

## Economic and Ecological Potential of Medicinal Plant-Based Agroforestry System

Shiwangee<sup>1\*</sup>, Navjot Singh Kaler<sup>2</sup>, KS Pant<sup>3</sup> and Rajesh Uppal<sup>4</sup>

<sup>1,2,3</sup>Department of Silviculture and Agroforestry, College of Horticulture and Forestry, Neri, Hamirpur, Dr Yashwant Singh Parmar University of Horticulture & Forestry, Solan, HP <sup>4</sup>Department of Horticulture and Agroforestry, CSKHPKV, Palampur, HP

Corresponding Author: [shiwangee2001@gmail.com](mailto:shiwangee2001@gmail.com)

### Abstract

Medicinal plants are essential to people's health and well-being. In the past as well as present a lot of people relied on plant-based treatments to treat illnesses in humans, plants and animals. World Health Organization (WHO) estimates that 80 percent of the world's population currently receives basic healthcare from traditional medical systems. This tilt is frequently caused by annoying side effects and a lack of therapeutic benefit in modern medicine. Agroforestry has become a vital land management strategy due to the growing demand for herbal products. It offers a variety of products, including food, fodder, fruit, fiber, pulp and medicinal products, for both trade and consumption. By incorporating Medicinal plants into the agroforestry system, concerns of conservation can be addressed. Promotion of these plant species cultivation seems to be a key tactic for reducing the harvest strain on wild populations. Also, Agroforestry as an integrated land use management system, supports livelihood by providing medicinal plants for consumption along with reduction of environmental degradation and act as a carbon sink.

**Keywords:** Agroforestry, Medicinal plants, Environment, Economic.

### Introduction

Plant-based medicines have been a part of Indian medicine since the Vedic era, as evidenced by the literature of Jivaka, Charaka, and the Ramayana. All ancient civilizations, including those of the Indus Valley, Mesopotamia, and China, relied on medicinal herbs to ensure the health of their human, livestock, and plant populations. Medicinal plants were employed in medicine for rituals and beliefs, as well as for prevention and treatment. Humans relied only on plants to treat illness before the development of modern medicine. The Indian medical systems of "Ayurveda," "Siddha," and "Unani," as well as "Homoeopathy," partially, rely on plant materials or their derivatives to cure human illnesses (Prajapati *et al.* 2003). The contemporary medical system is

expensive and out of reach for people living in rural and isolated places, thus they mainly rely on traditional medicine. For the steadfast belief that they are more successful than contemporary medications for specific chronic diseases, the fact that they lack some of the adverse effects that some modern medications do, or for financial considerations, many industrialized and developing nations turn to traditional medicine. The value of MAP (Medicinal and Aromatic plants) has expanded recently due to its use in the cosmetic and perfume industries, as well as dietary supplements. The demand for MAP is rising as a result of people's global insistence on leading natural lives. This raises some concerns about MAP's existence in the wild. Its cultivation could provide a sustainable supply and aid in conservation of biodiversity. It is important to encourage MAP species cultivation in order to aid in their conservation in the wild. A strong management system needs to be developed in order to maintain soil health, improve livelihood, and produce medicinal plants continuously while halting climate change.

Agroforestry is a brilliant tactic that combines modern technology with centuries-old knowledge. It is an integrated strategy that offers a viable answer by putting animals, crops, and/or trees all on one piece of land. Recognized as a sustainable approach, it balances environmental preservation with agricultural productivity. In order to address the needs of an expanding population, maintain the sustainability of agroecosystems, combat deforestation, prevent soil degradation, and protect biodiversity, this age-old method has sparked new scientific interest. Agroforestry provides environmental benefits like carbon sequestration and climatic resilience together with tangible products like food, lumber, and other non-timber forest items, all of which contribute to livelihood security. Economically speaking, this method of output diversification raises farmer income, which eventually improves both their standard of living and the state of the national economy. Because it offers a variety of ecosystem services, including food, fodder, fuel wood, fruit,

timber, and other non-timber forest products, as well as environmental benefits like watershed protection, carbon sequestration, and mitigation of the adverse effects of climate change, agroforestry is currently being acknowledged as a sustainable land use system.

**Table 1: Different types of medicinal plant-based Agroforestry system**

Agroforestry system	Tree Species	Intercrops
Agri-silvi system	<i>Acacia mangium</i>	<i>Pogostemon cablin</i> (Patchouli)
Agri-silvi system	<i>Pongamia pinnata</i>	<i>Plantago ovata</i> (Isabgol)
Agri-silvi system	<i>Eucalyptus</i>	<i>Withania somnifera</i>
Agri-silvi system	<i>Terminalia chebula</i>	<i>Vigna mungo</i> , Maize
Agri-silvi system	<i>Phyllanthus emblica</i>	<i>Vigna mungo</i> , maize, soybean
Horti-agri system	<i>Cocos nucifera</i> , <i>Psidium guajava</i> , <i>Prunus persica</i>	<i>Aloe indica</i> , <i>Asparagus racemosus</i> , <i>Kaempferia angustifolia</i>
Horti-agri system	<i>Litchi chinensis</i> , <i>Mangifera indica</i>	<i>Zingiber officinale</i> , <i>Curcuma longa</i> , <i>Asparagus officinalis</i>
Horti-agri system	<i>Manilkara acharas</i>	<i>Ocimum sanctum</i> , <i>Andrographis paniculata</i> , <i>Mentha arvensis</i>
Agri-silvi system	<i>Jatropha curcas</i>	<i>Ocimum sanctum</i> , <i>Andrographis paniculata</i> , <i>Mentha arvensis</i>

### Medicinal plant-based Agroforestry system

Agroforestry systems centered around medicinal plants can yield a variety of goods for trade and consumption, including food, fodder, fruit, fiber, pulp, and medicinal plants, along with this these systems can conserve biodiversity by lessening the strain on natural resources. Medicinal plants thrive in an agroforestry system in two ways. As **overstorey tree** in which trees may benefit from the inputs and management given to the intercrops or as **intercrop**

under the canopy of taller trees in which intercrops generate income for farmers when the main trees have not started production

### Economic potential of Medicinal Plant based Agroforestry system:

Integration of medicinal plants in agroforestry system is strategic driver of economic prosperity.

#### • Highly profitable to farmer:

Cultivating medicinal plants represents a lucrative venture for farmers, intertwining agricultural practices with economic prosperity. The demand for natural remedies and herbal products is escalating globally, creating a burgeoning market that smart farmers can tap into for substantial financial gains. Furthermore, the versatility of medicinal plants allows for value addition through the production of essential oils, extract and herbal formulations. This also opens avenues for establishing small-scale processing units, fostering entrepreneurship within farming communities. Benefit cost ratio of some medicinal plants under agroforestry system shows highest economic return than mono cropping as shown below in Table.

**Table 2: Benefit cost ratio of medicinal plant-based agroforestry system**

Agroforestry System	Benefit cost ratio	References
Coconut + Guava + Misridana	5.06	Bari and Rahim, 2012
<i>Psidium guajava</i> + <i>Curcuma longa</i>	4.74	Chandra, 2014
<i>Manilkara acharas</i> + <i>Jatropha curcas</i> + Basil	1.67	Solanki <i>et al.</i> 2014
Sapota+ Grass + <i>Dalbergia sissoo</i> + Maize + sun hemp	1.22	Patil <i>et al.</i> 2010
Coconut + Guava + Lemon + <i>Asparagus</i>	3.08	Bari and Rahim, 2012
Peach + <i>Ocimum sanctum</i>	1.87	Sharma <i>et al.</i> 2021

#### • Contribution in economy of country

India is expected to become the third largest economy in the world with a GDP of \$5 trillion in the next three years and touch \$7 trillion by 2030. The

cultivation of medicinal plants in agroforestry system and export of these play a pivotal role in bolstering a nation's economy. Extraction of active compounds from these plants not only fuels a robust domestic pharmaceutical industry but also position India as a key player in the international herbal medicine market. Beyond healthcare, cultivation and trade of medicinal plants provide a lifeline to rural economies while supporting livelihood of small-scale farmers and marginalized communities.

#### Some other potential of agroforestry system

- **Conservation of traditional culture and cuisine**

Medicinal plants serve as invaluable guardians of traditional culture and cuisine, intertwining heritage with health. Many traditional cultures have a rich history of incorporating medicinal plants into their culinary practices, creating a unique tapestry of flavor and remedies passed down through generations.

- **Solution to allelopathic medicines**

India has long time legacy of plant-based medicines since Vedic era and also evident from Ramayana epic, Charaka and Jivaka literatures. People in villages and remote areas primarily depend on traditional medicines as the modern system is out of reach and expensive. Many developed and developing countries use traditional medicines because of firm belief that they are more effective than modern medicines for certain chronic disease, do not have side effects as some of the modern medicine has and for economic reasons.

#### Ecological potential of medicinal plant-based agroforestry system

Medicinal plants emerge as ecological allies offering a myriad of environmental benefits that extend far beyond their therapeutic properties.

- **Soil Health Maintenance:** medicinal plant cultivation emerges as a boon not just for human health but also as a guardian of soil vitality. Unlike conventional system integration of medicinal plants in agroforestry systems contribute to soil fertility by enhancing microbial diversity and promoting nutrient recycling.
- **Biodiversity Conservation:** Medicinal plant-based agroforestry systems can support

biodiversity conservation, promoting sustainable land use and contributing to the overall health of the human as well as ecosystem. It provides diverse habitats, protection to various species, maintenance of native flora, fauna and pollinators.

- **Carbon Sequestration:** medicinal trees stand not only as a healer but inclusion of medicinal trees along with agricultural crops can contribute to carbon sequestration, which is essential for mitigating climate change. In agroforestry system where there is integration of woody perennial with crops, trees canopies and extensive root system sequester more carbon for longer time periods. than monocropping of crops. Thus, beyond their therapeutic properties, medicinal plants emerge as steadfast allies in the quest for balanced and carbon-neutral future.

#### Constraints facing in adoption of medicinal plant-based agroforestry system

- **Cultivation:** Agro technology is not available for MAP & Unavailability of QPM (Quality plant material). Issuing license or permit to farmers for growing medicinal plants is a time-consuming process. Lacking of linkages among different stakeholders involved.
- **Illegal acts:** Encroachment by outsiders and illegal collection from wild posing severe threats to sustainability and ecological balances. These illicit activities not only jeopardize the availability of crucial medicinal resources but also risking long term ecological consequences and depriving future generations from essential natural remedies
- **Marketing:** Unorganized & Large supply chain, dependency on middlemen, facing difficulty in selling the products. Improper sharing of benefits between farmers and industries and preference for wild over cultivated MAP. Lacking of well-planned marketing infrastructure (market place & technology). Inadequate marketing linkages e.g., Mandies, market place. Lack of marketing intelligence e.g., Assessment of demand, supply base, pricing.
- **Cultural system:** Adoption of traditional medicinal knowledge on preparing herbal



medicinal formulations is declining through generations. Traditional knowledge on many less known medicinal plant species has declined rapidly.

- **Bio piracy:** Biopiracy poses a grave threat to medicinal plants, as it involves the unauthorized exploitation of indigenous knowledge and genetic resources for commercial gains.

#### **Lack of post-harvest management facilities and semi processing unit for value addition**

##### **Solution/way forward**

- **Research and Development:** Development of high yielding varieties and in-depth research enhance the rate of success. Establishment of germplasm collection units and variety development for high yielding varieties with high active ingredients.
- **Efficient Extension Services:** Efficient communication channel, collaboration and effective extension services are needed in order to channelize the research results from lab to land which gone helpful to farmer in achieving their personal as well as nationally our Sustainable development Goals.
- **Farmer training and capacity building:** conduct training programs to educate farmers about best medicinal crop for particular region, including planting techniques, pruning, pest management, various combinations of intercrops grown along with medicinal plants for different agroclimatic zone.
- **Developing marketing infrastructure and linkages:** A market that is effective competitive, readily available, along with suitable post-harvest and marketing infrastructure, has the ability to meet its main goal of delivering net positive return to the producer (GOI, 2018).
- **Value chain development:** creating processing facilities, cold storage facilities, and cooperatives must ensure the purity and safety against microbial contamination and quality deterioration.
- **For Illegal collection:** For addressing this issue there is a need of multifaceted

approach combining regulatory measures, community engagement and sustainable practices. Formulation and enforcement of more act like Wildlife Protection act (WPA,1972), Biodiversity act (BDA,2002)

#### **Conclusion**

MAP indeed having an important role in people's healthcare and wellness in developing as well as developed world. People around world insisting on natural way of life, consequently demand of MAP is increasing. This growing demand is posing some problem of existence of MAP in wild. Its cultivation may be some answer for sustainable supply and also help to preserve diversity. For developing the "herbal industries", India possesses a rich diversity of medicinal plant species across the various forest along an altitudinal gradient. To support MAP species conservation in the wild its cultivation should be promoted. Apart from growing as a sole crop on agricultural farm, alternative land use system such as agroforestry can be better alternative to cultivate it. MAP is well adapted in forest ecosystems for their requirement for light, temperature, moisture, soil characteristics etc. so they can be accommodated in many tiers of agroforestry system. MAP intercropping with new plantations of coffee, tea, banana, coconut, palm, rubber, apple, mango and cacao offer scope for cultivation of forest medicinal trees that are in demand. It is imperative that this effort should be supported by research on agronomic practices of MAP species and their improvement in traditional, existing as well as new agroforestry system

#### **References**

- Ali, M. F., Hanif, M. A., Bari, M. S., Akher, S.A., & Fatema U. (2013). Phytochemical assessment of some medicinal plants under different agroforestry system. *Bangladesh research publications Journal*, 8(4), 186-190.
- Bari, M. S., & Rahim, M. A. (2012). Economic evaluation and yield performance of some medicinal plants in Coconut based Multistoried Agroforestry Systems. *A scientific Journal of Krishi Foundation*, 10(1), 71-80.
- Chandra, K. K. (2014). Evaluation of growth and economic parameters of *Curcuma longa* and *Amorphophallus paeonifolius* intercrops in medium aged *Psidium guajava* orchard.

- Caribbean Journal of Science and technology*, 2(1), 392-398.
- GOI. (2019). Exports of herbs and herbal products. Ministry of Commerce & Industry. [pib.gov.in](http://pib.gov.in).
- GOI. (2018). Operational guidelines Agricultural Marketing Infrastructure sub scheme of ISAM. Ministry of Agriculture and Farmer Welfare, GoI.63pp.
- Patil, S.J., Mutanal, S. M., Patil, H. Y., Shahapurmath, G., Maheswarappa. (2010). Performance of Sapota- Teak based agroforestry system in hill zone of Karnataka. *Indian Journal of Agroforestry*, 12(1), 27-34.
- Prajapati, N. D., Purohit, S. S., Sharma, A. K., & Kumar. T., A. (2003). Handbook of Medicinal Plants. Jodhpur: Agrobios,
- Sharma, S., Pant, K. S., Kapil, D. (2021). Economic analysis of Ocimum sanctum under peach and apricot based agroforestry system. *Journal of Pharmacognosy and Phytochemistry*, 10(1), 93-96.
- Solanki, V. K., Jadeja, D. B. & Tandel, M. B. (2014). Performance of herbal medicinal crops under Sapota-Jatropha based three-tier agroforestry system. *International Journal of Agricultural Sciences*, 10(1), 267-271.

\*\*\*\*\*