OPEN ACCESS Int. J. Agr. Ext. 13 (03) 2025. 200-209 DOI:-10.33687/ijae.013.03.5916

Check for updates

Available Online at EScience Press
International Journal of Agricultural Extension
ISSN: 2311-6110 (Online), 2311-8547 (Print)
https://esciencepress.net/journals/IJAE

CAN FARMLAND FACTORS INFLUENCE THE SUSTAINABILITY OF AGROFORESTRY PRACTICES AMONG FARMERS? A CASE STUDY OF THARAKA-NITHI COUNTY, KENYA

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ARTICLE INFO

Article History
Received: July 22, 2025
Revised: October 12, 2025
Accepted: November 25, 2025

Keywords
Adoption
Agricultural extension
Agroforestry practices
Farmland factors
Sustainability

ABSTRACT

The study contributes to the knowledge base on agricultural extension, specifically examining the potential influence of selected farmland factors on the sustainability of agroforestry practices among farmers, with a particular focus on landholding patterns in Tharaka Nithi County. The research used stratified sampling to select a representative sample of 400 respondents from the target population of 85,675 farmers. A peer-reviewed semi-structured questionnaire was used to collect data. The probit regression model was used to address the research question on the likely influence of farmland factors on the sustainability of agroforestry practices, using Stata version 15. The study revealed significantly higher sustainability of agroforestry practices among farmers with formal land titles (Coef. = 1.104, p = 0.007) and those who adopted a high number of nutrient management practices (Coef. = 0.679, p = 0.001). Additionally, natural features on a farm, such as wetlands, rock outcrops, hills, or uneven topography, significantly and negatively affected the adoption and sustainability of agroforestry practices (Coef. = -0.239, p = 0.038). On the contrary, other farmland factors, including infrastructure around the farm, soil quality perception, farm nature, and terrain type, were found to be statistically insignificant for the sustainability of agroforestry ($p > 0.05$). Therefore, the adoption and sustainability of agroforestry practices were mainly influenced by landholding structures and tenure security. To promote the efficient adoption and sustainability of agroforestry practices, the government should implement land reforms that secure land tenure and facilitate land consolidation.

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INTRODUCTION

Agroforestry sustainability, which involves economic, environmental, and social indicators, plays a pivotal role in conserving resources and enhancing long-term agricultural productivity (Awazi and Tchamba, 2019). As used in this study, environmental sustainability relates to tree diversity and improvements in soil fertility, economic sustainability encompasses income stability and diversification, and social sustainability involves farmers' perceptions and household food security. (Raj et al., 2019). Traditionally, agroforestry systems integrate crops, trees, and livestock, promoting soil structure, enhancing biodiversity, and improving carbon sequestration (Fahad et al., 2022). Sustainability of agroforestry farming systems enables mitigation of climate change effects through the reduction of greenhouse gas emissions and increased resilience against extreme weather variability (Bogale and Bekele, 2023). In areas where farmland is under intensive farming and land fragmentation is prevalent, the benefits of agroforestry practices are crucial for farmers (Asare-Nuamah et al., 2025). Agroforestry practices promote farmers' income diversification by reducing their over-dependence on single crops, thereby enhancing their economic growth (Raj et al., 2019). The incorporation of timber species that enhance crop productivity and fruit trees provides an additional stream of revenue, thus increasing the economic sustainability of farmers (Aleru et al., 2020). Additionally, sustainable agroforestry practices naturally enhance soil fertility and pest control, reducing the need for costly chemical inputs and lowering production costs, thereby improving long-term profitability (Fahad et al., 2022). Therefore, promoting agroforestry sustainability is both imperative for the environment and a socio-economic necessity (Mukhlis et al., 2022).

Sustainability of agroforestry farming systems in developed countries has increasingly gained momentum, although their adoption is not evenly distributed (Sollen-Norrlin et al., 2020). Many European and North American countries have incorporated agroforestry into their agricultural and environmental policies, recognizing its role in mitigating climate change and promoting sustainable land use management (Santiago-Freijanes et al., 2021). Notably, in its policies to encourage biodiversity and reduce carbon emissions, the European Union's Common Agricultural Policy (EUCAP) has included incentives for farmers practicing alley cropping and silvopasture systems (Santiago-Freijanes et al., 2021). However, despite policy support, the uptake of these practices often varies across regions due to limited technical knowledge, awareness, and economic constraints among farmers (Sollen-Norrlin et al., 2020). Although there is evidence of growing support for farmers engaging in agroforestry, large-scale industrialized farming dominates most regions of developed countries (Sollen-Norrlin et al., 2020). This limited adoption is constrained by biophysical factors, resource constraints, market incentives, and restricted access to extension services, which pose challenges to the broad adoption of agroforestry as a sustainable alternative (Jara-Rojas et al., 2020; Santiago-Freijanes et al., 2021). In Sub-Saharan African countries, agroforestry practices have been widely recognized as a pivotal approach to addressing challenges of food insecurity, climate change, and land degradation (Bogale and Bekele, 2023). The majority of farmers have adopted practices such as intercropping trees with food crops due to the economic and ecological benefits the system offers (Mthembu et al., 2019). In recent years, the sustainability of agroforestry has been promoted by NGOs and governments through initiatives such as farmer-managed natural regeneration (FMNR) and the Great Green Wall (GGW), aiming to restore degraded farmlands and improve agricultural productivity (Odisi Netaji et al., 2023). However, recent studies have highlighted the limited adoption of agroforestry practices in Sub-Saharan African countries, attributed to inadequate extension services, weak institutional frameworks, restricted market access, and characteristics of farmland (Muthee et al., 2022).

In Eastern Africa, there is growing attention to agroforestry farming due to its potential to combat the effects of climate change, reduce food insecurity, and mitigate land degradation (Yirga, 2019). These countries have incorporated various initiatives into their environmental and national agricultural policies, such as the African Forest Landscape Restoration Initiative (AFR100), which aims to restore degraded land by promoting agroforestry practices (Bastin et al., 2019). Although these strategies are encouraging infield agroforestry practices, they still largely depend on community engagement, local capacity, and donor support (Mbunda and Ndunguru, 2025). For instance, World Agroforestry-led initiatives and Community-based programs, such as Farmer-Managed Natural Regeneration (FMNR), have proven success in scaling up sustainable practices and increasing farmer participation (Islam et al., 2025).

In Kenya, especially in Tharaka-Nithi County, there is growing traction for sustainable, climate-resilient practices, such as agroforestry (Keprate et al., 2024). There is a notable increase in yields of about 65% resulting from agroforestry training programs such as fruit-tree integration, alley cropping, and the use of Faidherbia albida (Sileshi et al., 2021). Additionally, several initiatives and campaigns are ongoing, such as Farmer-Managed Natural Regeneration (FMNR), which aim to restore degraded farmlands, support soil and water conservation, and boost biodiversity (Chesire et al., 2025). These initiatives have helped farmers monetize carbon removal units (CRUs), generate income, and improve soil health by reducing inorganic fertilizer use by

20%–40% and increasing organic matter by 30%–50% (Mwaura, 2021).

The extent to which agroforestry enhances long-term economic, environmental, and social benefits is primarily determined by farmland factors (Plieninger et al., 2020). Farmland factors used in this study include structural (land size, tenure security, fragmentation) and biophysical (soil fertility, slope, rainfall), which influence farmers' ability to adopt and sustainably maintain combinations of trees and crops (Sollen-Norrlin et al., 2020). Farmland factors directly affect the economic viability, environmental performance, and social benefits that constitute the sustainability of agroforestry practices by defining land allocation, species suitability, and management intensity (Raj et al., 2020). Studies have shown that to ease existing strains on forest resources, sustainable agroforestry systems are vital and rely heavily on factors on farmland, such as secure land tenure, continued financial support, land size, and community engagement (Awazi, 2024). Research has shown that poor land tenure policies, lack of technical training for farmers, and deforestation often compromise the sustainability of these practices (Tesfaye et al., 2022). A recent study has also demonstrated that the wider spread adoption of sustainable agroforestry practices is deterred by the high cost of inputs, insecure land rights, low market returns, and limited access to credit (Mugambi et al., 2024). Despite the ecological, economic, and environmental solutions that agroforestry is recognized for offering (Santiago-Freijanes et al., 2021), its adoption and sustainability remain limited. Therefore, understanding the correlation between farmland factors and agroforestry sustainability is essential for designing timely interventions that strengthen agroforestry and achieve outcomes for farming communities (Castle et al., 2021). This study therefore focused on the potential influence of farmland factors on the sustainability of agroforestry practices among farmers.

Theoretical Framework

The study was grounded on the Theory of Sustainable Livelihoods Framework (SLF) (DFID, 1999). The Theory examines how natural and physical factors influence farmers' ability to adopt and sustain farming practices. Farmland characteristics, such as land tenure, soil fertility, and land size, act as natural and physical assets that influence farmers' willingness and ability to make long-term investments, including adopting agroforestry systems. The Theory also considers financial, human, and social capital, which interact with physical conditions to influence farmers' decisions (DFID, 1999). As such, farmers' skills, knowledge, and networks interact with farmland characteristics, significantly shaping their decisions on agroforestry management (Lin et al., 2021). Although farmers may be facing biophysical challenges in their farmlands, innovations and extension support can determine the extent to which farmland factors influence the sustainability of agroforestry practices (Bayisa et al., 2025). Additionally, livelihood benefits associated with agroforestry sustainability, such as food security and increased income, also motivate farmers to mobilize available resources to sustain these practices (Kuyah et al., 2020).

METHODOLOGY

This research was conducted in Tharaka Nithi County, Eastern Kenya. The study utilized a stratified sampling procedure to choose a representative sample of 400 from the target population of 85,675 (Krejcie and Morgan, 1970). Stratified random sampling was used because the target population was stratified by location (wards). Therefore, the fifteen wards in the county constituted the strata. Before data collection, the research instrument's validity and reliability were checked. The instrument's reliability was assessed using Cronbach's alpha, yielding coefficients greater than 0.60, the minimum recommended alpha level (Peterson, 1994). To measure the sustainability of agroforestry practices, 5-point Likert-type questions were developed based on three leading sustainability indicators: economic, social, and environmental. Respondents were requested to rate their level of agreement with the statements in the questions, ranging from 1 = Strongly disagree, 2 = Disagree = Neutral, 4 = Agree,5 = Strongly agree. The numerical value in the responses was used to calculate the mean scores for the environmental, economic, and social sustainability indicators individually, and then the overall sustainability dimensions for the three indicators were calculated. This approach helped, in a quantifiable way, to assess farmers' perceptions of agroforestry sustainability.

Descriptive statistics, including frequency, percent, mean, and standard deviation, were used to describe the data. A probit model was used to examine the effects of selected farmland factors on the sustainability of agroforestry practices. The model specification was as follows.

$$Y^*_i = X_i \beta + U_i \quad \ldots\ldots\ldots\ldots\ldots\ldots 1$$

Where:
Y^*_i = i represents the sustainability of agroforestry practices (dependent variable), whose data will be collected on a Likert scale, β=is a vector of the predictor variable (independent variables), and U_i =is the random error term distributed generally with unit variance.

RESULTS

This research collected data from 400 selected farmers, which was used to describe the farmers' characteristics and address the research question.

Farmers Demographic Characteristics

Demographic characteristics were examined to help describe the respondents. Table 1 shows the distribution of the sampled farmers by demographic characteristics.

Table 1. Farmers' Demographic Characteristics (*N* =400).

Variable	Freq.(*f*)	Percent. (%)
Gender		
Female	129	32.2
Male	271	67.8
Age(blanket)		
20-30 yrs	17	4.3
31-40 yrs	37	9.2
41-50 yrs	190	47.5
51-60 yrs	128	32.0
61 and above	28	7.0
Education level		
None	16	4.0
Pry school	51	12.7
Secondary school	83	20.8
Certificate	82	20.5
Diploma	56	14.0
Bachelors	86	21.5
Master's degree	20	5.0
Doctorate	6	1.5
Farm size (in acres)		
<1	18	4.5
2–3	205	51.3
3–5	161	40.3
Above 5	16	4.0
Ownership status (title deed)		
Yes	352	88.0
No	48	12.0

Table 1 shows that male respondents were the majority (67.8%), possibly because men headed most households, a cultural practice among the Ameru people that prevents women from owning land, heading a family, and making farm decisions. The majority of the farmers involved in agricultural practices were middle-aged between 41–50 years (47.5%) and 51–60 years (32%). This could be attributed to their ability to acquire land through purchase or inheritance, since farmers at this age are grown-ups with employment or businesses, and thus able to participate in farming activities. Young people aged 20-30 (4.3%) were involved in farming. Low youth participation in agriculture could be attributed to their limited ability to acquire farming resources, such as land and inputs, since at this age, many are college and university students with no employment or businesses. The results also indicated that the majority of farmers (60%) had attained secondary education or higher. This formal education background is essential for farmers practicing modern farming practices and innovations. Farmer education is key to the acquisition and uptake of agricultural technologies, as this requires knowledge and skills.

The majority of farmers (51.3%) owned farms ranging from 2–3 acres, while 40.3% owned farms ranging from 3-5 acres, suggesting that many were small-scale farmers.

Land fragmentation and subdivision, especially during inheritance, could have contributed to the small acreage, affecting not only the size of production but also the adoption and sustainability of agroforestry practices. Since many of the farmers were middle-aged, most of them owned the land with title deeds (88%). Permanent ownership of land is vital, as farmers can easily plan for the long term on their farms, such as through agroforestry. Farmers operating on leased land or without title deeds are reluctant to make permanent investments in the land. Therefore, the adoption of practices such as agroforestry is likely to be affected by the land tenure system.

Perceived Sustainability of Agroforestry Practices

Farmers' perceptions on the sustainability of agroforestry practices were examined using Likert-type scaled items. According to the scale, 1 represented 'not sustainable', 2 represented 'less sustainable', 3 represented 'moderately sustainable', 4 represented 'sustainable', and 5 represented 'highly sustainable'. Table 2 presents farmers' perceptions of the sustainability of agroforestry practices.

Table 2. Farmers' Perception about Sustainability of Agroforestry Practices.

Sustainability of agroforestry practices	*M*	*SD*
Sustainability of windbreaks	2.94	0.97
Sustainability of riparian forest buffers	3.93	0.53
Sustainability of alley cropping	3.54	0.82
Sustainability of forest farming	4.01	0.59

Note: [a]1=not sustainable, 2 =less sustainable, 3= moderately sustainable, 4 =sustainable, 5 =highly sustainable

As shown in Table 2, among the agroforestry practices used by farmers, forest farming was perceived as highly sustainable by the majority (M = 4.01, SD = 0.59). This could be attributed to farmers' strong consensus on its long-term viability, as well as the ease with which forest trees can be integrated into existing farming practices, thereby offering a continuous source of income. Forest farming also provides a wide range of ecological and economic benefits to farmers, helping protect crops from strong sunlight and providing fodder for animals during dry spells. These visible benefits directly influenced farmers' livelihoods, especially during periods of inadequate rainfall, helping them sustain crops. Since most residents depended on agriculture for sustenance, they would see forest farming as a highly sustainable practice. Forest farming offers diverse income benefits to farmers through the production of posts and timber, medical crops, and fruits and nuts. These numerous and varied benefits make the forest systems more viable than other agroforestry practices.

A majority of farmers also felt that riparian forest buffers (M = 3.93, SD = 0.53) and alley cropping (M = 3.54, SD = 0.82) were moderately sustainable. These practices played a key role in water management and soil erosion control, and this, in turn, led to increased crop production through soil conservation, especially for farmers on steep slopes. Adoption and sustainability of this practice were also easy; hence, farmers would practice it as they may not require complex management skills. The riparian buffers also helped stabilize stream banks with root systems, filter water pollutants and sediments from runoff, improve water quality, and provide habitat for aquatic and terrestrial wildlife. In contrast, windbreaks were perceived as less sustainable (M = 2.94, SD = 0.97) as most farmers preferred alley cropping to windbreaks. These farmers may not have maintained windbreaks and alley cropping, as agricultural land has been on the decline due to subdivision and fragmentation.

Farmers' Perceived Benefits of Sustainable Agroforestry Practices

To assess the benefits of agroforestry practices, farmers were given a set of Likert-type items and asked to indicate their level of agreement with each statement. According to the scale, 1 represented 'strongly disagreed', 2 represented 'disagreed', 3 represented 'neutral', 4 represented 'agreed', and 5 represented 'strongly agreed' as presented in Table 3.

According to the study, farmers reported a strong sense of satisfaction that consolidated landholdings offered a more conducive environment for the adoption and maintenance of agroforestry systems than subdivided land (M = 3.98, SD = 0.48). Consolidated land is often associated with efficient land planning, which could facilitate the easier integration of trees with crops and animals without compromising productivity. Farmers with fragmented landholdings could have faced difficulties in managing both tree and crop space simultaneously. Similarly, farmers with partitioned plots reported greater difficulty in adopting and sustaining agroforestry practices (*M* = 3.71, *SD* = 0.74), further supporting the importance of land consolidation initiatives and land-use planning. The farmers also noted that adopting agroforestry practices helped them manage risks associated with climate change, such as reducing greenhouse gas emissions (*M* = 3.61, *SD* = 0.80). Agroforestry systems provide numerous benefits, including improving soil health and resilience (*M* = 4.00, *SD* = 0.55), backup during crop failure (*M* = 3.99, *SD* = 0.64), offering alternative income (*M* = 3.77, *SD* = 0.79), and stabilizing farm income throughout the year (*M* = 4.00, *SD* = 0.61).

Farmland Factors and Sustainability of Agroforestry Practices

A probit model was used to determine if farmland factors can influence the sustainability of agroforestry practices. Table 4 presents the probit regression model results.

Table 3. Farmers' Perceived Benefits of Sustainable Agroforestry Practices.

Farmers' perception	M	SD
Consolidated land promotes agroforestry more than subdivided land	3.98	0.48
Agroforestry practices reduce GHGs and boost productivity	3.61	0.80
Agroforestry improves soil health and resilience to extreme weather	4.00	0.55
Partitioned plots of land pose a challenge to agroforestry sustainability	3.71	0.74
Agroforestry trees provide a backup during crop failure	3.99	0.64
Agroforestry trees offer an alternative income through fruit and timber	3.77	0.79
Diversified cropping stabilizes farm income throughout the year	4.00	0.61

Note: [a]1=strongly disagreed, 2 =disagreed, 3= neutral, 4 =agreed, 5 =strongly agree

Table 4. Probit Regression on Farmland Factors and Sustainability of Agroforestry Practices.

Farmland Factors	Coef.	St.Err.	p-value	Sig
Type of terrine	-.25	.493	.612	
Soil quality perception	-.576	.44	.191	
Infrastructure around the farm	.169	.291	.56	
Market distance	-.164	.242	.499	
Weather condition	.523	.261	.045	**
Title deed	1.104	.411	.007	***
Nature of the farm	-.071	.198	.721	
Natural features on a farm	-.239	.115	.038	**
Type of soil	.492	.268	.047	**
Reason for farming	.292	.158	.064	*
Number of nutrient management	.679	.195	.001	***
Land ownership	.284	.146	.052	*
Type of farmer	.45	.231	.052	*

Mean dependent var 3.464; SD dependent var 0.758; Number of obs 401; Chi-square 72.209; Prob > chi2 0.033; Akaike crit. (AIC) 910.036 **** p<.01, ** p<.05, * p<.1*

As shown in Table 4, the results indicated that land titles (*Coef.* = 1.104, *p* = 0.007), number of nutrient management practices adopted by famers (Coef. = 0.679, *p* = 0.001), weather conditions (coefficient = 0.523, *p* = 0.045), natural features on a farm (*Coef.* = -0.239, *p* = 0.038), and soil types (*Coef.* = 0.492, *p* = 0.047) sustained agroforestry practices among the famers. However, the reasons for farming (*Coef.* = 0.292, *p* = 0.064), type of farming system (*Coef.* = 0.450, *p* = 0.052) had no significant influence on the sustainability of agroforestry practices. On the same note, infrastructure around the farm, farmers' perceptions of soil quality, the nature of the farmland, market distance, and terrain type had no significant influence on the sustainability of agroforestry practices.

DISCUSSION

The main objective of this research was to determine the perceived influence of farmland factors on the sustainability of agroforestry practices. The study found that farmers with formal land titles sustained agroforestry practices more positively (*Coef*. = 1.104, *p* = 0.007). This could be due to farmers' confidence and their right to land and tree ownership, guaranteeing them profits from long-term agroforestry investment. Agroforestry trees can take more than 3 years before farmers can start reaping their benefits, so most farmers feel insecure about investing in agroforestry on leased land. In concurrence, Mugure et al. (2023) reported a statistically significant positive correlation between land tenure security and the adoption of agroforestry practices among farmers in rural areas.

The study revealed a significantly higher sustainability of agroforestry practices among farmers who adopted a high number of nutrient management practices (Coef. = 0.679, *p* = 0.001). Adopting nutrient management practices generally improves soil health and drainage, enabling farmland to support a wide range of agroforestry tree varieties. Nutrient management practices, such as mulching, biochar amendments, conservation tillage, and the use of leguminous cover crops, could also increase water retention and reduce high-rate evaporation, hence supporting the sustainability of fruit trees in dry areas.

Weather conditions, such as stable temperatures and optimal rainfall, were also significant positive predictors of agroforestry sustainability (coefficient = 0.523, *p* = 0.045). This suggested that farmers in areas receiving consistent, adequate annual rainfall invested more in agroforestry practices than those in lower regions of the county. The lower parts of the county experience extreme temperatures at certain times of the year, while the upper part is closer to Mt Kenya, which makes it a bit cooler. The cool climate favors the growth of a variety of tree species within the cropping and livestock production systems. However, agroforestry systems can be resilient to weather variability, especially when climatic conditions are favorable, increasing farmers' chances of reaping the benefits of soil conservation, carbon sequestration, and higher crop yields (Pancholi et al., 2023).

The study also found that natural features on a farm, such as wetlands, rock outcrops, hills, or uneven topography, had a significant adverse effect on adoption and sustainability of agroforestry practices (*Coef*. = -0.239, *p* = 0.038). This could be due to these features limiting the arable land, complicating management practices, and reducing overall land usability, thereby posing a challenge to farmers in integrating agroforestry into their farming systems. The findings also showed that soil types (*Coef*. = 0.492, *p* = 0.047) had a significant positive influence on the sustainability of agroforestry practices. This is because different soil types are suitable for the growth of specific tree species. Some trees will perform well in clay soil while others will do better in sandy or loamy soils.

Reason for farming (*Coef*. = 0.292, *p* = 0.064), type of farming system (*Coef*. = 0.450, *p* = 0.052) had an insignificant potential influence on the sustainability of agroforestry practices. The study found that land-use decisions are not likely to affect the adoption and sustainability of agroforestry practices. Farmers producing crops for commercial purposes had the same chance of using the practices as those engaged in subsistence farming.

Infrastructure around the farm, such as roads, schools, and hospitals, had no significant influence on the adoption and sustainability of agroforestry farming systems ($p > 0.05$). These suggest that farmers' decisions on the type and variety of agroforestry to invest in are independent of external physical infrastructures. As such, although rural infrastructure is essential for rural development, the long-term sustainability of agroforestry farming systems largely depends on on-farm factors such as farmland management practices, farmers' knowledge, and ecological functions.

Farmers' perceptions of soil quality were found to be an insignificant determinant of agroforestry sustainability ($p > 0.05$). This is because agroforestry farming has a substantial influence on soil health by incorporating organic matter and promoting nitrogen fixation. Therefore, even in areas where farmers perceive their soils as infertile, this does not prevent them from adopting agroforestry systems, as they help reclaim degraded farmland and increase production. This aspect of agroforestry farming systems motivates farmers to practice it across a wide range of landscapes as a sustainable farming option.

The nature of the farmland, whether scattered parcels, consolidated, fragmented, or partitioned plots, was statistically insignificant to the sustainability of agroforestry farming systems among farmers ($p > 0.05$). These indicate that the sustainability of agroforestry systems can be tailored to diverse farm structures, yielding achievable outcomes regardless of land type. By applying appropriate land management practices, suitable agroforestry systems can be integrated with livestock or crops, in either consolidated or scattered plots, without compromising their sustainability. This aligns with studies by Plieninger et al. (2020), which show that agroforestry sustainability can be enhanced, even on small landholdings or in fragmented landscapes, by maximizing land efficiency and ecological adaptability. On the other hand, market distance was not correlated with the sustainability of agroforestry practices ($p > 0.05$). This means that farmers in remote areas can sustain agroforestry systems, as well as those close to commercial market centers, if only agroecological principles are appropriately applied. Although market distance can influence the potential commercialization of agroforestry products, it does not hinder the sustainability of these systems (Keprate et al., 2024). The study showed that terrain type had no inherent adverse effect on agroforestry sustainability ($p > 0.05$). These were attributed to the ability of agroforestry systems to fit into various settings, such as terracing and contour planting, thereby promoting water retention and enhancing essential sustainability functions. These can be practiced on both flat and hilly terrain, demonstrating the applicability and sustainability of agroforestry farming systems across a wide range of terrain where other farming systems may not be successful.

CONCLUSIONS

This study's findings demonstrated that tenure security (e.g., title deeds), adoption of nutrient management practices, weather conditions, and soil type significantly influenced the adoption and sustainability of agroforestry practices among farmers. This finding aligns with trends observed in other developing regions, such as Africa and Asia, indicating that favourable soil conditions, secure land tenure, stable weather patterns, and effective nutrient management are vital for the sustainability of agroforestry systems. On the other hand, reasons for farming, farm infrastructure, farmers' perceptions of soil quality, the nature of the farmland, market distance, and land terrain did not influence the sustainability of agroforestry farming systems. Therefore, promoting soil and nutrient management, strengthening land rights, and supporting climate-resilient practices should be prioritized for enhancing the sustainability of agroforestry locally and in other developing regions.

The government, through the Ministry of Agriculture, should ensure that farmers have tenure security to enable them to invest in sustainable land management practices, such as agroforestry. The government should also raise awareness among farmers about the role of land fragmentation in ecosystem degradation and how agroforestry can mitigate these impacts. Climate-smart practitioners should raise awareness among farmers through training on the importance of adopting nutrient management practices to encourage widespread adoption and sustain agroforestry practices.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the farmers who provided the data necessary for this research.

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