

Land Tenure Inequality as a Barrier to Women's Climate-Smart Adoption in Baringo South Sub-County-Kenya

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Abstract

Climate change continues to threaten agricultural productivity and livelihoods in Kenya, particularly in arid and semi-arid areas such as Baringo-South Sub-County. Climate-Smart Agriculture (CSA) has been promoted as a key strategy for enhancing climate resilience, food security and sustainable livelihoods. However, women's adoption of CSA practices in Baringo South remains limited due to land tenure insecurity. 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. Customary land ownership system, patriarchal inheritance practices and weak enforcement of statutory land laws restrict women's access to, control over, and decision-making authority regarding land. This insecurity discourages women from investing in long-term climate smart practices such as soil and water conservation, agroforestry, pasture improvement and others. Moreover, lack of secure land tenure reduces women's access to credit, climate adaptation programs which further constraint CSA uptake. Given that women play a central role in agricultural production and are disproportionately affected by climate variability, these land-tenure-related barriers undermine local climate adaptation efforts. Quantitative data was analyzed using descriptive and inferential statistics, specifically correlation and regression analysis. Qualitative data were analyzed thematically. The regression analysis indicates that land tenure has a coefficient of $B = 0.308$, which rejects the null hypothesis (H_0). This means that Land tenure has a significant and positive influence on the adoption of climate-smart agriculture among women. Secure land rights encourage farmers to invest in long-term CSA practices such as soil conservation, agroforestry, and terracing. This paper examined land tenure as a key barrier to women's adoption of climate smart agriculture in Baringo South Sub-County and highlighted the need for gender responsive land governance, strengthened policy implementation, and localized institutional support to promote equitable and sustainable adoption of CSA practices.

Keywords: Land Tenure, Inequality, Barrier, Women, Climate-Smart Agriculture, Adoption

Introduction

Land tenure is an institution which has rules invented by society to regulate how property rights to land are to be allocated within society. Land tenure influences the size of land that individuals own. This directly influences crop farming because if a farmer has a big size of land, it would be possible to plant a lot of crops and put different varieties too. It also dictates on the type of crops to be grown on the farm (Carroll & Kinsella, 2013). Insecure land tenure, where farmers lack legal ownership or formal rights, often limits their incentive to adopt climate-smart practices, as they may be uncertain of the duration of their land use or worried about losing access to the land (Deininger & Xia, 2022).

Land tenure in Kenya is shaped by various legal, cultural, and institutional frameworks. The ownership and use of land are guided by both customary and formal land tenure systems (Mwaura, 2022). These systems govern access to land and rights over its use, which are crucial for agricultural activities, including the adoption of Climate-Smart Agriculture (CSA). The types of land tenure systems in Kenya have evolved over time, influenced by historical policies, land reforms, and shifts in governance structures. Below is an overview of the primary land tenure systems in Kenya, based on both formal and informal mechanisms (Wambu, Openda & Lydia, 2016).

According to Gichuki (2022), freehold tenure refers to a system where the owner holds absolute and perpetual ownership rights over the land. This type of tenure is common in private land ownership, especially in urban areas and high-potential agricultural regions in Kenya. The landowner has the right to sell, lease, or transfer the property at will, subject to the regulations and laws governing land use. Freehold tenure offers the highest degree of land ownership security, with the landowner having the right to use, lease, or dispose of the land without restrictions (except in cases where land use is governed by zoning laws or environmental protections). Although freehold tenure offers security, it is largely concentrated in a few high-income regions and urban areas. Many rural women face challenges in accessing freehold land, particularly due to patriarchal inheritance practices (Mwangi, 2023). According to Mwaura (2022), freehold land is seen as an attractive model for adopting Climate-Smart Agriculture, as it provides long-term security for investments in land improvement practices like agroforestry and irrigation. However, inequalities in access to this form of tenure, particularly for women, persist.

Leasehold tenure involves renting land for a specified period under a lease agreement, with terms that specify the rights of the lessee. Land under leasehold tenure is generally owned by the government, a private individual, or a corporation but leased to others for agricultural or commercial use. This form of tenure is common in urban areas or land leased for large-scale agriculture. In Kenya, leasehold land is often used for commercial agricultural ventures, such as large-scale farming of tea, flowers, or horticulture (Mwaura, 2022).

Lease-hold systems may create uncertainties for long-term investments in agricultural practices, including CSA, especially when leases are short-term and renewal is uncertain. Additionally, women, particularly in rural areas, may face barriers to leasing land due to limited financial resources or access to legal knowledge (Njiru, 2023). A study by Doss (2022) found that the leasehold system, while offering a temporary security of land access, limits the ability of women farmers to adopt long-term climate-resilient practices. Lease terms may not align with the planting cycles of CSA practices, thereby reducing incentives for women to adopt them.

Customary land tenure refers to the traditional system of land ownership and management, based on indigenous norms and practices. This system is particularly common in rural and communal areas of Kenya, especially among ethnic groups like the Kikuyu, Maasai, and Luhya, where land is managed collectively by the community or clan. Under customary tenure, land is often owned collectively by a community, and individuals within the community are granted usage rights, often through oral agreements. Land rights are typically passed down through generations based on kinship and community membership. In many cases, land is inherited according to traditional norms.

Customary tenure offers flexibility and community-level management, it often lacks formal documentation or legal recognition, making it difficult to access formal credit or engage in formal land transactions. Moreover, women often face limited control over land, as land ownership and decision-making are typically dominated by men (Gichuki, 2022). According to a study by Ochieng (2023), women under customary land tenure systems in Kenya frequently face land disputes and insecure land rights. Some rural land is held by the government and leased out to individuals or communities for agricultural use. Public land is administered by government agencies, and its use is often governed by national laws, regulations, or government policies.

Methodology

This study investigated the Socio-economic factors influencing the adoption of CSA among rural women. It also investigated how land tenure systems 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 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. Quantitative data was analyzed using descriptive and inferential statistics, specifically correlation and regression analysis. Qualitative data were analyzed thematically.

Results

Land Tenure and the Adoption of Climate-Smart Agriculture Among Women Smallholder Farmers

The descriptive results indicate a strong and consistent relationship between land tenure security and women's adoption of Climate-Smart Agriculture (CSA) practices. Across all statements, the mean scores are generally high (ranging from $M = 3.82$ to $M = 4.30$), suggesting that respondents strongly agree that secure land ownership significantly influences their willingness and ability to adopt CSA technologies.

The highest mean score ($M = 4.30$, $SD = 0.94$) shows that security of land ownership strongly encourages investment in long-term CSA practices. This suggests that women farmers are more willing to engage in sustainable practices such as agroforestry, soil conservation, and water management when they have confidence in continued access to their land. Similarly, the belief that land tenure security increases

willingness to adopt new CSA technologies also records a high mean ($M = 4.23$, $SD = 0.94$), reinforcing the importance of tenure stability in agricultural innovation.

Access to formal landownership documentation is also perceived as highly important ($M = 4.15$, $SD = 1.13$), as it facilitates access to credit and financial services necessary for CSA investments. In addition, respondents agree that uncertainty about land tenure discourages adoption of high-cost CSA practices ($M = 4.10$, $SD = 0.99$) and that CSA adoption is more beneficial when long-term control over land is assured ($M = 4.10$, $SD = 1.11$). These findings highlight the role of tenure security in reducing investment risk and enhancing farmer confidence.

Furthermore, respondents acknowledge that insecure or rented land reduces the likelihood of CSA adoption ($M = 4.13$, $SD = 1.00$), while traditional or customary tenure systems ($M = 3.96$, $SD = 1.11$) and joint ownership arrangements ($M = 3.82$, $SD = 1.19$) may limit decision-making autonomy and constrain adoption.

Overall, the findings demonstrate that land tenure security is a critical enabling factor for CSA adoption among women farmers. Secure land rights enhance investment confidence, improve access to credit, and support long-term planning, thereby significantly increasing the likelihood of adopting sustainable agricultural practices.

A key informant stated that,

“It is easier to practice CSA in your own farm knowing well that the land belongs to you and no one will evict you after a long-term investment unlike when leasing it from someone else. Some people lease the farm to you and when they see it producing high yield, they issue a notice to you to leave the land for him for the next season. This has made many women not to do a lot of investments on a lease land.” (IP-6, a woman leader from Marigat).

This indicates that women feel more confident investing in practices that yield benefits over extended periods when their land rights are assured. Another key informant reported that,

“It is hard for most women to plant long-term crops on a leased land. The benefits will be less and the owner might change his mind.” (IP-7, a woman leader from Marigat).

Another key-Informant reported that,

“In this area, women cannot inherit land from their fathers. Only men can do so. Only those who are not married can be given a small portion to live in but the rights to sell it are reserved. Very few women have bought small pieces of land and are facing a lot of resistance especially from older men.” (IP-8, a woman leader from Marigat).

However, customary systems remain an important barrier when it comes to land ownership.

A key -informant reported that,

“I cannot plant anything on our farm without seeking permission from my husband. If I ask for anything and he refuses, I won't plant it again. His decisions on land use are final because he owns the land. When

he decides to sell it the way he did last year, when he sold the land with my ground nuts, I don't have any say. The land is registered in his name.” (IP-14, a woman leader from Tuiyobei).

Table 1: Land Tenure on the Adoption of Climate-Smart Agriculture Among Women Smallholder Farmers

Statement	Mean	SD
Security of land ownership encourages me to invest in long-term CSA practices	4.30	0.94
Uncertainty about land tenure discourages adoption of CSA practices requiring high initial investment	4.10	0.99
Having legal land ownership documents makes it easier to access credit for CSA	4.15	1.13
Land tenure security increases my willingness to adopt new CSA technologies	4.23	0.94
Farmers with insecure or rented land are less likely to adopt CSA than those with secure tenure	4.13	1.00
Adopting CSA practices is more beneficial when I am assured of long-term control over the land	4.10	1.11
Traditional/customary land tenure systems influence my ability to adopt CSA	3.96	1.11
Joint/shared landownership limits decision-making on adopting CSA practices	3.82	1.19

Regression Results for Land Tenure and Adoption of Climate-Smart Agriculture

The regression results indicate that land tenure security has a positive and statistically significant influence on the adoption of Climate-Smart Agriculture (CSA) practices among farmers. The model summary shows a correlation coefficient ($R = .341$), suggesting a moderate relationship between land tenure security and CSA adoption. The coefficient of determination ($R^2 = .116$) reveals that land tenure security explains 11.6% of the variation in CSA adoption, while the adjusted R^2 (.109) indicates that approximately 10.9% of the variation is accounted for after adjusting for model complexity. This demonstrates that land tenure is an important but not sole determinant of CSA adoption.

The ANOVA results confirm that the model is statistically significant ($F = 17.921$, $p < .001$), indicating that land tenure security significantly predicts CSA adoption. The relatively high F-value suggests that the model provides a better fit than a model without predictors, reinforcing the relevance of land tenure in explaining differences in adoption behavior.

The coefficients further show that land tenure security has a positive and significant effect on CSA adoption ($B = 0.341$, $\beta = .341$, $t = 4.23$, $p < .001$). This implies that a one-unit increase in land tenure security leads to a 0.341-unit increase in CSA adoption, holding other factors constant. The standardized beta value (.341) indicates a moderate effect size, confirming that secure land ownership is a meaningful driver of CSA uptake.

The constant term ($B = 1.982$, $p < .001$) represents the baseline level of CSA adoption when land tenure security is absent, suggesting that some level of adoption may still occur due to other influencing factors such as income, knowledge, or social support systems.

Overall, the findings demonstrate that land tenure security is a significant enabling factor for CSA adoption. Secure land rights enhance farmers' confidence to invest in long-term, sustainable agricultural practices. However, since a substantial proportion of variation remains unexplained, other factors such as income, gender roles, and institutional support also play critical roles in influencing CSA adoption among farmers.

Table 2: Model Summary^b

Model	R	R Square	Adjusted R-Square	Std. Error of the Estimate
1	.341 ^a	.116	.109	.49782

a. Predictors: (Constant), Land Tenure

b. Dependent Variable: Adoption of Climate-Smart Agriculture

Table 3: ANOVA^a

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	4.439	1	4.439	17.921	.000 ^b
Residual	31.242	126	.248		
Total	35.681	127			

a. Dependent Variable: Adoption of Climate-Smart Agriculture

b. Predictors: (Constant), Land Tenure

Table 4: Coefficients^a

Model	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t	Sig.
(Constant)	1.982	.287		6.91	.000
Land Tenure	.341	.081	.341	4.23	.000

a. Dependent Variable: Adoption of Climate-Smart Agriculture

Discussion

Land Tenure and Adoption of Climate-Smart Agriculture

The results of this study also revealed that land tenure security had a significant positive influence on the adoption of climate-smart agriculture among women farmers.

From the study results, there is a consistently high mean scores observed across all statements align with empirical evidence indicating that secure land rights significantly enhance farmers' willingness to invest in long-term, productivity-enhancing, and climate-resilient practices. Studies across Sub-Saharan Africa show that tenure security exacerbates farmers' confidence in making irreversible investments such as agroforestry, soil conservation, and irrigation infrastructure, which are the key components of CSA (Place *et al.*, 2021; Deininger & Xia, 2022). This is because secure land ownership reduces the perceived risk of expropriation or displacement, thereby encouraging long-term planning and sustainable land management decisions.

The highest mean score ($M = 4.30$) reflecting the influence of ownership security on investment in CSA practices is in line with findings by Holden and Ghebru (2022), who report that formal land rights significantly increase adoption of land-improving technologies among smallholder farmers in East Africa. Similarly, Goldstein *et al.* (2023) emphasize that secure tenure is strongly associated with increased investment in soil fertility management and climate adaptation strategies, particularly among women farmers who often face higher tenure insecurity. This supports the interpretation that land security is one of the determinants of sustainable agricultural transformation.

The perceived importance of formal land documentation ($M = 4.15$) also reflects broader evidence that legal land titles improve access to financial services, which in turn facilitates investment in CSA technologies. According to Lawry *et al.* (2021), land certification programs in developing countries are

consistently associated with improved access to credit markets and increased agricultural investment. This is further supported by the World Bank (2022), which highlights that land documentation reduces transaction costs and enhances collateral value, enabling farmers—especially women—to secure loans for climate-resilient agricultural inputs.

The study results further indicated that tenure uncertainty discourages adoption of high-cost CSA practices ($M = 4.10$) are consistent with recent research emphasizing the role of risk perception in agricultural decision-making. Kusunose and Lybbert (2021) argue that insecure tenure increases perceived investment risk, leading farmers to prioritize short-term gains over long-term sustainability. In the same vein, FAO (2023) reports that tenure insecurity is a major barrier to climate adaptation in agriculture, as it discourages investments that require long gestation periods before yielding returns. This explains why farmers with uncertain land rights are less likely to adopt CSA practices that involve significant upfront costs.

The finding that insecure or rented land reduces CSA adoption ($M = 4.13$) is also well documented in recent literature. Ali *et al.* (2022) demonstrate that tenants and sharecroppers are significantly less likely to invest in soil conservation and agroforestry compared to landowners due to limited decision-making authority and uncertainty over land access duration. Similarly, Jayne *et al.* (2021) highlights that lease arrangements often discourage long-term investments, particularly in regions where land contracts are informal or short-term.

There was relatively lower mean scores associated with customary tenure systems ($M = 3.96$) and joint ownership arrangements ($M = 3.82$) reflect persistent, gendered constraints in land governance. Doss and Meinzen-Dick (2022) note that women's land rights are often mediated through male relatives in customary systems, limiting their autonomy in agricultural decision-making. In joint ownership contexts, intra-household bargaining dynamics frequently restrict women's ability to independently invest in CSA practices, even when they have partial ownership rights. This is further supported by Peterman *et al.* (2021), who emphasize that legal ownership alone does not guarantee control over land-use decisions, particularly in patriarchal settings.

The findings strongly align with recent empirical and policy literature, which consistently demonstrates that land tenure security is a fundamental driver of CSA adoption among women farmers. Secure land rights not only enhance investment confidence but also improve access to credit and strengthen long-term planning capacity, thereby enabling greater participation in climate-resilient agricultural practices. Conversely, insecure, customary, or shared tenure arrangements continue to constrain women's autonomy and reduce their likelihood of adopting CSA technologies. This underscores the importance of land governance reforms that strengthen women's land rights as a key strategy for promoting inclusive and sustainable agricultural transformation.

Secure land tenure plays a critical role in shaping farmers' incentives to invest in sustainable agricultural practices. Climate-smart agriculture often involves long-term land management strategies such as agroforestry, soil conservation, and water harvesting systems. Farmers are more likely to adopt these practices when they are confident that they will retain control over the land long enough to benefit from the investments they make. The importance of land tenure security in agricultural innovation adoption has been widely documented in the literature. Farmers who possess secure land rights tend to invest more in land improvement practices because they expect to benefit from increased productivity over time. As noted by

Agarwal (2023), secure land tenure encourages farmers to adopt sustainable land management practices that enhance long-term agricultural productivity.

Empirical evidence from several African countries supports this relationship between land tenure and agricultural investment. Research conducted by Place *et al.* (2020) found that farmers with secure land ownership were significantly more likely to adopt soil conservation practices and agroforestry technologies.

The relationship between land tenure and adoption of agricultural innovation is particularly important in the context of gender inequality. In many rural societies, women's access to land is often mediated through male relatives such as husbands or fathers. These arrangements can limit women's autonomy in agricultural decision-making and discourage long-term investments in land improvement. Njuki *et al.* (2021) observed that women farmers with secure land rights were significantly more likely to adopt climate-resilient agricultural practices compared to those who relied on informal or temporary land arrangements. On the contrary, Njuki *et al.* (2025) argue that women with insecure or secondary land rights are less likely to undertake investments that yield benefits over extended periods, thereby constraining their adoption of climate-smart innovations.

Similarly, Doss and Meinzen-Dick (2021) highlight that gender inequalities in land ownership represent one of the most persistent barriers to women's agricultural productivity and innovation. Further evidence suggests that farmers who lack secure land rights may avoid investing in long-term agricultural practices because they fear losing access to the land before the benefits of the investment are realized. This concern was highlighted by Schiavone *et al.* (2021), who found that insecure land tenure discourages farmers from adopting climate adaptation strategies that require long-term planning.

In Kenya, land tenure systems are shaped by a combination of statutory law and customary practices. Although legal frameworks increasingly recognize gender equality in land ownership, customary norms often continue to favor male control of land resources. Gichuki (2022) notes that these customary practices frequently limit women's access to land ownership and agricultural decision-making power.

According to Kenya land reports (2026), some rural land is held by the government and leased out to individuals or communities for agricultural use. Public land is administered by government agencies, and its use is often governed by national laws, regulations, or government policies. It is generally leased to individuals or groups for specific purposes, such as agriculture or community development. Women may face challenges in accessing public land due to the competitive nature of land allocation and the centralized control of land management by government officials. Women also often lack the legal capacity to bid for or apply for land under government programs, as land access is typically mediated through male heads of households. In a study by Gichuki (2022), public land tenure was found to be a significant barrier to the adoption of CSA practices among women farmers in Kenya. This study thus concurs with the findings of other researchers.

Studies in Kenya show that insecure and communal land tenure arrangements reduce incentives for long-term agricultural investments, including CSA practices (Chepkochei & Midamba, 2025; Chepkochei *et al.*, 2025). Similarly, Mbunda (2025) found that limited land access and entrenched gender norms restrict women's participation in climate-smart agriculture. In Kenya, structural inequalities in land ownership and access to agricultural resources continue to marginalize women farmers and limit their engagement in CSA initiatives (Rurii & Nzengya, 2025). Furthermore, Awoke *et al.* (2025) demonstrate that women's

constrained access to productive resources, including land, reduces their capacity to adopt climate-resilient technologies. Despite progressive policy frameworks, gender disparities in land access remain a major challenge to inclusive climate adaptation (Kamau *et al.*, 2024).

This mirrors results reported by Mutenje *et al.* (2022), who found that insecure land rights reduce the likelihood of adopting improved seed varieties, irrigation, and agroforestry because the benefits may not accrue to the farmer if land access is not guaranteed. Moreover, secure land tenure increases farmers' willingness to invest in irrigation and soil and water conservation, while tenure insecurity discourages such investments as Razzak, & Ali (2025). The statement that having legal land documents improves access to credit (mean = 4.15) also reflects the widely documented link between land tenure and financial services. Studies such as Tambo and Roberts (2023) highlight that women with formalized land tenure are more creditworthy, enabling them to invest in CSA innovations requiring upfront capital.

This pattern aligns with research by Kiptot *et al.* (2023), showing that joint ownership can empower women when decision-making is cooperative but restrict them when male household members dominate. The findings are consistent with previous studies which highlight the importance of land tenure security in promoting agricultural innovation. Njuki *et al.* (2025) found that farmers are more willing to adopt long-term climate adaptation strategies when they are assured of continued control over their land. Similarly, Mutenje *et al.* (2022) reported that insecure land tenure discourages farmers from adopting technologies whose benefits are realized over longer periods.

In addition, Tambo and Roberts (2023) note that formal land ownership documentation improves farmers' access to credit by providing collateral required by financial institutions. Improved access to credit enables farmers to invest in climate-smart agricultural technologies that require substantial upfront capital. Additionally, Njuki *et al.* (2025) observe that limited land ownership among women further constrains their ability to invest in climate-smart agricultural technologies that require long-term commitment. However, customary land tenure systems and gender inequalities still limit women's land ownership in many rural communities. Studies such as Doss and Meinzen-Dick (2021) show that patriarchal inheritance systems restrict women's control over land, which in turn reduces their ability to independently adopt agricultural innovations.

The results of this research clearly demonstrate that land tenure is a foundational factor influencing CSA adoption among women farmers. Secure and documented land rights enhance women's confidence, ability to invest, access to credit, and capacity to adopt long-term climate-resilient practices. Conversely, insecurity, customary restrictions, and shared ownership arrangements create uncertainty that limits women's ability to fully commit to CSA innovations. The literature strongly supports these findings, emphasizing that meaningful advancement in CSA adoption requires land tenure reforms that strengthen women's autonomy and long-term control over agricultural land. Recent literature strongly supports these findings, emphasizing that strengthening women's land rights through gender-responsive land policies, legal reforms, and improved land governance systems is essential for promoting equitable adoption of climate-smart agriculture and improving rural livelihoods (Meinzen-Dick *et al.*, 2023; Lawry *et al.*, 2024; Holden & Tilahun, 2024).

There was also strong agreement that uncertainty about land tenure discourages adoption of high-investment CSA practices (mean = 4.10). This aligns with the argument by Mwesigwa *et al.* (2024) that

insecure tenure forces farmers to avoid high-risk, high-return agricultural investments, thereby limiting the transformative potential of CSA. Women similarly expressed that adopting CSA practices is more beneficial when they have long-term control over the land (mean = 4.10), further underscoring the relationship between ownership security and investment horizons.

Cultural norms was a key influencing factor when it came to land ownership as noted by Doss and Meinzen-Dick (2021), who argue that patriarchal customary practices continue to restrict women's ability to independently use or make decisions about land, limiting their engagement in innovation-driven agriculture. Gendered land inheritance norms in many African societies still prioritize male heirs, leaving women with secondary or conditional land rights that weaken their decision-making authority over agricultural investments (Meinzen-Dick *et al.*, 2023; Lawry *et al.*, 2024). Quisumbing *et al.* (2023) reported that even when women actively participate in farming, land ownership and decision-making authority often remain concentrated in the hands of men, limiting women's autonomy to adopt new agricultural technologies or diversify production systems.

Cultural norms in many African societies, including Kenya, continue to shape women's land rights in ways that limit their ownership and control. In most cases, women are allowed to access and use land through their husbands or male relatives, particularly for agricultural production, but they often lack the authority to make independent decisions such as selling or transferring land. This reflects deeply rooted patriarchal systems where land ownership is traditionally vested in men, while women's rights remain secondary and conditional (Doss *et al.*, 2021; Meinzen-Dick *et al.*, 2022).

Recent studies further show that such gendered land arrangements constrain women's economic empowerment and agricultural decision-making. For instance, Rurii and Nzengya (2025) note that women's limited control over land reduces their incentives to invest in long-term climate-smart agricultural practices. Similarly, Mbunda (2025) found that although women actively engage in farming, their inability to control land assets restricts their participation in key agricultural and financial decisions.

In Kenya, Kamau *et al.* (2024) emphasize that customary norms continue to override statutory laws, limiting women's land ownership despite legal reforms. As a result, women's land use rights are often insecure and dependent on marital status, reinforcing gender inequalities in access to productive resources and hindering adoption of sustainable agricultural practices. This was also asserted by KIPPRA (2024) on promoting land ownership among women.

Land fragmentation is another challenge that has resulted to smaller pieces of lands in the study area. Land has been sub-divided into smaller portions amongst family heirs. According to Gichuki (2022), land rights are typically passed down through generations based on kinship and community membership. This shows that this study concurs with what other researchers have found out.

According to Mwaura (2022), the ownership and use of land are guided by both customary and formal land tenure systems. Some customary laws prevent women from owning land. For instance, the law that deny women the right to inherit property from their fathers.

According to Mutua *et al.* (2022), women with less control over land were less likely to adopt CSA practices like water conservation techniques because they did not have the authority to make decisions regarding the allocation of resources. The researcher in this study got the same findings thus indicating that this research

was in agreement with other research done in the past. This finding agrees with Nyamekye *et al.* (2023) and Mutesa & Rao (2022), who emphasize that land security improves farmers' willingness to invest in sustainable land management technologies.

The finding is consistent with recent studies such as Njuki *et al.* (2025), who argue that farmers particularly women are far more willing to undertake long-term soil and water conservation practices when their tenure is secure, as it provides a stable foundation for climate adaptation on their farms. Mwangi (2023) in his study found out that many rural women face challenges in accessing freehold land, particularly due to patriarchal inheritance practices. The belief that farmers with insecure or rented land are less likely to adopt CSA compared to those with secure tenure (mean = 4.13) reinforces this point, consistent with evidence from Okello *et al.* (2021), who noted that rental arrangements often discourage soil conservation, tree planting, and water harvesting due to short-term contracts and unclear benefit rights. Insecure rental arrangements, such as short-term contracts and unclear rights to long-term benefits, often discourage farmers from investing in soil conservation, tree planting, and water harvesting because the benefits of such practices may not accrue within the contract period (Prokopy *et al.*, 2019).

In general, the findings of this study therefore reinforce the importance of land tenure reforms that strengthen women's land rights as a strategy for promoting climate-smart agriculture adoption.

Conclusion

The study demonstrates that land tenure security is a crucial determinant of women's adoption of Climate-Smart Agriculture (CSA) practices. High levels of agreement across all indicators indicate that secure land ownership significantly enhances women's willingness and capacity to invest in long-term and capital-intensive CSA technologies. Secure tenure reduces perceived investment risks, improves access to credit, and strengthens farmers' confidence in making sustainable agricultural decisions. Conversely, insecure, customary, or shared land arrangements limit women's autonomy and discourage adoption. Overall, the evidence confirms that land tenure security is not only an agricultural issue but also a key gender and development concern shaping climate-resilient farming outcomes. The study, therefore, concludes that land tenure insecurity represents a major structural barrier to the adoption of climate-smart agriculture. Gender inequalities in land ownership further reinforce this challenge by limiting women's access to credit facilities and financial services that require land titles as collateral.

Recommendations

Governments and development stakeholders should prioritize strengthening women's land tenure security through formal land registration, enforcement of equitable land rights, and reforms that recognize women's ownership and decision-making authority. Such interventions should be complemented by awareness programs and legal support services to ensure that women can effectively claim, document, and exercise control over land resources, thereby enhancing their participation in Climate-Smart Agriculture.

Policies aimed at improving land tenure security for women should be strengthened. Government institutions responsible for land administration should promote gender-equitable land ownership policies that enable women to legally own and control land resources. Encouraging joint land titling for married couples can also help improve women's access to land ownership and strengthen their bargaining power within households.

Public awareness programs should also be implemented to educate communities on the economic and social benefits of gender-equitable land ownership. Such initiatives can help challenge cultural norms that restrict women's access to land and promote more inclusive agricultural development

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