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Sonam Rajput

Research Scholar, Department of
Silviculture and Agroforestry,
College of Forestry, Dr. YSP
University, Nauni, Solan,
Himachal Pradesh, India

PK Varshney

Department of Forestry, school
of life sciences, DBRA
University, Agra, Uttar Pradesh,
India

Vijay Upadhyay

Department of Forestry, school
of life sciences, DBRA
University, Agra, Uttar Pradesh,
India

A review: Agroforestry in Uttar Pradesh-India

Sonam Rajput, PK Varshney and Vijay Upadhyay

Abstract

Agroforestry is the deliberate growing of trees in conjunction with agricultural crops on the same unit of land organized in temporal and spatial mixture or sequence for benefits and services. Uttar Pradesh one of the largest and densely populated state in Indo-Gangetic plain with large agrarian communities, UP is not only the most populated state, but also major contributor to the national food grain stock of India. The state of Uttar Pradesh with 6.09% of its land area under forest cover of its geographical area required to be maintained under forests as per the National Forest Policy, 1988. Using wood pulp as a raw material from Eucalyptus, Bamboo, Poplar and other species also engaged in implementing and promoting agroforestry and social forestry programme on large scale in different districts of Uttar Pradesh. Rural people have been practicing tree planting with crops in their farms and homesteads to meet household requirements of fuel, poles, timber and medical plants and encouraged to generate high income.

Keywords: Agroforestry, practices, benefits, district

Introduction

A collective name for land-use systems in which woody perennials (trees, shrubs, etc.) are grown in association with herbaceous plants (Crops, pastures) or livestock, in a spatial arrangement, a rotation, or both; there are usually both ecological and economic interactions between the trees and other components of the system (Lundgren 1982) ^[1]. The earliest stages of agricultural history were dominated by shifting cultivation, with alternating periods of agriculture and forestry. This evolved into more settled systems involving woodland grazing and silvopasture with transfer of fertility from woodlands to cultivated crops via manure (Eichhorn *et al.*, 2006 and Maydell 1995) ^[2, 3].

Agroforestry is the deliberate growing of trees in conjunction with agricultural crops on the same unit of land organized in temporal and spatial mixture or sequence for benefits and services. It integrates forestry and agriculture to enhance profitability, productivity and sustainability of land use. It is considered to be more productive and sustainable than forestry and monoculture farming (Nair *et al.*, 2009) ^[4].

Agroforestry as a concept in the late 1970s, the emphasis has been on the development of new systems designed to fulfill the potential benefits of increased productivity balanced with resource and environmental conservation. Modern systems of silvoarable (Trees and crops) and silvopastoral (Trees and pasture/livestock) agroforestry for food, fuel and timber have been developed, along with systems established for environmental protection such as riparian (Riverside) buffers, shelterbelts and soil protection systems. In North America, Pinus-based silvopastoral systems are the most common form of agroforestry, and shelterbelts and riparian buffers have been established to protect the environment and modify the microclimate (Williams *et al.*, 2007) ^[5].

Agroforestry in India

Agroforestry plays a vital role in the Indian economy by way of tangible and intangible benefits. In fact, agroforestry has high potential for simultaneously satisfying three important objectives viz., protecting and stabilizing the ecosystems; producing a high level of output of economic goods; and improving income and basic materials to rural population. The origin of agroforestry practices in India i.e. growing trees with food crops, grasses and other components is believed to have started during Vedic era, though agroforestry as a science evolved in recent years. The long history and diversity of agroforestry system and practice in the country have been widely reviewed (Tejwani, 1994; Pathak *et al.*, 2000; Sharda *et al.*, 2001; Prasad and Dhyani, 2010; Kumar *et al.*, 2012.) ^[6-10].

Agroforestry was incorporated into national agricultural and forestry research agendas when ICAR launched an All India Coordinated Research Project (AICRP) on Agroforestry with 20 centers in 1983 followed by the establishment of National Research Centre on Agroforestry

Correspondence**Sonam Rajput**

Research Scholar, Department of
Silviculture and Agroforestry,
College of Forestry, Dr. YSP
University, Nauni, Solan,
Himachal Pradesh, India

(NRCAF) on 8th May, 1988 at Jhansi, U.P. The Centre is now upgraded as Central Agroforestry Research Institute (CAFRI) from 1st December, 2014. At present there are 37 centers of AICRP on Agroforestry located in 27 State Agricultural Universities (SAUs), 09 in ICAR and 01 in ICFRE Institutes representing all agro-climates of the country. In addition to ICAR, Indian Council of Forestry Research and Education (ICFRE) also conducts agroforestry research through its research institutes and advanced research centers in different parts of the country (Dhyani *et al.*, 2015) ^[11]. The agroforestry research through the AICRP on Agroforestry was conceptualized with the following six projects:

Diagnostic survey and appraisal of existing farming system and agroforestry practices including farmers' preference.

- ✓ Collection and evaluation of promising tree species, cultivars of fuel, fodder and small timber for agroforestry interactions.
- ✓ Studies on management practices of agroforestry systems.
- ✓ Analyze economical relation of agroforestry systems.
- ✓ Explore the role of agroforestry in environment protection.
- ✓ Studies on post-harvest technology, fishery, apiculture, lac, etc. in relation to agroforestry systems.

Agroforestry in Uttar Pradesh

Agroforestry is a dynamic, ecologically based natural resource management system that, through which the integration of trees/woody perennials in farm and rangelands, diversifies and sustains production for increased social, economic and environmental benefits (Leakey, 1996) ^[12]. Therefore, efforts have been made by the farmers, corporates and researchers for introducing tree based farming systems in the green belt of U.P. in the past two decades. Uttar Pradesh (U.P.), where every sixth Indian lives, contributes to 20.37 percent of the country's agricultural production (GOI, 2005) ^[13]. If Indian agriculture has to prosper, the situation in Uttar Pradesh has to improve in all sectors including crop diversification.

In recent years, the agroforestry practices have spread in central and eastern UP due to large-scale adoption, especially in marginal and degraded lands. UP is not only the most populated state, but also a major contributor to the national food grain stock of India. The state spreads over an area of 24.09 million hectare (m ha), comprising 6.8% of the total geographical area of the country. Agriculture is the backbone of the state's economy. According to the National Sample Survey Office (NSSO) Report 2014, about 74.8% of the state's rural households are dependent on agriculture for their income and livelihood support. (Verma *et al.*, 2017) ^[14].

Western UP is more advanced in terms of agriculture and agroforestry practices compared to other regions of the state. This region has well-developed agroforestry models due to well-developed wood-based industries, which have been promoting tree-based agroforestry framers to meet the demands of raw material (Dwivedi *et al.*, 2007) ^[15].

Eastern UP is now gradually adopting agroforestry, characterized by subsistence agriculture zone with low crop intensity and irrigation facility. Rainfall is the only source of water in the area. Fruit tree-based agroforestry is the most popular system maintained by large and medium farmers in this region. Majority of farmers cultivate vegetables and fruits like *Artocarpus heterophyllus* (jackfruit), *Psidium guajava* (guava), banana and various citrus fruits in their farmlands. In agri-silviculture system, eucalyptus, shisham and poplar are the main woody perennials integrated with agricultural crops by the farmers. The Eastern Plains and North Eastern Tarai zones of the state need to adopt proper agroforestry systems like agri-silviculture, silvi-horticulture, agri-silvi-horticulture and silvo-pastoral systems instead of monocropping (Rana *et al.*, 2007). In Uttar Pradesh, practices of agro forestry vary considerably according to the agro climatic zones, socioeconomic conditions and site-specific tree species. Agro forestry models with preferred timber, fodder, fuel and fruit tree species for different agro climatic zones of U.P. a state level workshop was conducted by the research circle of U.P. forest department at Kanpur. The aim of the workshop was to bring together different workers including forest officers, scientists, subject matter specialists and NGOs working in the field of agro forestry at different places. Suitable recommendations for tree-crop combinations in four different agro climatic zones of the state viz. tarai region, western plain gangetic region, eastern plain gangetic region and vindhya and bundelkhand region have been made. Area targeted for Agroforestry in Western U.P. The following type of land can be used for agroforestry development Uttar Pradesh:

- ✓ Cultivated land
- ✓ Field boundaries
- ✓ Along with farm roads and canals/nallahs sides affected by erosion
- ✓ Pockets with in cultivated holding where cultivation is not possible
- ✓ Old fallows
- ✓ Cultivable waste land
- ✓ Other area like community or panchayat land etc. in which agroforestry can be incorporated (Sharma 2007) ^[17].

Tree species used in agroforestry in Uttar Pradesh

Acacia nilotica, Albizia lebbeck, *Artocarpus heterophyllus*, *Dalbergia sissoo*, *Dendrocalamus strictus*, *Eucalyptus sp.*, *Leucaena leucocephala*, *Moringa oleifera*, *Syzgium cumini*, *Tectona grandis*, *Bixa orellana*, *Terminalia arjuna*, *Dalbergia Spp.*, *Populus spp.*, *Dendrocalamus hamiltonii*, *Bambusa balcooa*, *Pongamia pinnata*, *Azadirachta indica*, *Madhuca latifolia*, *Jatropha curcus* (small tree or shrub), *Bombax ceiba*, *cassia siamea*.

Fruit trees species used in agroforestry in Uttar Pradesh

Mangifera indica, *Embllica officinalis*, *Psidium guajava*, *Punica granatum*, *Syzygium cuminii*, *Artocarpus spp.*, *Anona squamosal*, *Citrus spp.*, *Aegle marmelos*, *Psidium guajava*, *Zizyphus spp.*

Table 1: Agroforestry practices in some districts of Uttar Pradesh

S. No.	District	Agroforestry practices
1	Saharanpur	Wood-based industries, eucalyptus and poplar for commercial agroforestry. Other species mostly on the boundaries are mango, sisham and jamun
2	Saharanpur	Agri-silviculture, Agri-horticulture with mango and agri-horti-silviculture with mango, eucalyptus and poplar. Wheat, mustard, sugarcane and paddy are the dominant crops
3	Aligarh	Traditional agroforestry – sisham, neem, babul and eucalyptus

4	Shahjahanpur	Poplar-based agroforestry; intercrops are wheat and sugarcane
5	Bijnor and Rampur	Poplar-based agri-silviculture – wheat, jowar and sugarcane. Other crops include maize, potato, mustard, soybean, lentils, turmeric, fodder crops and aromatic herbs
6	Mid-Gangetic Plain and Eastern Plains	Agri-horticulture and Agri-silvi-horticulture
7	Rohilkhand	Poplar in agroforestry and social forestry in block and boundary plantation
8	Allahabad	Jatropha-based agroforestry in wastelands, Eco-rehabilitation of degraded lands and social upliftment through bamboo cultivation North Western plains of UP61 Agri-horticulture and agri-horti-silviculture systems combined with a livestock component such as dairy, goat-rearing (for meat and milk) and vegetables. Trees – mango, guava, Citrus spp., papaya, shisham, jamun, eucalyptus and poplar
9	Mirzapur	Guava-based agri-horticulture with maize, Agri-horticultural system – custard apple and guava with moong
10	Indo-Gangetic Plains	Poplar and eucalyptus-based agroforestry, and agri-horticulture. Rehabilitation of lands degraded by salinization, ravines, gullies, and other water and wind erosion hazards

(Verma *et al.*, 2017) ^[14]

Benefits of agroforestry

The benefits of agroforestry is better understood by the farmers of the state, this may be attributed, to the assured market of agroforestry produce because of flourishing wood based industries. Eucalyptus and Poplar are preferred species in the western region, whereas shisham and Teak is preferred species in eastern region. Fruit trees also have considerable share of agroforestry particularly part of the state. The tangible and intangible benefits of agroforestry are as:-

- ✓ To meet the demand of fuel, fodder and timber for the increasing population.
- ✓ To reduce the biotic pressure on existing forests.
- ✓ To obtain maximum output in terms of yield form the same piece of land.
- ✓ To develop watershed/degraded lands by planting suitable tree species with agricultural crops.
- ✓ To reduce the environment pollution by planting tree species.
- ✓ To reduce soil erosion.
- ✓ To increase the soil fertility by planting nitrogen fixing tree species.
- ✓ To create availability of raw material for wood based industries.
- ✓ To create opportunity of employment to local people and to increase the return in terms of money by increase crop production.

Conclusion

Agroforestry plays a vital role in the Indian economy by way of tangible and intangible benefits. In fact, agroforestry has high potential for simultaneously satisfying three important objectives viz., protecting and stabilizing the ecosystems; producing a high level of output of economic goods; and improving income and basic materials to rural population. Uttar Pradesh has immense potential to develop a wide range of agroforestry models, as significant area is affected by various kind of land degradation and soil problems etc. The practicing of agroforestry in UP plays a major role in rehabilitation of land degradation, enhancing soil fertility, reduced nutrient leaching, reduced soil and wind erosion, water quality, enhanced biodiversity, increased aesthetic value, remediation of polluted land, sequestration of carbon and encouraged to generate income, livelihood and improve their life standard etc. This also helpful to increase the forest cover of the Uttar Pradesh according to National Forestry Policy 1988 and increasing demand of wood and raw material for such industries.

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