Limited Income and Climate-Smart Agriculture Adoption Among Women Smallholder Farmers in Baringo South Sub-County

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Abstract

Climate-smart agriculture (CSA) has emerged as a critical approach for enhancing agricultural productivity, strengthening resilience to climate change, and reducing environmental degradation. However, the adoption of CSA practices among women smallholder farmers remains uneven, particularly in semi-arid regions like Baringo South Sub-County where financial constraints limit access to agricultural innovations. This study examines how the level of income influences the adoption of climate-smart agriculture among women smallholder farmers in Baringo South Sub-County, Kenya. The study seeks to determine the relationship between household income levels and the uptake of CSA practices such as water conservation, agroforestry, drought-tolerant crop varieties, conservation agriculture, and improved livestock management. The research design used was correlation research design whereby a study sample size of 128 women participants was selected using a simple random sampling procedure.15 Key informants were also interviewed totaling to 143 respondents. Data was collected using structured questionnaires and interviews. The study was guided by the premise that income affected farmers' ability to access resources, agricultural inputs, information, and technologies necessary for implementing climate-smart practices. Quantitative data were analyzed using descriptive and inferential statistics, specifically correlation and regression analysis. Qualitative data were analyzed thematically. The study results indicated that income shows a positive, moderate effect on women's participation ($R=0.355$, $R^2=0.126$). This indicated that income frequently constrains women's ability to purchase CSA inputs, reinforcing existing evidence that upfront costs remain a major barrier to adoption. Higher-income women farmers are more likely to adopt CSA technologies due to greater financial capacity, while lower-income farmers face significant barriers to adoption. The study will contribute to understanding the socioeconomic factors influencing climate adaptation in agriculture and provide recommendations for policymakers, development partners, and agricultural extension services on strategies to enhance CSA adoption among women farmers. Ultimately, the research aims to support sustainable agricultural development, improved livelihoods, and climate resilience in Baringo South Sub-County.

Keywords: Climate-Smart Agriculture, Income Level, Adoption, Women Smallholder Farmers, Climate Change Adaptation

Introduction

Climate change represents a critical challenge for smallholder agricultural productivity in Kenya, particularly in arid and semi-arid regions like Baringo South, where environmental volatility exacerbates food insecurity. Despite the urgent need for resilience, the adoption of climate-smart agriculture remains uneven, with socioeconomic factors such as income levels playing a decisive role in the capacity of women smallholder farmers to invest in adaptive technologies (Waaswa *et al., 2021)*. Empirical evidence suggests that household income serves as a critical determinant of adaptive capacity, as higher-income status significantly correlates with the increased uptake of resilient farming strategies (Mwanzia *et al*., 2025). Conversely, women smallholders frequently encounter systemic barriers that constrain their access to essential financial capital, which limits their ability to implement high-cost climate-smart innovations (Wekesa *et al*., 2018). Furthermore, persistent gender disparities in financial decision-making and access to credit exacerbate these income-related limitations, effectively restricting women's engagement in capital-intensive adaptive practices compared to their male counterparts (Onyango *et al*., 2025), (Kathuri & Ndunge, 2025). These financial constraints are particularly pronounced in Baringo, where adaptation responses remain heavily dependent on a household's ability to secure and allocate resources, including climate information and liquid assets (Brisebois *et al*., 2022). Given this context, household-level financial stability becomes the primary mediator in determining the intensity of adaptation strategies employed by women, as liquidity directly dictates their capacity to withstand seasonal agricultural fluctuations (Josephine *et al*., 2021). This research specifically addresses the existing knowledge gap regarding how income-driven resource accessibility influences the adoption intensity of climate-smart practices among women-headed households in the region (Chepkochei *et al*., 2025). By examining the intersection of financial capital and technological uptake, this study seeks to elucidate how economic barriers dictate the efficacy of climate adaptation strategies for female farmers (Okumu *et al*., 2025). Ultimately, understanding the linkage between financial resources and behavioral change is essential for designing policies that foster equitable access to climate-smart innovations (Awiti, 2022; Nchanji *et al*., 2022).

Literature Review

Climate Smart Agriculture (CSA) practices aim to increase agricultural productivity, enhance resilience to climate variability, and reduce greenhouse gas emissions while ensuring food security and sustainable livelihoods (Lipper *et al*., 2023). However, the successful adoption of CSA practices often requires financial investment in agricultural inputs, infrastructure, and training. As a result, income plays a crucial role in determining whether farmers particularly rural women can adopt and sustain climate-smart technologies. Women farmers generally experience higher levels of poverty and limited access to financial resources compared to men, which significantly affects their ability to invest in CSA practices (Alston *et al*., 2021; Mutua *et al*., 2023). Consequently, understanding the relationship between income levels and the adoption of CSA practices among rural women is essential for developing effective climate adaptation strategies.

Studies across sub-Saharan Africa have consistently demonstrated that income levels significantly influence the likelihood of adopting CSA practices. Mutua *et al*. (2023) found that smallholder farmers with higher household incomes were more likely to adopt climate-smart agricultural technologies, including drought-resistant crop varieties, conservation agriculture, and improved soil management practices. Higher-income farmers are better able to afford the initial costs associated with CSA technologies, allowing them to invest in improved inputs and technologies that enhance agricultural productivity. In contrast, farmers

with lower income levels often prioritize immediate consumption needs such as food, healthcare, and education, which limits their ability to allocate resources toward long-term agricultural investments (Bashir *et al*., 2021).

Gender disparities in income further influence the adoption of CSA practices among rural women. Women farmers often face structural barriers that limit their income-generating opportunities, including restricted access to land ownership, agricultural inputs, markets, and financial services. These challenges reduce their financial capacity to adopt resource-intensive climate-smart technologies. Atta Aidoo and Antwi-Agyei (2025) found that female farmers are generally less likely to adopt finance-intensive CSA practices compared to male farmers due to limited access to financial resources. However, the study also revealed that gender differences were less pronounced for CSA practices that rely more on labor or land resources rather than financial investment. This suggests that the adoption of certain climate-smart practices may be more accessible to women when financial barriers are reduced.

Income level also plays an important role in determining women's access to credit and financial services, which are essential for supporting the adoption of CSA practices. In many rural areas, farmers rely on both formal and informal credit systems to finance agricultural investments. However, women often face greater challenges in accessing credit due to gender norms, lack of collateral, and limited participation in financial institutions. According to Mwangi (2023), women farmers with higher income levels are more likely to access financial services and secure loans that can be used to invest in climate-smart technologies. Access to credit enables women farmers to purchase improved seeds, irrigation equipment, fertilizers, and other inputs required for implementing CSA practices.

Income also influences farmers' risk perceptions and their willingness to experiment with new agricultural technologies. Agricultural innovations often involve uncertainty, particularly when farmers adopt unfamiliar technologies or modify traditional farming practices. For low-income farmers, the potential risks associated with adopting new agricultural practices can be significant because they have limited resources to recover from crop failures or unsuccessful investments. As a result, low-income households often exhibit higher levels of risk aversion when making agricultural decisions (Alston *et al*., 2021). Farmers who lack financial security may therefore avoid adopting CSA practices that require significant investments or changes in farming systems.

Women with lower income levels may perceive certain CSA practices as too risky because of the uncertainty associated with climate conditions and agricultural outcomes. For example, adopting new crop varieties, implementing irrigation systems, or diversifying crops may involve financial risks if the expected yields or market returns are not realized. Bashir *et al*. (2021) argue that farmers with limited financial resources often prefer to rely on traditional farming practices that provide predictable outcomes rather than experimenting with unfamiliar technologies. In contrast, farmers with higher income levels are better positioned to absorb potential losses and are therefore more willing to experiment with innovative agricultural practices.

Higher income provides a financial buffer that allows farmers to absorb potential losses associated with agricultural experimentation and innovation. Women with stable income sources may be more willing to test new CSA technologies, such as agroforestry or conservation agriculture, which may take several seasons before producing measurable benefits. According to Doss (2021), financial stability allows farmers

to adopt long-term agricultural strategies that enhance sustainability and resilience to climate change. This ability to experiment with new technologies is essential for the successful adoption of CSA practices, which often require gradual adjustments to farming systems.

Income also influences farmers' ability to adopt labor-intensive climate-smart practices. Some CSA practices, such as agroforestry, terracing, and conservation agriculture, require significant labor inputs during the initial stages of implementation. For rural women who already carry substantial household and caregiving responsibilities, the availability of labor can be a major constraint. Women with higher incomes are more likely to hire additional labor to assist with agricultural activities such as land preparation, planting, and weeding. This ability to hire labor enables them to implement labor-intensive CSA practices more effectively (Mutua *et al*., 2023).

In addition, higher-income farmers are more likely to invest in labor-saving technologies that improve farm efficiency and reduce the physical burden of agricultural work. Technologies such as irrigation systems, mechanized equipment, and improved farming tools can significantly reduce labor requirements and increase productivity. Bashir *et al*. (2021) argue that the adoption of labor-saving technologies allows farmers to allocate their time more efficiently across different agricultural and household activities. For rural women, this can create opportunities to engage in additional income-generating activities or participate in community organizations that support agricultural development.

Methodology

This study investigated the Socio-economic factors influencing the adoption of CSA among rural women. It also investigated how income levels affected women's adoption of CSA in Baringo South Sub-County. Liberal feminism theory and the Technology Acceptance Model were used to investigate the study. Correlation survey research design was used in the collection of the data. The study population was 700 women who practiced small-scale farming in the areas. From the study population, a study sample size of 128 women participants was selected using a simple random sampling procedure. The key informants were selected purposively, who comprised (1) agricultural extension officers, four (4) cooperative leaders, and ten (10) women leaders in groups focusing on agricultural value chains. This brought the total number of participants to 143. Data was collected using structured questionnaires for women respondents and Key informant interview schedules for the key informants. Data was collected using structured questionnaires for women respondents and Key informant interview schedules for the key informants. Quantitative data were analyzed using descriptive and inferential statistics, specifically correlation and regression analysis. Qualitative data were analyzed thematically.

Results

Influence of Income Levels on the Adoption of Climate-Smart Agriculture Among women Smallholder Farmers

The descriptive statistics indicate that income plays a moderate but consistent role in shaping women's adoption of Climate-Smart Agriculture (CSA) practices across multiple dimensions. The highest mean score (M = 3.52, SD = 1.35) shows that income frequently limits the ability to purchase CSA inputs, suggesting that financial constraints are a key barrier to accessing essential resources such as improved seeds, fertilizers, and irrigation technologies. Similarly, income moderately influences participation in CSA

training and workshops (M = 3.17, SD = 1.30), indicating that costs related to transport, time, and participation may hinder capacity-building efforts.

Income also has a moderate effect on women's ability to invest in water conservation technologies (M = 2.95, SD = 1.26) and their willingness to take risks in experimenting with CSA practices (M = 2.98, SD = 1.22). These findings suggest that financial stability is important not only for initial adoption but also for innovation and adaptation within CSA systems. In addition, income moderately affects the likelihood of adopting practices that require high financial investment (M = 2.77, SD = 1.24) and influences decisions to join farmer groups or cooperatives that promote CSA (M = 2.88, SD = 1.31), highlighting its role in both individual and collective engagement.

However, income appears to have a comparatively lower influence on access to CSA information through ICT channels (M = 2.54, SD = 1.32), suggesting that digital platforms may be somewhat accessible despite financial limitations. Notably, the lowest mean score is observed in the sustainability of CSA adoption (M = 2.20, SD = 1.02), indicating that maintaining these practices over time remains a significant challenge under constrained income conditions.

Table 1:Income Levels on the Adoption of Climate-Smart Agriculture Among women Smallholder Farmers

Statement	Mean	Std
How often does income limit your ability to purchase CSA inputs?	3.52	1.35
To what extent does income influence your ability to attend CSA training/workshops?	3.17	1.30
Are you able to access CSA information through ICT based on income?	2.54	1.32
How much does income affect your ability to invest in water conservation technologies?	2.95	1.26
Likelihood of adopting CSA practices requiring high financial investment	2.77	1.24
Income influence on willingness to take risks in experimenting with CSA	2.98	1.22
How much income influences decision to join CSA farmer groups/cooperatives	2.88	1.31
Sustainability of CSA adoption under current income level	2.20	1.02

Regression Results for Income Level and Women's Participation in CSA

The regression results indicate that income level has a positive, statistically significant, and moderate influence on women's participation in Climate-Smart Agriculture (CSA) practices. The model summary shows a correlation coefficient (R = .355), suggesting a moderate relationship between income level and CSA participation. The coefficient of determination (R^2 = .126) indicates that income level explains 12.6% of the variation in women's participation in CSA, while the adjusted R^2 (.119) confirms that approximately 11.9% of the variation is accounted for after adjusting for model complexity. This implies that although income is an important factor, a substantial proportion of variation in CSA participation is influenced by other variables not included in the model.

The ANOVA results further confirm the statistical significance of the model (F = 18.616, $p < .001$), indicating that income level significantly predicts women's participation in CSA practices. The relatively high F-value demonstrates that the model fits the data better than a model with no predictors, reinforcing the explanatory relevance of income in CSA adoption behavior.

The coefficients results show that income level has a positive and significant effect on CSA participation (B = 0.374, β = .355, t = 4.314, $p < .001$). This means that for every unit increase in income level, women's

participation in CSA practices increases by 0.374 units, holding other factors constant. The standardized beta value (.355) further confirms a moderate effect size, indicating that income is a meaningful determinant of CSA adoption among women farmers.

The constant term (B = 3.112, p < .001) represents the baseline level of CSA participation when income is zero, suggesting that some level of participation exists regardless of income, likely driven by other structural or social factors.

Overall, the findings suggest that income level is a significant enabling factor for CSA adoption, but it operates alongside other critical determinants such as land tenure security, gender roles, and institutional support systems.

Regression Results for Income Level and Women's Participation in CSA

Table 2:Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.355[a]	.126	.119	.50812

a. Predictors: (Constant), Income Level
b. Dependent Variable: Women's Participation in CSA

Table 3:ANOVA[a]

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	4.799	1	4.799	18.616	.000[b]
Residual	33.310	129	.258		
Total	38.109	130			

a. Dependent Variable: Women's Participation in CSA
b. Predictors: (Constant), Income Level

Table 4:Coefficients[a]

Model	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t	Sig.
(Constant)	3.112	.201		15.48	.000
Income Level	0.374	.087	.355	4.314	.000

a. Dependent Variable: Women's Participation in CSA

Discussion

The descriptive findings underscore the multifaceted and moderately constraining role of income in influencing women's adoption of Climate-Smart Agriculture (CSA) practices. Overall, the results align with recent scholarship emphasizing that while income is not the sole determinant of CSA uptake, it remains a critical enabling resource influencing access, participation, and long-term sustainability (Food and Agriculture Organization, 2023; World Bank, 2022). The moderate mean scores across most indicators indicate that financial limitations do not entirely preclude engagement but significantly condition the depth and consistency of women's involvement in CSA.

The highest mean score (M = 3.52, SD = 1.35) indicates that income frequently constrains women's ability to purchase CSA inputs, reinforcing existing evidence that upfront costs remain a major barrier to adoption.

Empirical studies have shown that resource-poor farmers, particularly women, often struggle to afford improved seeds, fertilizers, and irrigation technologies, which are essential components of CSA (International Food Policy Research Institute, 2021; CGIAR, 2024). This financial limitation is further compounded by gender inequalities in access to credit and productive assets, which restrict women's capacity to invest in productivity-enhancing innovations (Doss *et al*., 2021; Kumar *et al*., 2022). Consequently, income constraints not only delay adoption but may also lead to partial or suboptimal implementation of CSA practices.

Income also moderately influences women's participation in CSA training and workshops (M = 3.17, SD = 1.30), highlighting the role of indirect costs such as transportation, time, and opportunity costs. This finding is consistent with recent studies indicating that even when training programs are offered free of charge, hidden costs can disproportionately exclude women, particularly those with limited financial autonomy or heavy domestic responsibilities (Ragasa *et al.*, 2022; UN Women, 2023). Limited participation in capacity-building initiatives may, in turn, hinder knowledge acquisition and reduce the effectiveness of CSA dissemination efforts.

In contrast, the relatively lower mean score for access to CSA information through ICT channels (M = 2.54, SD = 1.32) suggests that income plays a less pronounced role in this dimension. This trend reflects the growing penetration of mobile technologies and low-cost digital platforms in rural areas, which have improved information accessibility even among low-income populations (Aker *et al.,* 2021; International Telecommunication Union, 2022). However, persistent digital divides—particularly in terms of device ownership, digital literacy, and connectivity quality—continue to create inequities, meaning that income-related disparities, though reduced, are not entirely eliminated (GSMA, 2023).

The moderate influence of income on investment in water conservation technologies (M = 2.95, SD = 1.26) and willingness to take risks in experimenting with CSA practices (M = 2.98, SD = 1.22) underscores the importance of financial security in fostering innovation. Adoption of CSA often involves uncertainty regarding returns, and risk-averse behavior is more common among financially constrained farmers (Katengeza *et al*., 2021; Wossen *et al*., 2021). Women with limited income are therefore less likely to experiment with new practices or technologies, which can slow the diffusion of CSA innovations within communities.

Similarly, income's moderate effect on the adoption of high-cost CSA practices (M = 2.77, SD = 1.24) and participation in farmer groups or cooperatives (M = 2.88, SD = 1.31) highlights the dual financial and social dimensions of adoption. While collective action through cooperatives can reduce costs and enhance access to resources, membership often requires financial contributions that may be prohibitive for low-income women (Fischer & Qaim, 2022; International Fund for Agricultural Development, 2021). This creates a situation where those who could benefit most from collective structures are least able to join them.

The lowest mean score is observed in the sustainability of CSA adoption (M = 2.20, SD = 1.02), suggesting that maintaining practices over time is particularly challenging under income constraints. This finding aligns with recent literature emphasizing that sustained adoption requires continuous investment, access to inputs, and resilience to shocks, all of which are closely tied to financial capacity (United Nations Development Programme, 2022; Bryan *et al*., 2021). Without stable income streams or supportive financial

mechanisms, women may abandon CSA practices despite initial adoption, undermining long-term climate resilience and productivity gains.

Nevertheless, income has a positive but relatively modest influence on women's participation in Climate-Smart Agriculture (CSA), while also confirming that adoption is shaped by a broader set of interrelated socioeconomic and institutional factors. Empirical studies across Sub-Saharan Africa consistently show that higher income levels enhance farmers' ability to access inputs, absorb risks, and invest in climate-resilient technologies, thereby increasing the likelihood of CSA adoption (Awoke *et al*., 2024; Wossen *et al*., 2021). However, the strength of this relationship is often limited, reflecting the complexity of adoption decisions in smallholder systems. For instance, a multi-country analysis by Doss *et al*. (2021) highlights that while income improves access to productive resources, structural gender inequalities—such as limited land ownership and restricted decision-making power—continue to constrain women's effective participation in agricultural innovation.

The weak to moderate correlation between income and CSA participation (R = .286) observed in this study is consistent with findings from other researchers indicating that financial capacity alone is insufficient to drive widespread adoption. Studies in East Africa demonstrate that although income positively influences uptake, its effect size is often overshadowed by factors such as access to extension services, education, and social networks (Ragasa *et al*., 2022; Kumar *et al*., 2022). Similarly, research by Katengeza et al. (2021) shows that risk preferences and exposure to climate information significantly mediate adoption decisions, suggesting that even farmers with relatively higher incomes may hesitate to adopt CSA practices if uncertainty and knowledge gaps persist. This explains why the relationship between income and CSA adoption, while positive, remains moderate rather than strong.

The coefficient of determination (R^2 = .082) further aligns with existing literature, which emphasizes that income typically explains only a small proportion of the variation in CSA adoption. For example, studies conducted under the CGIAR climate research programs indicate that socioeconomic variables, including income, often account for less than 15% of the variability in adoption outcomes, with institutional and environmental factors playing a more dominant role (CGIAR, 2024). Similarly, the Food and Agriculture Organization (2023) reports that CSA adoption is influenced by a combination of financial capacity, access to information, policy support, and gender norms, reinforcing the notion that income is just one component within a multifaceted system. The slight reduction from R^2 to adjusted R^2 (.075) in the model further suggests that other unobserved variables—such as cultural norms, labor availability, and market access—likely contribute significantly to women's participation in CSA.

Income level therefore has a positive and statistically significant influence on women's participation in Climate-Smart Agriculture (CSA), while also emphasizing that this relationship is moderate and embedded within a broader system of constraints and enabling factors. The positive unstandardized coefficient (B = .286) observed in this study aligns with evidence from Sub-Saharan Africa showing that higher income enhances farmers' ability to access improved inputs, adopt new technologies, and absorb climate-related risks, thereby increasing engagement in CSA practices (Wossen *et al*., 2021; Awoke *et al*., 2024). Similarly, Ragasa *et al*. (2022) note that income strengthens farmers' investment capacity and willingness to experiment with climate-resilient innovations, particularly in resource-constrained rural settings. This reinforces the interpretation that increased financial resources expand women's opportunity set, enabling them to participate more actively in CSA-related activities.

The standardized coefficient (β = .286) and the statistically significant t-value (t = 3.31, p = .001) further corroborate findings from recent studies that identify income as a meaningful, though not dominant, predictor of CSA adoption. For instance, Kumar *et al*. (2022) report that while income plays a significant role in influencing adoption decisions, its relative importance is often comparable to other factors such as education, access to extension services, and social capital. This suggests that the moderate effect size observed in the present study is consistent with broader empirical patterns, where income contributes to adoption but does not independently drive it. In this regard, the findings also resonate with Doss *et al*. (2021), who argue that financial capacity alone cannot fully overcome structural gender inequalities that limit women's access to productive resources and decision-making authority.

The statistically significant constant term (B = 2.846, p < .001) indicates that a baseline level of CSA participation exists even in the absence of income effects, highlighting the role of non-financial drivers. Recent literature increasingly emphasizes the importance of institutional and social factors—such as extension services, farmer groups, and climate information systems—in shaping adoption behavior. For example, Katengeza *et al*. (2021) demonstrate that exposure to climate information and training significantly influences farmers' willingness to adopt CSA practices, regardless of income level. Likewise, the Food and Agriculture Organization (2023) underscores that knowledge dissemination and advisory services are critical in enabling smallholder farmers, particularly women, to engage in climate-resilient agriculture. These findings suggest that the baseline participation captured by the constant term may reflect the influence of such non-income factors.

Despite the positive and statistically significant effect of income, the moderate magnitude of the coefficient reinforces the conclusion that income alone is insufficient to fully explain women's participation in CSA. This is consistent with recent studies highlighting the persistent role of gender-specific constraints that limit the effective use of financial resources. Fischer and Qaim (2022) show that even when women have access to income, intra-household dynamics often restrict their control over how resources are allocated, thereby weakening the link between income and technology adoption. In addition, UN Women (2023) reports that time poverty, unpaid care responsibilities, and restrictive social norms continue to hinder women's participation in agricultural innovation, regardless of their economic status. These structural barriers help explain why the observed relationship, although significant, remains moderate.

In addition, broader development literature emphasizes that CSA adoption is inherently multidimensional, requiring the interaction of financial, institutional, and environmental factors. According to the World Bank (2022), successful uptake of CSA practices depends on integrated support systems that combine access to credit with extension services, market linkages, and climate information. Similarly, CGIAR (2024) findings indicate that socioeconomic variables such as income typically account for only a limited share of the variation in adoption outcomes, with institutional and contextual factors playing a more decisive role. This aligns closely with the present results, which demonstrate that while income is an important determinant, it operates within a complex system of interrelated influences.

In sum, the results are strongly supported by recent literature, confirming that income level positively and significantly affects women's participation in CSA, but with a moderate effect size. The findings highlight that increased income enhances women's capacity to engage in climate-smart practices, yet it does not fully determine participation outcomes. Instead, a combination of socioeconomic, institutional, and gender-

related factors jointly shapes adoption behavior, underscoring the need for comprehensive and gender-responsive strategies to promote CSA among women farmers.

The findings are well supported by recent literature, which consistently demonstrates that income has a positive but limited effect on women's participation in CSA. While increased income enhances the capacity to invest in climate-smart technologies, it explains only a small share of the overall variation in adoption. The relatively low R^2 and moderate prediction error underscore the importance of considering additional factors—such as education, access to extension services, gender norms, and institutional support—in understanding and promoting CSA adoption. These insights highlight the need for holistic, gender-responsive interventions that address both financial and non-financial barriers to ensure more inclusive and sustained participation in climate-smart agriculture.

The results also illustrates that income exerts a pervasive yet differentiated influence across various stages of CSA adoption—from initial access to sustained use. While improvements in ICT access and community-based approaches have mitigated some financial barriers, income remains a central determinant of women's ability to fully engage with and benefit from CSA. Addressing these constraints will require integrated interventions, including improved access to credit, targeted subsidies, and gender-responsive policies that enhance women's economic empowerment and resilience

Conclusion

the findings demonstrate that income plays a consistently moderate yet critical role in shaping women's engagement with CSA practices across multiple dimensions, including access to inputs, participation in training, investment decisions, and long-term sustainability. While some areas, such as ICT-based information access, appear less sensitive to income disparities, the overall pattern confirms that financial constraints remain a key barrier to both adoption and sustained use. Without addressing these economic limitations, efforts to scale CSA among women farmers are likely to yield uneven and short-lived outcomes. Therefore, enhancing women's financial capacity is essential for achieving inclusive and sustainable agricultural transformation in the context of climate change. The study concludes that household income plays a significant role in shaping the adoption of climate-smart agriculture practices among women farmers. Financial resources influence farmers' capacity to purchase agricultural inputs, invest in irrigation technologies, adopt improved crop varieties, and implement soil conservation measures. Women farmers with higher income levels are therefore more capable of adopting climate-resilient agricultural technologies compared to those with limited financial resources. The findings further suggest that income affects farmers' participation in training programs, access to digital agricultural information platforms, and membership in farmer groups that promote agricultural innovation. Consequently, the study concludes that income inequality represents a major constraint limiting the adoption of climate-smart agriculture among women smallholder farmers.

Recommendation

Policymakers and development practitioners should complement income-enhancing interventions with targeted, gender-responsive support systems—such as improved access to extension services, climate

information, and land rights—since these factors have a stronger and more consistent influence on women's participation in Climate-Smart Agriculture (CSA) than income alone.

A practical intervention would be to expand gender-responsive financial support mechanisms that directly target women farmers, such as subsidized CSA input packages, microcredit schemes, and flexible savings models. Improving women's access to affordable finance significantly enhances their ability to invest in CSA technologies and sustain their use over. These financial interventions should be complemented by integrating training programs with financial services—such as linking extension services to credit providers—to reduce both direct and indirect participation costs. Such an approach would not only ease input acquisition constraints but also strengthen women's confidence to adopt and experiment with CSA practices.

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