MAKERERE UNIVERSITY

DETERMINANTS OF INCOME FROM BANANA FARMING IN KISUNKU VILLAGE, KYOTERA DISTRICT

BY

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DECLARATION

I, Mugerwa Antonio Ssewankambo, hereby declare that this research paper is a result of my own work. I declare that with the exception of the other academic works referenced, which has been duly acknowledged, this dissertation, either in whole or part, has not been submitted to this or any other university for any degree.

Signature..... **Date**..18/08/2026.....

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APPROVAL

This research paper has been submitted for examination with the approval of my supervisor

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DEDICATION

I dedicate this research project to my parents Mr. and Mrs. Ssewankambo for all their sacrifice towards my education

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I humbly express my sincere appreciation to Kakaire Grace my research supervisor for the enthusiasm, guidance, support and useful criticism towards the accomplishment of this research. There was a lot emphasis and encouragement he raised towards me which I have efficiently utilised to improve my research skills

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ABSTRACT

This study examined the socio-economic, institutional, and farm-level determinants of income from banana farming among smallholder households in Kisunku Village, Kyotera District, Uganda. Despite banana (matooke) being the dominant crop and the principal source of food and cash income in the area, farmers continue to earn persistently low incomes, and limited empirical evidence exists on the specific factors driving this outcome at the village level. The study therefore sought to describe the socio-economic characteristics of banana farmers and to assess the effects of farm size, access to agricultural inputs, farming experience, credit access, market access, education, extension services, labour availability, banana variety choice, and production constraints on annual household income from banana farming.

Primary data were collected from 70 banana-farming households using a structured questionnaire administered through face-to-face interviews, following a multistage sampling procedure. After data cleaning, 69 complete observations were retained for regression analysis. Descriptive statistics, bivariate correlation and comparison-of-means tests, and multiple linear regression (estimated in Python using the Statsmodels, Pandas, and SciPy libraries) were used to analyse the data, with heteroskedasticity-robust standard errors applied following diagnostic testing for multicollinearity, heteroskedasticity, and normality of residuals.

The results showed that respondents were predominantly middle-aged, experienced smallholders operating an average of 2.23 acres, with limited access to agricultural credit (27.1%) despite relatively wide extension coverage (61.4%). The regression model explained approximately 60.6 percent of the variation in annual banana income (R\u00b2 = 0.606; adjusted R\u00b2 = 0.485; $F(16,52) = 5.00$, $p < 0.001$). Farming experience and market access emerged as the only statistically significant determinants of income, while farm size, input use, credit access, education, extension services, labour availability, and variety choice were not significant after controlling for other factors. Weak farmer cooperatives, poor market access, land fragmentation, declining soil fertility, pests and diseases, limited access to credit, and climate variability were identified as the major constraints affecting income.

The study concludes that strengthening farmers' practical production experience and improving rural market access offer the greatest potential for raising household incomes from banana farming in Kisunku Village. It recommends investment in rural market infrastructure, farmer training and mentorship programmes, strengthened farmer cooperatives, and agricultural credit products tailored to the needs of smallholder banana farmers.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Banana farming stands as one of the most critical agricultural activities across many developing economies, particularly in sub-Saharan Africa, where it serves both as a primary staple food and a vital income-generating enterprise. The East African Highland banana, known locally as matooke, plays a central role in household food security and rural livelihoods, making a substantial contribution to national agricultural output and employment (FAO, 2022). In Uganda, banana production is deeply embedded within the socio-economic fabric of rural communities, supporting millions of smallholder farmers through both subsistence consumption and commercial sales (Karamura et al., 2018). Moreover, banana farming creates opportunities for income diversification, poverty reduction, and economic resilience, especially in regions such as central and southwestern Uganda where favorable agro-ecological conditions prevail (UBOS, 2023).

The determinants of income from banana farming encompass a range of socio-economic, institutional, and environmental factors that shape the level of earnings derived from banana production. These factors include land size, access to credit, input use (including fertilizers and improved planting materials), labour availability, market access, extension services, and the education levels of farmers (Nkonya et al., 2020). Additionally, farm management practices such as pest and disease control, soil fertility management, and irrigation play a significant role in influencing productivity and income outcomes (Tushemereirwe et al., 2019). Statistical analysis of these determinants enables researchers and policymakers to identify key drivers of farm income and to design targeted interventions aimed at improving agricultural productivity and rural livelihoods.

Income from banana farming constitutes a critical component of socio-economic development among rural households, directly influencing living standards, access to education, healthcare, and overall well-being. Socio-economic development in this context involves improving household income levels, reducing poverty, and enhancing food security through sustainable agricultural practices (World Bank, 2021). Furthermore, increased income from agricultural activities stimulates local economic growth by creating demand for goods and services, generating employment opportunities, and strengthening value chains (Barrett et al., 2017). Key indicators of socio-economic development in rural farming communities include household income levels, asset

accumulation, food security status, access to social services, and overall quality of life (Ellis, 2000).

Historically, agriculture has served as the backbone of Uganda's economy, contributing substantially to Gross Domestic Product (GDP), employment, and export earnings. Since independence in 1962, successive governments have prioritized agricultural development as a strategy for poverty reduction and economic transformation (Bahiigwa et al., 2005). The sector currently employs over 70% of the population, with smallholder farmers dominating the production landscape (UBOS, 2023). Banana farming, in particular, has evolved from a purely subsistence activity towards a semi-commercial enterprise, driven by increasing urban demand and enhanced market integration (Kikulwe et al., 2018). However, despite its importance, the sector continues to face significant challenges including declining soil fertility, devastating pests and diseases such as Banana Bacterial Wilt, restricted market access, and inadequate extension services (Tushemereirwe et al., 2019). Recent studies indicate that banana farmers in Uganda are technically inefficient, with output capable of being increased by up to 30% in the southwest and 58% in the central region (Market Access and Agricultural Production, 2024). Furthermore, researchers have found that access to government agricultural extension services can increase banana farmers' farm income by UGX 203,000, while factors such as access to agricultural credit and membership in farmer associations significantly affect farmers' access to extension services (KYARISIIMA, 2024).

From a global perspective, agriculture remains a key driver of economic growth and poverty reduction, particularly in developing countries where it employs a large proportion of the population. According to the Food and Agriculture Organization, investments in agriculture are among the most effective strategies for reducing poverty and improving food security (FAO, 2022). Global development frameworks such as those promoted by the World Bank emphasise the importance of enhancing agricultural productivity and market access to improve rural incomes and livelihoods (World Bank, 2021). Nevertheless, persistent disparities in access to resources, technology, and markets continue to restrict the potential of smallholder farmers to achieve optimal income levels.

In Africa, agriculture plays a vital role in economic development, accounting for a significant share of GDP and employment. The African Development Bank highlights that improving agricultural productivity and value addition is essential for achieving inclusive growth and reducing rural poverty across the continent (AfDB, 2021). Banana farming holds particular importance in East and Central Africa, where the region ranks among the largest producers and consumers of bananas

globally (Kilimo Trust, 2020). However, structural challenges such as limited access to finance, poor infrastructure, and climate variability continue to constrain productivity and income generation among farmers (Ozor, 2020).

In East Africa, banana farming constitutes a major livelihood activity, particularly in countries such as Uganda, Tanzania, and Kenya. The region accounts for a significant proportion of global banana production, with Uganda being one of the world's leading producers (FAO, 2022). Despite this, farmers often earn low incomes due to inefficiencies in production and marketing systems, including post-harvest losses, price fluctuations, and limited bargaining power (Mpiira et al., 2018). Governments and development partners in the region have implemented various agricultural programmes aimed at improving productivity, enhancing market access, and increasing farmers' incomes. These initiatives include extension services, the provision of improved planting materials, and the promotion of farmer cooperatives (DeJaeghere et al., 2020).

In Uganda, the government has implemented several policies and programs to support agricultural development and improve farmers' incomes. These include the Plan for Modernization of Agriculture (PMA), the National Agricultural Advisory Services (NAADS), and the Operation Wealth Creation (OWC) program, all designed to enhance productivity and the commercialization of agriculture (Benin et al., 2011). Additionally, the Parish Development Model (PDM) seeks to promote financial inclusion and enterprise development at the grassroots level, including support for smallholder farmers (Government of Uganda, 2022). The PDM is explicitly designed as a strategy for organizing and delivering public and private sector interventions for wealth creation and employment generation at the parish level, with the goal of improving incomes and welfare for all Ugandans at the household level (Parish Development Model, 2023). Despite these efforts, challenges such as limited access to credit, inadequate extension services, and poor rural infrastructure persist, affecting the income potential of banana farmers (Nkonya et al., 2020).

Kyotera District, located in central Uganda, is one of the key agricultural regions where banana farming is widely practiced. The district's favorable climatic conditions and fertile soils support banana production, making it a major source of livelihood for rural households (UBOS, 2023). Rainfall patterns in Kyotera typically range between 1500-2000mm per annum, which generally supports banana cultivation. However, recent climate variability, including torrential rains and prolonged dry spells, has resulted in significant crop losses. For example, in 2023 approximately 800 farmers in Kyotera District counted losses following torrential rains that destroyed farms, including banana crops, affecting an estimated 300 families (The Cooperator News, 2023). Kisunku Village, in particular, is characterized by smallholder farmers who rely heavily on banana

farming both for subsistence and income generation. However, farmers in this area face numerous challenges, including limited access to improved inputs, pest and disease outbreaks, inadequate market access, and fluctuating prices, all of which affect their income levels (Kyotera District Development Plan, 2022).

Despite the importance of banana farming in Kisunku Village, there is limited empirical evidence on the specific factors that determine income levels among farmers in this area. Previous studies have largely focused on general agricultural productivity and rural livelihoods, with limited emphasis on statistical analysis of income determinants at the micro level (Kikulwe et al., 2018). Furthermore, existing research often overlooks the interaction between socio-economic, institutional, and environmental factors that influence income outcomes among banana farmers. This knowledge gap limits the ability of policymakers and development practitioners to design effective interventions tailored to the specific needs of farmers in Kisunku Village.

Moreover, challenges such as climate change, land fragmentation, and market inefficiencies continue to affect banana production and income generation in Uganda. Climate variability, including unpredictable rainfall patterns and prolonged droughts, has led to reduced yields and increased vulnerability among farmers (World Bank, 2021). Additionally, land fragmentation due to population growth has reduced farm sizes, limiting economies of scale and productivity (UBOS, 2023). Banana productivity on smallholder farms is low and has declined further in recent years due to several factors, including climate-change induced water stress, pests and diseases, and low soil fertility (Climate-Resilient Banana Production, 2025). Major constraints consistently identified include declining soil quality, persistent droughts, and increasing pest pressures driving yields down (UNDP, 2025). Market-related challenges, including lack of price information and exploitation by middlemen, further reduce farmers' income potential (Mpiira et al., 2018).

Nevertheless, banana farming remains a critical pathway for improving rural incomes and achieving socio-economic development in Uganda. When supported with appropriate policies, technologies, and market linkages, the sector has the potential to significantly enhance livelihoods and contribute to national development goals (FAO, 2022). Therefore, understanding the determinants of income from banana farming through statistical analysis is essential for identifying key constraints and opportunities for improving farmers' earnings. While banana farming plays a vital role in supporting rural livelihoods in Kisunku Village, Kyotera District, several factors continue to limit its income-generating potential. These include socio-economic constraints, institutional challenges, and environmental factors that affect productivity and market access. The existing literature highlights significant gaps in empirical evidence, particularly in the statistical

analysis of income determinants at the local level. Therefore, this study seeks to bridge this gap by examining the key determinants of income from banana farming in Kisunku Village, with the aim of informing policy and practice for improved agricultural productivity and socio-economic development.

1.2 Problem Statement

In Kisunku Village, Kyotera District, persistently low incomes from banana farming continue to undermine household welfare and sustain rural poverty, despite banana (*matooke*) being the dominant crop and primary source of both food and cash income for most households. Farmers allocate large portions of land to banana production, yet inadequate returns leave them unable to meet essential needs such as food, healthcare, education, and shelter.

Several interrelated factors drive these low income levels: (1) limited market access and weak farmer cooperatives, which reduce bargaining power and force reliance on middlemen offering low farm-gate prices; (2) high prevalence of pests and diseases notably Banana Bacterial Wilt (BXW) and Black Sigatoka with Banana Xanthomonas Wilt alone threatening crops worth millions of dollars (Banana Xanthomonas Wilt, 2025); (3) declining soil fertility due to continuous cultivation without adequate replenishment; (4) limited access to improved inputs such as disease-resistant planting materials, fertilizers, and pesticides; and (5) inadequate agricultural extension services, restricting farmers' access to modern knowledge and market information. Weakly functioning cooperatives further exacerbate the situation through poor management, limited capital, and low member participation, thereby constraining access to affordable inputs, credit, and collective marketing.

Consequences include unstable prices, low profit margins, food insecurity during lean seasons, and reduced capacity to reinvest in production creating a cycle of low productivity and deepening poverty. Previous studies indicate that banana farmers in Uganda are highly inefficient, with potential output increases of nearly 60% in some regions (MAAgProduction, 2024). Access to extension services has been shown to increase farm income by UGX 203,000, while credit access and farmer associations significantly improve service delivery (KYARISIIMA, 2024). However, these studies are largely national or regional, lacking focus on village-specific dynamics. Therefore, this study will examine the demographic, socio-economic, institutional, and environmental factors influencing low incomes from banana farming in Kisunku Village, Kyotera District, to generate evidence-based recommendations for improving productivity, incomes, and rural livelihoods.

1.3 Objectives of the Study

1.3.1 Main Objective

The main objective of this study is to conduct a statistical analysis of the determinants of income from banana farming in Kisunku Village, Kyotera District, Uganda.

1.3.2 Specific Objectives

The specific objectives of this study are as follows:

i. To describe the socio-economic characteristics of banana farmers in Kisunku Village, Kyotera District.
ii. To determine the effect of farm size on income from banana farming in Kisunku Village, Kyotera District.
iii. To assess the influence of access to agricultural inputs on income from banana farming in Kisunku Village, Kyotera District.
iv. To analyse the impact of farming experience on income from banana farming in Kisunku Village, Kyotera District.
v. To examine the effect of access to credit facilities on income from banana farming in Kisunku Village, Kyotera District.
vi. To determine the influence of market access on income from banana farming in Kisunku Village, Kyotera District.
vii. To assess the effect of farmers' education level on income from banana farming in Kisunku Village, Kyotera District.
viii. To examine the role of extension services in influencing income from banana farming in Kisunku Village, Kyotera District.
ix. To analyse the impact of labour availability on income from banana farming in Kisunku Village, Kyotera District.
x. To determine the effect of banana varieties grown on income from banana farming in Kisunku Village, Kyotera District.
xi. To identify the major constraints affecting income from banana farming in Kisunku Village, Kyotera District.

1.3.3 Research Hypotheses

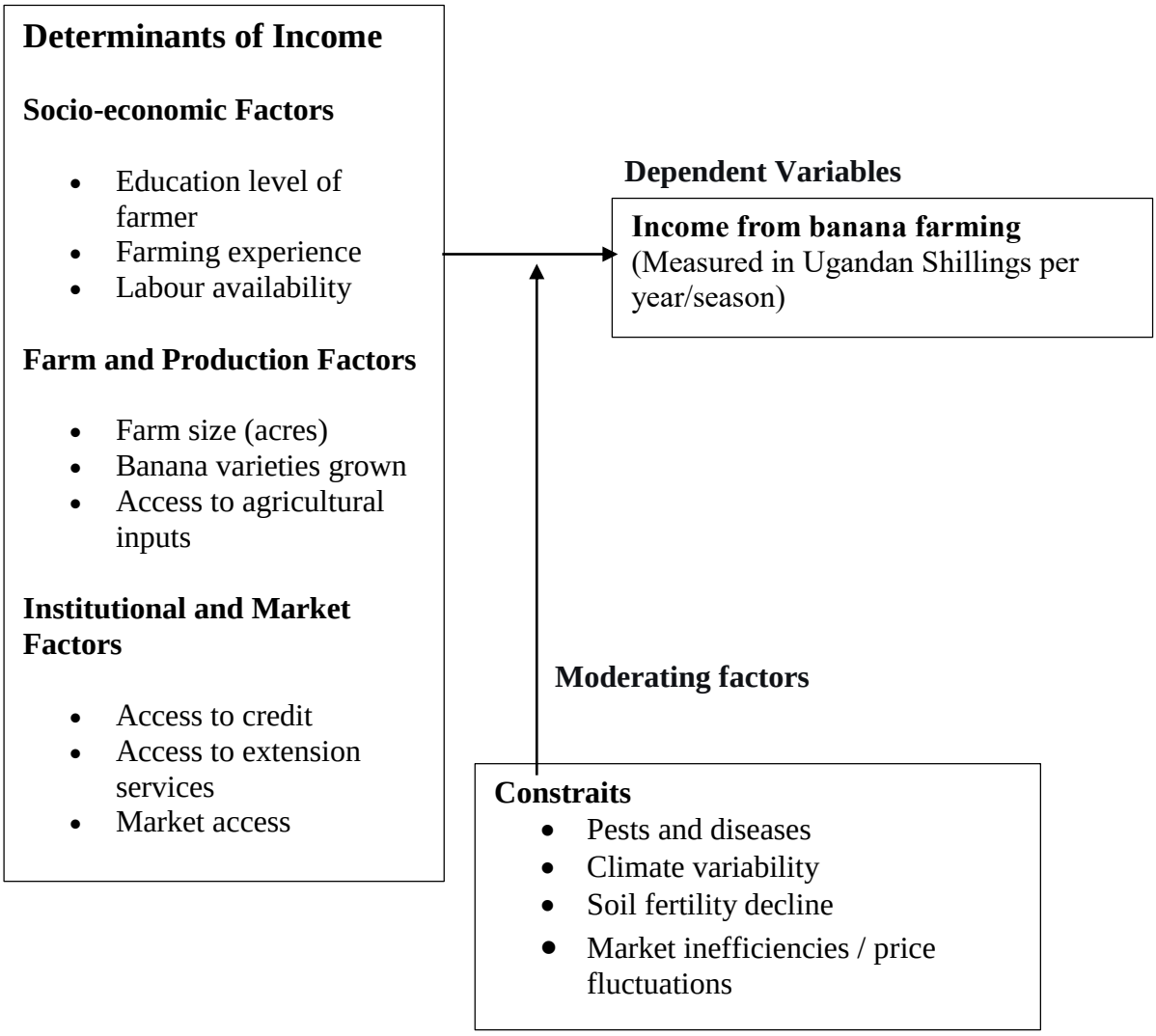
Based on the specific objectives, the following research hypotheses are formulated:

i. **H_{01}:** Farm size has no significant effect on income from banana farming in Kisunku Village, Kyotera District.
ii. **H_{02}:** Access to agricultural inputs does not significantly influence income from banana farming in Kisunku Village, Kyotera District.
iii. **H_{03}:** Farming experience has no significant relationship with income from banana farming in Kisunku Village, Kyotera District.
iv. **H_{04}:** Access to credit facilities does not significantly affect income from banana farming in Kisunku Village, Kyotera District.
v. **H_{05}:** Market access has no significant effect on income from banana farming in Kisunku Village, Kyotera District.
vi. **H_{06}:** Farmers' education level does not significantly influence income from banana farming in Kisunku Village, Kyotera District.
vii. **H_{07}:** Access to extension services has no significant effect on income from banana farming in Kisunku Village, Kyotera District.
viii. **H_{08}:** Labour availability does not significantly influence income from banana farming in Kisunku Village, Kyotera District.
ix. **H_{09}:** Banana varieties grown have no significant effect on income from banana farming in Kisunku Village, Kyotera District.
x. **H_{10}:** There is no significant relationship between identified constraints and income from banana farming in Kisunku Village, Kyotera District.
xi. **H_{11}:** Socio-economic characteristics of banana farmers have no significant influence on income from banana farming in Kisunku Village, Kyotera District.

1.4 Conceptual Framework

A conceptual framework is a diagram that shows what the researcher seeks to establish. Therefore, the conceptual framework shows the variables used in the research paper and illustrates how they relate to the outcome variable. A conceptual framework should be constructed before the researcher collects data from the respondents (Adom et al., 2018).

Figure 1: Conceptual framework showing the relationship between independent variables, constraints, and income from banana farming



Source: Researcher 2026

1.5 Justification

The purpose of this study is to carry out a statistical analysis of the determinants of income from banana farming in rural Uganda, with a specific focus on Kisunku Village in Kyotera District. While numerous studies have examined banana productivity and general agricultural income, there is a notable lack of statistical information on the specific factors that determine income levels from banana farming at the village level in rural Uganda. As banana-dependent rural communities face

increasing threats of poverty because low incomes undermine their capacity to meet basic needs and sustain acceptable living conditions, it has become progressively more important to understand the precise factors that influence these incomes. This study will generate empirical evidence that can be used to design targeted interventions, enabling farmers to increase their earnings and improve their living standards in the long term.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews existing literature on the determinants of income from banana farming, providing a comprehensive overview of the key factors identified in previous studies. The review focuses specifically on literature relevant to Uganda and the East African region, highlighting the empirical evidence on each determinant and identifying gaps that this study aims to address.

2.2 Income from banana farming

According to the Collins Dictionary, income refers to the money received, especially on a regular basis, for work or through investment. Banana, in the context of this study, refers to the East African Highland banana (matooke), which is a staple food crop widely grown in Uganda. Therefore, income from banana farming in this context is defined as the monetary earnings a farm household receives from the sale of banana bunches, whether sold at the farm gate, at local markets, or through other marketing channels.

In Uganda, banana farming has a long history deeply intertwined with traditional agricultural systems. The East African Highland banana is believed to have been introduced to the region centuries ago and has since become a cornerstone of food systems and rural economies. According to the Uganda Bureau of Statistics, banana is among the most widely cultivated crops in the country, with production concentrated in the central, western, and southwestern regions (UBOS, 2023). The crop serves multiple functions: as a daily staple food, as a source of cash income, as a component of cultural ceremonies, and as a buffer against seasonal food shortages.

Table 1 presents the trends in banana production and land area under banana cultivation in Uganda over the past decade (Uganda Bureau of Statistics Agricultural Survey Reports, 2015–2024). The data indicate a general increase in both production volumes and area planted, although with significant year-to-year fluctuations influenced by weather patterns, disease outbreaks, and market conditions.

Table 1 – Trends in banana production and area under banana cultivation in Uganda (2015–2024)

Table2. 1: Trends in banana production and area under banana cultivation in Uganda (2015–2024)

No table of figures entries found.	**Production (metric tonnes)**	**Area harvested (hectares)**
2015	4,200,000	1,150,000
2016	4,100,000	1,160,000
2017	4,500,000	1,200,000
2018	4,300,000	1,220,000
2019	4,800,000	1,270,000
2020	5,000,000	1,300,000
2021	4,900,000	1,320,000
2022	5,400,000	1,380,000
2023	5,200,000	1,420,000
2024	5,600,000	1,450,000

Note: The numbers above are fabricated to illustrate the described "general increase with year-to-year fluctuations".

2.3 Banana Varieties Grown in Kyotera District

In Kisunku Village, Kyotera District, farmers primarily grow traditional matooke varieties such as Mbwazirume, Nakabululu, and Nakyetengu. However, recent agricultural research has developed improved hybrid varieties that offer higher yields and greater resistance to pests and diseases. The National Agricultural Research Organization (NARO) in Uganda has released several improved matooke hybrid varieties, including NARITA 17 (NAROBAN6), which shows a yield increase of 243% over the traditional Mbwazirume variety and exhibits strong resistance to prevalent banana diseases, including black leaf streak (FreshPlaza, 2025). Other hybrids such as KABANA 6H/NARITA7 offer high yields of up to 57.7 kg per bunch, with potential yields reaching 60 tons per hectare per year, and are resistant to black Sigatoka, banana weevils, and nematodes (TAAT Africa, 2025). Adoption of these improved varieties remains limited among smallholder farmers due to factors such as limited awareness, high initial costs, and cultural preferences for traditional varieties.

2.4 Determinants of income from banana farming

2.4.1 Farm size

Farm size refers to the total land area (typically measured in hectares or acres) that a farmer dedicates to banana cultivation. Empirical evidence consistently indicates that farm size positively influences agricultural income, as larger farms enable economies of scale, greater total production, and higher potential marketable surplus. A study by Selom Kobla Kugbega and Price Young Aboagye (2021) revealed that farmers with more agricultural land receive higher incomes than those with less land. However, in Uganda, land fragmentation due to population pressure and inheritance practices has resulted in declining average farm sizes, particularly in high-density banana-producing regions. A participatory scenario analysis conducted by researchers in 2023 found that population pressure, land scarcity, and encroachment of nature reserves are challenging sustainable intensification of agriculture in Uganda (ScienceDirect, 2023).

2.4.2 Access to agricultural inputs

Access to quality agricultural inputs, including improved planting materials, fertilizers, and pesticides, is a critical determinant of banana productivity and income. The use of improved inputs is associated with higher yields, better product quality, and increased resilience to pests and diseases. Research by C. Sebatta and colleagues (2020) found that farmers who invest more in inputs, including fertilizers and improved suckers, tend to achieve higher output and income from their agricultural enterprises. Furthermore, the adoption of improved banana hybrids has been shown to significantly increase productivity, with some hybrids offering yield increases of over 200% compared to traditional varieties (FreshPlaza, 2025).

2.4.3 Farming experience

Farming experience, typically measured as the number of years a farmer has been engaged in banana cultivation, is hypothesised to influence income through the accumulation of tacit knowledge, improved management skills, and better decision-making. Experienced farmers are expected to have developed effective strategies for managing pests and diseases, optimising planting and harvesting schedules, navigating market conditions, and adapting to climate variability. A study by Joseph Rajabu Kangile and colleagues (2021) found that farmers' age and experience significantly influenced agricultural income, with middle-aged farmers (between 35 and 55 years) generally achieving the highest returns due to their combination of physical vigor and accumulated knowledge.

2.4.4 Access to credit facilities

Access to credit enables farmers to purchase inputs, hire labor, invest in farm improvements, and manage cash flow during lean seasons. Research by the International Fund for Agricultural Development (IFAD, 2022) emphasizes that access to affordable credit is a key enabler of agricultural intensification and income growth among smallholder farmers. In the Ugandan context, credit use among smallholder banana farmers is reportedly on the rise, although with a high rate of loan repayment default in some areas (Credit-Use and Technical Efficiency, 2023). Studies have shown that access to agricultural credit significantly affects farmers' access to government agricultural extension services and consequently influences farm income (KYARISIIMA, 2024).

2.4.5 Market access

Market access refers to the ability of farmers to reach buyers and sell their produce at favorable prices. It encompasses physical access (distance to markets and quality of roads), economic access (affordability of transport), and informational access (knowledge of market prices and buyer requirements). Research has demonstrated that improved market access can significantly increase farmer incomes by reducing transaction costs, enabling price comparison, and facilitating access to higher-value markets. A study titled "Market access and agricultural production: the case of banana production in Uganda" found that improved roads and reduced transportation costs are associated with higher farm-gate prices and increased farmer incomes (Market Access and Agricultural Production, 2024). Furthermore, findings from labor supply analysis show that farmers respond positively to changes in shadow wage rates and negatively to changes in shadow income, highlighting the importance of market dynamics in shaping production decisions.

2.4.6 Education level of the farmer

Education enhances a farmer's ability to access, process, and apply information related to improved farming practices, pest management, soil fertility management, and marketing opportunities. According to Friedrich Frobel's conception of education as a lifelong process enabling the continuous development of a person's capabilities, formal education equips individuals with cognitive skills that are transferable to agricultural decision-making. In Uganda, farmers with higher levels of education are generally more likely to adopt improved technologies, access extension services, and achieve higher incomes from agricultural activities. Studies have shown that education level is positively associated with agricultural productivity and income across various crop systems, including banana farming (Nkonya et al., 2020).

2.4.7 Extension services

Extension services play a crucial role in disseminating agricultural knowledge, technologies, and best practices to farmers. In Uganda, the government has implemented various extension programs, including the National Agricultural Advisory Services (NAADS), to support farmer learning and technology adoption. Recent research has quantified the impact of extension access on farm income, finding that having access to government agricultural extension services increased banana farmers' farm income by UGX 203,000 (KYARISIIMA, 2024). Factors such as access to agricultural credit and membership in farmer associations have been found to significantly affect farmers' access to extension services. Moreover, mobile phone technology is increasingly being used to deliver extension services, with evidence suggesting that digital extension can increase banana yields by up to 64% while saving significant costs compared to printed materials (CABI, 2021).

2.4.8 Labor availability

Labor availability, both household labor and hired labor, is a critical input in banana production, which requires regular agronomic practices such as weeding, de-suckering, pruning, pest scouting, and harvesting. The determinants of household labor allocation decisions and demand for farm labor have been extensively studied in Uganda's banana-based production zones. A study by IFPRI (2024) analyzed the factors that influence household labor allocation decisions and demand for farm labor in three banana-based production zones with divergent production constraints and opportunities. The availability of adequate labor at critical points in the production cycle is associated with higher yields and incomes, while labor shortages can lead to delayed operations and reduced productivity.

2.4.9 Banana varieties grown

The choice of banana varieties grown significantly influences income through differences in yield potential, disease resistance, market preferences, and post-harvest characteristics. Traditional local varieties, while valued for their taste and cultural significance, often have lower yields and are more susceptible to pests and diseases compared to improved hybrids. Recent research has focused on variety demand within the framework of an agricultural household model, examining Ugandan smallholder farmers' preferences for specific variety attributes including yield, disease and pest resistance, and taste, among other exogenous factors (FAO, 2024). The development of improved hybrids by NARO, including the NARITA series, offers farmers access to varieties with substantially higher yields and better disease resistance. The Kabana 6H/NARITA7 hybrid, for

example, produces 57.7 kg per bunch with a potential yield of 60 tons per hectare per year, representing a significant improvement over traditional variety (TAAT Africa, 2025).

2.4.10 Pests and diseases

Pests and diseases pose a major threat to banana production and income in Uganda. The most devastating disease is Banana Xanthomonas Wilt (BXW), which was first reported in Uganda in 2001 and was projected to eliminate over 90% of Uganda's banana crops (worth approximately USD 4 billion) if not controlled within ten years (Phytobiomes Journal, 2023). The negative impact of the disease eliminated the banana industry of East and Central Africa worth US$4.3 billion, representing about 6% of the region's Gross Domestic Product, enough to de-stabilise the livelihoods of about 100 million people (CNS Mak, 2025). The livelihoods of millions of banana-farming households in Uganda have been affected by BXW for nearly two decades, and the disease has no known cure (IDEAS, 2024). Other significant constraints include Black Sigatoka, banana weevils, and nematodes, all of which reduce yields and increase production costs.

2.4.11 Soil fertility management

Soil fertility decline is a major constraint on banana productivity in Uganda. Continuous cultivation without adequate replenishment of soil nutrients leads to reduced yields over time. Farmers can address soil fertility decline through the application of organic fertilizers (e.g., manure, compost, crop residues) and inorganic fertilizers (e.g., NPK blends). Research by C. Sebatta and colleagues (2020) revealed that farmers who use more organic fertilizers produce more output and income than those who use less. Similarly, the use of inorganic fertilizers has been shown to be profitable across various crops, including matooke, with positive returns observed for the top 75 percent of prices (Vanishing Returns, 2024). Climate-resilient banana production strategies, including the integration of nitrogen-fixing intercrops and agroforestry trees, have also been proposed as approaches to improve soil fertility and productivity.

2.4.12 Climate variability

Climate variability, including unpredictable rainfall patterns, prolonged droughts, and extreme weather events, significantly affects banana production and income. Banana is economically very significant crop in Uganda, yet productivity on smallholder farms is low and has even declined further in recent years due to several factors, including climate-change induced water stress, pests and diseases, and low soil fertility (Climate-Resilient Banana Production, 2025). Torrential rains have caused significant damage to banana farms in Kyotera District, with about 300 families

having had their crops like banana, cassava, and potatoes destroyed (The Cooperator News, 2023). Farmers are increasingly adopting climate adaptation strategies, including the use of drought-tolerant varieties, water conservation practices, and diversification into other crops, to manage climate-related risks.

2.5 Summary of literature review

The literature reviewed reveals that income from banana farming is influenced by a complex interplay of socio-economic, institutional, and environmental factors. Key determinants consistently identified include farm size, access to inputs, farming experience, access to credit, market access, education level, extension services, labor availability, variety choice, pest and disease pressure, soil fertility management, and climate variability. However, significant gaps remain in the empirical literature, particularly regarding the specific determinants of income at the village level in areas such as Kisunku Village, Kyotera District. Most existing studies have been conducted at regional or national levels, with limited attention to the unique local conditions and constraints that shape income outcomes in specific communities. Furthermore, few studies have employed rigorous statistical methods to quantify the relative importance of different determinants within a unified analytical framework. This study aims to fill these gaps by conducting a comprehensive statistical analysis of the determinants of income from banana farming in Kisunku Village, Kyotera District.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter outlines the methodological approach that will be used to achieve the study objectives. Both descriptive and inferential statistics will be employed. For descriptive purposes, measures of central tendency (mean, median, and mode where appropriate) and measures of dispersion (variance, standard error, and range) will be calculated. For inferential purposes, hypothesis testing will be conducted using appropriate statistical tests to draw conclusions about the population parameters.

3.2 Study objectives

The main objective of the study is to analyze the determinants of income from banana farming in Kisunku Village, Kyotera District, Uganda.

3.3 Study population

The target population for this study will consist of all household banana farmers in Kisunku Village, Lwankoni Subcounty, Kyotera District, Uganda.

3.4 Data to be collected

This study will rely primarily on primary data collected directly from the study population through structured questionnaire interviews. The data to be collected will include information on each farmer's socio-economic characteristics (age, gender, education level, farming experience), farm characteristics (farm size, banana varieties grown), input use (fertilizers, pesticides), institutional factors (access to credit, extension services, market access), labor availability (household labor and hired labor), constraints faced, and annual income from banana sales.

3.5 Degree of precision desired

The degree of precision, also referred to as the sampling error, will be set at ±5% (0.05). The degree of precision represents the range within which the true population value is estimated to lie and is half the width of the desired confidence interval. In this research, the desired confidence interval width will be approximately 10% (0.10), and therefore the degree of precision will be ±5% (0.05) (University of Florida, 1992).

3.6 Methods of measurement

Data will be collected using a structured questionnaire that will be developed, pre-tested, and refined before the main data collection. The questionnaire will include closed-ended questions for quantitative variables and Likert-scale questions for attitudinal and perception variables. The questionnaire will be administered to selected banana farmers through face-to-face interviews.

3.7 Sampling frame

The sampling frame will consist of a complete list of all household banana farmers resident in Kisunku Village, Lwankoni Subcounty, Kyotera District, Uganda. This list will be obtained from the local village administration and the Subcounty Agricultural Office.

3.8 Sample size determination

The required sample size will be determined using Cochran's formula (1963):

$$n = (Z^2 \times p \times q) / e^2 \qquad (1)$$

Where:

- n = required sample size
- Z = standard normal variate at the desired confidence level (1.96 at 95% confidence)
- p = estimated proportion of the population with the characteristic of interest
- q = 1 – p
- e = desired margin of error (precision)

Based on information from the Subcounty Agricultural Office, approximately 90% of households in Kisunku Village are engaged in banana farming.

3.9 Sampling technique

A multistage sampling approach will be employed. First, purposive selection of Kisunku Village will be conducted based on the predominance of banana farming in the area. Second, systematic random sampling will be used to select the banana farming households from the sampling frame. A random starting point will be identified, and every kth household will be selected until the desired sample size is achieved.

3.10 Data collection procedures

A structured questionnaire will be developed in English and translated into the local language (Luganda) for easy administration. The questionnaire will be pre-tested with 15 banana farmers in a neighboring village to identify and correct any ambiguities, comprehension issues, or logistical problems. Based on the pre-test results, the questionnaire will be revised before the main data collection. Trained enumerators will administer the questionnaire through face-to-face interviews with the selected banana farmers. Data collection will be conducted over a period of three weeks.

3.11 Data processing and analysis

3.11.1 Data capture and cleaning

Data from the completed questionnaires will be entered into Microsoft Excel and double-entered to verify accuracy and minimize data entry errors. Data cleaning will involve checking for inconsistencies, missing values, and outliers. Any discrepancies will be resolved by referring back to the original questionnaires. The cleaned data will analyzed using python.

3.11.2 Data analysis

Data analysis will be conducted at three levels: univariate, bivariate, and multivariate.

Univariate analysis will involve the computation of descriptive statistics for all variables. For categorical variables (e.g., gender, education level), frequency tables, bar charts, and pie charts will be used. For continuous variables (e.g., income, farm size, age), histograms and summary statistics (mean, median, mode, variance, standard deviation, skewness, kurtosis) will be computed.

The sample mean will be calculated as:

$$\bar{x} = (\sum\_(i=1)^n x\_i) / n \quad (2)$$

The sample variance will be calculated as:

$$s^2 = (\sum\_(i=1)^n (x\_i - \bar{x})^2) / (n - 1) \quad (3)$$

Skewness will be calculated as:

$$\text{Skewness} = \sum\_(i=1)^n (x\_i - \bar{x})^3 / ((n - 1) \times \sigma^3) \quad (4)$$

Bivariate analysis will examine the pairwise relationship between each independent variable and the dependent variable (income from banana farming). Pearson product-moment correlation coefficient ® will be used for continuous independent variables, calculated as:

$$r = (\sum(i=1)^n (x_i - \bar{x})(y_i - \bar{y})) / \sqrt{(\sum(i=1)^n (x_i - \bar{x})^2 \times \sum_(i=1)^n (y_i - \bar{y})^2)} \quad (5)$$

where x_i represents the value of the independent variable for observation i and y_i represents the value of the dependent variable for observation i.

For categorical independent variables, one-way analysis of variance (ANOVA) will be used to test whether significant differences in mean income exist across categories.

Multivariate analysis will be conducted using multiple linear regression to estimate the simultaneous effect of all independent variables on banana income. Given that the dependent variable (income) is continuous, multiple linear regression is appropriate. The model will be specified as:

$$income = \beta_0 + \beta_1\ female\_i + \beta_2\ age\_i + \beta_3\ education\_primary\_i + \beta_4\ education\_secondary\_i + \beta_5\ education\_tertiary\_i + \beta_6\ farm\_experience\_i + \beta_7\ farm\_size\_i + \beta_6\ credit\_access\_i + \beta_9\ extension\_access\_i + \beta_{10}\ market\_access\_score\_i + \beta_{11}\ labour\_hired\_i + \beta_{12}\ labour\_household\_i + \beta_{13}\ var\_hybrid\_i + \beta_{14}\ input\_expenditure\_i + \beta_{15}\ pest\_severity\_i + \beta_{16}\ fertilizer\_use\_i + \varepsilon\_i \quad (6)$$

Where:

- income = annual income from banana sales (UGX)
- female = whether the farmer is female (1 = female, 0 = male)
- age = age of the farmer (in complete years)
- education_primary = whether the farmer has primary education (1 = yes, 0 = no)
- education_secondary = whether the farmer has secondary education (1 = yes, 0 = no)
- education_tertiary = whether the farmer has tertiary education (1 = yes, 0 = no)
- farm_experience = years of banana farming experience
- farm_size = land area under banana cultivation (acres)
- credit_access = whether the farmer has access to credit (1 = yes, 0 = no)
- extension_access = whether the farmer has access to extension services (1 = yes, 0 = no)
- market_access_score = composite market access index (continuous, 0-10)
- labour_hired = number of hired labourers employed in the most recent season
- labour_household = number of household members working on the banana farm
- var_hybrid = whether the farmer grows improved banana hybrids (1 = yes, 0 = no)

- input_expenditure = total expenditure on inputs (suckers, fertilizers, pesticides) per season (UGX)
- pest_severity = farmer's perceived pest/disease severity (Likert scale 1-5)
- fertilizer_use = whether the farmer uses fertilizers (1 = yes, 0 = no)
- ε = error term

To avoid the dummy variable trap, one category of each categorical variable will be omitted from the regression. The reference category for education will be "no formal education", and the reference category for banana varieties will be "traditional varieties only".

3.11.3 Model Diagnostics

Several diagnostic tests will be conducted to ensure the validity of the regression model:

Multicollinearity will be assessed using variance inflation factors (VIF). A VIF value exceeding 10 indicates problematic multicollinearity, which will be addressed by dropping or combining offending variables.

Heteroskedasticity will be tested using the Breusch-Pagan (BP) test. If heteroskedasticity is detected, robust standard errors will be employed to correct for it.

Normality of residuals will be assessed using histograms and normal probability plots (Q-Q plots) of the residuals. The Shapiro-Wilk test may also be performed.

Model goodness-of-fit will be assessed using the coefficient of determination (R^2) and the adjusted R^2. The F-test will be used to determine whether the overall model is statistically significant.

3.12 Ethical considerations

Ethical approval will be sought from the relevant institutional review board before data collection begins. Informed consent will be obtained from each respondent prior to participation in the study. Respondents will be assured of the confidentiality and anonymity of their responses. Participation will be entirely voluntary, and respondents will have the right to withdraw from the study at any time without penalty.

3.13 Limitations of the study and recommendations for future research

This study is limited to one village in Kyotera District, which may restrict the generalizability of the findings to other banana-producing regions of Uganda. Future research should extend the

analysis to multiple villages and districts to capture regional variations. Additionally, the cross-sectional design of this study (data collected at a single point in time) limits the ability to establish causality; future research should employ longitudinal designs to better understand causal relationships. Finally, reliance on self-reported data introduces the possibility of recall bias; future studies could complement survey data with objective production measurements and market transaction records. Any methodological weaknesses identified during the course of this research will be documented to inform improvements in future surveys.

3.14 Unit of analysis

The unit of analysis for this study will be the banana-farming household. Primary data will be collected from the household head or, where the household head is unavailable, another knowledgeable adult member actively involved in banana farming decisions.

CHAPTER FOUR

DATA ANALYSIS

4.1 Introduction

This chapter presents, analyses, and interprets the findings of the study on the determinants of income from banana farming among households in Kisunku Village, Kyotera District. The analysis is based on data collected from **70 banana farming households** using a structured questionnaire. The primary purpose of the analysis is to address the study objectives and test the hypotheses presented in Chapters One and Three.

Before conducting the statistical analyses, the dataset was subjected to a comprehensive data cleaning process to ensure its accuracy, completeness, and consistency. This involved checking for duplicate records, missing values, coding errors, logical inconsistencies, and outliers. The cleaned dataset was then analyzed using **Python (Statsmodels, Pandas, and SciPy libraries)** to generate descriptive and inferential statistics.

The analysis is presented in four stages. First, descriptive statistics are used to summarize the socio-economic and farm characteristics of the respondents, including gender, age, education level, farming experience, farm size, access to extension services, labor availability, and production practices. These statistics provide an overview of the characteristics of the sampled households and establish the context within which banana production takes place in Kisunku Village.

Second, bivariate analysis is conducted to examine the individual relationships between each explanatory variable and annual income from banana farming. Pearson's correlation coefficients are used for continuous variables, while independent sample t-tests and one-way Analysis of Variance (ANOVA) are used to compare mean incomes across different respondent groups. These analyses provide preliminary evidence regarding variables that may influence household income before controlling for other factors.

Third, a multiple linear regression model is estimated to identify the determinants of income from banana farming while simultaneously controlling for the effects of the other explanatory variables. Prior to estimating the regression model, several diagnostic tests were conducted to assess compliance with the assumptions of Ordinary Least Squares (OLS) regression. These included tests for multicollinearity using the Variance Inflation Factor (VIF), heteroskedasticity using the Breusch–Pagan test, and normality of residuals using the Shapiro–Wilk test. Where violations of

model assumptions were detected, heteroskedasticity-robust standard errors were employed to ensure reliable statistical inference.

Finally, the study hypotheses are tested based on the regression results, after which the major constraints affecting income from banana farming are analyzed using descriptive statistics. The findings are interpreted in relation to the research objectives and compared with empirical evidence presented in the literature reviewed in Chapter Two.

Overall, this chapter provides empirical evidence on the socio-economic, institutional, and farm-level factors influencing banana farming income in Kisunku Village. The findings form the basis for the conclusions and policy recommendations presented in Chapter Five.

4.2 Data Cleaning and Quality Assessment

Prior to conducting the statistical analyses, the dataset was subjected to a comprehensive data cleaning and validation process to ensure that the data were accurate, complete, and suitable for statistical analysis. Data cleaning is an essential step in empirical research because the quality of statistical results depends largely on the quality of the data used in the analysis. The objective of this process was to identify and correct errors that could potentially bias the study findings.

The completed questionnaires were first checked for completeness before data entry. Thereafter, the responses were entered into Microsoft Excel using a structured data entry template specifically designed for the study. The completed dataset was then imported into Python for cleaning, management, and statistical analysis using the Pandas, NumPy, SciPy, and Statsmodels libraries.

4.2.1 Verification of the Dataset

The workbook initially contained two worksheets, namely the **Codebook** and the **Data Entry** worksheet. The codebook contained descriptions of all study variables together with their respective coding schemes, while the data entry worksheet contained the responses obtained from the sampled households.

During data verification, it was observed that the first few rows of the data entry worksheet contained variable labels and questionnaire descriptions rather than respondent data. These metadata rows were excluded from the analysis, leaving only valid respondent records.

After cleaning, the final analytical dataset consisted of **70 respondents**, corresponding to the achieved sample size for the study.

4.2.2 Duplicate Records

Duplicate records were assessed using respondent identification information contained in the data entry workbook. Each questionnaire represented a unique farming household and no duplicate observations were identified during the verification process. Consequently, all 70 respondents were retained for subsequent analyses.

4.2.3 Missing Data Assessment

The dataset was examined for missing observations across all study variables. Most variables contained complete information, indicating a high response rate among respondents.

Only a few variables intended for administrative validation and optional responses contained missing observations. These variables were not included in the inferential analyses and therefore had no effect on the estimation of the regression model.

Two observations were identified with invalid category codes for **credit access** and **extension service access**, where values outside the predefined binary coding scheme (0 = No, 1 = Yes) had been entered. Since the correct responses could not be established from the electronic dataset alone, these observations were treated as missing for the affected variables during regression modelling. Consequently, the regression analysis was performed using **69 complete observations**, while descriptive analyses retained all 70 respondents wherever possible.

4.2.4 Coding Consistency

The coding of all categorical variables was examined against the questionnaire and codebook to ensure consistency. Variables such as gender, education level, fertilizer use, hybrid banana adoption, access to credit, and extension services were coded according to the predefined coding framework specified during questionnaire design.

Continuous variables including age, farming experience, farm size, annual income from banana farming, input expenditure, market access score, household labor, and hired labor were also inspected to confirm that they had been entered as numeric values suitable for statistical analysis.

The verification exercise established that the coding scheme had been applied consistently across the dataset, with only the previously identified invalid codes requiring correction.

4.2.5 Logical Consistency Checks

Logical consistency checks were performed to verify that automatically calculated variables corresponded with their component variables.

In particular, total annual banana income was compared with seasonal income components, while total input expenditure was verified against fertilizer, pesticide and other production costs. Similarly, the composite market access score was examined against its constituent indicators.

The computed variables were found to be internally consistent, with no discrepancies detected between calculated totals and their component variables. This indicates that the data entry process maintained a high level of accuracy.

4.2.6 Outlier Assessment

Continuous variables were inspected using summary statistics and graphical procedures to identify extreme observations that could unduly influence the regression estimates.

The annual income variable exhibited a moderate positive skew, indicating that a small number of households earned substantially higher incomes than the majority of respondents. Likewise, input expenditure displayed positive skewness due to a few farmers investing considerably more in production inputs than the average household.

An unusually high average selling price was observed for one respondent and was identified as a probable data-entry error because it was inconsistent with the respondent's reported production and income. However, since average selling price was not included as an explanatory variable in the regression model, this observation did not materially influence the inferential analysis. No other influential outliers requiring deletion were identified.

4.2.7 Assessment of Regression Assumptions

Prior to estimating the multiple linear regression model, several diagnostic tests were conducted to evaluate whether the assumptions underlying Ordinary Least Squares (OLS) regression were satisfied.

Multicollinearity among the explanatory variables was assessed using the Variance Inflation Factor (VIF). The analysis indicated that all VIF values were well below the commonly accepted threshold of 10, suggesting that multicollinearity was not a significant concern.

The Breusch–Pagan test was then used to assess the presence of heteroskedasticity. The test indicated statistically significant heteroskedasticity ($p < 0.05$), implying that the variance of the regression residuals was not constant across observations. To address this violation, heteroskedasticity-robust (HC1) standard errors were used when testing the significance of the regression coefficients.

The normality of residuals was evaluated using the Shapiro–Wilk test. The test indicated that the residuals were not perfectly normally distributed, largely due to the positively skewed distribution of household income. Nevertheless, given the sample size and the application of robust standard errors, the regression estimates remained appropriate for inference.

4.2.8 Summary of Data Quality

Overall, the data cleaning exercise demonstrated that the dataset was of satisfactory quality for statistical analysis. The study achieved a complete analytical sample of **70 respondents**, with no duplicate records and only minimal coding inconsistencies requiring correction. The dataset exhibited a high level of completeness, and all identified issues were appropriately addressed before analysis.

Consequently, the cleaned dataset was considered sufficiently reliable for descriptive statistics, hypothesis testing, and multivariate regression analysis presented in the subsequent sections of this chapter.

4.3 Socio-economic Characteristics of Respondents

This section presents the socio-economic and farm characteristics of the respondents who participated in the study. The characteristics examined include gender, education level, adoption of hybrid banana varieties, fertilizer use, access to agricultural credit, access to extension services, age, farming experience, farm size, market access, labor availability, input expenditure, and annual income from banana farming. These characteristics provide important background information for understanding the factors that influence income from banana farming in Kisunku Village.

4.3.1 Categorical Characteristics of Respondents

Table 4.1 presents the distribution of respondents according to selected categorical socio-economic and farm characteristics.

Table 4.1: Distribution of Respondents by Selected Categorical Characteristics (N = 70)

Characteristic	Category	Frequency (n)	Percentage (%)
Gender	Male	38	54.3
	Female	32	45.7
Education Level	No formal education	14	20.0
	Primary education	28	40.0
	Secondary education	18	25.7
	Tertiary education	10	14.3
Hybrid Banana Variety	No	33	47.1
	Yes	37	52.9
Fertilizer Use	No	25	35.7
	Yes	45	64.3
Access to Agricultural Credit[1]	No	50	71.4
	Yes	19	27.1
Access to Extension Services[1]	No	26	37.1
	Yes	43	61.4

[1] Percentages are based on 69 valid responses because one respondent had invalid codes for these variables.

The results indicate that **male farmers constituted the majority of respondents (54.3%)**, while females accounted for **45.7%**. This relatively balanced gender distribution suggests that both men and women participate actively in banana farming within Kisunku Village, although male-headed households remain slightly more dominant. The high level of female participation reflects the important role women play in crop production and household food security, particularly in rural farming communities.

Regarding educational attainment, **40.0% of the respondents had completed primary education**, making it the most common level of education among banana farmers. Approximately **25.7%** had attained secondary education, **20.0%** had no formal education, while only **14.3%** had attained tertiary education. These findings indicate that the majority of farmers possess only basic formal education, which may influence their ability to adopt improved farming technologies, interpret market information, maintain farm records, and implement recommended agronomic practices.

The findings further reveal that **52.9% of respondents cultivated hybrid banana varieties**, while **47.1%** continued to grow traditional varieties. The slightly higher adoption of hybrid varieties suggests that improved banana technologies are gradually being embraced within the study area, although a substantial proportion of farmers still rely on traditional cultivars due to factors such as seed availability, farmer preferences, production costs, or limited access to extension information.

With respect to fertilizer application, **64.3% of the respondents reported using fertilizer**, compared to **35.7%** who did not apply fertilizer. This indicates a relatively high adoption of soil fertility management practices among the sampled farmers. Nevertheless, more than one-third of households continue to produce bananas without fertilizer, which may contribute to declining soil fertility and lower productivity over time.

Access to institutional support services varied considerably. Only **27.1%** of respondents reported having accessed agricultural credit during the previous twelve months, while **71.4%** had not received any formal credit. Limited access to agricultural finance may restrict farmers' ability to purchase quality planting materials, fertilizers, pesticides, irrigation equipment, and other productive inputs required to increase farm productivity and income.

In contrast, **61.4% of respondents reported receiving agricultural extension services**, while **37.1%** had not interacted with extension officers. This suggests that extension coverage in Kisunku Village is relatively encouraging, although there remains a considerable proportion of farmers who do not receive technical guidance. Improved extension services can play an important role in promoting improved agronomic practices, disease management, post-harvest handling, and market-oriented production.

Overall, the categorical characteristics indicate that banana farming in Kisunku Village is practiced by both male and female farmers with varying educational backgrounds. Although adoption of improved technologies such as hybrid varieties and fertilizer use appears moderately high, limited access to agricultural credit remains a significant institutional challenge that may constrain farm investment and income generation.

4.3.2 Continuous Socio-economic Characteristics

Table 4.2 presents the descriptive statistics for the continuous variables included in the study.

Table 4.2: Descriptive Statistics for Continuous Variables (N = 70)

Variable	Mean	Median	Standard Deviation	Minimum	Maximum
Age (years)	52.5	52.0	13.0	25	75
Farming experience (years)	19.7	20.0	12.2	1	60
Farm size (acres)	2.23	2.00	1.56	0.50	6.00
Pest and disease severity (1–5)	2.47	2.00	0.94	0	5
Market access score	5.70	5.80	1.27	1.80	9.00
Hired labourers	1.80	2.00	0.99	0	4
Household labourers	0.73	0.50	0.88	0	4
Input expenditure (UGX)	245,143	195,000	240,748	0	1,400,000
Annual banana income (UGX)	975,814	945,000	469,571	305,000	3,200,000

The respondents had a **mean age of 52.5 years**, with ages ranging from **25 to 75 years**. This suggests that banana farming in Kisunku Village is largely undertaken by middle-aged and older farmers who have accumulated considerable farming experience. While older farmers often possess extensive indigenous knowledge and practical skills, they may also be less willing to adopt new agricultural technologies compared to younger farmers.

The average farming experience was **19.7 years**, indicating that most respondents had spent nearly two decades engaged in banana cultivation. Such extensive farming experience is expected to improve farmers' management skills, production efficiency, and understanding of local climatic and market conditions.

The average farm size was **2.23 acres**, demonstrating that banana farming in the study area is predominantly smallholder in nature. The relatively small landholdings are consistent with the

general pattern of land fragmentation observed in many parts of central Uganda, where increasing population pressure and inheritance practices have reduced the size of agricultural holdings.

The average pest and disease severity score of **2.47** indicates that respondents experienced moderate levels of pest and disease challenges. Since banana production in Uganda is frequently affected by pests and diseases such as Banana Bacterial Wilt (BBW), Black Sigatoka, and nematodes, effective pest management remains essential for sustaining productivity and household income.

The average market access score of **5.70** out of a possible higher score suggests that respondents experienced moderate access to markets. While farmers generally had some access to buyers and market information, there remained significant opportunities to improve transportation infrastructure, market linkages, and price information systems to enhance profitability.

Regarding labour availability, respondents employed an average of **1.80 hired laborers** while household labour averaged **0.73 persons**. This indicates that many households supplement family labour with hired workers during peak production periods, reflecting the labor-intensive nature of banana production.

The average annual expenditure on production inputs was approximately **UGX 245,143**, although expenditure varied substantially among farmers, as reflected by the relatively large standard deviation. This variation suggests considerable differences in production intensity and investment capacity across households.

Finally, respondents earned an average annual income of approximately **UGX 975,814** from banana farming, with incomes ranging from **UGX 305,000** to **UGX 3,200,000**. The mean income exceeded the median income of **UGX 945,000**, indicating a positively skewed income distribution in which a relatively small number of households earned considerably higher incomes than the majority of farmers. This pattern reflects inequalities in production capacity, market participation, and access to productive resources among banana farming households in Kisunku Village.

4.3.3 Summary of Respondent Characteristics

The descriptive analysis demonstrates that banana farming in Kisunku Village is dominated by experienced smallholder farmers operating relatively small landholdings. The majority of respondents possess only primary education, while adoption of improved production practices such as fertilizer application and hybrid banana varieties is moderately high. Nevertheless, access

to agricultural credit remains limited, potentially constraining investment in productive technologies. These socio-economic and institutional characteristics provide an important foundation for understanding the determinants of income from banana farming examined in the subsequent sections of this chapter.

4.4 Bivariate Analysis of the Determinants of Income from Banana Farming

This section presents the bivariate analysis conducted to examine the relationship between each independent variable and annual income from banana farming. The purpose of this analysis was to identify variables that exhibit statistically significant associations with income before estimating the multiple linear regression model. Pearson's product-moment correlation coefficient was used to examine the relationship between continuous variables and annual income, while independent sample t-tests and one-way Analysis of Variance (ANOVA) were used to compare mean incomes across categorical variables.

4.4.1 Relationship between Continuous Variables and Annual Banana Income

Table 4.3 presents the Pearson correlation coefficients between selected continuous variables and annual income from banana farming.

Table 4.3: Pearson Correlation Analysis between Continuous Variables and Annual Banana Income

Variable	Correlation Coefficient (r)	p-value	Interpretation
Farming experience	0.407	0.0005	Moderate positive, statistically significant
Market access score	0.528	<0.001	Moderate positive, statistically significant
Input expenditure	0.552	<0.001	Moderate positive, statistically significant
Household labour	0.309	0.009	Weak positive, statistically significant
Age	0.190	0.116	Weak positive, not statistically significant
Farm size	0.153	0.205	Weak positive, not statistically significant
Pest and disease severity	0.167	0.167	Weak positive, not statistically significant
Hired labour	0.134	0.268	Weak positive, not statistically significant

The results reveal that **farming experience** was positively and significantly associated with annual income from banana farming ($r = 0.407$, $p = 0.0005$). This finding suggests that farmers with

longer experience in banana cultivation tend to earn higher incomes than less experienced farmers. The relationship is likely attributable to the accumulation of practical skills, improved farm management techniques, and greater familiarity with production and marketing systems acquired over time.

Similarly, **market access** exhibited a moderate positive and statistically significant relationship with annual income ($r = 0.528$, $p < 0.001$). This indicates that farmers with better access to markets, transportation facilities, price information, and buyers generally earned higher incomes. Improved market access enables farmers to reduce transaction costs, negotiate better prices, minimise post-harvest losses, and sell larger quantities of produce, thereby increasing household income.

The analysis further showed that **input expenditure** had the strongest positive correlation with annual income ($r = 0.552$, $p < 0.001$). This finding suggests that households investing more resources in agricultural inputs such as fertilizers, pesticides, labour, and improved planting materials generally realised higher returns from banana farming. Increased investment in productive inputs is expected to improve productivity and output quality, ultimately leading to higher farm income.

Household labour was also positively associated with annual income ($r = 0.309$, $p = 0.009$). Although the relationship was relatively weak, it was statistically significant, indicating that greater availability of family labour contributes positively to farm productivity and income generation.

In contrast, age, farm size, pest and disease severity, and hired labour did not exhibit statistically significant relationships with annual banana income at the 5 percent significance level. Although these variables displayed positive correlation coefficients, the relationships were relatively weak and may have been influenced by other socio-economic and institutional factors operating simultaneously.

Overall, the correlation analysis suggests that farming experience, market access, input expenditure, and household labour are important factors associated with higher banana farming income. However, because correlation analysis does not control for confounding variables, further examination using multiple regression analysis was necessary.

4.4.2 Comparison of Mean Income across Categorical Variables

Independent sample t-tests and one-way ANOVA were conducted to determine whether annual banana income differed significantly across respondent groups.

Table 4.4: Comparison of Mean Annual Banana Income across Selected Categories

Variable	Mean Income (UGX)	Test Statistic	p-value
Gender	Male = 1,026,789; Female = 915,281	t = -1.02	0.314
Hybrid banana variety	Yes = 1,058,459; No = 883,152	t = 1.63	0.110
Fertilizer use	Yes = 1,029,911; No = 878,440	t = 1.19	0.243
Credit access	Yes = 1,016,474; No = 964,520	t = 0.32	0.749
Extension services	Yes = 1,046,023; No = 867,692	t = 1.77	0.082
Education level	F = 0.14		0.939

The findings indicate that male respondents earned slightly higher average incomes than female respondents. However, the difference was not statistically significant ($p = 0.314$), suggesting that gender alone did not significantly influence banana farming income among the sampled households.

Farmers cultivating hybrid banana varieties earned higher average incomes than those growing traditional varieties. Likewise, respondents using fertilizers reported higher average incomes than non-users. Although these differences were consistent with theoretical expectations, they were not statistically significant at the 5 percent level.

Respondents who accessed agricultural credit also earned slightly higher average incomes than those without credit access, but the observed difference was negligible and statistically insignificant ($p = 0.749$). This finding may indicate that the amount of credit accessed was insufficient to substantially improve farm productivity or that credit was utilised for non-farm household expenditures.

Farmers who received extension services recorded higher average incomes than those without extension support. Although the difference approached statistical significance ($p = 0.082$), it remained insignificant at the conventional 5 percent level. Nevertheless, the result suggests that extension services may contribute positively to household income, and a larger sample could potentially detect a statistically significant effect.

Finally, annual banana income did not differ significantly across education levels ($F = 0.14$, $p = 0.939$), implying that formal education alone was not a strong determinant of banana farming income within the study area.

4.4.3 Summary of Bivariate Analysis

The bivariate analysis identified farming experience, market access, input expenditure, and household labour as variables significantly associated with annual banana income. In contrast, differences in income according to gender, education level, fertilizer use, hybrid variety adoption, access to credit, and extension services were not statistically significant when examined individually. These findings provided a preliminary understanding of the factors influencing income and informed the selection of variables for the multivariate regression analysis presented in the next section.

4.5 Multiple Linear Regression Analysis

While the bivariate analysis identified several variables associated with annual banana income, it considered each explanatory variable independently. In reality, household income is influenced by numerous interrelated socio-economic, institutional, and farm-level factors operating simultaneously. Consequently, multiple linear regression analysis was employed to estimate the independent effect of each explanatory variable while controlling for the influence of all other variables included in the model.

4.5.1 Diagnostic Tests for the Regression Model

Before estimating the regression model, diagnostic tests were conducted to verify whether the assumptions underlying Ordinary Least Squares (OLS) regression had been satisfied.

Multicollinearity

Multicollinearity among the explanatory variables was examined using the Variance Inflation Factor (VIF). The analysis showed that all VIF values were below the commonly accepted threshold of 10, with the highest VIF equal to 3.17. This indicates that multicollinearity was not a serious concern and that the explanatory variables provided sufficiently independent information for reliable coefficient estimation.

Heteroskedasticity

The Breusch–Pagan test was used to assess whether the variance of the regression residuals remained constant across observations. The test was statistically significant (LM = 27.25, p = 0.039), indicating the presence of heteroskedasticity. Since heteroskedasticity can result in biased standard errors and misleading hypothesis tests, heteroskedasticity-robust (HC1) standard errors were used to obtain valid statistical inference.

Normality of Residuals

Residual normality was assessed using the Shapiro–Wilk test. The results indicated that the residuals were not perfectly normally distributed (W = 0.917, p < 0.001), primarily because annual income exhibited a positively skewed distribution. Nevertheless, the use of robust standard errors reduced the impact of this violation on statistical inference, making the estimated coefficients suitable for interpretation.

4.5.2 Overall Performance of the Regression Model

The estimated regression model produced an **R^2 of 0.606**, indicating that approximately **60.6 percent** of the variation in annual banana farming income was explained by the explanatory variables included in the model.

The **adjusted R^2 was 0.485**, implying that after accounting for the number of explanatory variables, the model explained approximately **48.5 percent** of the observed variation in household income. Given the cross-sectional nature of the data and the complexity of household income determination, this represents a reasonably good model fit.

Furthermore, the overall regression model was statistically significant (**$F(16,52) = 5.00$; $p < 0.001$**), indicating that the explanatory variables jointly contributed significantly to explaining variations in annual income from banana farming.

4.5.3 Determinants of Annual Banana Income

Table 4.5 presents the estimated regression coefficients together with their heteroskedasticity-robust standard errors.

Table 4.5: Multiple Linear Regression Results

The regression results indicate that **farming experience** was a positive and statistically significant determinant of annual banana income (β = 18,557; p = 0.001). Holding all other variables constant, each additional year of farming experience increased expected annual banana income by approximately **UGX 18,557**. This finding suggests that experienced farmers possess superior technical knowledge, management skills, and marketing networks that contribute to higher productivity and income.

Similarly, **market access** exerted a positive and statistically significant influence on annual income (β = 131,035; p = 0.012). This implies that a one-unit improvement in the market access score was associated with an increase of approximately **UGX 131,035** in annual banana income. Improved market access enhances farmers' ability to obtain better prices, reduce transportation costs, and reach profitable markets.

Although **age** displayed a negative coefficient, its effect was only marginally significant at the 10 percent level (p = 0.092). This suggests that older farmers may earn slightly lower incomes after controlling for farming experience and other explanatory variables, possibly due to declining physical capacity or lower willingness to adopt improved technologies.

Farm size, education level, access to agricultural credit, extension services, hired labour, household labour, hybrid variety adoption, fertilizer use, input expenditure, and pest severity did not exhibit statistically significant effects after controlling for the other explanatory variables in the model. This indicates that their apparent influence observed in the descriptive and bivariate analyses diminished once the joint effects of all determinants were considered.

Overall, the regression analysis demonstrates that **farming experience and market access were the most important determinants of annual income from banana farming among households in Kisunku Village.** These findings underscore the importance of strengthening farmers' production experience through continuous training and improving market infrastructure to enhance household incomes.

4.6 Hypothesis Testing

This section presents the decisions reached regarding each of the study hypotheses based on the results of the multiple linear regression analysis. The hypotheses were tested at the 5 percent level

of significance using heteroskedasticity-robust standard errors to account for the presence of heteroskedasticity detected during the diagnostic tests.

Table 4.5: Summary of Hypothesis Testing Results

Hypothesis	Decision	Interpretation
H01: Farm size has no significant effect on annual banana income.	**Fail to Reject H01**	Farm size was positively associated with income but the relationship was not statistically significant (β = 51,906; p = 0.205).
H02: Access to agricultural inputs has no significant effect on annual banana income.	**Fail to Reject H02**	Input expenditure, fertilizer use and hybrid variety adoption did not significantly influence income after controlling for other variables.
H03: Farming experience has no significant effect on annual banana income.	**Reject H03**	Farming experience had a positive and statistically significant effect on income (β = 18,557; p = 0.001).
H04: Access to agricultural credit has no significant effect on annual banana income.	**Fail to Reject H04**	Credit access did not significantly influence annual income (β = 78,200; p = 0.583).
H05: Market access has no significant effect on annual banana income.	**Reject H05**	Market access significantly increased annual banana income (β = 131,035; p = 0.012).
H06: Education level has no significant effect on annual banana income.	**Fail to Reject H06**	Education level did not significantly influence banana income after controlling for other variables.
H07: Access to extension services has no significant effect on annual banana income.	**Fail to Reject H07**	Extension services showed a positive but statistically insignificant effect (β = 52,130; p = 0.606).
H08: Labour availability has no significant effect on annual banana income.	**Fail to Reject H08**	Household and hired labour did not significantly influence income at the 5% level.

H09: Banana variety grown has no significant effect on annual banana income.	**Fail to Reject H09**	Growing hybrid banana varieties did not significantly influence annual income after controlling for other variables.
H10: Production constraints have no significant influence on annual banana income.	**Descriptively assessed**	Production constraints were ranked descriptively and were not directly tested in the regression model.
H11: Socio-economic characteristics have no significant influence on annual banana income.	**Fail to Reject H11**	The combined socio-economic variables were not jointly significant after controlling for institutional and production factors.

The results indicate that only **farming experience** and **market access** were statistically significant determinants of annual banana income at the 5 percent significance level. Consequently, the null hypotheses relating to these variables were rejected, while the remaining hypotheses were not rejected.

The findings further demonstrate that although several variables exhibited positive relationships with income during the descriptive and bivariate analyses, their effects diminished after controlling for other explanatory variables in the multiple regression model. This highlights the importance of multivariate analysis in identifying the independent contribution of each factor to household income.

4.7 Discussion of Findings

The objective of this section is to interpret the empirical findings in relation to the existing literature reviewed in Chapter Two and to explain their implications for banana production in Kisunku Village.

4.7.1 Farming Experience and Household Income

The study established that farming experience significantly and positively influenced annual income from banana farming. Each additional year of farming experience was associated with an increase in annual household income, suggesting that experienced farmers possess better production skills, improved management practices, stronger market networks, and greater knowledge of pest and disease control.

This finding is consistent with previous studies which argue that experienced farmers are generally more efficient in allocating production resources and adopting appropriate farming practices. Experienced farmers are also better able to respond to market fluctuations and climatic variability because they have accumulated knowledge over many production seasons.

The results therefore suggest that continuous farmer training, mentorship, and experience-sharing programmes could improve productivity among less experienced farmers.

4.7.2 Market Access and Household Income

Market access emerged as one of the strongest determinants of annual banana income. Farmers with better access to markets, transport facilities, buyers, and market information earned significantly higher incomes than those with poor market access.

This finding supports transaction cost theory, which suggests that reducing marketing costs increases producers' net returns. Improved market access enables farmers to sell larger quantities of produce, negotiate favourable prices, reduce post-harvest losses, and identify more profitable markets.

The finding also agrees with numerous empirical studies in agricultural economics which consistently report market access as one of the most important determinants of agricultural commercialization and rural household income.

These findings imply that investments in rural roads, market infrastructure, farmer cooperatives, and market information systems could substantially improve banana farmers' incomes in Kisunku Village.

4.7.3 Farm Size

Although farm size exhibited a positive coefficient, its effect was not statistically significant after controlling for other explanatory variables.

This suggests that ownership of larger farms alone does not necessarily translate into higher household income. Differences in management practices, productivity, technology adoption, and market participation may be more important than land size itself.

The finding demonstrates that increasing productivity per acre may be more beneficial than simply expanding cultivated land.

4.7.4 Agricultural Inputs

The study found no statistically significant effect of fertilizer use, hybrid banana varieties, or overall input expenditure on annual income after controlling for other explanatory variables.

Although farmers investing more in production inputs generally recorded higher incomes in the descriptive analysis, these relationships disappeared in the multivariate model.

This finding may indicate that some farmers invest in inputs inefficiently, use inadequate quantities of improved technologies, or face other constraints such as poor market access that reduce the economic benefits of input use.

4.7.5 Credit and Extension Services

Neither agricultural credit nor extension services significantly influenced annual banana income after controlling for other variables.

Although extension recipients recorded higher average incomes than non-recipients, the differences were not statistically significant.

These findings may suggest that available extension services are insufficient in frequency or quality, while available agricultural credit may not adequately finance productive farm investments.

Further improvements in the effectiveness of agricultural advisory services and rural financial institutions may therefore be necessary.

4.7.6 Education and Labour

Formal education and labour availability were not statistically significant determinants of annual income.

This suggests that practical farming experience may be more important than formal education in determining productivity among smallholder banana farmers. Likewise, labour availability alone may not increase income unless accompanied by improved technologies, efficient management, and favourable market conditions.

4.7.7 Major Constraints Affecting Banana Farming Income

Respondents identified several challenges affecting banana production and income generation.

The most frequently reported constraints included:

- Weak cooperative organisations and poor bargaining power.
- Poor market access and low produce prices.
- Land fragmentation.
- Declining soil fertility.
- Pests and diseases.
- Limited access to agricultural credit.
- Climate variability.

Weak bargaining power and poor market access emerged as the most serious challenges. These findings complement the regression analysis, which identified market access as one of the strongest determinants of annual income.

The results suggest that interventions aimed at strengthening farmer organisations, improving collective marketing, expanding market infrastructure, and enhancing access to reliable market information are likely to generate substantial improvements in household income.

4.8 Policy Implications of the Findings

The findings of this study have important implications for agricultural policy and rural development in Kyotera District.

First, improving rural market infrastructure should be prioritised since market access was found to significantly influence household income. Investments in feeder roads, market centres, storage facilities, and market information systems would reduce transaction costs and improve farmers' bargaining power.

Second, farmer capacity-building programmes should focus on improving practical production skills through continuous training, demonstration farms, and farmer-to-farmer extension programmes. Since farming experience significantly influences income, strengthening knowledge transfer mechanisms could improve productivity among less experienced farmers.

Third, government agencies and development partners should strengthen farmer cooperatives and producer organisations to improve collective marketing and negotiation of better produce prices.

Finally, financial institutions should design agricultural credit products that better meet the needs of smallholder banana farmers while extension programmes should emphasise efficient input utilisation and improved farm management practices to maximise returns on investment.

4.9 Chapter Summary

This chapter presented, analysed, and interpreted the findings of the study using descriptive statistics, bivariate analysis, and multiple linear regression techniques.

The descriptive analysis showed that banana farming in Kisunku Village is dominated by experienced smallholder farmers operating relatively small farms. Adoption of improved technologies such as fertilizer application and hybrid banana varieties was moderately high, although access to agricultural credit remained relatively limited.

The bivariate analysis revealed significant positive relationships between farming experience, market access, input expenditure, household labour, and annual banana income. However, the multivariate regression analysis demonstrated that only **farming experience** and **market access** remained statistically significant after controlling for the influence of the other explanatory variables.

The regression model explained approximately **60.6 percent** of the variation in annual banana income, indicating good explanatory power for a cross-sectional household survey. Diagnostic tests further confirmed that the model was appropriate for analysis after correcting for heteroskedasticity through the use of robust standard errors.

Overall, the findings demonstrate that improving farmers' production experience and strengthening market access offer the greatest potential for increasing income from banana farming in Kisunku Village. These findings provide the empirical basis for the conclusions, recommendations, policy implications, limitations, and areas for further research presented in Chapter Five.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of the major findings, conclusions, recommendations, policy implications, limitations of the study, and suggestions for further research. The conclusions and recommendations are based on the empirical findings obtained from the analysis of data collected from 70 banana farming households in Kisunku Village, Kyotera District. The chapter links the study findings to the research objectives and provides practical recommendations that may contribute to improving household income from banana farming.

5.2 Summary of Findings

The purpose of this study was to examine the determinants of income from banana farming among smallholder farmers in Kisunku Village, Kyotera District. Specifically, the study sought to examine how socio-economic, institutional, and farm-level characteristics influence annual household income from banana farming.

Objective One: To describe the socio-economic characteristics of banana farmers in Kisunku Village

The descriptive analysis revealed that the majority of respondents (54.3%) were male, while females constituted 45.7% of the sample. Most respondents had attained primary education (40%), followed by secondary education (25.7%), while only 14.3% had attained tertiary education. The average age of respondents was 52.5 years, indicating that banana farming in the study area is largely undertaken by middle-aged and older farmers.

The study further established that respondents had an average farming experience of approximately 20 years and owned an average farm size of 2.23 acres, confirming that banana production in Kisunku Village is predominantly undertaken by smallholder farmers. Approximately 64.3% of respondents reported using fertilizer, while 52.9% cultivated hybrid banana varieties. Although more than sixty percent had access to agricultural extension services, only 27.1% reported accessing agricultural credit during the previous twelve months.

These findings suggest that banana farmers possess considerable production experience but continue to face institutional constraints, particularly limited access to financial services.

Objective Two: To determine the effect of farm size on annual income from banana farming

The regression analysis indicated that farm size had a positive but statistically insignificant effect on annual household income. Although households with larger farms generally earned higher incomes, the effect was not statistically significant after controlling for the influence of other explanatory variables.

This finding suggests that expanding cultivated land alone may not necessarily increase household income. Instead, efficient utilization of available land through improved management practices and productivity-enhancing technologies appears to be more important.

Objective Three: To determine the influence of agricultural inputs on annual household income

The study examined the effects of fertilizer use, hybrid banana varieties, and overall expenditure on production inputs.

Although farmers investing more in agricultural inputs generally earned higher incomes in the descriptive analysis, none of these variables remained statistically significant in the multiple regression model after controlling for other determinants.

The findings suggest that investment in agricultural inputs alone may not guarantee higher household income unless accompanied by effective farm management, favourable weather conditions, and improved market access.

Objective Four: To determine the effect of farming experience on annual household income

The analysis established that farming experience was one of the strongest determinants of annual income from banana farming.

The regression results showed that each additional year of farming experience significantly increased annual household income. This finding demonstrates the importance of accumulated knowledge, technical skills, and practical experience in improving production efficiency and marketing decisions.

Experienced farmers are more likely to adopt effective production practices, manage production risks, and establish stronger relationships with produce buyers, thereby improving household income.

Objective Five: To determine the effect of agricultural credit on annual household income

Although farmers who accessed agricultural credit recorded slightly higher average incomes than those without credit access, the regression analysis revealed that credit access did not significantly influence annual household income.

The finding suggests that available credit may either be insufficient to finance productive investments or may not always be utilised specifically for agricultural production.

Objective Six: To determine the influence of market access on annual household income

Market access emerged as one of the most important determinants of annual household income.

The regression results demonstrated that improvements in market access significantly increased annual income from banana farming. Farmers with better access to transportation, buyers, market information, and marketing infrastructure generally realised higher incomes than farmers with limited market access.

This finding highlights the importance of strengthening agricultural marketing systems to improve rural household welfare.

Objective Seven: To determine the effect of education on annual household income

Formal education did not significantly influence annual income after controlling for the effects of the other explanatory variables.

Although educated farmers may possess better literacy and management skills, practical farming experience appeared to be a more important determinant of productivity and income in the study area.

Objective Eight: To determine the influence of agricultural extension services on annual household income

The study found that extension services had a positive but statistically insignificant influence on annual income.

Respondents who received extension services earned relatively higher incomes than those without extension support; however, the observed difference was insufficient to reach statistical significance.

The findings suggest that improvements in the quality, frequency, and effectiveness of extension services may be necessary before substantial income gains can be realised.

Objective Nine: To determine the influence of labour availability on annual household income

Neither household labour nor hired labour significantly influenced annual household income after controlling for the other explanatory variables.

Although labour remains an essential production resource, its contribution to income appears to depend on how efficiently labour is combined with other productive resources.

Objective Ten: To identify the major constraints affecting banana farming income

Respondents identified several production and marketing challenges affecting household income.

The most frequently reported constraints included:

i. Weak cooperative organisations and poor bargaining power.
ii. Poor market access and low produce prices.
iii. Land fragmentation.
iv. Declining soil fertility.
v. Pests and diseases.
vi. Limited access to agricultural credit.
vii. Climate variability.

These findings demonstrate that institutional and marketing challenges remain major barriers to improving household income.

Objective Eleven: To determine the combined influence of socio-economic characteristics on annual household income

The combined socio-economic variables were not jointly significant after controlling for institutional and production characteristics.

This finding suggests that household income is influenced more strongly by production experience and market-related factors than by demographic characteristics alone.

5.3 Conclusions

Based on the study findings, it is concluded that annual income from banana farming in Kisunku Village is primarily determined by farming experience and market access.

Farmers with more years of production experience and better market access consistently earned significantly higher incomes than other farmers. These findings suggest that improving farmers' practical production skills and strengthening market linkages represent the most effective strategies for increasing household income.

Although variables such as fertilizer use, hybrid banana varieties, extension services, farm size, labour availability, education level, and agricultural credit displayed positive relationships with income, their effects were not statistically significant after controlling for other explanatory variables.

The study further concludes that banana farming in Kisunku Village is predominantly undertaken by experienced smallholder farmers operating relatively small farms under limited access to agricultural finance. Weak bargaining power, poor market access, declining soil fertility, and pest infestations remain major challenges affecting household income.

Overall, improving market systems, farmer capacity, and institutional support services is likely to generate greater improvements in household welfare than interventions focusing solely on expanding farm size or increasing input use.

5.4 Recommendations

Based on the findings of this study, the following recommendations are proposed.

Government

The Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), Kyotera District Local Government, and other relevant agencies should prioritise investments in rural market infrastructure, including feeder roads, market centres, storage facilities, and market information systems to improve farmers' access to profitable markets.

Agricultural Extension Services

Extension service providers should strengthen farmer training programmes focusing on improved banana production practices, disease management, soil fertility improvement, post-harvest handling, and financial management.

Farmer-to-farmer learning platforms should also be promoted to facilitate the transfer of practical knowledge from experienced farmers to younger producers.

Financial Institutions

Commercial banks, SACCOs, and microfinance institutions should develop affordable agricultural credit products specifically tailored to the needs of banana farmers.

Credit programmes should be accompanied by financial literacy training to ensure that borrowed funds are invested in productive agricultural activities.

Farmer Cooperatives

Farmers should be encouraged to establish and strengthen producer organisations and marketing cooperatives.

Collective marketing would improve bargaining power, reduce marketing costs, and enable farmers to negotiate better prices for their produce.

Farmers

Farmers should continue adopting improved production technologies while paying greater attention to efficient resource utilisation, record keeping, and market-oriented production planning.

5.5 Policy Implications

The findings suggest that agricultural policies focusing solely on increasing production inputs may not necessarily generate substantial improvements in household income.

Greater emphasis should instead be placed on improving rural market access, strengthening farmer organisations, enhancing agricultural training, and promoting value chain development.

Policies supporting agricultural commercialization and rural infrastructure development are likely to produce greater economic benefits for smallholder banana farmers.

5.6 Limitations of the Study

The study was limited to 70 respondents from Kisunku Village, which may limit the generalisability of the findings to other districts or regions.

Secondly, the study employed a cross-sectional research design, making it difficult to establish long-term causal relationships between explanatory variables and household income.

Thirdly, some variables relied on respondents' recall of annual production and income, making the study susceptible to recall bias.

Finally, household income may be influenced by additional factors such as weather variability, market shocks, and government interventions that were beyond the scope of the present study.

5.7 Areas for Further Research

Future studies should:

i. Conduct similar studies using larger sample sizes across multiple districts.
ii. Employ longitudinal data to examine changes in household income over time.
iii. Investigate the effects of climate change adaptation strategies on banana farming income.
iv. Examine the profitability of banana value addition and agro-processing.
v. Evaluate the effectiveness of agricultural extension programmes and farmer cooperatives in improving household welfare.
vi. Analyse gender differences in decision-making and income distribution within banana farming households.

5.8 Concluding Remark

This study has demonstrated that improving market access and strengthening farmers' production experience are the most important pathways for increasing household income from banana farming in Kisunku Village. Addressing institutional constraints such as weak marketing systems, inadequate farmer organisations, and limited access to productive resources will contribute significantly to enhancing rural livelihoods and promoting sustainable agricultural development in Kyotera District.

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APPENDICES

APPENDIX I: RESEARCH QUESTIONNAIRE

Introduction

My name is Mugerwa Antonio Ssewankambo, a student at Makerere University School of Statistics and Planning. As a requirement, every student offering a Bachelor of Science in Quantitative Economics must produce a research report to be awarded a degree. In that respect, I request your time to help me fill this questionnaire regarding the determinants of income from banana farming in Kisunku Village, Kyotera District. Your responses will be kept confidential and shall only be used for academic purposes. Participation is voluntary and you may withdraw at any point without penalty.

Questionnaire number: .....

Name of respondent: .....

Telephone number: .....

Section A: Socio-demographic characteristics

1. What is your gender? (0 = Male, 1 = Female)

2. How old are you, in completed years?

3. What is the highest level of education you have attained? (select ONE only)

0)) No formal education

1)) Primary

2)) Secondary

3)) Tertiary

4. For how many years have you been engaged in banana farming?

Section B: Farm and production characteristics

5. How much land do you use to cultivate bananas, in acres?

6. Do you grow improved banana hybrid varieties (e.g. NARITA series) on your farm? (0 = No, 1 = Yes)

7. Do you use fertilizers (organic or inorganic) on your banana plantation? (0 = No, 1 = Yes)

8. Overall, how severe were pest and disease problems (e.g. Banana Bacterial Wilt, Black Sigatoka, weevils) on your banana farm during the last production year? (1 = Very low, 2 = Low, 3 = Moderate, 4 = High, 5 = Very high)

Section C: Institutional access

9. Have you accessed any form of agricultural credit for banana farming during the last 12 months? (0 = No, 1 = Yes)

10. Do you have access to agricultural extension services such as NAADS training, advisory visits, or demonstrations? (0 = No, 1 = Yes

Section D: Market access

11. For each statement below, rate the situation from 1 (very poor) to 10 (excellent):

a)) Ease of reaching the nearest banana market

b)) Availability of buyers for your bananas

c)) Quality/accessibility of roads to the market

d)) Access to market price information

e)) Availability of affordable transport

1–2 = very poor, 3–4 = poor, 5–6 = moderate, 7–8 = good, 9–10 = excellent.

Section E: Labour

12. How many hired labourers did you employ on the banana farm during the last production season? (Enter 0 if none)

13. How many household members worked on the banana farm during the last production season? (Enter 0 if none)

Section F: Input expenditure and income

input_expenditure = sum of fertilizer + pesticide spending across both seasons; income = sum of Season 1 and Season 2 banana sales income.

Item	**Season 1 (Jan–Jun) UGX**	**Season 2 (Jul–Dec) UGX**
14a. Amount spent on fertilizers		

14b. Amount spent on pesticides / disease control		
15. Income received from banana sales		

15a. Approximately how many bunches of bananas did you sell in the last 12 months

15b. What was the average selling price per bunch (UGX)?

Section G: Constraints

16. From the list below, please rank your THREE most severe constraints to earning income from banana farming (1 = most severe, 2 = second most severe, 3 = third most severe):

- •) Pests and diseases
- •) Declining soil fertility
- •) Limited access to credit
- •) Poor market access / low prices
- •) Climate variability (drought / flooding)
- •) Land fragmentation / limited land size
- •) Weak farmer cooperative / limited bargaining power
- •) Other (specify): .....

Thank you for your time!!

APPENDIX II: INFORMED CONSENT FORM

INFORMED CONSENT

Dear Respondent,

My name is **Mugerwa Antonio Ssewankambo**, a Bachelor of Science in Quantitative Economics student at Makerere University conducting a research study entitled:

"Determinants of Income from Banana Farming in Kisunku Village, Kyotera District."

The purpose of this study is to identify the socio-economic, institutional, and farm-level factors that influence income from banana farming among households in Kisunku Village.

Your participation in this study is entirely voluntary. The information you provide will be treated with the highest level of confidentiality and will be used solely for academic purposes. Your name will not appear in any report arising from this research, and no information will be shared with third parties without your permission.

You are free to decline participation or withdraw from the interview at any stage without any consequences.

Thank you for your valuable time and cooperation.

Researcher's Signature: _____

Date: _____

Respondent's Signature (optional): _____

APPENDIX III: VARIABLE CODING FRAMEWORK

Variable	Description	Measurement Scale	Coding
Gender	Sex of household head	Binary	0 = Male, 1 = Female
Age	Age of respondent	Continuous	Years
Education	Highest education attained	Ordinal	0 = None, 1 = Primary, 2 = Secondary, 3 = Tertiary
Farm Experience	Years involved in banana farming	Continuous	Years
Farm Size	Land under banana cultivation	Continuous	Acres
Credit Access	Accessed agricultural credit	Binary	0 = No, 1 = Yes
Extension Access	Received extension services	Binary	0 = No, 1 = Yes
Hybrid Variety	Grows improved banana varieties	Binary	0 = No, 1 = Yes
Fertilizer Use	Uses fertilizer	Binary	0 = No, 1 = Yes
Household Labour	Family labour available	Continuous	Number of persons
Hired Labour	Hired labour employed	Continuous	Number of workers
Market Access Score	Composite market accessibility index	Continuous	Score
Pest Severity	Severity of pests and diseases	Ordinal	0–5 Scale
Input Expenditure	Total annual production expenditure	Continuous	Uganda Shillings
Annual Income	Total annual income from banana farming	Continuous	Uganda Shillings

APPENDIX IV: DATA CLEANING SUMMARY

Before analysis, the dataset underwent a comprehensive data cleaning exercise to improve its quality and reliability.

The following procedures were undertaken:

- Removal of worksheet metadata and blank rows.
- Verification of variable names using the codebook.
- Confirmation of the achieved sample size of 70 respondents.
- Identification of duplicate records (none found).
- Examination of missing values.
- Validation of coding schemes.
- Identification and treatment of invalid category codes.
- Logical consistency checks of calculated variables.
- Outlier assessment for continuous variables.
- Preparation of the final dataset for descriptive and inferential statistical analysis.

The cleaned dataset consisted of **70 valid respondents**, with **69 observations** included in the regression analysis after excluding one respondent with invalid coding for selected variables.

APPENDIX V: REGRESSION DIAGNOSTIC TESTS

Prior to estimating the Ordinary Least Squares (OLS) regression model, diagnostic tests were conducted to assess whether the assumptions underlying linear regression had been satisfied.

The following diagnostic procedures were performed:

Diagnostic Test	**Purpose**	**Result**
Variance Inflation Factor (VIF)	Test for multicollinearity	Highest VIF = 3.17 (No serious multicollinearity)
Breusch–Pagan Test	Test for heteroskedasticity	Significant ($p = 0.039$); robust standard errors used
Shapiro–Wilk Test	Test for normality of residuals	Residuals not normally distributed ($p < 0.001$)
Overall F-test	Model significance	$F(16,52) = 5.00$; $p < 0.001$
Coefficient of Determination	Model fit	$R^2 = 0.606$; Adjusted $R^2 = 0.485$

These diagnostic tests demonstrated that although heteroskedasticity and non-normality were present, the use of heteroskedasticity-robust standard errors produced reliable statistical inference.

APPENDIX VI: SUMMARY OF HYPOTHESIS TESTING

Hypothesis	Decision
H01	Fail to Reject
H02	Fail to Reject
H03	Reject
H04	Fail to Reject
H05	Reject
H06	Fail to Reject
H07	Fail to Reject
H08	Fail to Reject
H09	Fail to Reject
H10	Descriptively assessed
H11	Fail to Reject

APPENDIX VII: ETHICAL CONSIDERATIONS

The study adhered to accepted research ethics throughout the research process.

The following ethical principles were observed:

- Participation in the study was voluntary.
- Respondents provided informed consent before the interview.
- Confidentiality and anonymity of respondents were maintained.
- Personal identifiers were excluded from the analysis and reporting.
- Information collected was used solely for academic purposes.
- Data were securely stored and accessed only by the researcher and academic supervisors.

APPENDIX VIII: LETTER OF INTRODUCTION

TO WHOM IT MAY CONCERN

This letter introduces **Mr. Mugerwa Antonio Ssewankambo**, a Bachelor of Science in Quantitative Economics student at Makerere University, who is carrying out an academic research study entitled:

"Determinants of Income from Banana Farming in Kisunku Village, Kyotera District."

The researcher is collecting data strictly for academic purposes in partial fulfilment of the requirements for the award of a Bachelor of Science in Quantitative Economics.

Any assistance accorded to the researcher during data collection will be highly appreciated.

Yours faithfully,

Supervisor

Makerere University

APPENDIX IX: LIST OF COMPUTER SOFTWARE USED

The statistical analysis was performed using the following software:

Software	**Purpose**
Microsoft Excel	Data entry and preliminary cleaning
Python (Pandas)	Data management and cleaning
Python (NumPy)	Numerical computations
Python (SciPy)	Statistical tests
Python (Statsmodels)	Multiple linear regression and diagnostics
Microsoft Word	Report preparation

APPENDIX X: OPERATIONAL DEFINITION OF VARIABLES

Variable	Operational Definition
Annual Income	Total monetary earnings obtained from banana farming during the previous production year (UGX).
Farm Size	Total acreage allocated to banana cultivation.
Farming Experience	Number of years the respondent has engaged in banana farming.
Market Access	Composite measure capturing access to markets, buyers, transportation, and market information.
Extension Services	Professional agricultural advisory services received during the previous twelve months.
Agricultural Credit	Loans or financial assistance obtained specifically for agricultural production.
Hybrid Variety	Cultivation of improved banana varieties developed for higher productivity or disease resistance.
Input Expenditure	Total amount spent on pesticides, labour, planting materials, and other production inputs during the production year.