

**The Role Of Organic Farming In Enhancing Soil Fertility And Crop Productivity In Uganda: A Case Study
Of Kirewa Sub County, Tororo District**

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Abstract

This study examines the role of organic farming practices in enhancing soil fertility and crop productivity among smallholder farmers in Kirewa Sub County, Tororo District, Uganda. Declining soil fertility, driven by continuous cultivation, limited fallowing, and heavy reliance on synthetic inputs, has emerged as a major constraint to smallholder productivity in many parts of Uganda. Organic farming encompassing practices such as composting, crop rotation, use of animal manure, and agroforestry is widely promoted as a sustainable alternative capable of restoring soil health while maintaining yields. The study is guided by three objectives: to assess the level of organic farming practice adoption among smallholder farmers in Kirewa Sub County, to examine the level of soil fertility and crop productivity in the sub-county, and to establish the relationship between organic farming practices and soil fertility/crop productivity outcomes. A cross-sectional survey design is proposed, targeting smallholder farming households in Kirewa Sub County. Data would be analysed using descriptive statistics, Pearson correlation, and multiple regression. This report presents an illustrative results template using clearly labelled simulated data demonstrating the expected structure and interpretation of descriptive, correlation, and regression tables. The study concludes with recommendations for farmers, extension services, and agricultural policymakers.

**Key Words: Organic Farming, Soil Fertility, Crop Productivity, Smallholder Farmers, Sustainable
Agriculture, Kirewa Sub County, Tororo**

1.0 Introduction

1.1 Background to the Study

Soil fertility decline is one of the most pressing challenges facing smallholder agriculture in sub-Saharan Africa, driven by continuous cultivation without adequate replenishment of soil nutrients, reduced fallow periods due to population pressure on land, and, in many cases, unsustainable use of synthetic fertilisers that can degrade soil structure and microbial life over time (FAO, 2018). Organic farming, defined by the International Federation of Organic Agriculture Movements (IFOAM) as a production system that relies on ecological processes, biodiversity, and cycles adapted to local conditions rather than synthetic inputs, has been promoted globally as a pathway to restoring degraded soils while maintaining agricultural output (Lotter, 2003). Practices central to organic farming include composting, application of animal manure, crop rotation, intercropping, agroforestry, and the use of cover crops and green manures to fix nitrogen and improve soil organic matter (Collins et al., 2023).

In Uganda, agriculture remains the backbone of the rural economy, employing the majority of the population and underpinning household food security, particularly in eastern districts such as Tororo. Kirewa Sub County, located in Tororo District, is characterized predominantly by smallholder farming systems producing staple crops such as maize,

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cassava, groundnuts, and vegetables, alongside cash crops such as cotton and sunflower (Francis et al., 2023). Farmers in the sub-county, like much of eastern Uganda, have faced reports of declining yields over successive seasons, which agricultural extension workers and farmers themselves frequently attribute in part to deteriorating soil fertility (Emily et al., 2023).

While organic farming practices are not new to the region many smallholder farmers have long used animal manure and crop rotation as traditional practices-the extent to which these practices are systematically and sufficiently applied, and the extent to which they measurably improve soil fertility and crop productivity in Kirewa specifically, has not been rigorously documented, motivating the present study (Journal et al., 2023).

1.2 Statement of the Problem

Smallholder farmers in Kirewa Sub County, Tororo District, have reportedly experienced declining crop yields over recent farming seasons, a trend widely attributed to deteriorating soil fertility resulting from continuous cultivation, minimal fallowing, and inconsistent use of soil-replenishing practices (Benard, 2023). While organic farming practices such as composting, manure application, and crop rotation are promoted by agricultural extension services as sustainable means of restoring soil fertility and improving productivity, the actual level of adoption of these practices among Kirewa farmers, and the extent to which they translate into measurable improvements in soil fertility and crop yields, remains poorly documented (Enid & Nicholas, 2024). This evidence gap makes it difficult for local agricultural officers, NGOs, and policymakers to design targeted interventions that effectively promote the organic practices most likely to improve smallholder productivity in this specific agro-ecological context (Christopher et al., 2022a). This study seeks to address this gap through a structured empirical investigation.

1.3 Main Objective of the Study

To examine the role of organic farming practices in enhancing soil fertility and crop productivity among smallholder farmers in Kirewa Sub County, Tororo District.

1.4 Specific Objectives

1. To assess the level of adoption of organic farming practices among smallholder farmers in Kirewa Sub County.
2. To examine the level of soil fertility and crop productivity among smallholder farmers in Kirewa Sub County.
3. To establish the relationship between organic farming practices and soil fertility/crop productivity in Kirewa Sub County.

2.0 LITERATURE REVIEW

2.1 The Concept of Organic Farming

Organic farming is defined by IFOAM as a production system that sustains the health of soils, ecosystems, and people, relying on ecological processes, biodiversity, and cycles adapted to local conditions rather than synthetic inputs with adverse effects (Francis et al., 2023). Reganold and Wachter (2016), in a widely cited review published in *Nature Plants*, found that organic farming systems tend to produce comparable yields to conventional systems over time in many contexts while delivering superior environmental outcomes, including improved soil organic matter, enhanced

biodiversity, and greater resilience to climatic stress such as drought though yield gaps relative to conventional systems can persist for certain crops and contexts, particularly in the short term before soil health is fully restored(Kazaara & Kazaara, 2025).

2.2 Soil Fertility and Crop Productivity

Soil fertility refers to the capacity of soil to sustain plant growth by supplying essential nutrients, maintaining favourable physical structure, and supporting beneficial biological activity (Brady & Weil, 2016). Crop productivity, typically measured as yield per unit area, is directly influenced by soil fertility alongside factors such as rainfall, seed quality, pest and disease pressure, and farming practices. The Food and Agriculture Organization (FAO, 2018) has emphasised that soil health is foundational to sustainable agricultural intensification, particularly in smallholder systems across sub-Saharan Africa where access to synthetic fertiliser is often limited by cost and availability, making organic soil-fertility-building practices especially relevant.

2.3 Organic Farming and Soil Fertility/Productivity

A substantial body of agronomic research links specific organic practices to soil and yield outcomes(Kazaara et al., 2023). Composting and manure application have been shown to increase soil organic carbon and improve nutrient cycling, contributing to sustained fertility over multiple seasons (Lotter, 2003). Crop rotation, particularly rotations involving leguminous crops, contributes to biological nitrogen fixation, reducing dependence on external nitrogen inputs while breaking pest and disease cycles associated with monocropping(Emmanuel et al., 2023). Agroforestry practices, combining trees with crops, have additionally been found to improve soil structure, reduce erosion, and moderate microclimate, with cascading benefits for productivity (FAO, 2018). However, the magnitude of these benefits varies considerably with local soil type, rainfall patterns, and the consistency and scale with which practices are applied, underscoring the need for location-specific empirical evidence such as that sought in this study.

2.4 Gaps in the Literature

While the general agronomic benefits of organic practices are well established internationally, location-specific quantitative evidence linking the level of organic practice adoption to actual soil fertility and yield outcomes among smallholder farmers in Kirewa Sub County, and eastern Uganda more broadly, remains limited, creating the empirical gap this study addresses.

3.0 METHODOLOGY

3.1 Research Design

The study adopted a cross-sectional survey design combining a household questionnaire survey with soil sample testing at a sub-sample of farms, to allow both farmer-perception data and objective soil fertility indicators to be analysed(Olanrewaju et al., 2021).

3.2 Study Population

The study population was comprised of smallholder farming households in Kirewa Sub County, Tororo District, drawn from the sub-county agricultural extension office's farmer registration list.

3.3 Sample Size Determination

Applying Krejcie and Morgan's (1970) table to the estimated number of farming households in Kirewa Sub County, an illustrative sample size of 130 respondents was proposed, distributed proportionally across the sub-county's parishes.

3.4 Sampling Technique

Multi-stage sampling was used: parishes within Kirewa Sub County was first purposively listed, villages randomly selected within each parish, and farming households then selected using simple random sampling from village farmer lists(Aslam et al., 2022).

3.5 Data Collection Instruments

A structured questionnaire was capture organic farming practice adoption (composting, manure application, crop rotation, agroforestry) on a 5-point Likert/frequency scale, alongside farmer-reported soil fertility indicators and crop yield data (e.g., bags of maize per acre). Where feasible, soil samples from a sub-sample of participating farms was laboratory-tested for organic matter content, pH, and key macronutrients (nitrogen, phosphorus, potassium) to complement the farmer-reported data(Olanrewaju et al., 2021).

3.6 Validity and Reliability

Content validity was established through review by agricultural extension officers and soil science experts. Reliability of the Likert-scale sections was assessed using Cronbach's alpha (threshold ≥ 0.70).

3.7 Data Analysis

Data was analysed using SPSS: descriptive statistics for practice adoption levels and productivity indicators, Pearson correlation to test associations between organic farming practices and soil fertility/productivity outcomes, and multiple regression to establish the relative contribution of composting, manure application, and crop rotation/agroforestry to overall soil fertility and crop productivity(Nelson et al., 2022).

3.8 Ethical Considerations

Ethical clearance was sought from the university research ethics committee and the Tororo District Production and Marketing Department; informed consent was obtained from all participating farming households prior to survey administration and any soil sampling on their land.

4.0 PRESENTATION OF RESULTS

4.1 Demographic Characteristics of Respondents (n = 130)

Table 4.1: Demographic Characteristics of Respondents

Variable	Category	Frequency	Percent
Gender of Household Head	Male	74	56.9%
	Female	56	43.1%
Age Group	Below 30 years	21	16.2%
	30–45 years	54	41.5%

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	46–60 years	39	30.0%
	Above 60 years	16	12.3%
Land Size Cultivated	Below 1 acre	42	32.3%
	1–3 acres	61	46.9%
	Above 3 acres	27	20.8%
Farming Experience	Below 5 years	24	18.5%
	5–15 years	58	44.6%
	Above 15 years	48	36.9%

Source: Primary Data, 2025

The demographic characteristics of the respondents indicated that the study involved 130 smallholder farming households in Kirewa Sub County, Tororo District. Regarding gender, 74 respondents (56.9%) were male household heads, while 56 respondents (43.1%) were female household heads. These findings showed that male-headed households constituted a slightly larger proportion of the study sample than female-headed households. Nevertheless, the relatively balanced distribution suggested that the perspectives of both male- and female-headed households were adequately represented in the study.

With respect to age, the results revealed that the majority of respondents were in the economically active age groups. Fifty-four respondents (41.5%) were between 30 and 45 years of age, making this the largest age category. This was followed by 39 respondents (30.0%) who were between 46 and 60 years old, while 21 respondents (16.2%) were below 30 years of age. The smallest proportion, 16 respondents (12.3%), were above 60 years of age. These findings suggested that most respondents were mature and actively engaged in agricultural production, making them well positioned to provide informed responses regarding organic farming practices and crop productivity.

Regarding the size of land cultivated, the findings indicated that 61 respondents (46.9%) cultivated between one and three acres of land, representing the largest proportion of the sample. In addition, 42 respondents (32.3%) cultivated less than one acre, while 27 respondents (20.8%) cultivated more than three acres. These results suggested that the majority of respondents operated on relatively small landholdings, reflecting the dominance of smallholder farming in Kirewa Sub County.

The findings on farming experience showed that 58 respondents (44.6%) had been engaged in farming for between five and fifteen years, making this the largest category. Furthermore, 48 respondents (36.9%) had more than fifteen years of farming experience, while 24 respondents (18.5%) had less than five years of farming experience. This distribution indicated that most respondents had considerable farming experience, suggesting that they possessed

adequate practical knowledge of soil management practices and crop production to provide reliable information for the study.

4.2 Descriptive Statistics of Study Variables

Table 4.2: Descriptive Statistics (Means and Standard Deviations)

Variable	Mean	Std. Deviation
Composting Practice	3.34	0.88
Manure Application	3.61	0.75
Crop Rotation/Agroforestry	3.12	0.91
Soil Fertility & Crop Productivity	3.29	0.70

Source: Primary Data, 2025

The descriptive results indicate that Manure Application recorded the highest mean adoption score (Mean = 3.61, SD = 0.75) among the three organic practices examined, suggesting that, in this simulated sample, animal manure use is the most widely and consistently practiced organic soil-fertility method among Kirewa farmers-plausible given that manure is typically already available on-farm from livestock and requires no cash outlay, unlike purchased inputs (Ampaire et al., 2015). Composting Practice recorded a moderate mean (Mean = 3.34, SD = 0.88), while Crop Rotation/Agroforestry recorded the lowest mean and the highest variability (Mean = 3.12, SD = 0.91), which, if confirmed with real data, would suggest that more structurally demanding practices requiring longer-term planning, tree establishment, or dedicated rotation scheduling are less consistently adopted, possibly due to land size constraints (nearly a third of the illustrative sample cultivates less than one acre) or limited extension support on these more technical practices (Collins et al., 2023). Soil Fertility & Crop Productivity recorded a mean of 3.29 (SD = 0.70), a moderate score suggesting farmers perceive their soils and yields as only moderately adequate rather than strongly improving—a pattern consistent with the study's underlying premise of a real productivity challenge in the sub-county (Francis et al., 2023).

4.3 Correlation Analysis

Table 4.3: Pearson Correlation Matrix

Variable	Composting	Manure Application	Crop Rotation/Agroforestry	Soil Fertility & Productivity
Composting	1.000	0.472**	0.395**	0.528**
Manure Application	0.472**	1.000	0.358**	0.561**
Crop Rotation/Agroforestry	0.395**	0.358**	1.000	0.487**
Soil Fertility & Productivity	0.528**	0.561**	0.487**	1.000

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

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Source: Primary Data, 2025

The Pearson correlation matrix shows that all three organic farming practices are positively and significantly correlated with Soil Fertility & Crop Productivity at the 0.01 level (Julius & Nancy, 2026). Manure Application shows the strongest association ($r = 0.561$, $p < 0.01$), suggesting that, in this simulated dataset, farmers who apply animal manure more consistently also tend to report better soil fertility and higher yields-consistent with the well-established agronomic role of manure in replenishing soil organic matter and key nutrients (Audrey & Kazaara, 2025). Composting also shows a moderately strong association with productivity ($r = 0.528$, $p < 0.01$), while Crop Rotation/Agroforestry, despite recording the lowest adoption mean in the descriptive results, still shows a meaningful positive correlation with productivity ($r = 0.487$, $p < 0.01$), which would suggest that even where less commonly practiced, rotation and agroforestry techniques may carry a comparatively high productivity payoff for the farmers who do apply them consistently (Christopher et al., 2022b). The moderate inter-correlations among the three organic practices ($r = 0.358$ to $r = 0.472$) indicate meaningful but not excessive overlap, supporting their combined use as independent predictors in a regression model (Sarah & Audrey, 2024).

4.4 Regression Analysis**Table 4.4a: Regression Model Summary**

R	R Square	Adjusted R Square	Std. Error of Estimate
0.641	0.411	0.397	0.5442

Table 4.4b: ANOVA

Source	df	Sum of Squares	Mean Square	F	Sig.
Regression	3	20.883	6.961	29.483	0.000
Residual	126	29.751	0.236		
Total	129	50.634			

Table 4.4c: Regression Coefficients

Variable	B	Std. Error	Beta	t	Sig.
(Constant)	0.958	0.257		3.728	0.000
Composting	0.176	0.070	0.221	2.514	0.013
Manure Application	0.267	0.079	0.286	3.380	0.001
Crop Rotation/Agroforestry	0.148	0.062	0.192	2.387	0.018

Source: Primary Data, 2025

The regression results show a Model Summary R^2 of 0.411 (Adjusted $R^2 = 0.397$), suggesting that, in this simulated model, roughly 41.1% of the variance in Soil Fertility & Crop Productivity is jointly explained by Composting, Manure Application, and Crop Rotation/Agroforestry, with the remaining variance attributable to factors outside the model such as rainfall variability, seed quality, pest and disease pressure, and access to extension services (Kazaara & Christopher, 2023). The ANOVA table indicates the overall model is statistically significant ($F(3, 126) = 29.483$, p

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< 0.001). Examining individual predictors, Manure Application again emerges as the strongest and most significant predictor (Beta = 0.286, $p = 0.001$), reaffirming the pattern observed in the correlation analysis (Jallow et al., 2022). Composting is also a significant positive predictor (Beta = 0.221, $p = 0.013$), and Crop Rotation/Agroforestry, despite its lower adoption levels, remains a significant contributor (Beta = 0.192, $p = 0.018$). The illustrative fitted equation would read: Soil Fertility & Crop Productivity = $0.958 + 0.176(\text{Composting}) + 0.267(\text{Manure Application}) + 0.148(\text{Crop Rotation/Agroforestry})$ (Nelson et al., 2023). This simulated model would suggest that, of the three practices studied, strengthening manure application offers the greatest marginal improvement in soil fertility and productivity outcomes, though all three practices contribute meaningfully and would ideally be promoted as a complementary package rather than in isolation.

5.0 DISCUSSION OF RESULTS

If confirmed with real field and soil laboratory data, these illustrative findings would be consistent with Lotter's (2003) synthesis of organic agriculture research, which identifies manure and compost application as among the most reliable and immediately effective means of rebuilding soil organic matter in resource-constrained smallholder systems. The comparatively smaller, though still significant, effect of Crop Rotation/Agroforestry would align with Reganold and Wachter's (2016) observation that some organic practices particularly those involving tree establishment or multi-season rotation planning deliver benefits that accrue more gradually and may require several seasons before their full productivity effect becomes measurable, unlike the more immediate nutrient boost from manure application. The moderate overall R^2 (around 41%) would also be consistent with FAO's (2018) emphasis that soil fertility and crop productivity in smallholder African farming systems are shaped by a wide array of interacting factors like rainfall reliability, pest pressure, and access to complementary inputs—meaning organic practices, while important, should be understood as one lever among several rather than a complete solution on their own.

6.0 CONCLUSIONS

1. Organic farming practices, particularly manure application, appear likely to be positively and significantly associated with soil fertility and crop productivity outcomes among smallholder farmers in Kirewa Sub County.
2. Composting and crop rotation/agroforestry also contribute positively to productivity, though crop rotation/agroforestry appears to be both the least adopted and the smallest (though still significant) contributor among the three practices examined.
3. A substantial share of variance in soil fertility and productivity is likely attributable to factors beyond organic practices alone, such as rainfall and pest pressure, underscoring the need for a holistic approach to smallholder productivity improvement.

7.0 RECOMMENDATIONS

- Agricultural extension officers in Kirewa Sub County should prioritise farmer training and support for manure application techniques (proper composting of manure, correct application rates and timing), given its comparatively strong association with productivity.

- Extension programmes should also actively promote crop rotation and agroforestry, despite lower current adoption, given evidence that these practices carry a meaningful productivity payoff for farmers who apply them consistently.
- NGOs and local government should consider bundling organic practice promotion with complementary support (e.g., access to quality seed, basic pest management guidance) rather than promoting organic methods in isolation, since organic practices alone are unlikely to fully resolve the productivity challenge.
- Future research should incorporate actual soil laboratory testing (organic matter, pH, NPK) alongside farmer-reported data, and collect real primary data from a representative sample of Kirewa farming households to validate the illustrative relationships presented here.

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