CULTIVATION OF MEDICINAL PLANTS IN NATURAL ECOSYSTEM IN GUJARAT (INDIA): CONSTRAINTS AND CONSERVATION NEED

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Abstract : The present paper deals briefly about cultivation of medicinal plant of Gujarat. The number of plant species yielding raw materials used by the industry on regular basis and/or in substantially large quantities is put at around 143 species. Among these, 78 species occur wild in forests or other forms of natural vegetation, 23 species grow as weed, 42 species are grown as cash crop for other plant based products and 22 species are cultivated as medicinal crop. There has been a tremendous increase in the production of herbal medicines and other items in recent years. These include such important sources of raw materials as *Aegle marmelos*, *Commiphora wightii*, *Emblica officinalis*, *Eucalyptus*, *Mentha viridis*, *Terminalia arjuna*, *Terminalia bellirica*, *Terminalia chebula*, *Withania somnifera* and *Zingiber officinalis.* Few effects have been made to highlight the problems encountered for necessary constraints and conservation need to medicinal plants in this state.

Keywords: Medicinal plant, conservation, cultivated, natural vegetation, Gujarat

INTRODUCTION

Gujarat State is the western-most part of India. Gujarat is situated on the western coast of the country having longest coastline. It lies between latitude 20°07" to 24°43' N and longitude 68°10" to 74°29' E. The geographical area of the State is 196,022 km^2, which constitutes 5.96% of the country's geographical area (FSI, 2009). The forest cover in the state is poor but it has fairly rich biodiversity. The state comprise of less than 10% forest land of its geographical area. According to different studies on floral diversity, 2205 species of angiospermic plants belonging to 905 genera of 156 families have been recorded so far. Out of 2205 plant species, 748 plants were identified as medicinally important (Uma Devi, 1988). According to a study conducted by the Forest Department on status of medicinal plants in different forest types and agro-climatic zones, 915 medicinal plants are distributed across the state (Anon, 2002). The World Health Organization (WHO) has estimated that 80% population of developing countries relies upon traditional medicinal-mostly plant drugs-for their primary health care needs (Fransworth and Soejarto, 1991).

MATERIAL AND METHOD

A survey was carried out during Aug., 2011 to July, 2013 to collect information on the basis of cultivated of medicinal plants in different parts of Gujarat state. While collecting information on ethno medicinal plants, parts used, main area of natural occurrence, resources and demand such information have been gathered from the village chiefs, medicine man, and even local man and women and cultivators using semi-structured questionnaires. Analysis of data was made with the help of group discussions among different age classes of local communities that include both the genders of the society.

RESULT

The number of medicinal plants in India, both indigenous and introduced, has been variously put at between 3,000 to 3,500 species of higher plants. The Glossary of Indian Medicinal Plants has listed around 3,000 plants (Asolkar *et al.*, 1992; Chopra *et al.*, 1956, 1974). Two thousand five hundred plants have been reported to be used in ethno-medicine (Jain, 1991). Out of these the plants providing largely and/or regularly used raw materials by Indian Drug and Pharmaceutical Industry restricts to 265. This figure includes the raw materials imported from other countries, some of which such as liquorices, henbane, cassia bark, galangal, ephedra, long pepper and star anise are used in appreciably large quantities. The occurrence of these medicinal plants and availability of raw materials derived from them is as follows.

Plants occurring wild in forests, grassland, aquatic and desert ecosystems or associated with other forms of natural vegetation in Gujarat (Table 01): The number of such plants is around 78. These include such important sources of raw materials as *Commiphora wightii*, *Emblica officinalis*, *Gloriosa superba*, *Pterocarpus marsupium*, *Rauvolfia serpentine*, *Terminalia arjuna*, *Terminalia bellirica* and *Terminalia chebula*. The plants where the raw materials are leaf, flower, fruit, seed, exudates or other renewable part also suffer if the collection method is destructive.

Plants growing as weed or have run wild in Gujarat state (Table 02). Twenty three species of plants in this category provide the raw materials. Some of

these such as *Abutilon indicum*, *Cassia tora*, *Ocimum basilicum*, *Phyllanthus amarus*, *Tephrosia purpurea* and various species of Datura have large demand. These plants usually occur in fallow agricultural land, along road and railway tracts, in gardens and orchards, on dust and organic dumps, ponds, marshes and other waste places. Some of these are escapes from cultivation or colonizers of secondary scrub springing up in cleared or degraded forest land.

Plants cultivated as ornamentals or as cereal, fruit, vegetable, spice, oil seed, essential oil or other cash crop: fourty two plants in this category are also the source of medicinal raw materials (Table 03 and Table 04). The raw material in these cases is either the product for which the plant is being cultivated such as clove, cinnamon, castor seed, turmeric or a by-product such as bael fruit, ashoka bark and Jamun seed.

Plants cultivated as medicinal crop: Twenty two or so medicinal plants are under regular and/or large scale cultivated (Table 05). The major among there are *Aloe vera*, *Rauvolfia serpentine* and *Withania somnifera*.

DISCUSSION

Most of medicinal plants, even today, are collected from wild. The continued commercial exploitation of these plants has resulted in receding the population of many species in their natural habitat. Vacuum is likely to occur in the supply of raw plant materials that are used extensively by the pharmaceutical industry as well as the traditional practitioners. Consequently, cultivation of these plants is urgently needed to ensure their availability to the industry as well as to people associated with traditional system of medicine. If timely steps are not taken for their conservation, cultivation and mass propagation, they may be lost from the natural vegetation forever. *In situ* conservation of these resources alone cannot meet the ever increasing demand of pharmaceutical industry (Singh and Gautam, 1997). It is, therefore, inevitable to develop cultural practices and propagate these plants in suitable agroclimatic regions. Commercial cultivation will put a check on the continued exploitation from wild sources and serve as an effective means to conserve the rare floristic wealth and genetic diversity.

It is necessary to initiate systematic cultivation of medicinal plants in order to conserve biodiversity and protect endangered species. In the pharmaceutical industry, where the active medicinal principle cannot be synthesized economically, the product must be obtained from the cultivation of plants. Systematic conservation and large scale cultivation of the concerned medicinal plants are thus of great importance. Efforts are also required to suggest appropriate cropping patterns for the incorporation of these plants into the conventional agricultural and forestry cropping systems. Initiatives have already been taken by various agencies involved in conservation activities. A National Board of Medicinal Plants has been set up; one of whose activities is conservation. The Ministry of Environment and Forestry is funding an All-India coordinated project on conservation of endangered plant species (Raghupathy, 2001). Cultivation of this type of plants could only be promoted if there is a continuous demand for the raw materials. There are 143 major medicinal plants that can be cultivated in Gujarat and have established demand for their raw material or active principles in the international trade. It is also necessary to develop genetically superior planting material for assured uniformity and desired quality and resort to organized cultivation to ensure the supply of raw material at growers end. Hence, small scale processing units too have to be established in order that the farmer is assured of the sale of raw material. Thus, cultivation and processing should go hand in hand in rural areas. The Cultivation Vrs Collection of Medicinal Plants from Forest.

Cultivation	Collection from forest
1. Cultivation of medicinal plants can be controlled according to the need of market demand.	1. Collection of medicinal forest produce depends on various agencies starting from primary collectors to stockiest. Hence there is least control over all these agencies.
2. In cultivation, use of good varieties of planting materials, use of fertilizers and insecticide yield maximum amount of produce from smaller area.	2. Here the yield is very poor and larger area involves smaller amount of medicinal produce.
3. The quality of medicinal produce can be assured by improved method of cultivation and harvesting.	3. The quality of medicinal produce cannot be achieved while collection from wild. The collectors collect the produce without seeing their maturity.
4. In cultivation the mixing of other produce with desired produce can be checked.	4. There is always chance of mixing of several other produce with desired produce.

For developing the medicinal plants sector, there is a need to: 1) document indigenous uses of medicinal plants, 2) certify raw material for quality control, 3) develop and improve the agro-technology for valuable medicinal plants, 4) officially recognize and protect the customary laws of indigenous people, 5) prepare a clear policy for granting permits for cultivation within stipulated time, 6) conduct regular research and training on better harvesting and processing techniques, 7) investigate various

pathological agents infecting medicinal plants, 8) setup a community-based management of medicinal plants farming and marketing, 9) analyze the market policies, 10) monitor and evaluate the status of medicinal plants with the assistance of local communities, 11) conserve the critical habitats of rare medicinal plant species, and 12) share benefits judiciously arising from local people's knowledge on medicinal plants. These attempts may reduce dependency on wild resource base, and generate alternative income opportunities for the rural and underprivileged communities [KIT 2003; Kala 2005; Kaushik and Dhiman 1999 and Olsen and Larsen 2003].

The medicinal plants sector can be improved if the agricultural support agencies would come forward to help strengthen the medicinal plants grower and if research institutions would help the plant growers by improving their basic knowledge about cultivation practices [Prajapati *et al*., 2003]. Awareness and interest of farmers, supportive government policies, assured markets, profitable price levels, access to simple and appropriate agro-techniques, and availability of trained manpower are some of the key factors for successful medicinal plants cultivation [KIT 2004]. The diffusion of any available scientific knowledge on medicinal plants should be made operational by a network structure of communication. Currently there are number of herbs which are used in curing diseases but are not documented in details due to a lack of communication and relatively low frequency of their uses. The traditional uses of low profile and lesser known medicinal plants should also be documented to disseminate their therapeutic efficacy by preparing well acceptable medicines and also to reduce the pressure on over-exploited species.

Gujarat is a treasure house of a wide variety of medicinal plants. Some species are found wild, while a number of species have been domesticated by the farmers. Many species have been grown in homesteads and become part of traditional home remedies. A limited number of species are commercially cultivated though a few more have potential for large-scale production. The important natural and cultivating medicinal plants are discussed here highlighting the importance, medicinal and other uses activity.

Terminalia arjuna: The bark is useful in fractures, ulcers, urethrorrhoea, leucorrhoea, diabetes, vitiated conditions of *pitta*, anaemia, cardiopathy, fatigue, asthma, bronchitis, tumours, internal and external haemorrhages, cirrhosis of the lever and hypertension. It is used in fractures and the powdered bark is taken with milk. The bark powder is diuretic and has a general tonic effect in cases of cirrhosis of liver. The bark has been considered by the ayurvedic physicians as well as by modern practitioners as a cardiac tonic. It is given as a decoction with milk (NRF, 1998).

T. bellirica : The fruit is used in bronchitis, strangury, sore throat, diseases of eye, nose, heart and bladder, hoarseness and piles. It forms an important constituent of the ayurvedic drug '*triphala*'. Furit has anticancerous and flower has spermicidal activity. Bark is mild diuretic. Fruit is astringent, antidropsical, antileprotic, antiinflammatory, antidiarrhoeal, antibilious, stomachic, antiasthmatic, tonic, anticephalgic, bechic, anthelmintic and attenuant. Kernel is narcotic. Semi-ripe fruit is purgative. Gum is demulcent (Husain *et al*, 1992).

Terminalia chebula: In unani system, it is used as a blood purifier. The pulp of the fruit is given in piles, chronic diarrhoea, dysentery, costiveness, flatulence, asthma, urinary disorders, vomiting, hiccup, intestinal worms, ascites and enlarged spleen and liver. Powder of the fruit is used in chronic ulcers and wounds, carious teeth and bleeding ulceration of the gums. The bark is a good cardiac tonic. Fruits are astringent, purgative, tonic, carminative, alternative and antispasmodic. Flowers and fruits are antiviral and hypoglycaemic. Wood is oxytocic and hypothermic (Husain *et al*, 1992). Similar study of 'Haritaki' (fruits of Terminalia chebula) can be cited as an example where seven varieties originated from different parts of India have been attributed with different types of therapeutic properties (Pandey and Chunekar, 1995).

Asparagus racemosus: Asparagus is a climbing undershrub with widespread applications as diuretic, cooling agent and an excellent safe herbal medicine for ante-natal care. It is useful in nervous disorders, dyspepsia, diarrhoea, tumours, inflammations, vitiated conditions of *vata* and *pitta*, burning sensation, hyperdipsia, ophthalmopathy, nephropathy, hepatopathy, strangury, scalding of urine, throat infections, tuberculosis, cough, bronchitis, gleet, gonorrhoea, leucorrhoea, leprosy, epilepsy, fatigue, hyperacidity, colic haemorrhoids, hypertension, abortion, agalactia, cardiac and general debility (Warrier *et al*, 1993). Its powder boiled with milk is generally used to prevent abortion. It increases milk production in cows and buffaloes. It preparations in milk helps in increasing breast milk in lactating women. Its proper use helps in avoiding excessive blood loss during periods. It clears out infections and abnormalities of uterine cavity and hence it is used to rectify infertility in women. The leaves are used to prepare toilet soaps. The plant has also ornamental value both for indoor and out door decorations (Syamala, 1997).

Datura metel: The plant and fruit are spasmolytic, anticancerous and anthelmintic. Leaves and seeds are inhaled in whooping cough, asthma and other respiratory diseases. Root, leaf and seed are febrifuge, antidiarrhoeal, anticatarrhal and are used in insanity, cerebral complications and skin diseases. Datura is the chief commercial source of hyoscine available from natural source. Hyoscine, in the form

of hyoscine hydrobromide, is used as a pre-anaesthetic in surgery, child birth, ophthalmology and prevention of motion sickness. It is also employed in the relief of withdrawal symptoms in morphine and alcoholic addiction, paralysis agitans, postencephaletic parkinsonianism and to allay sexual excitement. Hyoscyamine and its salt hyoscyamine sulphate and hyoscyamine hydrobromide are used in delerium, tremour, menia and parkinsonianism (Kaul and Singh, (1995).

Piper longum: Its roots also have several medicinal uses. The root is useful in bronchitis, stomach ache, diseases of spleen and tumours . The root and fruit decoction are used in acute and chronic bronchitis and cough. It contains the alkaloid piperine which has diverse pharmacological activities, including nerve depressant and antagonistic effect on electroshock and chemo-shock seizures as well as muscular incoordination. Piperine is hypotensive, antipyretic, analeptic, and nerve stimulant (Warrier *et al*, 1995).

Rauvolfia serpentine: In Ayurveda it is also used for the treatment of insomnia, epilepsy, asthma, acute stomach ache and painful delivery. It is used in snake-bite, insect stings, and mental disorders. It is popular as "*Madman's medicine*" among tribals. '*Serpumsil'* tablet for high blood pressure is prepared from *Rauvolfia* roots. Reserpine is a potent hypotensive and tranquillizer but its prolonged usage stimulates prolactine release and causes breast cancer. The juice of the leaves is used as a remedy for the removal of opacities of the cornea. Serpentine group comprising serpentine, sepentinine, alstonine *etc* is mostly antihypertensive. (Husain, 1993).

Aegle marmelos: Every part of the tree is medicinal and useful. The roots are used in many Ayurvedic medicines for curing diabetes and leprosy. It is an ingredient of the '*dasamoola*'. The Bark is used to cure intestinal disorders. Leaves contain an alkaloid rutacin which is hypoglycaemic. '*Two leaves before breakfast'* is said to keep diabetes under control. Leaves and fruits are useful in controlling diarrhoea and dysentery. Fruit pulp is used as '*shampoo*' and cooling agent. '*Bael sharbat*' is prepared by mixing the fruit pulp with sugar, water and tamarind juice, which is very useful for stomach and intestinal disorders. The rind of the fruit is used for dyeing and tanning. The aromatic wood is used to make pestles in oil and sugar mills and also to make agricultural implements (Rajarajan, 1997).

Phyllanthus emblica: It goes in combination in the preparation *of triphala, arishta, rasayan, churna* and *chyavanaprash.* Seed is used in asthma, bronchitis and biliousness. Tender shoots taken with butter milk cures indigestion and diarrhoea. Leaves are also useful in conjunctivitis, inflammation, dyspepsia and dysentery. The bark is useful in gonorrhoea, jaundice, diarrhoea and myalgia. The root bark is astringent and is useful in ulcerative stomatitis and gastrohelcosis. The dried fruits have good effect on hair hygiene and used as ingredient in shampoo and hair oil. The fruit is a very rich source of Vitamin C (600mg/100g) and is used in preserves as a nutritive tonic in general weakness (Dey, 1980).

Withania somnifera: Its roots, leaves and seeds are used in Ayurvedic and Unani medicines, to combat diseases ranging from tuberculosis to arthritis. Roots are prescribed in medicines for hiccup, several female disorders, bronchitis, rheumatism, dropsy, stomach and lung inflammations and skin diseases. Its roots and paste of green leaves are used to relieve joint pains and inflammation. It is also an ingredient of medicaments prescribed for curing disability and sexual weakness in male. Aswagandha powder (6-12g) twice a day along with honey and ghee is advised for tuberculosis in Sushruta Samhita. It also provides sound sleep (Prakash, 1997).

Azadirachta indica: Every part of the tree, namely root, bark, wood, twig, leaf, flower, fruit, seed, kernel and oil has been in use from time immemorial in the Ayurvedic and Unani systems of medicine. It is valuable as an antiseptic, used in the treatment of small pox. Small twigs are used as tooth brushes and as a prophylactic for mouth and teeth complaints. Extract from the leaves are useful for sores, eczema and skin diseases. Boiled and smashed leaves serve as excellent antiseptic. Decoction of leaves is used for purifying blood. Neem oil is used in soaps, toothpaste and as a hair tonic to kill lice. Seed is used in snake bite. Extracts of neem seed oil and bark check the activity of male reproductive cells and prevents sperm production. Neem seed oil is more effective than the bark for birth control. Neem based commercial products are also available for diabetes treatment (Nimbola, JK-22), contraceptive effect (Sensal, Nim-76) and mosquito/ insect repelling (Tewari, 1992; Parmer and Katkar, 1993; Pushpangadan *et al*, 1993; Mariappan, 1995).

Gloriosa superba: The roots and rhizomes are used in traditional system of medicine. A paste of the root is also used as an anodyne; applications in bites of poisonous insects, snake bites, scorpion sting, parasitic skin diseases and leprosy (Nadkarni, 1954; Chaudhuri and Thakur; 1994).

Gmelina arborea: The whole plant is medicinally very important. It promotes digestive power, improves memory, overcomes giddiness and is also used as an antidote for snake bite and scorpion sting. Roots are useful in hallucination, fever, dyspepsia, hyperdipsia, haemorrhoids, stomachalgia, heart diseases, nervous disorders, piles and burning sensation. Bark is used in fever and dyspepsia. Leaf paste is good for cephalagia and leaf juice is a good wash for foul ulcers and is also used in the treatment of gonorrhoea and cough. Flowers are recommended for leprosy, skin and blood diseases. In south India the bark of the tree is used by arrack manufacturers to regulate the fermentation of toddy. The plant is also grown in garden or avenues (Dey, 1984; Sivarajan and Indira, 1994).

Bauhinia variegate: In traditional medicine, Bauhinia is extensively used in glandular diseases and as an antidote to poison. The drug is also reported to be useful in dysentery, diarrhoea, piles and worms (Kurup *et al*, 1979). Root is carminative and antidote for snakebite. Bark, flower and root promote suppuration. Bark and bud are astringent and vermifuge (Husain *et al*, 1992).

Constraints

The Gujarat Forest Department has identified some constraints in the development of medicinal plant sector. These are as follows;

Inadequate information on availability on selected species and resource assessment.

Lack of scientific farming for authentic source of raw material and bulk availability.

Poor interest in the people regarding conservation issues and scope of sustainable development due to lack of awareness.

Lack of marketing avenues and infrastructure. There is also a total absence of processing and manufacturing units.

Lack of proper survey of medicinal plants and documentation of local health traditions and practices.

Inadequate financial support for commercial ventures.

Absence of Non- Government Organizations working exclusively on this field and an effective extension service.

Lack of Directory of village/ traditional medicinal men/farmers/ traders/entrepreneurs involved in medicinal plant sector in different parts of the state for networking and co-ordination.

Inadequate trained and skilled manpower for medicinal plant related activities.

Conservation needs

With the impact of various influencing factors the medicinal flora of the Gujarat is on the decline in terms of Biological, (physiological, phonological, regeneration) ecological (habitat-genepool, modification and alteration, hotspots, phytogeography) and conservation aspects (*ex-situ, in-situ, in-vitro*). With regards to this significant group of plants adequate research and development (R & D) support using recent techniques of scientific and technological advances (S & T) is required. Following provides the various aspects and priorities.

1. Inventorization and characterization
- Development of baseline database on species and genetic diversity of specific sites.
- Taxonomic characterization using recent trends (biochemical, DNA, RFLP, PCR, etc. Cytological Palynological tools).
- Manpower (capacity building).
- Funding mechanism (collaborative).

2. Monitoring and Assessment
- Development of cost effective methodology for quantitative assessment of specific site.
- Application of remote sensing (RS) and GIS (Geographic Information System) technology in identifying critical habitats at landscape level. Conforming RS and GIS database with ground truthing.

3. *Ex-situ* conservation
- Development of nursery and planting technology for rare and threatened taxa.
- Development of gene bank (field oriented) on targer species.
- Networking for coordination and collaboration at inter disciplinary and inter institutional levels.
- Application of cost effective ways of conserving biological parts of medicinal flora (possibly through innovations and inventions at grassroots level).

4. *In-situ Conservation*
- Development of microhabitats, endemic centres, hotspots. A separate Working Plan Circle in forest Department may be constituted.
- Application of recent trends in the field of biodiversity conservation to the existing preservation plots, sacred gives and specific sites falling under various other key area o9f conservation, for example, 86 National Parks (PKs) and 480 Wildlife Sanctuaries (WLs) of the country.

Table 1: Medicinal plants growing in forests, grasslands, running or stationary water bodies, deserts and other forms of natural vegetation.

Name of the plants	Part used	Main area of natural occurrence	Resources	Demand
1	2	3	4	5
Acacia catechu	STBK, EXT	North, West & Central India; upto 800m	Poor (VU)	Med
Acacia nilotica	GM, BK	Maharashtra, Gujarat, Pajab and Rajasthan	Good	High
Ailanthus excelsa	STBK	West Bengal, Bihar, Orissa and Gujarat	Fair	Med
Aegle marmelos	FR/RT	Central & South India; upto 1000m	Good (*)	High
Alangium salvifolium	SD	Rajasthan, Gujarat,	Poor	Low

		Maharashtra		
Albizia lebbek	STBK	Throught India upto 1500m	Fair	High
Alhagi pseudalhagi	WP	Haryana, Rajasthan, Gujarat; arid plains	Poor (VU)	Low
Argyriea nervosa	RT	Throught India, sun-hill regions	Good	Med
Azadirachta indica	Panchang	Maharashtra, Gujarat and Madhya Pradesh	Good	V. High
Bacopa monnieri	WP	Throught Indian plains	Fair	Med
Bambusa arundinacea	Vanshlochan	Gujarat, Assam	Good	Med
Bauhinia variegata	STBK	Central & South India; Uttar Pradesh & Tamil Nadu	Good	V. High
Bombax ceiba	Mochras (GM)	Throught India upto 1200m	Fair	High
Butea monosperma	RT, FL	West Bengal, Madhya Pradesh and Rajasthan	Good	V. High
Caesalpinia crista	SD	Throught India upto 1000m	Good	Med
Careya arborea	STBK	Rajasthan, Gujarat	Good	Med
Casearia esculenta	STBK	Madhya Pradesh, Gujarat	Fair	Low
Cassia fistula	FR, LF	Throught India upto 1250m	Good	High
Celastrus paniculata	FR	Throught India upto 1200m	Good	Med
Centella asiatica	WP	Throught India upto 1000m	Good	V. high
Chlorophytum spp.	RT	Western and Central India, arid plains	Poor (VU)	Med
Cocus nucifera	FR (Endosperm)	Kerala, Andhra Pradesh, Karnataka and Gujarat	Fair	High
Coleus forskoholii	RT	Kumaon hills (UA), 600-1200m	Fair	Med
Commiphora wightii	GM	Rajsthan, Gujarat, arid hills and bet	V. Poor (EN)	High
Crateva nuevala	STBK, FR	Saputara (Gujarat), Maharashtra	Fair	Mar
Desmodium gangeticum	RT	North and Central India, sub-hills	Good	Med
Dioscorea bulbifera	RH	Throught India, sub-hill regions	Good	Low
Dioscorea deltoidea	RH	J&K, HP. UA, 1500-2500m	Poor (VU)	V. high
Dolichandrone falcata	STBK	Western and Central India, arid plains	Poor	Mar
Emblica officinalis	FR	Northern and Central India,upto 1000m	Good	V. high
Fagonia cretica	WP	Haryana, Rajasthan, Gujarat, arid plains	Fair	Mar
Ficus benghalensis	BK, HB	Northern and Central India, upto 1000m	Good	Med
Ficus racemosa	STBK	Northern and Central India, upto 1000m	Good	Med
Ficus tsiela	STBK	Banascatha (Gujarat)	V. Poor	Mar
Garcinia indica	FR	Maharashtra, Karnataka, W. Ghats	Fair	Med
Gloriosa superba	RT/ SD	Throught India upto 1000m	Good (*)	High
Gmelina arborea	RT, BK, ST	Sikkim, Assam and Central India	Good	V. High
Gymnema sylvestre	LS/RT	Andhra, Karnataka, TN, Kerala Plains	Fair (*)	Med
Helicteres isora	FR	Northern and Central India, upto 1000m	Good	mar
Hemidesmus indicus	RT	Karnataka, Kerala; Ghat, Coastal forest	Fair (*)	Med
Holarrhena	STBK	Throughout India, Sub-hill	Good	High

antidysenterica		regions		
Leptadenia reticulata	RT	Gujarat, Rajasthan, Maharashtra, arid plains	Fair	High
Limonia acidum	FR	Gujarat, Rajasthan	Fair	Med
Madhuca indica	FR, FL	Bihar, UP, MP	Good	High
Madhuca longifolia	FR/SD	Central and South-eastern India	Good	High
Mallotus philippensis	FR hair	Throught India upto 1100m	Good	Med
Melia azedarach	STBK	Throught India upto 1800m	Good	V. High
Mimusops elengi	STBK	South India and North-eastern	Fair	High
Moringa concanensis	STBK	Throught India upto 1200m	V. Poor (*)	Med
Moringa oleifera	STBK	Billawar (J & K), Dhinodar hill (Gujarat) and Ganjam (Orissa)	Good	V. High
Mucuna pruriens	SD	Throught India upto 1500m	Fair	High
Oroxylum indicum	RT	UP,Bihar, Gangetic Plains	Good	Low
Phoenix dactylifera	FR	Throught India upto 1500m	Poor	Low
Pongamia pinnata	SD	Throught India upto 1200m	Fair	Med
Pterocarpus marsupium	WD	UP, MP, Bihar, Jharkhand and Chattisgarh	Fair	Med
Putranjiva roxburghii	RT, SD	Gujarat, Maharashtra	Fair	Low
Pterocarpus santalinus	WD	Andhra, TN, Eastern Ghats, Dry hills	V. Poor (EN)	High
Rauwolfia serpentina	RT	Throughout India, sub-hill regions	Fair (*)	High
Santalum album	Heartwood	Mysore (Karnataka), Andhra Pradesh and Tamil Nadu	V. Poor (*)	V. High
Sapindus laurifolius	FR	Gujarat, Madhya Pradesh	Fair	Low
Semecarpus anacardium	FR	Tamil Nadu, Gujarat, Kerala	Fair	Low
Shorea robusta	GM	Madhya Pradesh, Gujarat	V. Poor	High
Sterculia urens	GM	Andhra, Maharashtra and Gujarat	Good	Med
Sterospermum personatum	RT, BK	Throught India upto 1500m	Good	Low
Strychnos potatorum	SD	Throught India upto 1000m	Rare	Low
Syzygium cumini	SD	Karnataka, Bihar, Gujarat and Madhya Pradesh	Good	V. High
Tamarindus indica	FR	Karnataka, Tamil Nadu, Gujarat and Andhra Pradesh	Good	Med
Tecomella undulata	STBK	West Rajasthan, Gujarat and Maharashtra	Poor (VU)	Med
Tectona grandis	STBK, FR	Central and Southern India	Good	High
Terminalia arjuna	STBK	Throught India upto 1000m	Good	Med
Terminalia bellirica	STFR	Throught India upto 600m	Good	Med
Terminalia chebula	FR	HP, UA, UP, Jharkhand and MP upto 800m	Good	V. high
Tinospora cordifolia	ST	Throught India upto 800m	Good (*)	V. high
Thespesia populnea	STBK	Coasts of Indian Peninsula and in mangrove swamps	Fair	Low
Vitex negundo	LS/FR	Throught India upto 1000m	Good	High
Woodfordia fruticosa	FL	Throughout India, foothills upto 1500m	Good	High
Wrightia tomentosa	SD	Throughout India, upto 1000m	Fair	Mar
Zanthoxylum armatum	FR	J&K, HP, UA, Upto 800-1300m	Poor (VU)	Med

Abbreviations and legends to tables 01 to 05.
Vegetative parts used: RT- Root; BK- bark; RTBK- root bark; ST- stem; STBK- stem bark, LF- leaf; FL- flower; FR- fruit; SD- seed; GM- gum,oleoresin; WP- whole plant; HB- herb (aerial parts).
Resources: Good- No decline foreseen; Fair- May decline if there is increase in current rate of collection; Poor- Already declining; V. Poor- Declining sharply and may exhaust shortly; Rare- Almost exhausted in the wild; (*)- Declined in wild but progressively cultivated.
Threat categories (IUCN): CR- Critically Endangered; EN- Endangered; VU- Vulnerable.
Demand (in Drug & Pharmaceutical and export industry): Mar (Marginal)- less than 100 MT per annum (P.a.); Low- between 100 to 500 MT P.a. ; Med (Medium)- 500 to 2500 MT P.a.; High- 2500-5000 MT P.a.; V. High (Very High)- above 5000 MT P.a.

Table 2: Medicinal Plants growing as weed or under run wild conditions in secondary forest scrub, fallow agricultural land, orchards, organic dumps, along rail track or roads, in and around stagnant water bodies and other waste places

Name of the plants	**Part used**	**Main area of natural occurrence**	**Resources**	**Demand**
1	2	3	4	5
Abution indicum	WH, SD	Throughout Indian plains	Good	Med
Acalypha indica	WP	Throughout Indian plains	Good	Mar
Achyranthus aspera	WP	Throughout Indian plains	Good	Low
Andrographis paniculata	HB	UP, Bihar, W. Bengal, Gangetic plains	Fair (VU) (*)	High
Boerhavia diffusa	RT	Throughout India, asending to 1000m	Good	High
Calotropis gigantea	RTBK	West Rajasthan, Gujarat & South India	Poor	Mar
Cassia occidentalis	SD	Throught India upto 1200m	Good	Med
Cassia tora	SD	Throught India upto 1200m	Good	Med
Curculigo orchioides	RT	Throughout India, under mango groves	Fair (VU)	High
Cyperus rotundus	Tuber	Throught India upto 1200m	Good	High
Datura strantonium	LS/SD	W. Himalayas, Southern hills upto 1500m	Good	Med
Eclipta prostrata	WP	Throughout India, moist & marshy loc.	good	High
Justicia adhatoda	LF, WP	Throught India upto 1800m	Fair	Low
Gymnema sylvestre	RT/LS	Andhra, TN & Kerala upto 1000m	Fair	Med
Lepidium sativum	SD	Throughout India,often cultivated	Good	Low
Mimosa pudica	SD	Northern & Central Himalayan foothills	Fair	Mar
Ocimum basilicum	HB	Throught India upto 1200m	Fair	Med
Ocimum canum	SD	Throught India upto 1000m	Good	High
Phyllanthus amarus	HB	Peninsular & South India, plains	Good	High
Psoralea crylifolia	SD	UP, Bihar, Chattisgarh, plains	Fair (*)	High
Solanum surattense	WP/RT	Throught Indian plains	Good	High
Sphaeranthus indieus	FL	Bihar, Jharkhand, Chattisgarh, plains	Fair	Low
Tephrosia purpurea	WP	Northern & Western plains	Good	Low

Table 3: Plants cultivated as avenue trees, embankment stabilizers, hedges or ornamentals in parks and gardens and yielding herbal raw materials

Plant	Part	Areas where cultivated	Demand
Abution indicum	SD	Throughout India as flowering herb	High
Acacia nilotica	STBK/GM	North, West & Central India on embankments	High
Aegle marmelos	RT/FR	Throughout India, around temples & villages	High
Alstonia scholaris	STBK	Throughout India as avenue tree	Mar
Annona squomosa	LF, SD	Throughout India as flowering herb	Med
Azadirachta indica	LS/STBK/SD	Throughout India as avenue tree	High

Cassia fistula	FR (pulp)	Throughout India as avenue tree	High
Cassia occidentalis	LF, SD	Throughout India	Med
Catharanthus roseus	HB/RT	Throughout India as flowering herb	V. High
Clitorea ternatea	FL/FR	Southern & Eastern India as flowering shrub	Mar
Clerodendron serratum	RT	Throughout India as flowering herb	Med
Clerodendron multiflorum	RT, LF	Throughout India as flowering herb	High
Commiphora wightii	GM	Throughout India	V. High
Euphoebia nerifolia	WP	Throughout India as flowering herb	Low
Gmelina arborea	RT	Throughout India as avenue tree	Med
Helicteres isora	FR	Throughout India as flowering tree	Low
Holarrhena antidysenterica	BK, SD	Throughout India as flowering tree	Low
Lawsonia alba	LF, SD	Throughout India as flowering herb	High
Moringa oleifera	FR/SD	Throughout India as avenue tree	Med
Nyctanthes arbortristis	LS,FL	Throughout India as flowering tree	Low
Saraca india	STBK	TN, Karnataka & Kerala as flowering tree	High
Syzygium cumini	SD	Throughout India as avenue tree	High
Terminalia arjuna	LS, STBK	Throughout India as avenue tree	High
Thespesia populnea	FL, FR	As flowering tree in Indian gardens	Low
Vitex negundo	LF	Gujarat, Madhya Pradesh, Karnaatakaa	Low
Woodfordia fruticosa	FL	West Bengal, Gujarat	Low
Xeromphis spinosa	FR	Andhra Pradesh, Western India	Low
Zizyphus spp.	RT	Hotter parts of northern and peninsular india	Med

Table 4: Plants grown as agricultural, horticultural or industrial or industrial crops and also yielding important herbal raw materials

Plant	Crop	Medical part	Demand
Allium sativa	Garlic (Lahsun)	Bulb/Oil	V. High
Amorphophalus campanulatus	Sooran	Corm	Mar
Anethum sowa	Indian Dill (Sowa)	Seed, Seed oil	V. High
Carica papaya	Papaya (Papita)	Latex (Pepain)	V. High
Cocos nucifera	Coconut (Narial)	Kernel,Oil	High
Curcuma longa	Turmeric (Haldi)	Root	High
Foeniculum vulgare	Fennel (Saunf)	Fruit	Med
Lawsonia inermis	Mehndi (Henna)	Leaf	High
Memordica charantia	Karela	Leaf, Seed	Low
Ricinus communis	Eranda (Castor)	Root/Oil	Med
Sesamum indicum	Sesamum (Til)	Seed/Oil	High
Trichosanthes dioica	Patol, Parval	Leaf/Fruit	Low
Trigonella foenum-graceum	Fenugreek (Methi)	Seed	Low
Zingiber officinalis	Ginger (Sonth)	Rhizome	V. High

Table 5: Plants cultivated exclusively as medicinal crop

Plant	Part used	Areas where cultivated	Demand
Alpiania galanga	Rhizomes	Bhuj (Gujarat)	Med
Aloe vera	LF (Juice)	Coastal areas of Saurashtra (Gujarat)	V. High
Asparagus racemosus	RT	Anand (Gujarat)	Med
Brassica nigra	SD	Waghai (Gujarat)	High
Chlorophytum boriwilianum	RT	Waghai (Gujarat)	V. High
Cichorium intybus	SD	Amreli (Gujarat)	Low
Citrus medica	FR	Valsad (Gujarat)	V. High
Curcuma zedearia	Rhizomes	Amreli, Mesana (Gujarat)	Med
Cymbopogon martinii	WP	Anand (Gujarat)	High
Dioscorea floribunda	RH	Dang (Gujarat)	High

Eucalyputus spp.	LF, Oil	South Gujarat	V. High
Gloriosa superba	RT/SD	Dang (Gujarat)	Med
Hibiscus rosasinensis	FL	Surat, Navsari (Gujarat)	High
Mentha viridis	WP	Bhavnagar (Gujarat)	V. High
Momordica charantia	FR	North and Central Gujarat	Med
Nerium indicum	RT	Junagadh (Gujarat)	Med
Piper longum	FR, RT	Surat, Navsari (Gujarat)	V. High
Rauwolfia serpentina	RH	Navsari, Bhavnagar (Gujarat)	Low
Ricinus communis	RT, LF	Surendranagar (Gujarat)	Med
Trapa bispinosa	FR	Bharuch, Kheda (Gujarat)	Low
Trichosanthus dioica	WP	Banaskantha (Gujarat)	Low
Withania somnifera	RT	Ratanmahal (Gujarat)	High
Zingiber officinalis	HB	Navsari, Bhavnagar (Gujarat)	V. High

CONCLUSION

The observations made in the foregoing discussion indicate that through there are problems facing the medicinal plant raw material resource in Gujarat; there is enough scope for its development to meet the requirements of Drug and Pharmaceutical Industry. Concerted multi-disciplinary efforts are required to execute large scale production of materials from both wild and cultivated sources. The augmentation and supplies of raw materials obtained from the plants growing in forests, specially those originated from trees and shrubs, may better be left with the foresters who may undertaken in-situ conservation, restocking and forestation with desirable species. Medicinal and aromatic plants play a very important role in the life support systems and well being of mankind. In Dang forest division there is an over-exploitation of forest area specially the medicinal aromatic plant species and a large number of species are endangered due to a combination of over-harvesting and habitat destruction. MAP's are being overused and degraded due to lack of local control over the resources, social and cultural traditions. However, with the increase in population and associated poverty in the present area, people are compelled to over harvest resources for commercial purpose and also for their traditional use. Research and development studies on domestication of wild plants and introduction on certain exotics have been going on at a number of governments, non-government and academic agencies since long but the success in large scale cultivation could be obtained in only a few cases. There appears to be a lack of coordination among various workers and between organizations engaged in the development of medicinal plant resources as also between these and the farmer who is the ultimate agency to undertake the job and deliver the goods.

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Summary

Gujarat has on floral diversity, 2205 species of angiospermic plants belonging to 905 genera of 156 families have been recorded so far. Out of 2205 plant species, 748 plants were identified as medicinally important. The number of plant species yielding raw materials used by the industry on regular basis and/or in substantially large quantities is put at around 143. Among these, 77 occur wild in forests or other forms of natural vegetation, 23 grow as weed, 42 are grown as cash crop for other plant based products and 22 are cultivated as medicinal crop. There has been a tremendous increase in the production of herbal medicines and other items in recent years. This paper makes an appraisal of present status of raw material resources and discusses prospects of its development. Effects have been made to highlight the problems encountered for necessary constraints and conservation need to medicinal plants in Gujarat state.

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