

## **Evaluating the Potential of Agro-forestry for Sustainable Land use Management: An Analytical Perspective**

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### **Abstract**

Evergreen trees are used in farming practises known as agroforestry. Since it offers farmers and rural communities a financially and environmentally viable option for extensive diversified agriculture to obtain more fuel, pasture, fruits and vegetables, and fibres on the one hand and a better environment on the other, it has been used for ages in India as a traditional land use system. To boost total output, food crops, trees, and animals are all kept together on the same plot of land. These management strategies make sense in terms of both the economy and the environment. To sustain the demand for forest cover, these two resources—forest vegetation and agricultural output—only need to be compromised. It is crucial for improving agricultural production overall, improving soil fertility by adding organic matter, reducing climate change through carbon sequestration, safeguarding watersheds, and preserving biodiversity. Agro forestry ecosystems have the possibility of offer important mitigation alternatives, but they need to be managed properly because this affects how much carbon is stored. In India, the full potential of agro forestry practices for reducing climate change may be realized.

**Keywords:** Agro Forestry, Agro Forestry Ecosystems, Potential of Agro-Forestry, Agro-Forestry For Sustainable Land Use, Agro Forestry Practices

### **Introduction**

When agricultural crops or animals are purposefully produced on the same piece of land in a spatial or temporal arrangement with woody perennials like trees, bushes, palms or bamboos, the practice is known as agroforestry. This approach, which combines crop and livestock production with tree planting, has the potential to diversify and increase farmers' output as well as provide environmental and social benefits like improved land growth, erosion prevention, water management, carbon preservation, biodiversity, and resistance to natural hazards. These benefits come from the provision of food, wood, fibre, and medicines. By assisting in the eradication of hunger, the reduction of poverty, the promotion of gender equity and social inclusion, the provision of affordable and cleaner energy, the protection of land life, the reversal of land degradation, and the fight against climate change, agroforestry can help achieve a number of Sustainable Development Goals. It is a type of farming that uses trees to produce food, demonstrating how they may coexist. It is a reliable and environmentally friendly farming method that might greatly reduce the consequences of the climatic disaster. Agroforestry is the combination of agriculture with trees,

specifically the use of trees for agricultural reasons. Trees on farms and in agricultural settings, as well as farming in forests and along forest boundaries, are all examples of cultivating trees for crop production (Chauhan, Sharma, Dhillon, 2012 and Handa, & Dhyani, 2015).

During agricultural production, a farmer may encounter a variety of difficulties and meteorological circumstances, including unpredictable rainfall, stone hail, drought, flood, and more. The issue is also being made worse by issues including post-harvest losses, storage, and a lack of readily available effective marketing. The conflict between humans and animals and between humans and crops, forest fires, soils deficient in organic matter, disease of plants and invasion, migration, and the unwillingness of young people to engage in agriculture are some of the current issues. Crop diversification, a traditional technique that uses low input-based vast and diverse agricultural practises, may be employed as a counter-strategy to farming irregularities to save farming. Crop diversification is a method used to cultivate more different crops on the same amount of agricultural land while also increasing yield. Lessening of the demands placed on natural forests. In the near term, agroforestry is recognised to have the ability to reduce the consequences of climate change by regulating microclimate and conserving natural resources. Sequestration of carbon Agroforestry species are known to absorb substantially more carbon in below-ground biomass than crop and grass systems, and even more than primary forests. Agroforestry makes it possible for agricultural land to survive climate change and adverse weather conditions like floods and droughts. It improves the soil's nutritional content while also reducing soil erosion (Dhyani, & Handa, 2014 and Kumar, Thakur, & Thakur, 2017).

Trees have traditionally played a significant part in all sorts of terrestrial ecosystems, offering both urban and rural inhabitants a variety of crucial services and goods. The vast majority of trees are used for a variety of purposes, including all the cultural advantages. The agroforestry system is also used to establish property lines and provide rights to utilise the land. They are essential for both land regeneration and the general enhancement of soil health. Agroforestry is advantageous in a number of ways, including by increasing soil organic matter, bringing up subsurface water and nutrients, eliminating carbon dioxide from the environment, and creating new and diversified agricultural practises. Because agroforestry is a form of land use that may boost the utilisation of agricultural land while offering long-term benefits and reducing negative environmental consequences on a local and global scale, techniques employed in agroforestry are being promoted more and more as feasible treatments. It supports sustainable forest management and environmental sustainability and conservation, which has the potential to reduce emissions brought on by deforestation and forest degradation. Applying agroforestry, a method of land use that encourages higher output and environmental stability is crucial (Chavan, Keerthika, Dhyani, Handa, Newaj, & Rajarajan, 2015).

### **Literature Review**

In a research it was found that it is impossible to overstate the significance of agroforestry because it has a number of benefits, including meeting the food and other basic needs of a large portion of the rural population, preserving soil fertility, limiting weeds, and reducing the destruction of the environment. Agro-forestry techniques are being promoted more and more as viable treatments because they have the ability to enhance agricultural land use systems, offer long-term advantages, and lessen negative environmental consequences on a local and global scale. Many of the negative

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consequences of human land use, such as greater agricultural production system variety, higher crop and animal yields, decreased non-point source pollution, and increased rural development, may be addressed with the help of agroforestry. This is accomplished by creating a management strategy based on ecosystems to guarantee sustainability and environmental quality. The deteriorating state of the environment, particularly the soil, should be addressed while also improving the farmer's production, and this is how agroforestry should be seen. This will improve the farmers' income in addition to ensuring the stability and security of the food supply (Gao, Barbieri, & Valdivia, 2014).

In a research it was observed that through its environmental, economic, and social roles, agroforestry significantly contributes to the sustainability of the environment. While increasing the soil's ability to produce, no harm is done to the environment. It is renowned for its capacity to maintain human activity while also conserving natural resources. The old farming system can no longer support the world's expanding population. Food demand is increasing, putting additional strain on forests and their products, which has considerably contributed to the unsustainable use of the country's natural resources. Agroforestry is regarded as one of the sustainable land management systems that boosts output, promotes ecological stability, and aids in sustainable environmental development in light of these factors. The inclusion of trees in the farming system could significantly aid in the reduction of environmental issues in addition to providing wood, food, and animal products by fostering microclimates that are favourable for crop growth and improving the recuperation of nutrients to provide a more complete vegetation cover. By doing so, you might be able to prevent soil erosion and temper high temperatures. Agroforestry makes a substantial contribution to sustainable development through its positive effects on the economy, the environment, and society. It has been established that agroforestry satisfies the requirements of sustainable development with no adverse effects on the environment (Jose, 2012 and Sharma, Singh, Verma, 2017).

Global difficulties in terms of economy, society, and the environment are brought about by climate change. According to research, human actions that cause CO<sub>2</sub> emissions by removing forest cover are to blame for climate change. Deforestation, or the human-induced conversion of forests to non-forest uses, is frequently accompanied with significant acute decreases in the forest carbon pool through land clearing. The ozone layer is being destroyed as a result of poor forest management practises, unlawful encroachment into forest reserves, urban growth, road building, the burning of fossil fuels, and an excessive collection of fuel wood. 18% of the world's carbon emissions are attributable to deforestation. It was also claimed that 12 to 15% of the world's carbon emissions from fossil fuels were sequestered through reduced deforestation, forest regeneration, enhanced plantation development, and agroforestry. Agroforestry has a significant potential to lower atmospheric carbon dioxide (CO<sub>2</sub>) concentrations and slow down climate change. It is well known that increasing the number of trees planted, the area covered by forests, or the density of the current forest in Nigeria will all assist to lessen the effects of climate change both locally and globally. Only by implementing CO<sub>2</sub> reduction techniques will the growing levels of atmospheric carbon dioxide and related global warming be addressed. Agroforestry, a system that mixes agronomic crops (annual or perennial) with trees and/or shrubs (perennials), has considerable potential for the sequestration of carbon both above and below ground. It has been noted that agroforestry systems offer a special chance to enhance carbon stock in the terrestrial biosphere even if they are not

mainly designed for the storage of carbon (Basu, 2014 and Murthy, Gupta, Tomar, Munsi, Hegde, & Ravindranath, 2013).

In a research it was found that no other long-standing, significant environmental issue that has a negative impact on the economy is soil erosion. This has a number of negative effects on the environment and the economy, particularly when the soil's capacity for resilience is low. Therefore, an agroforestry practice that includes woody perennials has the potential to reduce the effects of soil erosion by include both the above- and below-tree biomass. The system of agroforestry will assist address some of the country's economic instability challenges when it is properly improved and placed in the correct perspectives by all environmental stakeholders. In an agroforestry system, trees are known to offer a variety of benefits, including improved soil fertility, income, raw materials, and the provision of medicines, food, shelter, and fuel wood. In addition to offering a wide spectrum of environmental protection, forest goods and services are crucial to many facets of existence. Additionally, it was discovered that the gathering, processing, and selling of goods made from economic forest trees is crucial for generating employment, revenue, and food security. Agroforestry is crucial for preventing soil erosion since trees are crucial for holding the soil together. Agroforestry has a great deal of promise for concurrently achieving three key goals: safeguarding and conserving natural resources; creating a lot of commercial commodities; and boosting the income and access to raw materials for rural residents. To evaluate the changes occurring under agroforestry systems in comparison to planting a single tree or a single crop, soil organic carbon and accessible nutrients increased (Sobola, Amadi, Jamala, 2015 and Raj, Jhariya, Pithoura, 2014).

### Methodology

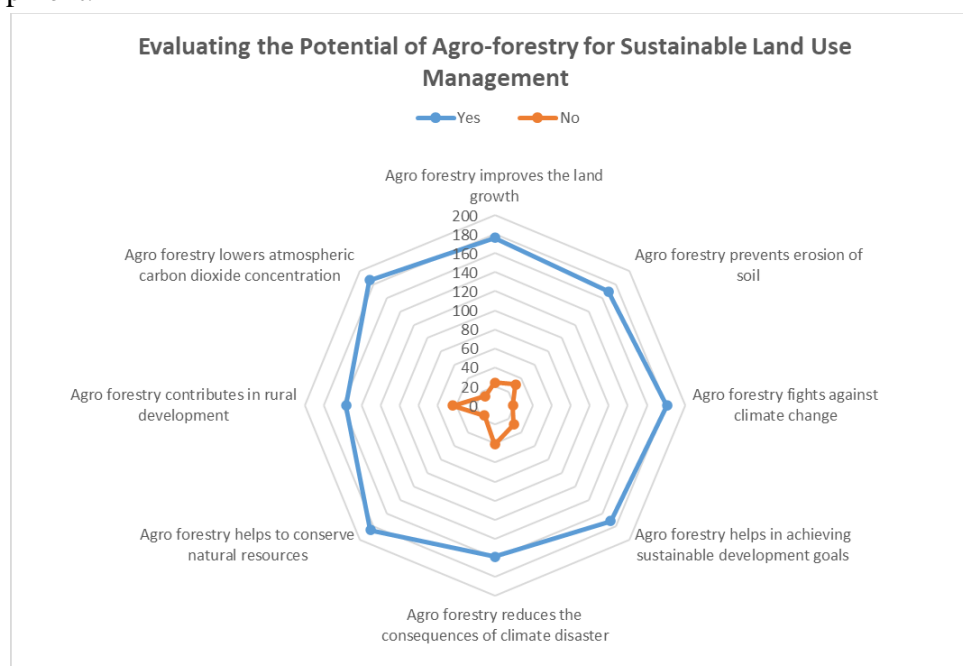
This study is descriptive in nature in which data is obtained from 200 respondents who have used agro forestry in place of traditional form of agriculture. A checklist question was used to analyze and interpret the data. In a checklist question respondents choose “Yes” or “No” for all the questions.

**Table 1. Evaluating the Potential of Agro-forestry for Sustainable Land Use Management**

Sl. No.	Evaluating the Potential of Agro-forestry for Sustainable Land Use Management	Yes	%Yes	No	%No	Total
1	Agro forestry improves the land growth	176	88.00	24	12.00	200
2	Agro forestry prevents erosion of soil	169	84.50	31	15.50	200
3	Agro forestry fights against climate change	181	90.50	19	9.50	200
4	Agro forestry helps in achieving sustainable development goals	172	86.00	28	14.00	200
5	Agro forestry reduces the consequences of climate disaster	159	79.50	41	20.50	200
6	Agro forestry helps to conserve natural resources	185	92.50	15	7.50	200
7	Agro forestry contributes in rural development	156	78.00	44	22.00	200
8	Agro forestry lowers atmospheric carbon dioxide concentration	186	93.00	14	7.00	200

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Table and Figure 1 show that 93% respondents agree that Agro forestry lowers atmospheric carbon dioxide concentration while 92.50% respondents agree that Agro forestry helps to conserve natural resources. 90.50% respondents agree that Agro forestry fights against climate change while 88.00% respondents agree that Agro forestry improves the land growth. 86.00% respondents agree that Agro forestry helps in achieving sustainable development goals while 84.50% respondents agree that Agro forestry prevents erosion of soil. 79.50% respondents agree that Agro forestry reduces the consequences of climate disaster while 78.00% respondents agree that Agro forestry contributes to rural development.



### Conclusion

The previously existing natural ecosystems have been severely disrupted by the issue of environmental instability, which is brought on by rising demand on the land resources as a result of population increase that won't stop. It is crucial to address these disruptions generated by humans and improper usage of the natural ecosystem since they presented a serious danger to the local biodiversity and deteriorated the environment. Combining various tree species with herbaceous plants, animals, and/or crops in a certain spatial arrangement or temporal sequence is known as agro forestry. Both household production in general and biodiversity in particular might benefit from these methods. Additionally, it lessens soil loss, enhances the chemical and physical characteristics of soil, and aids in reducing climate change for the sustainability of the ecosystem. A proper framework must be adapted towards the long-term preservation of the environment in order to fully utilize agro forestry practices and systems. The benefits of agro forestry for reducing rural unemployment as well as for coping with and adapting to climate change are major motivations. The only method to maximize farm output is to combine tree farming with agriculture due to the declining number of landholdings. Agro forestry is a means of addressing the issues of nutrition, sustenance, energy, employment, and security of the environment. Agro forestry will undoubtedly have a significant impact in the near future due to its significance in ensuring the

security of food and livelihoods as well as its role in addressing environmental concerns. In order to combat global warming, combat climate change, increase per-unit productivity of the land, and turn marginal and degraded fields into productive regions, agro forestry and trees outside of forests will be crucial issues. Agro forestry has the power to protect natural resources and expand the nation's forest cover. An important technique for achieving sustainability, maximizing production, and reducing the consequences of climate change is agro forestry or the integration of trees, crops, and cattle in an already established land use system.

## References

1. Handa, A. K., & Dhyani, S. K. (2015). Three decades of agroforestry research in India: Retrospection for way forward. *Agricultural Research Journal*, 52(3), 1.
2. Raj, A., Jhariya, M.K., Pithoura, F. (2014). Need Of Agroforestry And Impact On Ecosystem, *Journal Of Plant Development Sciences*, 6 (4), 577-581.
3. Kumar, Y., Thakur, T. K., & Thakur, A. K. (2017). Socio-Cultural Paradigm of Agroforestry in India. *International Journal of Current Microbiology and Applied Sciences*, 6(6), 1371-1377.
4. Sharma, P., Singh, M.K., Verma, K. (2017). Agroforestry Systems: Opportunitites and Challenges in India, *Journal of Pharmacognosy and Phytochemistry*, 6(6), 953-957.
5. Dhyani, S. K., & Handa, A. K. (2014). Agroforestry in India and its Potential for Ecosystem Services. *Springer eBooks*, 345–365.
6. Chauhan, S.K., Sharma, R., Dhillon, W.S. (2012). Status of Intercropping in Poplar Based Agroforestry in India, *Forestry Bulletin*, 12(1), 49-67.
7. Murthy, I. K., Gupta, M., Tomar, S., Munsi, M., Hegde, R., & Ravindranath, N. H. (2013). Carbon Sequestration Potential of Agroforestry Systems in India. *Journal of Earth Science & Climatic Change*, 04(01), 1-7.
8. Chavan, S. B., Keerthika, A., Dhyani, S. K., Handa, A. K., Newaj, R., & Rajarajan, K. (2015). National Agroforestry Policy in India: a low hanging fruit. *Current Science*, 108(10), 1826–1834.
9. Sobola O. O., Amadi D. C., Jamala, G. Y.(2015). The Role of Agroforestry in Environmental Sustainability, *Journal of Agriculture and Veterinary Science* , 8(5), 20-25.
10. Jose, S. (2012). Agroforestry For Conserving And Enhancing Biodiversity. *Agroforestry Systems*, 85(1), 1–8.
11. Gao, J., Barbieri, C., & Valdivia, C. (2014). A Socio-Demographic Examination Of The Perceived Benefits Of Agroforestry. *Agroforestry Systems*, 88(2), 301–309.
12. Basu, J. P. (2014). Agroforestry, Climate Change Mitigation And Livelihood Security In India. *New Zealand Journal of Forestry Science*, 44(Suppl 1), S11.