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Research Article

Balancing Tradition and Modernity: Smallholder Farmer Perspectives on Fertilizer Adoption and Improved Crop Varieties in the Teso Sub-Region, Uganda

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Abstract

Background: Smallholder farmers in Uganda's Teso Sub-Region are increasingly adopting fertilizers and improved crop varieties in response to declining soil fertility, climate variability, and the need to improve agricultural productivity. However, limited evidence exists on how farmers perceive and integrate these technologies into their farming systems. This study explored smallholder farmers' perspectives on fertilizer adoption and improved crop varieties within the context of resource constraints and changing agricultural conditions.

Methods: A qualitative exploratory study was conducted among 32 smallholder farmers in Katete, Nyero, Oriyo, and Apeduru sub-counties in the Teso Sub-Region of Uganda. Data were collected through focus group discussions using a semi-structured guide. Discussions explored experiences with fertilizer use, improved crop varieties, perceived benefits, and challenges associated with adoption. Audio-recorded interviews were transcribed verbatim and analyzed using thematic analysis to identify recurring patterns and themes.

Results: Five key themes emerged from the analysis: (1) continued reliance on organic fertilizers as the foundation of soil fertility management; (2) strategic integration of inorganic fertilizers to enhance crop productivity; (3) increasing use of commercial productivity enhancers to improve crop growth and manage pests; (4) adoption of improved crop varieties through public and private extension networks; and (5) persistent barriers to agricultural innovation, including limited technical knowledge, high input costs, climate variability, pest infestations, and post-harvest losses. Participants reported that combining traditional farming practices with modern agricultural inputs contributed to improved crop performance and increased yields. However, the benefits of these technologies were frequently constrained by

affordability challenges, inadequate training on input application, environmental risks, and market-related limitations.

Conclusion: The study concludes that sustainable agricultural transformation requires integrated support systems that combine access to inputs with farmer training, climate-smart extension services, post-harvest infrastructure, and stronger market linkages.

Keywords:
Smallholder Farmer; Perspectives; Fertilizer Adoption; Improved Crop Varieties; Uganda

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Introduction

Smallholder agriculture remains the primary source of livelihood for rural households across sub-Saharan Africa, where smallholder farmers contribute substantially to food production, household income, and national economies [1] (World Bank, 2023). However, agricultural productivity continues to be constrained by declining soil fertility, climate variability, pest and disease outbreaks, land degradation, and limited access to agricultural inputs [2]. These challenges have heightened concerns about food security and the sustainability of smallholder farming systems, prompting governments, development agencies, and private-sector actors to promote improved agricultural technologies as a means of enhancing productivity and resilience.

Among the interventions widely promoted are inorganic fertilizers and improved crop varieties. Fertilizers are intended to replenish depleted soil nutrients and improve crop yields, while improved seed varieties are designed to offer advantages such as higher productivity, resistance to pests and diseases, drought tolerance, and shorter maturity periods [3], [4]. Across sub-Saharan Africa, numerous studies have documented the positive effects of these technologies on agricultural productivity, household income, and food security. For example, improved seed varieties have been associated with increased crop yields and improved household welfare, while fertilizer use has been shown to enhance soil fertility and agricultural productivity when applied appropriately [3], [5].

Despite these potential benefits, the adoption and sustained use of agricultural technologies among smallholder farmers remain uneven across many rural settings. Previous studies have identified a range of factors influencing adoption, including input costs, access to credit, extension services, market opportunities, land ownership, and environmental conditions [6] (Mwangi & Kariuki, 2015). While these studies provide important evidence regarding adoption rates and determinants, they are largely quantitative in nature and often provide limited insight into how farmers perceive these technologies and make decisions regarding their use.

Increasingly, scholars recognize that agricultural technology adoption is not merely a technical or economic process but also a social and contextual one shaped by farmers' experiences, knowledge, livelihood priorities, and local realities (Chambers & Conway, 1992) [7]. Farmers operate within complex environments characterized by resource constraints, climatic uncertainties, cultural practices, and evolving market conditions. Consequently, they often adapt and combine modern technologies with traditional farming practices rather than completely replacing existing approaches. Understanding these experiences is essential for designing interventions that are responsive to local needs and realities.

In Uganda, agriculture remains the backbone of rural livelihoods, employing a large proportion of the population and contributing significantly to food security and economic development (Uganda Bureau of Statistics (UBOS, 2024). However, many farming communities continue to face challenges associated with declining soil fertility, erratic rainfall patterns, pest infestations, and limited access to agricultural inputs and services. In response, government programmes, non-governmental organizations, and private agro-input dealers have increasingly promoted the use of fertilizers and improved crop varieties to enhance productivity and strengthen household resilience.

The Teso Sub-Region of Eastern Uganda presents a particularly relevant context for examining these issues. The region is predominantly dependent on smallholder agriculture and has experienced increasing pressure from land degradation, changing climatic conditions, and declining agricultural productivity. Although fertilizers and improved crop varieties are becoming more accessible through extension services and agro-dealer networks, little is known about how farmers perceive these technologies, how they integrate them into existing farming systems, and the challenges they encounter during adoption and use. Existing literature has largely focused on measuring adoption rates and productivity outcomes, leaving a gap in understanding the lived experiences and perspectives of smallholder farmers.

This study therefore explored smallholder farmers' perspectives on fertilizer adoption and improved crop varieties in the Teso Sub-Region of Uganda. By examining farmers' experiences, perceptions, and decision-making processes, the study provides a deeper understanding of how agricultural technologies are adopted, adapted, and utilized within local farming contexts. Such insights are critical for informing agricultural policies, extension programmes, and development interventions aimed at promoting sustainable agricultural transformation and improving rural livelihoods.

Methodology

Study design, site selection, and Data collection techniques

To capture the detailed perspectives and practical realities of farming communities, this research utilized a qualitative exploratory design. Primary data collection relied on structured Focus Group Discussions conducted across four sub-counties within the Teso Sub-Region: Katete, Nyero, Oriyo, and Apeduru. This study sites were in selected purposively to capture communities with varying levels of market access, differing local soil conditions, and a representative mix of staple food production and high-value commercial horticulture.

The focus groups brought together male and female smallholders from diverse generational and asset backgrounds, ensuring a wide spectrum of household vulnerability was represented. The discussions were guided by semi-structured protocols designed to explore local soil fertility practices, experiences with inorganic and organic nutrients, the sourcing and dissemination of seed technologies, and the post-harvest risks associated with new crop varieties. All sessions were recorded, transcribed, and analyzed through an inductive thematic framework. Key themes were identified based on the recurring priorities, shared constraints, and distinct conceptual models described by the farmers themselves. To preserve the direct evidence of the field, verbatim narratives from transcripts were used throughout the analysis.

Data collection tools

The study employed a focus group discussion guide with 8 members per focus group. Four focus groups were recruited making a total of 32 participants.

Participants Recruitment

Participants were informed about the objective of the study. Recruitment of additional FGD groups stopped once transcripts were reviewed and saturation of themes was obtained. The study was conducted in accordance with established ethical principles governing research involving human participants. Ethical clearance was obtained from the Clarke International University Research Ethics Committee (Approval No. CLARKE-2025-1685) and the Uganda National Council for Science and Technology (UNCST) (Reference No. SS4673ES). Additional authorization was sought from relevant district and community leaders before commencing data collection. Data collected were entered into the Nvivo software version 20.2 to generate codes. Focus groups were coded and transcribed verbatim. Thematic analysis using an inductive approach generated themes that informed the study's qualitative findings.

All participants were provided with detailed information about the purpose of the study and were invited to participate voluntarily. Written informed consent was obtained prior to participation, and participants were informed of their right to decline participation or withdraw from the study at any stage without any consequences. Confidentiality and privacy were safeguarded by removing personal identifiers from the data and storing all research records securely. Given that the study explored routine agricultural practices and experiences, the risk of harm to participants was minimal.

To ensure credibility, participants' views and experiences were represented faithfully, with careful attention to accuracy and fairness. Transferability was supported through thick description of the agricultural and socio-cultural context, enabling readers to judge the applicability of findings to similar settings. Dependability was maintained by documenting the research process clearly, ensuring that data collection and analysis were consistent and traceable. Confirmability was upheld through reflexivity and transparency, ensuring that findings were grounded in participants' accounts rather than researcher bias.

Finally, authenticity was promoted by capturing diverse perspectives and presenting them in a way that reflects the realities of smallholder farmers.

Efforts were made to ensure that the findings would contribute to improved understanding of smallholder farming challenges and opportunities, thereby benefiting communities and relevant stakeholders. Throughout the research process, the researchers upheld principles of honesty, transparency, cultural sensitivity, and respect for participants, ensuring that their views and experiences were accurately and fairly represented.

Results

Demographic characteristics of the study respondents

A total of 32 smallholder farmers participated in the study. Participants ranged in age from 27 to 55 years, with a mean age of 40.8 years (refer to Table 1). Most participants were aged between 35 and 55 years (75.0%). The majority were male (56.3%) and married (75.0%). Regarding educational attainment, most participants had primary education (40.6%), followed by secondary education (31.3%), while a small proportion had attained tertiary education (15.6%). Participants represented diverse religious affiliations, with Catholics (37.5%) and Anglicans/Protestants (31.3%) forming the largest groups. Crop farming was the predominant occupation among respondents (65.6%), reflecting the agricultural nature of the study area.

Fertilizer Usage and Soil Fertility Management

The qualitative data demonstrate that smallholder farmers do not rely on a single agricultural input; rather, they employ a multifaceted matrix of organic, inorganic, and commercial productivity enhancers to navigate resource constraints and maximize crop output. Fertilizer usage and soil fertility management had five themes that emerged.

Theme 1: Organic Fertilizers as the Foundational Practice

The application of organic fertilizer, specifically cow dung, remains the most widely practiced soil fertility strategy. For resource-constrained households, the primary drivers of organic fertilizer use are its immediate local availability and minimal cost burdens. It serves as a financial safety net and

Table 1. Demographic Characteristics of Study Participants (N = 32)

Characteristic	Category	Frequency (n)	Percentage (%)
Age Group (Years)	27–34	8	25.0
	35–44	12	37.5
	45–55	12	37.5
	Mean Age (Range)	40.8 years (27–55)	
Sex	Male	18	56.3
	Female	14	43.7
Marital Status	Married	24	75.0
	Single	3	9.4
	Widowed	3	9.4
	Divorced/Separated	2	6.2
Education Level	No Formal Education	4	12.5
	Primary Education	13	40.6
	Secondary Education	10	31.3
	Tertiary Education	5	15.6
Religion	Catholic	12	37.5
	Anglican/Protestant	10	31.3
	Pentecostal/Born Again	6	18.7
	Muslim	3	9.4
	Other	1	3.1
Farming Type	Crop Farming	21	65.6
	Mixed Farming	7	21.9
	Small Business & Farming	4	12.5

Source: Primary Data Source (2024)

a sustainable traditional practice in zones where commercial supply chains are weak or prices are prohibitive.

"We use basically cow dung as manure, since it is readily available and affordable. Manufactured fertilizers are expensive." (FGD/07/2025, Katete Sub-County)

Theme 2: Strategic Integration of Inorganic Fertilizers

Rather than completely replacing traditional practices, modern inputs are used to complement them. Farmers are increasingly adopting inorganic chemical fertilizers like NPK (Nitrogen, Phosphorus, Potassium) and DAP (Di-ammonium Phosphate). This mixed-input approach reflects a transition toward Integrated Soil Fertility Management (ISFM), where chemical inputs target acute nutrient deficits while organic matter maintains soil structure.

"Apart from cow dung, we also buy chemical fertilizers such as NPK and DAP to supplement soil fertility and improve crop yields." (FGD/10/2025, Katete Sub-County)

Theme 3: Commercial Productivity Enhancers and Foliar Inputs

Beyond standard soil applications, smallholders are embracing liquid and specialized commercial enhancers, including trademarked brands like *SuperGrow* and *Booster*. Interestingly, farmers value these inputs not only for accelerating vegetative growth but also for acting as an informal line of defense against crop pests.

"The one that we buy is Supergrow and Booster… to boost productivity and control pests." (FGD/12/2025, Nyero Sub-County)

Theme 4: Perceived Impacts on Crop Productivity

Smallholders report highly positive visual and economic feedback from fertilizer applications. Accelerated vegetative cycles and elevated harvest volumes are frequently observed, which directly enhances household food availability and marketable surplus.

"Yes, they grow very fast and even give high yields, which makes them more reliable than local varieties we used before." (FGD/03/2025, Oriyo Sub-County)

Theme 5: Knowledge Gaps and Application Challenges

Despite clear productivity advantages, the adoption process is limited by technical knowledge gaps. The improper application of chemical fertilizers often results in "seedling burn," demonstrating that access to inputs without corresponding agronomic training can lead to crop damage.

"The fertilizer needs to be covered fast because it burns the seedlings if planted directly." (FGD/02/2025, Katete Sub-County)

Discussion

The findings demonstrate that agricultural modernization in the Teso Sub-Region is characterized by integration rather than substitution. Farmers do not abandon traditional practices when modern technologies become available; instead, they combine organic and inorganic inputs to manage risk, improve soil fertility, and maximize productivity. This finding is consistent with studies across sub-Saharan Africa that highlight integrated soil fertility management as a sustainable approach for enhancing agricultural productivity while maintaining soil health [6], [2]. The continued reliance on organic manure alongside chemical fertilizers reflects farmers' efforts to balance economic constraints with the need to improve crop yields, a practice widely documented among smallholder farming systems in Africa [5].

The adoption of improved crop varieties observed in this study further demonstrates farmers' willingness to embrace innovations that offer clear advantages in terms of yield potential, pest resistance, and shorter maturity periods. Similar findings have been reported by Abate et al. (2017) and Walker and Alwang (2015), who found that improved seed varieties can significantly enhance agricultural productivity and food security when accompanied by appropriate agronomic support. The active uptake of improved varieties in the study area suggests that farmers are responsive to technologies that address their production challenges and livelihood needs.

However, the persistence of post-harvest losses, climate-related shocks, pest infestations, and limited technical support underscores the need for agricultural interventions that extend beyond the provision of inputs alone. Previous studies have shown that the effectiveness of agricultural technologies is often constrained by weak extension services, inadequate market access, and environmental uncertainties [6], [7].

The clear improvements in crop growth and harvest volumes reported by Teso farmers match the findings of Musafiri et al. (2023), whose work in Western Kenya demonstrated that integrating inorganic fertilizers with climate-smart practices significantly raises yields and strengthens smallholder livelihood indicators. Similarly, Abate et al. (2023) confirmed across multiple African contexts that sustained fertilizer adoption plays an essential role in improving household food security and reducing rural poverty.

However, as highlighted by Jayne et al. (2018), the benefits of these inputs are often limited in areas facing declining soil fertility and unpredictable weather patterns, unless they are backed by strong public extension systems and steady input supply chains. The benefits observed from adopting improved varieties like *Narocas* cassava and *DK* maize mirror the findings of Abate et al. (2017), who noted that improved seed varieties consistently raise yield floors across sub-Saharan Africa. However, their study also emphasized that the final impact on household welfare depends heavily on local market access and complementary inputs.

This dependency is clearly seen in the Teso Sub-Region, where post-harvest perishability and climate shocks limit the benefits of higher yields. As Kassie et al. (2018) observed in Eastern Africa, seed innovations deliver the best livelihood outcomes when combined with good agronomic practices and effective fertilizer use.

Finally, the vulnerabilities identified by Teso farmers regarding pests and climate changes validate the conclusions of Walker and Alwang (2015). They argued that the standalone effects of improved seed varieties are often limited by environmental risks and institutional shortcomings, emphasizing that seed distribution must be accompanied by broader post-harvest and climate-adaptive support.

We recommend future research to explore xenobiotics as an important area of research, particularly in relation to farmer training and sustainable agricultural practices

Conclusion and Recommendations

While smallholder farmers in Uganda's Teso Sub-Region are actively adopting fertilizers and improved seed varieties, they must constantly balance input costs, application risks, and post-harvest losses. To protect these investments and ensure agricultural innovations translate into stable, long-term improvements in local livelihoods, the following interventions are recommended: First, agricultural extension services should move beyond basic input distribution to provide hands-on training on proper fertilizer application techniques, preventing seedling damage and optimizing input use efficiency. Second, to address the short shelf-life of high-yielding varieties like *Narocas* cassava, development programs should focus on providing affordable value-addition technologies, local processing units, and improved solar drying systems. Third, enhance climate and pest adaptive capacity by ensuring farmers get better access to early-warning weather information, comprehensive pest management training, and resilient farming practices to safeguard their fields against climate variability. Lastly, policymakers should work to lower financial barriers for high-value horticultural inputs and improve rural transport networks, helping isolated communities connect more reliably with profitable markets.

Competing Interests

The authors declare that they have no competing interests that could have influenced the conduct, findings, or reporting of this study.

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Authors' Contributions

VA conceived and designed the study. VA also led the data collection process. FOM and CE contributed to the methodological design and data analysis. All authors participated in the review, revision, and approval of the final manuscript and agree to be accountable for all aspects of the work.

Consent for Publication

Written informed consent was obtained from all participants prior to their involvement in the study. The consent process included explicit permission for the publication and dissemination of anonymized data and study findings. Participants were assured that no personally identifiable information would be disclosed in any publication or presentation arising from the research.

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