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# Role of Agroforestry Systems in Farmers' Livelihoods of Himachal Pradesh

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### *Abstract*

Agroforestry, or the deliberate integration of trees and shrubs with agricultural crops and/or animals, is a sustainable land-use system that contributes significantly to livelihood security, ecological resilience, and food sustainability in Himachal Pradesh's mountainous areas. This article highlights the multifaceted functions of agroforestry in farmers' socioeconomic lives and offers an outline of the key agroforestry systems used throughout the state's various agro-climatic zones. It emphasizes the importance of agroforestry in revenue diversification, fodder and fuelwood supply, soil and water conservation, and biodiversity improvement. The significance of agroforestry in climate change mitigation and adaptation, notably through carbon sequestration and increased system resilience, is also addressed. The article highlights agroforestry as a sustainable and climate resilient land-use plan.

### **1. Introduction:**

Agroforestry, the deliberate integration of trees with crops and/or livestock on the same land management unit, is widely acknowledged as a sustainable land-use system that improves productivity while maintaining ecological balance (FAO, 2020; Pattanaik and Priyadarshini, 2023). Agroforestry, which has been practiced for centuries, was formally established as a scientific land-management strategy in the late 21<sup>st</sup> century. Bene et al. (1977) defined agroforestry as a sustainable land management system that increases overall production by combining agricultural crops with animals, while Nair (1979) stressed its ecological soundness, social acceptability, and practical feasibility. Similarly, the International Centre for Research in Agroforestry (ICRAF) defined agroforestry as land-use systems in which woody perennials are deliberately grown with crops or animals in spatial or temporal arrangements (Lundgren and Raintree, 1982).

Mountain ecosystems, which support approximately 10 per cent of the global population, are critical for providing livelihoods and ecosystem services like water, forest products, and agricultural resources (UN, 2001). In India, the Himalayan region plays a vital role in sustaining downstream populations by acting as the source of major river systems. However, escalating population pressure, tourism, and economic expansion have exacerbated ecological fragility in these regions. The North-Western Himalayas, covering about 33 million hectares across Jammu & Kashmir, Himachal Pradesh, and Uttarakhand, support nearly 25 million people and 19 million livestock, despite having only limited cultivable land (Srivastava et al. 2009). Agriculture in this region is predominantly subsistence-oriented, with roughly 59 per cent of the workforce engaged in farming that remains insufficient to sustain livelihoods throughout the year (Raizada et al. 2009).

Nearly 90 per cent of people in Himachal Pradesh live in villages, and over 70 per cent of them are directly employed in agriculture and allied activities (Dhiman et al. 2025). Hill agriculture is constrained by steep slopes, small and fragmented landholdings, poor infrastructure, and climatic harshness, making traditional farming systems less remunerative for marginal and small farmers (Rana and Chopra, 2013). In these circumstances, agroforestry has emerged as a viable land-use option that enhances farm resilience, diversifies income sources, and supports sustainable livelihoods. A wide range of traditional agroforestry systems exists in the Himalayan region, including agrisilviculture, agrihorticulture, agrihortisilviculture, hortiagriculture, hortipastoral, and silvipastoral systems. The choice of system depends on altitude, landholding size, and farmer's household needs (Tokey et al. 1989). Agroforestry systems provide multiple ecological benefits in hill environments. Trees reduce soil erosion, augment soil fertility through litter decomposition, enhance nutrient cycling, and reduce nutrient leaching by accessing deeper soil layers (Shrestha, 1995; Walker et al. 1995). These systems also reduce dependency on forests for fuelwood and fodder while supporting long-term land productivity. Despite their ecological and socio-economic importance, comprehensive assessments of the roles and diversity of agroforestry systems in farmer's livelihoods in Himachal Pradesh remain limited.

### **1.1 Facts and figures of agroforestry potential:**

Himachal Pradesh's diverse agro-ecosystems are partly due to its considerable altitudinal variety, which ranges from 350 to 6,975 meters above mean sea level. Such variance results in significant climatic changes that form region-specific and need-based farming strategies, which farmers frequently choose owing to their flexibility and productivity (Thakur, 2020).

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

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

Source: (GoHP) [http://dolr.nic.in/dolr/downloads/spsp SPSP\\_Himachal%20Pradesh.pdf](http://dolr.nic.in/dolr/downloads/spsp SPSP_Himachal%20Pradesh.pdf)

**Table 2: Agroforestry systems and preferable tree/crop species practiced by farmers in Himachal Pradesh:**

Agroforestry system	Tree component (fodder/timber/fuel/fruit)	Crop component (Rabi)	Crop component (Kharif)	Key features
General agri-horticultural arrangements	Mango, Citrus, Guava, Apple, Kiwi	Wheat, Barley, Millets, Pulses, Vegetables	Maize, Sorghum, Soybean, Blackgram, Vegetables	Efficient land use; integration of fruit trees with seasonal crops to meet daily household needs
Agrisilvihorti culture (ASH)	Forest Trees: <i>Acacia</i> , <i>Abies</i> , <i>Picea</i> , <i>Grewia</i> , <i>Toona</i> , <i>Terminalia</i> , <i>Ficus</i> , <i>Sapindus</i> , <i>Cedrus</i> , <i>Juniperus</i> , <i>Poplar</i> , <i>Morus</i> , <i>Melia</i> , <i>Bauhinia</i> , <i>Albizia</i> , <i>Anogeissus</i> , <i>Salix</i> , <i>Robinia</i> , <i>Quercus</i> , <i>Celtis</i>	Wheat, Barley, Buckwheat, Millets, Mustard, Pulses, Vegetables	Maize, Rice, Blackgram, Pigeon pea, Tomato, Capsicum, Beans	Emphasis on fodder and fuelwood trees; diversified production of crops and tree products

	Horticulture Trees: Mango, Aonla, Kinnow, Guava, Papaya, Litchi, Apricot, Pear, Peach, Plum, Persimmon, Grapes, Apple			
Agrihortisilvi culture (AHS)	Horticulture trees planted within fields: Mango, Aonla, Kinnow, Guava, Papaya, Litchi, Pear, Peach, Plum, Apricot, Persimmon, Grapes, Apple; Forest trees: <i>Poplar</i> , <i>Quercus</i> , <i>bamboo</i> , <i>Cedrus</i> , <i>Acacia</i> , <i>Abies</i> , <i>Picea</i> , <i>Melia</i> , <i>Bauhinia</i> , <i>Albizia</i> , <i>Ficus</i> , <i>Grewia</i> , <i>Morus</i> , <i>Terminalia</i> , <i>Toona</i> , <i>Salix</i> , <i>Juniperus</i> , <i>Celtis</i>	Wheat, Buckwheat, Barley, Millets, Gram, Lentil, Mustard, Onion, Potato, Cabbage, Cauliflower , Beans, Peas	Maize, Rice, Blackgram, Pigeon pea, Capsicum, Tomato, Peas, Potato, Beans	Fruit trees given priority; fodder and fuelwood trees retained on bunds; intensive intercropping
Silvipastoral (SP)	Acacia, Eucalyptus, Olea, Myrica, Dalbergia, Albizia, Grewia, Morus, Bauhinia, Toona, Ficus, Robinia, Santalum, Poplar, bamboo, Ulmus, Pinus, Quercus, Cedrus, Salix, Juniperus	-	-	Combined with grasses: <i>Setaria</i> , <i>Chrysopogon</i> , <i>Cynadon</i> , <i>Arundinella</i> , <i>Themeda</i> , <i>Heteropogon</i> , <i>Panicum</i> , <i>Imperata</i> ; supports livestock-based livelihoods ("ghasani" system)

## 2. Socio-economic roles of agroforestry in farmers' lives

a) **Livelihoods and income generation:** Agroforestry contributes significantly to hill farmers' economic well-being by offering diverse and consistent revenue streams. Trees planted on farms produce lumber, fuelwood, fruits, fodder, medicinal items, and non-timber forest products. Species including *Grewia optiva*, *Bauhinia variegata*, *Toona ciliata*, *Populus deltoides*, and *Morus alba* are frequently kept or planted on field bunds

and borders. In higher altitudes, apple-based agrihorticultural systems are the foundation of rural lives, generating significant cash revenue and minimizing reliance on a single crop.

- b) Employment opportunities:** Agroforestry systems generate employment throughout the year via activities such as nursery rearing, planting, pruning, lopping, harvesting, fodder collection, and tree-based products. These activities provide sustained on-farm employment for family workers and prevent seasonal migration to the plains. Small-scale value-added industries such as leaf meal preparation, fuelwood sale, and fruit processing help to enhance local rural economies.
- c) Food, Fodder, Fuelwood and Nutritional Security:** Agroforestry systems significantly enhance food and nutritional security by enabling the simultaneous production of cereals, legumes, vegetables, fruits, and livestock products on a single land unit. Fruit trees such as apple, apricot, pear, peach, walnut, and plum contribute essential vitamins and minerals, thereby improving household dietary quality. Multipurpose tree species including *Grewia optiva*, *Bauhinia variegata*, *Moringa oleifera*, and *Morus alba* further enrich diets through nutrient-dense leaves and fruits, enhancing dietary diversity. Intercropping of cereals, pulses, and vegetables ensures a continuous supply of food to farming households throughout the year. In the context of increasing pressure on natural forests, agroforestry has emerged as a sustainable source of fuelwood and livestock feed. Species such as *Grewia optiva*, *Celtis australis*, *Bauhinia variegata*, *Ficus* spp., and *Morus alba* provide critical fodder, particularly during lean periods, thereby reducing dependence on forest resources. This not only lowers the time and labour burden on women but also supports livestock productivity and strengthens farm-based incomes.

#### **Ecological and environmental benefits**

- a) Soil and water conservation:** Soil erosion is a major challenge in hill agriculture due to steep slopes and intense rainfall. Trees in agroforestry systems stabilize soil through extensive root networks and reduce runoff. Leaf litter enhances soil organic matter, improves soil structure, and increases moisture retention, thereby improving long-term soil fertility and productivity.
- b) Climate change mitigation and adaptation:** Agroforestry systems act as effective carbon sinks by sequestering atmospheric carbon in tree biomass and soil. They also help farmers adapt to climate change by moderating microclimates, reducing temperature extremes, and buffering crops against erratic rainfall, frost, and drought conditions.

- c) **Biodiversity conservation:** Agroforestry systems create different habitats for plants and animals. They function as ecological corridors between forests and agricultural landscapes, therefore preserving on-farm biodiversity in fragmented hill ecosystems.

### 3. Challenges and opportunities

#### 4.1 Challenges:

- Lack of awareness and technical knowledge among farmers.
- Poor market access for tree products.
- Policy gaps and absence of agroforestry-specific incentives.
- Competition for resources (light, water) between trees and crops.

#### 4.2 Opportunities:

- National Agroforestry Policy (2014) supports integration at scale.
- Promotion of value-added products from NTFPs and agroforestry species.
- Carbon credit mechanisms for tree-based systems.
- Convergence with watershed and rural development programmes.

### 4. Conclusion:

Agroforestry is critical to enhancing the socioeconomic and environmental sustainability of hill agricultural systems in Himachal Pradesh. By integrating trees with crops and livestock, agroforestry systems improve livelihood resilience through diversified income sources, food and fodder security, fuelwood availability, and vital ecosystem services. These systems also contribute to soil conservation, biodiversity enhancement, and climate change mitigation in fragile Himalayan landscapes. Strengthening extension services, policy support, and market linkages for tree-based products is essential to promote wider adoption and innovation. With appropriate institutional backing, agroforestry can serve as a cornerstone of sustainable agricultural development in the Himalayan region.

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