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Scope of Medicinal and Aromatic Plants farming in Eastern India

Dr. K.M.Singh[1]

Introduction

The use of plants as medicine is older than recorded history. As mute witness to this fact marshmallow root, hyacinth, and yarrow have been found carefully tucked around the bones of a Stone Age man in Iraq. In 2735 B.C., the Chinese emperor Shen Nong wrote an authoritative treatise on herbs that is still in use today. Shen Nong recommended the use of Ma Huang (known as ephedra in the Western world), for example, against respiratory distress. Ephedrine, extracted from ephedra, is widely used as a decongestant. We find it in its synthetic form, pseudoephedrine, in many allergy, sinus, and cold-relief medications produced by large pharmaceutical companies.

Medicinal Plants and Human Health

South Asia is home to many rich, traditional systems of medicine (TSM). Ayurvedic system dates back to 5000 B.C. Along with the Unani, Siddha and Tibetan systems, these TSMs remain important source of everyday health and livelihood for tens of millions of people. Himalayan sage-scholars of Traditional Medicine have said "*Nanaushadhi Bhootam Jagat Kinchit"* i.e. `*there is no plant in the world, which does not have medicinal properties*.' The ancient scholars are estimated to know the medicinal properties of hundreds of species of plants. It is therefore, no exaggeration to say that the uses of plants for human health are probably as old as human beings themselves. Even so, the recent dramatic increase in sales of herbal products in global markets underscores the growing popularity of herbal therapies.

While this has created new opportunities for the countries, their largely impoverished populace and traditional herbal industry, it also poses unprecedented threats to the very resources on which the industry is dependent besides creating socioeconomic imbalances and erosion of spiritual and cultural heritage and knowledge systems. Medicinal and aromatic plants (MAPs), including trees, shrubs, grasses and vines, are a central resource for these traditional health systems, as well as for pharmaceutical (or allopathic) medicines. There are more than 8,000 plant species in South Asia with known medicinal uses.

Medicinal plants are accessible, affordable and culturally appropriate sources of primary health care for more than 80% of Asia's population (WHO). Poor and marginalized, who cannot afford or access formal health care systems, are especially dependent on these *culturally familiar*, *technically simple*, *financially affordable* and *generally effective* traditional medicines. As such, there is widespread interest in promoting traditional health systems to meet primary health care needs. This is especially true in South Asia, as prices of modern medicines spiral and governments find it increasingly difficult to meet the cost of pharmaceutical-based health care.

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Table 1: Distribution of medicinal plants

Country or region	Total number of native species in flora	No of medicinal plant species reported	% of medicinal plants	Source
World	297000	52885	10	Schippmann et al. 2002
India	17000	7500	44	Shiva 1996
Indian Himalayas	8000	1748	22	Samant et al. 1998

Medicinal plants form the basis of traditional or indigenous systems of health used by the majority of the population of most developing countries. In China, India and many other countries in South and East Asia, traditional systems of medicine use thousands of plant species to treat malaria, stomach ulcers, and various other disorders. Throughout the region, there is strong and sustained public support for the protection and promotion of the cultural and spiritual values of traditional medicines.

Herbal Medicine Today

The World Health Organization (WHO) estimates that 4 billion people, 80% of the world population, presently use herbal medicine for some aspect of primary health care. Herbal medicine is a major component in all indigenous peoples' traditional medicine and a common element in Ayurvedic, homeopathic, naturopathic, traditional oriental, and Native American Indian medicine. WHO notes that of 119 plant-derived pharmaceutical medicines, about 74% are used in modern medicine in ways that correlated directly with their traditional uses as plant medicines by native cultures.

Table 2: Status of various herbal based medical systems in India

Characteristics	Medical Systems				
	Ayurveda	Siddha	Unani	Tibetan	Homeopathy
Medicinal plants known	2000	1121	751	337	482
Licensed pharmacies	8533	384	462	-	613
Hospitals	753	276	74	-	223
Dispensaries	15193	444	1193	-	5634
Registered practitioners	438721	17560	43578	-	217460
Under graduate college	219	6	37	-	178
Post graduate college	57	3	8	-	31

Major pharmaceutical companies are currently conducting extensive research on plant materials gathered from the rain forests and other places for their potential medicinal value. In all the countries of South Asia, medicinal and aromatic plants (MAPs) play a significant role in the subsistence economy of the people, especially those living in the rural interiors. The collection, simple processing and trading of medicinal plants contribute significantly to the cash income of the poor and women in these regions. A recent study carried out by CECI-India (Regmi & Bista, 2002), indicated that from a single district of Pithoragarh in Uttranchal state of India, more than 1300 tons of MAPs are collected and traded annually, most of them illegally.

Unsustainable and large scale harvesting of MAPs from the natural habitats without providing equitable benefit to the local people and government is of grave concern to all. Therefore, by sustainably using and growing economically remunerative MAPs, there is an ample scope to maintain both the rural livelihoods and environmental sustainability. MAP-based local micro-enterprises can also bridge the gap between rural poor and relatively well-off urban rich and promote social harmonization and sound environment conservation.

Constraints and Opportunities in Cultivation:
Some of the practical applications integrating medicinal plants into traditional farming systems have taken an obligate relationship in backstopping upland agriculture or mixed farming. South Asian states have a rich and diverse traditions of practicing complex and rotational farming systems that includes herbal plants cultivation (Maikhuri, 2002) and therefore, conservation and *ex-situ* cultivation of medicinal plants especially applying organic farming protocols has a great scope especially to access international markets.

Other important opportunity and advantage of cultivating MAPs include ease of their incorporation in the existing cropping systems due to availability of a large number of species and choice of plant types i.e., trees, shrubs, forbs, vines and their suitability to grown in different eco-physical conditions. To sum up, wild stock management and cultivation of carefully selected species as a mixed, inter or companion crop in agro and farm forestry conditions is feasible and needs to be pursued. However, in order to ensure a good input and service delivery system including marketing cultivation may need to be carried out in selected pockets in an intensive manner.

What are medicinal plants?
A considerable number of definitions have been proposed for the term 'medicinal plant'. According to the World Health Organization, "a medicinal plant is any plant which, in one or more of its organs, contains substances that can be used for therapeutic purposes, or which are precursors for chemo-pharmaceutical semi synthesis".

This definition allows for a distinction between the already known medicinal plants whose therapeutic properties or character as a precursor of certain molecules have been established scientifically, and other plants used in traditional medicines and regarded medicinal, but which have not yet been subjected to thorough scientific study.

Plants for Health
Today's healthcare systems rely largely on plant material. Much of the world's population depends on traditional medicine to meet daily health requirements, especially within developing countries. Use of plant-based remedies is also widespread in many industrialized countries and numerous pharmaceuticals are based on or derived from plant compounds. Similarly, cosmetics and other household products may contain plants of medicinal or therapeutic value.

The pharmaceutical industry is both large and highly successful. Sales of plant derived drugs are expected to reach $30 billion worldwide in 2002. At present about 50% of the total plant-derived drug sales come from single entities, while the remaining 50% come from herbal remedies. Although the latter have greater volumes of consumption, the relatively low volumes of single entities, which are mostly prescription products, are more than compensated by their higher prices. Single entity plant drugs, which mostly treat serious medical ills, include atropine, digoxin, morphine, paclitaxel, pilocarpine, reserpine, scopolamine, topotecan and vincristine, among many others. Several of the compounds have outlived their usefulness in light of better alternatives,

however, and are exhibiting decline in sales. On the other hand, as a consequence of new drug developments, single entities overall are projected to increase their market share of the combined total future dollar sales.

The Eastern Region

The Eastern Region of India comprising of eastern UP, Bihar, Jharkhand, West Bengal, Assam, Orissa, and Chhattisgarh has a large number of valuable medicinal plants naturally growing mostly in fragile ecosystems that are predominantly inhabited by rural poor and indigenous communities. The sustainable management of these traditionally used plants not only help conserve nationally and globally important biodiversity but also provide critical resources to sustain livelihoods. In North Bihar plains and forests, for example, we find in abundance, a diverse range of herbs, shrubs, trees and vines that have significant medicinal value whose healing properties are known to the local healers and traditional doctors for centuries but are currently threatened due to lack of concerted conservation efforts, e.g. value of medicinal raw materials annually exported from Nepal to India and other countries is estimated between 18 to 20 million dollar (Kanel 2000). The Eastern Region could also benefit from the recent interest of the Western world in MAP grown in these areas bordering Nepal and earn a lot more than what Nepal earns by taking advantage of the liberal trade regime which has opened newer markets for our products post-WTO and also the renewed interest of the farmers towards this very lucrative sector.

The eastern region of the country, recognized as a 'low productivity high potential' region needs holistic management of land, water, crops, biomass, horticultural, livestock, fishery and human resources. The region, though endowed with rich natural resources has lacked in capitalizing on these resources. Though, it has a rich resource base for intensive and diversified agriculture, still, declining per capita land and water availability, reduced diversion of water for agriculture to meet the food requirement of burgeoning population coupled with degrading land and water resources are a serious challenge towards improving productivity and sustainability in this Region.

There is an urgent need to identify suitable crops and develop high yielding, disease and pest resistant, location-specific varieties of important, cereals, oilseed, pulses, fruits, vegetables and medicinal and aromatic plants to meet the global competition. (ICAR-RCER, Vision 2025,)

General Features of the Eastern Region

The eastern region comprising of eastern UP, Bihar, Jharkhand, West Bengal, Assam, Orissa, and Chhattisgarh occupies about 22.5 per cent of the country's geographical area and is inhabited by about 35 per cent of the country's population (Fig. 1). The region can be divided into 3 distinct physiographical units, namely (i) Plains of eastern UP, Bihar, West Bengal, and Assam; (ii) Hilly and plateau regions in eastern UP, Bihar, Jharkhand, West Bengal, Orissa, Chattisgarh, and Assam; and (iii) Coastal plains of West Bengal and Orissa.

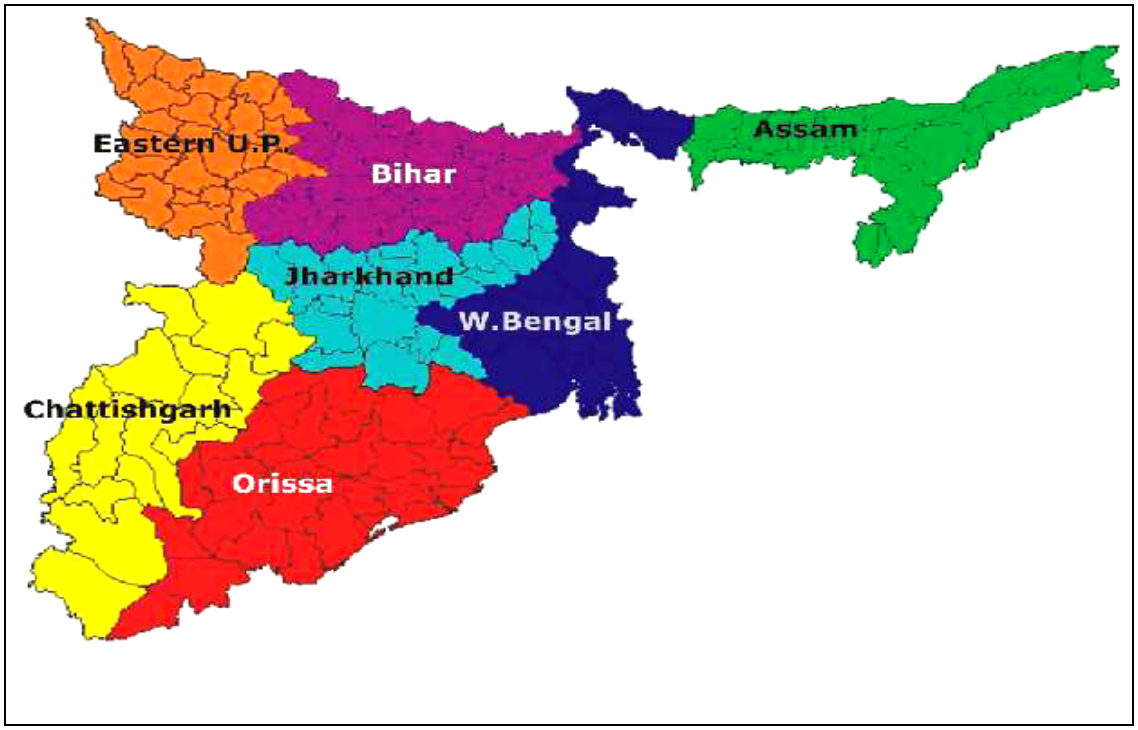

Fig-1: Spread of Eastern Region

The climate of the region is tropical, hot and humid except in hilly areas with high rainfall. The average annual rainfall varies from 1025-2820 mm. Even though the region has rich rain, surface and ground water resources, they are grossly underutilized, with the result that a large proportion of the cultivated area does not receive any irrigation water. The farmers depend on the vagaries of the monsoon for crop production. Owing to poor utilization of water resources, the cropping intensity in the region is low. Perennial and seasonal water bodies abound in this region but their potential has not been exploited. These provide a great scope for development of medicinal crops like sarpagandha, buch, shatawari, musli, etc and aromatic crops like mint (mentha), lemongrass, java citronella, palmarosa, jama rosa, tulsi etc . The eastern region has specific advantages as well as handicaps.

Though, eastern region is endowed with natural resources but, so far its potential could not be harnessed in terms of improving agricultural productivity, poverty alleviation and livelihood improvement.

Why Should the Eastern Region go the Herbal Way?

Social Perspective

Use of medicinal plants in primary health care and nutrition needs is traditional and imbedded in all cultures. No major problems of acceptability regarding familiarity with the usage of plant products, methods of cultivation of many commonly grown plants and technologies required for processing into items of common household uses and value. Med-plants have also been used to develop family-based health and livelihood oriented enterprises in rural areas. Medicinal and Aromatic Plants help in: a) Preserving the traditional medical knowledge, b) Provide easily adaptable enterprising opportunities for unemployed youth and rural poor who can learn the trade from their parents and peers and earn not only their livelihood but also contribute to the society.

Protection of Traditional Knowledge

The urgency and need to protect the fast disappearing medicinal plants-based traditional knowledge, which is still abundant in Eastern Region, cannot be overemphasized. If proper values can be added to the traditional medical knowledge-based health practices and subsistence-oriented MAP applications, a large number of jobs can be created in the rural areas. Even at current level of conversion of traditional medicinal knowledge into economic opportunities, enterprise-based application can account for thousands of jobs in rural areas of the Eastern Region. Thus, med-plants have high potential in creating jobs and pushing economic growth in resource-constrained areas suffering from limited educational opportunities, lack of infrastructure, and underdeveloped med-plants-based trade and commercial activities. The conversion of socio-cultural traditions and indigenous knowledge into livelihood means and economic opportunities also has the advantage of preserving the rapidly eroding cultural knowledge and practices which are increasingly threatened due to globalization and homogenization of people and communities.

Environmental Perspective

The growing apathy toward products made from chemical products becoming ethically unacceptable. This has created new markets for quality, certified and organic herbal products.
Medicinal plants have the potential to fill these needs as they provide green health alternatives and a number of other eco-friendly products of domestic and industrial usage. Found as trees, shrubs, grasses and vines, these plant species abundantly growing in the plains of eastern region. Its entry into the world food and drug market as the environment friendly botanical products is looked upon as an emerging and new opportunity. The development of medicinal plants-based economic incentives is being increasingly applied to enlist greater participation of people in conservation of forest ecosystem.

Potential of Equitable Commercialization

The MAP sub-sector has immense potential as the sustainable commercialization can benefit farmers and industry both by providing higher price and by opening up national and global markets for new products from the region. Private sectors stand to benefit by ensuring sustainable supply of quality raw materials to benefit their industry and trade if they can be facilitated to build partnerships with farmers. Many of the species are shade tolerant and others are climbers, trees, shrubs and herbs that can be grown in different configurations of crop geometry.

Trade and Enterprise Development

The demand for medicinal and aromatic plants in India – to meet both domestic and export market - comprising 162 species, is expected to increase at about 15 to 16% between 2002 and 2005 (CRPA, 2001). Medicinal and aromatic plants cultivation and management therefore, can become highly remunerative both in financial and economic terms for the small-scale growers.

The current gap between demand and supply is estimated to be 40,000 to 200,000 tons, which is expected to rise from 152,000 to 400,000 tons by 2010 (Planning Commission, 2000 & CRPA, 2001). Not only the plants are in increasing demand by major herbal drug industries as an essential raw material of their drugs, but also its collection, production, processing, packaging and transportation requires high labor input, which can create employment in job-starved eastern region of India. Collection from wild and selective harvesting in addition to primary processing is mostly done manually, and even at the secondary and tertiary levels, med-plants have substantial labour requirements. Moreover, not only do MAP-based industries expand jobs, enhancing traditional uses through value added processing can increase cash earnings to the local people.

World Market Trends

The European market for herbal supplements is estimated at over US$ 2.7 billion and for herbal remedies, a further US$ 0.9 billion. Germany is by far the largest market. The market is growing rapidly at over 4% per annum for herbal remedies and considerably faster for herbal supplements. The US herbal market is nearing saturation and is expected to peak at US$ 6-8 billion in the next few years. Demand for medicinal plants is expected to continue to expand rapidly, fuelled by the growth of sales of herbal supplements and remedies. Their basic uses in medicine will continue in the future, as a source of therapeutic agents, and as raw material base for the extraction of semi-synthetic chemical compound such as cosmetics, perfumes and food industries.

Domestication and Cultivation of MAP

Some of the practical applications integrating medicinal and aromatic plants into traditional farming systems have taken an obligate relationship in backstopping upland agriculture. Other important opportunities and advantages of cultivating MAPs include ease of their incorporation in the existing cropping systems due to availability of a large number of species and choice of plant types. Cultivation of carefully selected species as a mixed, inter or companion crop in agro and farm forestry conditions following a soil-improving crop rotation is highly feasible livelihood enhancing activities in Eastern region. However, this will require an improved input and service delivery system including marketing, and post harvest technologies. Cultivation needs to be done on a business platform by a chain of small and micro-enterprise-based groups and individuals. In order to achieve an economy of scale and desired impact, it may need to be concentrated in selected pockets in an intensive manner as cluster of activities and micro-enterprises.

Cultivation of medicinal plants

Information on the propagation of medicinal plants is available for less than 10% and agro-technology is available only for 1% of the total known plants globally. This trend shows that developing agro-technology should be one of the thrust areas for research. Furthermore, in order to meet the escalating demand of medicinal plants, farming of these plant species is imperative. Apart from meeting the present demand, farming may conserve the wild genetic diversity of medicinal plants. Farming permits the production of uniform material, from which standardized products can be consistently obtained.

Cultivation also permits better species identification, improved quality control, and increased prospects for genetic improvements. Selection of planting material for large-scale farming is also an important task. The planting material therefore should be of good quality, rich in active ingredients, pest- and disease-resistant and environmental tolerant. For the large scale farming, one has to find out whether monoculture is the right way to cultivate all medicinal plants or one has to promote poly-culture model for better production of medicinal plants.

Studies conducted on the agro-forestry of medicinal plants elsewhere suggest that since many medicinal plant species prefer to grow under forest cover, agro-forestry offers a convenient strategy for their cultivation as well as conservation through:

1. Integrating shade tolerant medicinal plants as lower strata species in multi-strata system,
2. Cultivating short cycle medicinal plants as intercrops in existing stands of tree crops,
3. Growing medicinal tree as shade providers and boundary markers, and
4. Inter-planting medicinal plants with food crops.

Notwithstanding, it is understood that the cultivation of medicinal plants is not an easy task as the history of medicinal plants farming reflects. Many farmers in trans-Himalayan region of northern India have replaced the medicinal plants farming with common crops [i.e., peas (*Pisum sativum*), and potatoes (*Solanum tuberosum*)] due to the lengthy cultivation cycle of medicinal plants. The cost of many medicinal plants in northern India is lower than many seasonal vegetables, which is a cause of scanty farming of medicinal plants. Attempts should however, be made by different organizations to cultivate various medicinal plant species, including rare and endangered categories.

Agro-technology for about 20 species of rare and endangered medicinal plants of the northern India has been developed by different organizations. However, the per hectare cost of cultivation, total annual production and cost benefit ratio fluctuate with different medicinal plant species. At present, however, the farming of most of the medicinal plant species is being operated on a very small scale and is restricted to a few hectares of land in various states of eastern India. There is also a market uncertainty, fear about lower prices and lack of knowledge about the necessary pre and post harvest processes, and needs for obtaining permits from government agencies for cultivation of medicinal plants.

Additionally, many farmers are unaware about the agency responsible for issuing permits. If the farmers are not granted permits needed to cultivate, they are forced to sell their products on the illegal market, which exposes them to action by government agencies and the exploitation by middlemen.

Opportunities in developing the medicinal plants sector

For developing the 'herbal industries', the eastern India possesses a rich diversity of medicinal plant species across the various forest types along an altitudinal gradient (as discussed in the use and diversity of medicinal plants). Such a high diversity of medicinal plants would be helpful for further scientific research on exploring their medical efficacy, value addition, and use in curing various old and new diseases.

India has already established a reputation as a low-cost manufacturer of high quality generic drugs in the global market. This fact can be used as an important tool for the marketing of herbal products produced in India. It is expected that India's aim to build a golden triangle between traditional medicine, modern medicine, and modern science will be a boon for developing the traditional herbal medicine and the medicinal plants sector.

Existing policies

The way forward

The Forest Departments of the eastern states will have to identify two major areas in each Forest Division; namely the conservation area and the developmental area. The conservation areas will be selected based on their rich medicinal plants diversity and marked for *in-situ* conservation and complete protection in the concerned Forest Division. In the developmental areas, apart from protection of the existing bio-resources, the medicinal plant species of the neighboring areas will also be introduced and cultivated at a large scale. The remaining areas in the Forest Division will remain open for sustainable harvesting of the medicinal plant species. A Joint Harvesting Team, composed of medicinal plants experts, Forest Department officials and some selected local people, will be constituted, which will decide the extent of annual harvesting of the desired medicinal plant species.

The various policies at national and state level and their subsequent implementation will provide an opportunity in the advancement of medicinal plants sector. This model of conservation and cultivation of the medicinal plants may be useful for generating the raw material for the 'Herbal Industries' as well as for ensuring the conservation of the rare medicinal plants.

Institutional support

In India, many government and non-government organizations have had the focused attention on improving the medicinal plants sector. Opportunities for funding have been created to assist the person who is willing to work and to build capacity of the medicinal plants sector. According to the mandate of NMPB, the projects may be submitted for funding within two major schemes: *viz.*, a promotional scheme and a commercial scheme. The major thrust areas within the promotional scheme are:

1. survey and inventory of medicinal plants,
2. *in-situ* conservation and *ex-situ* cultivation of selected medicinal plants,
3. production of quality planting material,
4. diffusion of knowledge through education and communication,
5. promotion of global and domestic market system, and
6. Strengthening research, development and man power.

Within the commercial scheme, the major thrust areas are:

1. bulk production of medicinal plants and ensuring supply of quality planting material,
2. expansion of selected medicinal plants farming areas,
3. Value addition in harvesting, processing and marketing of medicinal plants, and 4) developing innovative marketing mechanism.

Table- 3: Major institutions involved in funding projects to the medicinal plants research in India

Institutions	**Funding for major areas in medicinal plants research**
National Medicinal Plants Board, NMPB	Survey, documentation, cultivation, marketing, conservation
Department of Science & Technology, DST	Taxonomy, ecology, pathology, survey, propagation, documentation, cultivation, conservation
Council for Scientific & Industrial Research, CSIR	Ecology, taxonomy, biochemistry, survey, documentation, cultivation, genetics, agro-technology, conservation
Indian Council of Medical Research, ICMR	Breeding, value addition
All India Council for Technical Education, AICTE	Management technology
Department of Biotechnology, DBT	Agro-technology, molecular biology, biochemistry, rural bio-technology
Defense Research & Development Organization, DRDO	Agro-technology, survey, documentation, conservation
Indian Council of Agricultural Research, ICAR	Breeding, pathology, molecular biology, training the growers
Ministry of Environment & Forest, MoEF	Survey, documentation, conservation, management, ecological impact assessment, cultivation
National Bank for Agriculture and	Cultivation, marketing

Rural Development, NABARD	
University Grant Commission, UGC	Ecology, biochemistry, survey, documentation
Herbal Research and Development Institute, HRDI	Survey, documentation, nursery development
G.B. Pant Institute of Himalayan Environment & Development, GBPIHED	Survey, documentation, cultivation, conservation

Stake holder's participation

Local communities, especially weaker and marginalized groups or ethnic minorities need to be involved in planning, designing, development and implementation of the research activities and learning studies in the project. The NGOs and GOs should consult and work with community-based organizations and engage them into participatory process to involve collectors, producers and traders including ultimate users, women and disadvantaged groups in project implementation. In each of the selected villages or communities, stakeholder represented CBO, NGO or PRI should implement and/or supervise the execution of projects. Their involvement from the very beginning of the project development process is expected to enhance people's participation in the project and provide benefit to a wide range of users.

Marketing Perspective

In order to understand the complex market and marketing related issues, market-related information, scooping of problems & opportunities, successful case studies with `good practice' tag need to be surveyed and studied to develop a marketable product portfolio. The tool proposed is value-chain or Production-to-Consumption & Marketing (PC&M) model. The outcome of these studies can be useful to plan equitable commercialisation, identify potential small & micro enterprises, and assess available raw material resources and product mix.

The Efforts so far:

The efforts by different agencies, to promote the MAPs in this region can be summarized in the following manner:

- Assessment of Local Conditions and Requirements:
- Assessing the Demand for Medicinal and Aromatic crops
- Training and Capacity Building
- Role of Supporting Individuals and Institutions
- Development of Relevant Literature in Local language
- Emphasis on Group Approach
- Organizing the Growers
- Cultivation through the Organized Sector and linking the unorganized farmers
- Pricing Mechanism and Buy Back Arrangement with partner industry

Aromatic Plants suitable for cultivation in Eastern Region

- Lemon grass (Cymbopogon fleuosus)
- Palma rosa (Cymbopogon martinii)
- Java citronella (Cymbopogon winterianus)
- Mentha (Mentha arvensis)
- Tulsi (Ocimum basilicum)
- Vetiver (Vetiveria zizanioides)

- Geranium
- Patchouli
- CN-5
- Jama rosa

Table -4: Few medicinal plants found locally in Eastern India and their industrial products

Name of plants	Industrial Products
Sarpagandha (Rauvlofia serpentina)	Ajmaline
Nayantora (Catharanthus roseus), Sarpagandha	Ajmalicine
Bishalyakarani (Atropa belladonna); Dhatura (Datura stramonium)	Atropine
Chahgoch (Camellia sinensis)	Caffeine
Javacitronala or Ganbirina (Cymbopogon winterianus)	Citronellal
Javacitronala or Ganbirina	Citronellol
Agnisikha or Uluchandan (Gloriosa superba)	Colchicine
Haldhi (Curcuma longa)	Cucurmin
Javacitronala	Dimethyloctane
Dalchini, Tejapat etc. (Cinnamomum spp.)	Eugenol
Geranium (Pelargonium graveolens)	Geraniol
Bishyalakarani	Hyoscyamine
Bandar kekoa (Mucuna prurita)	L-Dopa
Podina (Mentha citrata)	Linalool
Podina	Linalyl acetate
Pani tengeshi (Marselia minuta)	Marsilin
Podina (Mentha spp.)	Menthol
Omita (Carica papaya)	Papain
Sarpagandha	Rescinnamine
Sarpagandha	Reserpine
Mekuri Kendu (Strychnos nux-vomica)	Strychnine
Chahgoch	Theobromine
Chahgoch	Theophylline
Birina (Vetiveria zizanioides)	Vetiverol
Birina	Vetiveryl acetate
Sadabahar or Periwinkle (Chtharanthus roseus)	Vinblastin
Sadabahar or Periwinkle	Vinristine

Source: http://assamagribusiness.nic.in/agriclinics/Entrepreneurship%20dev.%20through%20medicinal.pdf

Table-5: Medicinal Plants Commercially Suitable for cultivation in Eastern Region

Botanical name	Common name	Parts used	Nature of demand	Gestation period	Cultivation location	Demand as in 2004-05 (MT)
Andrographis paniculata	Kalmegh	Whole	Both, Dom/Exp	Short	Region wide	2197.3
Asparagus racemosus	Shatawari	Roots	Both, Dom/Exp	Short	Region wide	16658.5
Bacopa monnieri	Brahmi	Entire plant and leaves	Both, Dom/Exp	Short	Region wide	6621.8
Boehaavia diffusa	Punarnava	Stem	Both, Dom/Exp	Short	Region wide	3373.2
Centella asiatica	Brahmi	Whole	Both, Dom/Exp	Short	Region wide	134.5
Chlorophytum arundinaceum/ boerivillianum	Safed musli	Bulbs/ tuberous roots	Both, Dom/Exp	Short	Region wide	NA
Gloriosa superba	Shankhpushpi	Roots	Export	Short	Region wide	100.5
Glycyrrhiza glabra	Liquorice or Jethi madhu	Roots	Both, Dom/Exp	Short	Region wide	1359.8
Gymnema sylvestre	Madhunashini	Leaves, roots	Both, Dom/Exp	Short	Region wide	80.70t
Piper longum	Pippali	Fruits	Both, Dom/Exp	Short	Region wide	6280.4
Phyllanthus amarus/ P. niruri	Bhoomi amla	Roots	Both, Dom/Exp	Short	Region wide	2985.3
Rauwolfia serpentina	Sarpagandha	roots	Export	Short	Region wide	588.7
Tinospora cordifolia	Giloe	Roots, stem and leaves	Export	Short	Region wide	2932.6
Withania somnifera	Ashwagandha	Dried roots	Both, Dom/Exp	Short	Region wide	9127.5

Source: https://idl-bnc.idrc.ca/dspace/bitstream/123456789/27286/9/g-120936.pdf

Bio-Partnership to link Rural Communities with Industry

Links established with growers, traders, processors and consumers at different levels in a value-chain or production-to-consumption system framework. Equitable Bio-partnership arrangements between processing and marketing; health-care companies and community-based organizations developed to ensure dependable markets for the producers and quality supply for the industry.

Industries have shown interest in direct collaboration with producer groups/associations and many are committed to a fair and ethical commercialisation.

Table-6: List of some important Indian pharma Companies relevant to herbal Products

S. No	Indian Pharma Companies Diversified/ Marketing herbal product
1	Albert David Ltd.
2	Alembic Chemical Works Co. Ltd.
3	Biological E. Ltd.
4	Cadila Healthcare Pvt. Ltd.
5	Cadila Pharmaceuticals Ltd.
6	Cipla Ltd.
7	Concept Pharmaceuticals Ltd.
8	Croslands
9	Dabur pharmaceutical Ltd.
10	Deepharma Ltd.
11	Dey's Medical Stores (Mfg.) ltd.
12	Dr. Reddy's Lab.
13	East India pharmaceuticals Ltd.
14	Elders Pharma
15	Franco-Indian Pharmaceuticals Ltd.
16	Gufic Ltd.
17	J. B. Chemicals Pharmaceuticals Ltd.
18	Lupin Laboratories Ltd.
19	Lyka Labs. Ltd.
20	Merind Ltd.
21	Parke-Davis (India) Ltd.
22	Rallies India Ltd.
23	Ranbaxy Labopratories Ltd.
24	Themis (Phytomedica)
25	TTK Pharma Pvt. Ltd.
26	Wockhardt Ltd.

Response from the Farmers and the Government

Presently with support of ATMA, Patna and many other such agencies, more than about 2500 acres of land has been brought under the cultivation of MAPs in Bihar state alone. The number of farmers and area under these crops is likely to increase in future as a large number of farmers are attracted towards this sector in this region. Several civil society organizations have started working for promotion of this sector in this region, and the governments have also understood the need and importance of this sector and serious efforts are now being made to not only start their cultivation but also provide adequate financial support through commercial banks, provide quality planting material to the growers and provide market linkages, so that the growers are able to reap the benefits. Some Growers Associations are quite active in promoting cultivation of medicinal plants for enhancing livelihoods.

Recommendations for developing the medicinal and aromatic plants sector

The present worldwide interest in plant-based medicines of Indian origin needs to be harnessed by reframing a clear policy for the promotion of commercial cultivation, research and development, and for the increase in exports of medicinal plants. For the development of the medicinal plant sector, there is a need to develop the coordinated efforts at each stage (e.g. research, cultivation, collection, storage, processing, manufacturing and marketing), which would be supported by an appropriate policy framework. Some problems and their remedies for the medicinal plants-based economic venture identified are given in Table below.

Table-7: Assessment of problems and remedies for medicinal plant based economic venture in the Eastern India

Activity	Problems	Possible remedy
Cultural system	Adoption of traditional medicinal knowledge on preparing herbal medical formulations is declining through generations.	Incentives should be given to the traditional herbal healers for preparation of herbal formulations, and attempts should be made to organize them.
	Traditional knowledge on many less known medicinal plant species has declined rapidly.	Documentation of such less known medicinal plant species should be made without any further delay.
Collection	Continued illegal collection from wild has led to depletion of many important species.	Enforcement of existing Acts (e.g. Wildlife Protection Act, Forest Act, Biodiversity Act etc.).
	Mostly collected and processed by un-trained persons.	Training should be given for collection and processing.
	Competition for over-stocking has led to over-harvesting.	Large-scale farming of medicinal plants should be promoted.
Cultivation	Agro-technology is not available for many valuable medicinal plant species. Development of agro-technology is mainly focused on the low productive and high cost rare and endangered medicinal plant species.	Development of agro-technology and promotion of rural bio-technology for large scale cultivation of economically important species also. Farmers should be encouraged by providing incentives, training and awareness on the latest developments and policies related to the medicinal plants. Selection of planting material for cultivation should be based on their habitats, locality, climate and elevations.
	High risk in farming, long gestation period, and low prices of medicinal plants discourage farmers to cultivate medicinal plants.	Introduction of mixed cropping system to reduce the risk
	Issuing license or permit to farmers for growing medicinal plants is a time consuming process, and farmers are sometime not aware of the process.	Process of issuing permits for cultivation of medicinal plants should be made easier and faster.

	Small and scattered land holdings of the farmers, and cultivation is restricted to small plots near the farmer's houses.	Restoration of barren lands and allocation of land at one place based on farmer's choice and consensus.
	Unavailability or low availability of irrigation facility	Rain water harvesting and construction of check dams on rivers and rivulets for irrigation purposes
	Lacking of linkages among different stakeholders.	Development of capacity building programs for all stakeholders.
Role of Biotechnology	Low success rate in developing planting materials.	Need of in-depth research to enhance the rate of success.
	Low yield unable to meet the commercial needs.	Development of high yielding varieties.
Marketing	The supply chain of medicinal plants is quite large and primary producers are dependent on the middlemen and still they face difficulty in selling the product.	Direct selling to industry by producers should be encouraged. Buy-back arrangements between farmers and pharmaceutical companies might be useful.
	Improper sharing of benefits due to lack of awareness among farmers and herb collectors on the real prices of medicinal plant.	Need of diffusion of information by distribution of pamphlets and conducting awareness programs on various aspects of medicinal plants.
	Lacking of well-planned marketing infrastructure for medicinal plants.	Development of infrastructure with the help of various stakeholders including medicinal plants board.
Bio-prospecting	Low awareness on the values of resources and traditional knowledge.	Documentation of traditional knowledge on medicinal plants and their uses.
	The younger generations of herbal practitioners are not keen to adopt the tradition as a profession.	Renew the available herbal formulations by standardizing their efficacy, and to establish a Social Capital Trust for herbal practitioners in order to promote the tradition.
	Unequal distribution of profits to the low profile stakeholders such as farmers and herb gatherers.	Sharing of benefits should be on the basis of labor and efforts.
Conservation	Essential health commodity and maximum dependency on wild stock.	Setting up medicinal plants conservation areas.
	Encroachment by outsiders and illegal collection from wild.	Enforcement of Forest and Wildlife Protection (Acts).

Conclusions

Selection of medicinal plant species for cultivation is an initial important step for the development of the medicinal plants sector. Economic feasibility is the major rationale for a decision to bring medicinal plant species into cultivation. Apart from the priority species selected by the Planning Commission and the NMPB, the rare species banned for collection from the wild should also be taken on a priority basis for cultivation because a majority of such species are very expensive, have high demand and low supply.

Cultivation may not be economical if a medicinal plant species is abundant in the wild and easily collected. Therefore, the less abundant species in the wild should be promoted for the large-scale cultivation. Farming of any medicinal plant species should be brought into practice only after the reliable cultivation technology of the concerned species is available. A large variation in climatic and soil conditions in eastern India sustain a variety of medicinal plant species, which may be cultivated according to their niche. For developing the medicinal plants sector, there is an urgent 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.

The medicinal plants sector can be improved if the agricultural support agencies would come forward to help strengthen the medicinal plants growers and if research institutions would help the plant growers by improving their basic knowledge about cultivation practices. 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.

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.

On many occasions, the collection of planting material, especially of rare and endangered medicinal plant species from natural habitats for various experimental purposes by researchers, also poses a threat on their natural populations in wild. The researchers must be aware on the germination potential, seedlings and rhizomes survival strategies of the desired species collected from wild for scientific experiments. Researchers must plant a similar number of individuals back in nature after completion of research work on the collected species. There is also a communication problem between researchers and farmers.

This communication problem limits a researcher's capability to deal with the farmers' problems. Hence, communication links between researchers, extension services of institutions, and farmers should be strengthened.

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