

A Review on Agroforestry Systems Prevailing in Garhwal Himalayas

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ABSTRACT

The North Western Himalayan frontier encompasses a rich flora and fauna biodiversity. It is considered as hub of numerous medicinal and aromatic plants which are of prime importance for the local peoples and industries. The Garhwal region of this frontier particularly consists of numerous agroforestry systems. Systems like agri-silviculture, silvi-pastoral, horti-silvi systems are prominently followed in this region. Temperate fruit crops like citrus, apple, peach and plum are major crops with forest crops. The crop productivity is reported to be higher in different agroforestry systems as soil nutrients get enriched at regular intervals in comparison to monoculture. The average land holding of farmers is though less (0.5 ha) but productivity is supplemented by other forest tree species in this region. The multipurpose tree species grown on boundaries not only enriches biodiversity but also enhances farmer's income of the region. The recognition of various agroforestry systems in recent times have increased worldwide as it paves way for efficient land use planning and sustainability of food security.

HIGHLIGHTS

- To quantify various systems of agroforestry in Garhwal Himalayas.
- Socio-economic importance of Agroforestry systems.
- Role of agroforestry systems in mitigation of climate change.

Keywords: Agroforestry systems, Socio- Economic, Garhwal, Climate- change, Biodiversity, Land Use Efficiency, Sustainable development

Agroforestry is a broad term which encompasses plants, trees, animals and other biotic and abiotic components with an objective of enhancing land use efficiency (Nair 1979). Since ages, the North Western Himalayan region has been growing crops with tree species, animals. With a keen objective to enhance farm income farmers incorporate trees and animals in agroforestry systems. A sharply increasing population hasn't not pressured farm demands but has also decreased forest reserves due to industrialization in the region. The Garhwal Himalaya consists of permanent agroforestry systems due to its typical landscape (Bhatt and

Todaria 1999). This agroforestry system widens the scope of providing fuel, fodder; feed, animal products, medicinal and aromatic plants etc. which in comparison seems impossible in monoculture.

Farmers in the hilly regions fairly depend on trees for increasing their farm income such as fuel and fodder. The whole of North Western Himalayas lies in rain fed regions due to which the crop

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productivity and quality is meager (Bhatt 2002). In particular farmers don't have any selection of tree species as a result whatever is available they continue their production (Bhatt *et al.* 2010). The traditional agroforestry system consisted of growing multipurpose tree species on boundaries. But due to growing attention of agroforestry scientists now have focused on developing different systems for better farm income and balancing the local environment.

Agroforestry systems are reported to provide better sustainability in terms of soil biota, soil physico-chemical properties and ecological balance. The trees are mainly responsible for development of the 'O' horizon which is present in the uppermost layer of soil profile. Multipurpose tree species are pertinent in any agroforestry system as they not only improve soil properties for crop production but also provide fuel; fodder (Dhadwal *et al.* 1989). Moreover trees also enhance microbial activity in soil which further enhances available nutrient concentration. With such benefits crop productivity is always higher in agroforestry systems in comparison to sole intercropping systems. With all such benefits from agroforestry systems in the North Western Himalayan region there is a strict need for a sustainable and eco balanced agroforestry system which would serve 120 million population living at present (Rao *et al.* 2003).

Traditional Agroforestry Systems of Garhwal

The Himalayan inhabitants grow plants for food, feed, medicinal, religious and for aesthetic purposes (Samant *et al.* 1998). Traditional Agroforestry systems constituted well efficient growing of agricultural and forestry crops to maintain soil health and adopt efficient cropping systems. Multipurpose tree species were an integral part of the system which not only benefited production but also were environmentally friendly (Dhadwal *et al.* 1989).

Monsoon plays a wide role in cultivation of these medicinal herbs as rainfall is pertinent in these regions. Some districts like Chamoli and Dehradun receive maximum rainfall and are known for different herbs. Rainfall during monsoons helps in enhancing cropping area and production of such crops (Shiva 1996). In such an event all natural resources in these areas helped increase the lifestyle

of the local population (Gautam and Singh 2005). Two decades back 70 % of the population relied on agriculture for livelihood (Dadhwal *et al.* 1989). Rainfed agriculture occupies mostly 75% of Indian cropping area. Western Himalayas lie in rainfed areas and living inhabitants mainly rely on rain for agriculture purposes. Agroforestry systems in Uttarakhand also depend on rain for growth and development. Good rainfall helps in enhancing diversity of species in forest (Kothari 1994; Kala 2007; Kala *et al.* 2008; Kaur *et al.* 2009).

In such reference it is imperative to understand the nature of agroforestry as it affects the agricultural enterprise of the region (Maikhuri *et al.* 2000). Cereals, grasslands, pastures and others widely depend on agriculture (Sundriyal *et al.* 1994). Study related to agroforestry systems and their utilization is the need of hour (Iqbal *et al.* 2014).

Present Agroforestry Systems

The present data shows that cropping system villages come under rainfed regions. Three land use cover types were identified, settled farming, forest land and barren land. The cropping pattern in this area consists mainly of rice and wheat. Rice (*Oriza sativa*), finger millet (locally called Mandua, *Elusine coracana*), soybean (*Glycine max*) and Jhangora (*Echinochloa frumentacea*) were dominant rainy season crops. Wheat (*Triticum aestivum*), were dominant crops of winter season. *Triticum aestivum*, *Oriza sativa*, *Echinochloa frumentacea*, *Elusine coracana* and mix pulses are main crops for farmers.

The agroforestry system helps in reducing pressure from main forestry crops (Ram and Ramakrishnan, 1988). Fodder produced from trees is substantial for temperate climate, mainly throughout winter months, when alternate green fodders are available in scarcity (Singh and Kanstra 1981; Vishvakarma *et al.* 1998).

Intercropping MAPs under different agroforestry system in study Area

Indigenous and traditional agroforestry systems through ages have helped in enhancing agroforestry species their medicinal value. The medicine system of India, Ayurveda, Sidha and Unani totally and homeopathy partially, relies upon plant resources or their derivatives to cure human ailments. The

Table 1: Fruit trees found in study area under different Agroforestry Systems

Sl. No.	Scientific Name	Common Name	Family	Agroforestry System	Uses
1	<i>Carica papaya</i>	Papeeta	Caricaceae	AHS	Fruit
2	<i>Citrus aurentium</i>	Narangi	Rutaceae	AHS	Fruit, Medicine
3	<i>Citrus sinensis</i>	Malta	Rutaceae	AHS, AH	Fruit, Medicine
4	<i>Citrus limon (L.) Burm. f.</i>	Nimbu	Rutaceae	AHS, AH	Fruit, Medicine
5	<i>Juglance regia L.</i>	Akharot	Juglandaceae	AH, AHS	Fruit
7	<i>Prunus armeniaca</i>	Chullu	Rosaceae	ASH, AH	Fruit, Oil seed
8	<i>Musa paradisiaca</i>	Kela	Musaceae	AH	Fruit
9	<i>Psidium guajava</i>	Amrood	Myrtaceae	AH, AHS	Fruit
10	<i>Embelica officinalis</i>	Amla	Euphorbiaceae	AHS, AS, SP	Fruit, Medicine
11	<i>Pyrus communis</i>	Naspaati	Rosaceae	AHS,	Fruit
12	<i>Citrus aurentifolia</i>	Kagzinimbu	Rutaceae	AHS	Fruit, Medicine
13	<i>Citrus pseudolemon</i>	Pahari Nimbu	Rutaceae	AHS	Fruit, Medicine

AHS- Agr-ihorti-silviculture System; AH- Agri-horticulture system; AS- Agri-silviculture system; SP- Siloopasture System.

Table 2: MAPs recorded in various agroforestry systems in study area.

Sl. No.	Name	Scientific Name	Family	Uses	System
1	Tejpatta	<i>Cinnamomum tamala</i>	Lauraceae	Spices, Medicine	AS, SP
2	Akharot	<i>Juglance regia L.</i>	Juglandaceae	Teeth Care, Seed Insecticide	AS, SP
3	Reetha	<i>Sapindus mukorossi Gaertn.</i>	Sapindaceae	Cosmatic, Soap	AS, SP
4	Pudina	<i>Mentha pipertia</i>	Lamiaceae	Stomach Problem, Spices	AS, SP, AHS
5	Bhang	<i>Cannabis sativa</i>	Canabaceae	Asthama	AS, SP
6	Tulsi	<i>Ocimum sanctum</i>	Lamiaceae	Digestion	AS, SP
7	kirmod	<i>Berberis aristata DC.</i>	Barbidaceae	Eye Care, Fruit	AS, SP
8	Kingor	<i>Berberis asiatica Roxb. ex DC.</i>	Barbidaceae	Eye Care, Fruit	AS, SP, AHS
9	Timur	<i>Zanthoxylum armatum DC.</i>	Rutaceae	Teeth Care, Seed Insecticide	AS, SP
10	Satawar	<i>Asparagus recemosus</i>	Liliaceae	Roots Rhizome Used in Diarrhoea	AS, SP
11	Hishul	<i>Rubus ellipticus Smith</i>	Rosaceae	Whole Plant Used in Diarrhoea	AS, SP
12	Molu	<i>Pyrus pashia Linn.</i>	Rosaceae	Paste Applies in Skin Disease	AS, SP
13	kalabasa	<i>Eupatorium adenophorum Spreng.</i>	Astaraceae	Leaf Juice is Used in Blood Clotting	AS, SP, AHS
14	kandali	<i>Urtica dioica Roxb.</i>	Urticaceae	Applied in Body Cramp and External Pains	AS, SP
15	Gethi	<i>Dioscorea bulbifera L.</i>	Dioseoreaceae	Bark Juice Apply in Skin Disease	AS, SP, AHS

trend of curing diseases using traditionally available medicine may be decreasing day by day, but still lot of people especially in the rural areas realize the importance of these traditionally available medicine from different forest areas and agroforestry systems for curing different diseases.

The region consisted of various agroforestry systems, and some of the plants which are used for treating human and livestock disease are recorded on the basis of knowledge of the local farmers, and their uses for curing disease also dissipated in the table 2.

CONCLUSION

The indigenous agroforestry system plays an important role in diminishing pressure from forest resources in terms of fodder and fuelwood supplemented with the improvement of site. Tree fodder is substantial for communities of temperate climate during period of winter months, when alternate fodder availability is in scarcity. Fodder availability and quality declines with the commencement of dry season. Fodder resources used during the winter are basically influenced by the existing cropping system, the environment



and minerals types. Hence more research needs to be done in this arena to standardize agroforestry system on the basis of region and climate.

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