FARMING PRACTICES AND FOOD SECURITY OF SMALLHOLDER FARMERS IN KIRUHURA DISTRICT, SOUTH WESTERN UGANDA

BY

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A DISSERTATION SUBMITTED TO THE DIRECTORATE OF RESEARCH AND GRADUATE TRAINING IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE IN AGRICULTURE EDUCATION AND EXTENSION OF KYAMBOGO UNIVERSITY

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DECLARATION

I, Jackson Tumukunde, do hereby declare, to the best of my knowledge, that this research report is original and from my own efforts and that it has never been published or submitted to any academic awarding university or institution of higher learning for any degree.

Sign ……..…… **Date ……...……**

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APPROVAL

This is to certify that this research report entitled **"Farming Practices and Food Security of Households in Kiruhira District, South Western Uganda"** was submitted for further examination with our approval as University supervisors.

Signature …… **Date ……**

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Sign ……. **Date ……**

DR. MAKOSA DAN

DEDICATION

My parents, Mr. Late Kabera James and Mrs. Baryomunyena Ruth, as well as my brother Buntu Enock and sister Kembabazi Ruth, who always believed in me and whose support, prayers, and encouragement gave me hope and push to accomplish this study, are the ones I dedicate this research report to. I dedicate this intellectual accomplishment to you since you stood by me when I most needed you to.

I also dedicate my research report to my dearest friend and wife, Mrs. Kyakunda Hope, as well as to our beautiful daughters, Kankunda Joanita and Ankunda Tabitha, as well as to everyone who has in some way supported my decision to pursue this academic endeavor. May the love of the Lord envelop you all.

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LIST OF ACRONYMS

COVID-19	Corona Virus Disease 2019
CVI	Content Validity Index
FAO	Food and Agricultural Organization
FAO	Food and Agricultural Organization
GDP	Gross Domestic Product
GHI	Global Hunger Index
HH	Household
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
LCs	Local Councils
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
NAADS	National Agricultural Advisory Services
NAGRC-DB	National Genetics Resources Center and Data Bank
NDP I & II	National Development Plan One and Two
NPA	National Planning Authority
OECD	Organization of Economic Cooperation and Development
S/C	Sub-County
SACCO	Savings and Credit Cooperative Organization
SPSS	Statistical Package for Social Scientists
SSA	Sub-Saharan Africa
T/C	Town Council
UBOS	Uganda Bureau of Statistics
UNICEF	United Nations Children Fund
VIF	Variance Inflation Factors
WFP	World Food Programme
WHO	World Health Organization

ABSTRACT

This study examined how farming practices influence smallholder farmers' food security in Kiruhura district of Uganda. The specific objectives were to: describe the farming practices of smallholder farmers in Kiruhura district; determine the factors that influence the selection of farming practices among farmers in Kiruhura district, and to establish the relationship between household farming practices and household food security. Data were collected from a cross-sectional survey using questionnaires from a sample size of 310. In addition, key informant interviews and field observations was done.

The study findings showed that most smallholder farmers used varied levels of external inputs in agricultural production with about half of them combining use of external inputs with traditional farming practices. The choice of the farming practice to use was influenced by human, financial, social and natural factors, but natural factors have the greatest influence. Further, the dimensions of food security it is food availability and access that were assessed. The results showed that households that practiced high external inputs dependency farming were more food secure (food availability) than those that did not use external inputs in farming. The study revealed that there was a statistical difference between farming practices and food security within smallholder farmers at a 10% level of significance. Hence, farming practices that involve use of external inputs can significantly contribute to food security. Given that choice of whether or not to use external inputs largely depends on natural factors, designing interventions that conserve soil and water, and those that improve soil fertility to improve food security can enhance food security

CHAPTER ONE

INTRODUCTION

1.0 Introduction

The study's background, problem statement, purpose, objectives, scope, and significance are all included in this chapter.

1.1 Background to the Study

Farming households are prevalent throughout the world, according to Nelson et al. (2010), Yamano et al. (2011), and Jayne et al. (2006) are facing serious challenges including increase in birth rates, price fluctuations, reduction in soil fertility and crop produce, limited markets and reduced access to land. These challenges have worsened poverty and food insecurity, which are rising in many parts of the world (Kristjanson et al. 2010; Thornton et al. 2011). Food insecurity has persisted despite the introduction of millennium development goals over 15 years ago which calls for improvement of the agriculture systems (Zhou et al., 2013). Although there has been continued progress in hunger reduction at the global level, food insecurity is still a challenge (FAO, 2014).For instance, the World Food Programme (2021) reports that in 2020, 26.4% of the world's population was food insecure. According to the FAO, a situation is considered to have food security when everyone, at all times, has physical, social, and economic access to enough, safe, and nutritious food that satisfies their dietary needs and food choices for an active and healthy life. The four key components of food supply included in this approach are accessibility, stability, usability, and availability. Promoting food security ensures that households have access to quality and nutritious food which is fundamental to human existence and improved health (Asfaw, Kassie, Simtowe & Lipper, 2016). Unfortunately, there has not been sufficient progress towards international hunger targets in Africa, especially in the sub-Saharan region where more than one in four people are undernourished (FAO, 2014). In Africa, the highest level of food

insecurity was recorded in East Africa where 63% of the population (272 million) experience food insecurity (FAO et al., 2021). Most of the population in East Africa depend on agriculture. Hence, agriculture is essential for ensuring food security at both national and household level (Conceição et al., 2016). It can therefore be argued that food security among farming communities is largely determined by their agricultural productivity (Maziya et al., 2017), the key to long-term food security is increasing agricultural productivity. (Ssewanyana & Kasirye, 2010). Other than availing food for household consumption, there is the income pathway to food security where agricultural income can also be used to purchase food from the markets.

The primary objective in Uganda has been to improve smallholder farming by raising agricultural output in order to provide both on- and off-farm employment options for the majority of rural household members (NDP I and II; NAES, 2016). Smallholder farming is also thought to contribute up to 40% of a household's income, giving the impoverished the means to buy food from the markets. These salaries increase most households' ability to purchase food to fulfill their daily needs, which increases household food security (FAO, 2014). Furthermore, sustainable production is required for agriculture to have a long-term impact on food security. Indeed, advancing the use of sustainable farming methods in rural regions, where the majority of the hungry and impoverished reside, is essential to achieving the Sustainable Development Goals (Hazell, 2005). Low-income rural households, for instance, have adopted sustainable agricultural practices like composting, mulching, crop rotation, intercropping, agroforestry, biological pest control techniques, green manures, nutrient recycling, integrating livestock into farming systems, preventing soil erosion, and water harvesting to meet their food and nutritional needs (Amare et al., 2012). Farmers utilize farming practices, which are agricultural techniques or concepts, to improve agricultural results like better yields per acre, increased farm production, high-quality items, and efficient land use, among other things (Ward et al., 2018).

This study modified that concept and concentrated on agricultural practices that make use of outside resources like machinery, irrigation, fertilizers, pesticides, manures, and enhanced seeds. In the Kiruhura district, this study aimed to determine how such farming practices affect the food security of smallholder farmer households.

1.2 Statement of the problem

Small-scale farming offers a chance to raise the rural poor's standard of living and guarantee food security. Low yields are now a common problem for many smallholder farmers who had previously been successful in raising crops for revenue and subsistence.This undermines the ability of having food security at household level. In Uganda where most farmers are smallholders about 12% of total population were chronically food insecure in 2021 (FAO, 2021). For instance, in Kiruhura district, a report from the district NAADS coordinator indicates that 33% smallholder farmers face food insecurity manifested by limited availability, inadequate accessibility and instability (Kiruhura District Food Status Report, 2020). This could be attributed to the many challenges affecting smallholder farmers in Uganda. These include among others, the high cost of inputs such as seed, fertilizers and pesticides, limited markets, lack of or high cost of post-harvest storage facilities for crops as well as limited access to extension and financial services (Anderson, et al., 2016). Further, smallholder farmers seldom use production inputs, depend on rainfall, and operate on a subsistence basis (NPA, 2013). Smallholder farmers must therefore use innovative technology to boost production and, as a result, guarantee food security. A variety of programs have been put in place by the Ugandan government to raise productivity in smallholder agriculture. One of these is the development of the markets for agricultural inputs to motivate farmers to employ outside inputs like chemical fertilizers, pesticides, herbicides, and better crop types or livestock breeds. Farmers have utilised these outside inputs to varying degrees. Smallholder farmers in Uganda are aware of the value of using foreign inputs, much like in other regions of the

country, but it is unclear how much they use them or what factors into how much they use them. Furthermore, it is unclear how these farming techniques affect the household food security of smallholder farmers. The findings of this study contribute to a better understanding of the farming methods used by smallholders to increase food security.

1.3 Objectives of the Study

1.3.1 Overall objective

The main objective of this study was to examine how farming practices influence food security of smallholder farmers' households in Kiruhura district.

1.3.2 Objectives of the Study

(i) To assess the extent of smallholder farmers' use of farming practices that involve utilising external inputs in Kiruhura District.

(ii) To determine the factors that influence smallholder farmers' selection of farming practices in Kiruhura district.

(iii) To establish the relationship between farming practices and food security of smallholder farmers' household in Kiruhura district.

1.4 Research Questions

i. What is the extent of smallholder farmers' use of farming practices that involve utilising external inputs in Kiruhura District?

ii. What factors determine smallholder farmers' selection of farming practices in Kiruhura district?

1.5 Hypotheses

H_0 : There is no significant difference in the level of food security in smallholder farmers' households in Kiruhura district using the different farming practices of no use external inputs, moderate use of external inputs and highly dependent on external inputs

H_1 : There is a significant difference in the level of food security in smallholder farmers' households in Kiruhura district using the different farming practices of no use external inputs, moderate use of external inputs and highly dependent on external inputs

1.6 Scope of the study

The study's main objective was to determine how home farmers in the Kiruhura district's farming techniques and food security relate to one another. The study was conducted between July 2021 and December 2021 taking into consideration statistical information and secondary data ranging from 2015 to 2021. This period was chosen because this was the period when hunger struck many areas of Kiruhura district.

1.7 Significance of the Study

The findings of this study may be helpful in the following ways:

i) The study findings will help the government of Uganda through the ministry of agriculture, animal industry and fisheries (MAAIF) to formulate policies relevant for the development of agricultural production especially among household farmers in the rural areas.

ii) The study findings will contribute evidence-based findings to policy makers and other stakeholders on the practices that might be supported and encouraged in order to aid farming households in overcoming food poverty.

iii) For academia, this study will establish findings on farming practices and food security. Therefore, it will offer literature to future scholars interested in one or more of the variables in this study.

1.8 Conceptual framework

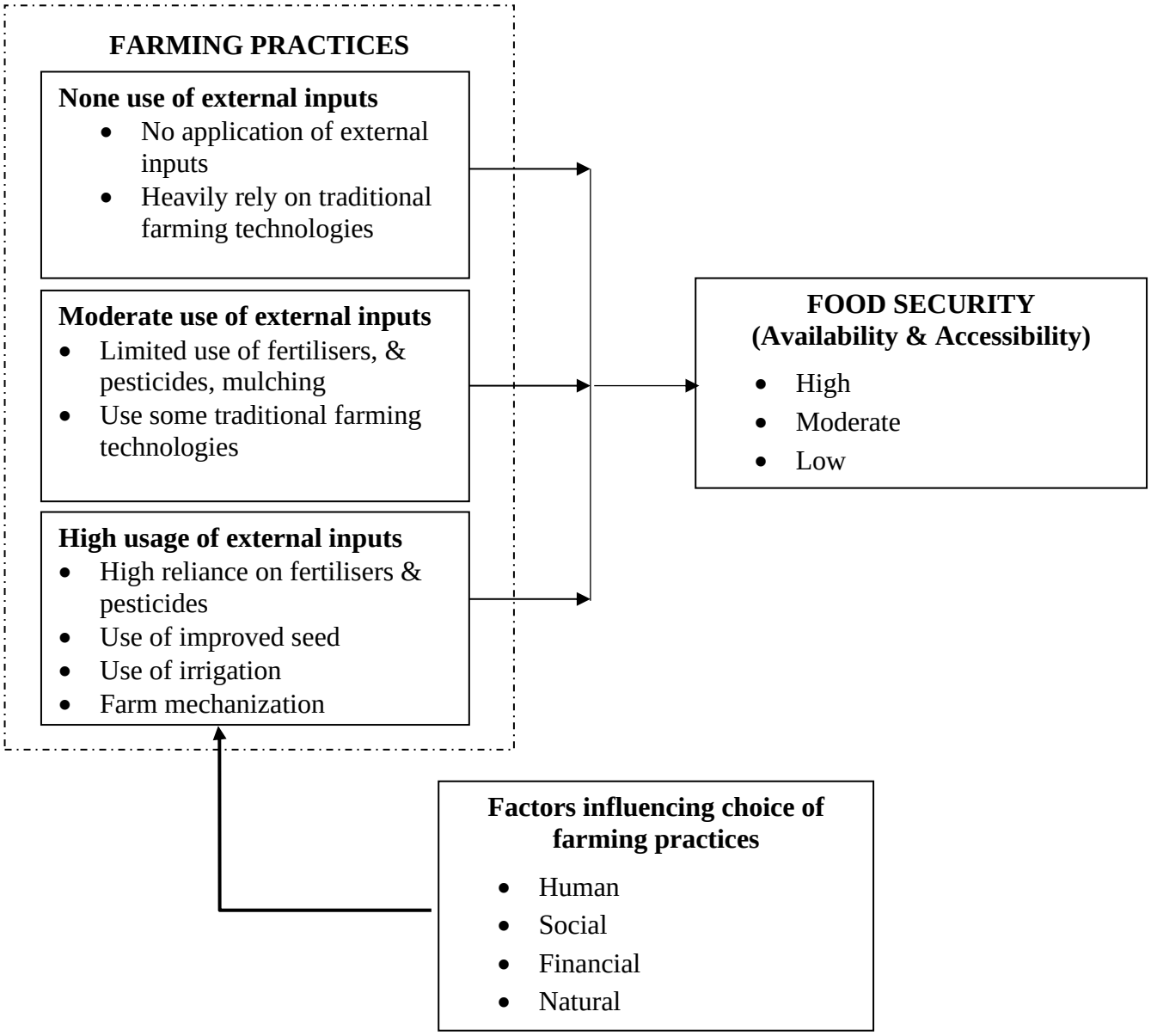

Figure 1.1: Conceptual framework indicating how farming practices influence food security

Source: *Adapted from Baer-Nawrocka and Sadowski (2019)*

The conceptual framework mentioned above suggests that farming methods might result in food security. The dependent variable was food security, while the independent variables were farming methods. Low, moderate, and no dependence on external inputs were used in agriculture, respectively.

These agricultural methods affect the household food production of smallholder farmers, which affects food accessibility and availability. The decision of which of these methods to employ is influenced by a variety of elements, which can be divided into human, social, financial, and natural ones (Gebremedhin & Jaleta, 2010; Ibeawuchi, et al, 2015; Serebrennikov, et al, 2020). Additionally, a study by Apanovich and Mazur (2018) and Baer-Nawrocka and Sadowski (2019) stated that nutritional security as well as availability, access, and stability are used to quantify food security among smallholder farmers. These qualities were applied in this investigation in an equal measure.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The purpose of this chapter is to provide the empirical review of previous studies on the variables of the study so that they guide on the approaches to be employed in the current study. In addition to that, the literature review was undertaken to identify research gaps in the relationship between farming households and food security. The chapter is organised into several sections; the theoretical review followed by empirical review of different scholarly works on the study variables. The theoretical review gives a discussion of induced innovation theory while the empirical review offers an overview of the literature related to farming in Sub-Saharan Africa, use of external inputs in farming, relationship between farming practices and food security as well as the factors which influence the choice of farming practices among household farmers.

2.2 Theoretical framework

According to Hayami and Ruttan (1970) induced innovation hypothesis, farming practices that increase food security can be theoretically explained.This theory stipulates that the relationship between factors of production and products prices determine the use of different technologies or innovations that can increase agricultural productivity leading to food security (Hayami & Ruttan, 1970; Ruttan, 1977; Armanville & Funk, 2013). According to this theory, farmers who strive to improve their agricultural output and productivity need to invest in improved methods of farming through application of external inputs thereby contributing to their food security. The theory asserts that in countries (places) with abundant labour but scarce land likely to embrace technologies that are biased toward increasing land productivity (such heavy reliance on external inputs), whereas nations and regions with a high ratio of land to labor prefer to adopt technologies that are biased toward enhancing labor productivity (Cowan, Lee & Shumway, 2015). Similarly,

from the theoretical lens of induced innovation theory, Bidabadi and Hashemitabar (2009) showed that the types of technology used by different categories of farmers to increase agricultural output are influenced by input factors. The induced innovation hypothesis is therefore appropriate for this study since it concentrates on how to raise agricultural output and land productivity, both of which are crucial for enabling expanding people to feed themselves and thereby maintaining food security.

2.3 Smallholder farming in Sub-Saharan Africa

Family agriculture is the primary source of income for the majority of sub-Saharan African households, and they produce at levels that leave little to nothing to sell on the food market (Gollin, 2014). Subsistence production largely relies on farming practices that are organic, which result in low yields, therefore may not guarantee food security for households on a sustainable basis (Boyac-Gündüz *et al.* 2021). In addition, as Agidew and Singh (2018) noted that land holdings of most farming households in sub-Saharan Africa are fragmented. This limits agricultural production and subsequent food availability and incomes of farmers that depend on agriculture. The annual and intraseasonal unpredictability of climate elements, particularly rainfall and temperatures, is another challenge for farmers. Many smallholder farmers' reliance of mostly family labor, insufficient access to markets and transportation services, and the limited availability of extension services all contribute to their low agricultural production.

Alleviation of poverty and reduction in food insecurity among most rural household in developing countries largely depend on sustainable increase in agricultural productivity since they depend on agriculture for food and livelihood (Gebre & Rahut, 2021). Using external inputs like chemical fertilizers, insecticides, improved seeds, herbicides, and irrigation could raise the low level of agricultural yields that are typical in underdeveloped nations (Ibeawuchi et al., 2015). Investment in agro-inputs has seen a resurgence in interest in Africa as a way to boost food security by

increasing agricultural output (Jayne & Rashid, 2018; Adenle, Weding & Azadi, 2019). But in many African countries, the majority of smallholder farmers are unable to afford the agricultural inputs and technologies needed to increase agricultural production, which is expected to provide food security (Wiggins & Brooks, 2016). Other difficulties include inadequate input quality, subpar post-harvest handling procedures, unreliable transportation infrastructure, and a lack of adequate storage facilities.

The poor quality of agricultural inputs is generally the result of a number of problems, including adulteration and inadequate formulations, which point to lax regulatory frameworks in the majority of African nations. Because of this, contemporary development programs have pushed for quality management of agricultural inputs by enhancing the regulatory structures (Galhena, Freed & Maredia, 2018; FAO et al., 2021). However, Oduniyi and Tekana (2020) pointed out that it is still difficult for most nations to operationalize their regulatory frameworks. The financial success of using input and output markets, together with the low quality of inputs, undercut inputs. This decreases farmers' capacity and desire in adopting agro-inputs in agricultural production, which ultimately increases food insecurity.

Given the aforementioned state of agriculture in sub-Saharan Africa, farming households can boost agricultural output and yields by utilizing practices like irrigation, mulching, improved seeds, fertilizers, pesticides, and farm machinery like tractors and ox ploughs. This will increase household food security by increasing food availability, accessibility, stability, and revenues from the sale of agricultural goods. In this study, these agro-inputs and practices have been classified as external farming inputs.

2.4 Farming practices

Farming practices are agricultural methods or principles used by farmers to increase agricultural outcomes such as higher yields per acreage, increased farm productivity, quality products and proper land usage among others (Ward et al., 2018). Farming practices may include use of manures, irrigation, application of herbicides, use of fertilisers, pest and disease control and mulching. Such practices enable farmers to get better yields subsequently improving food security among households (Amekawa, et al., 2021).

When smallholder farmers use of fertilisers and manures it improves soil fertility which results in increased crop yields hence enhancing food and nutritional security (Akerele, Momoh, Aromolaran, Oguntona & Shittu, 2018). In addition, farming practices such as pest and disease control can reduce loss in quality and quantity of agricultural produce. For instance, the contamination of agricultural produce by pests and diseases is reduced hence agricultural produce is likely to be of acceptable quality for both human and livestock consumption (Akerele *et al.*, 2018). Further, Adjimoti and Kwadzo (2018) explain that farming practices such as mulching, crop rotation and herbicide application can minimise problems arising from effects of weeds on crop growth which results in higher yields hence increased availability of food to households and increased incomes in case of sales.

2.4.1 Fertilizer use

Improved seed and integrated soil fertility management, particularly greater fertilizer use, can considerably minimize the yield gap in Sub-Saharan Africa (Udmale et al., 2020). In the context of subsistence farming, where many crop varieties are produced to provide a variety of meals with differing nutritional benefits, the increased agricultural production translates into more food availability, accessibility, and stability. Asfaw et al. (2016) also report that the use of fertilizers in

agriculture can increase land productivity, leading to higher yields and, consequently, more household disposable income that can be utilized to buy a variety of food for the family.

2.4.2 Irrigation

For agricultural productivity, irrigation is the provision of additional water to supplement rainfall (Sheahan & Barret, 2014). Irrigation is a yield-improving input that can be used in a variety of ways, including manual irrigation, surface irrigation, drip irrigation, spray irrigation, center pivot irrigation, and irrigation using lateral moves. For smallholder farmers, it may be more practical or inexpensive to get their irrigation water from places like rooftops, overflowing streams and rivers, or specially created catchments.

Irrigation allows agricultural production even when rainfall is inadequate or not available therefore it increases food security especially at household level (Mozumdar, 2016). Irrigation therefore reduces the risk of crop losses from low or variable rainfall thereby enabling farmers to cultivate all year-round and to time crop harvests so as to take advantage of seasonal price fluctuations. Thus, irrigation as a farming practice not only increases crop production but also promotes land productivity leading to food security by availing food and income to households throughout the year.

A study by Yamano *et al.* (2016) among 600 farmers in East Africa revealed that farming practices that rely on high use of external inputs more often than not involve the use of irrigation practices which help to provide water to crops in seasons of water scarcity hence supporting plant growth as a way of mitigating food insecurities among households. Similarly, Cardno (2017) noted that irrigation is an effective strategy for increasing food availability through enhancing the production of high-value and high-yielding crops. FAO (2021) observed that irrigation is an effective strategy in commercial agricultural for increasing food availability through enhancing the production of

high-value crops as it was illustrated in Asia, where following irrigation, the majority of crop yields increased by 100% to 400% (FAO, 2021). So, rather than relying on rainfall, irrigation enables farmers to apply water during the most advantageous times of crop development.

2.4.3 Use of agrochemicals

Agrochemicals in the form of pesticides, herbicides, fungicides and insecticides are used to control pests, parasites, diseases and weeds which in turn improves crop yields and increase livestock products (Sheahan & Barret, 2014). The control of weeds which compete with crops for sunlight, moisture and soil nutrients, increases crops yields. In the same way, control of crop pests that eat grains or the leaves and roots at any stage of plant growth necessitates the use of agrochemicals in order to improve crop yields (Béné, Headey, Haddad & von Grebmer, 2016). Diseases and fungi on the other hand, cause crop losses and lower livestock production which reduces food production and subsequently increase food insecurity of households. Hence, reducing agricultural losses through use of agrochemicals improves food availability, accessibility, stability and consequently leading to food security for households.

2.4.4 Improved crop varieties

Improved crop types are crucial for boosting and maintaining agricultural yields, and as a result, they significantly improve food security (Arouna, *et al*., 2017). To benefit from the improved varities framers need to use quality seeds. Improved crop varieties typically give higher yields, are tolerant to drought and other climatic factors, and are resistant to diseases. On the other hand, improved livestock breeds give higher quantity and better-quality products. These increase productivity or decrease risk hence increasing overall yields that can increase food security among households (Harvey, Rakotobe & Rao *et al.*, 2014; Keatinge, Yang, Hughes, Easdown & Holmer, 2019).

2.4.5 Farm power and mechanisation

Farm power and mechanization have been in the last few years accepted as avenues for increased agricultural production hence improving food security for households (Massawe, 2018). In Sub-Saharan Africa, human power is used for hand tools to bring new land under cultivation, prepare fields for planting and harvest crops. However, human labour can be saved through mechanisation which increases farm size and the timeliness of crop management practices such as seedbed preparation, planting and harvesting (Mango, Makate, Mapemba & Sopo, 2018). This would be especially important a developing country like Uganda where mechanisation can increase the area of cultivation and increase labour productivity. Mechanisation can therefore increase crop yields through increasing acreage and timeliness of agricultural production practices consequently contributing to improved food security at household level in terms of accessibility, availability and stability.

2.5 Use of external inputs in farming in Uganda

In Uganda, smallholder farmers make up 85% of the population and provide the majority of the nation's grain and animal products (Nabuuma et al., 2021). Due to their scarcity and accessibility, quality inputs like seeds, fertilizer, and insecticides are not widely used in Uganda (NPA, 2018). It has been determined that one of Uganda's problems with food security stems from the high prices and restricted availability of better agriculture inputs and production technology (Nuwatuhaire & Ainomugisha, 2019). Additionally, the belief among the majority of smallholder farmers in Uganda that the country's soils are inherently fertile restricts the use of agro-inputs to raise agricultural productivity and output (NPA, 2018). According to Bakhtsiyarava and Grace (2018), agricultural inputs like better seeds, fertilizer, equipment, and irrigation help lessen food insecurity at the home level. Therefore, increasing household food security in the nation depends on boosting access to high-quality agro-inputs.

The use of external inputs by farmers can be grouped into three categories where farmers demonstrate none usage, moderate usage and high usage or dependency on external inputs in farming (Serebrennikov *et al.,* 2020). According to these scholars, none use of external inputs refers to farming with minimum use of off-farm inputs such as fertilisers or manures. This farming practice is common with subsistence farmers and is characterised by growing small quantities of several crop varieties for home consumption and the surplus taken to the market for sale. This practice is easy to implement since it requires no skilled or labour specialty, relies on family labour and does not require sophisticated farming equipment (Borgerson, Razafindrapaoly, Rajaona, Rasolofoniaina & Golden, 2019). Its main shortcoming is that farmers rely on climatic conditions which are largely affected by unreliable weather conditions hence affecting the crop productivity and consequently food security of smallholder farmers.

The other farming practice is where farmers moderately apply external inputs in farming to improve yields (Massawe, 2018). This farming practice involves use of some of the modern agricultural best practices such as fertiliser application and improved seeds at a small scale (Baer-Nawrocka & Sadowski, 2019). This may also include use of drought animals, use of natural/organic pesticides and fertilizers, limited use of improved seed, use of simple irrigation technologies which increase yields (Udemezue & Osegbue, 2018). Further, farmers' moderate use of external inputs or low input farming approaches to boost livestock production aim at increasing animal products such as milk, meat and animal population (Herrera *et al.*, 2021). These methods seek to boost agricultural output in order to increase food availability and generate cash from surplus produce after marketing. Farmers in sub-Saharan Africa have accepted the moderate use of external inputs in recent years since it boosts land productivity (Ibeawuchi, Obiefuna & Iwuanyanwu, 2015). The degree to which farmers use external inputs varies greatly depending on the stage of crop production and the level of technological development.

The employment of contemporary agricultural technologies, such as high-yield crop varieties, chemical fertilizers, pesticides, herbicides, irrigation, and mechanization, is what distinguishes farming practices with a high dependency on external inputs (Kelly, 2015; Sridhar and Swaminathan, 2020). These methods significantly raise crop and animal production, ensuring food security and raising farmer earnings. However, it is crucial to remember that for these technologies to succeed, there must be a large capital investment and a robust physical and economic infrastructure (Otsuka, 2018) As a result, the majority of smallholder farmers in developing nations are unable to adapt the large usage of outside inputs in agriculture.

2.6 Farming practices and food security

The varied farming practices have different outcomes to the food security situation of households. For instance, a study by Conceição, Levine, Lipton and Warren-Rodríguez (2016) revealed that progressive farming that entails moderate use of external inputs involves mixed cropping which contributes to food availability and security for households. The use of external inputs in agriculture reduces crop failure which ensures that food is readily available to households (Pawlak & Kołodziejczak, 2020). Furthermore, progressive farming practices that involve high or moderate usage of external inputs sometimes involve the adoption of drought tolerant crops which help in growth of crops during unfavorable climatic conditions hence ensuring household food security (Sibhatu & Qaim, 2017). Similarly, Adelaja and George (2021) reported that use of drought tolerant crops is an effective approach in increasing the availability of food quantity in many developing countries.

The use of external inputs may encompass farming that involves crop diversification and this helps in production of crops in all seasons which improves food security for farmers in terms accessibility and availability (Ahmed, Ying, Bashir, Abid & Zulfigar, 2017). Such approach to diversification encourages farmers to produce for both home consumption and for the market

(Ahmed *et al.*, 2017). Besides, diversification may also promote transition from agriculture into nonfarm activities which are vital in boosting food security and incomes (Skoufias, Di Maro, González-Cossío & Ramirez, 2019).

The practice of using external inputs improves crop and livestock productivity thus contributing to food security through increasing availability, accessibility and stability of food at the household level. This is illustrated by a study by Asfaw, Shiferaw, Simtowe and Lipper (2016) among 800 small holder farmers in Tanzania and Ethiopia that established that high dependence or moderate use of external inputs is critical in reducing food shortages hence promoting food security in farming communities.

The majority of external inputs used in agriculture concentrate on raising soil productivity and crop yields so that large amounts of food can be produced. This helps to increase food availability, accessibility, and stability for households. Numerous academics draw the conclusion that there is a link between farming techniques and food security based on this empirical review.

2.7 The factors influencing the choice of farming practices

There are several the factors that have been identified to influence the choice of farming practices by farmers. These are broadly categorized as human, natural, social and financial factors and they are explained.

2.7.1 Human factors

Most farmers in Uganda are smallholder farmers who view their agricultural activities as their households' business. Smallholder farmers typically use family labour in agricultural production, therefore the agricultural practices are dependent on the knowledge and skills possessed by members of the household. Further, there are limited employment opportunities in rural areas in developing countries therefor most people are engaged in agriculture which makes labour

available. The availability of human labour encourages smallholder farmers to apply external inputs to increase agricultural output (Giller *et al.,* 2016). Most smallholder rely family labour, support and advise to promote their agricultural enterprises (Anderson, Learch & Gardner, 2016). Farming for many smallholder farmers is managed basing on resources owned by the household. Family farm labour is also used in to non-farm activities in the agricultural value chain such as post-harvest handling activities like drying and marketing. Therefore, such farming households rely mostly on their own human resources in form of family and friends and with limited outside assistance (Zizinga, 2017). Human resources from formal entities like financial institutions, agricultural input providers, resellers, buyers, or other entities play only a small part in Uganda's smallholder farming system (Anderson *et al.*, 2016).

Smallholder farmers usually rely on themselves and their families for labour to support the farming activities. They typically use other smallholder farmers, members of their families and friends as sources of information on agricultural production technologies, availability of markets, amount demanded, and prices for their produce (Yikii, Turyahabwe & Bashaasha, 2017). Family labour is very important even in countries largely commercialized agricultural (Beddington *et al.*, 2016).

Family labour is a valuable human factor in improving household food security since it is not affected by issues of incentive affect agricultural labour markets and close monitoring of hired labour which is costly (Omorogbe, Jelena & Fatima, 2014; Sseguya, Mazur & Flora, 2017). Further, family labour supply is flexible, for instance it can easily be mobilised during peak periods and they can work on other crop production activities such as drying and storage during slack periods (Gollin, 2014). Due to labor market inequalities, hired labor may find it challenging to be so flexible. In order to maintain food security at the home level, according to Nuwatuhaire and Ainomugisha (2018), smallholder farmers must rely mostly on family labor and employ few

external inputs in their farming operations. As a result, human factors play a crucial role in promoting food security at the family level and influencing households' decisions on farming practices.

2.7.2 Natural factors

Natural factors such as availability of climate, properties of soil and topography also influence the choice of farming practices. Unfavourable environmental conditions such as drought and floods increase smallholder farmers' vulnerability to food insecurity because such conditions hinder proper growth of crops (Kikoyo & Nobert, 2016). In particular, agricultural production is highly affected by rainfall pattern with places receiving adequate rains being more food secure compared to those with inadequate rains (Turyahabwe, Kakuru, Tweheyo & Tumusiime, 2013). Despite many areas in Uganda having the necessary conditions for agricultural production such as fertile soils and favourable climate many farmers experience poor crop yields because of drought (Republic of Uganda, 2017). Under such circumstances of insufficient rain external inputs such as irrigation need to be used to reduce the risk of poor yields that lead to food and nutritional insecurity (Swinnen & McDermott, 2020). Therefore, depending on natural rains alone poses a very big risk to food security efforts among households.

In Uganda's south-western rangelands where Kiruhura district is located agricultural productivity, is greatly affected by scarcity of water (Nanyeenya, Mutumba, Mutyaba & Wanyama, 2014). There is generally limited irrigation practiced in Uganda (NPA, 2018). For instance, in Uganda, only 14,418 hectares of the estimated 560,000 hectares of land with irrigation potential are subject to formal irrigation (MWE, 2018; UBOS, 2020). Due to the limited use of irrigation caused by smallholder farmers' inability to purchase it, agriculture production and land productivity have declined over time. To encourage sustainable output, this asks for smallholder irrigation programs tailored to smallholder farmers (NPA, 2018). Given the discussion of natural causes listed above,

smallholder farmers must adopt better agricultural methods, such as the use of irrigation and fertilizer to raise crop yields and hence, food security.

2.7.3 Social factors

Social factors such as availability of farmers cooperatives (unions), village SACCOs, and farmers' networks promote farmers' use of improved farming practices because such platforms act as knowledge repositories through which farmers can share information and best practices on different farming enterprises that can promote household food security (Abdullah *et al.,* 2019). This implies that farmers' selection of different farming practices is partially affected by social networks since they determine what appropriate farming methods that can improve crop yields are available for farmers to adopt (Abdullah *et al.,* 2019). Participation of farmers in groups promoted moderate use of external inputs in farming, increased levels of adoption of agricultural technologies and eased access to resources such as information for decision making (Gallaher, Kerr, Njenga, Karanja & WinklerPrins, 2015). In turn, this leads to higher agricultural yields and improved food security through enhanced availability and access of food for consumption and sale. Sseguya et al. (2017) assert that social capital has an impact on food security in Uganda. For instance, households with high external agricultural inputs and strong social capital were more likely to be food secure than households with low social capital (Sseguya et al., 2017). According to Sseguya et al. (2017), social capital alone is insufficient to achieve food security, hence human capital development must be coupled to it in order to create sustained food security among farmers.

2.7.4 Financial factors

The use of external inputs in farming requires financial investment to buy agro-inputs such as improved seed, fertilisers, machinery, and irrigation (Ijaz, Nawaz & Ul-Allah, 2019). For that reason, availability of capital for investment influences farmers' adoption of external inputs to

improve crop yields and subsequently household food security. Demeke and Zeller (2019) established that farmers' engagement in traditional saving associations improved their access to fund, which increased the use external inputs in farming. Income poverty is significantly associated with food insecurity especially among farmers who do not use or have limited use of external inputs in farming (Porkka *et al.*, 2018). Households having economically active members obtain off-farm income which enables farmers to use external inputs, which improves agricultural productivity and consequently improves food security (Nord, Coleman-Jensen & Gregory, 2014).

2.8 Overview

According to the literature assessment, farming in sub-Saharan Africa is characterized by little use of outside inputs, which leads to low yields. Human, ecological, social, and financial considerations all have a significant role in the limited utilization of external inputs. Farming practices that involve limited use of external inputs undermine household food security. This is because agricultural productivity is low which affects availability of food and income from agricultural products which ultimately affects access to food.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

The strategies and procedures used by the researcher to obtain data and delve into the study problem are described in detail in this chapter. It covers the following topics: the research design, study population, sample size and selection, sampling procedures, procedure, data collection methods, and instruments for data quality control, data analysis, and variable measurement.

3.2 Research design

In this study, a descriptive cross-sectional approach was employed. Creswell's (2014) guidelines called for the design of this research study to involve simultaneously gathering data from a variety of smallholder farmers. In order to draw conclusions on events affecting a large population, the researcher was able to employ this approach to capture a snapshot of a sample population at a specific point in time. Besides, findings from cross-sectional studies can be generalised to the entire population despite their reliance on samples. Moreover, the interest of this study was to examine the farming practices at a given time, and the food security situation, thus a cross sectional study was the best choice since it provided both analytical and descriptive findings.

3.3 Area of study

The Kiruhura District in Uganda's Western Region is surrounded by the districts of Kamwenge and Kyegegwa to the north, Sembabule to the north-east, Lyantonde to the east, Rakai to the south-east, Isingiro to the south, Mbarara to the south-west, and Ibanda to the north-west. The district office is 65 road kilometers to the northeast of Mbarara, the major town in the Ankole sub-region. Location of the neighborhood is 00 12S, 31 00E.

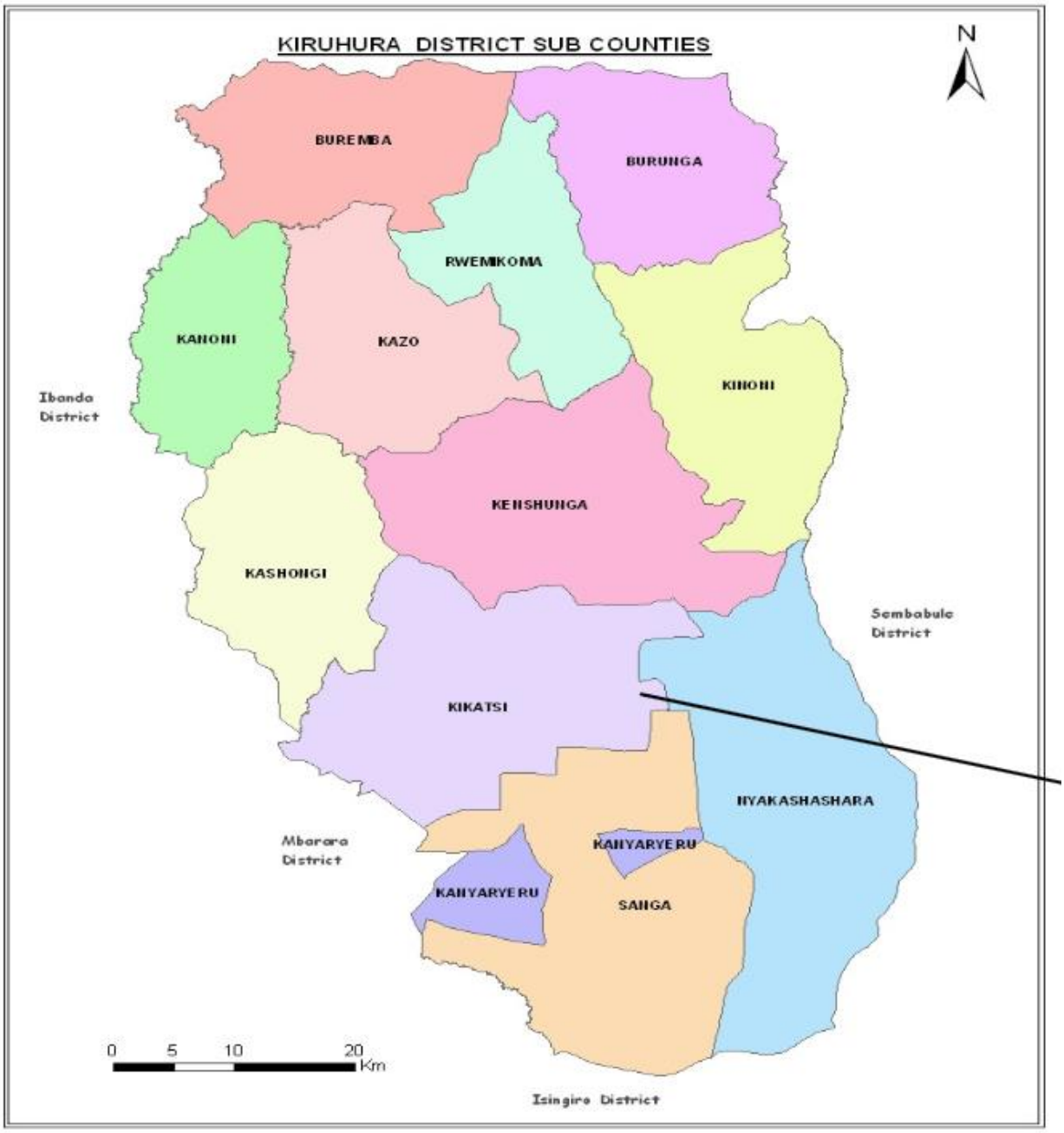

Figure 3.1: Map of Kiruhura District

Source: Google site

Kiruhura district was chosen for the research because it is prone to frequent food insecurity, yet the district relies on farming as a major economic activity. More so, the district is endowed with fertile soils and receives good amount of rainfall annually. Therefore, it is least expected for households

within this district to experience perennial food insecurity given the above-mentioned endowments.

In terms of economic activity, the district of Kiruhura relies heavily on cattle, with milk and meat being other significant outputs. African goats, hybrid cattle, exotic cattle, and Ankole cattle are some of the animals raised. Crop growing is a significant agricultural activity in Kiruhura district, with 83% of families involved in some capacity (UBOS, 2017).

3.4 Study population

The Kiruhura District's smallholder farmers made up the study's target population. The District NAADS Report (2020) shows that there about 1,800 smallholder farmers' household distributed among the eighteen Sub-Counties in Kiruhura District. These are; Buremba, Burunga, Engari, Kanoni, Kazo, Kazo Town Council, Nkungu, Rwemikoma, Kanyaryeru, Kashongi, Kenshunga, Kikatsi, Kinoni, Kiruhura Town Council, Kitura, Nyakashashara, Sanga and Sanga Town Council respectively. For purposes of this study, a household farmer is one engaged in either crop farming, livestock rearing or practicing a combination of the two. Concerning their distribution, the NAADS report (2020) further indicates that 418 dealt in crop farming, 579 were cattle grazers while 803 were mixed farmers respectively. Household farmers were chosen as the unit of analysis because they have wide knowledge on matters of farming practices and food security which were the focal variables of investigation in this study. Hence, the researcher believes these household farmers were suitable to inform this study.

3.5 Sample size

The sample size from a population of 1,800 smallholder farmer families was estimated using Yamane's formula (1967). According to Yamane (1967), a 95% confidence level and P = 0.5 are assumed for the equation for sample size calculation. This technique was chosen because it is

straight forward, precise and gives a numerical approach for determining an appropriate sample size for a known population. Yamane's formula is illustrated below;

$$n = \frac{N}{1 + N(e)^2}$$

Where n is the desired sample size, N is the population size, and e is the level of precision. Using this formula;

$$n = \frac{1800}{1 + 1800(0.05)^2}$$

n = 327 potential respondents

Table 3.1 hereunder indicates a summary of the sample and actual distribution of respondents in line with their Sub-Counties (S/C) and farming clusters.

Table 3.1: Sample size distribution of farming households by their clusters and Sub-County

Name of sub-county	HH Farmers	Sample size
Buremba	102	18
Burunga	103	19
Engari	100	18
Kanoni	113	21
Kazo	99	18
Kazo T/C	101	18
Nkungu	104	19
Rwemikoma	111	20
Karyaryeru	76	14
Kashongi	110	20
Kenshunga	105	19
Kikatsi	104	19
Kinoni	71	13
Kiruhura T/C	94	17
Kitura	108	20
Nyakashashara	107	19
Sanga	109	20
Sanga T/C	83	15
Total	**1,800**	**327**

Source: Kiruhura District Local Government Abstract, (2020)

The researcher also sought opinions from 6 important informants in the Kiruhura district in addition to home farmers. One district agriculture officer and three leaders of farmer organizations were among them. These categories of respondents were chosen based on their familiarity with and involvement in farming methods used in the district. They were therefore essential in voicing opinions about farming methods and food security. As a result, there were 331 prospective responders in the survey overall. Creswell (2014) argues that rather than the sample size reflecting

the population's size, the sample should accurately reflect the characteristics of the population being studied. As a result, a sample of four important informants was selected based on the roles they played in the district's farming methods and household food security.

3.6 Sampling technique

To arrive at the number of household farmers to be chosen from each Sub-County, the researcher applied stratified proportionate, purposive sampling techniques. Stratified proportionate sampling involved selecting household farmers proportionately in line with their total numbers in each Sub-County. Under stratified proportionate sampling, the population for household farmers was divided into three strata including one for crop farmers, another for cattle grazers followed by mixed farmers handling both crop growing and cattle rearing respectively. This categorization was preferred because it reflects the categorisation of household farmers in Kiruhura district in relation to their farming specialisation. It also indicated the heterogeneity and homogeneity characteristics of the population that was studied. Besides, proportionate sampling was used because it helped the researcher to obtain a proportional representation of household farmers from each of the main farming activities in Kiruhura district.

The researcher first calculated the total number of home farmers. Then, using the random number approach, the researcher conducted a basic random sample procedure. Each household farmer was given a sequential number to create the sampling frame. By using a random number generator, a subset of the population was obtained to form the required sample size from where participants were chosen one by one until the required number from each stratum was got. According to Kalton (2011), a simple random sampling strategy is appropriate because it is impartial because it gives every member of the population an equal chance of being included in the sample that is chosen. On the other hand, key informants were chosen through purposive sampling based on their familiarity with farming techniques and the state of food security in the Kiruhura district. A

overview of the sample and the distribution of respondents according to their Sub-Counties and farming clusters is shown in Table 3.2 above.

3.7 Data collection tools and methods

3.7.1 Questionnaires

The questionnaire was the main tool during the study and was used to collect primary data from household farmers. The reasons for adopting a questionnaire were because, it was affordable and easy to administer, preserved confidentiality, could be completed at respondent's convenience, and was administered in a standard manner (Choudhury, 2016). A semi-structured questionnaire was used and it had four sections which included; the respondents' bio-data, the farming practices, the factors that influence choice of farming practices by smallholder farmers, and the relationship between farming practices and household food security in Kiruhura district.

The researcher introduced himself to the respective local council leaders using the introductory letter from the University. The LCs also guided him to the respective smallholder farmers. The researcher was given permission to observe the farming practices being used within the villages. In other areas, the researcher was led by the farmers' group leaders and extension workers who have in-depth understanding of their members. Using farmers' group leaders and local council leaders as moderators facilitated the researcher in collecting the required data from the specific farmers who were deemed fit for the study.

The respondents were provided with questionnaires to answer and return to the researcher. The researcher conducted the process of data collection for all the respondents for a period of one month. Appointments could be made with the respondents 2 days before the day of data collection.

Respondents were able to openly share their opinions on the important study variables because the researcher could help them interpret questions that they were unable to understand on their own.

3.7.2 Interview guide

The district agricultural officer, three leaders of farmer groups or associations, and two Extension agents were used as key informants in the data collection process. The guide included many questions on agricultural methods, domestic food security, and factors that affect the choice of farming methods. The researcher conducted in-person interviews with the key respondents they had chosen using interview guides with open-ended questions. Interviewing allowed the researcher to get specific information about the respondents' attitudes, values, beliefs, and motivations about farming techniques and household food security. In addition, the interview guide helped the researcher direct the respondents to express their ideas, opinions, and responses to questions pertaining to the research topic.

3.7.3 Document review

Documents are materials which contain the information about a subject under investigation (Gill, Stewart, Treasure & Chadwick, 2014). The researcher reviewed production reports at Kiruhura district and from the different sub-counties of study. According to Kitzinger (2010), document review helps the researcher not to research into information which is available. It also enables the researcher to get acquainted with the objective and hypothesis of the past research which may inform those of the present study. The method involved the study on both primary and secondary documents such as text books and production reports regarding farming practices in Kiruhura district.

3.7.4 Observation checklist

Data from the smallholder farmers were also gathered using the observational method. The researcher used his own eye to see the farming practices employed by household farmers, the size of the farm, the size of stores used by farmers, the household outlook in relation to food availability, accessibility and the farming equipment (if any) used by farmers.

3.7.5 Key Informant Interviews

Face-to-face interviews were used by the researcher to get information from important informants. This gave him the opportunity to learn in-depth details about how smallholder farmers employ outside inputs and the overall state of food security among them. Information on agricultural methods, household income, and food security were among the kinds of qualitative data that were gathered. The key informants were District agricultural officer, Chairpersons of farmer groups, and Extension agents. A key informant interview guide was used to solicit specific responses about farming practices and household food security.

3.8 Validity and reliability of instruments

3.8.1 Validity of instruments

In determining validity of the research instruments that were used, expert judgment was employed. After designing the questionnaire and the interview guide, they were presented to the supervisors for advice before beginning the data collection exercise. Other than expert judgement by supervisors, the Content Validity Index (CVI) was also used. This involved evaluating how pertinent the instrument's questions were in light of the study's key variables. Field emphasized that the device that produced a CVI of 0.7 or higher was within the acceptable range (2009). The following formula was used to calculate the Content Validity Index (CVI):

$$CVI = \frac{\text{Number of relevant items}}{\text{Total number of items}} \times 100$$

The experts (supervisors) were provided with the instruments to evaluate the relevance of each item in the instrument in accordance with the objectives and rate each item on a scale of very relevant (four), quite relevant (three), somewhat relevant (two), and not relevant (one). This was done in order to establish validity qualitatively (1). Table 3.2 displays the various CVI ratios for the experiment.

Table 3.2: Showing the content validity index

Variable	Questions	CVI
Expert 1	70	0.71
Expert 2	70	0.67
Expert 3	70	0.89
Expert 4	70	0.73
Expert 5	70	0.91

***Source: Survey Data, 2021*.**

The CVI outcomes for the five experts were above 0.5 which means that the tools used were valid, suitable and appropriate for data collection.

3.8.2 Reliability of instruments

The reliability of the instruments was subjectively evaluated by a pilot test of the questionnaires, which allowed for the verification of consistency, dependability, and the capacity to collect data that addressed the study objectives. To establish dependability statistically, the Cronbach's Alpha Reliability Coefficient test was employed. The instrument's items were judged to be reliable after the test if the results were 0.7 or higher; otherwise, they were judged to be undesirable. For psychometric tests to be considered reliable, the ratio must fall within the range of 0.7 and above. The reliability of the instruments was assessed using the formula shown below:

$$\alpha = \frac{N.r-bar}{1+(N-1)\,.\,r-bar}$$

Where;

α is the Cronbach's alpha

N is equal to the number of items,

r-bar is the average inter-item correlation among the items

Table 3.3 hereunder indicates that the Cronbach Alpha coefficient for the questions on farming practices and household food security was 0.761 for 30 items, the one for farming practices and household food security stood at 0.783 with 23 items, questions on factors that influence choice of farming practices among household farmers returned 0.789 with 12 items while questions on measurement of farming practices had a coefficient of 0.875. These coefficients were all above 0.7 which is considered the standard cut off by most researchers and authors for measuring reliability. This implies that the questionnaires used for this study were reliable and fit for data collection and obtaining genuine information as indicated in Table 3.4 hereunder.

Table 3.3: Reliability results for the study variables

Variable	Items	Cronbach Value
Key farming enterprises and household food security	30	0.761
Farming practices and household food security	23	0.783
Factors that influence choice of farming practices among household farmers	12	0.789
Measurement of farming practices	5	0.875

***Source: Survey Data, 2021*.**

As emphasized by Nunnally (1978), these ratios are acceptable since they are above the minimum threshold of 70 percent, which is evidence of a high internal consistency and relevance of the instrument used for data collection.

3.9 Measurement of variables

In this study, "farming techniques" referred to the volume of outside inputs used. There were three levels used: no external input usage, moderate external input use, and heavy external input dependency. Contrarily, food security has four components: accessibility, use, stability/vulnerability, and availability (FAO, 2021). This study focuses on how easily people can acquire food. There were three options for food security: low, medium, and high. Information on the study variables relating to food security was gathered using a scale of 1 to 5. Highly disagree, disagree, disagree, not sure, agree, and strongly agree were the choices given to respondents. It was decided that the Likert scale was appropriate because Milne (2016) and Field (2013) asserted that it is acceptable for gauging people's perceptions, attitudes, values, and behaviours toward a certain phenomenon.

3.10 Data analysis

Data input and analysis were done using SPSS version 25 (the Scientific Package of Social Scientists). A descriptive analysis utilizing means, frequencies, and standard deviations was used to describe the farming methods used by household farmers in the Kiruhura district. To rate the factors that influence farmers' decisions on their farming practices, frequency analysis was employed. The use of no external inputs, moderate external input use, and heavy dependence on external inputs in farming were all examined in connection to the level of food security in families using the one-way analysis of variances (ANOVA) technique. Additionally, the strength of the link between farming techniques and food security was determined using a chi-square test.

CHAPTER FOUR

PRESENTATION OF RESULTS

4.1 Introduction

This study sought to determine the relationship between household food security and smallholder farmers' farming methods in the Kiruhura district of Uganda. The results are presented in accordance with the following research goals: characterize smallholder farming practices in the Kiruhura District of Uganda; establish a link between family farming practices and food security among households in the Kiruhura District of Uganda; and identify the factors that family farmers consider when deciding which farming practices to use. Before getting to the main goals of the study, the section starts with the response rate and the demographics of the respondents.

4.2 Response rate

Out of 333 household farmers and key informants sampled, 310 of them responded giving a response rate of 93.09% with only 17 questionnaires invalid. According to Shaughnessy and Zechmeister's (2010) study findings, a response rate greater than 70% is significant when the study's purpose is intended to examine both the relationship between variables as well as the descriptive statistics. Therefore, the responses obtained for this study are fit for generalization since the required response rate was attained.

4.3 Demographic characteristics of respondents

The findings on the respondents' sex, age, education level, and work status are presented in this section and may be found in Table 4.1.

Table 4.1: Demographic Characteristics of the Respondents

Variables	Levels	Percentages (n=310)
Marital status of the Respondents	Married	83.55
	Single	16.45
Gender of the Respondents	Female	27.42
	Male	72.58
Age of the Respondents	20 – 30yrs	5.48
	41 – 50yrs	45.48
	51 – 60yrs	38.39
	61yrs & above	10.65
Education level of the Respondents	None	16.45
	Primary	40.00
	Secondary	21.94
	Diploma	5.48
	Degree	16.13
Respondents' employment status	Employed	27.09
	Unemployed	10.97
	Self-Employed	61.94

***Source: Survey Data, 2021*.**

According to Table 4.5's findings, the majority of respondents (83.55%) were married. The majority of responders (72.58%) were men, which is not surprising given that men tend to be the heads of homes. According to the age distribution, an estimated 44.48% of respondents were between the ages of 41 and 50, and 38.39% were between the ages of 51 and 60. (Table 4.5). The lowest category comprised of smallholder farmers whose age ranged between 20-30 years at 5.48%. These findings imply that the age for the majority of respondents was within the average age of farmers in Africa, previously reported at 50 years (IFAD, 2019).

It was also noted that 40.0% of the respondents had a primary level of education; while 16.5% had no education at all. This indicates that most smallholder farmers either have no formal education or had low levels of education. In this study, the education level was examined because it has been observed to influence agricultural productivity as indicated by Oduro-Ofori (2014) and consequently food security of households as reported by Béné, Al-Hassan and Amarasinghe *et al.* (2016). This is seen through providing people with skills, knowledge and ability to make efficient use of their resources in addition to identifying innovative ways of doing things (Oduro-Ofori, 2014).

Furthermore, Table 4.5 results demonstrated that most of the respondents (61.94%) were self-employed. This shows the relevance of smallholder farming in Kiruhura district.

4.4 Socio-economic characteristics of respondents

This section presents the findings on the socioeconomic variables such as major source of income of respondents, affiliation to the farmers' group, access to training or extension services and type of labour used. Table 4.2 on the following page provides a summary of the findings.

Table 4.2: Socio-economic characteristics of respondents

Variables	Levels	Percentages (n=310)
Major source of income	Sale of agricultural produce only	10.97
	Employment income only	27.09
	Agricultural produce & business income	61.94
Affiliation to the farmers' group	Yes	22.26
	No	77.74
Type of labour used by farmers	Family labour	61.61
	Hired labour	38.39
	Mechanised operations	-
Farmers' access to training	Yes	16.45
	No	83.55
Form of training if trained	Soil improvement	33.33
	Agronomic practices	25.49
	Livestock management	21.57
	Marketing	19.61

Source: Survey Data, 2021.

The majority of respondents (about 62%) were earning their incomes from both agriculture and business. This shows availability of diverse income-generating activities within the study area. The majority of farmers (about 78%) were not affliated to a farmers group. This points to the need for sensitising farmers about the benefits of belonging to farmers' groups. The groups for which the 22.26% were affiliated to included; Rushere farmers group which had 8 farmers, Mugore Farmers

Cooperation Group which had 5 farmers while Akanaara Tweyambe Farmers' Association, Kashunga Dairy Farmers Association, Kijuma Farmers Group, Kinoni Farmers Group, Loloba Group, Mugore SACCO, Nswerenkye Farmers SACCO and Nyakashara SACCO had an equal number of 7 members each. In the current study, the limited membership to farmer groups for the household farmers in Kiruhura implies that the majority of them miss the opportunity to obtain benefits such as access to better agricultural technologies (Gibson, Byamukama, Mpembe, Kayongo & Mwanga, 2018); improved access to better markets for their produce (Aliguma, Magala & Lwasa, 2007); facilitating produce transport to markets (Kabubo-Mariara & Mulwa, 2019); and improved access to credit (Loevinsohn, Mugarura & Nkusi, 2009).

The type of labor employed by household farmers was also investigated. According to the findings, the majority of farmers (approximately 62%) relied on family labor for farm work, which is consistent with the theory. These results are in line with past research showing that farming in Uganda requires a lot of labor, most of which is provided by the household. While a small percentage of smallholder farmers use outside assistance by hiring on-farm labor, mostly during harvest season, an average family farm devotes 0.61 person-days to supporting on-farm activities (FAO, 2021). The availability of labor is also a significant factor in determining household agricultural productivity and, consequently, food security, as Silvestri et al. (2015) point out.

The findings indicate that the majority of 83.55% of the respondents did not have access to training or extension programs. The instruction focused mostly on soil development (33.33%) and agronomic techniques (25.49%) for the few farmers that used extension services. Marketing received the least training (19.61%), respectively. Because household farmers have less access to extension services, the delivery system for tested agricultural technology from research to end users with a feedback mechanism may be disrupted, lowering productivity of harvests.

4.5 Farming practices of smallholder farmers

The first objective of this study was to characterise the key farming practices among rural households in Kiruhura District. The farming practices considered in this study were based on the use of external inputs such as improved seeds, fertilisers, pesticides, machinery and irrigation. These practices have been proven to increase crop yields, consequently enhancing food security since more food is made available and farmers can access to food through the improved incomes. Smallholder farming practices where all the five technologies of improved seeds, fertilisers, pesticides, machinery and irrigation were used were referred to as *high dependency on external inputs*. Those that used some of them were referred to as *moderate use of external inputs*, while those that did not use any of them were referred to as *no use of external inputs*. Findings on the farming practices used by smallholder farmers are shown in Table 4.3.

Table 4.3: Category of farming practices used by small holder farmers in Kiruhura district

Categories	**Percent (n=310)**
No use of external inputs	27.42
Moderate use of external inputs	50.97
High dependency on external inputs	21.61
Total	**100.0**

***Source: Survey Data, 2021*.**

Slightly more than half of the respondents (50.97%) were engaged in farming practices that had moderate use of high dependency on external inputs. It was established that the most commonly used external input was the chemical fertilisers that were used by about 83.5% of smallholder farmers. This implies about half of smallholder farmers in Kiruhura district used of external inputs

in their farming to a limited extent. The types of external inputs used mainly included inorganic fertilisers and farm yard manure (organic) as illustrated in figure 4.2.

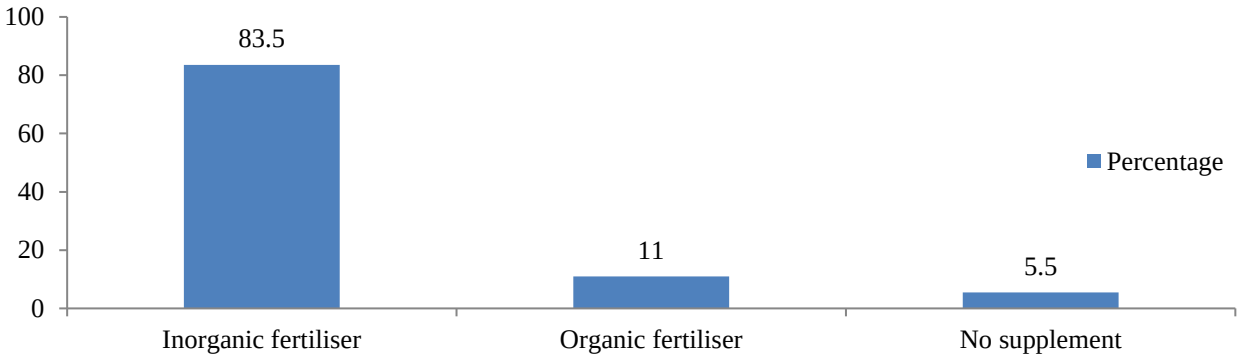

Figure 4.1:The external inputs purchased in the last cropping season by smallholder farmers

***Source: Survey Data, 2021*.**

The implication of this results on use of external inputs in farming could be that most soils in Kiruhura district have lost their fertility, and thus need to replenish the soil fertility. According to the study results, inorganic fertilisers are mostly used compared to organic fertilisers.

The study further sought to establish the agricultural enterprises that smallholder farmers specialised in (Table 4.4).

Table 4.4: Types of farming enterprises reported by the respondents

Farming enterprises	**Percent (n = 310)**
Crop farming	17.09
Livestock farming	18.39
Mixed farming	64.52
Total	**100.0**

***Source: Survey Data, 2021*.**

The majority of smallholder farmers (64.52%) carried out mixed farming. This could explain the moderate use of external inputs as animal wastes could be used to improve soil fertility.

The findings indicate that the use of external inputs in Kiruhura district is still limited. This implies that smallholder farmers still rely on their traditional farming practices to produce food for consumption and to earn income. Further, family labour is very important production of crops and rearing of livestock. Hence, it is largely the resources in the smallholder household that determine the availability and access to food.

4.6 Factors that influence choice of farming practice among smallholder farmers

The study also sought to determine the factors that influence the selection of farming practices among small holder farmers in Kiruhura district. Accordingly, descriptive statistics of mean and standard deviation were used to show the rating of the different factors that influence choice of farming practices by smallholder farmers (Table 4.5). The means and standard deviation values are reported because as Field (2009) indicates, the mean values represent the summary of the data, whereas standard deviations show how well the means represent the data. A mean value of 3 and above with a standard deviation lower than 1.0 signified that the majority of respondents agreed while a mean value of less than 3 with a high standard deviation above 1.0 implied that the majority of respondents disagreed to the statement.

The findings show ratings of the overall mean values for each factor above 3, which implies that most of the respondents agreed that human, financial, social and natural factors influence the selection of farming practices among small holder farmers in Kiruhura district. Notably, natural factors were rated by farmers to have the greatest influence on their choice of farming practices (Overall Mean = 4.11, SD = 0.92). The factors that had the lowest influence on the choice of farming practices were social factors (Overall Mean = 3.76, SD = 0.96). All factors had standard

deviations of less than 1, which indicates that there were small variations in the rating of all factors that influenced choice of farming practices by smallholder farmers.

Specifically, most smallholder farmers used family labour as illustrated under human factors. This is further confirmed by the following quote from a key informant:

> *Most of the farming households in our area rely on family labour to undertake different agriculture activities such as ploughing, weeding, harvesting and other post-harvest procedures such as drying. By relying on such labour, we minimise on some costs hence ensuring economy and sustainability of our farming activities.* (Key informant from Nyakashashara Sub-County, 12th July 2019)

Table 4. 5: Factors that influence choice of farming practices among smallholder farmers

Variable	Disagree (%)	Not Sure (%)	Agree (%)	Mean Rating	Standard Deviation
Human Factors				**3.93**	**0.87**
My household members participate in my farming initiatives	12.58	2.9	84.52	4.06	0.768
I have enough manpower for providing labour	16.45	4.19	79.35	3.97	0.899
My household members participate in marketing of farm produce	20.00	1.61	78.39	3.89	0.833
My household members sometimes carry out crop and livestock management practices	16.45	4.19	79.35	3.79	0.991
Financial Factors				**3.92**	**0.96**
I have money to buy inputs I need in farming	14.19	7.74	78.07	4.13	0.816
I have money to purchase farm equipment	18.39	6.13	75.48	4.11	1.186
I can afford to transport my farm produce to market centres	20.64	1.29	78.06	3.87	0.862
I can purchase modern management approaches for farming.	18.71	3.87	77.42	3.96	1.172
I can purchase improved seeds for improving farming.	10.97	2.58	86.45	3.53	0.751
Social Factors				**3.76**	**0.96**
I have social network that helps to market my produce	8.38	12.58	79.03	4.03	0.614
Other farmers share with me knowledge on how to manage crops and livestock	26.78	10.65	62.58	3.92	0.893
My relatives sometimes advise me on how to manage my crops and livestock	8.38	12.58	79.03	3.83	0.953
My farmers' group can give me credit/a	10.96	5.81	83.23	3.59	1.261

loan when I need it					
My family members support me whenever I face financial constraints.	20.00	1.61	78.39	3.45	1.075
Natural Factors				**4.11**	**0.92**
There is usually enough rain for farming	80.00	3.55	16.45	4.34	0.968
There are often favourable temperatures for farming	76.46	2.58	20.96	4.24	0.731
My farm is near to sources of water for irrigation.	78.71	2.26	19.03	3.97	1.314
My farm has good soils for farming.	21.62	0	78.39	3.89	0.654

***Source: Survey Data, 2021*.**

Most smallholder farmers agreed that financial factors play a role in their choice for farming practices (overall mean = 3.92, SD = 0.96). This is further illustrated by the quote from one of the key informants:

> *Young farmers, especially female farmers rarely use fertilisers, pesticides or improved seeds because they lack money to buy them. As such, most young farmers are usually engaged in subsistence farming using traditional methods of that they know*. (Key informant from Rwemikoma Sub-County, 20th July 2019]

In the same way, another key informant in Kazo Sub-County explained:

> *We face increasing challenges with regard to accessing money to buy agricultural inputs such as farm equipment like sprayers, fertilisers, seeds for high crop varieties. This makes it difficult to adopt of better agronomic practices even when we know them.* (Key informant from Kazo Sub-County, 26th July 2019).

With regard to social factors, most of the respondents agreed that social networks consisting of family members and other farmers support them in carrying out various crop and livestock farming practices. The influence of social factors on the choice of farming practices used by smallholders is exemplified by a quote from one of the key informants from in Karyaryeru Sub-County:

> *Most of the information we get about farming practices and other best practices on planting are generated from our social networks including friends and family who guide us on marketing the produce, demand, existence of improved seeds and where to get farm inputs* (Key informant from Karyaryeru Sub-County, 6th July 2019)

Notably, social factors had the lowest rating regarding their influence on choice of farming practices used by smallholder farmers.

It is evident that natural factors are the most important in determining smallholder farmers' choice of farming practices. This can be explained by the fact that most smallholder farmers largely depend on rainfall and the fertility of soil. The reliability of rainfall, and level of fertility of soil therefore determine whether or not they use external inputs.

4.7 Relationship between farming practices and food security

To examine the relationship between farming practices and food security, both One-way ANOVA and Pearson correlation analysis was undertaken as shown in Tables 4.10 and 4.11. Firstly, the respondents were asked about the food security status of their households on a three-scale index of low, moderate or high. A response with food shortage meant low food security, seasonal food shortage meant moderate food security while a score with food access/availability meant high food security respectively. The results are summarized in Table 4.6 hereunder.

Table 4.6: Reports of food security / availability at household level

Food Security Levels	Frequency (n=310)	Percent
HH has chronic food shortage	68	21.94
HH undergoes seasonal food shortage	157	50.64
HH has food access/ availability at all times	85	27.42
Total	**310**	**100.0**

***Source: Survey Data, 2021*.**

From Table 4.6 above, the findings show that 50.64% of the respondents undergo seasonal food shortages, 27.42% have food access or availability at all times while at most 21.94% reported that they experience chronic food shortage. This implies that the majority of respondents interviewed experienced food insecurity since they either faced chronic food shortage or faced seasonal food shortages. This finding is consistent with earlier report by UBOS (2017) which indicate that Kiruhura district experiences perennial food insecurity. Similarly, Sibhatu and Qaim (2017) highlight similar findings of the existence of food insecurity in Uganda.

4.7.1 One-way ANOVA

In establishing the relationship between farming practices and food security, the researcher used a one-way analysis of variances (ANOVA) technique to assess the relationship between the various farming practices of no use of external inputs, moderate use of external inputs and high dependency of external inputs in farming, and households' food security status. This technique was preferred because as Kim (2017) suggested, it helps to determine whether there are any statistically significant differences between the means of three or more independent (unrelated) groups to changes in the dependent variable. The dependent variable (food security) was analyzed using descriptive statistics, including the mean, standard deviation, and 95% confidence intervals

for each individual group (none, low, moderate, and high utilization of external inputs), as well as when all groups are combined (Total). As a result, the threshold was set at a significant value of less than 0.05 at a 95% level of confidence, and any correlations with values less than 0.05 had a statistically significant link, whilst associations with values over 0.05 were not significant. Tables 4.7 and 4.8 present these findings, respectively.

Table 4.7: Descriptive statistics on farming practices and food security

Farming Practices	**N**	**Mean**	**Std. Devn.**	**Std. Error**	**95% CI for Mean**		**Min.**	**Max.**
					Lower Bound	**Upper Bound**		
No use of external inputs	85	27.20	3.05	0.96	25.02	29.38	22.00	33.00
Moderate use of external inputs	67	23.60	3.31	1.05	21.23	25.97	18.00	29.00
High use of external inputs	158	23.40	3.24	1.02	21.08	25.72	18.00	29.00
Total	310	24.70	3.56	0.65	23.40	26.06	18.00	33.00

	Mean differences between and within groups				
	Sum of squares	**Df.**	**Mean Square**	**F**	**Sig**
Between groups	91.467	2	45.733	4.467	0.021
Within groups	276.400	27	10.237		
Total	367.867	29			

***Source: Survey Data, 2021*.**

From Table 4.7, it is indicated that *p-value* is 0.021 which is below 0.05. Thus, there is a statistically significant difference in the food security among farmers undertaking the different

farming practices of no use of external inputs, moderate use of external inputs, and high dependence on external inputs.

In addition, to complete the analysis on the relationship between the variables, the researcher also carried out the multiple comparisons, which analyses multiple comparisons of all possible pairwise means as guided by Moore, Notz and Flinger (2013)'s suggestions. Since the ANOVA test in Table 4.7 was significant, multiple comparisons test was done to compare the three possible pairwise comparisons of no use of external inputs to moderate use of external inputs, no use of external inputs to high dependency on external inputs as well as moderate use of external inputs to high dependency on external inputs to ascertain which groups differed from each other. In this regard, the Tukey post hoc test method which uses a t-multiplier based on the number of comparisons, was used. To this end, a p-value of less than 0.05 at 95% level of confidence was used as a threshold and any associations with values less than 0.05 had a statistically significant relationship while those above 0.05 were considered insignificant. Thus, the findings in relation to this sub-section are summarised in Table 4.8.

Table 4.8: Multiple comparisons for means of the farming practices

Farming practices		Mean Diff.	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
No use of external inputs	Moderate of external inputs	3.6*	1.43	.046	0.052	7.148
	High dependency on external inputs	3.8*	1.43	.034	0.252	7.348
Moderate use of external inputs	No use of external inputs	-3.6*	1.43	.046	-7.148	-0.052
	High dependency of external inputs	0.2*	1.43	.021	-3.348	3.748
High dependency on external inputs	No use of external inputs	-3.8	1.43	.034	-7.348	-0.252
	Moderate use of external inputs	-0.2	1.43	.021	-3.648	3.978

* The mean difference is significant at the 0.05 level

It can be seen from Table 4.8 above that there was a statistically significant difference in food security among smallholder farmers' households using different farming practices. For example, moderate use of external inputs differed significantly from high dependency of external inputs among smallholder farmers (p = 0.021). This implies that high dependency on external inputs among smallholder farmers was likely to improve food security for farmers using external inputs than their counterparts who were relying on moderate use of external inputs. There was also a significant difference among smallholder farmers households that do not use external inputs and those smallholder farmers dependent on high use of external use of inputs in their farming with values of (p = 0.034). This means smallholder farmers who did not apply external inputs in their farming were more food insecure in comparison to their counterparts who were dependent on high

use of external inputs in their farming. There was also a significant difference between smallholder farmers' households that moderately use external inputs from those not use external inputs (p = 0.046). This implies moderate use of external inputs among smallholder farmers improve food security in smallholder farmers' households.

In summary, the results from one-way ANOVA Tables 4.7 and 4.8 above show that there is a significant difference in food security status of households using the different farming practices. This suggests that use of external inputs improves availability and access to food by smallholder households. Therefore, it can be concluded from these findings that there is a positive relationship between food security and use of external inputs, as most food secure households were found to belong to the category of high dependency on external inputs for farming.

4.7.2 Pearson correlation analysis

The study also assessed the relationship between farming practices and food security using Pearson correlation technique (Table 4.8). The results of Pearson correlation coefficients (r) show the strength and direction of the relationships between farming practices and food security.

Table 4.9: Zero order correlation for the relationship between the study variables

Variables		**1**	**2**	**3**	**4**	**5**
Farming Practices	**1**	1				
No use of external inputs	**2**	.521**	1			
Moderate use of external inputs	**3**	.675**	.284**	1		
High usage of external inputs	**4**	.723**	.244**	.583**	1	
Food Security	**5**	**.603****	**.321***	**.360****	**.578****	1

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

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

Source: Primary Data, 2021.

The findings revealed a statistically significant and moderate positive relationship between farming practices and food security among smallholder farmers' households in Kiruhura district at a 10% level of significance ($r = .603$, $p < .01$). These positive relationships obtained between each of these constructs for farming practices provide statistical evidence for the significant relationship between farming practices and food security among smallholder farmers in Kiruhura district. Therefore, smallholder farmers' use of external inputs improves food security in their households.

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter is organised into five sections. The first section presents the discussion of the findings. The second section presents the conclusions drawn from the study findings while the third section describes the implications and recommendations. The study objectives were; to characterise the farming practices of smallholder farmers, determine the factors that influence smallholder farmers' selection of farming practices, and to establish the relationship between smallholder farmers' farming practices and food security of their households.

5.2 Discussion of findings

The findings in this study are presented in an objective-by-objective manner as explained hereunder.

5.2.1 Farming practices of smallholder farmers

Farming practices in study referred to levels of use of external inputs such as chemical fertilisers, manures, pesticides, improved seeds, and irrigation water. Accordingly, there were three types of farming practices: high dependency on external inputs, moderate use of external inputs and no use of external inputs respectively. This was based on Serebrennikov *et al.* (2020) who indicate that farming practices among farmers can be grouped into three categories of no use of external inputs, moderate use of external inputs, and high use or dependency on external inputs. These practices are characterised by none usage of external inputs, limited usage of external inputs and high dependency on external inputs among farmers. Similarly, other studies by Sheahan and Barrett (2014) as well as Boyac-Gündüz *et al.* (2021) suggest that increasing farmers' purchase of external

inputs such as fertilizers, seeds and pesticides is a known farming practice that can increase in yields in sub-Saharan Africa (SSA).

Findings revealed that about half of smallholder farmers (about 51%) use the moderate use of external inputs farming practice which relies on both traditional practices and some external inputs to boost yields. Further, about 22% of smallholder farmers highly depend on external inputs. Hence, about 73% of smallholder farmers in Kiruhura district use external inputs. This could be explained by having the majority of smallholder farmers (64.52%) carrying out mixed farming. Mixed farming is confirmed by Yikii *et al.* (2017) who indicated that there is crop and livestock production in Kiruhura district, and UBOS (2017) that points out that livestock farming is considered a traditional activity in the district. This implies that animal wastes could be used to improve soil fertility. The improved soil fertility leads to increased yields that enhance food security through both increasing availability of food as well as access through the incomes earned.

5.2.2 Factors influencing the choice of farming practices among smallholder farmers

Findings indicate that the choice of farming practices among smallholder farmers is influenced by human, social, natural and financial factors. The natural factors were rated by the smallholder farmers as the factor that most influence choice of farming practices used. These are followed by human factors and financial factors that had almost the same rating of 3.93 and 3.92 respectively. The social factors were rated by smallholder farmers to have the least influence on the choice of farming practices used.

5.2.2.1 Human factors

In this study, it has been revealed that human factors are critical determinants for farming practices used by smallholder farmers. Findings revealed that use of family labour is dominant in Kiruhura district. For instance, availability of family labour to participate in farming activities help

smallholder farmers to save costs thereby making it easy for them to expand agricultural production. In the same way, availability of family labour means that smallholder farmers can participate in marketing of farm produce which increases income to buy improved seeds among the moderate users of external inputs. Moreover, the presence of additional support by family members means that smallholder farmers have the leverage to save some money and invest it in other activities such as crop weeding and harvesting which are equally vital in promoting a better harvest and food security.

Empirically, literature supports that human factors contribute to determining the choice of farming practices. For instance, Anderson *et al.* (2016) and Moyo (2016) noted that farming is largely managed at household level therefore those households lacking the capacity to use external inputs in farming rely mostly on family labour to carry out agricultural production. Further, Gollin (2014) argues most smallholders use family labour because it is cheap and is most times available when needed. Reliance on family labours limits the acreage under agricultural production and is also likely to limit agricultural productivity since output partially depends on how skilled the labour is. Consequently, the ability to use external inputs will be limited by the limited income from agriculture which is the main source of livelihood.

5.2.2.2 Financial factors

This study has shown that financial aspects such as availability of money is a contributing factor on whether to apply external inputs in agriculture, moderately use them or not to use external inputs at all. For instance, smallholder farmers with reasonable income can purchase chemical fertilisers, manure, farming equipment and improved seeds. Consequently, availability of funds greatly determines smallholder farmers capacity to use external inputs in farming. In support of this view, Demeke and Zeller (2019) noted that use of external inputs in farming requires some financial investment to buy improved varieties of seeds, fertilisers, mechanisation as well as

irrigation equipment among others. Hence, smallholder farmers' capacity to use external inputs requires financial investments.

5.2.2.3 Social factors

The choice of farming practices can also be explained from a social perspective. The availability of a social network to market agricultural produce, other farmers to share knowledge on crop and livestock management as well as ability to get financial support from farmer groups or relatives influence choice of farming practices. These findings are consistent with Udmale *et al.* (2020) who noted that the presence of social cohesion among farmers is a key determinant for farming practices used by farmers. Sseguya *et al.* (2017) further emphasised the importance of social factors in ensuring food security. They established that households that have high social capital are more likely to be more food secure than those without adequate social capital. In addition, Gallaher *et al.* (2015) and Galanakis *et al.* (2021) show that participation of community members in groups promote moderate usage of external inputs in farming which leads to easy access to resources in terms of information for decision making, thereby leading to increased levels of agricultural technology adoption and productivity. This leads to higher agricultural yields and improved food security through enhanced generation of food for household consumption and sale to earn an income.

5.2.2.4 Natural factors

Natural factors such as rainfall reliability, temperatures, and soil fertility play a role in influencing the choice of farming practices used by smallholder farmers. The findings indicated that have the biggest influence on whether smallholder farmers use external inputs or not. This could be explained by the fact that most agricultural activities in Uganda are rain-fed and most soils can sustain crop growth with limited addition of external inputs. These findings are in line with Apanovich and Mazur (2018) who acknowledged that the choice for farming practices among

smallholder farmers is also dependent on natural factors. Similarly, Turyahabwe *et al.* (2013) as well as Kikoyo and Nobert (2016) revealed that smallholder farmers natural factors such as rain-fed agriculture, light and temperatures to choose their farming practices. Agricultural production is highly affected by rainfall pattern which has a direct effect on food security in the process. Specifically, Turyahabwe *et al.* (2013) observed that drought is one of the most frequent types of disasters that Uganda faces from time to time and this has an influence on farming practices as farmers characterised by moderate use of external inputs rely on natural rain to ensure they grow their crops.

5.2.3 Relationship between farming practices and food security of smallholder farmers

Results in Table 4.8 indicate that there is a statistically significant difference in the food security among farmers undertaking the different farming practices of no use of external inputs, moderate use of external inputs, and high dependence on external inputs ($F = 4.467$, *p-value* $= 0.021$). In addition, the results of Pearson correlation analysis that assesses the strength and direction of the relationships between farming practices and food security indicated a moderate positive relationship between farming practices and food security among smallholder farmers' households. In particular, there was a significant difference between smallholder farmers households that do not use external inputs and those smallholder farmers' households dependent on high use of external use of inputs in their farming with values of ($p = 0.034$). The findings further revealed that there was a significant difference between smallholder farmers' households that moderately use external inputs and those that do not use external inputs ($p = 0.046$). This implies moderate use of external inputs among smallholder farmers did not improve food security in smallholder farmers' households. There was also a significant difference in food security among smallholder farmers' households that are involved in moderate use of external inputs and those with high dependency of external inputs ($p = 0.021$). This implies that use of external inputs such as

improved seeds, mulching, manure, chemical fertilisers, pesticides, machinery and irrigation by smallholder farmers was likely to improve food security. These findings are in agreement with Dinesh (2016) who asserts that all interventions that improve soil fertility, improve soil water availability, increase soil organic matter and reduce the loss of nutrient-rich topsoil through erosion result in increased agricultural productivity subsequently improving availability of food. In addition, Mozumdar (2012) argues that increase in agricultural productivity increases availability of food and improves its supply in the market which results in lower prices hence increasing farmers' access to food. Besides, increased improved agricultural productivity can increase incomes of smallholder farmers' households which contributes to food security as they will be able to afford to buy food (Conceição, Levine, Lipton & Warren-Rodríguez, 2016). Leakey (2018) further argues that to improve food security at household level requires use of a multidisciplinary approach with a combination of interventions that improve yields. This is illustrated in the use of external inputs that included practices such use of chemical fertilisers and manures, application of pesticides, use of improved seeds, and irrigation. Deathier and Effenberger (2018) noted that subsistence farming practices considerably contribute to household food security in poor rural areas. However, Pawlak and Kołodziejczak (2020) noted that use of external input in farming greatly improves household food availability and incomes in many developing countries. The increases in households' incomes improves access to food from the markets whenever the food farmers produced is not enough for their home consumption. Hence, the improvement in food availability and incomes enhances food security of smallholders at household level.

Despite the positive relationship identified in this study, other scholars such as Bravo-Ortega and Lederman (2015) offered a contradictory view noting that food security is a multidimensional variable that is affected by very many variables. As such, it is unsatisfactory to attribute food security at household level to only farming practices. There are other factors such as post-harvest

handling, crop management, and amount of acreage and managerial competence of farmers, among other factors that affect food security. Despite these contradicting views, it can be concluded in this study that farming practices contribute to boosting food security among smallholder farmers through utilisation of resources such as land and family labour to ensure increased crop yields.

5.3 Conclusions

In this study, it was established that there were different farming practices used by smallholder farmers in Kiruhura district. Most smallholder farmers used varied levels of external inputs in agricultural production with about half of them combining use of external inputs with traditional farming practices. The choice of the farming practice to use was influenced by human, financial, social and natural factors but natural factors have the greatest influence. This study provided statistical evidence that there is a significant difference in food security status of households belonging to the different farming practices, with households practicing high dependency on external inputs being food secure than those with moderate or none use of external inputs. It was also established that there is a significant relationship between farming practices and food security among smallholder farmers. In other words, farming practices that involve use of external can significantly contribute to food security.

5.4 Recommendations

Smallholder farmers need to strengthen their use of external inputs in agriculture since these have been confirmed in this study to enhance food security. However, it important to note that this can only be realised if smallholders are supported to access financial services and reliable input markets.

Given that natural factors were found to have the greatest influence on the choice of farming practices used by smallholders, extension agents need to focus on issues of farming practices that improve soil fertility and conserve soil and water.

At the farm level, smallholder farmers should be encouraged to form cooperative unions where they can easily market their produce and acquire better advice on different farming enterprises. This will help them get access to best agronomical practices leading to increased productivity and crop yields and such a strategy can be achieved through sensitisation of smallholder farmers by the district agricultural officer on the relevance of farmers' cooperatives.

5.5 Areas for further research

(i) This study discussed only the influence of use of external inputs on food security of smallholder farmers in Kiruhura district, therefore other studies need be undertaken to examine other variables explaining food security other than farming practices.

(ii) This study was quantitative in nature and used primary data, studies using mixed methods would give more detailed explanation for the factors that influence food security.

5.6 Limitations of the study

The study used a cross-sectional research design and so it was difficult to trace the long-run changes in food security among farmers who participated in the study. Yet, reports from the ministry of agriculture, animal industry and fisheries (MAAIF) indicate that smallholder farmers in Uganda at large face challenges in ensuring food security. Nevertheless, the researcher used a bigger sample size and sought views from both farmers and policy makers like senior agricultural extension agents and district leaders who were knowledgeable and competent in answering questions on farming practices and food security.

Additionally, this study suffers from response bias, a well-known limitation of perception studies. This is because the farmers whose food security was examined were the very people who were involved in different farming practices. It is therefore probable that they could report views that they believe would reflect well on them rather than the actual behaviours. In view of this weakness, the researcher relied on responses from both farmers and key informants such as senior agricultural officers, heads of farmer groups or associations and district leaders who were knowledgeable and competent in answering questions on farming practices such that views from farmers were compared with those of key informants to establish consistency in the results.

Furthermore, the researcher faced disruptions due to COVID-19 as well as time constraints given the fact that various research activities needed to be undertaken in a shorter time frame, yet the researcher had other work-related obligations to undertake. This was minimised by designing a work schedule in which all activities were planned to avoid unbalanced apportionment of available time to the different research activities. While COVID-19 disruptions were managed by sending the instrument online for some respondents who were literate and had internet accessibility.

Nevertheless, despite the above limitations, this study results remain useful to academicians, agronomists, agripreneurs, extension officers and smallholder farmers in Uganda's agricultural sector and other environments with similar settings because it provides the statistical evidence on the contribution made by farming practices and how they influence food security of smallholder farmers in Kiruhura district.

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APPENDICES

Appendix I: Questionnaire for Household Farmers

I am Tumukunde Jackson conducting research on the ***"The assessment of Farming Practices and Households Income and Food Security in Kiruhura District"***. You have been identified as a suitable respondent because of your knowledge of farming practices and people's livelihoods in the district.

Please kindly respond to questions on this questionnaire as honest as you can.

Please attempt to answer all questions. Note that the information you give will be treated with confidentiality. I am grateful to you for sparing your time to fill this questionnaire.

Section A: Bio Data

1. Marital Status of Respondents Married ☐ Single ☐
2. Sex of Respondents: Female ☐ Male ☐
3. Age of the Respondents

   20 – 30 ☐ 31 – 40 ☐ 41 – 50 ☐ 51 – 60 ☐ 61 and Above ☐
4. Respondents' level of Education

   None ☐ Primary ☐ Secondary ☐ Diploma ☐ Degree ☐
5. Employment status of the Respondents

   Employed ☐ Unemployed ☐ Self-Employed ☐
6. What is your major source of income?

   .....

   7. What is the size of your farm?

   .....

   .....

8. What farming resources / assets do you own?

.....

.....

9. Do you belong to a farmers' group?

.....

10. If yes, which farmers' group do you belong to?

.....

11. What is the marketed proportion of farm produce?

.....

.....

12. What type of farm labour do you use?

(a) family labour [ ]

(b) hired labour or [ ]

(c) mechanized operations [ ]

13. Do you have access to training or extension services?

.....

14. If yes, what form of training or advice have you received about the farming practices on your farm?

a) Soil improvement;

b) Agronomic;

c) Livestock management;

d) Marketing;

e) Other (specify) .....

.....

SECTION B

The Farming Practices among Households in Kiruhura District

1. Which of the following farm enterprises do you engage in?

Forms of farming practices	
Cash crop farming (specify)	
Livestock farming(specify)	

2. How do you categorize your farming operations? (tick one)

a) No external inputs [ ]

b) Progressive/ moderate use of external inputs [ ]

c) High dependency on external inputs [ ]

3. In your own opinion, how would you classify the level of food security / availability in your household?

Low [ ] Reason:……..

Moderate [ ] Reason:……..

High [ ] Reason:……..

4. Can you also tell me about the nutritional security (balancing foods / changing diets) in your household?

Low [ ] Reason:……..

Moderate [ ] Reason:……..

High [ ] Reason:……..

5. What external inputs like seeds and fertilizers (if any) did you purchase in the last cropping season so as to improve your yields?

……

SECTION C

The Relationship between Farming Practices and Household Food and Income Security

1. Has your family experienced famine for the past 5 years? (Explain)

   .....

   .....

2. What were the effects of famine to individual members of your households?

   .....

   .....

3. Is there any of your household members that got malnourished due seasonal food shortage? How?

   .....

4. Do all members of your family access two to three meals a day throughout?

   ……

5. Is the food supply in your family supplemented by purchasing extra from the market?

   ……..

Please indicate to what degree you agree with each of the following statements by ticking one of the five alternatives below.

Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
1	2	3	4	5

No.	**Items**	**SD**	**D**	**NS**	**A**	**SA**
A	**Farming Practices**					
FP1	I am a no external inputs farmer because my farm operations are mainly for home consumption	1	2	3	4	5
FP2	I am a no external inputs farmer but also sell some of my food crops for income	1	2	3	4	5
FP3	I am a no external inputs farmer because I rely on my animals as source of food	1	2	3	4	5
FP4	I am a no external inputs farmer because I do not buy external inputs for my farm	1	2	3	4	5
FP5	I am a no external inputs farmer because I do not particularly produce for the market	1	2	3	4	5
FP6	I am a no external inputs farmer because of the small size of my farming land	1	2	3	4	5
FP7	I am a no external inputs farmer because I have very few animals for home use only	1	2	3	4	5
FP8	I am a no external inputs farmer because I mostly depend on a hoe and family labour	1	2	3	4	5
FP9	I am a no external inputs farmer because my main goal is for home consumption	1	2	3	4	5

FP10	I am a moderate use of external input farmer because I produce both for home and market	1	2	3	4	5
FP11	I am a moderate use of external input farmer because I use extension advice to improve my farm	1	2	3	4	5
FP12	I am a moderate use of external input farmer because I have both food and cash crops	1	2	3	4	5
FP13	I am a moderate use of external input farmer because I am a model for other farmers in my area	1	2	3	4	5
FP14	I am a moderate use of external input farmer because I produce surplus for sale to the market	1	2	3	4	5
FP15	I am a moderate use of external input farmer because I have an ox plough or hire tractors	1	2	3	4	5
FP16	I am a high dependency on external inputs farmer because my primary goal is to produce for market	1	2	3	4	5
FP17	I am a high dependency on external inputs farmer because I sell most of what I produce on my farm	1	2	3	4	5
FP18	I am a high dependency on external inputs farmer because I sell all my produce and then buy food	1	2	3	4	5
FP19	I am a high dependency on external inputs farmer because of the large size of my farm enterprises	1	2	3	4	5
FP20	I am a high dependency on external inputs farmer because I use a lot of external inputs on my farm	1	2	3	4	5
FP21	I am a high dependency on external inputs farmer because I also keep farm records and bank account	1	2	3	4	5
FP22	I am a high dependency on external inputs farmer because sometimes I use credit to improve my farm	1	2	3	4	5

FP23	I am a high dependency on external inputs farmer because I use hired labour or permanent employees	1	2	3	4	5
FP24	I am a high dependency on external inputs farmer because I produce specialized market commodity	1	2	3	4	5
FP25	I am a high dependency on external inputs farmer because I use my farm as a business	1	2	3	4	5
FP26	I am a high dependency on external inputs farmer because I sometimes pay for extension services high dependency on external inputs	1	2	3	4	5
B	**Food Security**					
FS1	My household has food availability at all times of the year	1	2	3	4	5
FS2	My household has food availability for only certain times of the year	1	2	3	4	5
FS3	My household has food availability during the harvesting times of the year	1	2	3	4	5
FS4	My household has food availability of different food types all year round	1	2	3	4	5
FS5	My household has food availability of only some food types through the year	1	2	3	4	5
FS6	My household has access to enough food at all times of the year	1	2	3	4	5
FS7	My household has access to enough food for only certain times of the year	1	2	3	4	5
FS8	My household has access to enough food only during the harvesting time	1	2	3	4	5
FS9	My household has access to different food types all year round	1	2	3	4	5
FS10	My household has access to only some food types in the year	1	2	3	4	5
FS11	My household can afford to have enough food at all times of the year	1	2	3	4	5
FS12	My household can afford enough food for only certain times of the year	1	2	3	4	5
FS13	My household can afford enough food only during the harvesting time	1	2	3	4	5

FS14	My household can afford to have different food types all year round	1	2	3	4	5
FS15	My household can afford to have only some food types in the year	1	2	3	4	5
FS16	My household experiences hunger at certain times of the year	1	2	3	4	5
FS17	My household experiences hunger for most parts of the year	1	2	3	4	5
FS18	My household utilizes different types of food throughout the year	1	2	3	4	5
FS19	My household utilizes different types of food only in some times of the year	1	2	3	4	5
FS20	My household utilizes different types for needs of all people in the home	1	2	3	4	5
C	**Nutrition**					
NT1	My household has a balanced diet for its members throughout the year	1	2	3	4	5
NT2	My household has a balanced diet for its members for only part the year	1	2	3	4	5
NT3	My household has a balanced diet for its members only during harvest time	1	2	3	4	5
NT4	My household has a balanced diet for its members only when money is there	1	2	3	4	5
NT5	My household does not have a balanced diet for all its members	1	2	3	4	5
NT6	My household does not have a balanced diet at all	1	2	3	4	5
	Food Availability					
FA1	My household has enough food	1	2	3	4	5
FA2	My household eat all types of foods	1	2	3	4	5
FA3	My household no longer spends on buying food	1	2	3	4	5
FA4	My household stores enough food for the whole season.	1	2	3	4	5
FA5	My household does not borrow and cannot work for food in community	1	2	3	4	5
	Food Access					
FC1	My household can afford to get daily food.	1	2	3	4	5

FC2	My household can get appropriate food.	1	2	3	4	5
FC3	My household can longer starve for food.	1	2	3	4	5
FC4	My household easily get food for all meals.	1	2	3	4	5
FC5	My households access healthier food for its members.	1	2	3	4	5
	Nutrition, Diet and Balanced Diet for your HH					
ND1	My household choose food varieties in different days.	1	2	3	4	5
ND2	My household change food varieties many days a week.	1	2	3	4	5
ND3	My household considers taste preferences when to choose food for a meal.	1	2	3	4	5
ND4	My household choose to eat what is health for their lives.	1	2	3	4	5
ND5	My household is exposed to food and eating patterns and habits.	1	2	3	4	5

16. How has the availability of food at your home improved the nutritious content of meals you eat at home?

.....

.....

17. How has increased access of food at your home helped to meet family food needs?

.....

.....

18. To what extent is your engagement in farming practices helped you to eat every type of food you want?

.....

SECTION D

Factors that influence choice of farming practices among smallholder farmers in Kiruhura District.

Please indicate to what degree you agree with each of the following statements by ticking one of the five alternatives below.

Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
1	2	3	4	5

No.	Items	SD	D	NS	A	SA
	Human Factors					
HF1	I have few / many household members	1	2	3	4	5
HF2	I have enough manpower for providing labour	1	2	3	4	5
HF3	My household members participate in my farming initiatives	1	2	3	4	5
HF4	My household members participate in marketing of farm produce	1	2	3	4	5
HF5	My household members sometimes collect money for farm investment	1	2	3	4	5
	Financial Factors					
FF1	I have money to increase farm investments	1	2	3	4	5
FF2	I have money to purchase farming equipments	1	2	3	4	5
FF3	I afford to transport my farm produce to market centres	1	2	3	4	5
FF4	I can purchase modern management approaches for farming.	1	2	3	4	5
FF5	I can purchase improved seeds for improving farming.	1	2	3	4	5
	Social Factors					
SF1	I have social network that helps to market my produce	1	2	3	4	5
SF2	I have social farmers' ties for sharing knowledge on marketing and price	1	2	3	4	5
SF3	My relatives sometimes purchase my farm produce	1	2	3	4	5

SF4	My farmers' group sometimes give capital when I need farm investment	1	2	3	4	5
SF5	My family members intervene whenever I face financial constraints.	1	2	3	4	5
	Natural Factors					
NF1	My farm receives enough rain for farming	1	2	3	4	5
NF2	My farm experience favourable temperature for farming	1	2	3	4	5
NF3	My farm is near to sources of water for irrigation.	1	2	3	4	5
NF4	My farm has good soils for farming.	1	2	3	4	5
NF5	My farm has a good landscape that facilitates soil mulching.	1	2	3	4	5

10. To what extent has your involvement in farming practices helped you to increase assets owned at home?

.....

.....

11. How have you improved technology for your farming improvement?

.....

.....

SECTION E

The Measurement of the characteristics of household farming practices

Please indicate to what degree you agree with each of the following statements by ticking one of the five alternatives below.

Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
1	2	3	4	5

No.	**Items**	**SD**	**D**	**NS**	**A**	**SA**
	Statements					
MC1	I produce crops for family use only	1	2	3	4	5
MC2	I concentrate on household farming to improve my family feeding practices	1	2	3	4	5
MC3	I use my family labor to produce crops	1	2	3	4	5
MC4	I use traditional farming practices	1	2	3	4	5
MC5	I use my own knowledge to come up with agricultural output.	1	2	3	4	5

Appendix II: Focus Group Discussion for Farmers

Objective 1: Farming practices

1) What farming practices are mainly practiced by smallholder farmers in Kiruhura district?
2) What are the key characteristics of each farming practice carried out by the farmers in Kiruhura?
3) What livelihood assets do farmers require to carry out a particular farming practice?

Objective 2: Household food and income security

4) What is the relation between smallholder farming practices and household food insecurity?
5) What is relation between smallholder farming practices and household nutritional security?

Objective 3: Factors that influence choice of farming practices

6) What are human factors influencing the choice of farming practices?
7) To what extent are socio-economic factors influencing the choice of farming practices?
8) What are the physical and natural factors influencing the choice of farming practices?

Appendix III: Key Informant Interviews for Agricultural Officers

Objective 1: Farming practices

1) What farming practices are mainly practiced by smallholder farmers in Kiruhura district?
2) What are the key characteristics of each farming practice carried out by the farmers in Kiruhura?
3) What livelihood assets do farmers require to carry out a particular farming practice?

Objective 2: Household food and income security

4) What is the relation between smallholder farming practices and household food insecurity?
5) what is relation between smallholder farming practices and household nutritional security?

Objective 3: Factors that influence choice of farming practices

6) What are human factors influencing the choice farming practices?
7) To what extent are socio-economic factors influencing the choice of agronomic practices?
8) What are the physical and natural factors influencing the choice of farming practices?

Appendix IV: Field Observation Checklist

The researcher will observe the following while at the household farms?

1) What form of farming practice is engaged by the households?
2) What size of the farm do they have?
3) What are the environmental factors influencing farming?
4) Do farmers have stores for keeping the harvested food?
5) What farming equipments do farmers own?
6) What is the household outlook in relation to food availability, nutrition and balanced diet?

Appendix V: Factors Influencing Choice of Farming Practices among Smallholder Farmers in Kiruhura District

Variable	SD (%)	D (%)	NS (%)	A (%)	SA (%)	Mean	Std.
Human Factors							
My household members participate in my farming initiatives	13(4.19)	26(8.39)	9(2.90)	81(26.13)	181(58.39)	4.06	0.768
I have enough manpower for providing labor	27(8.71)	24(7.74)	13(4.19)	121(39.03)	125(40.32)	3.97	0.899
My household members participate in marketing of farm produce	25(8.06)	37(11.94)	5(1.61)	112(36.13)	131(42.26)	3.89	0.833
My household members sometimes collect money for farm investment	27(8.71)	24(7.74)	13(4.19)	121(39.03)	125(40.32)	3.79	0.991
Financial Factors							
I have money to increase farm investments	19(6.13)	25(8.06)	24(7.74)	76(24.52)	166(53.55)	4.13	0.816
I have money to purchase farming equipments	23(7.42)	34(10.97)	19(6.13)	113(36.45)	121(39.03)	4.11	1.186
I afford to transport my farm produce to market centers	28(9.03)	36(11.61)	4(1.29)	97(31.29)	145(46.77)	3.87	0.862
I can purchase modern management approaches for farming.	24(7.74)	34(10.97)	12(3.87)	101(32.58)	139(44.84)	3.96	1.172
I can purchase improved seeds for improving farming.	13(4.19)	21(6.77)	8(2.58)	128(41.29)	140(45.16)	3.53	0.751
Social Factors							

I have social network that helps to market my produce	10(3.22)	16(5.16)	39(12.58)	89(28.71)	156(50.32)	4.03	0.614
I have social farmers' ties for sharing knowledge on marketing and price	34(10.97)	49(15.81)	33(10.65)	91(29.35)	103(33.23)	3.92	0.893
My relatives sometimes purchase my farm produce	10(3.22)	16(5.16)	39(12.58)	89(28.71)	156(50.32)	3.83	0.953
My farmers' group sometimes give capital when I need farm investment	13(4.19)	21(6.77)	18(5.81)	128(41.29)	130(41.94)	3.59	1.261
My family members intervene whenever I face financial constraints.	25(8.06)	37(11.94)	5(1.61)	112(36.13)	131(42.26)	3.45	1.075
Natural Factors							
My farm receives enough rain for farming	98(31.61)	150(48.39)	11(3.55)	25(8.06)	26(8.39)	4.34	0.968
My farm experience favourable temperature for farming	111(35.81)	126(40.65)	8(2.58)	29(9.35)	36(11.61)	4.24	0.731
My farm is near to sources of water for irrigation.	113(36.45)	131(42.26)	7(2.26)	23(7.42)	36(11.61)	z3.97	1.314
My farm has good soils for farming.	30(9.68)	37(11.94)	0(0.0)	112(36.13)	131(42.26)	3.89	0.654

Appendix VI: Map Showing Kiruhura district

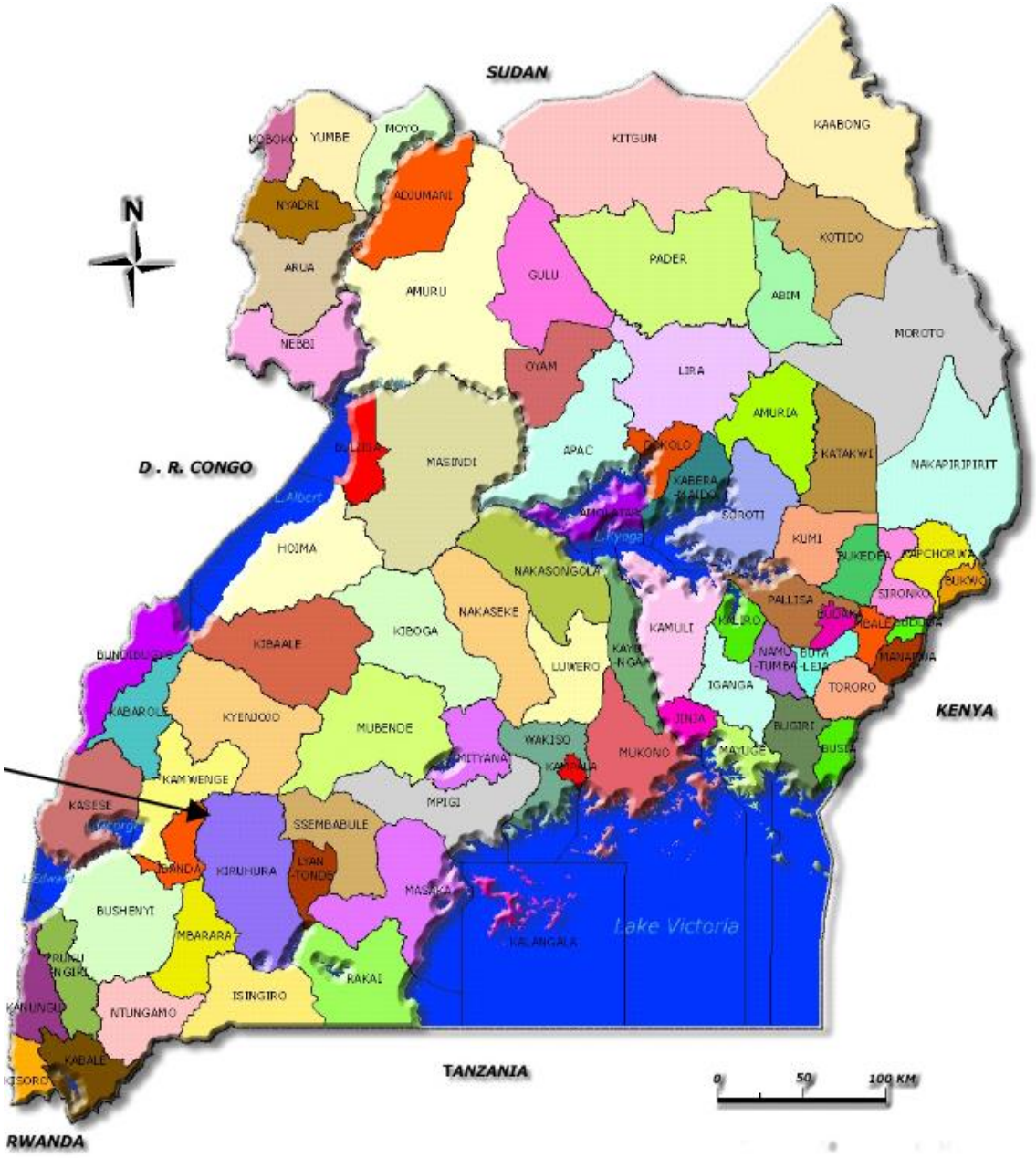

Figure 4.2: Map of Uganda indicating location of Kiruhura District

Source: Google site