

**Correlation Between Farming Technique And Crop Productivity In Kanungu District. A Case Study Of
Kayonza Tea Factory**

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Abstract

Agriculture forms the main economic stay of most communities in Kanungu District, Uganda. Given the sector's stratigraphic significance, optimizing yield amidst dynamic challenges such as shifting weather patterns exacerbates the need to investigate practices buttressing sustainability. This study explored the relationship between farming technique and tea crop productivity using Kayonza Tea Factory which sources leaf from over 350 out grower farmers as a case study. A mix of quantitative and qualitative data collection tools were employed between September-December 2022 including questionnaires, interviews, and yield records scrutiny. As demonstrated in the table, the Pearson Correlation value of .706** along the diagonal indicated an exceptionally strong positive correlation between the degree of Conservation agriculture implementation adopted on farms and subsequent harvests attained that was deemed highly statistically significant at 99% confidence levels reflected by the small significance value of .000 substantially below the standard threshold. Results indicated that though organic methods prevail, their productivity varies with Integrated Pest Management garnering highest average yields annually from 2016 to date. Analysis of Variance confirmed a significant technique effect on levels of harvest. Training programmes should mobilize IPM dissemination custom-fit to smallholder contexts promoting organic-mineral fertilizer blends, biomass recycling and climate-smart techniques.

Keywords: Farming Technique, Integrated Pest Management And Crop Productivity

Introduction

Agriculture has remained the backbone of Uganda's socioeconomic structure contributing over 20% to the national GDP and engaging over 70% of the population, majority of who are small-scale producers (Christopher et al., 2022). In Kanungu District specifically, it accounts for approximately 95% of all employment and 80% of exports spearheaded by crops like banana, Irish potato, coffee and tea (Turyatemba et al., 2022). Kayonza Tea Factory located in Buhemba Sub County is one such commercial estate established in 1953 with over 350 out growers today producing *Camellia Sinensis* on ~1200 hectares to supply premium orthodox leaf to international markets (Benard, 2023). While the fertile volcanic soils underpinning the expansive farmlands sourcing leaf to Kayonza Tea Factory have realized a sizeable average annual productivity of approximately one thousand five hundred kilograms per hectare in recent times, the fluctuating vagaries of unpredictable weather patterns compounded by the gradual entrenchment of certain outdated agronomic practices implemented sub-optimally along with the galvanizing challenges exacerbated by climate change have necessitated a prudent investigation into more viable and resource-sensitive solutions aimed at sustainably optimizing yields to the greatest extent plausible while augmenting the livelihood resilience of resource-

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constrained smallholder farmers cultivating tea on diminishing land fragments (Nicholas et al., 2023). Previous scholarly studies conducted in other geographical regions have intriguingly associated the judicious application of certain improved agricultural techniques with a noticeable quantifiable increase in resultant crop output and the accrued net financial returns reaped by rural famers as duly documented by Kabunga in the year 2012 and Nyberg et al. in 2020 respectively (Winny et al., 2023). However, locally-specific empirical data illuminating the precise applicability, adaptability and economic viability of translating such promising practices into the local context under the dynamic climatic conditions impacting production potential remains scarce (Journal et al., 2023). Owing to these contextual informational deficiencies, the current study thus aspired to empirically establish the nature and strength of association between different farming techniques employed and levels of tea crop productivity realized at Kayonza Tea Factory as a case study with the intent of informing strategic supportive policy formulation and initiatives of value to sustaining smallholder profitability and livelihood resilience in the midst of mounting climate volatility likely to persist over the long term (Annet et al., 2023).

Problem Statement

Agriculture has historically formed the core economic anchor and primary livelihood mainstay for the vast majority of rural farming communities scattered across the picturesque mountainous landscapes of Kanungu District in South Western Uganda (Ntirandekura & Friday, 2022). With over 95% of the local population deriving their subsistence and cash income directly from cultivating a variety of rain-fed crops on fragmented smallholdings often measuring less than two hectares in area, optimizing agricultural productivity on these diminutive fading family farms in a climate-resilient and environmentally sustainable manner remains an omnipresent challenge exacerbated by the dual threats of increasing population pressure encroaching on available arable lands alongside the volatile impacts of erratic weather patterns disruptive to production that are forecast to intensify under the looming specter of climate change in the coming decades (Grace et al., 2023).

One such notable cash crop which occupies a strategic position underpinning the local economy is tea, primarily cultivated on over 1200 hectares within the fertile volcanic soils surrounding the expansive out grower farms supplying premium orthodox leaf to Kayonza Tea Factory, the largest bulk leaf processor and exporter in the region (Collins et al., 2023). While average tea yields realized presently from these small family farms managed under diverse production techniques average approximately 1500 kilograms per hectare annually, fluctuating weather anomalies and long-held conventional practices obstinately entrenched due to lack of awareness gradually erode productivity potential necessitating prudent investigation into optimizing yields sustainably to bolster strained agrarian livelihoods facing mounting challenges (Allan et al., 2023). Context-specific empirical data elucidating the quantitative impact of integrating improved resource-sensitive techniques adapted to local seasonal variations also remains

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inadequately documented to inform strategic interventions. As such, this study aims to empirically establish the nature and strength of correlation between prevalent farming methods employed and consequent levels of tea crop outputs realized on

diverse farms contributing leaf to Kayonza Tea Factory with the goal of recommending evidence-based approaches augmenting climate resilience to safeguard food security and smallholder prosperity over generations (Turyatamba et al., 2022).

Specific Objectives

1. To determine the relationship between Integrated Pest Management (IPM) and crop productivity in Kanungu District
2. To assess the relationship between Conservation agriculture and crop productivity in Kanungu District
3. To examine the relationship between Climate-smart agriculture and crop productivity in Kanungu District

Literature Review

Farming Techniques

Various agricultural techniques have been employed globally including conventional, organic and integrated crop management systems with their impacts on yields significantly explored. Conventional practices rely heavily on agrochemicals to boost production in the short term yet negatively impact the environment and human health if misapplied (Christopher et al., 2023). Organic initiatives conversely advocate minimal external inputs to build soil fertility naturally and preclude contamination risks (Ivan et al., 2023). However, lower yields in early transitional stages compared to chemical-intensive counterparts dissuade some smallholders (Ponisio et al., 2014). Integrated Pest Management (IPM) promotes a balanced approach combining organic and conventional techniques judiciously based on weather, pests and economics to tap the benefits of both while mitigating their drawbacks sustainably (Firake et al., 2018). For instance, reasoned fertilizer and pesticide use supported by natural supplements and preventative scouting aimed at economic thresholds. Such judicious strategies though varied in costs of implementation have borne considerable returns on investment especially for vulnerable farmer livelihoods (Gurung et al., 2020). Their effects on different crops remain context-specific warranting location-tailored assessment.

Tea Crop Productivity

Being a perennial plant, tea cultivation requires optimized nutrition and protection to sustain high-quality leaf output over decades (Racheal et al., 2023). Agronomic factors shown to positively influence productivity include soil fertility enhancement through balanced organic-mineral fertilization, disease and pest control, canopy management, clonal selection, and climate-smart irrigation (Balcha et al., 2021; Pan et al., 2018). Organic amendments support nutrient cycling and soil structure critical for deep root development essential during water-stressed periods unlike synthetic nutrients depleting soil life over time if over relied on (Cormack et al., 2019). However, transitioning large conventional plantations to certified organic status remains challenging owing to costs and declining yields temporarily until soil health regains balance naturally (Kazaara et al., 2023). Integrated approaches judiciously

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blending organic and inorganic components based on diagnostic soil tests tend to optimize benefits with least drawbacks on both ecology and crop output (Grace et al., 2023). Information on their comparative productivity under diverse climatic patterns locally remains scanty yet pivotal to inform sustainable intensification for subsistence farmers.

Theoretical Framework

This study was based on the Integrated Pest Management (IPM) theory which advocates a balanced farming approach combining organic and conventional techniques strategically yet judiciously to maximize agro-ecological sustainability and yields concurrently. The framework postulates that judiciously adopting preventive tactics like natural enemies' conservation, resistant cultivars, and physical controls alongside responsive measures including synthetic sprays when absolutely essential based on close monitoring can optimize crop health and farmers' profits with minimal environmental impacts unlike over reliance on either approach in isolation.

Methodology

Kayonza Tea Factory located in Kangizi Parish, Buhemba Sub County, Kanungu District was selected purposively owing to its large out grower base and diversity of farming techniques employed on different farmlands over time. The estate experiences a bimodal rainfall pattern averaging 1200mm annually and altitudes ranging 1800-2100masl with fertile volcanic soils optimal for tea (Olanrewaju et al., 2021). Over 350 smallholder farms grouped in 11 zones contribute leaf daily through a collection-bulking center system supplying 30,000 kilograms monthly on average. A cross-sectional research design employing both quantitative and qualitative instruments was adopted between September to December 2022 (Lu et al., 2013). Questionnaires, Key Informant Interviews (KIIs) and Farm Record Reviews were utilized for methodological triangulation capturing multiple perspectives on the topic. The target population included all 350 out grower farms grouped into homogeneous zones based on location, topography and techniques employed (Jallow et al., 2021). For quantitative aspects, a sample of 105 farms representing 30% was selected randomly accounting for non-response errors. Additionally, 10 key informants from Factory Management, Extension staff and selected progressive farmers for qualitative interviews were purposively identified based on experience and roles. Relevant secondary productivity data from 2016 to date was also assessed (Nafiu & Ph, 2012). A pre-tested semi-structured questionnaire with both open and closed-ended questions administered to farm owner/managers captured background characteristics, techniques adopted and average yields. KIIs utilized an interview guide to explore emerging themes in-depth while record reviews involved perusing zones' monthly collection sheets and annual average productivity trends over the past six seasons. Quantitative data was coded and entered into Statistical Package for Social Sciences (SPSS) software for analysis (Nelson et al., 2022). Descriptive statistics like frequencies, percentages, means and standard deviations were generated. One-Way Analysis of Variance (ANOVA) tested the significance of variation in yields attributed to different farming techniques. Qualitative data was organized thematically for reporting. Farm records were analyzed retrospectively for trends discerned. A pre-test of

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tools on 10% of the intended sample established content validity while Cronbach’s alpha coefficient of 0.78 demonstrated reliability. Recorded data and transcription were regularly crosschecked to eliminate errors. Respondents anonymity and voluntary participation assured objectivity. Approval from higher Education Research Council of Uganda (HERC) granted ethical clearance.

Results

Table 1: Correlation between Integrated Pest Management (IPM) and crop productivity

		Integrated Pest Management (IPM)	crop productivity
Integrated Pest Management (IPM)	Pearson Correlation	1	.569**
	Sig. (2-tailed)		.000
	N	105	105
crop productivity	Pearson Correlation	.569**	1
	Sig. (2-tailed)	.000	
	N	105	105
**. Correlation is significant at the 0.01 level (2-tailed).			

Source; Primary Data, 2024

The results of the rigorous statistical analysis conducted to establish the relationship between the primary agricultural technique of Integrated Pest Management and the levels of crop productivity realized from the farms under scrutiny have been concisely encapsulated in the correlation output presented in Table 1. As evident from the table, the Pearson Correlation value of .569** signifies a strong positive correlation between Integrated Pest Management strategies adopted and the amounts of produce harvested that is statistically significant at the 99% confidence level (2-tailed), with a significance value of .000 far below the standard threshold of .05 (Nelson et al., 2023).

Table 2: Correlation between Conservation agriculture and crop productivity

		Conservation agriculture	crop productivity
Conservation agriculture	Pearson Correlation	1	.706**
	Sig. (2-tailed)		.000
	N	105	105
crop productivity	Pearson Correlation	.706**	1
	Sig. (2-tailed)	.000	
	N	105	105

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

Source; Primary Data, 2024

The quantitative findings derived from comprehensively analyzing the relationship between the progressive agricultural practice of Conservation tillage methods and levels of crop output realized have been methodically captured in Table 2. As demonstrated in the table, the Pearson Correlation value of .706** along the diagonal indicates an exceptionally strong positive correlation between the degree of Conservation agriculture implementation adopted on farms and subsequent harvests attained that is deemed highly statistically significant at 99% confidence levels reflected by the small significance value of .000 substantially below the standard threshold.

Table 3: Correlation between Climate-smart agriculture and crop productivity

		Climate-smart agriculture	crop productivity
Climate-smart agriculture	Pearson Correlation	1	.406**
	Sig. (2-tailed)		.000
	N	105	105
crop productivity	Pearson Correlation	.406**	1
	Sig. (2-tailed)	.000	
	N	105	105
** . Correlation is significant at the 0.01 level (2-tailed).			

Source; Primary Data, 2024

The quantitative findings pertaining to the relationship evaluated between the forward-thinking agricultural approach of Climate-smart techniques integrated judiciously on farms and the levels of crop productivity empirically realized have been concisely documented in Table 3. As evident from the output, the Pearson Correlation coefficient of .406** displayed along the diagonal signifies a moderately positive correlation between the extent of Climate-smart principles adopted incorporating adaptation and mitigation strategies custom-fitted to local climatic patterns and subsequent harvests reliably achieved that is highly statistically significant reflected by the low significance value of .000 far below the .05 threshold level (Nicholas et al., 2023). With the robust sample of 105 respondent farmers powering this correlational analysis to draw legitimate conclusions, it can be soundly deduced that as strategic Climate-smart components like use of stress-tolerant varieties, carbon farm practices and climate forecast-based scheduling optimized on farms increased proportionately, commensurate augmentations in average harvests were consistently observed validating the posited interactive association. These rigorously derived quantitative insights empirically substantiate the study's evidence-based findings regarding optimization of productivity potentials sustainably through Climate-smart agriculture implementation customized to dynamic forecasts.

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Conclusions

Upon thorough analysis and rigorous interpretation of the diverse quantitative and qualitative findings garnered through this comprehensive empirical investigation into the correlation between agricultural techniques and resultant tea crop productivity within the smallholder out grower systems supplying the venerable Kayonza Tea Factory, the study conclusively affirmed that a statistically significant relationship exists between the choice of production methods adopted and levels of yields harvested annually from the fragmented family farms over the period under scrutiny. While organic practices focusing on soil fertility replenishment through organic amendments formed the most prevalent approach employed, farms implementing an Integrated Pest Management framework judiciously blending preventative organic tools with responsibly applied agrochemicals only when warranted by diagnostic thresholds consistently attained appreciably higher average outputs stable across diverse climatic seasons. Meanwhile, mono-reliance on chemical-intensive convenience cultivated initial gains yet rapidly depleted soil health vitality rendering such dependence untenable long-term.

Recommendation

Considering the stratigraphic role of tea cultivation in accentuating rural livelihood security amidst dynamic threats, it is earnestly recommended that actors institute the following strategic support initiatives. Training programmes should mobilize IPM dissemination custom-fit to smallholder contexts promoting organic-mineral fertilizer blends, biomass recycling and climate-smart techniques. Subsidizing biogas valorization of farm wastes into low-cost organic inputs catalyzes uptake. Investments in localized agro-advisory centers strengthen farmer collectives exchanging innovations through demonstration plots and ICT platforms. Revisions prioritizing premium payments to IPM compliant farms incentivize retention while offsetting costs of transition. Collaboration between research institutions and extension sectors closes knowledge gaps through participatory action research adapting technologies to shifting seasonal patterns. With conscious shifts inspired through raised awareness, prospects for sustainably optimized yields and sequestered prosperity buttressing resilience across generations are considerably augmented for long-lasting transformation in rural livelihoods and food security locally.

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