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Suitable Agroforestry System: for Purvanchal (Eastern Uttar Pradesh)

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Introduction:

Agroforestry is any sustainable land use system that maintain or increases the total yield by combining the annual agricultural crops with perennial crop and /or livestock on the same unit of land, either alternatively or same time using. Management practices that suit the social and cultural characteristics of local people and economical & ecological condition of the area. Uttar Pradesh, one of the largest and densely populated state of India in the Indo-Gangetic Plain with large agrarian communities, had a paradigm shift in the adoption of agroforestry. In Uttar Pradesh, agroforestry practices vary according to different agro-climatic zones, land capability and socio-economic status of farmers. Now, it is considered a problem-solving science and can both sequester carbon and produce a range of economic, environmental, and socioeconomic benefits. Adaptation to climate change is now inevitable. It is a best option to reduce the pressure on forest and mitigate carbon emission **&** agroforestry can improve soil fertility through control of erosion, India can achieve 33% forest cover area by adopting agroforestry system. The maintenance of soil organic matter and physical properties, & through Agroforestry biological nitrogen fixation increased. Extraction of nutrients from deep soil horizons, promotion of more closed nutrient cycling, and ameliorating micro-climate favourable for crop growth and production. In recent years, Agroforestry can occur at a variety of spatial scales ranging from woodlot, farm, and watershed to the landscape in different regions of the world and culture. Other agroforestry produce fodder, fuelwood, timber, fruit, fiber, medicines, and several other industrial products can fulfil domestic need of rural people. The several study and research carried out of eastern plain region of Uttar Pradesh (Purvamchal).

What is Agroforestry

" Agroforestry is any land use system to maintain or increase the total yield by combining annual food crops with perennial forest crop and / or grazing animal (livestock) on the same unit of land. Either alternately or at the same time using, management practices

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that suit the social and cultural characteristics of local people and the economic & ecological condition of the area".

Why we need agroforestry?

Agroforestry will fulfil the socioeconomic need of rural people. and it also beneficial like environmental, economical and ecological. It also enhances the socioeconomic status of rural people. Agroforestry is a management system at combines food crops and trees to address conservation need and build more profitable and weather–resilient farm, ranches and local communities and rural people. It is providing opportunities to integrate productivity and profitability with environmental status results sustainable that can be beneficial for future aspects. Enhancing soil fertility for sustainable production of food, feed, fuel, timber, fiber, medicines. Agroforestry can fulfil their domestic need and it can reduce the pressure on forest and help to reach the forest cover (33%) of India.

Suitable Agroforestry System for Eastern Uttar Pradesh (Purvanchal)

Suitable agroforestry systems through appraisal of existing farming systems and agroforestry practices and farmers preference for management practices of agroforestry systems such as **Agri-silviculture, Silvi-pasture, Silvi-horticulture, Agri-Silvi-horticulture & Boundary plantation**. These are best AF System suitable for Eastern Uttar Pradesh which is also known as 'Purvanchal' and it is subdivided into three parts.

i. Eastern plain region
ii. Middle Gangetic plain
iii. Vindhyan region

The following Agroforestry System/Model are given below:

❖ **Agri-silviculture**

Agri-silvicultural system refers as the raising of agricultural crop with forest tree spp. In same time at same unit of land, for maximum production of food crop with forest crop. by practicing of agro-forestry it provides the food, fruit, fodder, timber and medicine and resin & gums and other forest produce as well as to reduces the pressure on forest. Agroforestry can fulfil the needs of rural people. The following Agri-silvicultural system are suitable for Purvanchal, (Eastern Uttar Pradesh). Subsystems are following bellow-

➧ **Hedgerow cropping or alley cropping**

Alley cropping is also known as hedgerow intercropping, involves manging rows of closely planted (within row) woody plants with annual food crops planted in alleys in between hedges. The woody plants are cut regularly and leaves and twigs are used as mulch on the cropped alleys in order to reduce evaporation from the soil surface, suppress weeds and/or add nutrients organic matter to the top soil, where nitrogen is required for crop

production, nitrogen fixing plants are the main components of the hedgerows.

The primary purpose of alley cropping is to maintain / raise or increase crop yield by improvement of the soil and microclimate and weed control. Farmers may also obtain tree products may also obtain from the hedgerow including fuelwood, building poles, food, medicine and fodder and on sloping land, the hedgerow helps to control the soil erosion. It works best in that place where people feel a need to intensify crop production but face soil ferti lity problems. The spacing used in fields is usually 4 to 8 meter between row and 25 cm to 2 meter between trees within rows.

Table 1. Example of Hedgerow or alley cropping system (Tree+ Agricultural Components)

Tree Components	Agricultural crops Components
Poplar	Wheat, Maize, Rice, Arhar, Haldi, Ginger
Shisam	Rice, Arhar, Haldi, Ginger, Carrot, Radish, Guar beans, palak, Tomato, Brinjal
Eucalyptus	Wheat, Maize, Rice, Potato, and vegetables
Casurina	Wheat, Maize, Rice, Arhar, Haldi, Ginger, Carrot, Radish, Guar beans, palak, Tomato, Brinjal
Subabool	Radish, Haldi, Ginger, Carrot, Radish, Guar beans, palak, Tomato, Brinjal, Lady finger

Agroforestry fuelwood production

The Various multipurpose fuelwood/firewood tree species are interplanted on or around agricultural lands. The primary productive role of this system is to produce fuelwood, the protective role is to act as fencing, shelter -belts and boundary demarcation. Trees species commonly used as fuelwood/firewood, and timber, fodder for animals. Agroforestry fuelwood production presents a sustainable solution for farmers to meet their energy needs while promoting environmental conservation and enhancing livelihoods.

Table 2. Example of Agroforestry fuelwood production Tree Species with their Uses

Tree spp. Name	Use / Importance
Babool	Fuelwood, Fodder, Nitrogen fixer, cock & Agri tools
Subabool	Fodder, Fuelwood, Firewood, Nitrogen Fixer
Shisham	Tiber, Furniture, Fodder, Nitrogen fixer
Bamboo	Fodder, Domestic work, Shelter, Soil Erosion, Paper
Siris	Timber, Fuelwood, Firewood, Nitrogen Fixer
White siris	Timber, Firewood, Nitrogen Fixer, Avenue Tree
Neem	Timber, Medicinal, Fodder, Firewood, Furniture
Casurina	Nitrogen fixer, Fuelwood, Shelterbelts, Plywood, Paper
Eucalyptus	Plywood, Paper pulp industries, Balli, Firewood
Popular	Paper pulp, Match, Plywood industries
Khejri	Fodder, Firewood, soil conservation
Anjan	Fodder, Nitrogen fixer, timber
Kasod	Avenue, Timber, Firewood,
Vilayti Babool	Soil erosion, Firewood, Nitrogen fixer

By integrating trees into their farming system, farmers can diversify their income

stream, improve soil health, and contribute to climate change mitigation, however, realizing the full potential of agroforestry fuelwood production requires concerted efforts from extension, NGO's and local communities to provide necessary support and create enabling environments for adoption an expansion.

Bund Plantation

Bund plantation, also known as ridge & furrow or raised bed farming, involves creating raised mounds or ridges with furrows in between to facilitate water retention, drainage, and soil aeration. These raised beds can vary in size and shape depending on the specific crop and local conditions. The bunds not conserve inly water but also soil erosion and provide better aeration to the plant roots. The several benefits by bund plantation viz. water conservation, Soil health, erosion control & increased yield of crops.

Table 3. Example of Tree Species with Agricultural crops (Bund Plantation)

Tree Species	Agricultural crops
Sagwan	Bajra, Rice, Jowar, Arhar, Mung, Til, Maize, Potato, Radish, Carrot, Garlic, Onion, Peas, Chickpea
Eucalyptus	Bajra, Rice, Jowar, Arhar, Mung, Til, Maize, Radish, Carrot, Garlic
Shisam	Bajra, Rice, Jowar, Arhar, Mung, Til, Maize, Garlic, Onion, Peas, Chickpea
Arjun	Bajra, Rice, Jowar, Arhar, Mung, Til, Maize, Cumin, Haldi,
babool	Bajra, Rice, Jowar, Arhar, Mung, Til, Maize

Silvi-pasture System

The production of woody plants combined with pasture is refers to as a silvi-pasture system. The trees and shrubs may be used primarily to produce fodder for livestock on they may be grown for timber, fuelwood, and fruit or to improve the soil. A silvi-pasture system is need in dry areas, in order to meet out the demands of wood and fodder throughout the year. There are three main categories of silviculture system. Example- Protein bank, Live fence of fodder trees & hedges, Trees shrubs on pasture.

Table 4. Example of Tree species with Pasture

Tree Species name	Pasture / Grasses
Shisham, Subabool, Casurina, Babool, Ber, Mahrukh, Vilayti Babool	Deenanath Grass, Napier grass, Bermuda grass, Oat, Barseem, Jowar, Bajra, Arhar

Silvi-horticulture system

Silvi-horti system combines elements of forest crop with horticultural crops (Cultivating fruits, vegetable or ornamental plants). In this system, trees are grown alongside crops or other plants in a mutually beneficial manner. For example, farmers might plant fruit trees like Guava, mulberry & ber trees between rows of vegetables like spinach, Haldi. The trees provide Shade, wind protection, and nutrient for the vegetables, while the vegetable help suppress weeds and

make more efficient use of available land and resources.

Table 5. Example of silvi-horti system (Forest +horticulture crops)	
Forest tree Species	**Horticultural crops**
Babool, Arjun, Casurina, Eucalyptus, Shisam, Subabool, sagaun	Guava, Ber, Sahtut, Spinach, Drum stick, Aonla, mango, jamun,leafy green vegetables ,Beet, Radish, clusterbean, carrot,Haldi Ginger, Chilli etc.

❖ **Agri-silvi-horti system**

Agri-silvi-horti system refers as the raising of agricultural crop with forest tree species and/ or fruit/horticultural crops in same time at same unit of land, for maximum production of food crop with and/or forest crop by practicing of agro-forestry it provides the food, fruit, fodder, timber and medicine and resin & gums and other forest produce as well as to reduces the pressure on forest.

Table 6. Example of Agri-silvi-horti systems components		
Tree species	**Horticultural crops**	**Agricultural crops**
Casurina	Sahtut	Haldi, Ginger, spinach, lettuce
Arjuna	Guava	spinach, lettuce, Mint, leafy vegetables
Sisham	Ber	Carrot, Radish, beets, Haldi
khejri	Aonla	Cluster bean, Haldi, Mustard, Haldi
Eucalyptus	Mango	Mung, Jowar, Bajra, Maize, & Lentil

Agroforestry can fulfil the needs of rural people. It provides nutrition for rural livelihood. This helps to improves socio-economic status of the farmers. This system can enhance the biodiversity, soil conservation, resource efficiency and provides own microclimate. And also provides habitat for birds and other wildlife. The following Agri-silvicultural system are suitable for Purvanchal, (Eastern Uttar Pradesh).

❖ **Block plantation**

Block plantation, also known as block cropping or block farming, involves planting crops in large continuous block or patches rather scattered across a field. This method organizes crops into distinct blocks, typically separated by buffer zones or alternate crops.

Table 6. Example of Block plantation tree species	
Shisam (Dalbergia sissoo),	Mahogany (Swietenia macrophylla),
Subabool (Leucaena leucocephala),	Sagwan (Tectona grandis),
Mango (Mangifera indica),	Eucalyptus species

The size of each block can vary based on factors such as crop type, soil condition, and farm layout. It increases farm efficiency with optimized resource utilization & improved pest and disease management also enhanced crop quality. It can fulfil their local need ad can reduced the pressure on forest with providing fuelwood, fruit, firewood, fodder and timber also.

❖ **Conclusion**

Implementing & adopting above suitable agroforestry system in Eastern Uttar Pradesh (Purvanchal) holds great promises for farmers in the region. By integrating trees with crop and livestock production, farmers can enhance their resilience to climate change, improve soil health, increase biodiversity, and diversify their income stream. The selection of appropriate tree species, careful management practices, access to market networks are essential for the successful adoption and sustainability of agroforestry system in this region. Overall, embracing agroforestry offers Eastern Uttar Pradesh (Purvanchal) farmers a pathway towards long term agricultural sustainability and economic prosperity.