

Impact of Agroforestry on Agricultural Productivity and Farmers

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Abstract - *By constructing integrated systems to achieve environmental and socio-economic goals, agroforestry, or the integration of trees with crops and livestock, to reduce environmental degradation, boost agricultural productivity, increase carbon sequestration, support healthy soil and ecosystems, and provide stable incomes and other benefits to human welfare. While more is known about the effects of actual agroforestry practices, the types of practices that have been studied are limited. Most studies have only looked at two-component systems, such as shelterbelts, windbreaks, hedgerows, riparian buffers, and scattered trees on farms with crops. Evidence on human well-being is few compared to that on the results of regulating ecosystem services and agricultural output, both of which are aspects of providing ecosystem.*

Keywords - *Impact, Agroforestry, Agricultural Productivity, Farmers.*

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INTRODUCTION

Before the arrival of man on the planet, a large portion of it was covered in various forms of vegetation. They made a living by hunting animals and birds, as well as collecting leaves from various plants. With his wisdom growing, the guy began clearing the forest to cultivate various types of agricultural crops. For tens of thousands of years, this has been the case. Man, on the other hand, could live in peace with the natural world as long as there were enough forests and a small population. Many countries have removed far more forest than could endure the environmental effects due to population growth (Bammanahalli, 2016). The rich's greed and the poor's necessity have wreaked havoc on our country's woods. A few decades ago, in our nation, little patches of forest might be found here and there in the proximity of communities, providing the village inhabitants with fire wood, leaf feed, grazing grounds, grasses, small timbers, and a variety of other necessities.

Vegetation of many kinds covered a large portion of Earth before the arrival of humans. To survive, they relied on the meat of animals and birds, as well as the leaves of various plants. With his newfound knowledge, the guy began clearing the forest to make way for agricultural crops (Asik, 2017). This has been happening for a very long time, maybe thousands of years. The human race, however, could coexist peacefully with nature so long as there were adequate woods and a low population density. There has been a greater loss of forest cover due to population growth in many nations than could be

sustained by natural processes. In the latter several decades of the twentieth century, our country plowed much more forest land than environmental concerns would allow. Thus, it is obvious that clearing certain woods for agricultural purposes was not wrong when there were adequate forests, provided that it did not disrupt environmental variables. The survival of the human species in a civilized fashion required the clearing of forest for the creation of habitations and the spread of agriculture. However, excessive forest destruction lies at the heart of modern ills, especially in our own nation (Ariza, 2013).

According to government data, over the past three decades, roughly twenty-five million hectares of land that were listed in revenue records as cultivable wastelands, barren uncultivated lands, or a miscellaneous tree groves were actually forests of one kind or another and were cleared primarily for the extension of agriculture and other crops. Our country's woods are in shambles due to the selfish actions of the wealthy and the desperation of the poor. A few decades ago, our nation was dotted with little swaths of forest near communities that provided residents with the firewood, leaf feed, grazing land, grasses, small timbers, and other necessities of daily life. It is impossible to overstate the importance of keeping adequate proportions of total land area under forests in an agricultural nation like ours, which is exerting Herculean effort to improve the economic

situations of countless millions (Behera, 2014). The National Forest Policy of India, enunciated in 1952, accurately reflects the critical need for a sufficient area under forest by stating, among other things, that "India as a whole should aim at preserving one third of its entire acreage under forests." Since the Deccan and other mountain regions are vulnerable to erosion, it is important to keep a greater percentage of the area under forests in the Himalayan (about 60%) for their productive functions and as insurance against denudation. The target percentage is 20% in plants located on flat terrain, where erosion is usually not a major issue (Chavan, 2015).

Agroforestry which typically involves growing of trees species and development of grazing land either on the farmers own lands or public lands, has a very crucial part to play in the up keep and enhancement of environment. The effectiveness of the agroforestry program depends on the people's active and direct participation in it. agroforestry is people's forestry since it is developed and maintained by ordinary citizens. Trees and other plants play a crucial role in preserving a healthy ecosystem and a stable natural equilibrium. The rapid expansion of our nation's manufacturing and transportation sectors, as well as the ensuing lack of investment in reforestation and other measures to mitigate air pollution, has had a devastating effect on our natural resources (Dhyani, 2013). Because of the dramatic rise in population in recent decades, the need for agricultural products and firewood has increased by a factor of many. Village woods and other vegetations that happen to be located near villages or urban populations were cleared as a short-term solution to suit the growing needs of the populace. Due to the lack of obvious negative effects, the government even promoted it. The destruction of forests and the clearing of other types of vegetation has led to the current state of affairs. The level of pollution in our atmosphere now is threatening the very survival of all forms of life on Earth. That's why everyone's being so cautious and doing their part to keep things ecologically stable and healthy (Ekpo, 2012).

Impact of agro forestry practices

Tree-crop management is an important part of indigenous knowledge and systems in farming practices. In order to derive tangible and intangible benefits, people especially villagers and farmers nurture trees on their farmlands to meet their domestic and commercial needs related to their livelihood. During last century, due to an ever-increasing population, the resources particularly available land started reducing that created an increased pressure on forests as well as agricultural land for providing more food, residential land, timber for commercial use and other produces to have income. Later, a large-scale conversion of forest-land to farming-land and urbanization hastened a disparity between the total forest cover, agriculture land, and people. This led to the required development of modern concept of agro forestry i.e. combination of traditional knowledge, tree

science and related technologies to provide sufficient amount of farm produces with limited resource utilization (Goswami S, 2014).

In farming context, agro forestry practices can only be accepted by rural farmers when opted with an interest towards it. This is because when a farmer develops interest, he seeks more information and tries to gain knowledge on his own or through other available sources which further leads to the development of a positive/negative decision towards agro forestry and when it happens, adoption of agro forestry may take place. Another important aspect in agro forestry adoption is to explore if agro forestry can lead greater economic returns to the farmers. In different agro-climatic conditions, various agro forestry models have been previously developed representing different agro forestry practices (Haokip, 2016).

Integral Role Of Trees In Sustaining Life

For eons, prehistoric people sought refuge in rocky caverns and lofty trees. Today, like in the past, trees and other green plants are crucial to human survival on Earth. Trees not only give us the benefits of their shade, food, fruit, fuelwood, fiber, fodder, and fertilizer, but they also wrap us in a warm, comforting embrace that helps us feel renewed on the inside. If the trees are not safeguarded, life will be in jeopardy. Trees serve as the backbone of the ecosystems they grow in, and the homes they give for a wide variety of creatures. They have a significant impact on the biogeochemical cycles of nutrients, light and water regimes, and crop-growing conditions in a given location, making them more or less valuable as a result of climatic shifts. Firewood, furniture lumber, and medicinal plants are all byproducts of trees that humans find useful. Because of this, their very survival is threatened by human harvesting practices and excessive use. Natural variety is also threatened by the destruction of forests for agricultural and other development purposes (Gupta, 2011).

Humanity has always revered trees and forests as important to our way of life. Trees have been appreciated for their value ever since recorded history began. It is believed that early humans adapted to their environment by making a home among the trees. By coordinating farming and grazing with the cycles of trees, livestock, and migrating birds, they were able to live a modest existence in perfect harmony with the natural world. Forests are crucial to a country's biodiversity and ecological balance, and they also play an important part in the country's social, cultural, historical, economic, and industrial growth. Forests give us access to a wealth of resources, including several ecological benefits. Carbon is absorbed by them, and clean air is produced for the benefit of all living things. Forests provide a variety of benefits, both

material and immaterial, that are rarely valued monetarily at the national level (Harrison, 2015).

According to the State of Forest Report 2009 of Forest Survey of India, the percentage of land covered by forests in India is 21.02%. However, forest degradation and destruction are a real threat due to encroachments on forestland and the illegal harvesting of timber, fuel wood, and non-timber forest products. That list of 17 nations is expanded to include India because of its abundance of diverse plant and animal life. The North East Himalayas, the Andaman and Nicobar Islands, and the Western Ghats are India's three largest biodiversity hotspots, or regions with particularly high species variety. Exploitation of these zones has led to deforestation and climate change in India as well. Deforestation results in the rapid loss of forest cover, which has a negative impact on local biodiversity. In order to promote responsible forest management, conservation, and development, the United Nations General Assembly proclaimed 2011 the International Year of Forests (Kumar, 2013).

Importance and impact of Agriculture to the Indian Economy

Despite the country's efforts to modernize its industrial base, India's agricultural industry continues to be a major contributor to GDP and an important employer of millions. Approximately 70% of rural households rely on agriculture as their primary source of income, and this industry supports the livelihood of roughly two-thirds of the country's population. With its 179.90 million ha of farmland, India ranks second worldwide. One-third of the country's gross domestic product comes from agriculture, fishery, and forestry combined. In 2013–14, at constant prices from 2004–05, the Central Statistics Office estimates that the agricultural and allied sectors made up 13.90% of GDP. This includes the agriculture, livestock, forestry, and fishing subsectors. According to the Economic Survey 2014-15, the agriculture sector faces a number of difficult problems, including a decline in cultivators, a growth rate in productivity that is far below global standards, a decline in the productivity levels of rice and wheat, and soil degradation as a result of a decline in the efficiency with which fertilizer is used. Although around 35% of India's arable land is irrigated, the country's food supply still relies heavily on the weather, since 60% of all food grains and oilseeds are cultivated during the kharif season (Mahato, 2017).

The challenges of health and the prudent use of primary natural resources, especially water, soil, and genetic resources, for a sustainable agricultural development, came into sharp focus in the last decade of the twentieth century. The availability and quality of water, soil health, genetic resource conservation, insulating farm production against increasing biotic and abiotic stresses, managing climate change, diversification, enhancing input-use efficiency, energy management, increasing preparedness to match rapidly evolving trade regime, and genetically modified organisms are all issues that have received attention

from India's National Agricultural Research System (Rajwar, 2011).

Agriculture-Environment Interaction

The weather has a major impact on how well crops grow and whether or not farmers are successful. The unpredictable nature of weather has an effect on farming by disrupting regular agricultural practices and plant protection methods. From planting seeds to storing harvested goods, weather plays a vital role in practically every facet of agricultural production. Pests, insects, and crop diseases all thrive and spread at different rates depending on the weather. Increases in air temperature owing to higher levels of CO₂ and other Green House Gases have emerged as the most obvious and alarming manifestation of man-made climate change during the past several decades. Both the frequency and total amount of rainfall have grown less predictable. Some of the expected implications of such changes include increased floods, droughts, and forest fires; decreased agricultural production; and strong tropical cyclones. There would be widespread effects on agricultural output and, by extension, food security, in any region where such changes occurred. Therefore, agriculture's fundamental goal is to provide enough food for the growing population despite the dwindling resources, all while avoiding environmental destruction.

Large-scale industrialization, deforestation, intense commercial agriculture, shifting dietary habits, and rising levels of consumption, all hallmarks of industrialized nations, have all contributed to the planet's worsening condition. When used to amend soil, wet waste combined with leaf litter and garden clippings creates a rich and nutritious black compost that restores the land's fertility and greatly boosts the soil's ability to absorb water, both of which are essential for organic farming.

Global Climate Change and Carbon Mitigation

Because of rising industrial emissions, fossil fuel combustion, extensive deforestation, burning of biomass, and other changes in land use and land management techniques, the gaseous composition of the atmosphere has experienced a major change during the past several decades. Human actions have led to a rise in the release of greenhouse gases such carbon dioxide, methane, and nitrous oxide. These gases act like a blanket, absorbing and holding on to the infrared heat that would otherwise escape from Earth's surface. Over the next century, scientists predict a rise in air temperature of between 1.4 and 5.8 degrees Celsius. Roughly 4% of all greenhouse gas emissions come from agriculture across the world. The phrase "climate change" refers to the gradual shift in Earth's average weather patterns that is caused by the release of greenhouse gases such as carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O). These

gases accumulate in the stratosphere, where they act as a blanket to keep infrared radiation and so contribute to global warming and altered weather patterns. Natural catastrophes such as landslides, tsunamis, droughts, famines, population migration, and serious health risks have become increasingly common as a result of the changing seasons, rising global temperatures, rising sea levels, and shifting agricultural patterns (Singh, 2011).

Carbon sequestration, which aids in lowering greenhouse gas emissions, is a subject that can no longer be ignored. Capturing carbon dioxide from the air or other human-made sources and putting it into a deep geological reservoir is one method of using this substance in the future. Carbon sequestrations may be divided into two broad categories: geological and terrestrial. Soil, roots, and stems are used to store CO₂ so that plants may use it for photosynthesis; when the plants die, their carbon content is returned to the soil, increasing its fertility. In this way, land management practices are utilized to naturally encourage increased plant and soil carbon storage over extended time periods. Increasing carbon inputs and lowering carbon breakdown can lead to increased carbon sequestration in soils. CO₂ emission from soil is affected by a number of factors. These include soil texture, temperature, moisture, pH, and available carbon and nitrogen. These variables may be manipulated to promote soil carbon sequestration, including the conservation of unused farmland, the repair of soil carbon on damaged lands, the reduction of tillage, and the increasing cultivation of agroforestry and biofuel crops.

Sustainable solutions that don't simply address the immediate problem but also provide for future generations are urgently required. Since the world's natural resources are finite, their use must be carefully regulated and controlled to avoid depleting them prematurely and jeopardizing the possibility of long-term progress. No one country has the burden of protecting mankind from the consequences of climate change; rather, this task falls on the shoulders of every person on Earth. According to the Millennium Development Goals, the world's CO₂ emissions have grown by more than 46.00 percent since 1990, making it critical to incorporate the concepts of sustainable development into policies and programs and halt the depletion of natural resources. For the most part, India has not contributed to global warming pollution in the past; now, the country ranks 135th among the world's least developed nations with per capita emissions of 1.60 tons, compared to the global average of 4.90 tons. However, with 1.97 billion tonnes of CO₂ emissions, it is the third largest emitter in the world, behind the United States and China. India, however, has committed to increasing its forest cover from 24.0% in 2013 to 33.0% by 2030.

Our farming systems should be strategically designed by the Indian Council of Agricultural Research (ICAR), Agricultural Universities, and Krishi Vigyan Kendras and popularized by local men and women to maximize the production benefits of good monsoons and

minimize the adverse impact of climate change, thereby protecting lives and livelihoods from the negative effects of unfavorable climate. Mitigation efforts that decrease deforestation and increase afforestation will have a positive effect on atmospheric CO₂ levels. In reality, "a biogas plant, a few fertilizer trees, and a farm pond in every farm" is the most efficient approach to contribute to low carbon development route at the local level. Since 1949, sea levels have risen by 15 centimeters due to human-caused global warming. The forest cover that helps absorb CO₂ has decreased from 4.70 billion hectare in 1949 to 714.90 million hectare in 2015, while CO₂ emissions have grown from 14.90 to 35.60 gigatonnes. To prevent a rise in atmospheric temperature of 2.0 oC, 196 countries signed a historic agreement in Paris to cut greenhouse gas emissions and transition to renewable, zero-carbon energy (Sujakhu, 2016).

Agroforestry productivity to farmers

The use of tree-based systems in agriculture, known as agroforestry, dates back thousands of years. The temporal and geographical features of the human relationship with trees and land use systems may be understood in different agroclimatic zones. It is generally agreed that agroforestry methods — the integration of tree planting with agricultural crop and grass production — have their roots in the Vedic period (around 1000 B.C.). Around 700 B.C., humans shifted their diets from a foraging and hunting lifestyle to one based more on agricultural production. Adapting farming methods to changing agroecological circumstances is an ancient practice in India. It is possible to trace the need for cattle in agriculture and a mixed economy back to the chalcolithic period of prehistory, when people began growing date palm, banana, pomegranate, coconut, ber, amla, bael, lemon, etc. However, in India, plant husbandry began during the Neolithic era despite the country's increasingly arid climate. Many common trees, like *Prosopis cineraria*, *Ficus religiosa*, and *Butea monosperma*, play important roles in Indian folklore that are referenced in the Rig Veda, the Atharva Veda, and other ancient Indian texts. Rural communities' ability to employ annuals and woody perennials in harmony has been documented in traditional agroforestry systems. This finding also shows that farmers and forest advocates share a unique bond with trees.

Agroforestry Global Scenario

Agroforestry has a long history of use in Central America. It was common practice in Europe to cut down old growth woods, burn the resulting slash, plant new trees, and raise livestock. Depending on the local agroclimate and agricultural demands, farmers in various areas of Asia include different types of woody perennials into their crop and animal production fields.

Agroforestry In India

In an effort to solve the land-use issues that plague India's rainfed and irrigated farming systems, scientists are experimenting with agroforestry approaches that employ both native and alien multifunctional and nitrogen-fixing woody perennials. They might be as easy as shifting cultivation or as involved as elaborate home gardens. In India, agroforestry may be found in every single ecological and geographical zone. There is a wide range of complexity and species richness, productive and protective features, and social and economic impact among the systems. To restore fertility in a shorter amount of time, the tree species chosen for afforestation of fallow lands or intercropping with arable crops should be fast-growing, ideally nitrogen-fixing, and should efficiently recycle available nutrients within the system. Plants such as *Acacia*, *Albizia*, *Casuarina*, *Erythrina*, *Glyricidia*, *Leucaena*, *Parkinsonia*, *Pithecolobium*, *Prosopis*, and *Sesbania* may be among those used. As a result, one strategy for discovering alternatives to shifting agriculture is intercropping between fast-growing trees during a fallow phase (Kaushal, 2014).

There is a complicated interaction between the soil, plants, and other components of the ground because the components are so intimately intermingled in space in horizontal and vertical strata, taking into account all nutrient and environmental elements. There are many trees that serve both productive and protective purposes, and they are arranged in a variety of spatial and temporal configurations. Teak (*Tectona grandis*), jack-tree (*Artocarpus* spp.), *Casuarina equisetifolia*, *Mangifera indica*, *Ceiba pentandra*, *Leucaena leucocephala*, *Bambusa arundinacea*, *Erythrina variegata*, and *Glyricidia sepium* are also examples of such trees (both good support to black pepper). *Thespesia populnea* is a popular tree in low-lying farmsteads, and the wood from these trees is frequently used to make tools for farming. The mangroves that line the shores of the lowlands are an integral element of the lowland lifestyle. As a typical type of fuelwood, they are widely utilized. Plants like the coconut palm and the pandanus (*Pandanus tectorius*) bush are frequently encountered in watery areas. In coastal Andhra Pradesh, the Palmyrah palm (*Borassus flabellifer*) is a widespread multi-use palm. The primary occupation of homesteaders is the cultivation of fish and shrimp in secluded waterways and in close proximity to mangroves. So, having a wide variety of crop species on farms is beneficial for providing the farmer with essentials like food, fuel, fodder, lumber, and money. This contributes to maintaining fertility through nutrient recycling, organic manuring, mulching, and enhanced microbial activity in the rhizosphere of crops, despite the high intensity of cropping. High family labor use and reduced risk are two societal advantages. In addition to helping preserve biodiversity and keep the ecosystem healthy, this method can assist reduce soil erosion caused by dense vegetation (Masakazu, 2017).

Need For Agroforestry in the Current Indian Context

The goals of the policy are to increase tree cultivation through an integrated approach, to protect and stabilize ecosystems, to promote resilient cropping and farming systems, to minimize risk during extreme climatic events, to meet the raw material requirements of wood-based industries and to reduce the import of wood and wood products to save foreign exchange, to supplement the availability of agroforestry products and reduce the pressure on natural forests (Gunaga, 2014), and to promote sustainable agriculture and forest management. However, in order to accomplish the goals outlined in the National Agroforestry Policy, it is essential to learn and analyze whether the most important stakeholders, i.e. farmers, understand the full potential of agroforestry on their farms in terms of the region's unique socioeconomic and microenvironmental outcomes.

CONCLUSION

It is clear that agroforestry has the ability to alleviate the consequences of global warming in the current climate change trend, and that it is receiving more attention in the current Indian agricultural environment as a sustainable technique of agriculture. Agroforestry's numerous benefits indicate that it is an efficient agroecological strategy for slowing the growth of the world's carbon footprint. The Government of India approved the National Agroforestry Policy in 2014 with the objectives of establishing a National Agroforestry Mission to coordinate, converge, and establish synergy among the stakeholders; increasing productivity and profitability; supplying food, fodder, fuel, fiber, fertilizer, timber, and other agroforestry products; ensuring environmental security; and expanding tree cover outside of natural forests. After learning about the types of people that work in agroforestry, it's possible to conduct an in-depth analysis of the challenges those people confront and the strategies that may be used to free them. The existing evidence demonstrating the impacts of agroforestry practices and interventions on agricultural productivity.

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