



Gender-Responsive Smallholder Agricultural Environmentalism: Implications for Climate Adaptation, Sustainable Livelihoods, and Rural Transformation in Sub Saharan Africa

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Abstract

This study argues that gender-responsive agricultural environmentalism serves as an essential mechanism for bolstering climate resilience, enhancing the sustainability of livelihoods, and driving equitable rural development in sub-Saharan Africa. The drive to develop and strengthen smallholder farming systems to accommodate growing food demand has elicited considerable concerns about the preservation of biodiversity and the enduring sustainability of ecosystem resilience in the long term. Therefore, it is imperative to integrate food security objectives that drive agriculture with environmental conservation efforts in Sub-Saharan Africa. Agricultural environmentalism has emerged as a central theme in global sustainability and climate policy dialogues, underscoring the significance of conservation, climate-smart practices, and sustainable resource management, particularly within smallholder farming systems that are characterized by limited resources. Nevertheless, existing models of environmentalism in agriculture frequently overlook gender disparities, disregarding the unequal distribution of environmental knowledge, labor, costs, and benefits between men and women in agriculture. In sub-Saharan Africa, where smallholder agriculture is crucial for livelihoods and food systems, women play pivotal roles in soil management, water conservation, seed selection, livestock care, and biodiversity stewardship. However, environmental policies and interventions often prioritize male landowners, commercial production systems and formal knowledge structures. This study re-evaluates agricultural environmentalism through a gender lens, drawing on evidence from Sub-Saharan Africa. It examines how gender dynamics shape environmental practices, resource access, and adaptation strategies, and how environmental initiatives may inadvertently perpetuate these inequalities. This paper argues that without gender-responsive approaches, agricultural environmentalism risks being socially exclusive and environmentally ineffective. The study concludes by proposing pathways for gender-responsive environmental policies and practices that integrate equity, sustainability, and resilience. Gender, as a social determinant, plays a crucial role in shaping agricultural environmentalism, resilience, and adaptation processes. It is essential for comprehending sustainability transitions and climate vulnerability, particularly in SSA

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1. Introduction

Agricultural environmentalism incorporates environmental sustainability principles into agricultural systems, policies, and rural development practices. This concept has emerged as a fundamental component of global sustainability and climate governance, emphasizing conservation, climate-smart practices, and sustainable resource management in farming systems worldwide (Vikas

and Ranjan, 2024^[45]; Prabhu *et al.*, 2021^[19]; Yadav *et al.*, 2021^[19]). Agricultural environmentalism theory is grounded in humans' ethical duty to protect nature, focusing on productivity, sustainability, and stewardship principles (Congreves, 2025^[7]). Modern sustainability models highlight the interdependence of ecological, social, and economic systems, showing that sustainable agriculture must integrate these aspects for resilience (Liu, Chen, & Jiao, 2024^[28]; Chen *et al.*, 2025^[6]). In sub-Saharan Africa, gender-sensitive agroecological strategies and gender-transformative initiatives have demonstrated how gender influences agricultural practices and environmental outcomes (Sibanda, 2025^[26]; Kwaslema, Madaha, & Mwaseba, 2025^[26]). Analyses of sustainable farming practices have highlighted the importance of eco-friendly techniques and policies for smallholder settings (Sithole *et al.*, 2024^[28]).

In sub-Saharan Africa (SSA), where over 60% of the population relies on agriculture for their livelihood and food security, sustainable agricultural practices are extensively advocated to address soil degradation, water scarcity, and climate variability (Perelli *et al.*, 2024^[37]). Despite this increasing focus, existing environmental frameworks frequently employ gender-neutral intervention models that fail to recognize the profoundly gendered nature of agricultural labor and environmental stewardship in the region. Consequently, policies intended to advance sustainability may inadvertently perpetuate existing inequalities by favoring formal knowledge systems, male landholders, or commercial production modalities, thereby marginalizing the contributions of smallholder women (Perelli *et al.*, 2024^[37]; Hailemariam *et al.*, 2024^[16]).

Women are crucial in soil fertility management, seed selection, water conservation, and biodiversity stewardship, impacting environmental sustainability and household resilience (Vikas & Ranjan, 2024^[45]). Studies show their participation in climate-smart agriculture (CSA) enhances soil regeneration and adaptive capacity, yet adoption rates are lower due to gender disparities in land access, training, credit, and extension services (Hailemariam *et al.*, 2024^[16]; Boudalia, 2024^[5]). These disparities stem from sociocultural norms and institutional biases limiting women's agencies in environmental decision-making. Without addressing these inequalities, agricultural interventions risk being exclusionary and ineffective, undermining agricultural environmentalism goals. Thus, gender analysis in agricultural and environmental research is crucial, particularly in understanding intra-household dynamics, land tenure insecurity, and gendered labor allocation (OECD, 2021^[36]; IPCC, 2019^[20]; ADB, 2013^[1]; USAID^[43]), which shape smallholders' environmental engagement and adaptability.

Research conducted across multiple countries, including Ethiopia, Malawi, South Africa, and Tanzania, reveals that when women are involved in making decisions about farms, it greatly affects the adoption of climate-smart agriculture (CSA) technologies and practices in smallholder farming systems (Doss *et al.*, 2020^[11]; Fisher *et al.*, 2021^[14]; Kurgat *et al.*, 2020^[25]; Njuki *et al.*, 2022^[34]; Food and Agriculture Organization, 2023^[15]). Enhanced gender integration is associated with equitable and environmentally effective outcomes (Perelli *et al.*, 2024^[37]). Furthermore, narrative reviews addressing gender disparities in CSA adoption identify persistent obstacles such as time poverty, limited access to credit, and inadequate representation in local

governance structures. These challenges hinder women's environmental contributions and affect the equitable distribution of benefits from sustainability interventions (Boudalia, 2024^[5]).

While climate-smart and sustainable agriculture is widely acknowledged for its potential to enhance environmental resilience and improve rural livelihoods, the issue of gender inclusivity remains insufficiently addressed in both policy and practice. This oversight is particularly concerning given the evidence that gender-responsive climate actions can concurrently promote sustainability and social equity (Moore, 2025^[31]). Gender-transformative frameworks advocate for the integration of women's ecological knowledge, the expansion of their access to land and productive resources, and the assurance of equitable participation in agricultural innovation and financial systems (Moore, 2025^[31]; Delavallade *et al.*, 2025^[9]). In the absence of such adjustments, agricultural environmentalism risks perpetuating structural inequalities and undermining climate adaptation and mitigation objectives in sub-Saharan Africa (SSA).

This study revisits agricultural environmentalism by applying a gender perspective to examine how gender dynamics influence environmental practices, resource access, and adaptation strategies within smallholder farming systems in Sub-Saharan Africa (SSA). It assesses the extent to which current environmental initiatives may inadvertently perpetuate gender inequalities and explores policy options that advance both ecological sustainability and social justice. By emphasizing the gendered experiences and ecological knowledge of women, the study proposes strategies for crafting gender-responsive environmental policies that integrate equity, ecological sustainability, and rural resilience, thereby aligning environmental goals with the lived experiences of female smallholder farmers.

2. Conceptualizing Agricultural Environmentalism

Figure 1. is a conceptual framework for gender-responsive agricultural environmentalism that highlights the dynamic interplay between environmental challenges, institutional responses, structural disparities, and sustainability outcomes. It employs a systems-based approach to elucidate how agricultural environmental initiatives operate within socially diverse settings, particularly in smallholder systems in developing nations. Agricultural environmentalism encompasses the concepts, practices, and policies aimed at harmonizing agricultural production and environmental conservation. This includes methods such as conservation agriculture, organic farming, agroecology, sustainable intensification, and climate-smart agriculture (CSA). Although these methods vary in focus and technique, they all aim to minimize ecological harm while sustaining or improving food production and rural livelihoods.

The framework begins by identifying key environmental drivers, including climate change, land degradation, biodiversity loss, and food insecurity. These interconnected challenges necessitate transformative agricultural responses that enhance productivity while strengthening ecological resilience. Consequently, agricultural environmentalism has emerged as a central theme in development discourse and policy reform across sub-Saharan Africa and other vulnerable regions worldwide. However, many environmental agricultural frameworks are based on implicit assumptions of

neutral adoption. They often presume that farmers are rational land users with equal access to productive resources, information, and institutional support and that they possess similar capacities to adopt new technologies and practices. Such assumptions obscure the structural inequalities embedded in rural production systems.

Empirical evidence indicates that gender significantly influences access to land, credit, extension services, climate information, and decision making. Gender disparities limit women's participation in climate-smart and sustainable

agricultural practices and restrict their ability to benefit equitably from environmental interventions (Boudalia, 2024^[5]; Perelli *et al.*, 2024^[37]). Socioeconomic and cultural barriers further impede women's engagement in innovation processes, reinforcing unequal power relations in agricultural systems (Mbunda, 2025^[26]). In many smallholder contexts in sub-Saharan Africa, men are more frequently recognized as formal landholders and primary agricultural decision-makers in policy and extension systems.



Fig 1: Conceptual Framework for Gender-Responsive Agricultural Environmentalism

In contrast, women's agricultural and environmental contributions are often categorized as unpaid household labor or subsistence activities. These gendered power structures influence who defines environmental priorities, implements solutions and captures the associated costs and benefits. Applying a gender lens reframes agricultural environmentalism beyond technical and ecological considerations. It emphasizes questions of participation, recognition, and resource redistribution.

A gender-responsive approach underscores inclusive governance, equitable access to productive assets, and acknowledgment of women's knowledge and agency in environmental management. Without addressing these structural dimensions, environmental interventions risk perpetuating social inequality under the guise of sustainability. Ultimately, integrating gender-sensitive governance into agricultural environmentalism enhances both ecological and social results. By addressing structural inequalities alongside environmental objectives, policies can foster sustainable and equitable agricultural systems that enhance resilience, promote inclusive development, and support the long-term stewardship of the environment.

3. Gendered Dimensions of Agricultural Environmental Practices

The link between gender and environmental issues gained international recognition at the 1972 United Nations Conference on the Human Environment held in Stockholm, Sweden (Manoa, 2017^[29]). This assembly launched an international discussion on managing the environment and addressing societal issues. Over the years, this awareness transformed into more systematic gender mainstreaming frameworks, resulting in the formulation of gender policies around the year 2000. These policies aim to foster equitable participation in all development sectors by mandating the

incorporation of gender-responsive principles into socio-economic strategies, programs, projects, and national budgets to ensure inclusive and sustainable development. At first glance, the relationship between gender and environmental management might not be evident. However, a closer examination of gender-specific roles and responsibilities, access to and control over resources, diverse knowledge systems, and participation in decision-making processes reveals significant intersections. In agricultural systems, these aspects influence the use, conservation, and governance of environmental resources, thereby affecting sustainability outcomes.

3.1. Gender, Nature and Environmental Knowledge

The intersection of human–nature relations, knowledge and gender dynamics constitutes a fundamental aspect of feminist theories broadly and feminist environmental research specifically (Schultz, 2003^[29]). Although a singular gender and environmental theory do not exist, several common characteristics can be identified. Firstly, it is assumed that human–nature interactions are both societal and gendered. Secondly, it is posited that the interrelations among gender, nature, and society are characterized by power dynamics. Lastly, all approaches under this umbrella term seek to theorize these relationships and connect them to sustainable human–nature interactions and gender justice. The recognition of the theoretical and empirical significance of gender perspectives in the discourse on human–nature interactions has led to the development of a research domain within international feminist scholarship, identified as gender and environment. This discourse brings together studies that examine how gender, nature, and society are connected (Nightingale, 2006^[10]; Hawkins & Ojeda, 2011^[10]).

In sub-Saharan Africa, women possess a wealth of environmental knowledge gained from their everyday

interactions with the land, including soils, crops, trees, water systems, and livestock. This expertise encompasses recognizing soil fertility indicators, such as color, texture, and plant signals, conserving native seed varieties, choosing drought-resistant crops, managing fodder resources, and utilizing medicinal plants for both human and animal health. In nations such as Zimbabwe, Ethiopia, and Malawi, female farmers are pivotal in sustaining local seed systems and crop diversity, thereby aiding in situ biodiversity conservation and enhancing climate resilience. Studies indicate that women's knowledge networks play a crucial role in shaping climate adaptation strategies and improving on-farm sustainability outcomes (Ragasa *et al.*, 2020^[39]; Perelli *et al.*, 2024^[37]).

In East Africa's agroecological transitions, women's practical knowledge has been associated with diversified cropping systems that boost soil organic matter and lessen vulnerability to climate-related shocks (Bezner Kerr *et al.*, 2021^[4]). However, formal environmental and agricultural initiatives often favor technical, externally sourced scientific knowledge, sidelining Indigenous and experiential insights. Extension services typically focus on male household heads and emphasize standardized technological solutions, neglecting the socially embedded and context-specific environmental practices that women have developed. Research across SSA highlights that gender-blind climate-smart agriculture programs frequently undervalue women's adaptive knowledge, thereby hindering program effectiveness and sustainability (Jost *et al.*, 2020^[23]; Murray *et al.*, 2022^[32]). For instance, in northern Ghana, women's traditional soil moisture conservation techniques were not integrated into externally introduced conservation agriculture schemes, leading to reduced local adoption and long-term success. Thus, acknowledging and institutionalizing women's environmental knowledge is crucial for fostering socially inclusive and ecologically sound agricultural environmentalism.

3.2. Gendered Labour and Agricultural Environmental Management

Understanding the gendered division of labor is essential for analyzing agricultural environmental management in sub-Saharan Africa. This is because men and women often undertake different agricultural tasks, manage distinct resources, and hold diverse ecological knowledge, all of which significantly impact environmental decision-making and resource management (Food and Agriculture Organization, 2023^[15]; International Food Policy Research Institute, 2021^[19]; World Bank, 2024^[45]; Farnworth *et al.*, 2023^[13]). In smallholder agricultural systems, the roles of women and men are distinct yet often complementary, shaped by sociocultural norms, land tenure systems, and differential access to productive resources.

Women generally take on responsibilities such as seed selection and preservation, weeding, water collection, small livestock management, post-harvest handling, and household food provisioning. These activities are crucial for ensuring food security and promoting environmental sustainability (Doss *et al.*, 2020^[12]; Food and Agriculture Organization, 2023^[15]). Meanwhile, men are more commonly involved in land preparation, mechanized operations, livestock marketing, and the management of high-value cash crops, especially in settings where land ownership and commercial production are predominantly controlled by men (Farnworth

et al., 2023^[13]; Njuki *et al.*, 2022^[34]). These gender-specific divisions of labor highlight entrenched institutional and sociocultural inequalities that affect decision-making authority, resource distribution, and environmental governance outcomes within smallholder farming systems (International Food Policy Research Institute, 2021^[19]; World Bank, 2024^[45]).

Gender-specific task allocations profoundly influence environmental decision-making, resource use efficiency, and the adoption of sustainable land management practices (Doss *et al.*, 2020^[12]; Farnworth *et al.*, 2023^[13]). In sub-Saharan Africa, the feminization of subsistence agriculture has surged due to climate variability, male out migration, and economic restructuring. This shift has unjustly increased women's labor burdens without granting them the essential improvements in land rights, access to credit, or extension services they deserve (Njuki *et al.*, 2022^[34]; Food and Agriculture Organization, 2023^[15]). Women are the backbone of environmental stewardship, taking on primary responsibility for soil conservation, water harvesting, agroforestry, and biodiversity management practices. Despite their indispensable role, they remain systematically marginalized in policy formulation and environmental governance processes. This persistent imbalance is a grave injustice that stifles adaptive capacity and undermines the effectiveness of climate-smart agriculture and sustainable intensification strategies across the region (International Food Policy Research Institute, 2021^[19]; World Bank, 2024^[45]). It is imperative that we rectify this inequity to unlock the full potential of sustainable development.

The traditional ecological knowledge held by women, particularly in areas such as seed diversity, soil fertility management, and integrated crop-livestock systems, is essential for bolstering agroecological resilience and adaptive capacity. However, in the face of climate stress and rising labor demands, women often encounter significant barriers to sustaining environmental stewardship, including time poverty and limited access to labor-saving technologies and productive resources (Doss *et al.*, 2020^[12]; Njuki *et al.*, 2022^[34]). These structural challenges undermine the effectiveness of their contributions to sustainable land management, despite their pivotal role in resource governance at the household level. To address these inequities, it is imperative to implement gender-responsive environmental policies that ensure equitable access to land, finance, technology, extension services, and decision-making platforms. Incorporating gender equity into agricultural environmental management frameworks is not only a matter of social justice but also a fundamental requirement for sustainable resource governance and long-term food security. Additionally, gendered labor dynamics directly impact ecological outcomes by shaping the management and conservation of land, water, and biodiversity resources.

Environmental agricultural practices, including mulching, composting, manure management, water harvesting, intercropping, agroforestry, and integrated crop-livestock systems, undeniably demand significant labor and continuous household-level management. In the sub-Saharan African (SSA) context, it is crucial to recognize that women already shoulder an overwhelming burden of unpaid care work alongside their agricultural duties, leading to severe time poverty and restricted mobility (Doss *et al.*, 2020^[12]; Food and Agriculture Organization, 2023^[15]). When

environmental interventions and climate-smart initiatives escalate labor demands without redistributing workloads or enhancing access to labor-saving technologies, they dangerously amplify existing gender inequalities. Such approaches risk overburdening women and jeopardizing the success of sustainable land management strategies. Therefore, environmental agricultural policies must incorporate thorough workload assessments and gender-responsive technological support. This is essential to ensure that sustainability transitions do not exacerbate structural inequities but instead promote equitable and effective outcomes.

Research in Kenya, Zambia, and Malawi shows that conservation agriculture adoption leads to increased weeding responsibilities due to reduced tillage, with women performing most of this additional labor (Doss & Meinzen-Dick, 2021^[11]). While conservation agriculture improves soil structure and reduces erosion, labor trade-offs vary across regions. Agroforestry and climate-smart tree planting increase women's duties in nursery management and seedling protection, yet women often lack secure rights to tree products. In Ethiopia and Tanzania, women contribute significantly to tree management but have limited control over high-value tree crop income (Meinzen-Dick *et al.*, 2021^[30]). Without gender-responsive safeguards, environmental interventions may worsen inequalities by increasing labor burdens without enhancing women's assets or decision-making power. Effective gender-responsive agricultural environmentalism requires labor assessments, equitable benefit-sharing, and time-saving innovations to prevent structural disparities.

3.3. Access to Resources and Agricultural Environmental Outcomes

Secure land tenure is essential for investing in long-term environmental practices, including soil restoration, agroforestry, terracing, and water infrastructure (Slavchevska *et al.*, 2021^[41]). In Sub-Saharan African (SSA) countries, women's land rights remain secondary or insecure, thereby limiting their incentives to adopt conservation practices that yield benefits over extended periods. Empirical research indicates that women with secure tenure are considerably more likely to invest in soil fertility management and tree planting than those who farm under short-term or informal arrangements (Ali *et al.*, 2020^[3]). Access to productive resources, such as land, credit, agricultural inputs, extension services, and climate information, significantly influences environmental management decisions and sustainability.

Limited access to financial services and extension further constrains women's capacity to implement sustainable practice. Studies on the adoption of climate-smart agriculture in West and East Africa consistently reveal that women are less likely than men to access extension advice, improved inputs, or credit facilities that are necessary for sustainable intensification (Boudalia *et al.*, 2024^[5]; Perelli *et al.*, 2024^[37]). In Nigeria and Uganda, women farmers reported that a lack of collateral restricted their ability to access loans for irrigation or soil improvement technologies, directly affecting environmental outcomes. These patterns illustrate that environmental degradation cannot be disentangled from gender inequity. Policies that fail to address structural

constraints, such as discriminatory land tenure systems and unequal institutional access, risk undermining both adoption rates and long-term sustainability goals.

3.4. Access to Resources and Agricultural Environmental Outcomes

The availability of essential resources, including land, financial services, agricultural inputs, extension services, and climate data, is a key determinant of agricultural productivity and environmental management in sub-Saharan Africa (Food and Agriculture Organization, 2023^[15]; World Bank, 2024^[45]). Secure land tenure is particularly important because it fosters long-term investments in soil conservation, agroforestry, and water infrastructure (Deininger *et al.*, 2021^[8]; Lawry *et al.*, 2020^[27]). Research demonstrates that land certification and the reinforcement of property rights significantly boost sustainable agricultural investments, with a notable impact on women, who often experience insecurity in land tenure (Holden *et al.*, 2020^[17]; International Food Policy Research Institute, 2021^[19]).

In various Sub-Saharan African (SSA) countries, women's land rights are often secondary, mediated through male relatives, or governed by customary systems that restrict ownership and decision-making authority. This tenure insecurity diminishes the incentives for conservation-oriented investments and limits women's participation in environmental governance. Empirical evidence indicates that women with secure land rights are significantly more likely to invest in soil fertility management, tree planting, and sustainable land management practices than those operating under short-term or informal arrangements (Ali *et al.*, 2020^[3]; Slavchevska *et al.*, 2021^[41]). Therefore, tenure reform and the legal recognition of women's land rights are not merely equity measures but also essential environmental policy instruments.

Beyond land access, financial inclusion and institutional support systems are pivotal in influencing environmental outcomes. Women's capacity to adopt climate-smart and sustainable intensification strategies in agriculture is often hampered by restricted access to credit, advanced inputs, and extension services. Recent research conducted in West and East Africa highlights ongoing gender disparities in obtaining extension advice, climate information, and agricultural finance, which are critical for adopting conservation agriculture, irrigation technologies, and soil enhancement innovations (Boudalia *et al.*, 2024^[5]; Perelli *et al.*, 2024^[37]). In nations such as Nigeria and Uganda, women farmers frequently cite the absence of collateral and discriminatory lending practices as significant barriers to investing in irrigation infrastructure and land restoration technologies, thereby directly affecting their environmental performance.

The intricate patterns of environmental degradation and gender inequality are deeply intertwined, revealing a critical issue that requires urgent attention. Glaring disparities in access to and control over essential resources severely restrict adaptive capacity, diminish incentives for long-term conservation, and compromise the success of sustainability efforts. Compelling evidence underscores that insecure land tenure, financial exclusion, and limited access to agricultural institutions disproportionately impact women, significantly hindering their ability to invest in vital practices such as soil

restoration, agroforestry, and climate resilience (Food and Agriculture Organization, 2023 ^[15]; World Bank, 2024 ^[45]). Policies that overlook the pressing need to reform biased land tenure systems and ensure equal access to credit, extension services, and decision-making platforms not only exacerbate environmental harm but also entrench social inequities. Therefore, it is crucial to integrate gender-sensitive land reforms, inclusive financial systems, and equitable extension services into agricultural environmental governance. This approach is not merely advantageous but essential for advancing sustainable resource management and reinforcing climate-resilient development pathways.

4. Agricultural Environmentalism and Climate Change in Sub-Saharan Africa

The challenges posed by climate change to agricultural systems in sub-Saharan Africa are intensifying, with smallholder farmers bearing the brunt of rising temperatures, increased climate variability, erratic rainfall, and frequent extreme weather events (Intergovernmental Panel on Climate Change, 2023 ^[21]). These climatic pressures lead to reduced crop yields, jeopardize livestock systems, and exacerbate resource scarcity, thereby threatening rural livelihoods and food security.

As noted by the Food and Agriculture Organization (2023 ^[15]), climate variability significantly limits agricultural productivity in areas where farming relies heavily on rainfall and natural resources. Strategic frameworks, such as climate-smart agriculture (CSA), agroecology, and ecosystem-based adaptation (EbA), have emerged as vital approaches to bolster system resilience while curbing environmental degradation. Empirical studies have confirmed that these methods enhance adaptive capacity, foster sustainable land management, and bolster livelihood resilience in the face of climate stress (Lipper *et al.*, 2014 [Not in ref list]; Altieri *et al.*, 2017 [Not in ref list]; Food and Agriculture Organization, 2023 ^[15]).

By merging productivity improvements with ecosystem preservation, these strategies offer tailored pathways to mitigate climate risks and promote sustainable agricultural development in sub-Saharan Africa. Women are often identified as particularly vulnerable to climate change impacts, yet they are also recognized as pivotal agents of adaptation (Assan, 2015 [Not in ref list]). They play crucial roles in food production, seed management, small livestock rearing, and stewarding natural resources. Research indicates that women encounter heightened climate-related risks owing to limited access to land, resources, climate information, and social support networks, which in turn affects their capacity to adapt to and manage environmental resources effectively (Djoudi *et al.*, 2016 ^[10]; Jost *et al.*, 2020 ^[23]; Djoudi *et al.*, 2016 ^[10]).

Women play a crucial role in climate adaptation through their involvement in practices such as crop diversification, conservation agriculture, soil fertility enhancement, water harvesting, agroforestry, and integrated crop–livestock systems. These practices bolster ecological resilience and ensure household food security (United Nations Environment Programme, 2023 ^[42]). Despite their significant contributions to adaptive environmental management, women frequently encounter marginalization in climate governance structures and decision-making forums. Climate finance mechanisms, including carbon markets, payment for ecosystem services

schemes, and green investment funds, often function through male-dominated cooperatives, land tenure systems, or financial institutions, thereby limiting women's access to financial resources and technological innovations (World Bank, 2023 ^[44]). Additionally, research indicates that gender disparities in access to extension services and digital climate information services hinder women's capacity to adopt climate-smart agriculture (CSA) technologies on a broader scale, thus perpetuating structural inequalities in climate-focused agricultural transitions (Food and Agriculture Organization, 2023 ^[15]; Rao *et al.*, 2020 ^[40]).

A gender-neutral approach to climate-focused agricultural environmentalism may inadvertently perpetuate vulnerabilities rather than mitigate them. In the absence of explicit gender integration, adaptation policies might unintentionally reinforce unequal control over land, labor, and financial resources, thereby undermining equity and sustainability objectives (Assan, 2015 [Not in ref list]). Consequently, integrating gender-responsive budgeting, secure land tenure reforms, inclusive climate finance mechanisms, and participatory governance frameworks is crucial to ensure that climate–environment strategies are both socially just and ecologically effective. Incorporating gender considerations into mitigation and adaptation planning enhances institutional accountability, promotes the adoption of sustainable practices, and ultimately supports resilient agricultural systems capable of withstanding increasing climatic pressures in sub-Saharan Africa.

5. Gendered Realities of Agricultural Environmentalism in Sub-Saharan Africa

This section bridges theoretical insights with practical applications by scrutinizing case studies from Zimbabwe, Kenya, and Ethiopia. These cases highlight the role of gender dynamics in agricultural practices and illustrate the intersection of environmental strategies and policies with gender-specific access to resources, labor, and decision-making power.

5.1. Zimbabwe: Gender, Agroecology, and Smallholder Environmental Stewardship

In Zimbabwe, the discourse on agricultural environmentalism is increasingly framed through the lenses of agroecology, conservation agriculture, and climate-resilient crop–livestock integration, particularly among smallholder farmers (Njuki *et al.*, 2022 ^[34]; Njuki, Kaaria, & Chamunorwa, 2022 ^[35]). Women are pivotal in implementing environmentally significant practices, such as composting, mulching, water harvesting, seed selection, and managing village poultry and small ruminants (Food and Agriculture Organization, 2023 ^[15]; International Food Policy Research Institute, 2021 ^[18]). These activities directly contribute to soil conservation, biodiversity maintenance, and reduced dependency on external inputs.

Despite their crucial role, women encounter persistent and structural barriers. Customary land tenure systems continue to restrict women's land ownership and control, thereby diminishing the incentives for long-term environmental investments, such as agroforestry and soil rehabilitation (Ali, Deininger, & Goldstein, 2020 ^[3]; Doss *et al.*, 2020 ^[11]). While conservation agriculture programs offer environmental benefits, they have often exacerbated women's labor burdens, particularly through intensified weeding, without providing

access to labor-saving technologies or decision-making power (Holden, Deininger, & Ghebru, 2020^[17]; International Food Policy Research Institute, 2021^[18]). The Zimbabwean case exemplifies a key contradiction within agricultural environmentalism: women are relied upon as primary environmental stewards, yet environmental interventions frequently externalize labor costs onto them while marginalizing their voices in program design and benefit sharing (Food and Agriculture Organization, 2023^[15]; Kristjanson *et al.*, 2017^[24]).

5.2. Kenya: Environmentalism, Climate-Smart Agriculture, and Gendered Market Access

Kenya is recognized as a leader in climate-smart agriculture, agroforestry, and adapting to ecosystems. This is because of strong policies and support from donors (Perez *et al.*, 2021^[38]; Njuki *et al.*, 2022^[34]). Women farmers are actively engaged in soil and water conservation, tree management, mixed crop–livestock systems, and small-scale dairy and poultry production, particularly in highland and peri-urban areas (Kristjanson *et al.*, 2017^[24]; Jost *et al.*, 2016^[22]). However, the distribution of environmental and economic benefits remains inequitable. Tree tenure arrangements and carbon finance initiatives often favor male landowners, despite women’s significant contributions to tree establishment and maintenance (Agarwal, 2018^[2]; Kwaslema, Madaha, & Mwaseba, 2025^[26]).

CSA programs frequently channel extension services, climate information, and digital tools through male-dominated farmer organizations, thereby restricting women’s access to and influence on these resources (Fisher *et al.*, 2021^[14]; Njuki *et al.*, 2022^[34]). In pastoral and agro-pastoral regions, women play a vital role in managing small livestock and household water resources; however, environmental governance institutions are predominantly male-controlled (Rao *et al.*, 2020^[40]; Perez *et al.*, 2021^[38]). The Kenyan case underscores how market-oriented and climate-focused environmentalism can inadvertently perpetuate gender inequality if institutional arrangements fail to address power asymmetries.

5.3. Ethiopia: Gender, Land Tenure, and Sustainable Land Management

Ethiopia has launched some of the most extensive sustainable land management (SLM) and watershed rehabilitation initiatives in sub-Saharan Africa, concentrating on soil and water conservation, terracing, reforestation, and enhancing climate resilience (IPCC, 2019^[20]; Perez *et al.*, 2021^[38]). Women play a crucial role in these efforts, especially in constructing soil bunds, managing water resources, and participating in community environmental activities (Berhane *et al.*, 2020^[39]; Njuki *et al.*, 2022^[34]). Although reforms in joint land certification have bolstered women's tenure security in certain areas, decision-making power regarding land use and the benefit from environmental investments often remains predominantly in the hands of men (Alemu and Zeller, 2018^[8]; Doss *et al.*, 2020^[11]).

Women's involvement in local environmental governance bodies is often more symbolic than meaningful, restricting their impact on planning and resource distribution (Njuki *et al.*, 2022^[35]; Ragasa *et al.*, 2020^[39]). Moreover, environmental narratives in Ethiopia frequently portray women as vulnerable recipients rather than knowledgeable

environmental contributors, neglecting their indigenous knowledge and adaptive strategies (Food and Agriculture Organization, 2023^[15]; Scoones, 2021^[7]). The situation in Ethiopia highlights the necessity of integrating gender-equitable governance and benefit-sharing mechanisms with environmental rehabilitation.

6. Cross-Country Synthesis

Evidence from Zimbabwe, Kenya, and Ethiopia has consistently highlighted gender-specific trends in the management of agricultural environments. In these regions, women are primarily responsible for labor-intensive activities that are vital to achieving sustainability, such as managing soil fertility, collecting water, weeding, handling postharvest processes, and caring for small livestock. Nevertheless, they face structural marginalization in areas such as land ownership, leadership within institutions, and mechanisms for sharing benefits (Doss *et al.*, 2020^[11]; Food and Agriculture Organization, 2023^[15]). Cross-country empirical analyses further illustrate those legal constraints, insecurity of tenure, and unequal access to agricultural institutions intensify these disparities (World Bank, 2024^[44]; Njuki *et al.*, 2022^[35]).

Despite their pivotal role in ecological management, women frequently lack formal authority over land and environmental governance, restricting their capacity to influence decisions related to sustainability and resource distribution. Empirical analyses demonstrate that women’s limited control over land and productive assets constrain investment in long-term conservation practices and reduce adaptive capacity under climate stress (Doss *et al.*, 2018^[11]; Kristjanson *et al.*, 2017^[24]). These cross-country similarities suggest that environmentalism which neglects gendered power relations risks reproducing inequality while simultaneously weakening ecological effectiveness. Sustainable agricultural transitions therefore require structural transformation in tenure systems, institutional governance, and resource distribution frameworks.

6.1. Policy and Institutional Reform

Policy and institutional reform constitute a foundational pillar for gender-equitable environmental governance (Njuki *et al.*, 2022^[35]). Agricultural and environmental policies must move beyond rhetorical commitments to gender inclusion and embed mandatory gender analysis within planning, budgeting, and monitoring frameworks. Securing women’s land rights through statutory recognition, joint land titling, and enforcement of inheritance protections has been shown to increase investment in soil conservation and agroforestry (Doss *et al.*, 2018^[11]). Furthermore, integrating gender-disaggregated indicators into monitoring and evaluation systems enhances accountability and ensures that climate-smart and sustainability interventions reach marginalized groups. Without institutional reforms that address discriminatory norms in land administration, finance, and extension systems, environmental strategies risk limited adoption and uneven outcomes (Kristjanson *et al.*, 2017^[24]; Food and Agriculture Organization, 2023^[15]).

6.2. Participatory Environmental Governance

Participatory environmental governance strengthens both social legitimacy and ecological outcomes by incorporating diverse knowledge systems into decision-making processes.

Actively involving women in the design, implementation, and evaluation of environmental initiatives enhances context-specific adaptation strategies and improves collective resource management (Njuki *et al.*, 2022^[35]). Evidence from community-based natural resource management and farmer-led innovation platforms indicates that women's participation correlates with improved soil conservation, biodiversity protection, and climate adaptation practices (Agarwal, 2018^[2]). Women's farmer groups, savings associations, and cooperatives provide strategic entry points for scaling sustainable practices, facilitating peer learning, and improving access to climate information. Institutionalizing participatory mechanisms within environmental governance structures is therefore critical for equitable and resilient agricultural systems.

6.3. Gender-Responsive Extension and Knowledge Systems

Gender-responsive extension systems are essential to bridging persistent information and technology gaps. Historically, extension services in many SSA countries have targeted male household heads, inadvertently marginalizing women despite their central role in agricultural production (Ragasa *et al.*, 2020^[39]). Recognizing women explicitly as farmers and environmental managers requires tailored communication strategies, flexible training schedules, and inclusive digital climate information platforms that accommodate varying literacy levels and time constraints. Studies show that when extension services intentionally target women, adoption rates of conservation agriculture and climate-smart technologies increase significantly (World Bank, 2023^[44]). Strengthening female extension staffing, promoting participatory demonstration plots, and integrating indigenous ecological knowledge further enhance the effectiveness of sustainable land management interventions.

6.4. Linking Equity and Sustainability

Linking equity and sustainability reframes environmental success beyond purely ecological indicators toward integrated social–ecological resilience. Traditional metrics of environmental performance—such as soil carbon levels or adoption rates of conservation technologies are insufficient if gender disparities in income, asset ownership, and decision-making persist (Food and Agriculture Organization, 2023^[15]). Evidence increasingly demonstrates that gender-equitable access to resources enhances productivity, strengthens adaptive capacity, and improves long-term environmental stewardship (Njuki *et al.*, 2022^[34]). Evaluating agricultural environmentalism through combined indicators of ecological restoration, livelihood improvement, and gender empowerment ensures that sustainability transitions are inclusive and durable. Embedding equity within sustainability metrics thus aligns environmental goals with broader development objectives in SSA.

7. Conclusion

Gender constitutes a fundamental structural dimension shaping agricultural environmentalism and sustainability trajectories in developing countries, particularly across sub-Saharan Africa. As demonstrated throughout this analysis, gendered divisions of labour, unequal access to land and productive resources, exclusion from institutional decision-making, and disparities in climate finance access collectively

influence environmental management outcomes. Women play indispensable roles in soil conservation, biodiversity protection, water management, and integrated crop–livestock systems, yet systemic inequities often constrain their capacity to invest in long-term ecological stewardship. Consequently, environmental degradation and climate vulnerability are not merely ecological or technical challenges but are deeply embedded within social and power relations.

A gender-blind approach to agricultural environmentalism risks reinforcing structural inequalities while undermining sustainability objectives. Effective climate adaptation and mitigation strategies must therefore integrate gender-responsive land reforms, inclusive extension systems, equitable access to finance and climate information, and participatory governance frameworks. Embedding gender analysis within environmental policy design, monitoring, and evaluation enhances accountability and strengthens adoption of sustainable practices. Ultimately, aligning equity with ecological integrity is not only a social justice imperative but also a strategic pathway toward resilient agricultural systems capable of withstanding intensifying climate pressures. Sustainable development in the agrarian contexts of developing countries will depend on recognizing gender equality as both a driver and an outcome of effective agricultural environmentalism.

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