

Indian march from forestry and agrobased traditional knowledge to industry based pharma industry

Lokendra Singh* and Preeti Vats

Department of Botany, Meerut College, Meerut - 250 004 (U.P.) India

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Agroforestry was born as a branch of forestry in 1960 at FRI, Dehradun to optimize production and economic returns per unit area in lieu of sustainable development besides meeting the social, cultural, religious, spiritual needs of human beings and maintain ecological equilibrium of the biome. Along with social forestry, farm forestry, organic farming and herbal gardens, agroforestry is also the answer to the good and technique based raw materials to the Pharma industry and alternative therapies such as Ayurvedic, Unani, Sidha, Homeopathy and Tibetan traditional system to meet the needs of domestic medicinal markets and as an export earner.

Key words: Traditional knowledge, Agroforestry, Medicinal wealth, Pharma industry.

INTRODUCTION

AS megabiodiversity centre of the world, India is a hotspot for a variety of forests having 8 distinct floristic regions and 16 main natural formations with several subtypes (Aren, 2002). Despite a forest policy which dates back to 1894, rising human and cattle population, deforestation, forest fires, denudation, shifting cultivation, commercial exploitation of flora and biopiracy, placed forests under constant pressure, necessitating comprehensive and holistic forest policy with priorities of efficient and sound forest management, conservation and sustainability which was framed as NFP by the government of India in 1952 and approved by MEF in 1988 and recommended the need based and time bound programme of afforestation and strip planting of trees along roadside, canal-side, railway track, urban and industrial areas along with development of village and community lands and encouraging agroforestry and farm forestry for increasing productivity & tree cover area (Tiwari, 1991) hand in hand the renaissance of the traditional herbal medicine (Wealth of India, NISCAIR's 15 Volume Publication from 1987-1996). Recent traditional knowledge based ethnobotany has made quantum jump from social forestry, agroforestry, herbal forestry to pharma industry deriving new drugs from plants by Micropropagation, Meristem culture, Somatic embryogenesis, Somaclonal variation, Andro and Gynogenesis, Protoplast fusion, Somatic hybridization, Clonal propagation, Provenance trials, Metabolic engineering, Tissue banking, Genetic engineering and Component labeling for heavy metals and pesticides of raw drug materials (Mathur, 2005; Arya *et al.*, 1993; Singh *et al.*, 1994; Soni *et al.*, 2000; Singh and Vats, 2006). Application of GIS on human health environment especially in relation to epidemiology and vector borne diseases is also important aspect of the subject under reference (Pandey, Tiwari and Sadhana, 2005). Scope of remote sensing and GIS in forestry and ecology has been emphasized by Kushwaha (2005) and utility of PCR method for biodiversity and biosystematic studies in plants using DNA profiling method, RAPD, ISSR and DAMD in genetic diversity assessment cannot be overstated (Ranade, 2005; Singh & Raychoudhury, 2005).

Agroforestry and its scope in people welfare:

In 1985, National Waste Lands Development Board (NWDB) was set up for afforestation through people's participation. The 8th (1992-1997) and 9th (1997-2001) five year plans of forestry laid

main thrust on "Biodiversity conservation (BDC) and Joint Forest Management (JFM)" aimed at benefiting both the local people as well as country at large. Along with Social Forestry, Urban Forestry, Farm Forestry was launched in the late 1970 with the main focus on planting trees by government on village lands and uncultivated lands (BISR, 1986; Chaturvedi, 1979; FAO, 1988; Bhattcharya, 1990; Tiwari, 1991; Saxena, 1996) to improve the biological productivity and economic return of the same piece of land. This type of forestry includes Peripheral planting on field boundaries and Block plantation along with usual agricultural practices including herbal gardening.

The Agroforestry in India was initiated in 1960 by FRI, Dehradun and State Forest Departments chiefly to develop potential technologies in areas like Shifting cultivation, Taungya system and Agri-silvi culture and Tree farming.

JFM is the latest concept in forestry (Mukherji, 1994; Shahbaz, 1998) where people are directly involved in the production and management of forest and forest products along with the government officials (Status report on JFM in U.P. by Government Forest Department; Anon, 1993).

Social forestry or sharing in took off in 1976 after the national commission on agriculture recommended intensive planting programmes (Banerjee & Mishra, 1994; Guha, 1990; Mukherji, 1994).

Agroforestry/Farm forestry/ Taungya system thus, is a part of a social forestry to meet needs of a society vis-a vis fuel, fodder, small timber, fruits, wind breakers, herbal medicines, water erosion, environmental conservation and materials for cottage industry. Agri-silvi culture is a system, which involves the use of lands for the production of forest crop and agriculture crops while Silvi-pastoral system is a land management system in which forests are managed for the production of wood and rearing of domestic animals and are part of social forestry therefore.

In Uttar Pradesh, the Agroforestry system has been adopted on a fair scale covering an average area of about 10,000 to 12,000 ha/annum. Two practices in vogue under the system are raising Sal by Taungya system in forest divisions of Gorakhpur and Gaunda. The second is to auction the lease for raising agricultural crop between the trees in lines in the large scale of mechanized plantations of Eucalyptus, Popular etc. raised by the State Forest Department being followed in Haldwani, Tarai, Bhabar and Ramnagar etc. (Guha, 1990). DFO, Meerut in addition, is trying to take steps towards social forestry and establishment of herbal gardens under agroforestry programme in Hastinapur Forest Range.

Renaissance of traditional knowledge and phytotherapy

*Based on a lecture delivered before the forest personnel at Hastinapur

* Author for Correspondence

through alternative health care systems:

Spurt in the interest in traditional knowledge about herbal drugs was initiated because of the diversity, accessibility, affordability, preventive as well as curative properties of plants and their products in Ayurvedic, Unani, Sidha, Homeopathic or Tibetan traditional system of Indian alternative therapies, which are looking east if not by compass than in concept and took off from ethnobotany to agrobased industries and pharma industries and have successfully used to treat stress related, anxiety related, psychosomatic, post-traumatic, digestion related, radiation related, toxicity related, disability related and infection related disorders (Janmeda, 2005; Singh and Vats, 2006) calling for public sensitization on the biodiversity, *in-situ* and *ex-situ* conservation of endangered plants, utility of medicinal plants, cultivation of medicinal plants by farmers and foresters, setting up of National and State Medicinal Plant Board, market managements at domestic and international levels, development of R & D infrastructure, IPR of plant products, germplasm preservation and multiplication and component labeling for heavy metal and pesticide requirements, ensuring sustainable future not only of 565 Indian tribal communities, 227 ethnic groups and 5000 forested villages of Indian forests but of local agricultural farmers too (Trivedi and Sharma, 2004).

Ethnobotany and Medicinal Plants:

Ethnobotanical studies and its various prospects have been dealt with by Trivedi and Nargas (2000) and an overview on Ethnobotany has been written by Trivedi (2002). Ethnomedicinal plants, their utilization and conservation have been dealt with by Trivedi and Sharma (2004), Trivedi (2004), Bhattacharjee and De (2005) and Janmeda (2005), while Indian probing for a healthier and sustainable future concerning ethnobotanical and related modern prospects have been adequately touched upon by Singh and Vats (2006) wherein Status of Ethnobotany in various Indian States, Major Indian contributions of medicinal plants and Herbal cure in the treatment of major diseases etc. have been dealt by the last authors. In an International conference on Medicinal plants and Ayurveda held on 6th December, 2002, following issues were raised by the chairman of UTTAN:

1. Policy and legal issues for the development of Ayurveda and medicinal plants
2. Development of Medicinal plants sector
3. Ayurvedic drugs development and product standardization
4. Globalization of Ayurvedic and Medicinal plant sector.

Consequently, National Medicinal Plant Board was found to coordinate, administer and give technical advice by a government resolution notified on 24th Nov., 2000. NMBP has since been opened 25 SMPBs in 21 States and 4 Union Territories for this purpose. Of the total angiospermic plants, 7500 are medicinal (Trivedi, 2004) and they mostly belong to Asteraceae, Euphorbiaceae, Lamiaceae, Fabaceae, Rubiaceae, Acanthaceae, Rosaceae and Apiaceae (Rawat and Uniyal, 2003).

Utility wise certain interesting plant groups comprise the following:

1. There are certain plants which can be recommended for soldiers at high altitudes suffering from Acute mountain sickness, Pulmonary oedema, Cerebral oedema and Retinopathy. Such plants include Golden root, Seabuckthorn etc.
2. For the elevation of Blood Pressure and Hypertension, plants like Beet roots, Beans, Cabbage, Carrots, Cauliflower, Onions, Pepper and Arjuna and Herbal tea may be recommended.
3. Herbal antifertility agents like Phytoestrogens, Saponins and Resins and Gonatotropin inhibitors may be used. Neem and

Gurhal are common plants for the purpose (Ansari and Joshi, 2004).

4. Certain plant products are endowed with radio-protective properties. These include Liv. 52, Brahmasayana and Churn like Kayam and Abana etc.
5. Some plants have cosmetic and dietary properties. Amla is rich in Vit. C while Aloe is rich in oxidants like Vit. A, C and E and used in almost every cosmetic product.
6. Sweet Stevia is recommended for patients of Diabetes.
7. Wonder Ausadhi of Ayurveda are many of which some examples shall not be out of place: Guggul is divya ausadhi; Neem is versatile pesticide; Safed Musli is remunerative medicinal crop; Turmeric is antiseptic with antioxidative properties; Black pepper is king of spices; Aswagandha is useful in diseases and promotes health and longevity; Tulsi is helpful in cold and cough; Sarpagandha is used for uterine contraction, expulsion of foetus and treats worms and intestinal disorders (Singh and Vats, 2006).
8. Plants are also helpful in the removal of oxidative stress. Such plants are *Withania*, *Ocimum*, *Mentha*, *Cassia*, etc. (Goyal, 2004).

Domestic and Global market of plant materials in alternative systems of health care:

Indian systems of medicinal market in India including Ayurveda, Unani, Sidha, Homeopathy and Tibetan medicines are estimated upto 4,205 crores per year. In global market India's share is about 0.5%. The quantity (kg) of medicinal plants export in 2001 was 47,477,464 kg whose value in rupees were 3,15,77,40,878. According to WHO, EXIM bank of India, in its report has reported the value of medicinal plant related trade in India of the order of 5.5 billion dollars and is growing rapidly.

Herbal Drug Delivery Systems And Pharmacopoeial Status:

Liposomal and Phytosomal are the delivery systems, which are used. The former is water-soluble and forms complexes with phosphatidylcholine while the latter forms phospholipid complexes with flavanoids, terpenoids and saponins. The second one is preferred because it provides enhanced bioavailability, faster delivery good entrapment and absorption in the intestinal tract (Jain *et al.*, 2005).

Government of India has set up Pharmacopoeial committees for alternative health care systems. Ayurveda has 634 formulations involving 500 medicinal plants; Central Council of Unani Medicines involves 100 medicinal plants and the Sidha Pharmacopoeial committees have standards of 910 drugs.

Documentation Of Traditional Knowledge And Main Medicinal Research Centres:

Documentation work has recently been taken up in Kerala, Karnataka, Bangalore, Tehri Garhwal and we now have a digital library for the purpose. Sam Pitroda is Chairman to look into these aspects (Singh and Vats, 2006).

CSIR with 38 labs is party to the global Research Alliance and the four main units working on herbal medicines are located at Lucknow (U.P.). These are CDRI, CIMAP, NBRI and ITRC. CDRI has Pharmacology, Toxicology, Pharmacokinetics and Drug delivery systems as main departments and Dr. C.M. Gupta is the Director of the Institute. At CIMAP, extracting of Phytochemicals from plants is done and the thrust area is being Agro-biotech chemical sciences. Dr. S.P.S. Khanuja is the Director of the Institute. NBRI aims at self-reliance in food, nutrition and primary health care. It has traditional knowledge digital library and Dr. P. Pushpangadan is the Director of the Institute. ITRC, monitors toxic challenges in India and develops Pharmacopoeial standards for Ayurvedic drugs. For the common people the Institute has Electronic Information Database.

Threats To Biodiversity, Conservation Policy, Measures and Strategies for Conservation:

Constant threats to rich biodiversity amongst many reasons were caused by (1) unscientific exploration of plants (2) commercial overexploitation (3) environmental degradation (4) increase in user population (5) intensive cultivation (6) genetically modified organisms forcing BSI and ICAR to record endangered, vulnerable, threatened and rare plants using remote sensing techniques (Red Data Books; Nayar and Sastry, 1990; Chaudhuri and Sarkar, 2004) and some 42 plants are already listed as endangered ones. Therefore, there is a priority based need for exploration, collection, maintenance, evaluation, cultivation, domestication and introduction of plant genetic resources (germplasm) or exchange of PGR through NBPGR per CBD (1993) and WTO (1995) provisions (Mukherjee, 2004; Jakhar *et al.*, 2004).

To conserve plants in their natural habitats we have 140 Botanical Gardens, Sacred Grooves, Biosphere Reserves, Sanctuaries and Natural Parks, while for *in-situ* conservation, Gene banks, Pollen banks, Seed banks, DNA libraries, Provenance trials of plant materials, Plant tissue culture repositories and Cryo-preservation (Arya, Toki, Tomar, Singh and Harris, 1993; Singh, Tomar and Arya, 1994; Soni, Singh, and Toky, 2000; Mashelkar, 2001; Singh, 2004; Malik, 2004) are used.

To conserve PGR, we have 8 government departments and 40 NAGS (National Active Germplasm Structures): (1) DAC (Department of Agriculture and Co-operation) (2) DARE (Department of Agriculture Research and Education) (3) DOE & F (Department of Environment and Forestry) (4) DOC (Department of Commerce) (5) Ministry of Health and Family welfare (6) Ministry of Textiles (7) CSIR (Council and Scientific and Industrial Research) (8) Department of Biotechnology and NGOs (Varalakshmi and Kaul, 1999). Besides, Social Forestry is also important tool for environmental conservation (Tewari, 1983; Tiwari, 1991).

According to Dr. Mangla Rai (D.G., ICAR) following measures have been taken towards making India a developed nation through sustainability efforts.

1. Over 2.5 lakh germplasm stored in the National Gene Bank for posterity.
2. Shifting cultivation banned.
3. Large capacity, evaporatively cooled storage structures developed for enhancing shelf life for herbal products.
4. To manage pests and diseases, diagnostics developed.

Thrust Areas:

Organic farming using vermi-compost and cow dung compost, Social forestry, Agroforestry, Herbal Gardening, Contract Research and manufacturing, Clinical Research, IPR, Bioinformatics are the areas which need our immediate attention. All these require trained forest personnel for which purpose FRI, Dehradun, Tropical Forest Research Institute, Jabalpur, Arid Forest Research Institute, Jodhpur, Himalayan Forest Research Institute, Shimla, Institute of Forest Productivity, Ranchi, Institute of Forest Genetics, Coimbatore, Rain Forest Research Institute, Jorhat and Centre for Social Forestry at Allahabad are recommended.

Plants Recommended For Herbal Gardening In India:

Purohit and Prajapati (2003) and Kumar (2004) recommend following plants for countrywide herbal gardening:

1. *Aconitum ferox* (Vatsnabha)
2. *Aconitum heterophyllum* (Atees)
3. *Acorus calamus* (Bach)
4. *Aegle marmelos* (Bael)
5. *Aloe barbadensis* (Ghrat Kumari)
6. *Andrographis paniculata* (Kalamegh)

7. *Asparagus* (Satawar)
8. *Bacopa monari* (Brahmi)
9. *Berberis aristata*
10. *Cassa augustifolia* (Senna)
11. *Catharanthus roseus* (Sadabahar)
12. *Chlorophytum arundinaceum* (Safed Musli)
13. *Citronella* sp. (Citronella)
14. *Coleus barbeters* (Palterchur)
15. *Commiphora wightii*
16. *Crocus sativus* (Kesar)
17. *Curcuma amada* (Amahaldi)
18. *Cymbopogon pendulus* (Lemon grass)
19. *Embelia ribes* (Valvidang)
20. *Embllica officinalis* (Amla)
21. *Garcinia indica* (Kokun)
22. *Glycyrrhiza glabra* (Mullati)
23. *Gloriosa superba* (Kali Hari)
24. *Jatropha curcas* (Ratan Jyot)
25. *Matricaria chamomilla* (Babuna)
26. *Mentha arvensis* (Mentha)
27. *Nardostachys jatamansi* (Jatamansi)
28. *Ocimum sanctum* (Tulsi)
29. *Piper nigrum* (Pepper)
30. *Plantago ovata* (Isabgol)
31. *Plargonium graveolense* (Geranium)
32. *Pueroria tuberosa* (Vidarikand)
33. *Rauwolfia serpentina* (Sarpagandha)
34. *Santalum album* (Chandan)
35. *Saraca asoca* (Ashok)
36. *Solanum nigrum* (Makoy)
37. *Swertia chirata*
38. *Tagetus minuta* (Gainda)
39. *Tinospora cordifolia*
40. *Withania somnifera* (Aswagandha)

Agroforestry and cultivation of Medicinal Crops at Commercial Level:

Upadhyaya, Kumar and Srivastava (2003) have recommended plants for water logged soils (*Acorus calamus*, *Bacopa monari*), usar land (*Azadirachta indica*, *Eucalyptus microtheca*, *Jatropha curcas*), waste land (*Rosa demicina*, *Withania somnifera*, *Aloe* sp., *Symbopogon pendulus*), and gardens (*Curcuma amada*, *C. domestica*, *Andrographis paniculata*, *Plantago ovata*, *Gloriosa superba*) while for Ultranchal *Plargonium graveolense* is suitable. Sushila Tiwari Herbal Garden at Bhadrakali already houses medicinal plants. Likewise *Pepperis* recommended for South India.

Due to the leadership of DFO, Meerut, Agroforestry and Herbal cultivation plans are in the offing in this part of the state. List of suitable plants comprises *Chlorophytum arundinaceum* (Safed Musli), *Withania somnifera* (Aswagandha), *Andrographis paniculata* (Kalamegh), *Aloe barbadensis* (Ghrat Kumari), *Gloriosa superba* (Kali Hari), *Acorus calamus* (Bach), *Bacopa monari* (Brahmi), *Asparagus racemosus* (Satawar), *Curcuma amada* (Amahaldi), *C. domestica* (Haldi), *Pueroria tuberosa* (Vidarikand), *Catharanthus roseus* (Sadabahar), *Tagetus minuta* (Gainda), *Citronella winteriana* (Citronella), *Ocimum sanctum* (Tulsi), *Cymbopogon pendulus* (Lemon grass), *Embllica officinalis* (Amla) and *Jatropha curcas* (Ratan Jyot).

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