

ROLE OF MEDICINAL PLANTS IN SUSTAINABLE HILL AGRICULTURE

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Systems of medicine in India namely Ayurveda, Unani, Siddha and Tibetan Medicine. According to the World Health Organization (WHO), 80% of the population in developing countries relies on traditional medicine, mostly in the form of plant drugs for their health care needs. Additionally, modern medicines contain plant derivatives to the extent of about 25%.

On account of the fact that the derivatives of medicinal plants are non-narcotic having no side effects, the demand for these plants is on the increase in both developing and developed countries. Over 1.5 million practitioners of the Indian system of medicine in the oral and codified streams use medicinal plants in preventive, promotional and curative applications. It is estimated that there are over 7800 medicinal drug manufacturing units in India, which consume about 2000 tonnes of herbs annually (Singh 2001).

During the past decade, a dramatic increase in exports of medicinal plants attests to worldwide interest in these products as well as in traditional health systems. In the last 10 years, for example, India's exports of medicinal plants have trebled.

India recognizes more than 2,500 plant species as having medicinal value, Sri Lanka about 1,400, and Nepal around 700. Some of these, found at high altitudes in particularly stressful environments, grow very slowly and cannot live elsewhere. Others are more broadly distributed and adapt more easily to different ecological conditions. But with most of these plants being taken from the wild, hundreds of species are now threatened with extinction because of over harvesting, destructive collection techniques, and conversion of habitats to crop-based agriculture. For instance, the small coniferous Himalayan yew (*Taxus baccata*) has recently become a heavily traded species. It is avidly sought because it contains taxol, used to treat ovarian cancer. If the present trend continues, there is every possibility that whatsoever the medicinal plants are available, may become extinct and to overcome this speculation wherever possible medicinal plants which can be put to cultivation should be brought under this arena at the earliest for their conservation in addition to supporting the agricultural income.

The current Growth Rate of Agriculture is just 1.7 per cent per annum against the required one of four per cent. This can only be achieved if the horticultural component of growth contributes a GDP growth rate of at least 7-8 per cent. According to Exim Bank, the international market for medicinal plant related trade is to the tune of US\$ 60 billion having a growth rate of 7% per annum. The annual export of medicinal plants from India is valued at Rs.1200 million. Thus, the role of cultivation of medicinal plants can further supplement the slacking GDP growth rate of agriculture, thereby providing sustenance to the agriculture.

Role of Medicinal Plants in Sustainable Agriculture: India inhabits approximately 7500 medicinal plants (table.1), out of which so far only 22 plants have been put under cultivation and there can be many more which can be brought under this list.

Table 1. Medicinal plants: species diversity and representative species of different biogeographic zones of India (Ved et al. 2001)

Biogeographic region	Estimated no. of Examples of some typical medicinal species medicinal plants
Trans Himalayas	700 <i>Ephedra geradiana</i> Wall., <i>Hippophae rhamnoides</i> L., <i>Arnebia euchroma</i> (Royle) John
Himalayan	2500 <i>Aconitum heterophyllum</i> Wall. ex Royle., <i>Ferula jaeshkeana</i> Vatke and <i>Saussurea costus</i> (Balc). Lipsch., <i>Nardostachys</i> <i>grandiflora</i> D.C. <i>Taxus wallichiana</i> Zucc., <i>Rhododendron</i> <i>anthopogon</i> D.Dun and <i>Panax pseudoginseng</i> Wall.
Desert	500 <i>Convolvulus microphyllus</i> Seib ex Spreng., <i>Tecomella</i> <i>undulata</i> (Sm.) Seem., <i>Citrulus colocynthis</i> (L.), Schrader and <i>Cressa cretica</i> L.
Semi-Arid	1000 <i>Commiphora wightii</i> (Arn.) Bhandari, <i>Caesalpinia bonduc</i> (L.) Roxb, <i>Balanites aegyptiaca</i> (L.), Delilie and <i>Tribulus</i> <i>rajasthanensis</i> Bhandari & Sharma.
Western Ghats	2000 <i>Myristica malabarica</i> Lam., <i>Garcinia indica</i> (Thou.) Choisy, <i>Utleria salicifolia</i> Bedd and <i>Vateria indica</i> L.
Deccan Peninsula	3000 <i>Pterocarpus santalinus</i> L.f., <i>Decalepis hamiltonii</i> Wigh & Arn, <i>Terminalia pallida</i> Brandis and <i>Shorea tumbuggaia</i> Roxb.
Gangetic Plain	1000 <i>Holarrhenaq pubescens</i> (Buch-Ham.) Wall. ex DC., <i>Mallotus philippensis</i> (Lam.) Muell –Arg., <i>Pluchea</i> <i>lanceolata</i> C.B. Clarke and <i>Peganum harmala</i> L.
North-East India	2000 <i>Aquilaria malaccensis</i> Lam., <i>Smilax glabra</i> Roxb., <i>Ambroma augusts</i> (L.) L.f. and <i>Hydnocarpus hurzii</i> (King) Warb.
Islands	1000 <i>Claophyllum inophyllum</i> L. <i>Adnanthera pavonina</i> L., <i>Barringtonia asiatica</i> (L.), Kurz and <i>Aisandra butyracea</i> (Roxb.), Baehni.
Coasts	500 <i>Rhizophora mucronata</i> Lam., <i>Acanthus ilicifolius</i> L., <i>Avicennia marina</i> Vierth and <i>Sonneratia caseolaris</i> (L.) engl.

In Himachal Pradesh, also there are 900 plus medicinal plant species (Table.2) distributed over areas difficult to access and rarely few ones are cultivated. Most of them are endangered and require intensive conservation and utilization.

Table.2. Forest area and flora of Himachal Pradesh

Item	Area (sq. km.)	%age
Geographical Area	55,673	-
Recorded Forest Area	35,407	63.60
Forest Cover (1999)	13,082	23.50
Area above 4000m	16,700	30.00
Pastures, uncultivable wastes	7,894	14.20
Plant species		
Item	No.	%age
Higher Plants	3,120	-
Medicinal Plants	+900	28.90
Mps Threatened in wild		34 **
Kullu CAMP April, 1998 assessment		

Initiatives for Conservation and Utilisation of Medicinal Plants

NATIONAL : Schemes for medicinal plants in operation

- Vanaspati Vana scheme: Min. of Health & Family Welfare, Department of ISM&H. GOI, New Delhi. Operational since 1999.
- NTFP including Medicinal Plants, a CSS of the MoEF during the Ninth Plan,. Now clubbed with other schemes in the Tenth Plan.
- Medicinal Plants Conservation Scheme under National Medicinal Plants Board, New Delhi. Sanctioned projects for 2 areas (for 3 years) in HP during 2002.

STATE : The Govt. of Himachal Pradesh has taken an initiative by setting up different Herbal Gardens in the different Agro-climatic zones for raising the nurseries and development of agro techniques of valuable plants.

1. Herbal Garden at Neri, Hamirpur

To cater the important species of Medicinal plants of Sub-tropical agro-climatic zone, the department has set up one Herbal Garden at Neri in Hamirpur district during 1998, in about 28 acres of land. The main focus is being given to those Medicinal plant species which are perennial in nature. About 78 species of different herbal plants have been identified for this garden. Some of the important species are *Desmodium gangeticum*, *Abrus precatorious*, *Holarrhena antidysentrica*, *Terminalia chebula*, *T.belerica*, *T.arjuna*, *Gmelina arborea*, *Aegle marmelos*, *Acacia somniferous*, *Plumbago zeylanica* etc.

2. Herbal Garden at Joginder Nagar

For Mild Hills Sub-Temperate Climate: At Joginder Nagar a Herbal Garden has been set over a land of about 24 acres of land. The cultivation practices of some selected important species are being worked out. Apart from it, more than 200 species have been grown for the practical

demonstration and identification of the medicinal plants. This garden is conducting various research activities for developing the agro-techniques of valuable medicinal plants through modern technologies for boosting up the productivity & yield of important species and various crop protection & agronomical practices etc. Among the important medicinal plants grown here are: *Valeriana wallichii*, *Rauwolfia serpentina*, *Cymbopogon flexuosus*, *Bergenia ligulata*, *Ocimum sanctum*, *Glycyrrhiza glabra*, *Elaeocarpus ganitrus*, *Bacopa monnieri*, *Hypericum perforatum*, *Taxus baccata*, *Celastrus paniculatus*, *Centella asiatica*, *Viola canescens*.etc

3. Herbal Garden at Sarivasa, Rohru (For temperate –wet climate)

To cater to the important medicinal plants of temperate –wet Agro- climatic zone, one herbal garden has been established in about 14 acres of land at Dhamreda, Sarivasa at Rohru (District Shimla) during the year 2000. Main focus is being given to the high valued temperate Medicinal herbs like *Aconitum heterophyllum*, *Angelica glauca*, *Asparagus filicinus*, *Berberis aristata*, *Bergenia ligulata*, *Dactylorhiza hatageria*, *Dioscorea deltoidea*, *Hedychium acuminata*, *Heracleum candicans*, *Picrorhiza kurroa*, *Podophyllum hexandrum*, *Polygonatum multiflorum*, *Polygonatum verticellatum*, *Rheum emodi*, *Hypericum perforatum*, *Selinum vaginatum*, *Swimmier laureola*, *Swertia angustifolia*, *Taxus baccata*, *Thymus serphyllum*, *Urgenia indica*, *Viola canesens*, *Valeriana wallichii* etc.

4. Herbal Garden at Raksham, Chhitkul, Kinnaur (Semi –Temperate Dry Climate)

A herbal Garden has been proposed to set in Distt. Kinnaur in Sangla valley for developing selected valuable Medicinal plants of the region.

Cultivation of Medicinal Plants

There is a wide scope for cultivation of medicinal on uncultivable wastes and pastures which mostly remain covered by obnoxious weeds and are health hazardous both for human as well as livestock. Few among these natural occurring medicinal plants as well as certain other adoptable species can easily be inducted into the existing farming system on cultivable lands.

To bring them under cultivation it is essential that package of practices for their cultivation are standardized without compromising the quality of medicinal constituents. Package of Practices for the cultivation of Medicinal plants and profitability of their cultivation have been standardized . To peep into all these aspects important medicinal crops have been selected.

1. AONLA

1. Name of Medicinal Plant	<i>Emblica officinalis</i> Gaertn
2. Habit and Habitat	A deciduous tree, found in deciduous forests of the country upto 1350 m. on hills. Often cultivated.
3. Cultural Practices	Banarasi, Chakaiya, Francis, Kanchan, Krishna,
i. Varieties/Types/Clones released/ identified	Balwant, NA-6, NA-7, NA-9, Anand-2 and BS-1.
ii. Planting time	June to August
iii. Fertilizer dozes	1000 gm N, 500 gm P ₂ O ₂ and 750 gm K ₂ O per plant/year. The fertilizer should be given in two split doses viz. Sep - Oct and April -May.

iv. Irrigation schedule	Irrigation to young plantation at 10 days interval during the summer. To fruit bearing plantations, first irrigation should be given just after manuring and fertilization and then at 15 days intervals after fruit set (April) till onset of monsoon. Avoid irrigation during flowering period.
7. Planting time i) Rainy season ii) Spring season	July to September Mid of January to March
8. Biochemical analysis (Active ingredients)	The fruit is rich source of vitamins and minerals. High vitamin C content (750-850 mg/100 gram pulp)
9. Post Harvest Management	Different varieties mature at different period e.g Chakaiya (January), Banarasi (October end), Krishna (December) and Francis (mid November - December). Large size fruits (4 cm. & above) free from blemishes are used for preserve, candy and pickle. Small sized fruits are used for chayavanprash making and defective fruits are used for Trifala making. Generally, basket for pigeon pea stem and gunny bag of 40-50 kg capacity with newspaper as liners are used for packing of aonla fruits. However, wooden crate with polythene lines is most suitable for packing and long distance transportation. Aonla fruits can be stored upto 15-20 days at low temperature (10-15°C). However Chakaiya can be stored upto 45 and 75 days in 10% and 15% salt solution respectively without any decay.
10. Cost of Cultivation	Cost benefit ratio is 1 :4. Pay back period is six years.
11. Internal consumption and export potential	Export potential yet to be exploited. Huge internal demand in ISM.

2. ASWAHAGANDHA

1. Name of Medicinal Plant	Withania somnifera Dunal
2. Yield Plant Part	300-400 kg roots/ha + 50-75 kg seeds/ha
3. Actual Ingredients	Withaferin, Anaferin, Tropine and many other Alkaloides and Steroides
4. Cultural Practices i) Varieties/Types/Clones released/identified	Jawahar Asgandh - 20, Jawahar Asgandh 134 and Rakshita
ii) Propagation methods and	Direct sowing of seeds (Broadcasting) Planting time in 3rd

planting time	week of August to September.
iii) Fertilizer doses	The crop is mainly grown on residual fertility. Hence, no fertilizers applied
iv) Irrigation schedule	Rainfed
5. Biochemical analysis (Active ingredients)	Alkaloids and Steroids
6. Post Harvest Management	The crop is ready in six month, harvesting starts from January and continues upto March. Average yield 400-500 kg of root and 50 kg seed/ha. Cleaning, drying and grading of roots.
7. Cost of cultivation (Cost : benefit ratio)	About Rs.1000/ha and gross return about Rs.2800 (CB ratio 1:2:8)
8. Internal consumption export potential	Huge internal consumption also being and exported.
9. Action and uses	Alterative, aphrodisiac, tonic, deobstruent, diuretic, narcotic, abortifacient. Used in rheumatism, consumption, debility from old age.

3. ASHOKA

1. Name of Medicinal Plant	Saraca asoca (roxb.) DC Wild.
2. Local Name	Ashoka
3. Habit and Habitat	A small evergreen tree 6-9 m. high, found wild along streams or in the shade of evergreen forests. It occurs almost throughout India up to an altitude of 720 m in the Centre and Eastern Himalayas & khasi, Garo & Lushai hills. It is also found in the Andaman islands. Leaves pari-pinnate, 15-20 cm long, leaflets 6-12, oblong, lanceolate, flowers orange or orange- yellow, very fragrant, pods flat, leathery, seeds 4-8, ellipsoid- oblong.
4. Important Habitat	Himalayas, Bengal and Western Peninsula.
5. Cultural Practices i. Propagation methods and planting time ii. Irrigation Schedule	Seeds. Seedlings are raised and planted in rainy season Rainfed
6. Post Harvest Management	Bark is removed and sun dried for use in preparation of various herbal medicines.
7 Internal consumption and export potential	Internal consumption is quite high in pharmaceutical industries. Good export potential
8. Action and uses	Astringent, used in menorrhagia and uterine

9. Compound Preparations	Ashokarishta, Ashokaghrita
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4. ATIS

1. Name of Medicinal Plant	Aconitum heterophyllum Wall
2. Use of Plant Part Actual Ingredients	Root Alkaloids (atisine 0.4%)
3. Important Habitats	Common in Alpine and subalpine zone of the Himalayas from Indus to Kumaon from 6000 to 15000 ft. from the sea level.
4. Cultural Practices	Local clones Propagation through seeds in rainy season
5. Post Harvest Management	Roots are dried and powdered
6. Cost of cultivation	Not exploited commercially.
7. Internal consumption and exports	Roots are exported
8. Compound Preparations	Balachaturbhadra, Ativishadi Churna

5. BAIBERANG

1. Name of Medicinal Plant	Embelia ribes Burm. F
2. Habit and Habitat	A shrub, reported to be distributed in the hilly parts of India, Assam and Tamilnadu up to 1700 m.
3. Plant Part used	Fruits
4. Cultural Practices i) Varieties/Types/Clones released/identified	Local types
ii) Propagation methods and planting time	Seeds are sown in rainy season
5. Post Harvest Management	Fully mature fruits are harvested and dried in sun.
6. Compound Preparations	Vidangadi churna, Vidanga lauha, Vidanga taila.

6. BAEL

1. Name of Medicinal Plant	Aegle marmelos L.Corr.
2. Habit and Habitat	A small or medium sized tree, distributed throughout the country.
3. Yield	200-400 fruits/tree
Plant Part used	Fruits and leaves

4. Cultural Practices i. Varieties/Types/Clones Released/identified	Some well known types have been named according to fruit shape and locality e.g Mirzapuri, Darogaji, Ojha, Rampuri etc. Some improved selections are: NB-4, NB-5, NB*9.
ii. Planting time	June-July.
iii. Fertilizer dose	For 8 years old and onwards trees, 80 kg FYM, 480 g N, 320 g P and 480 g K/ tree/year is recommended.
iv. Irrigation	In the initial years, plants require frequent irrigation. Once established, light irrigation should be given after manuring and fertilization and proper soil moisture may be maintained after fruit set.
5. Post Harvest Management	At the time of harvest, tree become leafless and fruits get completely exposed. The fruits are picked individually from the tree keeping a portion of fruit stalk. Fruits are usually packed in gunny bags, baskets or wooden crates using newspaper as cushioning material. Fruits are quite hardy and they can be stored well at ambient temperature. However, fruits can be
6. Internal consumption and export potential	Fruits are mostly consumed in our country. Export potential to be explored.
7. Cost of cultivation	Cost-benefit ratio is 1:3 and pay back period is six years.
8. Parts used	Fruits, root bark, leaves, rind of the ripe fruit, flowers.
9. Compound Preparations	Bilwanchaka Kwath, Bilwandi Churna, Dashmoola rishta, Dashmoola Kwath.
10. Any other remarks	Presence of marmelosin in fruits has anthelmintic activity.

7. BRAHMI

1. Name of Medicinal Plant	Bacopa monnieri L
2. Yield Plant part Actual Ingredients	Whole plant especially leaves (100 kg dry herb/ha) Alkaloid, brahmine
3. Habit & Habitat	A small herb found throughout India upto 4000 feet. Plant an annual, creeper is mostly found near water- logged place.
4. Cultural Practices i. Varieties/Types/Clones Released/identified	Subodhak and Pragyashakti

ii. Propagation methods and planting time	By runners and by seeds, In rainy season
iii. Fertilizer doses	100 kg N/ha in three splits; 60 kg P ₂ O ₅ 60 kg K ₂ O/ha at the time of planting
iv. Irrigation	After sowing/transplanting
5. Post Harvest Management	Harvesting in October-November
6. Cost of cultivation Gross return	Rs. 35,000 / ha Rs.2,00,000 / ha
7. Internal consumption and export potential	Having internal and external demand.
8. Compound Preparations	Brahmighrit, Sarasvatarisht, Brahmivati.

8. CHANDAN

1. Name of Medicinal Plant	Santalum album Linn
2. Actual Ingredients	Essential oil (1.5-6%)
3. Distribution	A small evergreen tree, distributed in dry scrub forests of Salem, Mysore, Coorg, Coimbatore, Nilgiris upto 900 m. altitude. Also reported to be found in Andhra Pradesh, Bihar, Gujarat, Kamataka, Madhya Pradesh, Maharashtra and Tamilnadu.
4. Cultural Practices I. Varieties/Types/Clones released/identified	Local type
ii. Propagation methods and planting time	By seed and grafting. Seedlings are raised in polythene bags and plants during rainy season.
iii. Fertilizer dozes	20t FYM/ha. Fertilizer requirement not yet worked out.
iv. Irrigation schedule	Rainfed
5. Post Harvest Management	Sandal wood trees are harvested at the age of 30-60 years. The soft wood is first removed, the hard wood is chipped and then converted into powder in a mill. The powder is soaked in water for 48 hours and then distilled. Distillation takes place in 48 hours. The oil is

6. Internal consumption and export potential	Export of sandal wood chips and oil and dust was 552.2 and 29.5 t respectively during 1995-96. Besides our internal consumption in cosmetics and perfumery industries is also high.
7. Compound Preparations	Chandanasava

9. CHIRATA

1. Name of Medicinal Plant	Swertia chirata syn. S.Chirata Buch - Ham.
2. Used Plant Part Actual Ingredients	Whole plant used Alkaloids
3. Habit and Habitat	An erect herb, found in temperate Himalayas between 1300-3000 m. from Kashmir to Bhutan and Khasia hills. It is scarcely available in the market and generally substituted by <i>Andrograpis paniculata</i> Nees or other species of <i>Swertia</i> .
4. Cultural Practices	Propagated by seeds. The seeds are sown in the Nursery and then seedlings are transplanted in the field.
i. Propagation methods and planting time	
ii. Fertilizer doses	FYM is ideal for these plants
5. Post Harvest Management	Drying of plants
6. Internal consumption and export potential	Huge demand in ISM and was imported at a tune of 58.22 t valued at Rs.14.61 lakhs in 1995-96.
7. Compound Preparation	Kiratadi Kwath, Sudarshan Churna.

10. GILOE

1. Name of Medicinal Plant	<i>Tinospora cordifolia</i> wild miers, ex hook
2. Local Name	Giloe
3. Habit & Habitat	A large, glabrous, deciduous climbing shrub found throughout tropical India. Ascending to an altitude of 300 m. Stem rather succulent with long filiform flesh aerial roots from the branches. Bark gray-brown or creamy white. Leaves membranous, cordate with a broad sinus. Flowers small, yellow or greenish yellow, appearing when the plant is leafless. Drupes

4. Propagation	The Plant is sometimes cultivated as ornamental & propagated by cuttings.
5. Utilisation	The plant is used in general debilities, dyspepsia, fever & urinary disease. The leaves are good as fodder for cattle and rich in proteins and fairly in calcium and phosphorous. A decoction of the leaves is used for the treatment of gout. The young leaves bruised in milk, are used as a liniment in erysipeals. The leaves are beaten with honey and applied to ulcers. Dried & powdered fruit mixed with ghee or honey is used as a tonic and also in the treatment of Jaundice and rheumatism. The root is a
6. Active Ingredients	Alkaloid
7. Cultural Practices	Locally grown
i. Varieties/Types/Clones Released/identified	
ii. Propagation methods and planting time	Stem cuttings. Planting time is rainy season.
iii. Crop duration	Perennial
8. Post Harvest Management	The stem and leaves are harvested and dried in sun.
9. Internal consumption & export potential	Mostly consumed by Ayurvedic pharmaceuticals
10. Action	Rejuvenator, astringent, antipyretic, blood purifier and curative of dermatosis.
11. Uses	General debility, pyrexia, skin diseases, gout, rheumatic arthrites and spure.

11. GUGGAL

1.	Name of Medicinal Plant	Commiphora wightii (Arn) Bhandari
2.	Yield Plant Part Actual Ingredients	700-900 g gum per plant Tree yield an oliogum-resin-guggulipid
3.	Habit and Habitat	A shrub or small tree, reported to be found in Karnataka, Rajasthan, Deccan and Gujarat.
4.	Cultural Practices	
	i. Varieties/Types/Clones	Local types

	ii. Propagation methods iii. Fertilizer doses iv. Irrigation Schedule	Plants raised (about 80% success) by cutting. Application of 5 kg FYM and 25-50 gm urea per bush per year.
5.	Harvesting and yield	Plants attain normal height and girth after 8-10 years of growth when they are ready for tapping of the gum by shallow incision on the bark between December and March.
6.	Compound Preparations	Yogarajaguggulu, Kaishoreguggulu, Chandraprabha vati.
7.	Marketing	Gum - resin is in great demand.

12. BARBERY

1.	Name of Medicinal Plant	Berberis aristata DC
2.	Local Name	Chitra, Rasaut
3.	Habit & Habitat	An erect spinous shrub, 2 - 6 m. high, often forming gregarious patches, pale yellowish-brown bark, closely and rather deeply furrowed. Flowers are golden-yellow. It occurs in the Himalayas between 2000 - 3000 m & also in Nilgiri Hills
4.	Plant part used	Root bark, stem, wood fruit.
5.	Cultural Practices i. Varieties/Types/Clones Released/identified	Local clones
6.	Post Harvest Management	Drying of barks
7.	Utilisation	The use of the roots as a source of Rasaut has been referred to. The dried berries are edible. The root bark is rich in alkaloidal content. Berberine, the principal alkaloid can be easily obtained from the roots in the form of its salts. Rasaut, mixed with butter and alum, or with opium & lime-juice & painted over the eyelids as a useful household remedy in acute conjunctivitis and in chronic ophthalmia. A yellow dye is obtained from root and the
8.	Compound Preparations	Darvyadi Kwath, Darvyadi leha, Darvyadi taila.

13. ISABGOL

1. Name of Medicinal Plant	Plantago Ovata Forsk
2. Habit and Habitat	A herb found in Punjab plains and low hills from Sutlej westwards, Sindh and Baluchistan.
3. Yield Plant part	Seeds 900-1500 kg/ha, Husk-225-375 kg/ha
4. Cultural Practices	
i. Varieties/Types/Clones released/identified	RI-87, RI-89, AMB-2, GI-1, GI-2, MI-4, MIB-121, HI-34, HI-2, HI-1, HI-5, NIHARIKA
ii. Propagation methods and planting time	By seeds Mid October to Mid December
iii. Fertilizers doses	N:P 50:25 kg/ha (25 kg of N + full P as basal dose 25 Kg N as top dressing 35 DAS)
iv. Irrigation schedule	3 to 6 irrigations, Presowing, after sowing, Seedling stage, Spike formation stage, Flowering stage, Seed development stage depending upon the soil type and agro climatic condition.
5. Biochemical analysis (Active ingredients)	Protein, polysaccharides, cellulose, pectin, oil, mucilage.
Post Harvest Management	Crop matures during March-April (110-130 days). It should be harvested when atmosphere is dry. Harvested plants spread over and after 2 days they are threshed with tractor/bullocks. Pinkish type husk are removed from the seed coat by processing through a series of grinding in
6. Cost of cultivation	Cost of Cultivation = Rs.19320/ha
7. Internal consumption and export potential	Isabgol seed 17,680.63 tonnes valued at Rs.4,069.78 lakhs and husk 2580.29 tonnes valued at Rs.1663.73 lakhs exported during the period from April - October, 1997-98. Besides our internal consumption is also quite
8. Any other remarks	This crop has good export potential and can be exploited commercially

14. JATAMANSI

1. Name of Medicinal Plant	Nardostachys jatamansi De
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2.	Habit and Habitat	An erect perennial herb with long, stout, woody rootstock; found in alpine Himalayas at 3500-5000 m. extending eastwards to Sikkim and Bhutan. The
3.	Yield Plant part Actual Ingredients	Rhizome (1290 kg/ha) Valeopotriate and Essential Oil
4.	Cultural Practices i. Varieties/Types/Clones	Dalhousie clones
	ii. Propagation methods and planting time	Seeds and Roots. Seed nursery preparation in July/Aug. Transplanting after 6-8 weeks (April/May)
	iii. Fertilizer doses	60:20:40 NPK
	iv. Irrigation schedule	One irrigation soon after sowing and 2-3 irrigations during rain free condition
5.	Cost of cultivation (Cost: benefit ratio)	Not commercially cultivated
6.	Action and uses	Aromatic, bitter, tonic, antispasmodic, deobstruent, stimulant, antiseptic, diuretic, emmenagogue. Used in epilepsy, hysteria, chorea, convulsions, palpitation of heart, mental disorders, insomnia.
7.	Parts used	Root-stock
8.	Compound Preparations	Mansyadi Kwath
9.	Any other remarks	Crop is not under regular cultivation, so there is a rapid depletion of the plant from its natural sources. Quality degradation under storage is reported.

15. KALMEGH

1.	Name of Medicinal Plant	Andrographis paniculata
2.	Yield Plant part Actual Ingredients	Panchang (Stem, leaf, flower, seed and root) Kalmeghin Andrographolide (0.8-2.%%). Leaves contains maximum while stem contains minimum amount.
3.	Habit and Habitat	A small herb found throughout India in plains of Himachal Pradesh to Assam, Mizoram, Gujrat, Bihar and South India.
4.	Cultural Practices i. Varieties/Types/Clones released/identified	Local clones. There is no named variety.
	ii. Propagation methods and Planting time	Propagated by seed and cuttings. Seedlings/plantlets raised in nursery in last week of July.
	iii. Fertilizer doses	Poultry manure or FYM 10 t/ha, Castor cake 2 t/ha, 75 Kg N, 75 Kg P ₂ Q ₅ .

	iv. Irrigation schedule	Kharif season crop. If rain is inadequate then 2-9 irrigations are given.
5.	Post Harvest Management	Crop duration 90-100 days. Harvesting is done in end of October and 1st week of November. Harvest should be spread over on the floor and it should be covered at night to protect from dew. One week drying under shade is required. Average yield 2-2.5 t/ha dry herb
6.	Cost of cultivation Gross return Net return	Rs.10,000/ha Rs.43,000/ha Rs.33,000/ha
7.	Internal consumption and export potential	Ayurvedic formulations for debility, chronic malaria, jaundice, anemia and loss of appetite. Andrographis preparations in different potencies for Homeopathic medicines.

16. KATKI

1.	Name of Medicinal Plant	Picrohiza Kurroa Royle ex Benth
2.	Habit and Habitat	A perennial herb, found in Alpine Himalayas from Kashmir to Sikkim at altitudes of 2700 -4500 m.
3.	Cultural Practices Propagation method	Through seeds and rhizome
4.	Parts used	Root and rhizome
5.	Compound Preparations	Arogyavardhani, Katukadya lauha, Tikkadi Kwath, Tiktadighrita
6.	Internal consumption and export potential	Limited internal consumption
7.	Any other remarks	Threatened perennial herb but can be domesticated and cultivated.
8.	Internal consumption and export potential	Fruit mainly used for preparation of value added products like Kokum syrup, dried kokum rind etc. which are consumed within the country. However, kokum seed fat is exported to Netherlands, Italy, Japan, Singapore, U.K and Malaysia. Good export potential
9.	Any other remarks	Hardy rainfed crop in coastal tropical region in the country. Crop has outstanding medicinal properties (acidulent, dysentery, pains, heart problems etc.) and also spice quality.

17.KERTH

1. Name of Medicinal Plant	Saussurea lappa
2. Area under Cultivation	About 100 ha
3. Production	About 200 t
4. Yield Plant part Actual ingredients	Tuberous Roots (25000-30000 Kg/ha) Essential oil (1.5%) Saussunine (0.05%)
5. Important States	Kashmir valley (J&K) Lahaul spiti (HP) Garhwal (UP)
6. Cultural Practices i. Varieties/Types/Clones released/identified	Kashmir & Punjab types
ii. Propagation methods and planting time	Seeds are sown in May
iii. Irrigation schedule	5-6 irrigations between May-September.
v. Crop duration	3 years.
7. Cost of cultivation (Cost : benefit ratio)	1:3.2 (in 3 years) Cost of cultivation : Rs. 14, 000- Gross income : Rs. 45,000-
8. Internal consumption and export potential	Exported to China, Japan, Italy and France. Internal consumption is limited.

18. MULHATI

1.	Name of Medicinal Plant	Glycyrrhiza glabra Linn
2.	Habit and Habitat	A herb, reported to be found in sub-Himalayan tracts. Most of the requirement of Pharmaceutical industries is met by import only. Recently introduced in Gujarat, Himachal Pradesh and Haryana.
3.	Cultural Practices i. Varieties/Types/Clones released/identified	Haryana Mulhati No.1 (HM No.1) EC-111236, EC-124587, EC-21950

	ii. Propagation methods and planting time	By root cuttings February-March or July-August
	iii. Fertilizer doses	10 t FYM/ha applied at the time of planting Chemical fertilizers: N 80 kg (40 kg basal dose + 20 kg each at 2nd + 3rd year), P ₂ O ₅ - 40 kg/ha and K ₂ O 20 kg/ha.
	iv. Irrigation schedule	At 30-45 days intervals in summer or in dry season, 7-8 irrigations are needed.
	v. Crop duration	2.5 to 3 year
4.	Compound Preparations	Yashtyadi chuma, Yashtyadi Kwath, Yashtimadhwadya tails.
5.	Internal consumption and export potential	It is imported (about 5,000 to 10,000 of dry roots annually) from Afghanistan, Iran and Iraq.
6.	Any other remarks	Cultivation not yet popularised.

19. SATAVARI

1.	Name of Medicinal Plant	Asparagus racemosus Willd
2.	Habit and Habitat	A climber found almost all over India
3.	Yield Plant Actual Ingredients	Tuberous roots (100-150 q/ha 3rd year). Saponin
4.	Cultural Practices i. Varieties/Types/Clones ii. Propagation methods and planting time	Local clones By seeds/adventitious roots March-April (Sowing) July-August (Transplanting)
5.	Post Harvest Management	Tuberous roots are ready for harvesting in 3rd year. After harvesting, roots (tuberous) are washed and dried in sun for making of powder.
6.	Parts used	Root
7.	Compound Preparations	Shatavari ghrita, Naraina taila, Vishnu Tails, Shatmulyadi lauha, Shatavari panaka.

20. SHANKAPUSHPI

1.	Name of Medicinal Plant	Convolvulus pluricaulis
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2.	Distribution	A prostrate perennial herb found all over India, in Lalitpur district found in Talbehata, Meharauni and Lalitpur forest ranges. Present day availability is very low, approximately 50 - 60 quintal per year.
3.	Part used	Whole plant
4.	Soil type	Sandy loams, Block cotton soils Red sandy soils; PH 5.5 to 7. It is also grown in marginal lands with good drainage and some organic matter applied to the soil.
5.	Rainfall	800 mm - 1200 mm
6.	Field preparation	Deep ploughing in the month of May and is allowed to weather. 15 tons per hectare farm yard manure is spread out in the field during June before rains. After FYM applied and after on set of monsoons second ploughing is done followed by two cross harrowing. The land is finally
7.	Sowing	The seeds are broadcast mixing with sand or Line sowing 30 cm x 30 cm also done. After sowing light top dressing of FYM is given. Very light watering is done. Seedlings appear within 30 days.
8.	Harvesting	Plants get flowers in October and seeds developed in December. Crop harvesting period is January to May. Whole plant is dried in shade and is stored for marketing.
9.	Uses	Insomnia, Insanity and Epilepsy, Cough, Skin disorders, Hyperpyrexia, General debility

21. SAFED MUSLI

1.	Name of Medicinal Plant	Chlorophytum borivillanum
2.	Yield Plant part Actual Ingredients	Tuberous roots (1000 kg/ha) Saponin 2-4%
3.	Cultural Practices i. Varieties/Types/Clones released/identified	Selections viz. RC-2, RC-16, RC-36, RC-20, RC-23. RC-37 have been collected and maintained at RAU, Udaipur

	ii. Propagation methods and planting time	By seed and by tuberous roots, second week of June
	iii. Fertilizer doses	No chemical fertilizer tested on this crop. 10-15t FYM/ha provides good nutrient status for healthy growth.
	iv. Irrigation schedule	First irrigation immediately after planting. If there is no rainfall, then irrigation may be done after 10-15 days interval.
	v. Crop duration	90-110 days
7.	Post Harvest Management	Harvested roots are spread in the shade for about 4-7 days. Later, fleshy roots separated from the bunches. Slight pressure exerted by thumb and finger on the skin of root so that they get separated and milky white root come out. It should be cleaned and dried for 7-10 days
8.	Cost of cultivation (Cost : benefit ratio)	Cost of cultivation = Rs.22,000/- Gross return = Rs.65,000/- Cost benefit ratio = 1:2:95
9.	Internal consumption and export potential	Mainly consumed in herbal based pharmaceutical industries. It has large and consistent market demand in the country and current projection of the annual demand is estimated between 300-500 t.
10,	Any other remarks	Safed musli is a well known tonic and a aphrodisiac drug given to cure general debility and extensively used in Ayurvedic medicines. Still major requirements of the pharmaceutical industries is fulfilled through collection from the forest, thus it has become threatened species in India. Effort should be made for its regular cultivation to fulfil the growing demand.

For sustainable agriculture, consequent upon finalization of package of practices for cultivation of these medicinal plants, it is essential that they are incorporated into the general package of practices of horticultural / agricultural crops to supplement the income from a mixed farming system. Besides improving the income of the farmers through the introduction of these high value medicinal crops, the environment friendly ecological changes will help assist the present as well as future generations to live in a pollution free environment. Introduction of these medicinal plants will minimize the disease and insect pest incidence owing to their medicinal constituents and breaking the life-cycles of those diseases / insects which otherwise continue to survive on preferred hosts of regular cropping sequence. Along with these benefits, the overall low water requirement of these money spinning medicinal crops will lessen the ever-increasing demand of water for diversified agriculture especially with the introduction of vegetables. Thus, the integration of agriculture / horticulture with the herbiculture will provide opportunities for achieving most desired objective of organic farming by minimizing the use of pesticides and chemical fertilizers.

Strategy for the Future

In the future, it will be important to mainstream medicinal plants into natural resource management and development programs. To boost the quality of plant resource management and increase supplies of these resources:

- Agricultural support agencies should strengthen extension efforts to farmers.
- Research institutions need to improve basic knowledge about cultivation practices and dissemination of medicinal plant species.
- Conservation agencies and NGOs should promote conservation of vulnerable species at the grass-roots level.
- Community organizations need to adopt sustainable collection and management practices on public lands.
- Profitable private enterprises for processing, transporting, and marketing must be developed.
- Government institutions need to be strengthened to regulate these important resources and, at the same time, foster their sustainable development and conservation.
- Future initiatives should also link the management and conservation of medicinal plants with the commercial development of these resources.

Conclusion

Cultivation of medicinal plants as a component of pollution free ecologically balanced agricultural production system is a sustainable alternative to the arduous collection of medicinal plants from the wild and can become a source of increased income to the marginal and poor farming households.

SELECTED REFERENCES

1. Chandra P. Kuniyal, Yashwant S. Rawat, Santaram S. Oinam, Jagdish C. Kuniyal and Subhash C. R. Vishvakarma .2005. Kuth (*Saussurea lappa*) cultivation in the cold desert environment of the Lahaul valley, northwestern Himalaya, India: arising threats and need to revive socio-economic values. *Biodiversity and Conservation*: 14(5):1035 - 1045
2. Medicinal Plants 2006: <http://indianmedicine.nic.in/html/plants/mcmain.htm>
3. Nautiyal M.c-1995 - cultivation of medicinal plants and Biosphere Reserve Management in Alpine zones.
4. Rao, K.S., and K.G. Saxena 1994. Sustainable Development and Rehabilitation of Degraded Village Lands in Himalaya.
5. Tewari D.N. Cultivation of Medicinal Plants - unpublished manuscript