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Agroforestry in woody-encroached Sub-Saharan savannas: Transforming ecological challenges into sustainable opportunities

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ABSTRACT

Woody plant encroachment (WPE) is the widespread proliferation of trees and shrubs into historically open ecosystems. This phenomenon affects Sub-Saharan savannas, challenging biodiversity conservation and agricultural productivity. While typically viewed negatively in protected areas due to impacts on grass-dependent species and ecological processes, WPE has nuanced effects in agricultural contexts. Encroaching woody species can enhance soil fertility, moderate microclimates, control erosion, and provide valuable non-timber forest products, supporting agricultural resilience and rural livelihoods. This perspective paper advocates agroforestry as a transformative way to convert WPE from an ecological threat into an opportunity for sustainable land management. Drawing from successful West African agroforestry practices, including Assisted natural regeneration, Parkland agroforestry, and Alley cropping, we illustrate their benefits for agricultural productivity, climate resilience, and income diversification. However, scaling up agroforestry faces technical and institutional barriers, notably limited farmer knowledge, insufficient extension services, insecure land tenure and weak market structures. We recommend clear land and tree tenure policies, explicit agroforestry integration into national policies, financial incentives such as subsidies and payments for ecosystem services, and capacity building through targeted training. Finally, we highlight critical research priorities, emphasizing species-specific ecological studies, socio-economic evaluations, climate resilience assessments, and participatory community engagement. Our ongoing research in the Guinean savannas of Côte d'Ivoire near Lamto Reserve and Mont Sangbé National Park addresses all these aspects, aiming to enhance rural livelihoods, food security, and biodiversity conservation.

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INTRODUCTION

Sub-Saharan savannas are among the most extensive and ecologically significant ecosystems in Africa, covering over 13 million square kilometers. These landscapes are characterized by a coexistence of C3 woody species and C4 grasses and support hundreds of millions of people whose livelihoods predominantly depend on rain-fed agriculture and pastoralism (Sankaran *et al.*, 2008; de Leeuw *et al.*, 2019). Maintaining this open savanna structure is crucial, as it sustains biodiversity, supports essential ecological processes such as nutrient cycling, and provides critical habitats for numerous specialized species (Venter *et al.*, 2018; Osborne *et al.*, 2018).

In recent decades, many sub-Saharan savannas have experienced significant structural transformations due to woody plant encroachment (WPE)– a widespread increase in tree and shrub densities at the expense of grassy vegetation (Axelsson and Hanan, 2018; Anchang *et al.*, 2019). Over the past three decades, woody vegetation has expanded by approximately 7.5 million km^2 in this region, representing ~55% of non-forest savanna biomes, while only 2.2 million km^2 (16%) experienced woody cover loss (Venter *et al.*, 2018). This net gain corresponds to an 8% increase in woody cover continent-wide, with particularly high encroachment rates observed in *Caesalpinioid savannas* (+20%) and countries like Cameroon, Central African Republic, and Uganda where average increases exceeded 30%.

Several studies have documented that WPE is primarily driven by rising atmospheric CO_2 levels, shifts in fire regimes, changes in herbivore communities, and demographic pressures, with far-reaching consequences for savanna ecosystem dynamics, biodiversity conservation, and local livelihoods (Stevens *et al.*, 2016; Archer *et al.*, 2017; Venter *et al.*, 2018).

Traditionally, WPE is perceived negatively due to its detrimental effects on grass-dependent biodiversity, disruption of fire regimes, and alteration of hydrological cycles (Eldridge *et al.*, 2011; Honda and Durigan, 2016; Acharya *et al.* 2018). Consequently, management interventions, especially within protected areas, have historically aimed at maintaining open savannas through mechanical thinning and prescribed burning to preserve biodiversity and ecosystem functions (Smit, 2004; Case and Staver, 2016; Bassett *et al.*, 2020; Giles *et al.*, 2021; N'Dri *et al.*, 2021). Beyond ecological consequences, there are also significant socio-economic impacts, particularly for rural communities dependent on pastoralism and tourism-based economies. Increased woody cover reduces grazing areas, intensifies human-wildlife conflicts, and reduces tourism attractiveness (Donovan *et al.*, 2018; Luvuno *et al.*, 2022; White *et al.*, 2024).

Nonetheless, the effects of WPE in agricultural landscapes are nuanced, presenting potential opportunities alongside evident challenges. Encroaching woody species can deliver substantial ecosystem services, such as soil fertility enhancement, erosion control, microclimate moderation, and provision of economically valuable non-timber forest products (NTFPs), including fodder, fuelwood, and medicinal plants (Blaser *et al.*, 2014; Aweto, 2024; Ding and Eldridge, 2024). Recognizing and strategically managing these species can therefore increase agricultural productivity and resilience to climate variability, turning an ecological threat into an opportunity for sustainable land management (Weston *et al.*, 2015; Roessler *et al.*, 2025).

In this context, agroforestry– the intentional integration of woody vegetation into agricultural systems– emerges as a promising and adaptive strategy. By capitalizing on selective management rather than indiscriminate removal of encroaching species, agroforestry practices such as Assisted natural regeneration, Parkland agroforestry, and Alley cropping have demonstrated notable successes in improving soil fertility, crop yields, and income diversification in various West African contexts (Lawry *et al.*, 1994; Bayala *et al.*, 2014; Bayala *et al.*, 2015; Roessler *et al.*, 2025). These systems can effectively convert woody encroachment challenges into multifunctional landscapes that offer both ecological sustainability and enhanced rural livelihoods.

This article explores how agroforestry can transform the management of woody-encroached savannas from a focus on ecological degradation to opportunities for environmental and socio-economic benefits. First, we synthesize current knowledge on ecological and socio-economic impacts of WPE. Subsequently, we discuss how targeted agroforestry interventions can leverage these impacts positively. We then identify critical technical, institutional, and policy barriers to successful implementation. Finally, we propose research directions and practical strategies necessary for scaling up agroforestry, emphasizing its importance in achieving sustainable development, food security, and climate resilience objectives in sub-Saharan Africa.

Contrasting ecological impacts and socio-economic opportunities of woody plant encroachment

WPE represents a significant ecological transformation in sub-Saharan savanna ecosystems, marked by the proliferation of trees and shrubs at the expense of grasses (Fig. 1). This phenomenon is driven by multiple interacting factors, including altered fire regimes, reduced grazing pressures, climate variability, elevated atmospheric CO_2 concentration, and changing land-use practices (Stevens *et al.*, 2016; Case and Staver, 2016; Archer *et al.*, 2017; Venter *et al.*, 2018).

Fig. 1. Structural contrast between open savanna (left) and woody-encroached savanna (right) in the Lamto Reserve, Côte d'Ivoire (6°13′–6°25′N and 5°15′–4°97′W).

Ecologically, WPE substantially alters vegetation dynamics and ecosystem functioning. It reduces grass cover, disrupts fire frequency and intensity, and significantly modifies habitat structures, ultimately affecting species composition and biodiversity (Smit and Prins, 2015; Archer *et al.*, 2017; Andersen and Steidl, 2019; Lima *et al.*, 2021; Wieczorkowski and Lehmann, 2022) (Fig. 2). Increased woody biomass further exacerbates these ecological shifts by reducing grass-dependent nutrient cycling processes and altering hydrological dynamics through reduced water infiltration and intensified competition for groundwater resources (Mitchard and Flintrop, 2013; Honda and Durigan, 2016; Acharya *et al.*, 2018; Osborne *et al.*, 2018; Basant *et al.*, 2023). These alterations often threaten the persistence of grassland-specialist species while facilitating the proliferation of generalist woody species, thereby compromising biodiversity heterogeneity (Alofs and Fowler, 2013; Stevens *et al.*, 2016; Brewer, 2017; Archer *et al.*, 2017; White *et al.*, 2024).

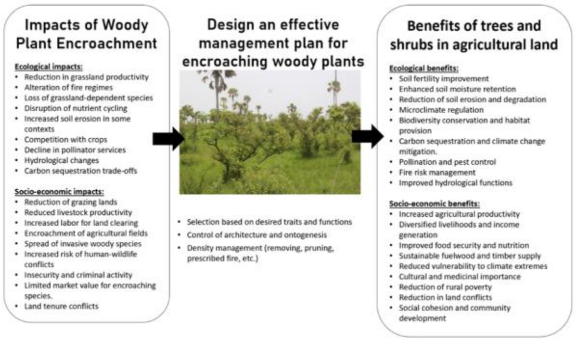

Fig. 2. Contrasting ecological and socio-economic impacts of woody plant encroachment and the potential benefits of integrating trees and shrubs into agricultural landscapes.

The open savanna is characterised by widely spaced trees and a continuous layer of C4 grass, whereas the woody-encroached savanna exhibits an increased density of multi-stemmed shrubs and medium-sized trees, indicating a shift towards a more closed canopy structure. Such encroachment alters ecosystem functions and presents challenges and opportunities for the sustainable management of agricultural land through the integration of agroforestry.

Within protected areas, the consequences of WPE extend beyond ecological concerns to include socio-economic implications. Increased woody cover reduces visibility and accessibility, which has a negative impact on tourism and revenues from wildlife-based ecotourism, both of which are crucial for financing conservation (Gray and Bond, 2013;

Donovan *et al*., 2018; Luvuno *et al*., 2022). Dense woody vegetation also increases human-wildlife conflict by providing shelter for predators and large herbivores, enabling them to move closer to inhabited areas and increasing the risk of livestock predation and subsequent economic losses (Atkinson *et al*., 2022; Luvuno *et al*., 2022; Kuiper *et al*., 2023). Furthermore, dense vegetation facilitates illegal activities such as poaching and illegal logging, complicating management efforts and increasing conservation costs (Muboko *et al*., 2014; Donovan *et al*., 2018; Hunninck *et al*., 2020).

Despite these challenges, recent evidence suggests that conventional approaches aimed at removing encroaching woody vegetation may not fully restore savanna ecosystems or effectively mitigate the structural and functional alterations induced by encroachment (Fogarty *et al*., 2020; Eldridge and Ding, 2021). Indeed, many encroached areas exhibit some ecological characteristics, such as enhanced soil fertility, improved water retention and increased carbon sequestration potential. These attributes can be used strategically and beneficially rather than being eliminated through indiscriminate clearing (Eldridge and Ding, 2021; Ding and Eldridge, 2024). Therefore, adaptive management approaches that advocate the selective retention and targeted integration of beneficial woody species into savanna ecosystems are gaining traction as viable alternatives (Fogarty *et al*., 2020; Eldridge and Ding, 2021).

Unregulated woody plant encroachment can lead to declines in grassland productivity, alterations in fire regimes, and increased human–wildlife conflicts (Eldridge *et al*., 2011; Archer *et al*., 2017; Donovan *et al*., 2018). However, strategic management—through species selection, architectural control, and density regulation- can harness the ecological functions and livelihood opportunities provided by trees and shrubs. These benefits include soil fertility improvement, microclimate regulation, carbon sequestration, enhanced food security, and income diversification (Blaser *et al*., 2014; Aweto, 2024).

Outside of protected areas, the ecological and socio-economic effects of WPE are highly context-dependent, varying according to the specific woody species involved, local land-use practices and livelihood strategies. In pastoral regions, for example, excessive woody encroachment can reduce available grazing land, thereby negatively impacting livestock productivity and threatening rural livelihoods (Eldridge *et al*., 2011; Luvuno *et al*., 2018; Hare *et al*., 2021; Luvuno *et al*., 2022). Similarly, agricultural communities experience challenges as increased woody cover intensifies the cost and labour required for land clearing and reduces the availability of arable land (Anchang *et al*., 2019; Luvuno *et al*., 2022).

However, in agricultural and pastoral contexts, encroaching woody species can deliver substantial ecosystem services, enhancing agricultural productivity and resilience to climate variability (Fig. 2). Certain species, particularly nitrogen-fixing legumes such as *Faidherbia albida* A. Chev. (Fabaceae), *Acacia* spp. Mill. (Fabaceae) and *Parkia biglobosa* (Jacq.) R.Br. ex G.Don. (Fabaceae), can significantly improve soil fertility, boost crop yields and provide vital fodder during dry periods (Umar *et al*., 2013; Bayala *et al*., 2015; Sileshi, 2016; Akpalu *et al.* 2020). Furthermore, the collection of economically valuable non-timber forest products (NTFPs), including fuelwood, fodder, medicinal plants, and edible fruits, offers considerable potential for income diversification and improved household resilience, particularly when adequately integrated into local market systems (Binam *et al*., 2015b; Derebe and Alemu, 2023; Asamoah *et al*., 2024).

Therefore, rather than viewing WPE as an ecological threat alone, it can be strategically leveraged through context-specific agroforestry systems. Adaptive management strategies emphasising selective tree retention, species-specific thinning and integrating beneficial woody species into agricultural and pastoral practices can transform WPE from a liability into an asset (Fig. 3). Therefore, recognising and promoting the dual ecological and socio-economic roles of encroaching woody species is critical to the sustainable management and optimisation of productivity in sub-Saharan savannas.

Agroforestry offers an innovative and adaptive strategy for managing WPE, transforming a significant ecological challenge into opportunities for sustainable land management (Fig. 3). By intentionally integrating trees and shrubs into agricultural and pastoral systems, agroforestry capitalizes on the ecological services provided by woody vegetation, while mitigating their potentially negative impacts (Rosenstock *et al.*, 2019; Kuyah *et al.*, 2019; Mukhlis *et al.*, 2022).

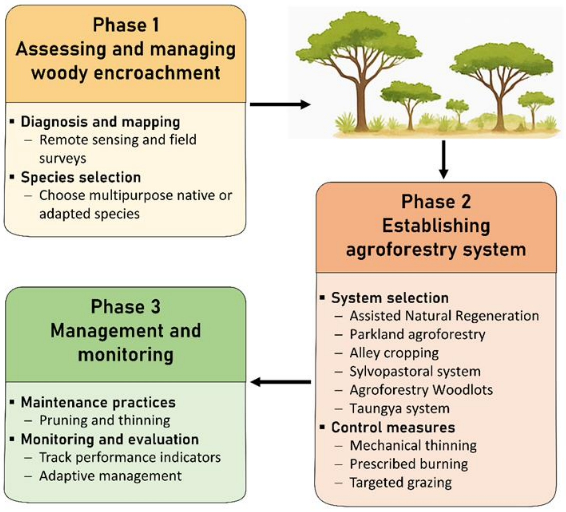

Fig. 3. Strategic phases for transforming woody-encroached savannas into efficient agroforestry systems. The diagram illustrates key steps including initial assessment and management of woody vegetation, selection and establishment of suitable agroforestry systems, and ongoing management and participatory monitoring to ensure ecological sustainability and socio-economic benefits (adapted from Bayala *et al.*, 2014; Venter *et al.*, 2018; Kuyah *et al.*, 2019).

Agroforestry as a strategic approach to transform woody encroachment into ecological and economic opportunities

Empirical evidence from various sub-Saharan African countries illustrates the effectiveness of agroforestry in addressing woody encroachment. Farmer-Managed Natural Regeneration (FMNR), for instance, has significantly revitalized degraded agricultural lands in Niger by allowing selective management of naturally regenerating woody species. This practice substantially enhances soil fertility, boosts crop productivity, and diversifies farm incomes through products derived from trees (Weston *et al.*, 2015; Binam *et al.*, 2015a; Rosenstock *et al.*, 2019). Similar success have been documented in Burkina Faso and Senegal, where integrating specific woody species like *Faidherbia albida* into cropping systems markedly improved nutrient availability, increased crop yields under drought conditions, and provided valuable fodder for livestock (Marston *et al.*, 2017; Anchang *et al.*, 2019).

Beyond direct agricultural productivity benefits, agroforestry significantly contributes to environmental conservation and climate resilience (Fig. 4). Selective preservation and management of native tree species within agroforestry systems help mitigate soil erosion, enhance carbon sequestration, and create wildlife habitat corridors, thereby aligning ecological objectives with agricultural productivity (Jose, 2009; Devine *et al.*, 2017). These integrated systems also support pollinators and beneficial insects, which are essential for agricultural sustainability, especially under changing climatic conditions (Liu *et al.*, 2018).

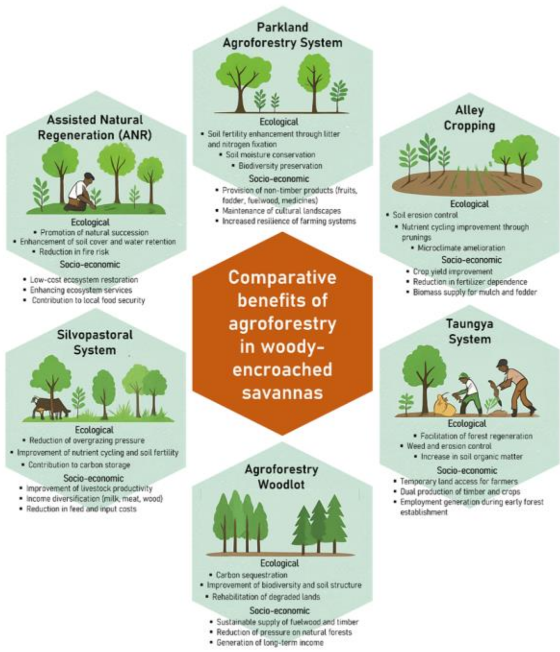

Fig. 4. Ecological and socio-economic benefits of six major agroforestry systems. This typology is derived from key reviews on agroforestry systems and their multifunctionality in Sub-Saharan Africa and beyond (Nair, 1993; Gao *et al.*, 2014; Roy *et al.*, 2025).

However, the adoption of agroforestry practices requires careful planning and species selection to avoid unintended ecological and socio-economic consequences (Figs 2 and 3).

In Côte d'Ivoire and other West African countries, the development of agroforestry practices has followed different trajectories. Sometimes these practices have served as a tool for reforestation, while at other times they have accelerated deforestation. Reforestation-oriented agroforestry aims to restore degraded landscapes by gradually integrating trees into farmland to strengthen ecosystem functions and promote biodiversity conservation. However, deforestation-driven agroforestry occurs when natural non-degraded forests are converted into agroforestry systems, resulting in substantial biodiversity loss and land degradation (Zo-Bi and Hérault, 2023). These contrasting outcomes highlight the importance to develop agroforestry interventions that promote tree retention and enrichment planting within already cultivated or degraded lands, rather than facilitating further forest clearing under the pretext of agroforestry expansion.

To ensure the long-term sustainability and multifunctionality of savanna landscapes, agroforestry systems should prioritize native, multipurpose tree species that offer both ecological and socio-economic advantages. For example, nitrogen-fixing trees such as *Faidherbia albida* and *Parkia biglobosa* have proven particularly effective in enhancing soil fertility, improving water-use efficiency, and supporting integrated crop-livestock systems (Pouliot *et al.*, 2012; Sileshi, 2016; Marston *et al.*, 2017). Additionally, fruit-bearing and multipurpose trees like shea tree *Vitellaria paradoxa* C.F.Gaertn. (Sapotaceae) and baobab *Adansonia digitata* L. (Malvaceae) provide valuable economic opportunities, further incentivizing local communities to adopt and sustainably manage these agroforestry practices (Nasare *et al.*, 2019; Meinhold and Darr, 2021).

Furthermore, integrating agroforestry systems such as Alley Cropping, Silvopastoral Systems, and Taungya Systems into woody-encroached landscapes offers various ecological and economic advantages (Fig. 4). Alley Cropping, where trees are planted in crop alleys, effectively controls erosion, enriches soil nutrients, and sequesters carbon, thereby enhancing crop yields and diversifying farmer income (USDA, 2011; Hombegowda *et al.*, 2022).

Silvopastoral Systems, combining trees with livestock management, improve grass productivity, maintain soil moisture, and increase livestock productivity, thus supporting both ecological balance and rural livelihoods (June *et al.*, 2019). Meanwhile, the Taungya System, integrating temporary cultivation of food crops with reforestation initiatives, contributes to forest recovery while ensuring farmer livelihoods during initial establishment periods (Appiah *et al.,* 2020; Mukosha *et al.* 2024).

By aligning agroforestry strategies with local ecological contexts and socio-economic realities, WPE can be strategically leveraged as a critical tool for sustainable land management. Rather than being viewed solely as an ecological challenge, agroforestry enables the transformation of woody encroachment into productive landscapes, fostering environmental sustainability, biodiversity conservation, and economic resilience in sub-Saharan savannas.

Technical and institutional challenges in agroforestry implementation

Despite its significant potential, the widespread adoption and implementation of agroforestry in woody-encroached sub-Saharan savannas face several technical and institutional challenges that must be addressed strategically. These barriers require integrated approaches that involve targeted technical support, capacity building, policy adjustments, and robust market structures to ensure the sustainable success of agroforestry systems.

One primary technical challenge is the selection of appropriate woody species compatible with existing agricultural systems. Incorrect species selection can lead to excessive competition for critical resources such as water, nutrients, and sunlight, negatively impacting agricultural productivity and increasing vulnerability for smallholder farmers (Utaile *et al.*, 2021; Luvuno *et al.*, 2022). Effective agroforestry thus requires comprehensive ecological knowledge to identify species-specific interactions, architecture and growth patterns, and synergies that minimize negative impacts and maximize ecological and economic benefits (Jose, 2009; Liu *et al.*, 2018).

Additionally, agroforestry practices demand specialized management skills that are often limited among farmers and rural communities. Essential practices such as optimal tree spacing, pruning techniques, harvesting strategies, and system maintenance require targeted knowledge and training that may be lacking in rural contexts. To address this challenge, substantial investment in farmer education, extension services, and practical training programs is essential, ensuring the successful adoption and sustainability of integrated agroforestry systems (Kuyah *et al.*, 2019; Fané *et al.*, 2024).

From an institutional perspective, insecure land tenure and unclear tree ownership rights constitute significant barriers. Without clear and secure tenure rights, farmers are reluctant to invest in agroforestry practices whose benefits typically accrue over the long term. This uncertainty is particularly acute in communal land systems where land-use rights and tree tenure are often ambiguous or contested (Kgosikoma and Mogotsi, 2013; Sanou *et al.*, 2017; Zabala *et al.*, 2025). Consequently, strengthening land tenure frameworks and clearly defining tree ownership rights are critical policy priorities for incentivizing long-term investments in agroforestry.

Furthermore, existing agricultural and forestry policies often fail to adequately recognize or support agroforestry, operating instead within distinct sectoral silos. Restrictive regulatory frameworks and insufficient policy integration between agricultural, forestry, and environmental sectors can significantly limit the adoption and expansion of agroforestry practices (Current *et al.*, 1998; Asseldonk *et al.*, 2023; Do *et al.*, 2025). Developing comprehensive, integrated policies that explicitly prioritize agroforestry within broader agricultural and rural development strategies can significantly mitigate these institutional barriers and encourage widespread adoption.

Market access and economic incentives also present substantial challenges. Farmers need viable economic opportunities and market structures that provide fair value for products such as fuelwood, fruits, medicinal plants, and fodder derived from agroforestry systems (Binam *et al.*, 2015b; Marston *et al.*, 2017). Strengthening local markets, establishing value chains for agroforestry products, and providing targeted economic incentives (e.g., subsidies for tree seedlings or payments for ecosystem services) could significantly enhance farmer motivation and adoption rates. For example, the commercialisation of agroforestry products remains largely informal in Côte d'Ivoire, Burkina Faso and Niger, with weak value chains limiting farmers' ability to generate stable incomes from tree-derived goods such as non-timber forest products (NTFPs) and fodder (Binam *et al.*, 2015b). Binam *et al.* (2015b) highlighted how the lack of organized markets and fair pricing mechanisms discourages smallholder farmers from investing in tree-based systems, reducing the adoption rates of agroforestry despite its potential benefits.

Moreover, agricultural extension services frequently lack the necessary capacity, specialized knowledge, and resources to effectively support agroforestry practices. Extension agents often have insufficient expertise regarding integrated tree-crop-livestock systems, limiting their ability to provide relevant advice and support to farmers. Addressing this issue requires targeted investments in extension services, specialized training programs for extension workers, and enhanced dissemination of agroforestry knowledge and technologies at the community level (Kuyah *et al.*, 2019).

Finally, socio-cultural acceptance and community involvement represent critical factors influencing agroforestry adoption. Participatory approaches that actively engage local communities, incorporate indigenous knowledge, and align with cultural norms and practices are essential for achieving sustained adoption and community ownership of agroforestry systems. Inclusive stakeholder engagement and co-management frameworks are thus indispensable for overcoming social resistance and ensuring long-term sustainability (Donovan *et al.*, 2018; Dumont *et al.*, 2019, Barlagne *et al.* 2023).

Policy and research priorities for sustainable agroforestry in woody-encroached savannas

To achieve the full potential of agroforestry in woody-encroached sub-Saharan savannas, targeted policy interventions and strategic research initiatives are required. A coordinated approach that integrates technical, economic and institutional considerations is essential in order to support sustainable land management, enhance ecosystem services and foster rural development and resilience.

Policy priorities

One of the most critical policy interventions required is clarifying and securing land and tree tenure rights. Uncertain tenure significantly deters farmers from making long-term investments in agroforestry, particularly in communal land systems where rights to trees and land use are often unclear or disputed. Therefore, strengthening legal frameworks to explicitly define and protect tenure and tree ownership rights is crucial in order to incentivise long-term commitment to agroforestry practices (Kgosikoma and Mogotsi, 2013; Sanou *et al.*, 2017; Zabala *et al.*, 2025).

Financial incentives and support mechanisms are equally vital for overcoming the initial barriers to investment. Subsidies for tree seedlings, accessible microcredit for implementing agroforestry, and payments for ecosystem services can significantly encourage farmers to participate and facilitate the transition to sustainable agroforestry systems. Furthermore, the establishment of organised markets for agroforestry products, including fuelwood, fodder, fruit, medicinal plants and carbon credits, can improve economic viability and encourage wider adoption (Current *et al.*, 1998; Binam *et al.*, 2015b; Marston *et al.*, 2017; Asseldonk *et al.*, 2023; Do *et al.*, 2025).

Furthermore, it is essential to explicitly integrate agroforestry into national agricultural, environmental and climate adaptation policies. Many existing policies favour monoculture cropping and extensive grazing systems, inadequately recognising the multifunctional benefits provided by agroforestry. Incorporating agroforestry into national development strategies ensures targeted resource allocation, institutional support and effective scaling up through strengthened extension services and comprehensive training programmes (Place, 2012; FAO, 2013; Wilcox *et al.*, 2022).

Research directions

From a research perspective, it is fundamental to address key knowledge gaps and generate robust scientific evidence in order to optimise agroforestry practices in sub-Saharan savannas. Understanding the ecological roles, productivity trade-offs and economic potential of individual woody species across diverse agroecological zones requires species-specific studies. Research should focus on identifying species that enhance soil fertility, improve crop yields and offer significant economic opportunities while minimising competition with agricultural crops (Kuyah *et al.*, 2019; Luvuno *et al.*, 2022).

Another critical research area is understanding the hydrological impacts of WPE and agroforestry systems. Researchers should quantify the influence of trees and shrubs on local water cycles, groundwater recharge, soil moisture retention and drought resilience, particularly in the context of increasingly variable climatic conditions (Osborne *et al.*, 2018; IPCC, 2021). Deep-rooted woody species such as *Faidherbia albida* and *Acacia senegal* (L.) Willd. (Fabaceae) are of particular interest as they have the potential to access deeper soil moisture reserves, maintaining productivity during drought periods and enhancing landscape resilience (Pouliot *et al.*, 2012; Sileshi, 2016; Kuyah *et al.*, 2019).

Social-science research focusing on farmer perceptions, indigenous knowledge, and socio-economic outcomes is equally critical for successful agroforestry adoption. Participatory research methods, engaging local communities directly, can provide insights into farmer decision-making processes, perceived benefits and barriers, and preferred agroforestry configurations. Such community-driven approaches significantly enhance the likelihood of long-term success and sustainability of agroforestry interventions (Donovan *et al.*, 2018; Dumont *et al.*, 2019, Barlagne *et al.*, 2023).

Priority is also given to research on climate resilience, specifically the quantification of the contributions of agroforestry to carbon sequestration, drought mitigation and adaptation to climate extremes. It is crucial to evaluate how agroforestry systems influence ecosystem stability and productivity in the context of changing rainfall patterns and increased evapotranspiration, in order to develop resilient agricultural systems in sub-Saharan Africa (Weston *et al.*, 2015; IPCC, 2021).

In light of these priorities, our future research will focus specifically on the Guinean savannah regions of Côte d'Ivoire, with a particular focus on the rural landscapes surrounding the Lamto Reserve and Mont Sangbé National Park. These regions are valuable case studies due to ongoing processes of woody plant encroachment and the presence of well-established ecological research frameworks. Furthermore, their proximity to protected areas provides a unique opportunity to evaluate the effectiveness of agroforestry as a solution to agricultural sustainability and rural livelihood improvement, as well as its potential as a complementary biodiversity conservation strategy in multifunctional landscapes. Our integrated research approach aims to improve the ecological, economic and social outcomes of agroforestry, thereby helping to achieve broader sustainable development, food security and climate resilience objectives in sub-Saharan Africa.

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