



Traditional Agroforestry systems for effective land management – Lessons from Indian Landscapes

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Abstract

India is basically an agriculture country and known for its traditional practices. Agroforestry is one such age-old system of land management, which includes structure, function, socio-economic attributes and ecological services. Indian sub-continent with varied agroclimatic regions has representation from arid, semi-arid, humid, sub humid, humid tropics which has their own uniqueness of upholding the native tree species and agriculture crops. Agroforestry is now branded with a series of benefits to the farming community while safe guarding the environment and sustainable development. In addition to this the ecosystem services from the agroforestry landscapes are gaining high importance. According to the IPCC This study is an attempt to study the traditional agroforestry systems, its uniqueness and land management ecosystem services to current scenario. Maximizing the benefits to meet the rising demands for food and other ecosystem services for the well being of the societies has been the main problem for sustainable landscapes in Agriculture.

Introduction

India with its growing population is in the thrust of feeding the people and satisfying the basic needs of food, firewood, timber and fodder. This heavy pressure of human and livestock population, decreasing land to man ratio, acute shortage of food, fuel wood, fodder, timber and other tree-based products, continued land erosion, depletion of soil fertility and ecological imbalance, agroforestry has a great scope as a practical solution to many of these challenging problems (K.T.Parthiban, 2023). In general, the agroforestry practices can be classified as, fruit trees in combination with agricultural crops, fodder trees with agriculture crops, fodder trees with pasture for fodder production, trees and grasses for soil conservation, fuel, timber and fodder.

Agroforestry was recognized by inter-governmental panel on climate change as having potential for sequestering carbon as part of climate change mitigation strategies (Watson, 2000). It is mainly mentioned as sustainability enhancing practice that combines the best attributes of forestry and agriculture. Among all foremost important is the role of agroforestry in assuring food security. In addition to that it also reduces poverty and enhances ecosystem resilience mainly among the small farmers in

the tropics. It also emphasis in the upstream and downstream linkages in the systems, because these systems integrate crops, livestock with trees and shrubs, which gives multiple benefits for both humans and wildlife. Global systems has different types of eco system services and multispecies agro silvi based cropping pattern. Totally 17 different types of Eco system services are estimated for a total value of \$33 trillion on average. (Vandermeer, J. et. al, 1998). A normal peri urban forest-based communities are measured with the four types of ecosystems. The local climate and air quality measures for 70.45 %, carbon sequestration and storage of waste water treatment has regulating types of habitats for 22.73%, provisional for 34.09 and 22.73 % for cultural services. (Paul, 2019)

Traditional Agroforestry - structure and system

Agroforestry systems can be of boundary plantations, and agri-silvi- horti-pasture systems. (Handa, A K. 2021).

In agroforestry there is a difference between the traditional agroforestry systems compared to the classical agroforestry, prominent in longevity and degree of intensification and devoid of intensified cultivation of agricultural or forage crops.

In a global scenario agroforestry is practiced in tropics, subtropics and even temperate regions across continents and In India traditional agroforestry systems are practiced in almost all the ecological and geographical regions in India.

Crop based and system-based agroforestry for effective land magaement

Crop based agroforestry is crop centric in nature. The main/ major crop will the critical component of crop based system. System based agroforestry is mainly on the cropping pattern and individual component integrated. (Viswanath, 2018& Tewari, 2013)

The international models in agroforestry systems speaks either as crop based or system based. Some typical example of the scenario are:

Country	Agroforestry systems adopted
Europe	Completely fell derelict forests, burn and cultivate crops
Tropical America	Stimulate forest ecosystem in farm lands with beneficial effects of forests to grow food crops
Philippines, Asia	Modified method of shifting cultivation where few trees were left erect to provide shade and foliage
Africa	Food crops grown amidst scattered trees
India	Trees along with agriculture and horticulture crops, pasture crops, aquaculture, home steads, block plantation

(Viswanath, 2018)

But, Indian scenario is completely different wherein one system could not be fit in. Almost all the ecological and geographical regions of India are practicing agroforestry in one form or the other. Similarly, there is lot of diversity in agroforestry within the country. This variation could be in the structural complexity, species diversity, productive and protective attributes and socio-economic

dimensions. The various forms of Agroforestry systems could be shifting cultivation, complex home gardens, sparse strands of trees, high density complex, etc.

This review is a simple attempt to explore the traditional agroforestry practices of India. Their structural base, socio-economic and environmental benefits.

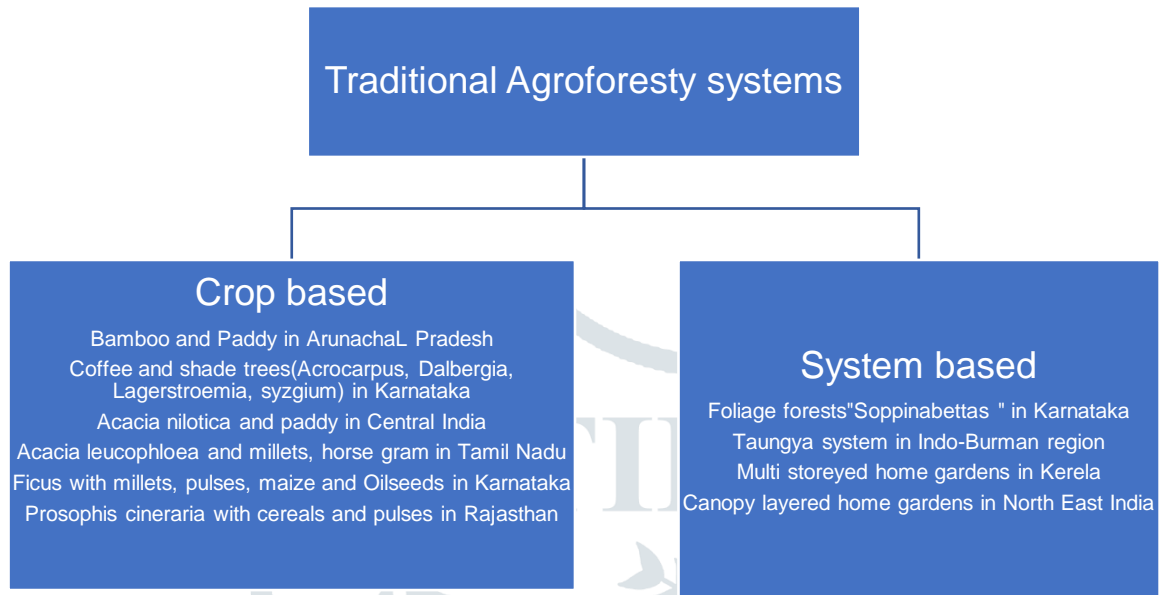


Fig. 1. Crop based and system based agroforestry practiced in India

Effective Land Management through Agroforestry:

Agroforestry is a collective nomenclature for land use management and technologies. World wide research claims the direct and indirect benefits of agroforestry towards effective land management. The practices includes the general agroforestry systems, multistorey systems, fodder banks, improved fallows, windbreaks, shelterbelt and multifunctional agroforestry. The impacts of the effective land management is evidenced on the following criteria:

Ecological benefits

Socio- economic benefits

Socio cultural benefits

Offsite benefits such as employment creation, alternate source of fuel and timber, etc.

Classification of Traditional Agroforestry systems based on climate zones

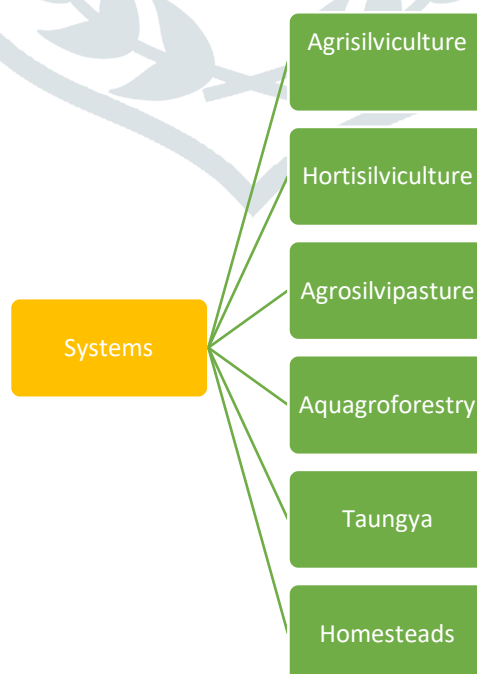
Crop based Agroforestry

Climatic Zone	Agroforestry system
Sub-Tropical high lands	Bamboo in Paddy in Ziro valley. Two crops of rice per year along with rearing fish in Paddy fields.
Tropical humid and sub humid zones	<ol style="list-style-type: none"> 1. Traditional coffee plantations under shaded conditions of Coorg region which contains. 2. Agroforestry system practiced mainly by smallholder farmers in Madhya Pradesh in which <i>Acacia nilotica</i> is grown in rice fields. 3. <i>Dendrocalamus stocksii</i> as live fence in home gardens in Konkan region.
Arid and Semi-arid zones	<ol style="list-style-type: none"> 1. Integration of multipurpose tree species and shrubs with agricultural crops such as millets, pulses, maize and oil and /or livestock 2. <i>Ficus</i> spp along with millets, pulses, maize and oil seeds in Mandya region of Karnataka. 3. <i>Prosopis cineraria</i> along with cereals and pulses in rainfed agriculture and silvo-pastoralism in Western Rajasthan

System based traditional Agroforestry

Climatic Zone	Agroforestry system
Tropical humid and sub humid zones	<ol style="list-style-type: none"> 1. Foliage forests are minor forests allowed for Arecanut farmers to use organic waste as manure in Malnad region of Karnataka 2. Organized and systematically managed shifting cultivation in the Indo Burman region
Tropical wet humid	<ol style="list-style-type: none"> 1. Homegardens of Kerela which constitutes the predominant farming system which includes woody perennials such as Mango, Arecanut, <i>Tamarindus indicus</i>, Teak and Ailanthus along with vegetables, fruits and spices 2. Homegardens of North east India predominantly in the Barrack region of Assam which composed of 3-4 layers of canopy

Classification of Traditional Agroforestry systems- Ecological benefits and Socio-economic functions



A. Agrisilviculture

Agrisilviculture system are the combination of the predominant tree species and the agriculture crops such as cereals, millets, pulses and other vegetable crops. Mainly it can be said as a complete organic venture wherein the compost is prepared from the locally available materials such as leaf litter and green foliage. Native trees contribute to the quality and consistency of the crops grown in between. External cost of the inputs is also reduced. It is a community based farming with integrated farming system, which ensured sustainable income through the system. (Purushothaman et al, 2005)

B. Hortisilviculture

Forest trees along with the horticulture trees is called as Horti silviculture. Predominantly the shade loving horticulture fruits or plantation crops are grown among the trees. This system enhances higher yield and ensures quality of the product. The combination of the species in an integrated manner has higher profit margin. Native tree species has higher valuation in the ecosystem and sustains the environmental benefits of the society. (Dhanya, 2014)

C. Agri-silvipasture

This system increases the growth of the fodder species like Sorghum under shade condition. Fuel wood, charcoal, fruit and fodder harvested regularly. Drought tolerant Kangeyam breed is grown and the native veterinary system gets into the system. Agrisilvipasture system is one of the important traditional agroforestry system to bring in back the Animal husbandry Integrated farming system in the country, as there is an acute shortage of the fodder for cattle. (Jambulingam, 1986)

D. Aqua-agroforestry

Rice and fish cultivated system has recorded an average increase of nearly 30% in the NPK of the soil compared to the regular systems. The emission of CH₄ also reduced to 30%. Further, this system has an average contribution of 50% increase in the regular income of the farming system. This integrated farming system is self sustainable, sufficient and highly efficient system ever recorded. (Tangiang and Nair, 2015)

E. Taungya

Initial year the agriculture crops are grown which gives an additional income and found beneficial. Later stages farmers find income from the seedlings of the tree species. This type of traditional system is economically viable and environmentally beneficial to the community. (Tewari, 2008)

F. Homesteads

Natural fence against conventional fence. Leaf litter as compost for other vegetable and fruit crops. Food, energy and building materials are supplied form these types of home steads. Ornamental and medicinal plants are also included in the system. This ensures higher crop diversity, high productivity, diversity of production and ensures consistent income to the farmers. (Depomier, 2003 and Das, 2005)

Traditional Vs Classical Agroforestry

Factorial studies have revealed that the traditional agroforestry practices have been disappearing over the classical agroforestry systems. Some of the important reasons are non-availability of Agriculture labour, higher income from the tree component, less attention needed, less risks, less inputs and climate vagaries (Saravanan, 2021) and the important interventions such as high yielding short rotation clones, high productivity of the clones, feasible R&D Mechanism, profitable and Multifunctional were the important reasons for adoption of classical agroforestry systems (K.T.Parthiban, et al, 2021). Similar to this traditional agroforestry also should get the attention through the government mechanism such as organized supply chain system, price supportive mechanism, contract farming, institutional credit, insurance for tree species and business model agroforestry.

Way forward

Traditional Agroforestry systems are practiced world wide systematically and has been recorded with maximum benefits in ecological and economic sectors. The system may vary with the systems, structure, functions, socio economic attributes and ecological services. But the distribution is world wide and contributes to the economic valuation of the community. In Indian condition the traditional agroforestry systems are tree centric and scattered approach along with agriculture, horticulture, pastoral and aquaculture systems. But due to intentional intensified cultivation of agriculture and horticulture crops the traditional agroforestry systems are found extinct. It is right time to sustain the age-old agroforestry practices and bring them into the farming systems for the betterment of the society and economic enhancement of the community. Policy initiatives would be a matter of concern to all the developmental sectors.

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