Conservation of Natural Resources in Medicinal ,Aromatic and Dye Crops

G.Pratibha
Senior Scientist(Agron.)
CRIDA, Hyderabad-59

The rainfed regions are characterized by erratic and ill distribution of rainfall, low fertility, high temperature, fast blowing dry winds, rapid percolation of water and higher transpiration rate as a result the vegetation is very poor and this causes soil erosion. .(Rock storm *etal* 2003). Moreover the population explosion has extended arable farming to the marginal lands, which has led to their further degradation and farming on such lands is is leading to falling factor productivity and profitability of dryland crops and this has widened the socio-economic gap between rainfed and irrigated systems. Hence to increase the productivity and profitability of the farmers there is an urgent need to improve the rain water productivity by utilizing the dwindling water resources efficiently This can be achieved by including some drought resistant, efficient water utilizing high value crops like medicinal aromatic and dye crops in to the drylands production systems, soil and water conservation. Soil moisture stress during reproductive phase is the most important limiting factor. Diversification with high value crops like medicinal and aromatic plants (MAPs), which do not have critical stages, or reproductive stages help in increasing the water productivity and provide stability to rainfed agriculture. Moreover the water stress may have positive reactions in improving the quality of the crops through biosynthesis of secondary metabolites and this secondary metabolites may improve the drought resistance to plants. Therefore the quality of this crops is enriched under dryland conditions. Preliminary studies at CRIDA proved these assumptions (Pratibha and Korwar 2002). Hence cultivation of MAPs have become a highly desirable proportion for realising higher water productivity and can replace the existing uneconomical arable crops and also play vital role in sustained environmental restoration of degraded lands and provide livelihoods for the poor farmers. In India, it is estimated that the collection and processing of medicinal plants contributes to at least 35 million workdays of employment per annum (Karki, 2002). The different alternate high value crops that can be cultivated in rainfed regions are medicinal, aromatic and dye crops.The article describes MAPDS conservation, and the role of MAPDs in natural resource conservation.

.

Conservation of bio diversity

Natural products such as crude drugs bio molecules of pharmaceutical importance from plants gained global significance and are utilized in many commercial industries like pharma, flavor, fragrance textile and food industry. The present global value of medicinal plants trade has been put at over USD 80.0 billion per year and is growing at an approximate rate of 7% per year with an expected growth to USD 5.0 trillion by the year 2050. (Rajeshwar Rao and Rajput 2005). According to the World Health Organization, over 80% of the world's population, or 4.3 billion people, rely upon such traditional plant-based systems of medicine to provide them with primary health care. The task force on medicinal plants recognized that the pharma industry is the only industry, which is showing a constant growth of 15 % and more after software Industry. This burgeoning need for medicinal plant in both developing and developed countries due to growing recognition of natural products, as they are non-narcotic, having no side-effects, easily available at affordable prices and sometime the only source of health care available to the poor. Also, modern pharmacopoeia still contain at least 25% drugs derived from plants and many others which are synthetic analogues built on prototype compounds isolated from plants. (Tewari 2000) Medicinal plants have the potential to fill these needs as they provide healthy alternatives. Hence they have become major sector of

trade and commerce. In India 90 percent of the demand is met through wild sources. 70 % of the plant collections involve destructive harvesting. The market and community demand has been so great that there is a great risk that many medicinal plants today, face either extinction or loss of genetic assortment. In certain situation it demands a serious legislation about wild collection. As a precautionary step the Directorate General of Foreign Trade has therefore banned the export of 46 such plants, which are on the verge of extinction. Moreover the MAPDs have been ignored altogether and as a result this sector is facing problems such as:

- Depletion of the existing stock and presently most of the plants are found scattered in the distant areas.
- Threat of genetic erosion due to indiscriminate exploitation by the collectors.
- Quality deterioration.
- Few species are reported endanger to be extinct.
- Development of the technology of propagation and regeneration of medicinal plants in their natural habitat
- Conservation of this natural resource
- The eco-system in which they are growing has intrinsic association with environmental values in conserving soil, water and providing a habitat for other species.

It is important to develop strategies, which not only ensure steady supply of quality raw material but also reduce the pressure on natural medicinal herbs resources. Hence there is immense scope for cultivation in India.

Cultivation of Medicinal Herbs

In India , cultivation of medicinal plants is very intermittent. Defiantly the medicinal plants are not alternative to food crops. However, based on their importance in health care, precious natural resources and economic value in trade, efforts are needed to promote them for cultivation as minor crops. This will help to reduce heavy burden on forest resources, and can be exported and earn foreign exchange. From agronomic point of view, there are sufficient opportunities to cultivate medicinal plants in various agro-ecological zones of India. However, it is important to mention that agronomic suitability is only meaningful if the chemical and pharmaceutical properties are acceptable as per requirements of the end users and market. Regarding promotion of cultivation of medicinal herbs and spices a few of the suggestions may be given as follows

Cultivation on rainfed lands

These crops are non conventional in nature and compete with food crops hence it is not possible to produce them on fertile irrigated lands. So marginal rainfed lands where profitable returns are not possible from agricultural crops could be successfully utilized for the cultivation of this high value crops Systematic cultivation of medicinal plants in rainfed regions is a possible way for sustained supply of the raw materials. Mere 5-10 % increase in area under rainfed conditions would definitely help to achieve the targeted growth rate, sustained production and quality. Origin, Soil, climate, age, agrotechniques and post harvest handling t cause perceptible variations in yield, and quality (content & composition of the final produce.

In certain crops the use of physical inputs (irrigation, fertilizers, and growth chemicals) have optimized the active ingredient significantly. Pareek and Gupta (1993) suggested that psyllium, senna, periwinkle, asgand, lemongrass, palmarosa, vetiver, indigo, mesta, henna can be grown over low fertility soil in dry and warmer tracts in the country. Solanum, basil, annato, safflower are profitable to grow over medium fertile soils using moderate inputs.

The forests in the region being of the dry deciduous nature is home to a wide variety of medicinal plants like *Chlorophyton borivilianum* (safed musli*), Gloriosa superba* (kalihari*),*

Costus speciosus (Keokand*), Asparagus racemosus* (shatawari*)* etc all of which hold immense market value.

Studies at CRIDA suggested that in rainfed areas low water-requiring aromatic grasses like lemongrass, palmarosa etc , medicinal plants like senna , andrographis , dye plants like Henna, Indigo ,etc., can be successfully grown. Where groundwater is available supplemental irrigation allows cultivation of high-value medicinal plants such as *Coleus forskolii, Andrographis paniculata, Cassisa angustifolia, and Withinia sominifera* . These crops can be processed in a decentralized manner in villages and value added products can then be marketed. The medicinal, aromatic and dye crops are likely to ensure better returns due to better utilization of land and rainfall. Further planting these crops may minimize the risk of crop failure due to biotic and abiotic factors.

The drought tolerance of these crops helped in cultivation of these crops economically in drylands. The cultivation of these plants help in conserving water and forest resources. They serve as alternatives to traditional crops and help in crop diversification in semi-arid regions.

Only efforts are needed to educate the farmers about the medicinal value and harvesting techniques of such plant for their efficient utilisation and economic importance for medicine value.

Cultivation as inter-cropping in various cropping systems

The area available for agriculture is limited and the demand for food production has been increasing considerably, replacement of traditional crops with the alternative crops may be unsustainable in the large context. Therefore it is necessary to explore the possibilities of growing these crops in areas where traditional agriculture is uneconomical. Alternatively these crops may be incorporated with traditional crops in efficient cropping systems. Various medicinal plants, keeping in view their growth habits can be inter-cropped in orchards , forests and with major crops. When grown as intercrops They may also control soil erosion and nutrient loss. Tropical soils in general and red soils in particular are medium to low in available plant nutrients for growth of the crops.

Land use efficiencies can be increased substantially by incorporating food legumes as intercrops. Experiments conducted at CRIDA revealed that cultivation of Ashwagandha with green gram is proved to be more profitable than compared to sunflower and sesamum. It is also observed that planting of any alternate high value crop with green gram is more remunerative. Maheswari etal (1995) has found that intercropping of pigeonpea in palmarosa increased profitability. Experiments at CRIDA also has revealed that intercropping of green gram with bixa is more profitable than sole bixa. Senna also can be intercropped with green gram, black gram and gingelly.

Cultivation as Trees

The deciduous nature medicinal plants require more than 10 to 15 years for harvesting and economic returns. Depending on suitability of their growth habits such plants may be planted on separate lands, on slops of hillsides, banks of canals and watercourses.

Management of weeds as medicinal value crop

In almost all the cropping systems and agro-ecological zones of India weeds are quoted as a big factor causing yield disadvantage to farmers. To eradicate these weeds, herbicides use have been promoted which cost very high and are not environment friendly. To manage these weeds in a useful way, as a first step it is important to explore and research medicinal value of the weeds of that particular system. Then there is need develop agro technologies to keep

these weeds as a secondary crop. Information of the marketing and education of farmers about the medicinal and economic value of these weeds as secondary crop are the other important factors in this regard. The farmers can earn an additional income by collecting and selling different parts of weeds. It will help reducing chemical pollution due to herbicides and also will provide self-employment opportunity to resource poor people in rural community.

Role of MAPDs in soil and water conservation

Management of water and soil are very important in rainfed regions to sustain the productivity of drylands without much degradation. Medicinal aromatic and dye crops and their wastes can be utilised for conservation of soil and water.

Vetiver has received widespread recognition as being an ideal plant for soil and water conservation as well as environmental protection. This, however, has met with difficulty in promoting vetiver grown as hedgerows for soil and water conservation since the farmers complain that they do not obtain any direct benefit (i.e. cash return) from planting vetiver. However, it is argued that the indirect benefits the farmers could obtain are enormous.

The lacework of root system of vetiver provides a large surface area for colonization by heterotrophic bacteria that degrade organic materials. At the same time, vetiver root system creates a hostile environment for other pathogenic organisms. The roots produced in the wetland can be harvested and used as a source of essential oil for non-fragrance applications, especially as pesticides. If the quantity and quality of oil produced by vetiver plants used in treating wastewater are comparable to conventionally produced oil, the revenues from vetiver production that could be recovered could off set the investment and operating costs of a waste water treatment plant.

Incorporating palmarosa spent material in rainfed palmarosa has contributed substantially to insitu moisture conservation increased the yields of the palmarosa

Palmarosa is tolerant to several moisture stresses. The time of irrigation also significantly influenced the herbage production. However the effect was more apparent under limited water supply of one irrigation per harvest with two or more irrigations there was no significant difference on herb production. If only one irrigation is available irrigating immediately after harvest increase the yield as well as the total oil content. Changes in oil composition as a result of stress has been reported in basil and lemongrass.

Soil fertility

Besides drought another constraint is poor soil fertility. Improved cropping systems involving major crops rely on the use of high rates of chemical fertilizer. The application of this fertilizers continuously leads to multinutrient deficiencies and fertilizer related environmental pollution. To avoid this and reduce cost of cultivation integrated nutrient supply of nutrients to plants through organic and inorganic sources is becoming an increasingly important aspect of environmemtally sound agriculture. Moreover the adverse effect of moisture stress can be minimized by organic amendments. Farm residues are very efficient supplements to supply nutrient as well as conserve moisture. (Ramesh etal., 2005). The aromatic crops produce lot of distilled biomass these can be used economically for many purposes and reduce cost of cultivation they reduce the weed biomass as well as conserve soil moisture.(Prakasha Rao and Puttanna 2000)

A number of studies have shown that organic practices reduce the adverse impact of drought and produce significantly sustainable higher yields than the conventional practices. Moreover the organically grown material is not only readily accepted but fetches higher prices. . Drylands that have advantages of negligible use of synthetic inputs and can be

considered as niche areas for organic medicinal crops farming. Many metabolites have been found to protect plants against viruses, bacteria, and fungi. Several secondary metabolites such as cyanogenic glycosides, glucosinolates, terpenes, saponins, tannins, anthraquinones, and polyacetylenes also act as allelochemicals influencing the growth and development of neighboring plants (Wink 2003). Understanding the activity of these chemicals on crops soil and as pesticides is imperative to optimize the yield and quality of the plants in organic farming. Moreover the consumers require plants with low residue of toxic chemicals. Hence organic cultivation is catching up globally.

The international markets prefer organically grown medicinal crops. Hence the organic cultivation also helps to maintain the productivity and develop ecologically viable, economically sound and sustainable farming systems. The production cost in organic farming is high and an effective way to reduce the expenses on manure is to recycle the farm residues, as manure and botanicals Bio wastes of crops is important material for nutrient recycling. They can be applied as mulch, cover crop, crop rotation, and crop mixture/intercropping systems or under planting in orchard to suppress or control weeds.

Experiences at CRIDA has shown that application of organic fertilizers has influenced the yield and quality differently. It has revealed that different crops responded differently. Application of FYM enhanced the yield and withanoide concentration in Ashwagandha whereas castor cake application increased the yields and quality in senna and andrographis.

In aromatic crops Palmarosa , menthol mint (Patra etal 2000) responded to application of FYM without affecting the quality of these essential oils.

Dye crops like Henna indigo and bixa also responded to organic fertilisers.

Composting of these residues not only reduce the mass and volume by 50 % but also provide material of uniform quality. The compost from biological residues materials of medicinal plants like Ashwagandha and Andrographis was found to have positive influence on quality and yield of crops. Moreover composting also promotes and enhances agro ecosystem health including soil biological activity.

The bixa shells when used in nursery bed the germination and vigour of the seedlings was better. But when the bixa shell was applied to the fields it did not decompose even after one year. Hence this material was tried for decomposition by various methods. It was observed that the shell decomposed faster (20 days) when vermicomposted. Whereas composting of the material took longer time (>5 months). The nutrient content of the vermicompost was better when compared to vermicompost of other wastes.

The indigo is a legume and the nutrient content did not change much even after dye extraction. Hence the material was decomposed to use it as manure. Then the decomposition was faster and it took only 65 days for decomposition.

The nutrient analysis of different materials revealed that, vermicompost had higher nutrients than FYM. Vermicompost had higher P content than in base materials. Indigo vermicompost had higher NPK than other vermicompost.

It was tested on different crops viz., Senna, Indigo, Andrographis and was observed that the yields in this crop increased when compared to inorganic fertilizer and FYM application.

The waste liquor obtained after dye extraction also had nutrients. The micronutrients Cu and Mn are absent in water where as the liquor has these elements. The nutrient content of liquor was higher when compared to the control (water). This can be applied to the crops.

In aromatic crops a large amount of distilled biomass is obtained this can be used as mulch and for many purposes and helps in reducing cost of cultivation. The menthol mint distilled waste and pyrethrum flowers showed significant nitrification inhibitory property which is better than neem cake (Ram etal., 1993).These materials can be used in integrated nutrient management system along with N fertilizers for improving N use efficiency.

All the medicinal plants harbours AM fungi (Venkateshwar Rao etal 2000) and Rao etal., 2001) The yield increase and nutrient uptakewas recorded in palmarosa datura sps with inoculation of glomomosseae (Camprubi etal 1990)

Environment conservation

The medicinal and aromatic plants are in use since time immemorial for variety of uses including pest control. Since plant derived substances are of highly safe to the environment and do not damage the ecosystem, they are gaining importance as components of Integrated Pest Management.

During the last four decades intensive cultivation practices involving use of agro-chemicals to meet the growing food requirement of our population led to a spurt in the incidence of pests and diseases. The crop-pest management started with the introduction of chemical pesticides during the early 19th century with the discovery of DDT & BHC. Later on, introduction of many synthetic insecticides replaced the use of plant derivatives, which were in vogue for a long time in different parts of the world to kill the pests of agriculture, veterinary and public health importance. However many undesirable side effects and hazards from indiscriminate use of synthetic pesticides have surfaced in recent years. These include spread of pests to new areas, secondary pest resurgence, resistance development, and toxicity to non target organisms (Armes, et al, 1992). These problems of the conventional insecticides have led to a reappraisal, and reevaluation of the current insect control strategies.

The essential oils and plant extracts of many medicinal plants exhibit pesticidal and antimicrobial properties.

Future prospects

Future prospects of medicinal plants are bright with the current upsurge in interest in their use for natural drugs and aromas India, endowed with varied edapho climatic conditions coupled with enormous trained manpower has a distinct edge to take advantage of this boom. India can organise the whole chain of cultivation, processing and marketing successfully. However, maintenance of quality standards is important to compete in the international market. This can be achieved by cultivating superior varieties, following good agronomic practices avoiding indiscriminate use of pesticides and fertilisers and internationally accepted methods of processing and handling.

Farmers are generally wary of taking up the cultivation of such non-conventional crops in the absence of some success stories. The processing industry on the other hand will be anxious to procure raw material from nearby at reasonable prices. Contract farming in such cases would be an effective channel wherein the farmer is assured of the price well in advance and the industry is sure about the quality and quantity of the raw material likely to be available. NGOs can demonstrate the practical feasibility and profitability of cultivating such crops involving few progressive farmers. They can also provide linkage between the growers and industry by organizing the collection and marketing of the produces. Few such successful examples will

build confidence among the farmers and encourage them to take up the cultivation of such new crops. With concerted efforts outlined above India can once again emerge as the leader in production and supply of plant based natural products.

The difficult aspect of cultivation is marketing there are high price fluctuations. So the prices may be fixed by these committee. It should also offer financial support. This board should link five other components viz., user industry, growers cooperatives, extension units R&D institutions which might offer a price umbrella to growers monitor export and import issues.

Strategies for promoting cultivation of medicinal herbs

To promote cultivation of medicinal herbs and spices as a good agricultural practice, few of the important points are as follows for the consideration of researchers and policy makers.

- . Provide information regarding medicinal herbs and spices to the farmers and collectors in the form pamphlets in local language and using media such as radio, news-paper and television. The information of this sort should include package of technology as well as marketing demand and price of various MAPDS.
- Agriculture Extension Departments through consultation with the specialists should provide productions guides and appropriate technology to the farmers of their areas.
- . The reputed pharmaceutical, dealers, exporters and manufactures of finished products may help promotion of medicinal herbs and spices through contract growing of these plants and crops.
- . Private and public organisations involved in this sector may join their hands to hold farmer's/collectors conferences and promote community participation through concept of "Herb Associations".
- Some of the companies buying herbs and contract growing also can provide some useful
- Production information and some seed companies who sell large volumes of herb seed may
- Provide technical assistance.

Epilogue

A win win situation can occur when a system research integrate alternate high value crops with germplasm, crop and resource management strategies with a explicit focus on increasing the profitability and take market opportunities and raise the income of the farmers.

References

Pareek,S.K., and Gupta R., 1993 Medicinal and aromatic improve profitibality of cropping systems in India. In glimpses in plant research (.J.W.Govil etal eds)pub Today and tomorrow printers and pub, New Delhi)Vol.11 pp 325-35

Pratibha G., and G.R.Korwar (2002) Crop diversification through medicinal, aromatic and dye yielding plants for sustainability in semi-arid regions Proceedings of First national meet on Medicinal & Aromatic Plants. eds Mathur A.K., S Dwivedi , DD Patra, GD Bagchi, NS Sangwan, A Sharma and SPS Khanuja . CIMAP, Lucknow PP: 129-132.

Prakasha Rao, E.V.S and Puttanna, K. 2000 Role of leaf mulchand FYM in N economy of Java citronella . Proceedings of National seminar on development of soil science Bangalore pp 97

Rajeshwar Rao and B.R Rajput D.K 2005 Organic farming Medicinal and Aromatic plants Extended summaries National seminar on organic farming Current scenario and future trust organized by MOA ICAR and ANGRAU, Hyderabad 41-51

Ramesh P., Mohan Singh an Subba Rao 2005, A. Organic farming :Its relevance to the Indian contexzt Current Science 88(4) 561 –568

Rockstorm, J. Barron. J and Fox P (203) Water productivity in rainfed agriculture : challenge and Opportunities for smallholder farmers in drought prone tropical agro ecosystems. In : J.W. Kijne, R.Baker and D.Molden Editors Water Productivity in Agriculture : Limits and Opportunities for improvement , CABI Publ., CAB International /IWMI, Cambridge MA/Colombo, SriLanka (2003) , pp145-162