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CARBON FARMING: A GATEWAY TO PROMOTING SUSTAINABLE AGRICULTURE AND MITIGATING THE IMPACTS OF CLIMATE CHANGE IN THE SOUTHWEST REGION OF CAMEROON

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ABSTRACT

Introduction: *Agriculture, which constitutes approximately 17% of Cameroon's economy, and employs 70% of Cameroon's labor is grappling with substantial challenges posed by climate change. This study explores carbon farming practices, such as cover cropping, agroforestry, and reduced tillage, as climate-smart strategies to promote sustainable agriculture while mitigating the adverse impacts of climate change.*
Methods: *This study employs a mixed-methods approach, involving 27 semi-structured interviews with farmers, exporters, NGOs, and officials from the Ministry of Agriculture, as well as a focus group discussion with community stakeholders. Secondary data review and trade dataset analysis are also incorporated.*
Results: *70% of respondents expressed willingness to adopt at least one carbon farming practice, provided they received adequate training and financial support. Most farmers expressed concern about the potential of reduced yields but were excited by the possibility of trading CO2 captured for extra income. Key barriers identified by Stakeholders include measurement, reporting, and verification (MRV), cost, and regulatory gaps.*
Discussion: *The study concludes that integrating carbon farming into Cameroon's agricultural strategy offers a practical pathway to achieving Sustainable Development Goals 2 and 13. Moreover, it positions Cameroon as a potential regional leader in climate-smart agriculture while balancing economic, environmental, and social priorities.*

Keywords: Carbon farming, climate-smart agriculture, climate change, SDG2, SDG13, adaptation, mitigation

1. Introduction

Cameroon grapples with the impacts of climate change on the lives of Cameroonians and on agriculture, which employs 70% of the population and accounts for about 17.0% of GDP (Musa 2024). A combined effect of these impacts includes food insecurity, inequality, poverty, reduced yields, impacts on health, and forced migration. These effects are visible in many parts of the country, most especially in the Northern regions, which experience dry spells, and the coastal regions, which have become victims of floods and heavy rainfalls (IMF 2024, 32). These challenges are not isolated incidents because, aside from the natural causes, human activities have contributed largely to these unfortunate outcomes, and they include activities such as deforestation, unsustainable agricultural practices, and the burning of fossil fuels.

Despite knowledge of these practices, the state's implementation of measures to address these issues doesn't match prescribed measures on paper. To address these issues, it is important to adopt international best practices that have worked in other countries and can fit within the context of Cameroon. One of such international best practices is carbon farming, a practice that is implemented in some European countries, Brazil, Australia, and the United States (May 2022). In Australia as of 2022, through the crediting and purchasing of emissions reductions by the Government, the Emissions Reduction Fund has delivered 77 million tonnes of greenhouse gas abatement from a total of 217 million tonnes contracted for delivery (Carbon Market Institute "n.d.", 3). This emissions reduction was realized through carbon farming practices.

One of the major sources of greenhouse gases emanates from agriculture; this is because traditional agriculture is known to use fertilizers that contain methane. Carbon farming, on the other hand, is a deviation from conventional farming and involves the use of agriculture in such a way that, rather than emitting greenhouse gases, it sequesters carbon in the soil (Carbon Cycle Institute "n.d."). This helps to enhance soil sequestration capacity, increase agricultural productivity, and at the same time build resilience to drought. How this works is that plants capture and store $CO2$ from the atmosphere and deposit the carbon into the soils through roots, root exudates, seeds, and plant residues at different depths of the soil profile (Hans 2020, 3). Once the crop decomposes, part of it is later released into the atmosphere, and the rest remains in the soil (organic matter). This practice has several benefits, such as environmental, economic, social, and cultural benefits. The scientific basis of carbon farming is rooted in research conducted by numerous global North research institutes, such as the University of California Davis Institute of the Environment, the 4 per 1000 Initiative, and the Marin Carbon Project.

Taking into consideration the diverse nature of Cameroon's agroecology landscape, there are many ways by which Cameroonian farmers can engage in carbon farming. Building on research conducted by these institutions and acknowledging that carbon farming is an umbrella term for several smart agricultural practices. These carbon farming practices include agroforestry, rotational grazing, companion cropping, crop rotation, cover cropping, perennial crop cultivation, and non-chemical fertilizer and pest control management. This new kind of climate-smart practice will also open doors for farmers to access new revenue streams through carbon credits and enhance long-term soil health and productivity. Cameroon has the potential to adopt this climate-smart practice. It is important we keep in mind, as Green Australia highlights, that, "Every farm is unique, so to maximize the benefits from carbon farming, projects need to be tailored to each farmer's preferences and priorities – and also the landscape they are operating within" (Green Australia, "n.d."). This paper will examine the perspective of farmers and other stakeholders towards the adoption of carbon farming in Cameroon.

1.1.Problem statement

Despite the threats posed by climate change to agriculture in Cameroon, adequate measures designed towards tackling it and promoting sustainable agriculture are underexploited and under implemented. Farmers, lack adequate information, financial incentives, and required expertise to adopt approaches that both enhance productivity and contribute to climate mitigation. Although carbon farming presents a promising pathway for improving soil health, sequestering carbon and unlocking new income streams through carbon credits, it remains largely unexplored. This gap in knowledge and implementation underscores the need to assess stakeholder perspectives, identify barriers to adoption, and evaluate the potential of carbon farming to support sustainable agriculture and climate change mitigation in the Southwest Region of Cameroon.

1.2.Objectives

This study aims to investigate stakeholder perspectives on carbon farming within the Southwest Region of Cameroon and to assess the extent to which farmers are willing and able to adopt carbon-farming practices. It further seeks to identify the perceived benefits, challenges, and enabling conditions associated with adoption, providing an evidence-based understanding of how carbon farming may serve as a pathway to sustainable agriculture and climate-change mitigation in the region

1.3 Significance

This study is timely because it comes at a time when Cameroon is grappling with the impacts of climate change on every sphere of life. This research will assist the government of Cameroon to better shape its agricultural strategy and National Determined Contribution to address SDG 2 and SDG 13. It's also important to Cameroonian farmers because it provides a feasible approach to sustainable agriculture and extra income to farmers through the exchange of carbon credits.

2. Literature Review

Cameroon, like many developing countries in Africa, is seriously affected by the impacts of climate change, and these impacts are not limited to droughts, heatwaves, flooding, and food insecurity. These impacts exacerbate the gap between the rich and the poor, with women being more vulnerable to the impacts. While it is true that the government, civil society organizations, and local communities have adopted several climate-smart practices to curb the impacts of climate change, the effects of climate change remain visible across many geographic and demographic groupings in Cameroon. This prompts a call to action, and sometimes reliance on the best available science and internationally best practices is a promising way to go about climate adaptation and mitigation practices. Carbon farming presents Cameroonian farmers with an opportunity to not only grow their crops sustainably but also mitigate the impacts of climate change and presents an avenue for farmers to generate income. This literature review will examine the work done by different scholars and experts in the field of climate-smart agriculture in Cameroon. It will also analyze the gaps in literature and make a compelling case for why Cameroon should engage in carbon farming.

Tankou C.M.'s analysis of climate-smart agriculture through passive and active strategies acknowledges the role played by smart agriculture in tackling the threats of climate change on our agricultural system (Tankou 2023). According to him, a changing climate will impact temperature and precipitation, which are very essential for crop growth. The resulting impact is an increase in mean annual temperature by more than 2°C by the end of this century–reducing crop productivity across sub-Saharan Africa (Tankou 2023). Against this background, he recommended that the resilience of agricultural systems needs to exploit sustainable preservation strategies. Adopting climate-smart agriculture helps farmers adapt and prepare for impacts to preserve and improve their livelihoods.

He went further in his analysis to shed more light on how these adaptive measures, which encompass active and passive methods in climate-smart agriculture, can be used to tackle climate change. The distinction Tankou makes between active (agroforestry), and passive (site and species selection) adaptation strategies is practical and grounded in real-world farming conditions. Agroforestry, as an active measure, represents a forward-thinking alternative to more destructive practices like slash-and-burn, helping to sequester carbon and preserve biodiversity. Passive strategies such as choosing appropriate sites and resilient crop varieties are equally critical, especially where resources are limited and formal infrastructure is lacking (Tankou 2023).

He concluded by stating that agricultural systems remain largely rain-fed and underdeveloped because most farmers have limited financial resources, limited access to infrastructure, and disparate access to information (Tankou 2023). His study is limited to climate adaptation measures. The research on carbon farming explores agriculture as both an adaptation and a mitigation measure, thereby giving farmers alternatives to farmers in the southwest region. The paper widens the scope of benefits: not only does it protect and restore soils, but it also gives farmers in the Southwest region of Cameroon potential new income streams through carbon credits. This synthesis could guide not just policy, but on-the-ground practices, benefitting both the environment and farmers' livelihoods across Cameroon.

DingaTambi's analysis the role of climate-smart agriculture in sustainable food production among producer organizations in Cameroon (Dinga 2024). Tambi identified several challenges faced by farmers in Cameroon, particularly in the Southwest region, which impact various stages of agricultural activities (Dinga 2024). Among these challenges, financial difficulties and climate change emerge as the most significant. Tambi also highlighted the limited understanding of farmers regarding the impacts of climate change on their agricultural output. To address these challenges, Tambi mentioned state efforts, such as subsidizing agricultural inputs like nitrogen, phosphorus, and potassium fertilizers, and urea. According to him, reinforcing farmers' capacity through efficient, ecological, and environmentally friendly agricultural methods is a good solution towards increased crop yield and the eventual empowerment of farmers. His analysis, which touches on subsidization of agricultural inputs by the state to curb the challenge of financial shortfalls, undermines the contributing impacts of fertilizers to climate change.

Sadly, these assistance programs lack the prerequisite technical knowledge, which poses limitations that goes beyond inefficient use of farm inputs and machines for agriculture, which has effects on climate change. Also, in the wake of European Union regulations like the Caborn Border Adjustment Mechanism, which targets fertilizers on agricultural inputs, Tambi's suggestion is bound to hinder the exportation of agricultural products from Cameroon to the E.U.

This paper focusing on carbon farming is proposing new methods of farming that use agriculture as a tool for climate mitigation. The practices we are suggesting will make farmers' crops more resilient to climate change and make them compliant with the regulations of one of her largest trading partners, the European Union. It also offers solutions to the challenge of finance by making it possible for Cameroonian farmers through agricultural practices that sequester carbon to generate credits and trade them in the Carbon market.

Friederike Schilling et al., analyzed the opportunities and challenges of carbon farming for smallholder farmers, highlighting the momentum gained by natural climate solutions towards attaining net-zero emissions (Friederike 2023). According to them, agricultural practices that increase carbon sequestration in soils and plants and reduce or avoid greenhouse gas (GHG) emissions in agricultural production possess the potential to meet net-zero (Friederike

2023,1). Carbon farming, which involves agroforestry, cover crops, improved crop rotations, reduced tillage, retaining of crop residues, the addition of biochar, and manure management, improves the rate at which CO2 is removed from the atmosphere and transformed into plant material (Friederike 2023,2).

This approach to agriculture has the potential to meet contemporary global challenges of realizing net-zero by 2050 and resilient food systems to address persistently high levels of food insecurity (Friederike 2023, 12). Drawing from different literatures, they established a distinction between carbon farming and carbon farming practices (Friederike 2023, 3). By carbon farming practices, they refer to agricultural management practices that either avoid, reduce the release of greenhouse gas emissions, or promote active sequestration of carbon in vegetation and soils. They are not limited to agroforestry, crop and soil management, and livestock management. Meanwhile, carbon farming is a business model that remunerates farmers for the implementation of carbon farming practices. As part of their framework, though limited to small-scale farmers, they added intermediaries (Friederike 2023, 5).

These intermediaries have numerous roles, including engaging with the smallholder farmers at different stages of the process, providing information or inputs, and serving as a means for aggregating farmers into carbon farming projects and engaging in monitoring, reporting, and verification (MRV). Looking at some of the challenges they identified, the absence of a well-developed agricultural carbon market was listed as one of the barriers to the development of agricultural carbon markets. According to them, this is because the recognition of carbon farming practices in international climate change discussions and negotiations only got international attention at the UNFCCC's COP27 in 2022. One of the challenges they identified associated with carbon farming is the risk of low or no additionality. They also highlighted some benefits of carbon farming to farmers, which include additional sources of profits and being in alignment with global sustainability standards.

This paper expatiates on this issue further and contextualizes its application in the Southwest region of Cameroon. This policy paper makes use of data collected on the field to provide solutions to the challenges highlighted above, such as the need for a legal framework for carbon markets, resources for monitoring, reporting, and verification, and financial resources.

Verina Ingram et al. analyzed the implications of cocoa as the main driving force causing deforestation in Cameroon (Verin 2025). In their analysis, they hinted that cocoa, a crop foreign to Africa's soils, was introduced in the colonial times as a pioneer export commodity cash crop on fertile, converted forested lands (Verin 2025, 1). According to them, Africa, which accounts for over 76% of global cocoa production, takes the lead in the production of cocoa, with Cameroon amongst the leading exporters of the crop. This lead comes at the cost of Cameroon's forest, accounting for over a quarter of forest lost in Cameroon between 2001 and 2020. Citing existing policies on the ground, such as the National Agricultural Investment Plan 2020–2030, cocoa is seen as the future of Cameroon, and the state has allocated 40,000 million CFA towards its development (Verin 2025, 5). To regulate the impact cocoa production has on forest cover in Cameroon, the European Union adopted several policies, like the Deforestation Regulation. The aim of this policy is to reduce the deforestation caused by cocoa (deforestation-free) by requiring that the cocoa be sourced from farmland that has not been deforested since December 31, 2020 (Verin 2025, 2).

At the national level, the Ministry of Forestry and Wildlife, which regulates forests in Cameroon, has highlighted that several farmers fail to obtain permission from the state before cutting down trees. Also, they stated that only a few stakeholders (NGOs, government, academia, development organizations) they interviewed indicated they have been engaged in discussions on how to actively protect remaining forests. Using a sample size representing

five cocoa-producing villages with two located in forested areas and two in degraded forest areas, they identified. Participants from this interview who stated that financial pressures and climate shocks are some of the reasons for deforestation. (Verin 2025, 11).
Their work focuses solely on cocoa as a driver of deforestation in Cameroon. However, our paper focuses on carbon farming as a solution for sustainable agricultural practices in Cameroon. This has some implications for cocoa farmers because they will be able to cultivate cocoa while conserving the forest and not be victims of regulations that target cocoa in the EU that are not deforestation-free. It will also make it possible for farmers to cultivate their crops free of the pressures associated with climate change, such as black pods.

Based on Cameroon's national development strategy 2020-2030, the government plans to increase agricultural productivity (National Development Strategy 2020-2030, 7). This national strategy is timely and comes at a time when the government of Cameroon is seeking to become a developed economy. This will entail investments in major sectors that constitute the country's economy, such as agriculture. The challenge with the document is the realization of this big vision, especially with the impacts of climate change on agricultural output. This paper, which focuses on carbon farming, provides a timely solution for the realization of this grand vision. With a careful step-by-step implementation, Cameroon will not only realize her climate and agricultural goals but will place the country as a major hub for sustainable agriculture.

Despite the above research, no study has examined farmer perceptions of carbon farming in Cameroon using a mixed-methods empirical approach, nor has any study explored its market, regulatory, and adoption barriers in the Southwest Region.

3. Methodology

The study employed a purposive sampling strategy to intentionally recruit respondents with direct experience in farming or climate-smart practices, as this approach is well suited for research requiring information-rich cases and domain-specific expertise (Palinkas et al., 2015). The initial sample size target of 30 individual interviews and two focus group discussions was guided by methodological recommendations suggesting that thematic saturation in qualitative and mixed-methods agricultural studies is commonly reached between 20 and 30 participants (Guest et al., 2006). Sampling was conducted through agricultural cooperatives, local networks, and extension contacts in Southwest Cameroon. However, due to recurrent lockdowns, mobility restrictions, and regional insecurity, the final realized sample was adjusted to 27 individual interviews and one focus group discussion. Data collection was conducted using a Kobo Toolbox digital questionnaire administered through mobile devices, which ensured safety, accessibility, and data accuracy under field constraints.

Investment willingness was analyzed in R using self-reported categorical ranges, which were converted into numeric midpoints (e.g., "Up to 10,000 XAF" = 5,000 XAF; "10,001–50,000 XAF" = 30,000 XAF; "More than 50,000 XAF" = 75,000 XAF) to enable continuous quantitative analysis. Climate-smart and carbon-farming practice variables were identified using regex-based matching and standardized into binary indicators (1 = adopted, 0 = not adopted). An adoption intensity score was generated by summing these indicators, after which respondents were categorized into four ordered groups (0, 1, 2, or 3+ practices). Willingness-to-invest values were cleaned, stripped of non-numeric characters, and converted into CFA francs (XAF).

Descriptive statistics—including means, standard deviations, and mean ±1 SD ranges—were used to summarize central tendency and variability across adoption groups. Normality and homogeneity assumptions were evaluated to determine appropriate inferential tests; one-way ANOVA was applied when assumptions were met, whereas the Kruskal–Walli's test was used for non-normal distributions. Associations between categorical variables (e.g., adoption level, cooperative willingness) were assessed using Chi-square tests, with Fisher's exact correction applied when expected cell counts were low ($p < .05$). Willingness to adopt carbon farming was examined using proportional descriptive statistics. Climate-smart practices were extracted by pivoting all "current practice" fields into long format, cleaning binary selections ("1," "yes," "true"), and aggregating frequencies to identify the three most adopted practices. All visualizations were produced in ggplot2 using standardized color palettes to enhance clarity, reproducibility, and interpretability.

3.1.**Results**

Figure 1: The boxplot shows that farmers' annual willingness to invest in carbon-farming practices varies across adoption levels but remains broadly comparable. Farmers with zero practices reported tightly clustered willingness values around 70,000–75,000 CAF, whereas those practicing one or two methods showed greater dispersion, ranging from approximately 10,000 CAF to above 70,000 CAF, with median values near 50,000–55,000 CAF. Farmers already adopting three or more practices again displayed concentrated willingness around the 70,000–80,000 CAF range. Although medians differ slightly across groups, the substantial overlap between interquartile ranges indicates no statistically distinct separation in investment willingness by practice level.

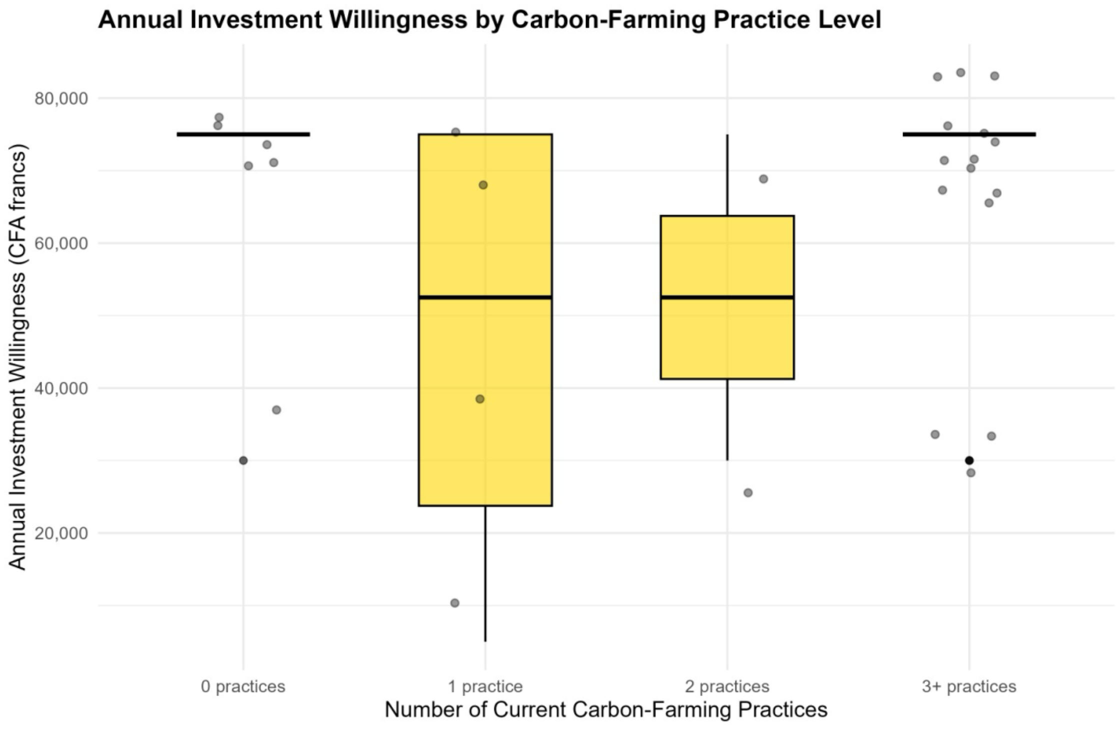

Figure 1: Annual investment willingness by number of Carbon-Farming Practices

The results indicate that farmers' financial willingness to invest in carbon-farming does not vary significantly with the number of climate-smart practices they currently adopt. Although median investment levels are slightly higher among farmers implementing one or two practices, the substantial overlap in distributions suggests that investment intentions remain highly heterogeneous and are influenced more by external constraints than by current engagement in carbon-farming. This pattern likely reflects broader structural barriers—including perceived financial risk, limited disposable income, and uncertainty about the reliability or fairness of carbon-credit benefits, which can temper farmers' readiness to make out-of-pocket investments even when they are conceptually supportive of climate-smart agriculture. Collectively, these findings underscore the need for targeted financial instruments, transparent carbon-market communication, and strengthened institutional support to translate general willingness into sustained and scalable investment in carbon-farming practices.

Figure 2 below presents the results of the thematic analysis conducted on the focus group transcript, showing the frequency with which farmers raised specific issues related to carbon farming and climate-smart agriculture. The most frequently mentioned theme was high agrochemical costs, cited 41 times. Farmers repeatedly emphasized that rising input prices—particularly chemicals for pest and disease control—are a major constraint to cocoa productivity and a barrier to adopting improved farming practices. This is closely followed by interest in carbon farming (38 mentions), indicating that although farmers face structural limitations, they are willing to adopt carbon-farming practices when these practices are clearly explained and accompanied by tangible benefits such as income generation, improved soil fertility, or reduced reliance on chemical inputs. Mentions relating to climate impacts on cocoa (20 occurrences) also featured prominently, highlighting farmers' lived experiences with changing rainfall patterns, increased pest outbreaks (especially black pod), and declining yields—factors that directly shape their perceptions of carbon farming as a potential adaptation and resilience-building strategy.

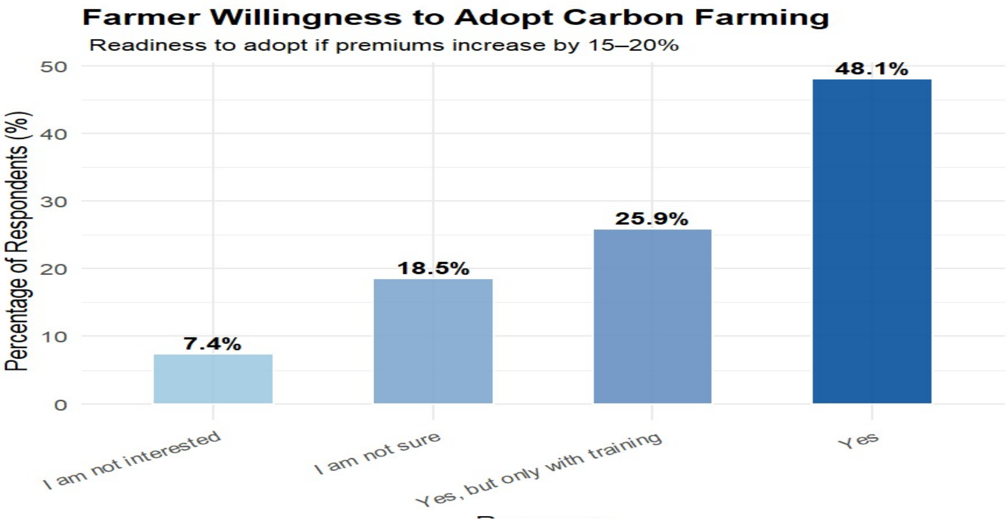

Figure 2: Farmers Willingness to adopt Carbon Farming

The results show a generally favorable disposition toward adopting carbon farming among surveyed farmers in the South-West Region of Cameroon. Nearly half of the respondents (48.1%) indicated a clear willingness to adopt carbon farming practices if premiums increased by 15–20%, demonstrating a strong sensitivity to economic incentives. An additional 25.9% expressed willingness to adopt only if adequate training is provided, underscoring the centrality of knowledge and capacity-building as enabling conditions for adoption. Together, these two groups represent more than 74% of respondents, suggesting that both financial motivation and technical support play decisive roles in influencing behavioral change and uptake of low-carbon agricultural practices.

In contrast, a smaller proportion of farmers exhibited reluctance or uncertainty toward adoption. About 18.5% responded that they were unsure, reflecting ambiguity regarding the benefits, requirements, or long-term viability of carbon farming within local production systems. A minority (7.4%) indicated no interest at all, suggesting structural, informational, or contextual barriers that outweigh potential incentives. Overall, this distribution indicates that while the majority of farmers are receptive to transitioning into carbon farming—particularly when supported by economic and capacity-building mechanisms—a targeted combination of financial incentives, farmer training, and risk-reducing interventions remains essential to ensure broad and sustainable adoption across the region

4. Discussion

The findings of this study provide a compelling understanding of stakeholder perspectives on carbon farming in the Southwest Region of Cameroon and reveal both strong potential and notable constraints for adoption. Quantitative results show that farmers' willingness to adopt carbon-farming practices is generally high, with more than 74% of respondents expressing readiness to adopt if provided with either financial premiums or technical training. This indicates that economic incentives and capacity-building remain the most decisive drivers of behavioural change. The analysis of annual investment willingness further demonstrates that farmers across all levels of current climate-smart practice adoption are willing to invest modest but comparable amounts (typically 30,000–75,000 XAF). This suggest that investment readiness is shaped less by current exposure to carbon-farming practices and more by broader financial limitations, perceived risks, and uncertainty regarding carbon-credit benefits. These insights align with existing literature showing that financial constraints and perceived market instability often limit farmers' engagement in climate-smart agriculture, even when environmental attitudes are positive(Dinga 2024).

Qualitative findings deepen this understanding by revealing the specific structural challenges shaping farmers' decisions. The most prominent themes revolve around the high costs associated with agrochemicals, climate-induced yield losses, and the growing interest in carbon farming. These themes underscore the intricate interplay between day-to-day production pressures and long-term sustainability concerns. The recurring emphasis on interest in carbon farming suggests that farmers view it not just as a mitigation tool but as a strategy to stabilize yields and reduce reliance on increasingly expensive inputs. However, concerns over monitoring, reporting, and verification (MRV), regulatory uncertainty, and fears of reduced productivity mirror barriers documented in other African contexts and stress the need for credible institutional frameworks (Bronagh 2024). Importantly, farmers' enthusiasm about earning income through carbon credits underscores carbon farming's potential contribution to SDG 2 (Zero Hunger) and SDG 13 (Climate Action), demonstrating that well-designed programs could simultaneously improve livelihoods and enhance resilience to climate change.

Collectively, these results point to a clear opportunity: carbon farming is both conceptually accepted and practically relevant for farmers in the Southwest Region. However, its successful scaling depends on strengthening financial incentives, improving access to training, and building trustworthy regulatory systems. Tailoring interventions to local agroecological realities, while ensuring transparency, fair benefit-sharing, and long-term support, is crucial for translating emerging willingness into measurable climate and agricultural outcomes. This study presents evidence that carbon farming could play a significant role in Cameroon's pursuit of sustainable agriculture. However, this potential is contingent on addressing implementation challenges through coherent policy action, institutional collaboration, and sustained stakeholder engagement.

5. Conclusion

This study identifies carbon farming as a viable pathway for strengthening sustainable agriculture and climate resilience in the Southwest Region of Cameroon. Farmers demonstrated strong conceptual willingness to adopt carbon-farming practices.However, investment readiness remained modest and did not increase consistently with the number of practices currently used, indicating that financial decisions are influenced more by income constraints, perceived risks, and uncertainty about carbon-credit benefits than by practice engagement alone. These findings highlight the need for clearer incentives, stronger institutional frameworks, and targeted capacity-building to convert willingness into sustained adoption. By addressing issues such as market volatility, additionally, permanence, and benefit-sharing transparency, Cameroon can better align carbon-farming initiatives with its agricultural priorities and NDC commitments while advancing progress toward SDG-aligned climate and livelihood goals.

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