International Journal of Environmental Sciences & Natural Resources
ISSN: 2572-1119

Juniper Publishers
key to the Researchers

Review Article
Volume 34 Issue 1 - August 2024
DOI: 10.19080/IJESNR.2024.34.556379

Int J Environ Sci Nat Res


# Promoting Agroforestry Systems for Livelihoods and Ecosystem Management: The Role of Global, National and Sectorial Initiatives

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**Submission:** August 6, 2024; **Published:** August 22, 2024

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## Abstract

Agroforestry is one of the few landuse systems in the world with a capacity to contribute to livelihood improvement while fostering ecosystem management. In recent years, agroforestry has gained increasing attention globally as a climate-smart and multifunctional practice. Despite the popularity of agroforestry in recent years, there are currently few global, national and sectorial initiatives geared towards promoting agroforestry as a sustainable strategy for livelihood improvement and ecosystem management. This paper which is based on an in-depth review of existing literature seeks to fill this void while proposing pathways for future empirical research. Findings reveal that, agroforestry systems contribute to livelihood improvement through the provision of food, fodder, fuelwood, income, honey, fruits, poles, building materials, meat, milk, eggs. Agroforestry systems are equally vital for ecosystem management through the conservation of flora and fauna in-situ as well as contributing to the conservation of protected areas through the buffering of pressure on the latter. The main global initiatives promoting agroforestry as a sustainable strategy for livelihood improvement and ecosystem management are the sustainable development goals (SDGs), Green Economy Financing Facility (GEFF), Green Climate Fund (GCF), REDD+, the Paris Climate Agreement, Global Environment Facility (GEF), Clean Development Mechanism (CDM), African Forest Landscape Restoration Initiative (AFR100). Nationally, countries such as Nepal, Kenya and India have well developed initiatives geared towards promoting agroforestry as a strategy for livelihood improvement and ecosystem management. Other countries across the world have factored in agroforestry into their Nationally Determined Contributions (NDCs). There are also sectorial initiatives championed by stakeholders such environmental non-governmental organizations, community organizations as well as environmental and development agencies such as CIFOR-ICRAF, IUCN and WWF as well as community organizations geared towards promoting agroforestry as a strategy for livelihood improvement and ecosystem management. A better alignment and synchronization of global, national and sectorial initiatives will contribute towards fostering agroforestry as a sustainable strategy for livelihood improvement and ecosystem management.

**Keywords:** AFR100; Agroforestry; Agroforestry systems; Ecosystem management; Global Environment Facility; Green Climate Fund; Livelihoods; REDD+; SDGs

## Introduction

Agroforestry systems, characterized by the deliberate integration of trees with crops and/or livestock on the same land, offer multifaceted benefits for livelihoods and ecosystem management [1-4]. These systems have gained increasing recognition as sustainable land-use practices that contribute to food security, climate resilience, biodiversity conservation, and rural development [5-8]. Promoting agroforestry systems for livelihoods and ecosystem management involves leveraging the efforts of global, national, and sectorial initiatives [9,10]. To fully realize these benefits, coordinated action across different levels of governance and sectors is essential. Global Initiatives championed by global organizations like the United Nations, the World Bank, as well as international NGOs and development partners play a crucial role in advocating for agroforestry on the global stage [11]. They provide funding, technical expertise, and policy guidance to support agroforestry projects and initiatives in various regions.

Global initiatives such as the UN Decade for Ecosystem Restoration, spanning from 2021 to 2030, plays a pivotal role

in advancing agroforestry globally by promoting sustainable land management practices that integrate trees into agricultural landscapes [12-15]. Agroforestry, which involves growing trees alongside crops or livestock, is recognized as a critical approach for enhancing ecosystem health, biodiversity conservation, and climate resilience. Through awareness and advocacy, policy integration, capacity building, research and innovation, partnerships and collaboration as well as monitoring and evaluation, the UN Decade for Ecosystem Restoration is playing an active role to enhance the adoption and implementation of agroforestry practices across different landscapes in the world. It raises awareness about the benefits of agroforestry in restoring degraded landscapes, improving soil fertility, and sequestering carbon. It advocates for policy support and investment in agroforestry systems as part of broader ecosystem restoration efforts. It encourages countries to integrate agroforestry into national policies and strategies for ecosystem restoration. This includes aligning agricultural, forestry, and environmental policies to promote sustainable land use practices that enhance ecosystem services. It supports capacity building initiatives to train farmers, extension agents, and policymakers in agroforestry techniques. This helps to disseminate knowledge on sustainable land management practices that can restore degraded lands while promoting food security and livelihoods. It fosters research and innovation in agroforestry, promoting the development of resilient tree species suitable for diverse agroecological conditions. This includes exploring the economic viability of agroforestry systems and their potential to provide multiple benefits such as timber, fuelwood, food, and fodder. It equally facilitates partnerships between governments, international organizations, research institutions, NGOs, and local communities to implement large-scale agroforestry projects. This collaborative approach enhances the effectiveness and impact of ecosystem restoration efforts. It emphasizes monitoring and evaluating the outcomes of agroforestry initiatives to assess their contributions to ecosystem restoration goals. This includes measuring improvements in soil health, biodiversity conservation, water management, and carbon sequestration. The UN Decade for Ecosystem Restoration therefore serves as a catalyst for promoting agroforestry worldwide by integrating sustainable land management practices into ecosystem restoration strategies [16,17].

National policies and programs championed by national governments have the responsibility to create an enabling environment for agroforestry through supportive policies and programs [18-22]. This includes land tenure reforms, financial incentives, extension services, and capacity building initiatives to encourage the adoption of agroforestry practices by farmers. Integrating agroforestry into national development agendas contributes to poverty alleviation, food security, and environmental sustainability. Sectorial collaboration including collaboration between different sectors such as rural development, agriculture, environment, and forestry is essential for mainstreaming agroforestry. This involves engaging diverse stakeholders including civil society organizations, farmers, policymakers, and researchers in collaborative decision-making processes. By promoting synergies between agroforestry and other land use practices, such as sustainable agriculture and forestry, stakeholders can maximize the benefits of integrated landscape management. It is against this background that this paper examines the role of global, national and sectorial initiatives in promoting agroforestry systems for livelihoods and ecosystem management.

## Agroforestry for Livelihood Improvement

Agroforestry systems contribute to livelihood improvement through the provision of food, fodder, fuelwood, income, honey, fruits, poles, building materials, meat, milk, eggs as well as other products and environmental services (Table 1). Dagar et al. [3] highlight the role of agroforestry in enhancing food security through the domestication of fruit trees, utilization of indigenous species, and improving the nutritional value of tree products. It equally contributes significantly to rehabilitating degraded lands, conserving soil and water, modifying microclimates, and preserving biodiversity. Despite its potential benefits, the adoption of agroforestry faces challenges, including technical complexities that require further scientific input. Nevertheless, the researchers emphasize agroforestry's promise in increasing land productivity, improving livelihood security, and enhancing food security, particularly in arid and degraded regions of SSA. Zerihun [23] underlines the urgency of promoting smallholder agriculture in South Africa to tackle food security and rural unemployment issues, emphasizing agroforestry's role in boosting agricultural productivity and supporting sustainable rural livelihoods. Agroforestry, by integrating trees with crops and livestock, helps diversify income sources and enhances resilience to recurring challenges like droughts. The study suggests that agroforestry practices can significantly increase household incomes, contributing to poverty alleviation and food security. Similarly, Kuyah et al. [9] explore the multifaceted benefits of agroforestry systems in SSA, emphasizing their role in providing essential resources such as fiber, food, fodder, and fuelwood, crucial for improving livelihoods. Despite their potential, the authors identify barriers and knowledge gaps hindering the full harnessing of agroforestry-based livelihoods, advocating for further research and supportive policies. In a study focused on semi-arid Isiolo County, Kenya, Quandt et al. [24] highlight that households practicing agroforestry exhibit greater resilience, with improved access to shade, fruit, and diversified income sources contributing to overall quality of life. The study underscores agroforestry's importance in bolstering livelihood resilience in the face of climatic uncertainties. These studies collectively demonstrate agroforestry's significant role in promoting sustainable rural livelihoods across diverse contexts by providing various ecosystem services that enhance food security, generate income, and build resilience to environmental challenges.


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**Table 1:** Agroforestry systems/practices for livelihood improvement.

| Agroforestry System/Practice | Products and Services Provided that Enhance Livelihoods | Country/Region | Existing Studies |
|---|---|---|---|
| Traditional and innovative agroforestry systems | Food, erosion control, soil fertility improvement, and afforestation | Africa (particularly sub-Saharan Africa) | Dagar et al. [3] |
| Silvicultural, agrisilvicultural and agrisilvipastoral systems | Food, employment opportunities, income | South Africa | Zerihun [23] |
| Silvicultural, agrisilvicultural and agrisilvipastoral systems | Fibre, food, fodder, fuelwood, and other products | Sub-Saharan Africa | Kuyah et al. [9] |
| Silvicultural, agrisilvicultural and agrisilvipastoral systems | Shade, fruits, and diversified income sources | Kenya | Quandt et al. [24] |
| Silvicultural, agrisilvicultural and agrisilvipastoral systems | Food, employment opportunities, income, soil and biodiversity conservation, environmental security | Sub-Saharan Africa | Adelani [25] |
| Silvicultural, agrisilvicultural and agrisilvipastoral systems | Food, income, and environmental benefits such as carbon sequestration and soil conservation | Arid regions of the world (particularly those in Asia and Africa) | Tiwari et al. [26] |
| Silvicultural, agrisilvicultural and agrisilvipastoral systems | Food, fodder, shade | Arid zones of India | Tewari et al. [27] |
| Silvicultural, agrisilvicultural and agrisilvipastoral systems | Food, fodder, and fuelwood | Bangladesh | Hanif et al. [28] |
| Silvicultural, agrisilvicultural and agrisilvipastoral systems | Food, timber, fodder, and fuelwood | Bangladesh | Akter et al. [29] |
| Alley cropping and silvopastoral systems | Restoration of degraded lands | Global | Gupta et al. [30] |
| Silvicultural, agrisilvicultural and agrisilvipastoral systems | Improvements in financial, physical, natural, and social capital. | Pakistan | Ahmad et al. [31] |
| Silvicultural, agrisilvicultural and agrisilvipastoral systems | Income, food, environmental services | Indonesia | Rahman et al. [32] |
| Chestnut, jujube, date palm, carob, and mahlab based agroforestry systems | Food, timber, fodder, and fuelwood | Southwest Asia | Al-Mohamed et al. [33] |
| Silvicultural, agrisilvicultural and agrisilvipastoral systems | Food, Fodder, income, and soil enrichment | South Asia | Datta and Behera [34] |
| Silvicultural, agrisilvicultural and agrisilvipastoral systems | Food, timber, income, shade, fodder, and different environmental services | Europe | Díaz et al. [35] |
| Silvicultural, agrisilvicultural and agrisilvipastoral systems | Food, timber, income, shade, fodder, and different environmental services | North-Eastern Europe | Elbakidze et al. [36] |
| Silvicultural, agrisilvicultural and agrisilvipastoral systems | Improve economic and ecological sustainability | Latin America | Krishnamurthy et al. [37] |
| Coffee-based agroforestry system | Ecosystem-based benefits, diversification of income streams, and household food security | Tropics | Siles et al. [38] |

Agroforestry is increasingly recognized as a dynamic and ecologically-based approach to managing resources, offering sustained benefits for rural communities worldwide. Adelani [25] emphasizes the role of agroforestry in supporting rural livelihoods by ensuring food security, creating jobs, boosting income, conserving soil health and biodiversity, and enhancing environmental stability. The study highlights agroforestry's economic impacts, including poverty reduction, resilience to climate change, and carbon sequestration, particularly beneficial for sustainable livelihoods in Sub-Saharan Africa (SSA). Tiwari et al. [26] stress the importance of sustainable access to resources amid environmental challenges, noting agroforestry as a critical land-use strategy for enhancing livelihood security and reducing vulnerability. By ensuring food security, poverty alleviation, and environmental benefits like carbon storage and soil conservation, agroforestry emerges as a promising solution to mitigate climate risks while improving rural livelihoods. In arid regions of Asia and Africa, such as the Thar Desert studies by Tewari et al. [27] uncover that traditional agroforestry practices have evolved over centuries to adapt to harsh climates. By integrating drought-resistant trees with food and fodder crops, these systems are more resilient and contribute to livelihood improvements and climate adaptation. In a study in Bangladesh, Hanif et al. [28] underscore the role of agroforestry in northern regions, where it enhances farmers'


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livelihoods by providing essential resources like food, fodder, and fuelwood. Despite challenges such as pest outbreaks, agroforestry in Bangladesh supports species diversity, economic returns, and sustains local livelihoods.

Other studies have equally examined the role of agroforestry for livelihood improvement. Akter et al. [29] highlighted the diverse array of tree and crop species utilized, showcasing how agroforestry significantly enhances farmers' livelihoods by providing essential resources like food, timber, fodder, and fuelwood. They underscored the need for policy interventions to promote sustainable reforestation practices and improve overall livelihoods in Bangladesh. Gupta et al. [30] discussed the widespread impact of land degradation on global livelihoods, particularly affecting vulnerable populations reliant on natural resources. They emphasized agroforestry as a crucial strategy for restoring degraded ecosystems and mitigating soil degradation. By integrating technologies like alley cropping and silvopastoral systems, agroforestry can rehabilitate degraded lands sustainably, enhancing biodiversity and ecosystem services. They stressed the importance of stakeholder engagement in designing effective agroforestry systems that support sustainable land productivity and climate resilience. Ahmad et al. [31] conducted a comparative study on the livelihood impacts of agroforestry versus conventional farming among smallholder farmers in Pakistan. Their findings showed mixed impacts of agroforestry on farmers' livelihoods, with significant improvements in financial, physical, natural, and social capital. While agroforestry boosted financial capital through timber and non-timber income, conventional farming excelled in crop income and asset ownership like tractors. They highlighted the need for enhanced extension services and government support to maximize agroforestry's contribution to rural livelihoods. Rahman et al. [32] explored agroforestry as an alternative to swidden cultivation in Indonesia's Gunung Salak valley, aiming to protect local forests. Their study demonstrated that agroforestry systems offer higher economic returns and benefit-cost ratios compared to swidden cultivation, indicating economic viability. However, cultural and capacity-related barriers hindered farmers' adoption of agroforestry, necessitating support to build capacity and promote agroforestry practices for effective forest conservation. Al-Mohamed et al. [33] discussed various agroforestry systems in Southwest Asia and their roles in enhancing livelihood security and ecosystem services. They highlighted diverse tree species integrated into agroforestry across the region, such as chestnut, jujube, date palm, carob, and mahlab, which provide food, timber, fodder, and fuelwood while delivering environmental benefits. The chapter stressed agroforestry's importance in sustaining societies and environments in Southwest Asia, recommending future strategies for agroforestry and forest planning to enhance sustainability and resilience.

Studies carried out in South Asia, Europe and different arid regions in the world have also highlighted the importance of agroforestry for livelihood improvement. Datta & Behera [34] conducted a study focusing on agroforestry systems in South Asia and their impact on food security. They found that while existing studies on the topic are limited, agroforestry contributes to food security through diversification of food options, fodder supply, income generation, and soil enrichment. However, challenges such as reduced crop yields and increased pest populations were also noted. The study emphasizes the importance of effective policy formulation to maximize the benefits of agroforestry while mitigating potential drawbacks. Rois-Díaz et al. [35] explored European farmers' perspectives on agroforestry adoption through interviews across eight countries. They discovered that many farmers were implementing agroforestry practices without necessarily identifying them as such, influenced by family traditions, regional practices, and learning from peers. The study highlights the diversity of agroforestry approaches in Europe and the significance of understanding farmers' motivations for adopting or not adopting these practices. Elbakidze et al. [36] examined the values associated with agroforestry landscapes in North-Eastern Europe through structured interviews. They found that these landscapes are highly valued for their contributions to quality of life, with respondents attributing multiple nature's contributions to people (NCP) to them. The study underscores the relational values linked to agroforestry landscapes, emphasizing their importance for identity and overall well-being. Krishnamurthy et al. [37] focused on agroforestry systems in arid and semi-arid regions of Latin America, exploring their characteristics and benefits across various climatic zones. Their field research highlighted the context-specific nature of these systems, showing their potential for economic and ecological sustainability. Farmers noted benefits such as improved soil fertility and resilience to climate change, reinforcing the holistic advantages of integrating trees with crops and livestock. Siles et al. [38] addressed smallholder coffee production and its challenges, advocating for improved agroforestry management strategies. They proposed transitioning current practices to enhance ecosystem-based benefits, diversify income sources, and ensure food security for households. The study identifies practical approaches to address issues like declining profitability, labor shortages, pest pressures, and climate risks within coffee agroforestry systems. These studies highlight the diverse benefits and challenges associated with agroforestry across different regions and contexts, emphasizing agroforestry's potential to contribute significantly to sustainable agriculture, livelihood security, and environmental resilience worldwide.

## Agroforestry for Ecosystems Management

Agroforestry systems are vital for ecosystem management through the conservation of flora and fauna in-situ, sustainable landscape management, pest control, environmental regulation as well as contributing to the conservation of protected areas through the buffering of pressure on the latter (Table 2).


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**Table 2:** Agroforestry systems/practices for ecosystem management.

| Agroforestry System/Practice | Ecosystem Services of Agroforestry Systems for Enhanced Agroforestry Management | Country/Region | Existing Studies |
|---|---|---|---|
| Silvicultural, agrisilvicultural and agrisilvipastoral systems | Sustainable landscape management | Global | Plieninger et al. [39] |
| Silvicultural, agrisilvicultural and agrisilvipastoral systems | Different supporting, regulating services | Global | Pantera et al. [40] |
| Cocoa-based agroforestry system | Pest control, carbon sequestration | Cameroon | Andreotti et al. [41] |
| Silvicultural, agrisilvicultural and agrisilvipastoral systems | Biodiversity conservation and landscape restoration | Brazil | Santos et al. [42] |
| Silvicultural, agrisilvicultural and agrisilvipastoral systems | Biodiversity conservation and landscape restoration | Pakistan | Baig et al. [43] |
| Silvicultural, agrisilvicultural and agrisilvipastoral systems | Landscape restoration | Karst rocky desertification regions | Xiao & Xiong [44] |
| Silvicultural, agrisilvicultural and agrisilvipastoral systems | Climate change mitigation | Europe | Mosquera-Losada et al. [45] |
| Silvicultural, agrisilvicultural and agrisilvipastoral systems | Landscape restoration | Global | Van Noordwijk et al. [46] |
| Cacao agroforestry systems | Pest control and climate regulation | Tropics | Mortimer et al. [47] |
| Silvicultural, agrisilvicultural and agrisilvipastoral systems | Improved aboveground biomass production, nutrient stocks, soil fertility, and soil microbial activity, pollination, pest control, and environmental regulation | Africa | Santos et al. [48] |
| Silvicultural, agrisilvicultural and agrisilvipastoral systems | Soil health enhancement, water regulation, carbon sequestration | Global | Raj et al. [49] |
| Silvicultural, agrisilvicultural and agrisilvipastoral systems | Landscape restoration, carbon sequestration, environmental regulation | Global | Castle et al. [50] |
| Silvicultural, agrisilvicultural and agrisilvipastoral systems | Rocky desertification control | Rocky desertification regions | Jiang et al. [51] |

Studies such as those of Plieninger et al. [39] for example emphasize key steps to leverage agroforestry for sustainable landscape management, including advancing "agroforestry sustainability science," understanding local land-use contexts, scaling up agroforestry practices, promoting its multiple values, fostering inclusive landscape governance, and supporting innovation in agroforestry system analysis and design. Pantera et al. [40] discuss the potential environmental benefits of agroforestry, highlighting its role in addressing environmental challenges in agriculture. They emphasize the importance of agroforestry in promoting eco-intensification through the deliberate integration of woody vegetation with crops and/or animal systems. Agroforestry provides numerous provisioning, supporting, regulating, and cultural, ecosystem services while promoting more efficient resource use. Andreotti et al. [41] identifies distinct clusters of agroforestry systems characterized by varying levels of ecosystem service provision and associated management strategies. The findings underscore the potential of this approach in designing effective benchmarks for studying and enhancing multiple ecosystem service provision within complex agroecosystems.

In south America, Asia and Europe, studies have emphasized the importance of agroforestry for ecosystem management. Santos et al. [42] by comparing agroforestry systems with both conventional production methods and old-growth forests, found that biodiverse agroforestry systems exhibit significantly higher levels of biodiversity and ecosystem service provision. Specifically, these systems offer up to 45% and 65% more benefits for biodiversity and ecosystem services, respectively, compared to conventional production systems. The findings advocate for the adoption of biodiverse agroforestry systems as an alternative approach to mitigate biodiversity loss and enhance ecosystem services in degraded areas, presenting a promising avenue for sustainable production practices within the region. Baig et al. [43] emphasize the significance of agroforestry in mitigating the challenges confronting forest ecosystems in Pakistan, which are under pressure due to population growth. Agroforestry offers a promising avenue to boost productivity, enhance economic outputs, improve ecological conditions, and maintain social acceptance. Despite its potential benefits, the widespread adoption of agroforestry in Pakistan encounters several obstacles, including attitudes among extension staff, inadequate research-extension coordination, a shortage of trained personnel, limited farmer responsiveness to advice, constraints related to tree species, and challenges in market mechanisms and wood prices. The study advocates for the establishment of model agroforestry farms at the village level as an effective extension approach and underscores the importance of shared vision and effective


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communication tools in successful promotion endeavors. Xiao & Xiong [44] bring out the role of agroforestry ecosystem services (AFES) in the restoration of degraded ecosystems, particularly in karst rocky desertification (KRD) regions. The study identifies areas for improvement in controlling KRD ecosystems. It offers valuable insights for agroforestry practitioners and decision-makers to enhance AFES supply capacity and effectively manage ecosystems. On their part, Mosquera-Losada et al. [45] examine the promotion and prevalence of agroforestry practices in Europe, assessing their potential for climate change mitigation. They find that agroforestry covers nearly 20 million hectares in Europe, with silvopasture and homegardens being the most widespread practices. However, agroforestry promotion at the European level is complex, involving over 25 measures aimed at enhancing existing practices. The study suggests simplifying promotion measures to facilitate evaluation and recommends future policies tailored to European contexts.

On their part, Van Noordwijk et al. [46] highlight the need for social and ecological fine-tuning to balance upstream and downstream interests effectively. The study proposes the use of serious gaming as a participative approach to achieve shared understanding among stakeholders. However, they acknowledge that serious games currently have limitations, including ad hoc development, cultural limitations, and uncertainty about their use in policy-making. Mortimer et al. [47] provide an extensive review of the ecosystem services offered by cacao agroforestry systems (CAFS) globally emphasizing how CAFS contribute to supporting services, such as providing optimal light conditions for cacao growth, cycling water and nutrients, and regulating services like pest control and climate regulation. The study discusses how the crown structures of associated trees in CAFS facilitate ideal light conditions for cacao, aid in nutrient cycling through leaf litter and root systems, and help manage pests and diseases through shade regulation. CAFS also store carbon to varying degrees and promote biodiversity conservation, albeit not to the extent of natural forests. The need to optimize spatial arrangements to enhance nutrient cycling and landscape connectivity for biodiversity conservation, all while considering trade-offs between carbon storage, biodiversity, cacao yield, and socio-economic resilience is very important. On their part, Santos et al. [48] found that selective management of regenerating community in agroforestry systems promotes greater biomass production and nutrient accumulation compared to conventional treatments. Furthermore, it enables other shrub and tree species to overcome ecological filters imposed by grasses, thereby enhancing ecosystem functions like pollination, pest control, and environmental regulation. These findings indicate the importance of selective management practices in augmenting ecosystem functions within agroforestry systems.

In other parts of the world, studies such as those of Raj et al. [49] discuss the multifunctional role of agroforestry systems (AFs) in sustaining landscapes and providing ecosystem services (ES). The study enumerates various ES provided by AFs, including timber and non-timber forest products production, soil health enhancement, water regulation, carbon sequestration, and food and income security. The study calls for technological advancements and effective policies to strengthen AFs globally, highlighting the importance of crop diversification to enhance ES. They emphasize the transformation of AFs into sustainable landscapes to ensure soil-food-climate security at local and global levels. Jiang et al. [51] identified key scientific issues that must be addressed to enhance the supply capacity of ecosystem services in agroforestry systems, especially concerning rocky desertification control. These insights offer valuable guidance for policymakers, land managers, and researchers involved in sustaining agroforestry ecosystems and their associated benefits over the long term.

## Global Initiatives Promoting Agroforestry as a Sustainable Livelihood Improvement Strategy

The main global initiatives promoting agroforestry as a sustainable strategy for livelihood improvement and ecosystem management are the sustainable development goals (SDGs), Green Economy Financing Facility (GEFF), Green Climate Fund (GCF), REDD+, the Paris Climate Agreement, Global Environment Facility (GEF), Clean Development Mechanism (CDM), African Forest Landscape Restoration Initiative (AFR100). Bernard & Minang [52] highlight the potential of community forests (CFs) in Cameroon to support the objectives of REDD+ (reducing emissions from deforestation and forest degradation). Their study focuses on cocoa agroforestry as a competitive strategy within CFs, providing ecological, economic, and social co-benefits aligned with forest conservation and sustainable management goals. The authors note that while reduced-impact logging and conservation/natural regeneration can reduce emissions, their viability may be challenged by more profitable activities unless carbon market prices rise significantly. The study underscores the importance of addressing governance issues, unclear carbon rights, and financing challenges within CFs. Proposed actions include clarifying carbon rights, establishing benefit-sharing mechanisms, and improving monitoring and reporting for effective REDD+ implementation. Duker et al. [53] discuss the role of agricultural practices in climate change mitigation, particularly focusing on integrating smallholder agricultural interests into REDD+ programs. Their research identifies shortcomings in current REDD+ projects that fail to accommodate smallholder farmer needs, leading to livelihood losses and reduced community engagement. The study advocates for revising benefit-sharing mechanisms and financial incentives to better align with agricultural interests and ensure sustainable forest management. By integrating agricultural concerns and restructuring financial incentives, the approach aims to enhance livelihoods while reducing greenhouse gas emissions, thereby promoting more effective and inclusive forest management under REDD+. Reang et al. [54] explore pineapple


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agroforestry systems (PAFS) in the Indian Eastern Himalayas, highlighting their role as biodiversity reservoirs and contributors to ecosystem services. Their study evaluates tree diversity and ecosystem carbon storage in PAFS of different ages, demonstrating their potential to support biodiversity conservation and climate action, including REDD+. While younger PAFS have lower carbon storage compared to native forests, older systems maintain stable carbon stocks while providing additional benefits to local communities. The findings suggest that traditional PAFS offer a promising avenue for implementing REDD+ by combining carbon sequestration with sustainable development benefits, thereby supporting both environmental conservation and community livelihoods.

Rosenstock et al. [55] evaluate how agroforestry is addressed within national measurement, reporting, and verification (MRV) systems under the UNFCCC. Despite agroforestry's recognized potential for climate change mitigation and adaptation, the study reveals a significant gap between countries' aspirations and their actual capacity to measure and report on agroforestry practices. While many nations include agroforestry in their climate plans, its quantitative integration into MRV systems remains limited. The research identifies various challenges such as institutional, technical, and financial obstacles that hinder the comprehensive incorporation of agroforestry into MRV frameworks. The study provides recommendations to overcome these barriers, aiming to enhance the inclusion of agroforestry in climate change programs effectively. Singh et al. [56] emphasize the role of agroforestry in contributing to REDD+ objectives, noting that many agroforestry systems qualify as forests under REDD+. The study discusses challenges related to assessing socio-economic impacts, monitoring carbon sequestration, and implementing policies to incentivize agroforestry adoption within the REDD+ framework. The authors highlight the need to address issues such as market infrastructure, tree rights policies, and safeguards to maximize the potential of agroforestry in achieving REDD+ goals and Intended Nationally Determined Contributions (INDCs). Rosenstock et al. [57] review the status of agroforestry within national MRV systems under the UNFCCC. They identify substantial gaps between national ambitions and actual actions, citing technical, institutional, and financial barriers that limit the comprehensive integration of agroforestry into MRV frameworks. The authors stress the importance of robust measurement, reporting, and verification of agroforestry resources to access the financial and other support necessary for effective climate change adaptation and mitigation strategies. Sunderlin et al. [58] analyze the implementation of REDD+ initiatives, focusing on the combined interventions and their impact on household land use decisions. The study finds that households experience multiple interventions, including both conditional and non-conditional benefits, alongside restrictions on forest access and conversion. The research suggests that employing multiple interventions, rather than relying solely on conditional incentives, effectively influences land use changes that reduce carbon emissions.

Other studies have equally highlighted the importance of global initiatives to the promotion of agroforestry particularly in the context of livelihood improvement. Bettles et al. [59] explore strategies for non-state actors to stimulate agroforestry adoption among smallholders in low and middle-income countries, identifying market failures within the agroforestry sector. They propose interventions such as market incentives, capacity building, and policy advocacy to address these challenges and accelerate agroforestry adoption. Dieng et al. [60] analyze tree recovery efforts in Senegal and assess the potential role of REDD+ in consolidating land management strategies outside forested areas. They suggest integrating REDD+ activities like tree planting, agroforestry, bushfire management, and erosion control to enhance land restoration and management, stressing the need for expanded scope and community engagement for effective implementation. Asaah et al. [61] present a project in Cameroon establishing rural resource centers (RRCs) to enhance local livelihoods through land rehabilitation, food security promotion, income generation, and skill dissemination. The RRCs aim to empower smallholder communities, fostering economic independence and knowledge sharing among neighboring communities. Ali et al. [62] use the SWOT analysis to evaluate Ghana's transition to a green economy, highlighting strengths like favorable geography and environmental policies, alongside weaknesses such as institutional capacity gaps and inadequate funding for green technologies. They identify opportunities in green technology investment and global climate change focus, while noting threats from insufficient technology development and escalating climate impacts. Prokopenko et al. [63] discuss strategic approaches to regulate sustainable agroforestry, emphasizing the assessment of territorial potential and methodologies for evaluating environmental and economic impacts of forest shelterbelt creation. They propose strategic targets to promote sustainable agroforestry practices. Swainson & Mahanty [64] examine the Aceh Green intervention in Indonesia, assessing barriers and opportunities in the green economy approach. They highlight challenges including vested interests and coalition-building difficulties, complicating natural resource management and benefiting green investors. Mosquera-Losada et al. [45] assess agroforestry practices in Europe for climate change mitigation and adaptation, advocating for simplified and coordinated policies at the European level. They emphasize the potential of silvopasture and silvoarable systems in climate change strategies, aiming to enhance agroforestry adoption across Europe. Dhyani et al. [65] review traditional agroforestry systems in South Asia and their role in offsetting greenhouse gases, providing sustainable livelihoods, and contributing to biodiversity targets. They discuss enabling conditions, such as regional resolutions supporting agroforestry policies, and constraining conditions, including lack of uniform methodologies for monitoring carbon stocks and insufficient financial support for rural farmers. Duguma et al. [66] explore the representation of agroforestry in nationally determined contributions (NDCs) to the Paris Agreement on climate change. They highlight the potential


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DOI: 10.19080/IJESNR.2024.34.556379

of agroforestry to fulfill NDC commitments and reduce emissions from agriculture, emphasizing the need to address financial, policy, and technology challenges to maximize its contribution. de Albuquerque [67] discusses the role of agriculture, particularly agroforestry, in achieving several Sustainable Development Goals (SDGs) and its potential for climate change mitigation and adaptation. The paper analyzes international instruments promoting agroforestry adoption and identifies legal and policy elements essential for successful agroforestry regimes, while also acknowledging potential constraints posed by adverse national policies.

Studies by Santiago-Freijanes et al. [68], Quandt et al. [69], Datta & Behera [70], Andrea [71], Foundjem-Tita et al. [72], and Sahoo et al. [73] highlight various dimensions of the role played by global initiatives in the promotion of agroforestry and challenges across different regions and contexts. Santiago-Freijanes et al. [68] emphasize the need for promoting agroforestry practices in Europe, highlighting gaps in policy support within the Common Agricultural Policy (CAP). They advocate for linking management plans to establish agroforestry and enhancing knowledge transfer through stakeholder integration. Quandt et al. [69] focus on the socioeconomic and biophysical aspects of agroforestry in climate change adaptation, identifying knowledge gaps in research influencing adaptation policy. They underscore the importance of understanding the geographic distribution of agroforestry benefits, its effectiveness during climate hazards, and integrating biophysical and socioeconomic research for informed policy. Datta & Behera [70] explore agroforestry's role in climate change adaptation and mitigation in India, particularly under State Action Plans on Climate Change (SAPCCs). Their findings reveal a focus on tree-based systems within SAPCCs but highlight gaps in addressing the crop-tree-livestock nexus and precision in strategy implementation. Andrea [71] reviews forest policy directions in Mediterranean countries, noting the forestry sector's potential as carbon sinks for climate change mitigation. The study calls for policy reconstruction to align forest industry models with climate neutrality goals, emphasizing the need for efficient policy frameworks to meet international climate commitments. Foundjem-Tita et al. [72] focus on Chad's agroforestry landscape, identifying opportunities within existing policies despite the absence of dedicated agroforestry policies. Challenges such as gaps in forestry legislation understanding and exploitation by rent-seekers hinder agroforestry adoption, suggesting the integration of agroforestry elements into existing policies to address livelihood and environmental issues. Sahoo et al. [73] advocate for promoting agroforestry systems in forest landscape restoration initiatives, particularly where natural forest restoration or full sun crops are not viable. They stress understanding local livelihoods and farming systems for successful agroforestry implementation while addressing challenges such as support mechanisms, access to quality materials, and tenure rights for local landholders.

## National Initiatives Promoting Agroforestry as a Sustainable Livelihood Improvement Strategy

Nationally, countries such as Nepal, Kenya and India have well developed initiatives geared towards promoting agroforestry as a strategy for livelihood improvement and ecosystem management. Other countries across the world have factored in agroforestry into their Nationally Determined Contributions (NDCs). Ghimire et al. [74] provide a comprehensive review of agroforestry systems in Nepal, emphasizing their broad-ranging benefits for food security, rural livelihoods, and environmental sustainability. They highlight the positive impacts of agroforestry on soil quality improvement and carbon sequestration. Despite these benefits, challenges persist, particularly related to technical knowledge and market access. The authors stress the importance of enhancing communication between researchers and farmers and aligning agroforestry practices with government strategies to maximize their potential for sustainable development. Pandit et al. [75] discuss a market-oriented agroforestry action research program in Nepal, focusing on its role in enhancing livelihoods and food security. The program facilitated significant increases in household income and food security by promoting priority products through agroforestry systems. Collective marketing strategies and farmer empowerment were crucial components contributing to its success, demonstrating the importance of integrating market-oriented approaches to enhance economic outcomes for farmers. Khadka et al. [76] examine agroforestry practices in the Bakaiya rural municipality of Makawanpur District, Nepal, highlighting agri-silviculture as the predominant system providing essential forest products like fuelwood, fodder, and leaf litter to local communities. Despite its potential, the study identifies a lack of promotional activities and development initiatives, underscoring the need for stakeholder collaboration to promote and facilitate agroforestry systems effectively. On their part, Ghimire et al. [74] offer a broad overview of agroforestry's benefits and challenges across Nepal, focusing on its sustainable impacts on food security and environmental health. Pandit et al. [75] provide a specific case of a successful market-oriented agroforestry initiative, emphasizing economic empowerment and food security improvements through strategic product cultivation and collective marketing. Khadka et al. [76] narrow down to a local context, highlighting the predominance of agri-silviculture and the gaps in promotional efforts and stakeholder collaboration necessary for scaling agroforestry benefits in rural Nepal.

Paudel et al. [77] compare traditional and improved agroforestry practices in Nepal's midhills, focusing on income generation and forest conservation. They find that improved agroforestry practices are more effective in both generating income and meeting forest product needs compared to traditional methods. The study suggests that practitioners of traditional agroforestry should consider adopting improved practices to enhance contributions to local livelihoods and forest conservation


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efforts. Aryal et al. [78] scrutinize major agroforestry practices in Nepal, emphasizing the transition from forest-based to integrated farm-based approaches. They highlight integrated agroforestry systems as crucial for balancing trade-offs and optimizing synergies among ecosystem services. The study advocates for integrated models that address socio-economic, ecological, and institutional factors, aiming to achieve sustainable development goals such as poverty reduction, food security, climate action, and biodiversity conservation. Overall, it underscores the potential of integrated agroforestry systems to deliver multifaceted benefits aligned with broader sustainability objectives. Fuchs et al. [79] evaluate a community-driven local development project in Kenya's Nyando river basin, focusing on enhancing farmer livelihoods through agricultural and agroforestry training. The study reveals significant improvements in farmer livelihoods, particularly through the adoption of climate-smart agricultural practices. However, impacts varied by locality, emphasizing the importance of considering both biophysical and socioeconomic contexts in supporting climate-smart agriculture initiatives. Reppin et al. [80] investigate the relationship between agroforestry, livelihoods, and climate change mitigation in smallholder farming systems. They find that farm carbon stocks were influenced by farm size, tree density, and tree size, rather than tree diversity or land use categories. While agroforestry contributed to on-farm carbon accumulation and provided benefits like firewood self-sufficiency, reliance on exotic tree species for timber production posed trade-offs between livelihood options and environmental goals.

Nyberg et al. [81] assessed the Kenya Agricultural Carbon Project (KACP) and its impacts on Sustainable Agricultural Land Management (SALM) practices, maize yields, food self-sufficiency, and savings among participating farmers. They found that farmers involved in KACP significantly increased their adoption of SALM practices and achieved higher maize yields compared to non-participating farms. However, the project did not show a significant overall effect on food self-sufficiency or savings. Endeki et al. [82] examined the impacts of agroforestry technologies on livelihoods in Vihiga County, Kenya, and identified socio-economic factors influencing their adoption. Their study revealed that agroforestry technologies positively impacted farmers' livelihoods, particularly through increased income from agroforestry product sales. Factors such as income levels and land size were critical in influencing adoption rates, highlighting the importance of extension services and market development to further promote agroforestry adoption. Witcomb & Dorward [83] analyzed the shamba system in Kenya, where farmers grow tree saplings on state-owned forest land while intercropping perennial food crops until tree canopy closure. Despite its potential benefits, the system has faced challenges due to mismanagement and abuse. The study underscored local communities' interest in reintroducing the system but emphasized the need for improved administration and plot allocation rules, as well as concerns over the devolution of power under the new Plantation Establishment and Livelihood Improvement Scheme (PELIS). Thorlakson & Neufeldt [84] investigated agroforestry techniques' efficacy in helping subsistence farmers in western Kenya mitigate climate change vulnerabilities. Their research highlighted that engaging in agroforestry enhanced households' overall standards of living by increasing farm productivity, generating off-farm incomes, building wealth, and improving environmental conditions. The study suggested that agroforestry could play a crucial role in broader development strategies aimed at reducing climate risks for subsistence farmers.

Mugure & Oino [85] addressed low adoption rates of agroforestry among Kenyan farmers despite its potential to alleviate poverty and food insecurity. They highlighted the necessity for appropriate policies and increased awareness about the benefits of agroforestry. Their study recommended promoting best land use practices, developing suitable policies, and involving rural households in training on agroforestry management to enhance adoption rates. Mganga et al. [86] focused on dryland ecosystems in Kenya, where agropastoralists combat land degradation due to climate variability through Sustainable Land Management (SLM) technologies. The study identified indicators of land degradation such as vegetation change and overgrazing, and documented SLM technologies including grass reseeding, rainwater harvesting, soil conservation, and dryland agroforestry. These practices were recognized for their additional benefits in combating land degradation and improving rural livelihoods. Dhyani [87] explored the historical evolution of agroforestry practices in India, emphasizing their significant contributions to small and marginal farmers and the Indian economy. The paper underscored the role of scientific research in promoting awareness about tree preservation, expanding agroforestry adoption, and enhancing environmental services such as biodiversity conservation, watershed protection, carbon sequestration, and climate change mitigation. It highlighted agroforestry's potential in sequestering carbon in soils and vegetation to mitigate global warming impacts from high atmospheric $CO_2$ concentrations. Quli et al. [88] focused on crisis management of rural livelihoods through eco-friendly agroforestry practices. Their study analyzed agroforestry scenarios, the multifunctional roles of agroforestry, dynamics of ecosystem services, and factors contributing to livelihood distress. It compiled scientific information on region-specific agroforestry systems across India and proposed strategies for utilizing suitable agroforestry systems to enhance natural resource resilience and sustainable rural livelihoods. The study concluded with recommendations to optimize outcomes from proposed agroforestry interventions.

## Sectorial Initiatives Promoting Agroforestry as a Sustainable Livelihood Improvement Strategy

There are also sectorial initiatives championed by stakeholders such CIFOR-ICRAF, IUCN and WWF as well as community organizations and NGOs (African Food Security and


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Climate Army – AFSACA, Sustainable Run for Development - SURUDEV, Environment and Rural Development Foundation – ERuDeF, Green Forest Foundation - GREFF, Ozone Friendly People – OFP) geared towards promoting agroforestry as a strategy for livelihood improvement and ecosystem management. A better alignment and synchronization of global, national and sectorial initiatives will contribute towards fostering agroforestry as a sustainable strategy for livelihood improvement and ecosystem management. Gupta et al. [30] highlight the global issue of land degradation and its severe impacts on the livelihoods of resource-dependent communities. They discuss various forms of land degradation, with a particular emphasis on soil degradation as a critical threat to food security, ecosystem health, and overall environmental sustainability. The paper advocates for ecological restoration and positions agroforestry as a pivotal approach for rehabilitating degraded lands caused by intensive agriculture, deforestation, soil erosion, and overexploitation. It explores diverse agroforestry options that play crucial roles in soil protection, biodiversity conservation, carbon sequestration, and climate change adaptation and mitigation. The importance of stakeholder engagement in designing effective agroforestry systems is underscored to support sustainable land productivity and enhance biodiversity and ecosystem services across different scales. Plieninger et al. [39] introduce a special feature dedicated to examining the role of agroforestry within sustainable landscape management strategies. This feature includes eleven studies employing interdisciplinary perspectives integrating ecological, agricultural, and socio-economic sciences. These studies explore how agroforestry contributes to ecosystem goods and services and their interactions with sectors like agriculture, forestry, nature conservation, and urban planning. The papers advocate for conceptualizing agroforestry as part of "nature-based solutions" that address various societal challenges and inform land-use policies. They emphasize the importance of inclusive landscape governance, scaling up agroforestry practices for broader landscape benefits, and advancing innovation in agroforestry system analysis and design to maximize its contributions to sustainable landscape management. Dawson et al. [89] focus on the significance of tree genetic diversity within agroforestry ecosystems, emphasizing its role in supporting rural livelihoods and biodiversity conservation. The paper underscores the importance of integrating research on tree genetic variation with on-the-ground practices to enhance productivity and sustainability in agroforestry landscapes. It stresses the need to conserve a diverse genetic base in agroforestry trees to mitigate risks such as inbreeding depression and to enhance adaptability to changing environmental conditions and market demands. The study suggests practical interventions, including strengthening community-based seed and seedling exchange networks and initiating local tree domestication programs. Additionally, it addresses the challenge of promoting markets that support genetic diversity in tropical tree species, advocating for collaborative efforts to ensure the conservation and sustainable utilization of diverse genetic resources within agroforestry systems.

Urruth et al. [21] explore the potential of agroforestry as a land-management approach in Brazil's Atlantic Forest region. The paper identifies legal and bureaucratic obstacles hindering agroforestry development in the area. It introduces SEMA's agroforestry certification (SAC) as a simplified process to ensure legal compliance and sustainable management of native vegetation. The study detail SAC's application process and its benefits for small rural landowners, indigenous communities, and traditional populations. They highlight key agroforestry management practices and products identified by SAC applicants, underscoring the importance of supportive policies in conservation efforts for the Atlantic Forest. The paper concludes by advocating for enhanced agroforestry-support policies beyond legislative measures to promote conservation opportunities and sustainable land management in the region. Montagnini & Metzel [90] provide a comprehensive overview of agroforestry systems (AFS) globally, emphasizing their diverse forms and contributions to rural livelihoods. The study discusses the significance of traditional knowledge in AFS and the role of international entities and organizations in conducting research aimed at addressing rural poverty, hunger, and promoting landscape integrity and ecosystem services. It addresses critical issues such as integrating traditional and scientific knowledge, identifying suitable AFS products and markets, enhancing market access for smallholders, and scaling up AFS regionally and internationally. Ayyam et al. [91] focus on the role of agroforestry in coastal and island eco-regions, highlighting its potential to enhance rural livelihoods while conserving biodiversity and the environment. The study discusses various agroforestry systems integrated with plantation crops, livestock, poultry, and rice, emphasizing their contributions to farm production and income enhancement. It underlines the importance of conserving and utilizing diverse indigenous tree species alongside crops and livestock in agroforestry models tailored to specific coastal and island environments. The paper advocates for sustainable agroforestry practices that balance economic benefits with environmental conservation in these unique ecological settings.

Lacerda et al. [92] explore integrated landscape approaches in Southern Brazil, emphasizing the necessity of genuine transdisciplinary and multi-stakeholder research to address diverse social, ecological, economic, and political contexts. Their case study underscores the importance of integrating local communities' knowledge and experiences into developing solutions for integrated landscapes. The efforts discussed include supporting traditional agroforestry practices, optimizing and scaling out agroforestry systems, enhancing biodiversity, protecting ecosystem services, and diversifying agricultural landscapes. The paper advocates for holistic approaches that reconcile various stakeholders' interests to achieve sustainable


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landscape management. Gurung et al. [93] highlight the importance of livelihood sustainability and land degradation neutrality (LDN) within the framework of sustainable development. They emphasize empowering rural and indigenous communities through economic opportunities, particularly through non-timber forest products (NTFPs) and homegardens. The study also discusses agroforestry-based REDD+ strategies as crucial options for mitigating climate change and promoting sustainable development. These strategies focus on conserving forests and increasing woody biomass outside forests in agricultural landscapes, thereby enhancing resilience to climate change and supporting biodiversity conservation. Ashley et al. [94] examine the potential of agroforestry to improve rural livelihoods while alleviating pressure on protected areas and enhancing habitat for wildlife in Sub-Saharan Africa. The study analyzes the policy landscape surrounding protected areas in Uganda, Cameroon, and Mali, identifying market constraints, contradictions between development approaches and conservation goals, and inconsistencies in institutional and regulatory frameworks. It underscores the importance of recognizing agroforestry's dual benefits for conservation and livelihoods to enhance the effectiveness of conservation landscape strategies in these regions. Foncha & Ewule [95] focus on Mt Oku forest in Cameroon, highlighting its innovative forest management approach with devolved management rights to local communities. The study examines the legal, institutional, socio-economic, and regulatory frameworks established to support conservation and livelihood sustainability post-devolution. It discusses alternative livelihood options adopted by frontline and secondary villages, including direct employment, bee farming, agricultural intensification, and agroforestry. The study emphasizes the positive impacts of community forest ownership on transparency, accountability, social stability, forest regeneration, and conservation efforts, ultimately improving local livelihoods and fostering sustainable forest management practices.

Ashiagbor et al. [96] investigate the impact of integrating trees into agroforestry land-use systems on food and income security in six communities in Ghana. The study assesses farmers' awareness and adoption of agroforestry practices and links adoption to reduced forest degradation and susceptibility to forest fires. Results indicate a significant increase in households practicing various agroforestry technologies, expansion of agricultural lands, and a decrease in forest fire incidents. The study highlights the role of integrating high-value tree species into household farms to promote broader adoption of agroforestry, mitigate forest degradation, and reduce forest fire risks. Dumont et al. [97] propose a novel approach to developing agroforestry options in the eastern part of the Democratic Republic of Congo (DRC). Their study integrates local knowledge acquisition with structured stakeholder engagement to design inclusive agroforestry options that balance production and conservation goals while accommodating diverse local conditions. The results emphasize the importance of enhancing tree diversity across landscapes rather than focusing solely on a few priority tree species. This approach aims to foster more resilient and productive livelihoods by promoting diverse agroforestry systems tailored to local contexts. Fuchs et al. [79] evaluate the impact of an asset-based community-driven local development project aimed at enhancing farmer livelihoods through agricultural and agroforestry training in Kenya's Nyando river basin. The study assesses the project's influence on farmer incomes by examining the adoption of climate-smart agricultural practices. Findings reveal that factors such as location, participation in the project, land size, farming techniques, and socioeconomic conditions significantly influence the adoption and success of these practices. The study underscores the importance of considering both biophysical and socioeconomic contexts in providing external support for climate-smart agriculture initiatives to ensure their effectiveness and sustainability.

The studies by Papa et al. [98], Hemel et al. [99], Islam et al. [100], and Telwala [101] emphasize the transformative role of agroforestry in enhancing farmer livelihoods and fostering resilience in diverse sectorial contexts. Papa et al. [98] focus on sub-humid West Africa, investigating farmer responses to climate change within agroecological systems, particularly agroforestry parklands. Their qualitative approach reveals that farmers employ adaptive management strategies, with trees playing a crucial role in providing ecosystem services like provisioning, biodiversity enhancement, nutrient cycling, and climate regulation. The study underscores trees' multifunctional contributions in bolstering livelihoods and fortifying resilience amidst climate challenges. Hemel et al. [99] shift the focus to Bangladesh's northern region, examining Choi Jhal (Piper chaba)-based agroforestry's impact on farmer livelihoods. Their findings indicate that Piper chaba cultivation significantly enhances livelihood sustainability by providing food, fruit, timber, fodder, and fuelwood. Despite these benefits, the study identifies challenges faced by farmers, highlighting the need for addressing these barriers to maximize livelihood gains from diversified agroforestry practices. Islam et al. [100] extend the discussion to communities around the Sundarban mangrove forest in Bangladesh, assessing farmers' participation in various agroforestry systems. Their research underscores high levels of engagement in homestead agroforestry and aquasilviculture, which contribute to livelihood diversification, natural resource management, and resilience to climate change. The study positions agroforestry as a sustainable alternative that reduces dependency on protected forests while enhancing community resilience. Telwala [101] broadens the perspective by advocating agroforestry as a Nature-based Solution (NbS) for achieving Sustainable Development Goals (SDGs) in a drought-prone region of southern India. Through qualitative research, the paper illustrates agroforestry's positive impacts on 10 out of 17 SDG targets, emphasizing its role in addressing local challenges and promoting environmental stewardship. The study highlights


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the intrinsic motivations of farmers, identifies adoption barriers, and discusses the potential of carbon markets to incentivize sustainable practices.

## Conclusion

Promoting agroforestry systems holds immense potential for enhancing livelihoods and ecosystem management, and the involvement of global, national, and sectorial initiatives is crucial in realizing this potential. Global organizations, such as the United Nations and international NGOs, play a pivotal role in advocating for and supporting agroforestry initiatives worldwide. They can provide funding, technical expertise, and policy guidance to facilitate the adoption and scaling up of agroforestry practices. Additionally, global initiatives like the UN Decade for Ecosystem Restoration provide a platform for raising awareness about the benefits of agroforestry and mobilizing action at the international level. National governments play a key role in creating an enabling environment for agroforestry adoption through the formulation of supportive policies and programs. This includes incentivizing agroforestry practices through subsidies, land tenure reforms, and extension services. Furthermore, integrating agroforestry into national development plans can help address multiple priorities, including poverty alleviation, food security, and environmental sustainability. Sectorial Collaboration including agriculture, forestry, environment, and rural development, is essential for mainstreaming agroforestry into broader development agendas. This involves engaging diverse stakeholders, such as farmers, researchers, policymakers, and civil society organizations, in participatory decision-making processes. Furthermore, promoting synergies between agroforestry and other land use practices, such as conservation agriculture and sustainable forestry, can enhance overall landscape resilience and productivity. Promoting agroforestry systems requires concerted efforts at the global, national, and sectorial levels. By harnessing the collective action of stakeholders and aligning policies, programs, and initiatives, agroforestry can emerge as a powerful tool for improving livelihoods, conserving ecosystems, and mitigating climate change on a global scale.

## Acknowledgement

The authors are thankful to the Department of Forestry and Wildlife Technology of the University of Bamenda and the Department of Forestry of the University of Dschang for providing an enabling environment for this study.

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**How to cite this article:** Nyong P Awazi, Titus F Ambebe, Njilin A Njamnjubo, Tchoutezou Guy H Zanguim. Promoting Agroforestry Systems for Livelihoods and Ecosystem Management: The Role of Global, National and Sectorial Initiatives. Int J Environ Sci Nat Res. 2024; 34(1): 556379.
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**How to cite this article:** Nyong P Awazi, Titus F Ambebe, Njilin A Njamnjubo, Tchoutezou Guy H Zanguim. Promoting Agroforestry Systems for Livelihoods and Ecosystem Management: The Role of Global, National and Sectorial Initiatives. Int J Environ Sci Nat Res. 2024; 34(1): 556379.
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DOI: 10.19080/IJESNR.2024.34.556379





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