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# AGRO-ECOLOGICAL PRACTICES AND PRODUCTIVITY OF SMALL-SCALE CROP FARMING IN TAITA TAVETA COUNTY, KENYA

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## ABSTRACT

**Statement of the Problem:** Agro-ecological practices offer a sustainable approach to improving productivity and environmental resilience in small-scale crop farming systems, especially in resource-constrained regions. However, with increasing challenges such as soil degradation, unpredictable rainfall patterns, and declining yields, there is a growing need to evaluate alternative farming systems that align with ecological principles and farmer livelihoods.

**Purpose of the Study:** The study aimed to investigate the influence of agro-ecological practices on the productivity of small-scale crop farmers in Taita Taveta County, Kenya.

**Research Methodology:** The study adopted a descriptive cross-sectional design using stratified random sampling to select 380 small-scale farmers across the sub-counties of Taveta, Mwatate, Voi and Taita. Data was collected using structured questionnaires and analyzed using logistic regression to determine the relationship between agro-ecological practices such as intercropping, crop rotation, use of organic inputs, and soil moisture conservation and farm productivity indicators like yield per acre, net income, and crop diversification.

**Findings:** The findings reveal that farmers who consistently apply agro-ecological techniques experience significantly higher productivity compared to those relying on conventional inputs. Moreover, farmer characteristics such as training, experience, and access to extension services enhance the effectiveness of agro-ecological practices.

**Keywords**: *Agro-ecological practices, Small-scale farming, Productivity, Sustainable agriculture and Soil fertility*

## INTRODUCTION

Agro-ecological practices are increasingly recognized as viable pathways for achieving sustainable agricultural productivity, particularly among small-scale farmers facing environmental and socio-economic challenges. These practices encompass techniques such as intercropping, crop rotation, cover cropping, organic fertilization, and soil moisture conservation, all aimed at enhancing biodiversity, improving soil health, and reducing dependency on synthetic inputs. In the context of small-scale farming systems, agro-ecology aligns with the ecological processes already present in the environment and emphasizes the sustainable use of locally available resources. In Kenya, agriculture accounts for approximately one-third of the Gross Domestic Product (GDP) and is a critical source of livelihood for over 40 % of the population (KNBS, 2022). However, small-scale farmers in regions such as Taita Taveta County continue to face persistent challenges, including poor soil fertility, land degradation, unpredictable rainfall patterns, and low crop yields (Muindi et al., 2021; Nyamwena et al., 2021).

According to Kimaru-Muchai et al. (2022), practices like crop rotation, intercropping, and cover cropping help maintain soil fertility and control pests and diseases through natural means, reducing the need for chemical interventions. Mwangi et al. (2023) also highlight that agro-ecological practices contribute to improved resilience against climate variability, especially through methods such as mulching, conservation tillage, and organic soil amendments. These practices enhance soil structure, increase water infiltration, and retain moisture—critical in arid and semi-arid zones like Taita Taveta. The adoption of agro-ecological practices is closely linked to farmer awareness, training, and socio-economic factors. A study by Mutune et al. (2024) found that access to extension services, credit, and farmer education significantly influenced the uptake of climate-smart and agro-ecological farming practices in Taita Taveta County. Similarly, Kibwage et al. (2023) observed that while awareness of sustainable practices is growing, practical implementation remains limited due to knowledge gaps, financial constraints, and cultural factors.

Taita Taveta County is characterized by diverse agro-ecological zones, ranging from lowland dry areas to highland regions with relatively higher rainfall. Despite this diversity, crop farming is predominantly small-scale and largely dependent on seasonal rainfall. Key crops include maize, beans, vegetables, and fruits (CIDP, 2018). According to Kapoi (2022), many farmers operate on marginal lands with limited external inputs, which necessitates the adoption of

integrated and resource-efficient farming systems. The use of agro-ecological methods not only helps to improve productivity but also contributes to ecological restoration and long-term sustainability. By focusing on agro-ecological practices and their influence on productivity, this study seeks to generate empirical insights that inform sustainable farming policies and interventions in Taita Taveta County.

## STATEMENT OF THE PROBLEM

Small-scale crop farming is a vital pillar of food security, rural employment, and household income in Kenya. In Taita Taveta County, smallholder farmers cultivate a wide range of crops under challenging environmental and socio-economic conditions. However, despite its importance, productivity in this sector remains low and unstable due to factors such as soil degradation, erratic rainfall, limited access to quality inputs, and unsustainable land management practices (Nyamongo et al., 2021; Muindi et al., 2021). Traditional reliance on conventional farming approaches has often led to declining soil fertility, reduced biodiversity, and increased vulnerability to climate change. Agro-ecological practices offer a promising alternative to address these challenges by promoting environmentally sound, resource-efficient, and locally adapted farming systems. Techniques such as crop rotation, intercropping, use of organic inputs, and soil moisture conservation have the potential to improve soil health, enhance water retention, and increase yields sustainably (Kimaru-Muchai et al., 2022; Mwangi et al., 2023). However, the adoption of these practices in Taita Taveta remains limited and inconsistent.

While policy frameworks and environmental advocacy increasingly emphasize agro-ecology, there is a significant gap in empirical evidence linking these practices to improved productivity among small-scale farmers in the region. Studies such as those by Mutune et al. (2024) and Kapoi (2022) have examined the broader challenges affecting farming systems in Taita Taveta, yet few have focused specifically on agro-ecological methods and their measurable impact on productivity outcomes like yield, income, and crop diversity. Additionally, factors such as limited training, lack of extension support, and inadequate farmer sensitization have hindered the effective implementation of agro-ecological techniques (Kibwage et al., 2023).

Given the growing urgency to build resilient agricultural systems that can withstand environmental stresses and improve livelihoods, there is a pressing need to assess the actual contribution of agro-ecological practices to productivity in Taita Taveta County. Without such evidence, policymakers, development agencies, and farmers themselves lack the information

needed to make informed decisions about sustainable agricultural investments and interventions. The study therefore sought to fill this gap by examining the influence of agro-ecological practices on the productivity of small-scale crop farming in Taita Taveta County.

## RESEARCH OBJECTIVE

The objective of the study was to examine the influence of agro-ecological practices on the productivity of small-scale crop farming in Taita Taveta County.

## RESEARCH HYPOTHESIS

**$H_{01}$:** Agro-ecological practice does not significantly influence productivity of small-scale crop farmers in Taita Taveta County.

## THEORETICAL REVIEW

This study was underpinned by The Theory of Planned Behavior (TPB). TPB originated from the work of Icek Ajzen, who developed the theory in the late 1980s as an extension of the Theory of Reasoned Action (TRA) which he co-formulated with Martin Fishbein (Ajzen, 1991). The TPB was introduced to address the limitations of TRA by including perceived behavioral control as a critical factor influencing intentions and behaviors. Ajzen's theory posits that human action is guided by three kinds of considerations: behavioural beliefs (attitudes), normative beliefs (subjective norms), and control beliefs (perceived behavioural control). These components are interrelated and collectively shape an individual's behavioural intentions and actions (Ajzen, 1991).

The TPB stipulates that an individual's intention to perform a specific behaviour is determined by their attitude towards the behaviour, the subjective norms surrounding the performance of the behaviour, and the perceived behavioural control over the behaviour. Attitude refers to the degree to which a person has a favourable or unfavourable evaluation of the behaviour in question. Subjective norms involve the perceived social pressure to perform or not perform the behaviour, while perceived behavioural control refers to the perceived ease or difficulty of performing the behaviour, which is assumed to reflect past experience and anticipated obstacles. These three factors combine to influence behavioural intention, which directly affects actual behaviour (Ajzen, 1991; Wolde et al., 2022).

In the context of agroecological practices in agriculture, the TPB can be particularly useful for understanding and predicting the behavior of farmers regarding the adoption of these practices. For instance, farmers' attitudes towards agroecological practices are influenced by their beliefs

about the benefits and drawbacks of these practices (Yazdanpanah et al., 2022). If farmers believe that such practices lead to improved soil health and yield, their attitude will be positive, thereby increasing the likelihood of adoption. Subjective norms also play a critical role, as farmers are influenced by the opinions and behaviors of peers, family members, and agricultural extension agents. Moreover, perceived behavioral control is essential as it encompasses farmers' perceptions of their ability to implement these practices given their resources and knowledge (Yazdanpanah et al., 2022; Zhang et al., 2022).

The theory is applicable in this study as pertains agroecological practices. By examining farmers' attitudes towards agroecological practices, their perceived social pressures, and their perceived control over adopting such practices, researchers can predict the likelihood of adoption and its subsequent impact on productivity. This approach not only helps in identifying the barriers and facilitators of adopting sustainable practices but also aids in designing interventions that can positively influence farmers' intentions and behaviors towards agroecological practices.

**EMPIRICAL REVIEW**

Agroecological practices are increasingly recognized for their ability to sustainably manage agricultural landscapes while enhancing productivity and resilience. These practices, which integrate ecological principles into farming, aim to create a sustainable and equitable food system by promoting biodiversity, improving soil health, and reducing dependency on chemical inputs (IFAD, 2024). Agroecology's holistic approach addresses environmental, social, and economic dimensions, making it an effective strategy for sustainable agricultural development.

Recent studies have highlighted the positive impacts of agroecological practices on smallholder farmers' productivity and resilience. For instance, a study in Tanzania's Kilombero District showed that agroecological practices, such as intercropping and organic farming, significantly improved crop yields and farmer well-being. These practices contributed to better soil health and increased biodiversity, which in turn enhanced the farmers' capacity to adapt to climate change (Van der Ploeg et al., 2023). Similarly, research in North Africa demonstrated that no-till farming and crop rotation improved soil water retention and reduced erosion, leading to higher yields in semi-arid regions (Aboudrare et al., 2023).

Kimaru-Muchai et al. (2022) employed a longitudinal study design to investigate the effects of agroecological practices on farm biodiversity and crop resilience in eastern Kenya. Over a three-year period, they monitored 200 small-scale farms that had adopted practices such as

intercropping and crop rotation. Using multivariate analysis, they found that farms implementing these practices had 30% higher crop diversity and were 40 % more resilient to pest outbreaks compared to mono-cropping systems.

A comprehensive meta-analysis by Ndegwa et al. (2021) reviewed 50 studies on agroecological practices in sub-Saharan Africa. Their findings indicated that on average, farms using agroecological methods had 18% higher yields and 23 % lower production costs compared to conventional farming methods. The study also highlighted the positive impacts on soil health and biodiversity.

Wanjala et al. (2023) conducted a case study in the Mount Kenya region, observing that agroecological practices such as agroforestry and organic pest management improved soil fertility by 20% and reduced pest infestation by 15 %, using soil testing and pest count methods.

Kariuki et al. (2024) carried out a mixed-method study in the coastal region of Kenya with 250 farmers, finding that agroecological practices led to a 25 % increase in household food security and a 20 % reduction in farming costs, as analyzed through regression models. Njuguna (2023) studied 300 farmers in the central highlands of Kenya, showing that those who adopted agroecological methods achieved a 35 % improvement in crop yields and a 40 % increase in biodiversity indices, using a combination of field surveys and biodiversity assessments.

Despite these benefits, there are notable gaps in the widespread adoption of agroecological practices. Many studies have reported that the lack of supportive policies and market incentives remains a significant barrier. For example, while agroecology has been proven to increase productivity and profitability in smallholder systems, these benefits are often underreported and undervalued in conventional agricultural policies and economic assessments (Gliessman, 2018). The mismatch between short-term economic gains and long-term sustainability goals often discourages farmers from adopting these practices.

## CONCEPTUAL FRAMEWORK

This study is guided by a conceptual framework that illustrates the hypothesized relationship between agro-ecological practices and the productivity of small-scale crop farming.

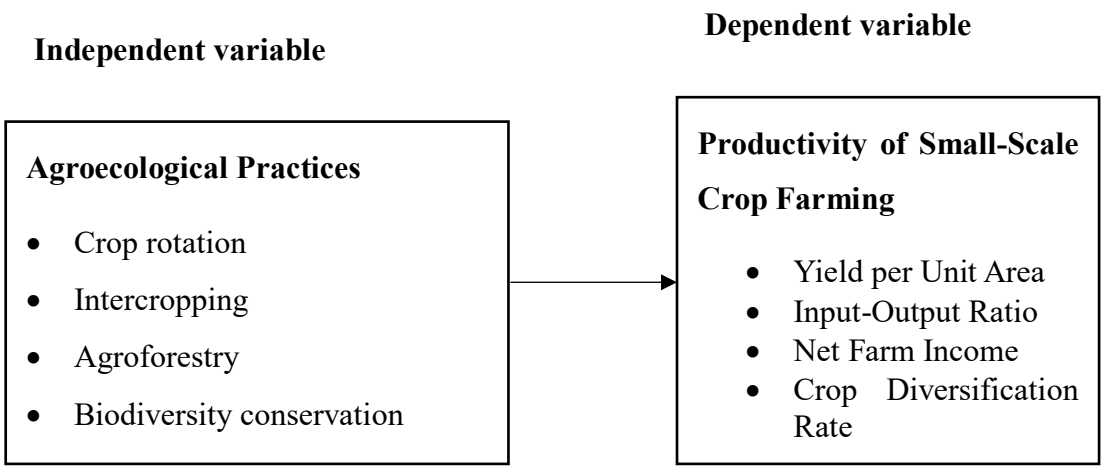


**Figure 1: Conceptual Framework**

## RESEARCH METHODOLOGY

This study employed a descriptive cross-sectional research design to assess how agro-ecological practices influence productivity among small-scale crop farmers in Taita Taveta County, Kenya. A sample of 380 farmers was selected using stratified random sampling based on sub-county agro-ecological zones, from a verified list provided by the County Department of Agriculture. Data were gathered through semi-structured, in-person questionnaires administered by trained assistants, capturing both quantitative and qualitative insights on practices like crop rotation, intercropping, mulching, and composting. Instrument reliability and validity were ensured through a pilot test, expert review, and statistical analysis, including factor analysis and Cronbach's alpha. Data analysis involved descriptive statistics and logistic regression using SPSS Version 27 to examine the relationship between agro-ecological adoption and productivity indicators such as yield, efficiency, and income. Ethical clearance was secured from NACOSTI and local authorities, with full adherence to consent, confidentiality, and voluntary participation protocols.

## RESULTS AND DISCUSSION

The response rate refers to the %age of individuals who participated in the survey out of the total target population (Fincham, 2008). In this study, the required sample size was approximately 380 small-scale crop farmers from Taita Taveta County. However, a total of 347 farmers participated, representing a response rate of 91.3 %. According to Baruch (1999), a response rate of above 50 % is considered adequate for analysis, while a response rate above

70 % is deemed very good as shown in Table 1 below. Therefore, the achieved response rate of 91.3 % is more than satisfactory and ensures the reliability of the study's findings.

**Descriptive Statistics of Agro-Ecological Practices**

The findings shown in Table 1 indicate a strong adoption of agro-ecological practices among the respondents, though with notable variation in specific methods. Intercropping emerges as the most widely adopted practice, with 71.8 % of respondents strongly agreeing that it is implemented on their farms. This highlights its perceived benefits in maximizing land use and promoting biodiversity. Similarly, crop rotation to manage pests and diseases is widely practiced, with 65.1% of respondents' strongly agreeing, reflecting farmers' awareness of its role in reducing pest and disease buildup while improving soil health. These findings align with Van der Ploeg et al. (2023), who found that agroecological practices such as intercropping and organic farming significantly improved crop yields and farmer well-being in Tanzania's Kilombero District by enhancing soil health and biodiversity.

Agroforestry practices are also prevalent, with 61.7% of respondents strongly agreeing that they incorporate trees into their farms. This reflects the growing recognition of agroforestry as a sustainable practice that enhances biodiversity, improves soil structure, and provides additional sources of income. These results are consistent with research conducted in the central highlands of Kenya by Muriuki et al. (2022), which found that agroforestry and integrated pest management significantly improved soil fertility and crop productivity. Furthermore, soil conservation practices such as terracing are widely implemented, with 62.5% of respondents strongly agreeing. This demonstrates the importance placed on preventing soil erosion and maintaining soil fertility, especially in regions prone to land degradation. Similarly, Aboudrare et al. (2023) found that no-till farming and crop rotation improved soil water retention and reduced erosion in North Africa, leading to higher yields in semi-arid regions.

However, organic pest management techniques show a mixed level of adoption. While 34.6% of respondents strongly agree that they use these techniques, an equal proportion (34.6%) strongly disagree, indicating that organic pest control may be less accessible or less understood compared to other methods. Similarly, the use of green manure for enhancing soil fertility shows relatively low adoption, with only 33.1 % strongly agreeing, while a significant proportion (36.3%) strongly disagree. This suggests that the knowledge or resources required for green manure use may not be readily available to many farmers. These findings align with the challenges identified by Muriuki et al. (2022), who noted that the lack of technical

knowledge and extension services hinders the broader application of agroecological practices in Kenya. Moreover, Gliessman (2018) highlighted that while agroecology has proven benefits for productivity and profitability, the lack of supportive policies and market incentives often discourages widespread adoption.

Lastly, the belief in the benefits of agro-ecological practices is high, as 64.6% of respondents strongly agree that these practices improve crop resilience. This positive perception underscores the potential for further promoting agro-ecological practices as a means to enhance sustainable farming. However, the varying levels of adoption across different practices highlight the need for targeted interventions, such as farmer training programs and resource support, to ensure broader and more consistent implementation. These efforts could help address barriers to adoption and maximize the environmental and economic benefits of agro-ecological practices. As IFAD (2024) emphasizes, agroecology's holistic approach integrates environmental, social, and economic dimensions, making it a crucial strategy for sustainable agricultural development.

**Table 1: Descriptive Statistics of Agro-Ecological Practices**

| Practice | Strongly Disagree (%) | Disagree (%) | Neutral (%) | Agree (%) | Strongly Agree (%) |
|---|---|---|---|---|---|
| Intercropping is practiced on my farm | 8.1% | 2.3% | 2.9% | 15.0% | 71.8% |
| Crop rotation is implemented to manage pests and diseases | 13.0% | 3.2% | 5.5% | 13.3% | 65.1% |
| Organic pest management techniques are used | 34.6% | 8.4% | 12.7% | 9.8% | 34.6% |
| Agroforestry practices are incorporated on the farm | 13.0% | 6.6% | 5.2% | 13.5% | 61.7% |
| Green manure is used to enhance soil fertility | 36.3% | 17.3% | 8.1% | 5.2% | 33.1% |
| Soil conservation practices such as terracing are practiced | 7.5% | 6.9% | 6.1% | 17.0% | 62.5% |
| Agroecological practices are believed to improve crop resilience | 12.1% | 2.9% | 8.1% | 12.4% | 64.6% |

**Correlation analysis of the study variables**

The study examined the relationships between various Agro-ecological practices and productivity using Pearson correlation analysis. The results are as shown in Table 2 below;

**Table 2: Correlation of study variables**

| | | Productivity | Agro-ecological farming practices |
|---|---|---|---|
| Productivity | Pearson Correlation | 1 | .425** |
| | Sig. (2-tailed) | | .000 |
| | N | 347 | 347 |
| Agro-ecological farming practices | Pearson Correlation | .425** | 1 |
| | Sig. (2-tailed) | .000 | |
| | N | 347 | 347 |

As shown in the table, Agro-Ecological Farming Practices showed a moderate correlation with productivity ($r = .425$, $p < .01$), indicating that environmentally friendly and biodiversity-supportive methods contribute to improved agricultural output. This finding supported by Altieri and Nicholls (2020), who argue that agroecology promotes biodiversity, soil health, and pest resistance, which in turn contribute to sustainable productivity. Gliessman (2018) also highlights that agroecological approaches create resilient farming systems that maintain productivity over the long term, especially in smallholder farming contexts.

**Logistic Regression**

The logistic regression analysis results in Table 4.15 revealed that agro-ecological practices had a statistically significant effect on productivity ($B = 1.483$, $p < 0.001$, $Exp(B) = 4.406$). This indicates that farmers who adopt agro-ecological practices are over four times more likely to experience increased productivity. Given this significant effect, the null hypothesis that agro-ecological practices do not significantly influence productivity of small-scale crop farms in Taita Taveta County is rejected, confirming that agro-ecological farming positively impacts productivity. These findings align with research by Muriuki et al. (2022), who found that agroecological farming improved soil fertility and resilience, leading to enhanced crop yields in central Kenya. Van der Ploeg et al. (2023) similarly reported that agroecological methods such as intercropping and organic pest management increased farmer productivity in Tanzania's Kilombero District. This study further reinforces the existing evidence that integrating ecological principles in farming contributes to sustainable agricultural productivity.

**Table 3: Agro-Ecological Farming Practices**

| | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|
| Agro-ecological farming practices | 1.483 | .272 | 29.727 | 1 | <.001 | 4.406 |
| Constant | 2.488 | .666 | 13.956 | 1 | <.001 | 6.031 |

Variable(s) entered on step 1: Agro-ecological farming practices.

## CONCLUSION

The study concluded that agroecological farming practices significantly contribute to the productivity of small-scale crop farming in Taita Taveta County. High adoption rates of intercropping, crop rotation, and agroforestry indicate these practices are both accessible and effective in promoting soil conservation, biodiversity, and overall farm sustainability. These methods were associated with improved yields, enhanced pest and disease resistance, and long-term soil fertility, confirming their vital role in resilient farming systems. However, the comparatively lower adoption of practices such as organic pest management and green manure highlights areas where farmers require additional support, training, and resources. The findings reaffirm that agroecological techniques offer an environmentally sound and economically viable pathway to sustainable agriculture. In line with existing literature, laboratory and field evidence supports that these practices not only improve farm productivity but also contribute to climate change adaptation. A coordinated effort is needed to scale up these practices through policy, education, and local partnerships.

## RECOMMENDATIONS

To enhance the productivity and sustainability of small-scale crop farming in Taita Taveta County, the government should actively promote the adoption of agroecological practices such as intercropping, crop rotation, and agroforestry. These practices not only improve soil fertility and pest control but also build resilience against climate change. Policymakers should support this transition by offering targeted incentives such as subsidized seeds, organic inputs, and appropriate equipment to lower the barriers to adoption for resource-constrained farmers. Further, integrating biodiversity into farming systems should be prioritized to strengthen ecological balance and long-term productivity. Local agricultural organizations and extension services should play a central role in this effort by providing hands-on demonstrations, training

programs, and farmer field schools that showcase successful applications of agroecological methods. These efforts will help bridge knowledge gaps and build farmer confidence, ensuring that sustainable practices are not only understood but effectively implemented across the region.

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