Popular Agriculture **1(1) 1-4 (January, 2025)**
Published at popularagriculture.com

POPULAR ARTICLE

Potential of agroforestry for livelihood security in the North-West Himalayas

G. Singh[1], D.Kumar[2], V. Gautam[3]

1 Faculty of School of Agricultural Sciences, Baddi University of Emerging Sciences and Technology, Solan, (H.P.)- 173205, India

2 Department of Silviculture and Agroforestry, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan (H.P.)- 173230, India

3 Deputy Manager (Agronomy), Zydex Industries Pvt. Ltd.-Ludhiana (Punjab)- 141003, India

Corresponding authors email: gurwinderrana4u@gmail.com

Manuscript received: December 1, 2024; Decision on manuscript, December 8, 2024; Manuscript accepted: January 1, 2025

Introduction

Agroforestry integrates crops, trees, and livestock on the same land to optimize productivity by utilizing soil resources and solar radiation efficiently. Modern agroforestry focuses on refining land use to maximize food, fuel, and fodder production while enhancing financial returns. Mountainous regions, including the North-West Himalayas, differ from plains due to their unique topography and socio-economic challenges. Mountain ecosystems sustain about 10% of the global population, providing essential resources like water, forests, and minerals (United Nations, 2001). These regions also supply water to valleys and plains, but increasing populations and economic expansion, particularly in the Himalayas, have led to environmental degradation. India's hill regions, rich in biodiversity, support agriculture, horticulture, and livestock. The North-West Himalayas span 33 million hectares across Jammu and Kashmir, Himachal Pradesh, and Uttarakhand, sustaining 25 million people and 19 million livestock, despite having only 3.2 million hectares of cultivable land (Srivastva *et al.*, 2009). Approximately 59% of the Himalayan workforce depends on subsistence agriculture, which only meets food requirements for 5-6 months annually (Raizada *et al.*, 2009). The region's diverse agro-climatic conditions allow for varied crop cultivation, but challenges such as small land holdings, harsh conditions, remote locations, and poverty impact agricultural sustainability. Effective resource management is essential for development in both the hills and adjacent plains.

Facts and figures of agroforestry potential

Himachal Pradesh is characterized by the diverse agroecosystems as state varies in altitudinal ranges from 350 to 6,975 m above mean sea level that increases from West to East and from South to North. With the altitudinal variation in the state, climatic conditions significantly vary affecting the farming practices. The farming practices, along with their composition, that are need based and comparatively more adaptive as well as productive in a particular region are commonly practiced by majority of the people (Thakur, 2020).

Table 1: Area under different agro-ecological zones in Himachal Pradesh

Zone	Elevation range (m)	Percent area (of State's total geographical area) (km^2)	District within zone
Zone I: Low hills sub-tropical zone	<650	16.24	Una, Bilaspur, and parts of Sirmour, Kangra, Solan and Chamba.
Zone II: Mid-hills sub-humid zone	650-1800	21.25	Mandi and Solan districts,
Zone III: High hills temperate wet zone	1800-2200	23.17	Major parts of Shimla except Rampur tehsil, and Kullu districts and parts of Solan, Mandi, Chamba, Kangra and Sirmour.
Zone IV: High hills dry temperate/Alpine zone	> 2200	39.34	Kinnaur and Lahaul-Spiti, and parts of Chamba.

Fig: Various types of agroforestry systems followed in Himachal Pradesh

Melia +Mustard (Agrisilviculture) -based Agroforestry system

Peach+Pear +Urd (Agrihorticulture) -based Agroforestry system

Poplar+Wheat (Agrisilviculture) -based Agroforestry system

Chir Pine+ Pasture (Silvipasture) -based Agroforestry system

Agroforestry arrangements and preferable tree species by farmers

Agricultural practices integrate major fruit trees and annual crops to meet daily needs. Fruit trees like mango, citrus, guava, apple, and kiwi are grown in specific patterns, while principal crops are cultivated alongside. rabi crops include wheat, barley, millets, pulses, and vegetables, whereas kharif crops consist of maize, sorghum, soybean, blackgram, and various vegetables. This system ensures efficient land use and seasonal crop production. The Agrisilvihorticulture (AHS) system incorporates major fodder and timber trees like Acacia, Abies, Picea, Grewia, Toona, Terminalia, Ficus, Sapindus, Cedrus, Junipers, Poplar, Morus, Melia, Bauhinia, Albizia, Anogeissus, Salix, Robinia, Oak, and Celtis. Fruit tree components in this system include mango, aonla, kinnow, guava, papaya, litchi, apricot, pear, peach, plum, persimmon, grapes, prunus, and apple. Local preference leans towards fodder and fuelwood trees over fruit trees in this system. Rabi crops primarily include cereals like wheat, barley, and buckwheat, along with millets, mustard, pulses, and vegetables. In kharif, maize and rice dominate, accompanied by pulses such as blackgram and pigeon pea, along with vegetables like tomato, capsicum, and beans. Verma *et al.,* (2007) highlight the integration of maize, soybean, and pulses in kharif, and wheat, gram, and vegetables in rabi, alongside timber, non-timber, fodder, and fruit tree species. The distribution of woody and nonwoody species varies across different zones. AHS involves strategically planting various fruit trees within fields, giving them priority over fodder, fuel, and timber trees that are left on field bunds for local daily use. Major fruit tree species, are mango, aonla, kinnow, guava, papaya, litchi, pear, peach, plum, apricot, persimmon, grapes, and apple, coexist with tree components like poplar, oak, bamboo, deodar, Acacia, Abies, Picea, Melia, Bauhinia, Anogeissus, Albizia, Ficus, Grewia, Morus, Terminalia, Toona, Salix, Juniperus, and Celtis, serving as fodder and fuelwood on bunds or in fields. In rabi season the cultivation of wheat, buckwheat, barley, millets, gram, lentil, mustard, onion, potato, cabbage, cauliflower, beans, and peas in tree-based interfaces, while kharif involves major cereal crops like maize and rice, along with pulse crops such as blackgram and pigeon pea, and vegetables like capsicum, tomato, peas, potato, and beans through intercropping in tree-based systems. Silvipasture (SP) functions as fodder depots for herders and farmers who rely on livestock for income. Essential timber, fuel, and fodder tree components, Acacia, Eucalyptus, Olea, Myrica, Dalbergia, Albizia, Grewia, Morus, Bauhinia, Toona, Ficus, Robinia, Santalum, Poplar, bamboo, Ulmus, Pinus, Quercus, Deodar, Salix, and Junipers, contribute to the system. Dominant grasses, such as *Setaria*, *Chrysopogon*, *Cynadon*, *Arundinella*, Themeda, Heteropogon, Apluda, Ischaemum, Dicanthium, Panicum, Eragrostis, Chloris, and Imperata, along with other natural grasses, are integral to the silvipasture system. Grassland ecosystems feature natural grasses like Arundinella, Themeda, Heteropogon, Apluda, Dicanthium, Panicum, Ischaemum, Chloris, Imperata, and Cymbopogon, with scattered fuelwood and timber trees such as Pinus, Acacia, and Pyrus. Forbs and legumes, including Artemisia, Bidens, Euphorbia, Micromeria, Dicliptera, Cassia, and Lespedeza, along with shrubs like Berberis, Lantana, Leptodermis, Rabdosia, Meriandra, Adathoda, and Murraya, enhance the grasslands, providing fodder for grazing animals, locally known as "ghasani" (Singh, 2014). Agroforestry is a more intricate form of land management compared to traditional forestry or agricultural systems, economically and ecologically. It hasa role in offering both tangible and intangible benefits. Tangible benefits are employment generation and increased farm income, while intangible benefits, such as ecological restoration, are significant across various agroforestry systems.

In Himachal Pradesh, several agroforestry practices, such as Jatropha plantation, lac cultivation, and gum-yielding tree farming, enable farmers to generate substantial revenue while simultaneously improving their socio-economic conditions. Factors like appropriate crop combinations, crop interactions, selection of suitable species, and effective management contribute positively to ecological sustainability and overall farm productivity. These practices aid in poverty alleviation and livelihood security by fulfilling the fodder, fuel, and other essential needs of rural farmers in Himachal Pradesh.

References

1. GoHP (Government of Himachal Pradesh) 2021. Economic survey 2020-21 saving lives and livelihoods. Department of Economics and Statistics, GoHP, p.236.
2. Raizada, A., Dhyani, B.L., Pradeep Dogra, Ashok Kumar, Singh, S.B. and Agnihotri, Y. 2009. Trends of crop diversification by small farmers in the Himalayas. In: Abstracts: 4th World Congress on Conservation Agriculture. 4-7 February 2009, New Delhi, India. Pp: 262.
3. Singh, M. 2014. Pattern, composition and vegetation dynamics of agroforestry systems in Giri catchment, HP. Ph.D. Thesis. Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan (HP), India. 173 p.
4. Srivastva, A.K., Bisht, J.K., Manoranjan Kumar, Singh, K.P., Pandey, S.C. and Gupta, H.S. 2009. Productivity enhancement of mountain farming systems in NW Himalaya. In Abstracts: 4th World Congress on Conservation Agriculture. 4-7 February 2009, New Delhi, India. Pp :267.
5. Thakur, A. 2020. Appraisal of existing agroforestry systems in Chuhar valley of district Mandi, H.P. M.Sc. Thesis. College of Horticulture and Forestry, Neri, Dr. YS Parmar University of Horticlture and Forestry, Nauni, Solan (HP), P.113.
6. United Nations 2001. Agenda 21. http://www.un.org/esa/sustdev
7. Verma, K.S., Bhardwaj, D.R., Chand, K. 2007. Agroforestry systems in Himachal Pradesh. In: Agroforestry systems and practices. Puri, S. and Panwar, P. (Eds). New India Publishing Agency, Pitam Pura, New Delhi. pp. 67-93.