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Determinants of Agro-Ecological Practices Application among Self-Help Group Farmers in Makueni County, Kenya

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ABSTRACT

Purpose: The study aimed at investigating the determinants of agro-ecological practices application among self-help group farmers in Makueni County, Kenya. The study specifically examined the effect of information source, motivation, accelerator and barrier factors on agro-ecological practices application in Makueni County, Kenya.

Methodology: Quantitative research approach and cross-sectional descriptive design was employed in the study. Crop growing farmers of 30 self-help groups were reached out as the target population of the study. A sample size of 163 respondents from 280 targeted farmers of self-help groups was obtained through stratification and proportionate sampling technique.

Findings: The findings of the study revealed that access to information (B = 0.978, SE = 0.437, Wald = 4.999, $p = .025$), with an odds ratio of 2.659, accelerator (B = 2.080, SE = 0.773, Wald = 7.240, $p = .007$), with an odds ratio of 5.655 and motivation (B = 2.728, SE = 0.525, Wald = 27.007, $p < .001$), with an odds ratio of 7.417, factors significantly affect agro-ecological practices application. Additionally, the study revealed that barriers (B = -2.752, SE = 0.732, Wald = 14.132, $p < .001$), with an odds ratio of 0.064 significantly reduce application probability.

Unique Contribution to Theory, Policy and Practice: The need to design context-specific mitigation strategies for barriers to agro-ecological practices application necessitated this dual focus study that enhances agro-ecological transitions' effectiveness and informs policy frameworks to strengthen sustainable agriculture. Reflects on determinants of agro-ecological practices application in arid and semi-arid areas in order to incorporate local innovations and indigenous farming practices in agricultural development. Hopefully, the goal is to inform county-level agricultural policies and assist customize interventions by NGOs and government agencies supporting sustainable farming. The study advances for prioritization of the development of integrated intervention models that improve information accessibility to crop growing farmers, strengthen motivational and accelerator factors like training programs, incentives and farmer networks.

Keywords: *Agro-Ecological practices, Determinants, Farmers, Self-Help, Sustainability, Kenya*

INTRODUCTION

In the current global context of food insecurity, climate change, and biodiversity loss, agro-ecological practices have emerged as sustainable alternatives to conventional agriculture. Agro-ecological practices have been defined as the application of social and ecological principles in designing and managing sustainable agricultural management systems (Food and Agriculture Organization of the United Nations, n.d.). Agro-ecology is both a science and a social movement that optimizes interactions between living organisms like animals, plants, and humans, and the environment, while encouraging socially equitable food systems (Wezel et al., 2009). Agro-ecology consists of integrated pest management, crop diversification, organic fertilization, and agro-forestry aimed at improving biodiversity, climate resilience, and soil health. Cultural attitudes, ecological awareness, access to knowledge, policy support, and market incentives have been reported as factors that affect the application of agro-ecological practices in most regions in the world (Ministry of Agriculture and Livestock Development, 2024).

Examining determinants of agro-ecological practices application is a critical issue in agricultural development, as these factors have an influence on the pace and success of transforming sustainable farming systems. Agro-ecology has been linked to food security, biodiversity protection, and mitigation of climate change (Food and Agriculture Organization of the United Nations, 2018). Agro-ecology practices such as agroforestry, crop diversification, and organic fertilization have been reported to promote food security, improve soil health, and climate resilience in arid and semi-arid areas of the world (International Fund for Agricultural Development, 2022). Although agro-ecological practices have immense benefits, their global adoption and application remain uneven because of many factors, including limited institutional support, information inaccessibility, fragmented policies, and a lack of integrated frameworks that can incorporate ecological goals in agricultural development. This gap calls for localized strategies that take into account the socio-cultural and economic contexts to enhance agro-ecological innovations utilization and thus promote sustainable agricultural development.

In Africa, agro-ecology has become a solution to declining soil fertility, climate vulnerability, and land degradation (Food and Agriculture Organization of the United Nations, 2021). Behavioral intention, expected performance, and social influence have been linked to agro-ecological practices adoption (Sidibé et al., 2024). Africans integrate traditional knowledge with ecological principles to improve sustainability, food security, and climate resilience. Organic fertilization, integrated pest management, agroforestry, and crop diversification are customized to local contexts to restore soil, reduce dependency on external inputs, and climate adaptation (Intergovernmental Panel on Climate Change, 2022). The application of agro-ecological practices has become an issue in African agricultural development, as it affects the ability of the continent to transition to sustainable and resilient food systems. The application of these agro-ecological practices is limited due to unsupportive policy regimes, market barriers, and limited access to information.

Furthermore, despite recognition of agro-ecology as a transformative potential by the African Union and PAFO (African Union & Pan-African Farmers' Organization, 2022), its implementation remains slow. This has been attributed to many factors, including resource constraints, access to information, lack of coordinated action, accelerator and motivation factors.

Agro-ecology is gaining momentum in Kenya, particularly among smallholder farmers. Group membership, farmer education, perceptions of agro-ecology's economic benefits, and access to information regarding extension services have been linked to agro-ecology adoption in Kenya (Kithinji et al., 2025; Nabiswa et al., 2024). However, other factors such as climate vulnerability, lack of market access, and resistance to change are yet to be explored and their relative effect on agro-ecological practices in semi-arid and arid regions like Makueni County, Kenya. Although the National Agro-ecology Strategy of 2024 to 2033 aims at addressing these challenges through the promotion of ecological farming, biodiversity restoration, and support of agro-ecological businesses (Ministry of Agriculture and Livestock Development, 2024), there still exist gaps in transiting policy into practice, particularly in semi-arid and arid areas where infrastructure and institutional support are weak. Makueni County is one of such regions in Kenya that encounters challenges such as soil degradation, food insecurity, and erratic rainfall. Although Makueni County government has made efforts to outline a framework to promote sustainable practices like ecosystem restoration, agroforestry, and organic farming (Makueni County Government, 2023), there still exist limitations in the implementation of agro-ecological practices. It is upon this background that the study sought to examine determinants of agro-ecological practices application to bridge the gap between policy ambition and grassroots implementation.

LITERATURE REVIEW AND HYPOTHESES

Theoretical overview

The study utilized the Extended Unified Theory of Acceptance and Use of Technology (UTAUT) to understand the dynamics that shape farmers' behavior to apply agro-ecological practices. UTAUT, developed by Venkatesh et al. (2012), provides an explanation of how determinants such as effort expectancy, hedonic motivation, performance expectancy, social influence, and facilitating conditions influence the intention of an individual to actually use the technology. Although UTAUT was originally developed to explain acceptance of technology, it has successfully been adapted to agricultural contexts to capture the interactions between performance expectancy, social influence, effort expectancy, and facilitating conditions. UTAUT has become a valuable theory in agro-ecological practices studies as it provides structured ways of analyzing behavioral intention and actual application, particularly in terms of information accessibility, social influence, and perceived benefits. For instance, Sidibé et al. (2024) applied extended UTAUT in their study and found that social influence and performance expectancy affected behavioral intention, while perceived net benefit and facilitating conditions enabled the actual application. Similarly, a study of tea farmers in China indicated that perceived value mediates the link between performance expectancy and adoption (Xie et al., 2022). This has enhanced the explanatory power of the model. However, the UTAUT model has limitations to contextual and cultural dynamics such as land tenure systems, indigenous knowledge, and gender roles that are essential in making decisions pertaining to the application of agro-ecological practices. Furthermore, although UTAUT describes individual-level determinants well, it underrepresents combined action and institutional determinants that are very important in promoting agro-ecological transitions. To bridge this gap, the study integrated UTAUT with the Sustainable Livelihoods Approach to explain the complexity of rural innovation systems.

The Sustainable Livelihoods Approach (SLA) was first introduced by the Department for International Development (DFID) of the UK to explain and promote assets, activities, and capabilities that are needed for sustainable living amid the shocks and stresses (Department for International Development, 1999). SLA focuses on natural, financial capital, human, social, and physical asset categories as well as the wider institutional and environmental context in which livelihoods are pursued. Integrating SLA's asset-based framework with UTAUT's behavioral constructs enabled researchers to examine accessibility of farmers to livelihood assets that affect their perceptions and application of agro-ecological technologies. For instance, financial and physical capital were highlighted to shape performance and effort expectancy, while social capital shaped social influence, indicating a nuanced understanding of applying agro-ecological practices in a climate-vulnerable and resource-constrained context like Makueni County, Kenya. Furthermore, inclusion of more constructs like motivation, experience, and perceived value strengthens the applicability of the model in the agro-ecological contexts. Using the extended UTAUT framework enabled researchers to systematically examine how information accessibility, motivation, accelerator, and barrier factors shape the application of agro-ecological practices in a semi-arid and arid area like Makueni County. This not only enabled identification of key factors for agro-ecological practices application but also provided a predictive and explanatory lens via which sustainable agricultural development could be understood and accelerated.

Agro-ecological Practices Application

Agro-ecology entails integration of ecological principles into agricultural farming to enhance biodiversity, promote resilience and sustainability, while at the same time reducing the usage of fertilizers and pesticides (Food and Agriculture Organization of the United Nations, 2018). Agroforestry, organic soil management, crop rotation and diversification, as well as conservation tillage, are among the agro-ecological practices that are aimed at promoting sustainable agriculture development (Food and Agriculture Organization of the United Nations, 2021). Agro-ecological application methods have been linked to improved land productivity (International Panel of Experts on Sustainable Food Systems, 2016). Nevertheless, there exists varying yields in different crops and climates, and many studies have failed to specify the agro-ecology concept, hence skewing its scope. Few studies have highlighted measures of agro-ecological practices like organic soil management, agroforestry, crop diversification, recycling of nutrients and biomass, and integrated pest control (Biovision Africa Trust, 2023; Food and Agriculture Organization of the United Nations, 2018; International Panel of Experts on Sustainable Food Systems, 2016). These agro-ecological principles serve as benchmarks for assessing agro-ecological transitions and reducing overdependence on external inputs, fostering climate resilience and social equity.

Agro-ecological practices are increasingly becoming an alternative form of farming to conventional agricultural practices globally, yet their application varies across developed and developing countries. In developed countries, agro-ecology is framed in the context of organic and regenerative agriculture movements, and has immense institutional support, and consumers have created demand for its application (International Panel of Experts on Sustainable Food Systems, 2016). Nevertheless, large-scale monocultures and industrial farming are still prevalent in these developed countries, limiting the transition to agro-ecological systems. Furthermore, policy incentives favor conventional agriculture, hence limiting agro-ecological practices thriving in these developed nations. In Africa, agroecology is seen as a pathway to sustainable food production among smallholder farmers (Food and Agriculture Organization of the United Nations, 2019). Intercropping, composting, and agroforestry have been linked to high yields and climate resilience. Localized, diversified, and resource-efficient farming systems offer a pathway to sustainable food security (Michael et. al (2022). For instance, push-pull pest management systems in Kenya have minimized crop losses by 60% (International Centre of Insect Physiology and Ecology, 2021). Despite the policy progress in Kenya regarding agro-ecology systems, the application of agro-ecological practices remains fragmented and under-resourced, limiting their scalability.

Agro-ecology has increasingly gained interest as an alternative form of agriculture to conventional agriculture, particularly in climate-vulnerable areas. A study by Fan et al. (2025) synthesized 34 global studies on cropping systems like organic soil amendments, agroforestry, and intercropping, and utilized statistical modeling as well as ecological indicators, and found that diversified systems promote soil fertility and climate resilience. This study recommended the need for more integrated ecological designs to better understand multi-trophic interactions and sustainable productivity balance. Similarly, a study in North Africa covering Egypt, Morocco, Tunisia, and Libya through field surveys and literature synthesis, identified crop diversification and direct seeding as practices being applied in wheat-based systems (Boutagayout et al., 2023). Although Egypt and Morocco reported moderate application, Libya indicated low application because of limited institutional support and inadequate support in research. The study further reported on the exploration of allelopathic extracts and indigenous pest control, showing the need to localize experiments and share knowledge in local platforms. Embedment of agro-ecological principles into Kenyan national food systems through the National Agro-ecology Strategy (2024 to 20330) has seen farmers-led innovation and biodiversity conservation improve. This has positioned agro-ecology as a major factor in promoting food security and driving climate adaptation. Nevertheless, implementation challenges are imminent, especially in coordinating efforts across the diverse agro-ecological regions of Kenya.

Lindemann et al. (2024) utilized ethnographic methods and longitudinal case studies to examine agro-ecological transitions in Latin America and found that community-based approaches promoted food security, yielded stability, and enhanced biodiversity. The study further noted that limited market access for agro-ecological products and weak institutional support made it difficult for agro-ecology to thrive. The study recommended strong policy frameworks and the creation of regional knowledge centers to support transitions, particularly in vulnerable communities. Similarly, an experimental study on microbial diversity and nutrient cycling found that agro-ecological inputs had a significant effect on microbial richness and nitrogen retention in semi-arid plots in India and Ethiopia (Han et al., 2025). Nevertheless, this study failed to explore crop productivity and carbon sequestration, hence the need for multi-season trials and deeper ecological monitoring. Collectively, studies report dimensions of agro-ecological practices and indicate persistent gaps in institutional support, scalability, and long-term impact assessment.

Determinants of Agro-ecological Practices

Access to information has been linked to the adoption of agro-ecological practices. Farmers who are able to access context-specific agricultural knowledge, particularly via extension services and farmer groups, are in a good position to apply sustainable methods like integrated pest management, crop rotation, and organic fertilization (Biovision Africa Trust, 2023). Farmers interacting with active group membership and agricultural officers influence them to adopt agro-ecology (Chatterjee et al., 2021). Nevertheless, uneven dissemination of information, especially in rural areas, still remains a challenge. Limitations of digital access and under-resourced extension services have accelerated the challenge of uneven dissemination of information. Therefore, there is a need to examine inclusive communication channels that align with indigenous knowledge systems and their effects on agro-ecological practices.

Social networks, perceived economic benefits, and institutional support are some of the factors considered as accelerators (Kithinji et al., 2025). Application of UTAUT in Mali indicated that social influence and expected performance had a significant effect on the behavioral intentions of farmers to apply agro-ecological methods (Sidibé et al., 2024). Similarly, agricultural cooperatives and lead farmers as accelerators, facilitated peer learning and modelled successful practices (Nabiswa et al., 2024). Although market accessibility for agro-ecological products and accommodative policy environments act as accelerators, they are rarely applied in most regions. Coordination among NGOs, private actors, and government is needed to strengthen the accelerators and create an environment that is rewarding to ecological stewardship.

Motivation factors are linked to values, perceived risks, and experiences of farmers. In Mali, net benefit and expected effort had a positive effect on behavioral intention (Sidibé et al., 2024), implying that farmers feel motivated when they are convinced that agro-ecological practices are both rewarding and manageable. In Kenya, climate resilience, soil fertility, and reduced input costs have been reported as the key motivators (Biovision Africa Trust, 2023). Nevertheless, motivation wanes once the benefits are delayed or when high initial capital or intensive labor is required in applying agro-ecological practices (Khader, 2024). This, therefore, needs alignment of interventions with the livelihood goals of farmers and provides short-term benefits together with long-term ecological benefits.

Land tenure, labor intensity, insecurity, inadequate financial incentives, and the abandonment of agro-ecological practices once donor ends are among the major barrier factors reported in the adoption of agro-ecology (Biovision Africa Trust, 2023). In Mali, accessibility to tools and improved infrastructure were essential to use behavior, but many farmers were unable to get that support (Sidibé et al., 2024). Furthermore, cultural norms and skepticism about adopting non-conventional practices have become an obstacle (Biovision Africa Trust, 2023). To address some of these challenges, there is a need to understand the extent to which these barrier factors affect the adoption of agro-ecological practices.

In conclusion, few studies have hypothesized a relationship and effects between some determinant variables and the application of agro-ecological practices. Also, there is limited empirical evidence from the reviewed literature that has explored the effect of accelerators, motivation, access to information, and barrier factors on the application of agro-ecological practices. The current study proposes and explores the effect of these determinants on the application of agro-ecological practices in Makueni County, Kenya.

The conceptual model displayed in Figure 1 indicates a direct relationship between motivation, accelerator, access to information, barrier and agro-ecological practices application.

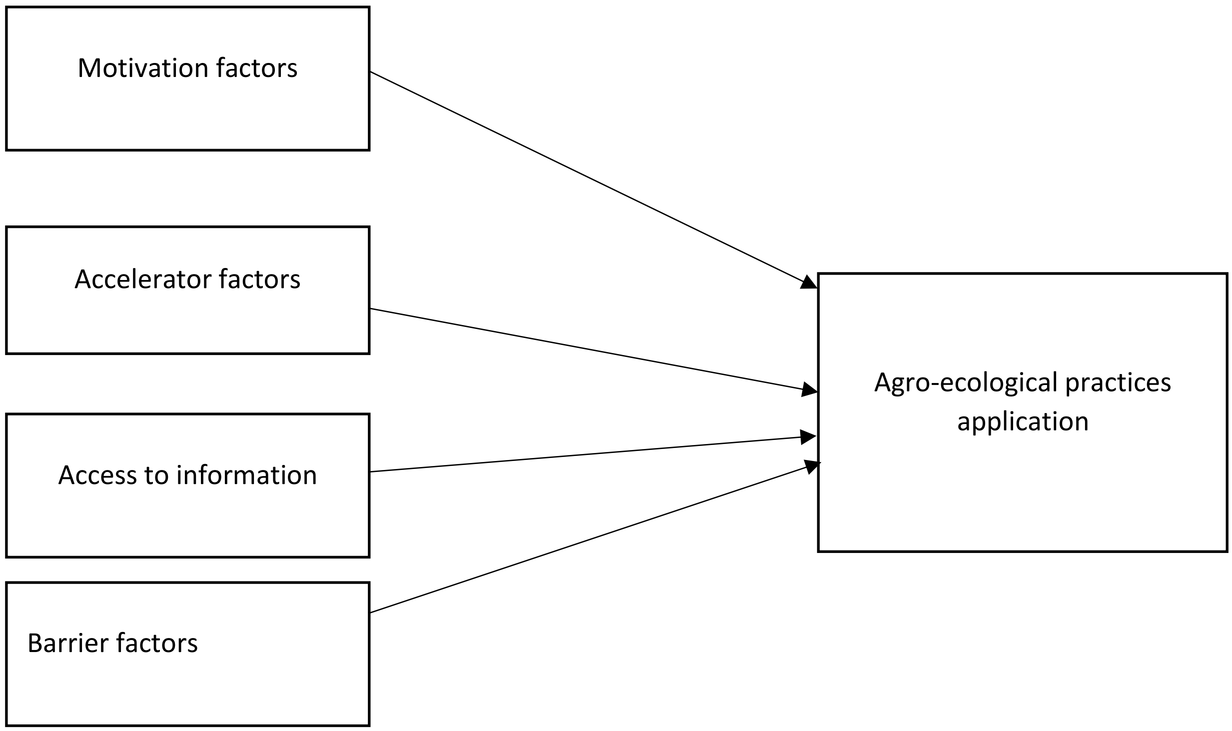

Figure 1 Conceptual Model

METHODOLOGY

A quantitative research approach and a descriptive cross-sectional design were utilized to collect data from crop-growing farmers in Makueni and Kibwezi East sub-counties of Makueni County, Kenya. A descriptive cross-sectional design gave an opportunity for data collection at a single point in time, protecting data and variable integrity and allowing analysis of relationships among the variables. A total of 280 farmers from 30 self-help groups were identified as the target population, with a sample size of 163 farmers chosen via stratification and proportionate sampling techniques. The selection was based on sub-county representation, and data were collected using a researcher-guided questionnaire designed to capture quantitative information.

Respondents were asked to complete a structured questionnaire with a 5-point Likert scale to measure the effect of motivation, access to information, accelerator, and barrier factors on agro-ecological practices in Makueni County, Kenya. The Likert scale quantified responses across defined percentage ranges, enabling large-scale data collection and promoting interpretive validity. A pretest of the questionnaire involved 20 participants who represented 10 percent of the sample. The pretest was conducted to test the validity and reliability of the questionnaire. Feedback from the pretest informed revisions to enhance the effectiveness of the instrument, and this ensured a robust collection of data for the main study.

Data Analysis

The collected data was analyzed quantitatively. The collected data were first edited, coded and entered into IBM SPSS 22 for regression analysis to examine determinants of agro-ecological practices application among farmers in arid and semi-arid areas.

RESULTS

Factors influencing the application of specific agro-ecological practices

The study sought to assess the factors influencing the adoption of specific agro-ecological practices in Makueni County, Kenya. The study utilized a simple binary logistic regression model to predict the binary outcome of adopting agro-ecological practices, whereby 1 for adoption of agro-ecological practices and 0 for absence as per the independent variables of access to information, motivation, accelerator, and barrier factors. Table 1 below indicates the binary logistic regression analysis to examine the influence of access to information (Ac), accelerator factors (CC), motivation (Mo), and barrier factors (Bo) on the application of agro-ecological practices (AGRO).

Table 1

Variables not in the Equation			Score	df	Sig.
Step 0	Variables	Ac	7.183	1	.007
		Mo	51.770	1	.000
		Bo	34.151	1	.000
		CC	9.359	1	.002
	Overall Statistics		74.382	4	.000

Table 1 reveals that access to information, accelerator, motivation, and barrier factors have a significant effect on the application of agro-ecological practices when they are taken into account individually. Motivation factors (Score = 51.770, $p < .001$) indicated a strong, significant effect on the application of agro-ecological practices, followed by barrier factors (Score = 34.151, $p < .001$). Access to information (Score = 7.183, $p = .007$) indicated the least effect on the application of agro-ecological practices among the farmers. Generally, the model (Chi-square = 74.382, df = 4, $p < .001$) had a highly significant effect, implying that predictors collectively contributed meaningfully to the application of agro-ecological practices.

Table 2 shows Omnibus Tests of Model Coefficients that confirm the significance of the full model with a Chi-square value of 89.979 (df = 4, $p < .001$). This implies that including all four predictors improved the model's fit significantly.

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Table 2 Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	89.979	4	.000
	Block	89.979	4	.000
	Model	89.979	4	.000

Table 3 shows a model summary with a -2 Log Likelihood of 121.026, and the pseudo R-squared values—Cox & Snell $R^2 = .424$ and Nagelkerke $R^2 = .584$. This implies that the model has a moderate to strong explanatory power in predicting the application of agro-ecological practices.

Table 3 Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	121.026[a]	.424	.584

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Table 4 indicates the Hosmer and Lemeshow test with a Chi-square of 9.746 (df = 5, p = .083), which is above the .05 threshold. This implies that there is a good fit between the observed and predicted values. Table 5 supported this by indicating close alignment between observed and expected frequencies across subcategories.

Table 4 Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	9.746	5	.083

Table 5 Contingency Table for Hosmer and Lemeshow Test

		AGRO = Not applied		AGRO = Applied		
		Observed	**Expected**	**Observed**	**Expected**	**Total**
Step 1	1	14	16.269	3	.731	17
	2	14	13.757	3	3.243	17
	3	18	14.977	10	13.023	28
	4	8	7.768	17	17.232	25
	5	1	.878	4	4.122	5
	6	2	2.447	33	32.553	35
	7	0	.904	36	35.096	36

Table 6 shows that access to information, motivation, accelerator, and barriers are all statistically significant. Access to information (B = .978, SE = .437, Wald = 4.999, p = .025), positively predicts application of agro-ecological practices. The odds ratio (Exp(B)) of 2.659 implies that farmers with greater access to information are 2.7 times more likely to apply agro-ecological practices. Similarly, motivation (B = 2.728, SE = .525, Wald = 27.007, $p < .001$) and accelerator (B = 2.080, SE = .773, Wald = 7.240, p = .007) had a positive effect on agro-ecological practices, with both factors indicating odds ratios of 7.417 and 5.655, respectively. On the contrary, barrier factors (B = -2.752, SE = .732, Wald = 14.132, $p < .001$) had a negative effect on the application of agro-ecological practices, with an odds ratio of .064, implying that higher barriers reduce the chances of applying agro-ecological practices significantly. Generally, the findings indicate that promoting access to information, motivation, and accelerator factors while reducing barriers would improve the application of agro-ecological practices among farmers.

Table 6 Variables in the Equation

		B	**S.E.**	**Wald**	**df**	**Sig.**	**Exp(B)**
Step 1[a]	Ac	.978	.437	4.999	1	.025	2.659
	Mo	2.728	.525	27.007	1	.000	7.417
	Bo	-2.752	.732	14.132	1	.000	.064
	CC	2.080	.773	7.240	1	.007	5.655
	Constant	9.169	1.779	26.558	1	.000	9599.129

a. Variable(s) entered on step 1: Ac, Mo, Bo, CC.

Discussion

Access to information, motivation, and accelerator factors have a significant and positive effect on the application of agro-ecological practices. On the other hand, barriers have a significant and negative effect on the application of agro-ecological practices. These findings corroborate with Rizzo et al. (2023), who reported that accessibility to information is a major driver for sustainable innovation application among farmers. Additionally, Ndaba et al. (2022) and Sachet et al. (2021) reported that farmers who were accessible to agro-ecological knowledge and extension services were in a better position to apply agro-ecological practices. Motivation is another essential factor, as indicated by the high odds ratio, and it corroborates with Newton et al. (2020) and Ferreira et al. (2022), who emphasized that intrinsic motivation, like long-term productivity goals and environmental concern, improves agro-ecological adoption. Furthermore, the present study findings agree with D'Amato et al. (2021), who reported that accelerators such as community networks and supportive policies enhance the application of agro-ecological practices.

Barriers become an impediment to the application of agro-ecological practices, as indicated by a negative coefficient and a very low odds ratio. The presence of barriers immensely reduces the chances of applying agro-ecological practices. This corroborates with Foguesatto et al. (2020), who found that innovation aversion, complexity, and lack of perceived control are the main obstacles to the application of agro-ecological practices. Similarly, Biovision Africa Trust (2023) reported that structural and individual barriers like inadequate capital, training, and limited access to land were the major challenges that hindered agro-ecology adoption. Collectively, these studies support the regression implications of the model that states that improving access to information, fostering motivation, and leveraging accelerators, while at the same time reducing barriers, would improve the application of agro-ecological practices.

The present study presents clarity of the statistical relationships between access to information, motivation, accelerator, barrier variables, and the application of agro-ecological practices. Although previous studies acknowledged the significance of access to information, motivation, accelerators, and barriers, the present model precisely quantifies their effect on the application of agro-ecological practices. High odds ratio displayed by predictor variables suggests a stronger predictive power compared to those reported in prior studies. In early studies, motivation was generally treated as a qualitative or secondary factor. Similarly, the barrier's negative effect on the application of agro-ecological practices is highly pronounced in the present study, implying a complete hindrance. This differs from previous studies, such as Foguesatto et al. (2020) and Biovision Africa Trust (2023), which described barriers broadly without providing specific statistical weight. Furthermore, including accelerators as a unique variable with a significant positive effect on the application of agro-ecological practices shows a more nuanced understanding of enabling conditions. In previous studies, accelerators were categorized under community support or general institutional support, and now, with its specificity in the current model, it enables the provision of a rigorous, data-driven model that both confirms previous work and sharpens it.

Theoretical implications

The study findings provide support and extend the application of the Extended Unified Theory of Acceptance and Use of Technology (UTAUT) within agro-ecology contexts while being grounded in the Sustainable Livelihoods Approach (SLA). The motivation and access to information in the present study indicated strong predictive power, hence aligning with UTAUT's constructs of performance expectancy and enabling conditions. This implies that the behavioral intention of farmers to apply agro-ecological practices is mainly influenced by the availability of support systems and perceived benefits. Including accelerators as a positive factor and barriers as a deterrent further improves UTAUT. Furthermore, integration of SLA provides clarity on how institutional support and structural challenges recognition enable technology acceptance. The dual-theory approach in the present study indicates that application of agro-ecological practices is not just a single function of an individual element but an embeddedness in socio-economic realities that requires an integrated framework in analyzing sustainable agricultural transitions.

Practical Implications

The present study provides actionable findings for policymakers, development agencies, and agricultural extension services aimed at developing agro-ecological practices. The strong effect of access to information and motivation indicates that interventions ought to prioritize creating awareness campaigns, educating farmers, and personalizing communications to improve perceived benefits and self-efficacy. The significant effect of accelerators on agro-ecological practices indicates the need for supportive infrastructure like subsidies, mentorship programs, and farmer cooperatives. This would create an enabling environment for the application of agro-ecological practices. On the other hand, the identified negative effects of barriers call for targeted efforts to solve the structural constraints such as land tenure insecurity, bureaucratic obstacles, and limited access to credit. Aligning program design with identified drivers and barriers would enable stakeholders in agriculture to effectively enhance sustainable agriculture and rural livelihoods.

Limitations and future research

Although the present study has provided strong statistical information, it has many limitations that require further research. Firstly, the study relied on cross-sectional data that only captures temporal dynamics and causal relationships in the application of agro-ecological practices. There is a need for future study that should take into account longitudinal designs and incorporate mixed methods to examine behavioral nuances deeply and expand the model by including more variables. Furthermore, the study overlooked other essential factors, like psychological or socio-cultural factors, that could provide more understanding of the topic. The sample size lacks diversity across agro-ecological zones in the country and the continent, hence its generalizability is limited. Thus, future studies should consider different contexts to enrich the understanding of the applicability of agro-ecological practices for diverse farming communities.

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