tejpal/compositae)	Mainly used to cure toothache, cough, fever and give warmth.	Stem, bark, annual demand 1000-2000 metric tonne	Off-farm harvesting is in practise, the majority of the current supply is from existing wild plantations.	Propagation through vegetative propagation, branch may be harvested after 1 year of plantation.
<i>Berberis aristata</i> Liverin(Chitra/Berberida ceae)	Mainly used to for the treatment of ophthalmic infections along	Fruit and leaves, annual demand 500-1000 metric tonne	Off-farm harvesting is in practise, majority of the current	Propagation through seed dispersal, about 25-30 seedlings are planted; fruit may be harvested



Ficus palmate Himalayan fig(Bedu/Moraceae)	with antiperiodic, antidiarrheal properties Mainly used for the diseases of lungs and the bladder.	Fruit, annual demand expected to be 0.282 lakh metric tonne	supply is from wild existing plantations. Off-farm harvesting is in practise, majority of the current supply is from wild existing plantations.	after 3-4 months of plantation. Propagation through seed dispersal, about 25-30 seedlings are planted; fruit may be harvested after 3-4 months of plantation.
<i>Aconitum heterophyllum</i> Wall Atisiva (Atis/Ranunculaceae)	Mainly used to boost the eye, skin and ingestion processes. Prevents diarrhoea and dysentery.	Leaves, annual demand 200-500 metric tonne	Cultivation of harvested crops, majority of the current supply is from existing and new plantations.	Propagation through vegetative propagation, branch may be harvested after 1 years of plantation.

**CONCLUSION:** Uttarakhand is blessed with the perfect climate for the production of numerous medicinal and aromatic plants, which may ultimately help to increase the state's economy and industrial revenue by the supplies of the raw drugs or the extracted product<sup>20</sup>. We have analyzed the production of the Uttarakhand state's Medicinal and aromatic plants, which gives insights about the export volume and value of the different product categories under Medicinal and aromatic plants.

Amongst the different product categories, medicinal plants and fruits and flavors are the most important export commodities under Medicinal and aromatic plants category and shares a major percentage, both in terms of volume and value. Although India is dominating the exports to other developing countries in terms of volume but Chinese interest in high valued Medicinal and aromatic plants has significantly increased the export value<sup>21</sup>.

Uttarakhand high altitude regions may increase the yield up to 2-3 folds, providing more preserving environmental conditions for better cultivation and propagation of the crops. Many of the unique varieties of fruits and plants are grown at the subsistence level with poor scientific techniques, which leads to the scanty agro produce.

Besides, there are many potential causes of growth rarity in Medicinal and aromatic plants, including habitat specificity, narrow range of geographical distribution and exploitation of land use, the introduction of non-natives, habitat alteration, and heavy livestock grazing<sup>22</sup>. The use of proper training and scientific techniques may help people

to understand the culturing process well and would provide a number of employments with increased wages to the local people of the state. The state has immense potential for medicinal plant cultivation, and it can become one of the important options for sustainable livelihood for the hilly area.

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