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Agroforestry-based carbon farming: Agronomic strategies for climate change mitigation and sustainable agriculture

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Abstract

Agriculture has a paradoxical place in the global climate system: it is both a significant anthropogenic source of greenhouse gas (GHG) emissions and a landscape with significant capacity to sequester carbon. The agriculture, forestry, and other land use (AFOLU) sector contributes about a fifth of the global anthropogenic GHG emissions, which are mainly due to enteric fermentation, soil management, land-use change, and rice production. Agroforestry: The intentional combination of trees and crops and/or livestock has become a scientifically sound, multifunctional land-use approach that can effectively balance agricultural productivity with carbon sequestration in the atmosphere. The review is a synthesis of peer-reviewed literature on the carbon sequestration capacity of agroforestry systems, agronomic systems that maximize carbon sequestration, and the co-benefits of environmental and socioeconomic aspects of adoption. The most important results suggest that agroforestry systems have the potential to capture 1.12 Pg CO₂ equivalent of CO₂ per year at the global level, and as a rule, hold two to four times more carbon than the monocropping systems. Agroforestry systems have an average of 34% greater soil organic carbon stocks compared to adjacent monocultures. In spite of this possibility, large-scale implementation is limited by land tenure insecurity, lack of knowledge, limited carbon monitoring systems, and lack of financial incentives. The review ends with a discussion on policy levers, carbon market mechanisms, and priority research directions needed to scale agroforestry-based carbon farming as a mainstream climate-smart agricultural practice.

Keywords: Agroforestry, carbon sequestration, climate-smart agriculture, carbon farming, nature-based solutions

1. Introduction

Climate change is an existential menace to the world's food systems. The increase in the levels of CO₂, CH₄, and N₂O contributes to warming, changes in precipitation patterns, and the frequency of extreme weather events, which directly affect crop production, food security, and rural livelihoods, especially in climate-sensitive developing countries^[14]. The AFOLU sector is a major source of anthropogenic GHG emissions in the world, with land-use change, livestock systems, fertilizer application, and soil carbon loss as the main contributors^[2, 5]. Traditional tillage-based monocrop agriculture increases the rate of soil organic carbon (SOC) loss and CO₂ emissions, and degrades the physical and biological characteristics of soil^[6, 7]. Historical cultivation has reduced SOC stocks in most agricultural soils by 3050 percent of their pre-cultivation baselines^[9]. Restoring carbon to agricultural landscapes has become a key goal of global climate policy. Both the 4 per 1000 Initiative and the climate-smart agriculture (CSA) framework rely on improved land management as a route to net-zero agriculture^[10, 11]. Agroforestry is one of the strategies that has been proposed to be used in farming systems that combine perennial woody species with farming systems due to its ability to sequester carbon, maintain agricultural production, and provide a variety of ecosystem services at the same time^[12, 13]. This review offers a critical synthesis of the scientific evidence on agroforestry-based carbon farming. It discusses (i) agroforestry systems typology and carbon pools; (ii) carbon sequestration processes and potential; (iii) agronomic strategies to maximize carbon capture; (iv) environmental and socioeconomic co-benefits; (v) measurement and monitoring systems; and

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(vi) policy constraints and enabling mechanisms to scale up adoption.

2. Agroforestry Systems: Typology and Carbon Pools

2.1 Definition and Conceptual Framework

Agroforestry is defined as a land-use management system in which woody perennials (trees or shrubs) are deliberately integrated with herbaceous crops and/or livestock on the same unit of land, either spatially or temporally [15]. In contrast to monocropping, agroforestry forms vertically and temporally stratified landscape interacting to exploit ecological complementary within the system components. Trees reach

deeper in the soils not only in nutrients and water but also offer canopy shades, litter, and root-mediated soil enhancement that promotes beds with them [20, 29, 30]. Agroforestry is based on a major carbon farming concept that perennial woody crops sustain a variety of carbon pools exceeding biomass above ground and root structure and a larger SOC compared to annual crop systems [18].

2.2 System Types

Radical agroforestry forms, five in total, are differentiated having characteristic structural features and carbon sequestration capacity (Table 1).

Table 1: Comparative Overview of Major Agroforestry System Types and Their Carbon Sequestration Rates

System Type	Components	C Sequestration Rate	Key Ecological Benefits
Agrisilviculture	Trees + annual/perennial crops	2–8 Mg C ha ⁻¹ yr ⁻¹	Improved SOC, biodiversity, and microclimate regulation
Silvopastoral	Trees + forage + livestock	1.5–6 Mg C ha ⁻¹ yr ⁻¹	Enhanced pasture productivity, livestock welfare, and soil carbon
Agrosilvopastoral	Trees + crops + livestock	3–10 Mg C ha ⁻¹ yr ⁻¹	Maximum biodiversity, complex nutrient cycling
Alley Cropping	Hedgerow trees + crops in alleys	2–7 Mg C ha ⁻¹ yr ⁻¹	Systematic SOC enrichment, reduced soil erosion
Forest Farming	Shade-tolerant crops under canopy	5–15 Mg C ha ⁻¹ yr ⁻¹	High biomass retention, litter-driven SOC build-up

Sources: Nair *et al.* [15]; Montagnini & Nair [18]; Murgueitio *et al.* [28]; Jose [17]; Zomer *et al.* [16]

2.3 Carbon Pools in Agroforestry Systems

Agroforest systems contain four main carbon pools that interact to establish the overall system carbon holding capacity (Table

2). These pools are important to the correct carbon accounting and to the design of systems that maximize the long-term carbon stability.

Table 2: Carbon Pools in Agroforestry Systems: Components, Stock Ranges, and Key Determinants

Carbon Pool	Components	Stock Range	Key Determinants
Aboveground Biomass	Stems, branches, leaves	10–200 Mg C ha ⁻¹	Species, age, climate, density
Belowground Biomass	Roots, rhizomes	2–40 Mg C ha ⁻¹	Root architecture, soil depth, species
Soil Organic Carbon	SOM, humus, microbial	20–150 Mg C ha ⁻¹	Tillage, organic inputs, texture
Litter & Deadwood	Leaf litter, prunings	1–10 Mg C ha ⁻¹	Decomposition rate, management intensity

Sources: Lorenz & Lal [21]; Nair *et al.* [15]; Cardinael *et al.* [14]; Six *et al.* [19]

3. Carbon Sequestration Potential

3.1 Mechanisms of Carbon Capture and Storage

The CO₂ that is fixed in agroforest systems mainly occurs via a process called photosynthesis. Unlike annual crops, perennial trees are persistently long-term carbon sinks, as they build woody biomass-stems, branches, and roots- over decades, thus serving as persistent long-term sinks of carbon [6, 15]. Organic carbon is deposited in the soil as root turnover, rhizodeposition, and litter decomposition to recalcitrant humic compounds by microbially establishing stabilization processes [19]. Less tillage of agroforestry systems, which leads to reduced soil perturbation compared to tillage-based annual cropping retards SOC mineralization and increases aggregate-guarded carbon pools [7].

3.2 Comparison with Conventional Agricultural Systems

This evidence clearly shows that agroforestry has better carbon performance than monocropping. Soc stocks. According to a worldwide meta-analysis by Cardinael *et al.* [14], SOC stocks were found to be on average 34 percent higher in agroforestry systems compared to monocultures. According to Zomer *et al.* [16], the estimated amount of carbon sequestered by agroforestry systems as compared to monoculture systems is up to two or

four times higher. Agroforestry, which has layers of different kinds of vegetation, is better able to exploit solar radiation and the resources beneath the ground because of structural diversity, hence being able to do this better than the simplified forms of cropping structures [17, 18].

3.3 Global Sequestration Estimates

There is now a huge existing carbon store of an area of in excess of one billion hectares of agricultural land around the globe that is in any way engaged in agroforestry (LernimateARC). Griscom *et al.* [13] have approximated that a large-scale use of agroforestry on appropriate agricultural landscapes could reduce 1.1–2.2 Pg of CO₂ annually, a material contribution to global climate mitigation targets. The highest potential of sequestration occurs in tropical regions due to greater rates of growth, unlike the silvopastoral and windbreak systems of temperate and semi-arid regions, which some offers significant opportunities of restoring degraded lands [12, 17]. The question of whether stored carbon will be permanent over varying climatic conditions still lingers and there is also the need to monitor it over long periods [24].

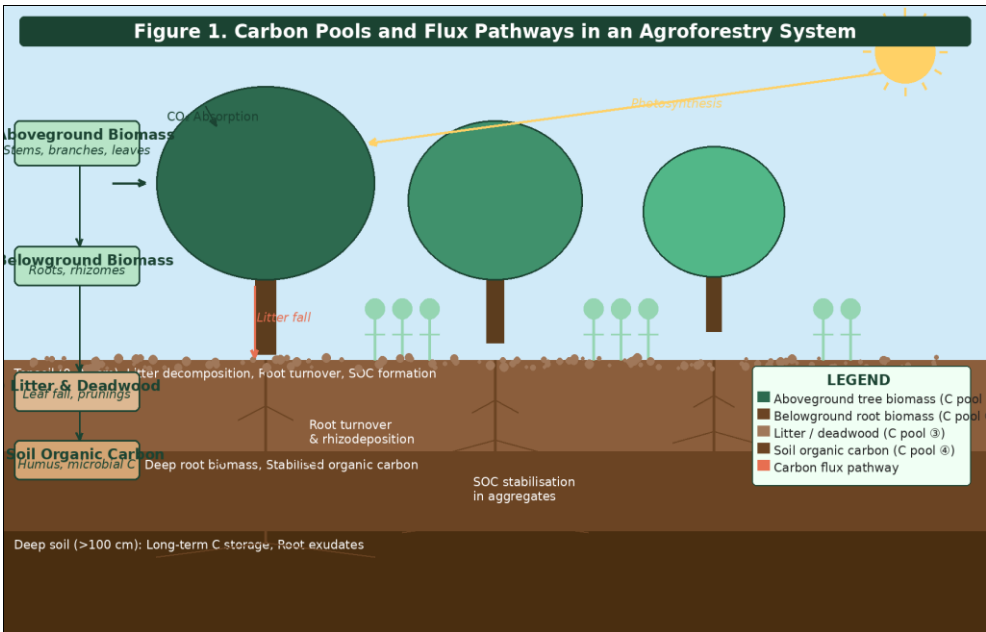


Fig 1: Carbon pools and carbon fluxes within a typical agroforestry system. Displayed aboveground biomass (1), belowground root biomass (2), litter, deadwood (3), and soil organic carbon (4) relative to major directions of carbon flux such as photosynthesis, litter fall, root turnover, and rhizodeposition.

4. Agronomic Strategies for Enhancing Carbon Sequestration

Evidence-based agronomic management is also necessary to

achieve the maximum carbon sequestration potential of agroforestry. Table 3 overviews key strategies, mechanisms, benefits, and considerations of their implementation.

Table 3: Agronomic Strategies for Enhancing Carbon Sequestration in Agroforestry Systems

Strategy	Mechanism	C/Agronomic Benefit	Implementation Notes
Species Selection	Fast-growing, high wood density species (Leucaena, Gliricidia, Populus)	Carbon stock, soil N	Species-site compatibility; competition risk
Nitrogen-Fixing Trees	Biological N fixation reduces synthetic fertilizer use	Soil N, SOC, microbial	Match species to climate zone
Alley Cropping Design	Systematic row spacing; pruning biomass returned as mulch	SOC, crop yield	Optimize canopy-crop light balance
Conservation Tillage	Minimal disturbance; permanent soil cover via residues/cover crops	SOC stability	Residue management logistics
Integrated Nutrient Mgmt	Compost, green manure, and pruning biomass as organic amendments	SOC, crop nutrient	Labor requirements for smallholders
Water Management	Contour planting, mulching, and deep-rooted trees reduce evaporation	Biomass, resilience	Avoid over-competition in semi-arid zones

Sources: Nair *et al.* ^[15]; Sileshi *et al.* ^[26]; Isaac *et al.* ^[20]; Cardinael *et al.* ^[14]; FAO ^[11]; Paustian *et al.* ^[7]; Minasny *et al.* ^[10]

4.1 Species Selection and Tree–Crop Interactions

The selection of tree species is the most significant design in agroforestry for carbon farming. Rapid biomass carbon-accumulating, rapid-growing, high wood-density species, such as *Leucaena leucocephala*, *Gliricidia sepium*, and *Acacia* spp. in tropical systems and *Populus* spp. and *Salix* spp. in temperate systems, are rapid-growing species that have high biomass carbon turnover and accumulate high root biomass, enriching SOC. Complementary interactions- trees-crops that take advantage of the varied depths of soils and levels of canopies-give optimal effectiveness of resource-use and overall system output ^[29].

4.2 Nitrogen-Fixing Trees and Soil Fertility

Agroforestry carbon farming thinks of nitrogen-fixing tree species, which play a particularly strategic position in forestry. They fix atmospheric N₂ to nitrogen and plant-usable form, supporting symbiotic rhizobial bacteria, eliminating the need to use synthetic fertilizers, which dominate as a major source of N₂O emissions ^[26]. They are rich in nutrients, and when applied as mulch or green manure, they rapidly accumulate SOC and promote the living organisms ^[26]. Subsequently, the resultant

accelerated nutrient cycling and stabilization of organic carbon by the improved soil biological community in soil aggregates ^[19].

4.3 Spatial Design and Conservation Agriculture Integration

The trade-off between the accumulation of carbon and the yield of crops depends mainly on the spatial arrangement of the tree density, the row spacing, and even the orientation. The design of alley cropping provides enough light to crop reaching the soil and directing cut biomass as mulch on the alleys, forming SOC and weed suppression ^[20]. The application of agroforestry systems incorporating conservation agriculture (minimal disturbance, permanent ground cover, year-round biological activity through diversified rotations) leads to synergies that further stabilize SOC through decreased oxidation, aggregate preservation, and biological activity throughout the year ^[7, 10].

5. Environmental and Socioeconomic Co-Benefits

5.1 Environmental Benefits

In addition to carbon sequestration, agroforestry regimes provide a bundle of ecosystem services. Increased organic matter inputs, enhancement in soil aggregation, and heightened microbial

diversity lead to soil health improvement, which increases water penetration, nutrient retention, and long-term soil productivity [6, 8]. The structural heterogeneity of agroforestry landscapes is useful in biodiversity conservation since it supports pollination and wildlife control, as well as supporting insects, birds, and other fauna [17, 23]. By lowering the extreme temperatures and wind speed, tree canopies help in regulating the microclimate that alleviates the effects of heat stress and moisture loss in crops [12]. Mature trees anchor slopes, lessen surface runoff, and recharge groundwater, which offers invaluable watershed protection services [18].

5.2 Socioeconomic Benefits

Agroforestry practices facilitate the diversification of farm revenue through the sale of timber, fuelwood, fruits, nuts, medicinal plants, and non-timber forest products in addition to

the staple crops [27]. It is this income diversification that is best in line with the smallholder farmers who are highly exposed to price and climate variability. Enhanced soil capacity also increases productivity, leading to a reduction in spending on artificial products, which decreases the cost of production [27]. The use of agroforestry has also been linked to the enhancement of food security and dietary diversity since fruit and nut trees is complementary to the production of staple foods [18]. On a community scale, agroforestry programs usually spur an exchange of knowledge and the collective management of resources, enhancing social capital [12].

6. Measurement and Monitoring of Carbon Sequestration

In order to support sound carbon accounting, there should be complementary measurement methods. Table 4 compares the key approaches used in agroforestry systems.

Table 4: Methods for Measuring and Monitoring Carbon Stocks in Agroforestry Systems: Advantages and Limitations

Method	Description	Advantages	Limitations
Field Inventory	Direct tree measurements (DBH, height) + allometric equations; soil core sampling	High accuracy	Labour-intensive; limited scale
Allometric Modelling	Statistical models predicting biomass from easily measured variables	Non-destructive; scalable	Generalized equations less precise in diverse systems
Remote Sensing / LiDAR	Satellite (Sentinel, Landsat, MODIS) and drone imagery for canopy mapping	Large-scale; cost-efficient	Low resolution for scattered trees
Carbon Modelling	Process-based models (CENTURY, RothC, CO2FIX) integrating climate/soil data	Long-term scenario projection	Requires high-quality input data; calibration needed
IPCC Accounting	Standardized tier-based reporting for national GHG inventories	Policy-compatible	Agroforestry-specific tiers underdeveloped

Sources: IPCC [1]; Chave *et al.* [25]; Zomer *et al.* [16]; Smith *et al.* [24]; Montagnini & Nair [18]

A common and standard inventory has been field-based (diameter at breast height, allometric equations, soil core analysis), which is the reference standard to carbon stock estimation, but which is cost- and labor-intensive at scale [25]. Spatially extensive canopy and biomass mapping is made possible through remote sensing platforms, such as Sentinel, Landsat, and LiDAR, but is accompanied by resolution issues due to scattered agroforestry trees [16]. Process-based models (CENTURY, RothC, CO2FIX) combine growth and soil

interactions within plants with climate controls to forecast and estimate long-term carbon patterns across various management conditions [24]. New techniques integrating drone imaging with high-resolution spectroscopies of SOC through digital soil mapping provide affordable and scalable methods of monitoring that should be expanded and standardized [24].

7. Challenges and Limitations

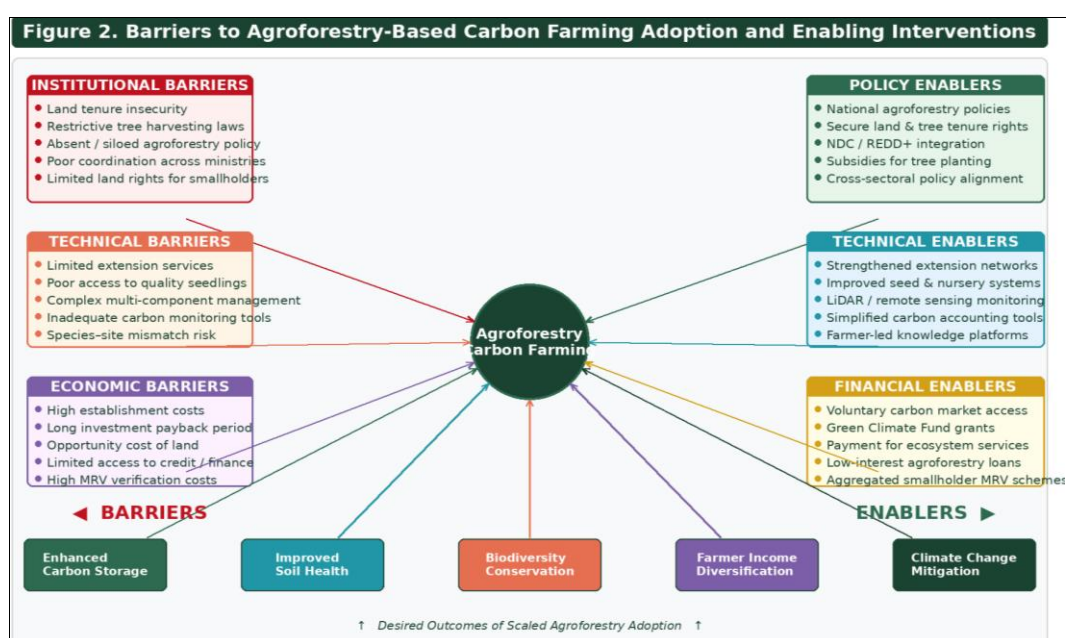


Fig 2: Theoretical model of obstacles and facilitating interventions of adopting agroforestry-based carbon farming. The presence of institutional, technical, and economic barriers (left) is offset by the presence of policy, technical, and financial enablers (right), and desired results can be found at the bottom

Carbon farming through agroforestry encounters integrated institutional, technical, and economic barriers. Security of tenure: perhaps the oldest bottleneck, but still with little resolved, is land tenure insecurity: unless farmers have any form of security on land or on trees, their incentive to invest in a system where it takes years to get an economic return is limited [22]. Control policies against the cutting of trees and the selling of timber in most countries hamper tree planting on farms, which is counterintuitive [27]. Technical barriers consist of inadequate availability of good planting material, inadequate extension services, and complexity involved in managing multi-component systems that involve understanding of ecological complementarity and competition interactions [17, 30]. Smallholders who are enrolled as part of carbon credit schemes may find it difficult to access carbon markets due to the costs of

monitoring carbon surpassing the monetary rewards [24]. The very act of climate variability is a threat: any extreme events may cause destruction of tree elements and loss of permanence of carbon, and the fluctuation of pest and disease pressure can make the system vulnerable [1]. Smallholder land resources are especially vulnerable to economic constraints, especially the long payback period of tree-based investments and the opportunity costs that land represents. Credit and climate finance tend to be unavailable to close the investment gap [27].

8. Policy Implications and Carbon Market Opportunities

Financial mechanisms and policy are essential vehicles of agroforestry carbon farming scaling. In Table 5 key international and national instruments are highlighted and their application to the sector.

Table 5: Policy Mechanisms and Carbon Market Instruments Relevant to Agroforestry-Based Carbon Farming

Mechanism / Policy	Description	Relevance to Agroforestry Carbon Farming
Paris Agreement / NDCs	Nationally Determined Contributions include agroforestry as an emission-reduction strategy	National climate targets; land-use emission accounting
REDD+	Reduces deforestation pressure; agroforestry rehabilitates degraded land without clearing	Carbon credits for avoided deforestation; MRV requirements
Voluntary Carbon Markets	Companies purchase credits from agroforestry projects to offset emissions	Revenue stream for farmers; no regulatory mandate required
Green Climate Fund	International climate finance for agroforestry in developing nations	Overcomes initial cost barriers for smallholders
National Agroforestry Policies	E.g., India's National Agroforestry Policy 2014; subsidies and extension services	Policy alignment; land tenure security; market access
Payment for Ecosystem Services	Direct payments to landowners for carbon sequestration and biodiversity outcomes	Incentivizes adoption; links ecological value to income

Sources: Griscom *et al.* [13]; Smith *et al.* [24]; Place *et al.* [22]; Garrity [27]; Nair *et al.* [15]

The best national agroforestry policies focus on the security of land tenure, inclusion of tree products in the market, and alignment of extension services in a district land use perspective. The National Agroforestry Policy (2014) of India illustrates how subsidies, extension, and market integration can promote the incorporation of trees within the smallholder landscapes. The REDD+ and the Green Climate Fund offer complementary methods internationally of financing the adoption of agroforestry in developing countries, should simplified and cost-effective systems of MRV be designed to apply to small-holder settings [13, 22]. VCTs offer an expanding revenue source to agroforestry initiatives; nevertheless, the entitlement to join such markets is restricted to recognized, standardized carbon accounting protocols and authentication procedures that presently suit bigger plantation forestry more than assorted smallholder agroforestry landscapes. The policy focuses on democratizing market access by streamlining verification methodologies and minimizing transaction costs [24].

9. Research Gaps and Future Directions

There are a number of important research gaps in the optimization and scaling of the agroforestry carbon farming. First, the majority of existing empirical data cover a duration less than 20 years, which is not enough to describe the long-term SOC dynamics, the biomass accumulation curves, or the carbon permanence within the system in the face of shifting climate conditions [15, 18]. There is an urgent need to have long-term experiment sites in various agroecological regions. Second, carbon measurement technologies need to be sophisticated and standardized to the complexity of agroforestry landscapes. A combination of LiDAR, high-resolution satellite images, and spectroscopic SOC sensors with harmonized protocols would lower costs involved in monitoring and enhance accuracy,

especially for scattered and smallholder-owned trees [16, 24]. Third, the socioeconomics aspects of adoption, such as value chain, gender-differentiated effects, and efficiency of various payment and incentive designs, need methodical research to guide policies to enhance equitable and long-term adoption among smallholders [22]. Lastly, agronomy, ecology, economics, and governance research are required to develop context-dependent agroforestry systems that can effectively maximize carbon sequestration, farming productivity, and socioecological strength of the entire range of global farming systems.

10. Conclusion

Agroforestry-based carbon farming has emerged as one of the most radical and scientifically based nature-based solutions to humanity that face the concurrent crises of climate change and agricultural unsustainability. This review has brought together a wide range of evidence that the intentional incorporation of perennial woody species into agrosystems does much more than sequester carbon - it fundamentally reorganizes the ecological and economic design of farming systems in a manner that creates compounding benefits over time and scale. Agroforestry systems have a high potential of carbon sequestration, as has been reported all throughout this paper. Agroforestry consistently does better than the traditional monoculture systems in terms of total carbon storage, holding two to four times more total carbon above ground biomass, below ground root systems, litter and deadwood pools, and also in terms of soil organic carbon (SOC) stocks, which remain on average 34 times higher than comparable croplands. These are not cosmetic changes, but a structural change in the ability of agricultural land to act as a real carbon sink and not a net emitter. This potential, when multiplied by millions of hectares of degraded or underutilized agricultural land around the world, is directly relevant to the

realization of the goals established under the Paris Agreement and a net-zero emission level by mid-century. But the carbon capture, as important as it may be, is not the only aspect of the value proposition of agroforestry. The evidence examined in this paper shows consistently that agroforestry systems provide a set of co-benefits that cannot be decoupled from their carbon consequences. The long-term productivity of these systems is based on enhanced soil health by increasing the range of microbial diversity, increasing organic matter turnover, decreasing soil erosion, and improving moisture retention. Ecological dividends, such as restoration of habitat corridors, recovering pollinator communities, and re-establishing predator-prey relationships that would provide natural pest control, are biodiversity outcomes that are systematically lost by monoculture systems. The benefits of water resources, such as good watershed performance, decreased water runoff, and an increase in groundwater recharge, are especially important in areas that are becoming more susceptible to unpredictable rainfall and extended droughts - processes that are already being exacerbated by climate change in much of the tropics and subtropics.

Regarding livelihoods, diversification of farm income provided by agroforestry, in the form of timber, fruit, fodder, medicinal plants, and non-timber forest products produced in conjunction with primary crops or livestock, is found to yield significant benefits on the household level in terms of economic resilience. This is no mere trifle. The long-term success of agroforestry systems in smallholder farms in most of the most climate-exposed areas of the world requires that such systems be economically viable at the farm level. Carbon finance, done in the right way, can be a valuable and significant auxiliary income stream; but it needs to be placed as a supplement to, rather than a replacement of, the inherent agronomic and economic benefits that well-planned agroforestry systems can bring. It is not just a matter of course, however, to realize this potential at the level that would allow a meaningful contribution to global climate targets. The impediments to mass adoption (institutional, technical, financial, and social) are real and need to be dealt with urgently and specifically. There is a need to have coherent and sustained policy frameworks that acknowledge the niche position of agroforestry at the convergence of forestry, agriculture, and environmental services. Many countries have unintentionally discriminated against agroforestry through their existing regulatory frameworks, which treat trees on farms as forest resources and are liable to timber management regulations, which discourage their adoption. Scale is a precondition to reform these structures to be able to plant trees on agricultural land, as opposed to hindering them. Carbon surveillance and verification are among the important technical issues. Agroforestry systems contain a lot of spatial heterogeneity, and the complexity of carbon dynamics across a multitude of pools and time horizons makes it difficult and expensive to measure in a standardized fashion. There is an urgent need to invest in the development and democratization of remote sensing instruments, allometric models that are calibrated to fit different agroforestry systems, and simplified field-based protocols. Frequent and cost-effective monitoring systems will ensure that agroforestry is not represented in the carbon markets and in the country's greenhouse gas inventories, which will restrict financial flows and political acknowledgment.

Carbon finance is still increasing, but in an uneven manner. The transaction costs of developing projects, certifying and verifying them, are disproportionately high to both small holders and

community-level projects in the Global South, the very place where agroforestry growth and carbon sequestration could be most useful. Aggregation, community carbon cooperatives, jurisdiction, and simplified standards adapted to small-scale agroforestry systems are all potential avenues that should be more heavily institutionalized and financed by both the government and non-governmental organizations. It is also important to invest in extension services and knowledge transfer in the long-term. Agroforestry is knowledge-intensive. The choice of right species mixes, spacing patterns, management systems, and harvesting periods should be adapted to local soils, climates, markets, and cultures. This would need a long-term and adequately funded advisory structure - one which at present, is immature in most of the low and middle-income nations. P2P learning networks, farmer field schools, and participatory research methods that co-create knowledge with farming communities have proven to be effective and should be scaled. There are also some priority gaps in research. The long-term distribution of carbon in agroforestry systems during the mature stage, the saturation dynamics, disturbance recovery dynamics, and net sink persistence on the decadal time scale are not well described. There is a need to systematically compare the relative roles of various agroforestry typologies in the sequestration of carbon under different climatic and edaphic conditions, with respect to silvo-pastoral, agrosilvo-pastoral, home gardens, windbreaks, and riparian buffers. Also, the socioeconomic aspects of agroforestry adoption, such as gender, land tenure security, labor, and market access, constrained needs to be more stringently incorporated into research paradigms so that recommendations can be practically actionable to policy and development actors. To sum up, carbon farming through agroforestry is not just an opportunity at the fringes of climate and agricultural policy, but it is a cornerstone of the food system change in the Anthropocene. The scientific arguments are strong: agroforestry has the potential to sequester large amounts of carbon, rehabilitate eroded landscapes, increase biodiversity, stabilize water flows, and improve the livelihoods of farmers at the same time. These results are complementary and not competitive. What is now needed is not additional evidence of concept, but institutional will, financial architecture, and technical infrastructure to roll agroforestry out at a scale appropriate to the ambition needed by the climate crisis. Through synergetic efforts in research, policy, finance, and extension, agroforestry-based carbon farming can play a pivotal and long-lasting role in global climate targets as well as provide the framework to a more fair, robust, and ecologically based agricultural future.

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