Agroforestry: is a boon and good tactics for farmers

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Introduction

The word agroforestry is not something new it is practiced since thousands of year ago from vedic period. Agricultural crops are raised with forest tree spp. Agroforestry, historically, is as old as agriculture when domestication of both trees and herbaceous plants and crops in the vicinity of each other was practiced by early humans in ancient times. Incidentally, there are several examples of forest and fruit trees mentioned in ancient literature throughout the world. Recognizing the ability of agroforestry systems to address multiple problems and deliver multiple benefits, most of the scientific achievements in agroforestry research developments took place only during the last three decades. 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, and research on agroforestry as an adaptation to climate change and as a buffer against climate variability is one of the priority areas of research.

Traditionally, trees in agroforestry systems improve soil fertility through control of erosion, the maintenance of soil organic matter and physical properties, increased biological nitrogen fixation, extraction of nutrients from deep soil horizons, promotion of more closed nutrient cycling, and ameliorating micro-climate favorable for crop growth and increased biological 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 cultures. Agroforestry provides approaches and technologies for mitigating the effects of harsh and erratic climatic conditions, restoring degraded ecosystems and landscapes, and enhancing soil fertility for sustainable production of food, feed, fuel, timber, fiber, medicines, and several other industrial products for the ever-increasing human population. Agroforestry is becoming increasingly important because of its multiple roles and services for biodiversity conservation, carbon sequestration, adaptation and mitigation of climate change, restoration

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of degraded ecosystems, and providing livelihood security to people. (Swaminathan MS)

Agroforestry is the production of forest crops (perennial trees and annual crops) or animals on same unit of land at same time. It employs integrated concepts which make this land use management system the most self-sustaining and ecologically sound of any agricultural system (Sharma et al. 2017a.

It includes a integrating trees, crops and grazing animals in a conservative and productive manner. It can be considerd more as an approach than a single finished technology. The flexibility of agroforestry approach is one of its advantages (sharma et al.,2017b).

"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 that suit the social and cultural characteristics of local people and the economic & ecological condition of the area". (Dwivedi A.P., Agroforestry principles and practices, International book distributor, Dehradun 2006)

An agroforestry implies that:

❖ Agroforestry normally involves two or more species of plants (plants or animals) at least one of which is a woody perennial.

❖ An agroforestry system always has two or more output.
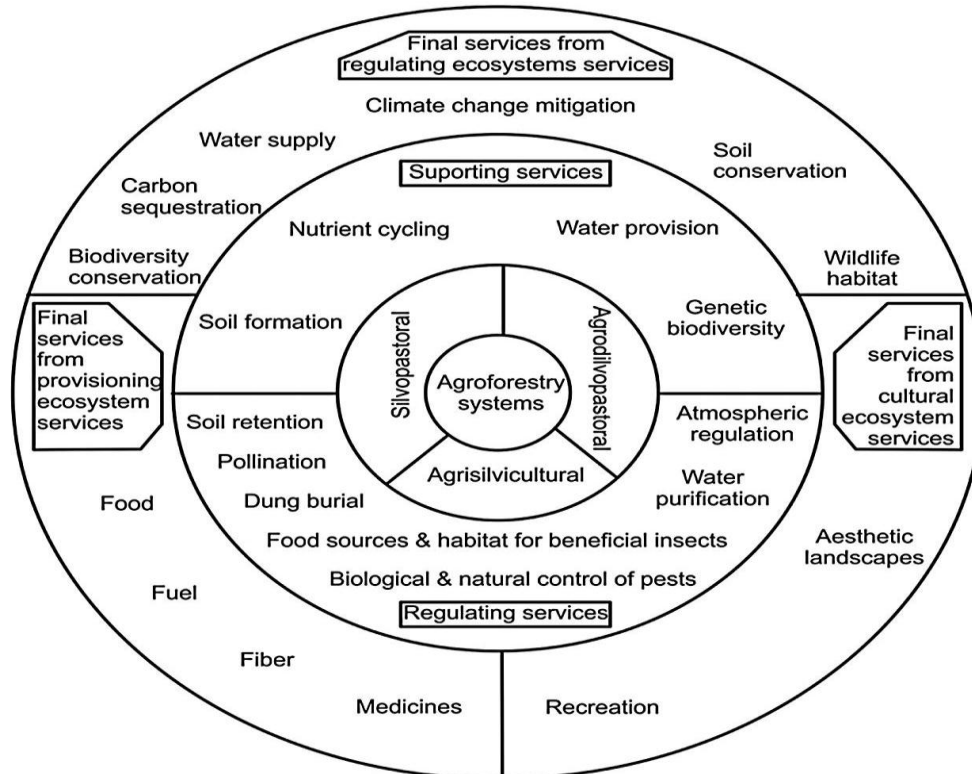
❖ The cycle of an agroforestry systemic always more than one year.

❖ Even the very most simple agroforestry system is more complex ecologically (structurally and functionally) and economically than a monocropping

Why we need agroforestry?

Agroforestry will fulfil the socioeconomic need of rural people. and it also beneficial like environmental, economical and ecological. It also enhance the socioeconomic status of rural people. these are following important benefits from agroforestry. 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.

Objectives of Agroforestry:-

• To manage land efficiently so that its productivity is increase and restored.

• To us e available resources efficiently and economically

• To generate the employment opportunity for rural people.

• One of the main objectives of agroforestry is the raise the production of the agricultural crops and forest crop with more economical an ecological value.

• Agroforestry aims to raise the supply for small timber used by village for agricultural implements, house construction other domestic purpose. in this way agroforestry can meet this requirement of the rural population and reduce pressure on forest.

• To raise supply of fuel in the rural areas at convenient distance for consumer in India above to 70 million tones of dried cow dung issued every years,which can be used for natural organic fertilizer moreover under pressure in on traditional forest for obtaining fuelwood.

Characteristics of agroforestry and trees

• We should choose that tree crops which not compete or interfere with agricultural crops &each other.

• Trees and crops spp. should not compete for nutrient, soil fertility and solar radiation and moisture also.

• Tree spp. should be high survival rate and easy establishment. & should be fast growing and deep root with easy management and the leaves of selected tree will be easily decomposable nature in soil.

• We should choose that type of tree spp. don't have any toxic effect or **allelopathic effect** like some chemical **ferulic**

acid,cinnamic acid,tarpenes,phenols, **phenolic acid amines,coumarines** , **juglones, leptospermone** and some plant family viz; maple **family (aceraceae),beech family(fagaceae),walnut family (juglandaceae)** because it can reduce the yield of crops.

- Adequate shade regulation and trees bole should be straight and high growing & high yield potential & efficiently and profitability also.

- We should select the tree spp. that suit the social and cultural characteristics local people.

❖ **Environmental benefits;**

- Agroforestry can reduces the pressure on forest enhanced better protection of ecological system.

- Agroforestry augments diversity by favouring environmental condition.

- Agroforestry improve the micro climate of the area by lowering of soil temperature, reduction of evaporation and maintenance leaching and soil moisture and soil erosion.

- Agroforestry can reduced run off nutrient leaching and soil erosion & enhance efficient recycling of nutrient with in soil at different depths.

- Agroforestry is good tactic to improve the soil by addition the organic matter on soil

& improves the soil fertility through addition N_2 fixation from environment to soil and also by the litter fall.

❖ **Ecnomical benefits:-**

- Agroforestry can increasess yield and output per unit are (more crops per unit area with addition economic value of timber, fuel etc).

- Agroforestry system reduced the total crop failure.

- All these benefits increase and results the increase of total farm income.

❖ **Social benefits:-**

- Agroforestry improves the rural living standard by increasing their income in a sustained manner.

- Agroforestry improves the health and nutrition of the people by providing diverse, nutrient rich farm produce.

- Agroforestry gave the multiple outputs without the risk of total failure stabilize the farm communities

Potential and scope of Agroforestry

The tremendous scope of agroforestry are followings

- A large hectarage is available in the form of boundaries, bunds, wasteland where agroforestry system can be adopted.

- By using fast growing tree spp. in the field where most annual crops are growing well and the advantage of soil.

- Agroforestry can be severe a power tool for social forestry in India

- Agroforestry has potential of at least partially meeting the challenges of present scarcities of unemployment and has a vital role to play in rural development.

- Agroforestry can be adopted on agricultural land, forest land, marginal& sub marginal wasteland not presently available for cultivation of arable crops.

- India has achieved them self-sufficiency in food production. to its attention is becoming focused on the problems of acute shortage of fodder, fuel and other products.

- Agroforestry has vast scope in meeting these requirements because it combines with mostly multipurpose tree spp. which will solve the problem of fuel, fodder, fruits, timber shade protection etc.

- Size of land holding are decreasing order day by day resulting in an increase in no. of small & marginal farmers, for rural people to provide employment. Agroforestry are labour intensive hence employment opportunities to unemployment rural people to provide the employment

- Since agroforestry system involves intensive use of land under proper management without deterioration of its

fertility that results in more output which add in national economy. Thus agroforestry in India is inevitable bright future.

Enormous Potential of agroforestry:

- The humid zones of India have the highest for carbon sequestration through agroforestry. Among the different type of agroforestry system with combine the agricultural crops with tree spp. and livestock have the highest potential to store carbon.

- Expanding the area under agroforestry by five percent of the current area, in five year interval could help of set India's total projected emission by 2050

- It's believed by expert and scientist that increasing the area under agroforestry could also fulfil multiple sustainable development goals established and will achieved

- Increasing the area under agroforestry system which integrate trees alongside crops, is a promising strategy to offset greenhouse gas emission and could help achieve India's nationally determined contribution in climate change.

- Recognising the potential of agroforestry in meeting various development and environmental goals, India launched a" *National Agroforestry Policy in 2014"*, by

increasing the area under agroforestry, the policy aims to ' *Address the increasing demand'* for timber, fruit, food, fodder and fiber &creating employment and generating income to farmers.

Classification of Agroforestry

Agroforestry system can be grouped on the basis of anyone factor of the farming system. P.K. Ramchandran Nair (1985) classified the agroforestry system into four groups as following –

On the basis of structure	On the basis of socioeconomic
On the basis of function	On the basis of ecological

On the basis of Structural
Nature of component

Agrisilviculture system	Agrisilvipasture system
Silvipasture system	Other system

Agrisilvicultural system:-

Agrisilvicultural 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.

Agrisilvicultural Sub system:-

➡ Improved fallow (in shifting cultivation)

➡ Taungya System

➡ Multispecies Tree Garden

➡ Multipurpose trees and shrubs on farm land

➡ Tree and shrubs on pastures

➡ Hedgerow cropping or alley cropping

➡ Crop combination with plantation crop

➡ Agroforestry fuelwood plantation

➡ Shelterbelts & windbreak

➡ Soil conservation hedges

The following example of Agri silvicultural system viz.

➡ Wheat (Triticum aestivum) + Poplar (Populus deltoids) based agroforestry system

➡ Wheat (Triticum aestivum) + Eucalyptus hybrid based agroforestry system

➡ Wheat (Triticum aestivum) + Shisam (Dalbergia sissoo) base agroforestry system.

Fig:- Populus deltoids (poplar) based agroforestry system

Fig1.2. Triticum aestivum) + Eucalyptus hybrid based agroforetry system

Fig 1.3 Wheat + Shisham based agroforestry system

Silvipasture system

The production of woody plants combined with pasture is refers to as a silvipasture system. The trees and shrubs may be used primarily to produce fodder for livestocks on they may be grown for timber, fuelwood, and fruit or to improve the soil. A silvipasture 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

Protein bank:

In this system various multipurpose trees (protein rich trees) are planted on or around farmland and rangelands for cut and carry fodder production to meet the fodder requirements of livestock during the fodder deficit period in winter.

These trees are rich in protein :- 1.*Grewia optiva,2.Bauhinia variegate,3.Morus alba, 4.Artocarpus spp. 5.Angeissus latifolia,6.Cordia dichotoma, 7.dalbergia sissoo, 8.Eutralobium saman,9. Zizyphus jujube, etc(ICAR –iasri.res.in)*

Fig :- A model of Silvipastural system

- **Other system**

  i. Aquaforestry,

  ii. Sericulture with agriculture

  iii. Apiculture with forestry

  iv. Lac cultivation with trees

Fig :- A model of Silvipastural system

Suitable Agroforestry components (food crops + trees) for Ecological Zones:-

In India with a wide variation in climatic, edaphic and physiographic conditions and with a large biological diversity of flora and fauna, it is difficult to have a perfect ecological classification.

Conclusion:

Agroforestry system is sustainable and multifunctional approach to land use system, management, integrating trees with crops and / or livestock. It offers a range of environmental, economic, ecological social benefits, including improvement of health, increased biodiversity,

Sr. No	Region/area	Agricultural component	Forestry component
1.	Alluvial region	Rice, wheat, sugarcane, pulses, oilseed	*Eucalyptus spp. Populus spp., Delbergia sissoo, Morus alba,Acacia nilotica, Bombax ceiba,etc*
2.	Arid and semi-arid areas	Maize, jowar, bajra, small millets wheats, pulses etc .	*Acacia nilotica. Prosopis cineraria, Eucalyptus camaldulensis, Azadirachta indica, Ziziphus species.*
3.	Northern hill areas	Maize, Paddy, wheat, fruits and vegetables	*Grewia optiva, Morus serrata, Celtis australis, Albizia chinensis, Populus ciliata, etc*
4.	Central region	Rice, wheat, jowar, bajra, pulses and oil seed	*Bamboos, Mangifera indica, Delberia sissoo, Moringa oleifera, Acacia nilotica, Azadiracta indica, Terminalia arjuna, Albizzia spp., Tectona grandis, Eucalyptus hybrid*
5.	Southern region	Rice tobacco, Chillis, sugarcane	*Casurina equisetifolia, Eucalyptus hybrid, Eucalyptus tereticornis, Acacia spp., Dendrocalamus hamiltoni, Tamarindus indica, Ancrdium occidentale*
6.	Coastal areas	Rice	*Casurina equisetifolia, Cocus nucifera, Areca catechu*
7.	Plantation crops areas of south and eastern states	Tea, coffee, cocoa, banana, black pepper, Pineapple	*Albizia odoratissima, Erythrina spp., A. chinensis*
8.	North eastern areas	paddy	*Dendrocalmus hamiltonii, Cocus nucifera, Areca catechu, Diptocarpus macrocarpus, Anthocephalus chinensis*

enhanced resilience to climate change, and diversified income stream for farmers. Through careful planning and implementation, agroforestry can contribute to addressing various global challenges such as food security, poverty alleviation, and environmental conservation.However, successful adoption knowledge sharing , and capacity , embracing agroforestry.