FACTORS ASSOCIATED WITH THE SUSTAINABILITY OF CONTRACT FARMING AMONG SORGHUM FARMERS IN THARAKA NITHI COUNTY, KENYA

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CHUKA UNIVERSITY

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DECLARATION AND RECOMMENDATION

Declaration

This thesis is my original work and has not been presented for an award of diploma or conferment of degree in any institution.

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Recommendation

This thesis has been examined, passed and submitted with our approval as the university supervisors.

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DEDICATION

This thesis is dedicated to my parents, Elizabeth Maitha and my late dad George Kasina, my sisters Joyce Kamene and Jackline Ngwasi, my niece Angel Mueni, and nephews Ethan Amani and Kelwin Mwendwa, as well as all my friends and loving uncle, Geoffrey Mutua Ndeme.

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ABSTRACT

Contract farming has gained prominence as a strategy to enhance agricultural productivity and improve farmers' livelihoods in Tharaka Nithi County, Kenya. There has been an increasing demand for sorghum in the county, especially from malting companies such as East African Breweries Limited (EABL). The EABL has been contracting farmers in the last decade in the county to produce the crop to meet its sorghum needs. Despite the potential benefits of contract farming, such as access to a reliable market and provision of advisory services regarding appropriate production techniques, high-quality seeds, and fertilizer, the system's sustainability is uncertain due to the numerous challenges the farmers have been experiencing. These challenges are most likely associated with factors such as farmer and farm characteristics, farming systems, and the kind of contractual arrangements between farmers and buyers. Understanding these factors is crucial to develop effective interventions and policies that can promote the long-term viability of contract farming. Additionally, there is little empirical evidence relating to the sustainability of sorghum contract farming since most of the previous studies have focused on the impact and performance of the contractual agreements. Therefore, this study aimed to establish the factors associated with the sustainability of contract farming among sorghum farmers in Tharaka Nithi County, Kenya. The study employed a correlational research design. The population of the study comprised 17,000 contracted farmers from the county. A sample of 375 contracted sorghum farmers selected using cluster sampling was engaged in the research. A semi-structured questionnaire was used to collect primary data regarding farm and farmer characteristics, farming systems, contact terms for sorghum production, and sustainability of contract farming. A pilot study was carried out in Mitunguu ward in South Imenti constituency, Meru County involving 38 contracted sorghum farmers to check the reliability of the research instrument. University supervisors, peers, and experts in the field of agribusiness were invited to check the validity of the questionnaire. A Cronbach alpha coefficient (α) was used to estimate the reliability of research instrument items. The pilot data reliability coefficients for the various variables were as follows: farmers' characteristics ($\alpha = 0.76$), farm characteristics ($\alpha = 0.74$), farming systems ($\alpha = 0.76$), contract terms ($\alpha = 0.84$), and sustainability of contract farming ($\alpha = 0.72$). Data was analyzed using Statistical Package for Social Sciences (SPSS Version. 29) and Stata Version 15. Descriptive statistics and inferential statistics were employed in data analysis. A multiple linear regression model was used to determine the relationship between farmers' and farm characteristics versus the sustainability of contract farming. The findings revealed that only household size ($p < 0.05$) among the farmers' characteristics of the study significantly contributed to the sustainability of contract farming. Land ownership ($p < 0.05$) and land location ($p < 0.05$) were the farm characteristics that significantly contributed to the sustainability of contract farming. Pearson's correlation was utilized to examine the relationship between contract terms, farming systems, and the sustainability of contract farming. The study's results indicated a weak correlation ($r = 0.27$) between the farming system and the sustainability of contract farming, while a strong correlation ($r = 0.75$) was observed between contract terms and the sustainability of contract farming. The study recommends that contracting firms focus on farmers with larger households, higher education, substantial off-farm income, and extensive sorghum experience. Additionally, firms should assist in land acquisition, provide transportation for remote farmers, develop comprehensive training programs, and formalize contracts with fair terms and clear specifications. These strategies aim to enhance the long-term viability of contract farming arrangements and address the challenges identified in the study.

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LIST OF ABBREVIATIONS AND ACRONYMS

ASALs: Arid and Semi-Arid Lands

EABL: East African Breweries Limited

FAO: Food and Agricultural Organizations

FAOSTAT: Food and Agriculture Organization Statistic

ICRISAT: International Crop Research Institute for the Semi-Arid Tropics

IFPRI: International Food Policy Research Institute

INTSORMIL: International Sorghum and Millet Collaborative Research Support Program

KALRO: Kenya Agricultural and Livestock Research Organization

NGOs: Non-Governmental Organizations

SPSS: Statistical Packages for Social Sciences

USA: The United States of America

USDA: United States Department of Agriculture

CHAPTER ONE
INTRODUCTION

1.1 Background to the Study

Sorghum is grown worldwide, with Africa and Asia accounting for more than 90% of the crops harvested every year (Mundia *et al*., 2019). Sorghum serves many purposes, encompassing human consumption, biofuel production, animal feed, flour manufacturing, and the production of alcoholic beverages (Fuller & Stevens, 2018). The world sorghum production in 2021 was 61,364,997 tonnes, an increase from 58,705,915 tonnes produced in 2020 (Pandian, 2022). The United States, whose sorghum production was 11,374,900 tonnes in 2021, has the world's highest total sorghum production. Also, the USA has the highest average production of sorghum per year, followed by Nigeria, Ethiopia, India, and Mexico (FAOSTAT, 2021). The United States Department of Agriculture (USDA) estimates that in 2022/2023, the world production of sorghum will be 60.32 million tonnes, representing a decrease of 1,780,000 tonnes or 2.87% in sorghum production compared to 61.3 million tonnes produced in 2021/2022 (USDA 2022). Globally, sorghum continues to fall short of its production potential due to its ancient status as a coarse grain used mainly as animal feed and termed "the poor man's diet" reserved for low-income people (Mundia *et al*., 2019).

In Africa, sorghum is still primarily a subsistence food crop (Taylor, 2019). In 2021, Africa produced an estimated 26,280,475 tonnes of sorghum from 28,134,341 hectares of land, giving an average yield of 9,341 kg/ha (FAOSTAT, 2021). Approximately 20 million tonnes of sorghum are produced annually on the continent, accounting for one-third of global production and ranking second in importance only to maize (Orr *et al*., 2020). Nigeria is Africa's top producer of sorghum, with 6,725,000 tonnes produced in 2021; Ethiopia, Sudan, and Niger follow (FAOSTAT, 2020). Due to its ability to endure periods of high temperature and drought resistance, sorghum is crucial to the food security of Africa. According to Smale *et al*. (2018), sorghum is not only a traditional grain in Africa but is also playing a bigger role as an ingredient in innovative, non-traditional food and beverage products that are proving to be quite popular.

In Kenya, sorghum ranks third in cereal production after maize and wheat and has performed well on various soils, including those with very low fertility (Mwadalu & Mwangi, 2013). More than 3 million people in Kenya depend on sorghum for their income, with demand rising to 275,000 tonnes year compared to an expected production of 150,000 tonnes (Kanana & Mbugua, 2019). In Arid and Semi-Arid Lands (ASALs), Kenya's productivity for sorghum is 0.7 tonnes/ha, significantly less than the crop's potential yields of two to five tonnes/ha. In Kenya, the crop is usually farmed in the Eastern, Nyanza, and Coastal regions at elevations between 0 and 2,200 meters above sea level (Mwema & Mulinge, 2013). In 2021, the country produced 135,000 tonnes of sorghum from the 197,403 ha harvested area, producing 6,839 kg/ha (FAOSTAT, 2021).

Sorghum is one of the main crops grown in Tharaka Nithi County due to the favourable climatic conditions making the region highly prospective for the its growth (GoK, 2013). According to Kanana and Mbugua, (2019) the county is the second largest producer of sorghum after Meru County. The most common variety of sorghum grown in the county is the "gadam" variety (Kipchumba, 2021). Many sorghum farmers in the county produce the crop through contractual arrangements with East African Breweries Ltd (EABL) as the contractor. The EABL initiative significantly increases demand for the "gadam" sorghum variety, which has good malting characteristics (KALRO, 2021). Sorghum has been identified as the best substitute for barley for lager beer brewing in the competitive market of multinational enterprises (Suguna *et al.*, 2021).

Contract farming has been utilized in agricultural production for a long time. According to Chazovachii *et al*. (2021), 45% of the world's crop and animal producers, both major and small, are growing on contract, suggesting that its popularity has increased recently. A contract's major goal is to offer farmers with convenient markets, agricultural extension services, and inputs (Birthal & Hazrana, 2020). Conversely, growers should pledge to produce the contracted crop in accordance with the buyers' requirements with respect to standards, quantity, and quality (Ikeda & Natawidjaja, 2022). Contract farming, which gives resource-poor farmers access to inputs and extension services, is predicted to reduce hunger, poverty, and speed up economic development (Chazovachii

et al., 2021). Adjei *et al*. (2022) discovered that, 15% of the agricultural output in developed nations comes from contract farming.

According to Bellemare and Bloem, (2018) Contract farming encourages the farmers to participate in a rationalized market, thereby increasing and securing returns A majority of farmers feel that contracting improves their farming practices, provides more stable incomes, creates jobs, particularly for women, introduces new farming skills, and eliminates patron-client relationships between large and small producers (Musa *et al*., 2018; Beinah *et al*., 2020). Contract farming models have significantly impacted farmers' welfare by boosting agricultural growth through better technology, coordinating the producer and consumer markets, and building solid grassroots connections (Hirpesa *et al*., 2022).

Success in various crops like rice, cotton, and sugarcane in Contract farming has been witnessed by enhancing productivity, improving quality, and increasing farmers' income (Bidzakin *et al*., 2020; Susilowati *et al*., 2020; Nsimbila, 2021). However, challenges such as power imbalances, stringent requirements, inadequate enforcement, and limited access to resources can undermine its viability (Mango & Kugedera, 2022). Additionally, farmers often face difficulties in meeting stringent quality and quantity requirements set by the buyers, limiting their market access and potential benefits (Ikeda & Natawidjaja, 2022). Furthermore, inadequate enforcement of contracts, price volatility, and lack of access to inputs and credit can undermine the viability of contract farming arrangements (Mukherjee, 2022).

Since the late 1980s, contract farming has been the subject of numerous kinds of research (Saigenji & Zeller, 2009). Most of these studies have focused on the impact and performance of contract farming (Gwon & Kim, 2020; Hoang, 2021). Research has shown that the performance of contract farming is influenced by factors such as social-economic factors, income, the nature of contracts, and interlinked services (Kanana & Mbugua, 2019). Empirical evidence also indicates that the interlinked services included in the contract terms positively and significantly influence the compliance of contract farming (Muriithi *et al*., 2011). Research further indicates that farm and farmer characteristics such as age, gender, education, land ownership, and size greatly affected

the participation of farmers in contract farming (Rondhi *et al*., 2020). Kagwiria and Gachuki (2017) observed that farming systems such as land conservation, integrated pest management, mechanized production, and crop water management enhanced contract farming.

Although there is considerable empirical evidence on the benefits and participation in contract farming, very few studies have related the farming systems, terms of the contract, farm, and farmer characteristics to the sustainability of the contractual arrangements (Ikeda & Natawidjaja, 2022). Sustainability of the contract in this context refers to the ability to maintain and uphold an agreement over an extended period, ensuring its longevity and continuity. Most studies have concentrated on formal agreements neglecting informal or unwritten ones. The issues of mistrust and lack of transparency that violate the contract's terms have received relatively little attention in the quantitative literature to explain dissatisfaction, dropouts, and possibly the complete breakdown of contract schemes (Ruml & Qaim, 2021). Therefore, creating a vivid understanding of modern contract schemes and their sustainability is imperative. This study seeks to analyze factors that are associated with the sustainability of these contracts. Additionally, there is little or no research on contract sorghum farming in Tharaka Nithi County, a gap this research intends to fill.

1.2 Statement of Problem

Contract farming has gained prominence as a strategy to enhance agricultural productivity and improve the livelihoods of farmers in Tharaka Nithi County, Kenya. However, despite its potential benefits, the sustainability of contract farming among sorghum farmers in the county faces several challenges due to several factors. Understanding these factors is crucial to develop effective interventions and policies that can promote the long-term viability of contract farming. The increased demand for sorghum products has made malting companies contract farmers to produce sorghum in the county. Even though there is a scheme by these malting companies to provide appropriate farming techniques, high-quality seeds, and fertilizers to the contracted farmers, the demand for sorghum is not met. Farmers are not able to supply the right quantities as stipulated in the contractual terms leading to a violation of the contractual agreements, dissatisfaction, dropouts, and possibly the complete breakdown of contract

schemes. The failure of the contracted farmers to meet the set quantities of sorghum yield and supply at the right time is a clear indication that the contractual farming's sustainability cannot be guaranteed. Most previous studies focus on the performance and impact of contract farming on farmers' livelihoods. Very little or no attention has been paid to the sustainability of contract farming, particularly in sorghum production. Therefore, this study intends to examine the association between farmers' characteristics, contract terms, farm characteristics, and sorghum farming systems, and the sustainability of contract farming among sorghum farmers in Tharaka Nithi County.

1.3 Objectives of the Study

1.3.1 General Objective

To determine the factors associated with the sustainability of contract farming among sorghum farmers in Tharaka Nithi County.

1.3.2 Specific Objectives

i. To determine the relationship between farmers' characteristics and the sustainability of contract farming among sorghum farmers
ii. To examine the association between farm characteristics and the sustainability of contract farming among sorghum farmers
iii. To determine the relationship between farming systems and the sustainability of contract farming among sorghum farmers
iv. To determine the association between contract terms and sustainability of contract farming among sorghum farmers

1.4 Research Questions

i. What is the relationship between the farmers' characteristics and sustainability of contract farming among sorghum farmers?
ii. What is the association between farm characteristics and the sustainability of contract farming among sorghum farmers?
iii. What is the relationship between farming systems and the sustainability of contract farming among sorghum farmers?
iv. What is the association between contract terms and the sustainability of contract farming among sorghum farmers?

1.5 Significance of Study

The research findings will be beneficial to various groups of people, namely contracting companies, farmers, national and county governments, extension agents, academicians, practitioners, and policymakers. The research finding will help contracting companies better develop and administer contract farming programs to entice additional growers to improve quantity and quality of the produce. The research findings will help farmers understand the need to participate in and sustain the contractual arrangements to boost the productivity of the crop. The study findings will also help the government and other practitioners in the agricultural sector to formulate policies and regulations relating to contract farming to help develop sustainable contractual agreements between the buyers and the farmers. The results will provide guidelines to the extension officers on the type of information to disseminate to the contracted farmers to ensure maximum production for sustainable contracting. The research findings will help the academicians by providing knowledge about the sustainability of contract farming and help future researchers to identify areas for further research.

1.6 Scope of the Study

The study was carried out in Tharaka Nithi County, covering contracted sorghum farmers. The study examined the relationships between farmer characteristics, contract terms, farming systems, farm characteristics (independent variables), and the sustainability of contract farming among sorghum farmers (dependent variable). The target population comprised 17,000 contracted sorghum farmers in Tharaka Nithi County (EABL, 2022). This study would be grounded on the agency theory. The field data collection was done for a period of four weeks between June and July, 2023.

1.7 Assumptions of the Study

The research assumed that the data acquired from this study accurately represented the circumstances surrounding contract sorghum cultivation in Kenya. It was also assumed that the respondents provided truthful and accurate information that appropriately addressed the research questions. This study also assumed that all sampled contracted sorghum farmers had a clear understanding of the contractual arrangements they were involved in to provide sufficient information to meet the research needs.

1.8 Limitations of the Study

The study was limited by the fact that some farmers had difficulties recalling some information regarding contract farming. However, the researcher ensured that there was in-depth interaction with the farmers to help them remember the information needed for this study. Due to the language barrier, the researcher found it challenging to communicate with the farmers. However, this was solved by using enumerators who use the local language to assist in interpreting and clarifying the questions to respondents. Moreover, some respondents gave information to please the researcher, but this was minimized by informing them that the research was not subjective but purely objective.

1.9 Operational Definition of Terms

Contract Terms: Any requirement or condition included in an agreement between the EABL and sorghum farmers. The guidelines relating to the quantity, quality, and time of delivery of sorghum to the EABL by sorghum-contracted farmers. Moreover, other contract terms may include negotiating the buying price of sorghum by the EABL and provision of services such as training and education as well as inputs such as certified seeds and fertilizer.

Farm Characteristics: These are qualities or features of an area of land used for growing sorghum. The farm characteristics to be studied include the land size, the land ownership, and the farm's location.

Farmer Characteristics: These are the qualities, abilities, attainments, and traits sorghum farmers possess. The farmer characteristics to be studied include education, age, and gender.

Farming Systems: A farming system is a decision-making unit that consists of the farm household, cropping, and livestock systems that convert land and labour into useful products that may be consumed or sold (Fresco & Westphal, 1988**)**. The farming systems to be studied include mono-cropping and intercropping.

Extensive Farming: An agricultural system that involves low inputs and relies more on natural processes and resources. It is often practiced on large areas of land, with less intensive cultivation methods.

Intensive Farming: An agricultural system characterized by high inputs of labor, capital, and technology to maximize yields from a given land area. It involves the use of advanced techniques, such as high-yielding crop varieties, chemical fertilizers, pesticides, irrigation systems, and mechanization.

Sustainability of the Contract: The ability to maintain and uphold a farming agreement over an extended period, ensuring its longevity and continuity. The sustainability of the contract between farmers and EABL for sorghum production the sustainability of contract between

farmers and EABL for sorghum production was evaluated based on indicators including: Growth in the number of contracted sorghum farmers, Acreage under contracted sorghum crops, Number of years of contractual arrangements and Volume of sorghum delivered to EABL by contracted farmers.

CHAPTER TWO
LITERATURE REVIEW

2.1 Overview of Sorghum Production and Sustainability of Contract Farming

2.1.1 Overview of Sorghum Production

Sorghum is largely utilized in feeding livestock and the production of ethanol. Still, it is also finding favour in the consumer food business and other uses in areas where it is cultivated (Zhao *et al*., 2022). Sorghum cultivation spans across various regions in Kenya, encompassing the western, northern Rift Valley, eastern, and central areas. Sorghum comes in different varieties, including Gadam, Seredo, Kari Mtama 1, and Serena (Njinju *et al*., 2022). According to Namoi *et al*. (2014), gadam is a short cultivar with chalky white grain, and it produces an average yield of 3.15 tonnes per hectare. It is a particularly early-developing cultivar that matures in two and a half to three months. It is drought tolerant and suitable for moderately arid and dry areas like upper and lower eastern Kenya, including Kitui, parts of Embu, Tharaka Nithi, and Makueni counties (KALRO, 2021).

According to Njinju *et al.* (2022), sorghum is exceptional in its ability to produce in challenging environmental situations where other crops either fail to thrive or produce badly. FAO (2013) reported that sorghum is cultivated by numerous small-scale farmers in various countries using scarce water resources and with little fertilizer or other inputs. Fetene *et al*. (2011) assert that sorghum, often referred to as the 'camel of the plant kingdom', stands out as a crucial drought-tolerant crop. Sorghum grows well on clay, clay loam, and sandy loam soils and performs effectively in the pH range of 6.0-8.5 because it tolerates high salinity and alkalinity (Schlemper *et al*., 2017). Sorghum displays a preference for warm climatic conditions, yet its adaptability allows it to thrive across diverse climates. Its cultivation is not limited to specific regions, as it is also cultivated widely in temperate countries and even at elevated altitudes up to 2300m (Muui *et al*., 2013). Furthermore, Chadalavada *et al.* (2021) state that sorghum possesses a short maturity period and demonstrates the ability to flourish under both irrigated and rain-fed conditions.

Empirical evidence shows that Sorghum exhibits a remarkable ability to endure elevated temperatures more effectively than any other crop throughout its entire life

cycle (Tadesse, *et al*., 2023; Thurber *et al*., 2013; Gano *et al.,* 2021). The optimum growth conditions for the crop lie within the temperature range of 26 to 30˚C. Notably, sorghum seed germination occurs at a minimum temperature of 7 to 10˚C (Mwema & Mulinge, 2013). Research shows that the crop grows best in places with an average annual rainfall of 45 to 65 cm and a seed rate of between 7 and 10 kg/ha of certified sorghum seeds (Eggen *et al*., 2019). A recent study has shown that the average yield of sorghum is 1,435 kg/ha (Getachew *et al*., 2021). However, as observed by Kisilu and Ngugi (2021), the yield of sorghum is influenced, at least in part, by the specific cultivars employed and the cultural practices adopted within the respective regions.

Various studies have highlighted sorghum's potential importance in household welfare. A survey by Timu *et al*. (2014) indicates that the most significant welfare gains from sorghum come from improved varieties since they have a desirable maturity period, good grain yield capacity, yield premium market prices, and takes the shortest time to cook. However, the indigenous varieties possess a favored taste, along with the capability to endure extended periods of drought and enhanced brewing qualities. According to Opiyo *et al*. (2020), adopting enhanced sorghum varieties resulted in a significant rise in household income (33.3%), with the income gain being much higher among disadvantaged households. Mwadalu and Mwangi (2013) demonstrated that sorghum could improve food security in semi-arid Eastern Kenya. This is due to its drought tolerance abilities and capacity to thrive in a variety of soils.

Despite sorghum's potential to improve household food security and regional growth, the industry confronts numerous hurdles. According to Chepng'etich *et al*. (2015), despite Kenya's growing population relying primarily on cereal grains as a staple diet, sorghum's contribution is much below potential. The issues are made worse by input and output marketing inefficiencies, which include poor market infrastructure, a dearth of marketing support services, and a lack of market intelligence (Koima *et al*., 2022; Kilambya & Witwer, 2019). According to a report published by the International Food Policy Research Institute (IFPRI) (2011), despite agriculture's importance as a primary source of income, the sorghum sector confronts numerous challenges, particularly in arid and semi-arid regions. Furthermore, crop productivity has been lower in recent

years, particularly for sorghum. Based on this report, the sorghum sub-sector has received virtually little attention.

Global sorghum output remains below potential yield. A number of reasons could have contributed to this. According to a Teressa *et al*. (2021) study, the main obstacle to sorghum cultivation is the scarcity of stable, high-yielding cultivars. Mundia *et al*. (2019) noted that climate change and variability negatively affected sorghum production. The following variables were found to have an impact on sorghum production based on research conducted by Njagi and Opiyo (2021): climate change, population growth/economic development, demand for non-food items, agricultural inputs, demand for other crops, scarcity of agricultural resources, biodiversity, cultural influence, price, and armed conflict. Srivastava *et al*. (2010) found that climate change will reduce sorghum yields significantly and increase volatility. Furthermore, sorghum production will face new hurdles in the future, and communities that rely on it as a staple will face growing food insecurity.

Over the past 20 years, Kenya's production of sorghum has fallen short of that of its neighboring nations, including Uganda, Tanzania, and Sudan. In spite of this unfavorable pattern, Kenya has witnessed a rise in sorghum production in recent times (Njagi, 2019). It's worth noting that despite this increase, farmers often fail to realize the potential yield gains of more than 2.8 tons per hectare, particularly from the utilization of improved sorghum varieties. Omoro (2013) stated that insufficient access to fertilizer and high-quality seeds because of a lack of funding for agricultural investment could be a contributing factor in the low yields of sorghum grains. According to Smale *et al*. (2018), the use of hybrid sorghum led to significant yield increases, a wider range of foods consumed a lower percentage of sorghum in food expenses, and a higher share of the sorghum harvest that was sold. Additionally, the research revealed that the use of enhanced seeds was associated with a shift in cereal consumption toward substitutes and a higher percentage of excess produce that was available for sale.

According to a study by Muui *et al*. (2013), the majority of farmers grow sorghum in mixed farming systems, which include growing the commodity alongside other crops

like maize, cowpea, beans, and pigeon peas. For sorghum, mono-cropping is strongly advised, although very few farmers follow through on this advice. According to a study by Ojo *et al*. (2019), there are over 240,000 sorghum farmers in Kenya who mostly cultivate sorghum for sustenance. Their farms range in size from 0.4 to 0.6 hectares (1 to 1.5 acres). According to an FAOSTAT (2021) report, Kenya's sorghum production area grew from 184,654 Ha in 2016 to 219,657 Ha in 2021, and during that time, the country's average output per hectare climbed from 6,336 Kg/Ha to 14,341 Kg/Ha.

Although the productivity of the crop has been improving for the last four years (FAOSTAT, 2021), there have been concerted efforts supplemented by non-governmental organizations and other stakeholders. As observed by Adugna (2014), the International Sorghum and Millet Collaborative Research Support Program (INTSORMIL) and International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) for instance, they have implemented interventions aimed at capitalizing on opportunities for enhancing productivity, thus contributing to the improvement of sorghum marketing. The interventions encompassed activities such as breeding, the dissemination of improved high-yield sorghum varieties resistant to pests and diseases, and the promotion of practices that conserve resources, (Praveen *et al*., 2022). The utilization of sorghum for industrial processing is on the rise, evidenced by significant crop expansion in recent years (Njinju *et al*., 2022).

Sorghum serves as a raw material for producing various products, including wax, starch, syrup, dextrose agar, and edible oils. As noted by Timu *et al.* (2012), sorghum stands as a significant staple food crop for some of the most economically disadvantaged populations across the globe. Studies have additionally demonstrated that within the last five years, there has been a 25 percent increase in the utilization of sorghum for industrial applications in Kenya (Davana & Revanna, 2021). A study by Dabija *et al*., 2021 shows this growth is primarily attributed to the emergence and popularity of sorghum beer. According to Einfalt (2021), sorghum production for the beer is highly commercial. Sorghum is demonstrating superior performance and yielding better returns to farmers, surpassing other agricultural enterprises like maize, millet, and pigeon peas in terms of competition for essential resources such as land and water (Dabija *et al*., 2021).

As observed by Kanana and Mbugua (2019), East African Breweries Limited (EABL) is at the forefront of Kenya's sorghum commercialization, acting as a malting corporation that contract with farmers to improve productivity. EABL provides an easily accessible market for agricultural produce at reasonable pricing, according to a study by Njagi *et al*. (2019). The analysis also showed that an increase in beer consumption is anticipated to raise the 60,000 metric tonnes per year that the EABL requires. It is unmistakably proof that sorghum producers have a huge market opportunity. Research shows that in 2019, farmers who supplied products to KBL earned Ksh 1.2 billion, while distributors and merchants earned Ksh 1 billion and Ksh 4.5 billion, respectively, for their value-added. In addition, taxes of Ksh 9.8 billion were received by the government in that same year. It serves as an example of the growing importance of the sorghum value chain in both the industry and the nation's overall economy (Kale, 2022; Njagi & Opiyo, 2021; Quinter *et al*., 2021).

Kenya Breweries Limited's demand for sorghum is high, but the supply from farmers is low. The KBL, to overcome this challenge of sorghum shortages, can minimize it through contract farming. The contract arrangements are designed in a manner where (KBL) collaborates with universities and research institutions to distribute the preferred sorghum varieties to agro-dealers and stockists across various regions. Additionally, the inputs are extended to farmers on credit, accompanied by supplementary guidance on effectively managing the crop in the field (Njagi & Opiyo, 2021). This arrangement also addresses the issue posed by inadequate extension systems, which serve as a crucial channel for disseminating information and knowledge to smallholder farmers. The study further suggests that the collaboration for enhancing improved varieties is anticipated to persist, driven by the increasing adoption of improved seeds by farmers and the imperative to enhance profitability for small-scale sorghum producers. According to Kanana and Mbungua (2019), KBL-contracted farmers grow sorghum as a commercial venture. According to a study by Njagi and Opiyo (2021), the amount of sorghum grown by contracted farmers for EABL rose from 9,000 tons to 32,418 metric tons between 2015 and 2019. This represents a 260% increase. Furthermore, during the same time period, the number of farmers hired by EABL to cultivate and supply sorghum increased by 40%, from 30,000 to 42,000 farmers.

2.1.2 Sustainability of Contract Farming

Few studies have been conducted on the sustainability of contract farming, especially in sorghum production. Empirical evidence shows that for contract farming arrangements to be sustainable and mutually advantageous for both farmers and firms, they must effectively tackle challenges related to both production and marketing aspects (Poku & Birner, 2018). According to Poku and Birner (2018), the capacity and dedication of firms to formulate contracts that incorporate supportive services for outgrowers are crucial factors influencing smallholder engagement and the enduring sustainability of contract farming. Researchers such as Abebe *et al*. (2013); Abbasi *et al*. (2021) have illuminated the shortcomings associated with contract farming. According to these researchers, many farmers regret engaging in contract farming due to unjust payments for agricultural products, monopolistic exploitation caused by customers' bargaining power, and high input costs brought on by customers' persistent desire for high quality and high credit ratings.

Farmers find contract arrangements to be manipulative and unpleasant (Chazovachii *et al*., 2021). Since contracting firms profit more at the expense of smallholder farmers, they see it as economically feasible. Additionally, the terms of the contracts are characterized by transaction costs, uncertainties, and information asymmetries notwithstanding the assurance of inputs, extension services, and a market for their produce. Ncube (2020) notes that non-governmental organizations, legislators, funders, and researchers have suggested to governments, especially in poor nations, to support and facilitate contract farming in order to increase agricultural output, realizing the effectiveness of this practice. Bellemare and Bloem (2018) state that contract farming can be an effective tactic for expanding markets and facilitating the transfer of technical knowledge for both the farmer and the contractor.

The success of contracts might be defined in terms of the agreement continuing over many seasons, continuing viability of the contract, and the distributional effects of the contract (Prasetyo *et al*., 2022). Kozhaya (2020) carried out a study on a systematic review of contract farming in Lebanon. The results of farmer interviews indicate that assurance of pricing, sustainability; risk mitigation, financial facilities, and technical support are the main justifications for entering into a contract. Farmers, on the other

hand, have voiced worries regarding the contractors' responsibilities, including late delivery and payment. Moreover, farmers sell their produce on the open market when prices are high.

Studies have indicated that, the degree of interaction between farmers, purchasers, and other contract scheme parties determines how effective a contract arrangement will be (Tschirley *et al*., 2009; Eaton & Shepherd, 2011; Prowse, 2012). Additionally, numerous instances of inadequate party management, unfavourable terms and conditions, and post-determination of prices determined by contract markets have been cited as reasons why contract farming has failed. As a result, this has led to the poor selection, moral hazard, and contract violations. A study by Bellemare and Bloem (2018) showed that contract farming can be a successful strategy for both the contractor and the farmer to grow markets and facilitate the transfer of technical skills. A report by Prasetyo *et al*. (2022) indicated that the success of contracts may be defined in terms of the contract continuing over many seasons, continuing viability of the contract, and the distributional effects of the contract.

The success and sustainability of contract farming are significantly impacted by contract violations (Hambloch, 2022). Dzulkarnain *et al*.'s (2020) study demonstrated that in order to increase contract farming's productivity, product quality, and sustainability, it is important to comprehend the variables that could affect the industry's viability. Internal and external factors impact the contract farming collaboration between agribusiness corporations and farmers, according to a different study conducted by Musa *et al*. (2018). The study also concluded that the sustainability of contract farming is significantly impacted by a number of factors, including small-scale farmers' ability to fulfill contractual obligations, the reliability of the services these farmers provide to agribusiness companies, and the consistent alignment of variables such as land access, infrastructure availability, quantity and quality of products produced.

According to Berdegué *et al*. (2008), collaboration between an organized and skilled small-scale farmer and an open-minded agribusiness company is a key component of effective contract farming, Studies reveal that a few of the disparate critical elements

impeding the practice of contract farming are inadequate quality seeds, mistrust, a lack of entrepreneurial aptitude, and formal contract agreements (Khapayi *et al*., 2018). A report by Sinaga *et al*. (2022) indicated that the success of contract farming is significantly affected by production input, technological support, and information transparency. Research by Kimbi *et al*. (2022) demonstrated that farmers' attitudes and abilities play a major role in their ability to succeed in contract farming endeavors, while Astriawati's (2015) findings indicated that selling price and educational attainment are important variables that affect contract farming success.

Lack of enduring commitment and reciprocal trust emerges as principal catalysts for contract breaches and disputes. The study also concluded the success and sustainability of contract farming critically hinge upon the presence of commitment and mutual trust between firms and farmers (Birthal & Hazrana, 2020). Empirical evidence shows that the opportunistic behaviour of farmers caused by asymmetric information seriously affects the sustainability of contract farming (Wang & Liang, 2022). According to Prasetyo *et al*. (2022), the sustainability of contract farming is evaluated based on the Weight and Rank of Dimensions, with a notable emphasis on partnership dimensions such as equality, transparency, and mutual benefit. Additionally, equality is the highest dimension determining the sustainability of contract farming because equality between farmers and the contracting firms makes communicating easier.

2.2 Farmers' Characteristics Associated with Sustainability of Contract Farming

Most empirical investigations on the farmers' characteristics that influence the sustainability of contract farming mostly focus on age, education, and gender (Le Ngoc, 2018; Sambuo, 2013; Odunze *et al*., 2015). A particular study deduced that sociological factors such as age, education, and gender positively and significantly influence the performance of contract farming (Bhadel, 2020). Kanana and Mbugua (2019), in their study on the influence of farm characteristics on the performance of contract farming, found that a farmer's age, gender, and education level influenced a farmer's contract performance.

Previous studies have shown that the age of the household head influences contract farming in different ways. Research shows that the farmer's age significantly influenced

the smallholders' preferences for different contract farming models (Hung *et al*., 2019). According to Hermawan and Heri (2017), age was among the factors influencing the running of contract farming. Meanwhile, Nazifi *et al*. (2021) affirmed that age was a significant factor influencing the extent of farmers' participation in contract farming. A study by Kimbi *et al*. (2022) on factors influencing brewery contract farming participation among sorghum farmers reported that age influenced sorghum farmers to participate in contract farming. The study highlights that older farmers are more inclined to engage in contract farming, potentially due to agriculture's status as a primary income source in rural regions, which makes them receptive to opportunities they perceive as advantageous.

Existing research indicates that contract farming is more prevalent among elderly farmers (Hirpesa *et al*., 2020; Akumu *et al*., 2020; *et al*., 2019; Johnny *et al*., 2019). Nevertheless, these findings were in contrast to those of Rondhi *et al*. (2020), who assert that younger farmers are more inclined to participate in contract farming due to their perceived lack of tradition and greater receptiveness to new technologies than their older counterparts. Additionally, Melesse (2018) contends that younger generations may exhibit less conservatism than their elders due to their increased education and access to more contemporary technologies and knowledge. All of these studies have failed to demonstrate the extent to which age affects the sustainability of contract farming, a lacuna that this study aims to address.

Sinaga *et al*. (2022) found that farmers' level of education and farming experience had a negative impact on contract farming success, limiting its sustainability and continuous implementation. Bidzakin *et al*. (2020) found that farmers' educational levels influenced their engagement in contract farming. Similarly, Nazifi *et al*. (2021) looked into the factors that influence small-scale maize farmers' participation in contract farming in northwestern Nigeria. The findings revealed that farmers' degree of education had a substantial impact on their decision to participate in contract farming. According to Hermawan and Heri (2017), education level was one of the elements influencing the operation of contract farming.

Education level of contract growers is significant and positively related to the adaptation behaviour of contract growers (Pandey, 2016). Additionally, the causes of the literacy level and labour mobility are higher in men than in women since they can go anywhere anytime for one or more agreements. Astriawati's (2015) report showed that the level of education significantly influenced the success of contract farming. The study's conclusions are consistent with Rantlo and Bohloa (2022) conclusions. According to the findings, farmers who have access to information and expertise concerning demand, quality grades, and standards are more well-informed and tend to align their production and marketing practices accordingly. Consequently, there exists an increased probability of meeting the criteria for quality, quantity, delivery timelines, and other relevant terms and conditions outlined in market specification contracts. This research intends to determine the influence of education on the sustainability of contract farming.

Empirical evidence shows that the gender of the farmer is significant and positively related to the adaptation behaviour of the contract growers under the contract farming arrangement. However, according to Kimbi *et al*. (2022), the gender of the household head was found not among the important factors influencing farmers' uptake of contract farming. This finding was in accordance with the findings of Setboonsarng *et al.* (2018), who studied rice contract farming and poverty reduction in Lao PDR. According to Rondhi *et al*. (2020), gender is insignificant in affecting farmers' decision to participate in contract farming.

In his research, Astriawati (2015) found that males are more likely to participate in contract farming arrangements than women. Conversely, certain investigations determined that contract farming was considerably less prevalent among women (Bellemare, 2012). This discrepancy may be attributed to the substantial institutional pressure that women experience in less developed countries, which prevents them from engaging in contract farming. Nevertheless, numerous prior studies have utilized gender as a predictor of producers' involvement in contract farming, leaving no consensus regarding the significance and impact of gender on the sustainability of contract farming.

In a study conducted by Kokeyo (2013), household size was identified as a significant factor that influenced the participation of sugarcane farmers in contract farming. These findings are in agreement with Musara *et al*. (2011), who discovered that the decision to participate was substantially and positively influenced by household size. The likelihood of a household being contracted increases as the effective labor available increases, as the likelihood of labor shortages during peak periods is minimal. This increases the likelihood of favorable yields and the capacity to participate in contract farming. Nevertheless, these results are in agreement with Akumu *et al*. (2020), who contended that farmers with larger households are more likely to engage in contract farming due to the more affordable access to family labor. The significant labor demand, particularly during the planting, weeding, and harvesting phases, emphasizes the significance of on-farm family labor availability in determining participation in the contract scheme. As a result, contract agricultural endeavors are more likely to be successful in households that are larger.

According to the report by Ganewo *et al*. (2022), farmers with substantial household sizes are more likely to cultivate extensive areas of the crop with the assistance of contractors who provide sufficient financing. This is due to the fact that households with big family sizes discovered that using family labor for agricultural farming was less expensive than using outside labor. Thus, it was predicted that family size would influence contract farming of malt barley in a favorable manner. These findings, however, were at odds with those of Kimbi *et al.* (2022), who found that household size has a detrimental effect on contract farming involvement. The findings showed that larger sorghum farming households were less likely to engage in contract farming. Although empirical evidence exists to show the influence of the gender of the household head on the performance and success of contract farming, the studies have not examined the correlation between gender and the sustainability of contract farming.

2.3 Farm Characteristics Associated with Sustainability of Contract Farming

The factors that influence the participation of small-scale maize producers in contract farming in north-western Nigeria were evaluated by Nazifi *et al*. (2021). The extent of farmers' participation in maize contract farming was significantly influenced by the scale of the farm and the distance of the farm from the collection center, as indicated

by his research. Kanana and Mbugua (2019) also conducted a study to investigate the factors that affect the performance of contract farming. The results indicated that the efficacy of contract farming was not definitively determined by the size of the farmer's land. In Ghana, Bidzakin *et al*. (2020) investigated the efficacy of rice production and contract farming. The technical, allocative, and economic efficiency measures of the producers were positively influenced by farm size, which was a common factor.

Larger farms benefit more from the contracts regarding credit disbursement. Again, an increase in one hectare of land raises participation in contract farming likely (Kokeyo, 2013). Musa *et al*. (2018) found that farmers typically face challenges when trying to participate in contract farming programs, even though they have access to suitable property. These challenges include things like poor infrastructure, farms' distance from markets, and a lack of finances to cover transportation fees. The determinants of the participation of fresh fruits and vegetables producers in contract farming in Peninsular Malaysia were evaluated by Hoang and Nguyen (2023). The results of the research suggested that the size and ownership of land have a positive impact on the participation of producers in contract farming.

According to Kimbi *et al*. (2022), among the factors that influence sorghum farmers to participate in contract farming is off-farm income. The study's conclusion suggests that farmers possessing off-farm income sources are more inclined to engage in contract farming, likely due to their access to additional financial resources, which facilitates the mobilization of production inputs and the willingness to take on risks associated with participating in such initiatives. These findings were consistent with Sokchea and Culas (2015), who reported a positive correlation between off-farm income and the involvement of farmers in contract farming programs in Cambodia.

Land ownership had a positive impact on the adoption of contract farming, as noted by Adnan *et al*. (2020). To evaluate the feasibility of contract farming, Odunze *et al*. (2015) evaluated various factors. The viability of contract farming was determined to be enhanced by the production area. Furthermore, the viability of contract farming was determined to be influenced by the location of the land, soil type, accessibility, and road network, as well as the quantity and pattern of rainfall. Although the majority of these

studies have examined the farm factors that affect farmers' participation in contractual farming, none have attempted to analyze the impact of these factors on sustainable contract schemes.

2.4 Farming Systems Associated with Sustainability of Contract Farming

Sorghum intercropping with various legumes in rice paddy fields was examined by Song *et al*. (2021) with respect to its growth characteristics, forage productivity, and feed value. These findings indicated that the intercropping of sorghum with legumes in paddy fields is a promising cultivation method for the maintenance of consistent forage productivity. Furthermore, the intercropping of sorghum with legumes in paddy fields results in the development of advantageous forage properties. Additionally, research has demonstrated that the productivity of forage is diminished when sorghum is intercropped in comparison to sorghum monoculture (Baghdadi *et al*., 2021). Intercropping is more efficient than monocropping, as evidenced by the high land equivalent ratio values, as noted by Daou *et al*. (2022). The research confirmed that the performance of sorghum is enhanced when intercropped with cowpea, contingent upon the variety and season. Additionally, the yield of sorghum and cowpea is significantly influenced by the sowing date and monsoon season in the intercropping system.

Kagwiria and Gichuki (2017) conducted an analysis of the factors that influence contractual farming in Kenya and discovered that farming systems significantly influence contract farming. The study concluded that the adoption of contract farming is facilitated by agricultural practices such as the land conservation method, while the profitability of contract farming endeavors is significantly increased by effective crop water management. Additional research has shown that contract farming is less expensive when using integrated pest management, that contract farming is somewhat supported by mechanized production methods, and that salinization of the soil discourages contract farming (Key & Runsten, 2013). Although the differences are not statistically significant, contracted farmers tend to employ less intercropping and more mono-cropping, as per Dubbert *et al*. (2021).

Sita *et al*. (2018), from their study's findings, it was observed that the intercropping system under contract farming positively impacted the growth of tea plants. Also, tea

plants in the intercropping system showed better growth than those in the garden under the mono-cropping system. Empirical evidence has shown that contract farming through the intercropping system has weaknesses and potential problems, especially for farmers with low bargaining power from contracts (Hong *et al.*, 2019). In their study, Setboonsarng *et al.* (2018) affirmed many contract farming arrangements are based on mono-cropping of a non-traditional crop. From the study's economic analysis, contract farming through the intercropping system was found to generate efficiency in investment costs. However, this study focuses on farming systems such as mono-cropping and intercropping of sorghum crops and their impact on the sustainability of contract farming.

2.5 Contract Terms Associated with Sustainability of Contract Farming

The terms of a contract can be ascribed to two distinct factors: the conditions in the contract and the agreement, whether it is written or spoken (Cao *et al*., 2022). Kanana and Mbugua (2019) evaluated the impact of contract terms on the performance of contract farming among small-scale sorghum producers in Imenti North, Meru County. The research demonstrated that the majority of farmers preferred written contracts to oral ones. Key and Runsten (2013) conducted research on rural development, smallholders, and contract farming in Latin America. The study revealed that input supply arrangements are crucial in the development of contracts that are intended to benefit small-scale farmers. These arrangements are designed to resolve the constraints that small-scale farmers encounter, including their limited access to certified inputs and input loans.

Rondhi *et al*. (2020) looked at what makes farmers want to take part in touch farming. The data showed that the late delivery of inputs was a big problem that made it hard for small-scale farmers to take part in contract farming. According to Odunze *et al*. (2015), one of the most important things that determine whether contract farming will work is the supply of inputs. In addition, this study found that workers must provide inputs on time for a project to be successful. Regarding the supply of inputs, Kalamkar (2012) found that one of the issues farmers had with contract farming was that inputs were sometimes late, which had a big effect on contract farming. In 2016, Chamahwinya

discovered that giving farmers high-quality inputs was a big reason why they produced more when they were on organized contract farming.

The availability of extension services is one of the elements that motivate sorghum farmers to engage in contract farming, as stated by Kimbi *et al*. (2022). The results of this study indicate that sorghum farmers who have access to extension services are more likely to engage in contract farming. This may be attributed to the production and marketing knowledge that extension officers provide. This may also suggest that extension workers provided sorghum producers with information regarding the advantages of engaging in contract farming. Additionally, extension services can readily facilitate the demonstration and awareness of improved technologies, thereby increasing the adoption of improved seeds and technologies by farmers (Ndossi *et al*., 2021).

A study by Musa *et al.* (2018) indicated that agribusinesses choose informal verbal contracts instead of formal written contracts. This situation arises due to the inability of farmers to consistently generate high-quality commodities within the supply chains, coupled with the limitations faced by agribusiness firms in compensating producers according to contract terms, even during periods of market downturns. Again, the study noted that farmers encounter challenges in accessing high-quality seeds and new hybrid cultivars, which can lead to instances of reduced production and the generation of low-quality agricultural produce. Pandey (2016), in his study on socio-economic factors influencing contract farming, found that the availability of the inputs is not significantly related to contract farming decisions for contract growers. Also, the study suggested that the availability of information is the major component of the contract farming system. In order to better understand how contract terms, influence the sustainability of contract farming in Tharaka Nithi County, a study was conducted.

2.6 Theoretical Framework

The theoretical framework is comprised of fundamental ideas, concepts, and information about the research subject. It serves as a guide and the basis for research (Ahmad *et al.,* 2019). The study was guided by the agency theory of exchange developed by Jensen and Meckling (1976). The origins of agency theory can be traced

back to agricultural and insurance contract studies, which focused on the trade-off between incentives for effort and risk-bearing (Huffman & Just, 2004). The agency theory of exchange revolves around the concept that a sorghum farmer, acting as an agent, might obtain personal advantages by refraining from exploiting their trading partner. This dynamic enhances the trading partner's motivation to invest in activities specifically related to the transaction. Over the past twenty years, the theory has undergone significant advancement. Within the framework of agency theory, a scenario is envisioned wherein a principal enters into a contract with an agent to undertake a certain effort. This occurs when production is uncertain, and the agent's effort remains unobservable (Maertens & Velde, 2017). In other words, although the results or outcomes are discernible to both the principal and agent, an external entity like a court is unable to validate the level of effort exerted in the process. Hence, contracts are necessarily informal (Gwon & Kim, 2020; Liang & Wang, 2022) and, thus, may be oral. These contracts must possess characteristics that ensure incentives are aligned, are compatible with the parties' interests, and adhere to voluntary participation conditions. This guarantees that both an economically rational principal and agent find it more advantageous to uphold their contractual obligations rather than defaulting.

Agency theory operates under the assumption that contracts are considered effective when the objectives of both the principal and the agent are in harmony and alignment (Tate *et al.*, 2010). The agent (farmer) will only consent to become involved with the principal (buying firm) in the context of this study if they are guaranteed higher returns, as well as short-term and long-term benefits. Therefore, in these circumstances, the principal is presented with two options: either to monitor the behavior of the agents or to incentivize them in an evident manner (Ketchen & Giunipero, 2004). Kokeyo (2013) posits that contract farming is likely to flourish when both the principal and agent are motivated.

In the context of contract farming, agency theory presupposes that both the firm (principal) and smallholders (agents) are self-interested, risk-averse, and possess bounded rationality, as per Bendickson *et al*. (2016) and Panda and Leepsa (2017). The company, as a principal, endeavors to circumvent the expenses and hazards associated with in-house production, while contract farmers charge margins for the cultivation and

distribution of the product. Research has demonstrated that the management of a contract with an agent is simplified when the contract includes incentives that motivate the agent to act in the firm's best interest. Incentives may be public (legal reparation), private (contractual terms), or a combination of both (Prowse, 2012). As long as there is an adequate incentive for both parties to continue their collaboration, they will continue to collaborate. Various contracts are used to maintain relationships based on the relationship's context, information system, outcome uncertainty, task programmability, and measurability (Bajari & Tadelis, 2001).

Uncertainty and information asymmetry give rise to two principal agency issues: moral hazard and adverse selection. Moral hazard refers to a situation where, within a contractual arrangement, one party stands to benefit by disregarding the agreed-upon principles (Alulu, 2020). In this context, moral hazard entails that a party could opt to undertake riskier actions, understanding that the consequences of those risks will be borne by the other party. Adverse selection pertains to a scenario where there is asymmetric information on the agent's part, and the principal lacks adequate information to ascertain whether the agent is adhering to the contractual agreement by executing the tasks they are enabled and compensated for (Mulatu, 2018).

2.7 Conceptual Framework

A conceptual framework is a set of concepts or variables a study operationalizes to accomplish the stated objectives (Gagliardi *et al*., 2011). It shows the relationship between the independent and the dependent variables in a study (Mugenda & Mugenda, 2008). This research hypothesized that gender, age, education, provision of inputs, oral contracts, written contracts, land size, land ownership, land location, monoculture, and intercropping may significantly influence the sustainability of contract farming. Figure 1 shows the relationship between the study's independent and dependent variables. The independent variables include farmers' characteristics, farm characteristics, contract terms, and farming systems, while the dependent variable is the sustainability of contract farming.

In this study, the farmer's characteristics were expected to have an influence on the sustainability of contract farming. The age of the farmer, education level, and gender

were the farmer’s characteristics that likely affected the sustainability of sorghum contract farming. Farm characteristics such as land size, land ownership, and location of the land under contract were also likely to be correlated with the sustenance of the contractual arrangements. These factors, among others, determine the amount of produce the farmers’ harvest. If a farmer harvested enough quantity of sorghum to meet the agreed amount, the success of the contracts was likely to be achieved.

The terms of contractual arrangements were also believed to influence the sustainability of contract farming. The provision of inputs at the right time and the purchase of the produce at the prices agreed upon by the parties enhance the sustainability of the arrangements. Additionally, favourable contract terms encourage farmers’ participation in contract farming. The type of farming system practiced by the farmer is also thought to have an influence on the ability of the farmer to maintain the contractual arrangements. Farmers in the study area produce sorghum through a monoculture or mixed farming systems.

The intervening variables included climatic change and the farmers' attitudes. The attitude of the farmer can negatively or positively influence their engagement in contract farming. Climatic changes are beyond the farmer's control and thus would negatively impact his expected output if unfavorable. The implementation of government policies regulating contractual arrangements in agriculture is needed as a critical precondition for successful contract farming.

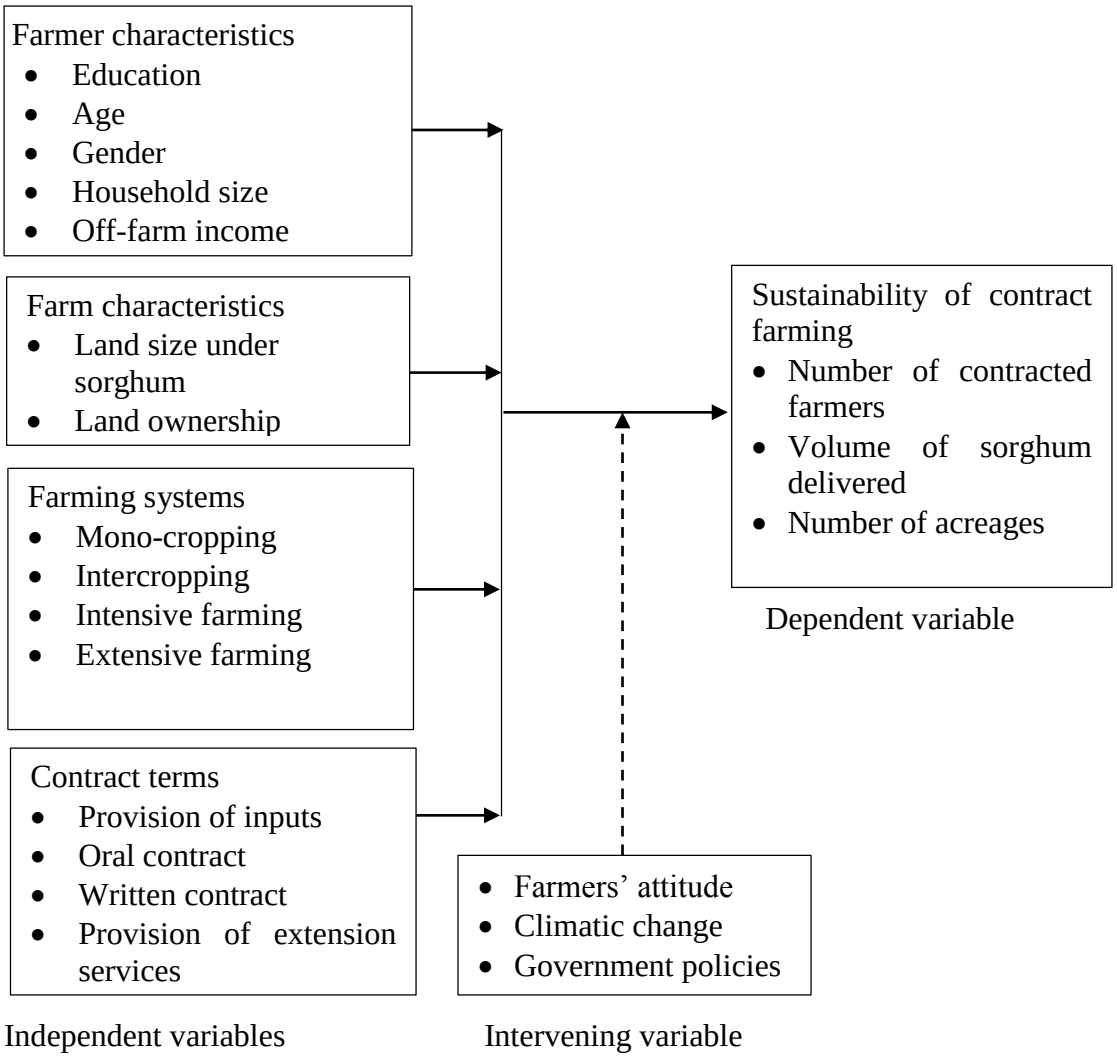

Figure 1: Conceptual Framework

Source: Conceptualization by Researcher (2023)

CHAPTER THREE
METHODOLOGY

3.1 Study Area

The research was conducted in the sub-counties of Tharaka South and Tharaka North of Tharaka Nithi County, Kenya, where sorghum is a widely produced crop. Tharaka-Nithi County shares borders with Embu in the south, Meru in the north, Kirinyiga and Nyeri in the west, and Kitui in the east. The county is located between latitudes 00˚ 07' and 00˚ 26' South and longitudes 37˚ 19' and 37˚ 46' East, as per Gioto *et al*. (2016). The county's highest altitude is 5,200m in Chuka/Igambang'ombe and Maara, while the lowest is 600m in Tharaka, which is located to the east. The Mount Kenya forest occupies 360 km2 of the county's total land area of 2,662.1 km2 (Kenya National Bureau of Statistics, 2019). Tharaka Nithi County is home to 393,177 individuals, as indicated by the most recent census (KNBS, 2019).

The county is made up of three constituencies, namely Maara, Tharaka, and Chuka/Igambang'ombe. This county was chosen due to its favorable climatic and soil conditions for sorghum production, making it the second leading producer. It was noticed that majority of sorghum farmers in this county carry out contractual sorghum farming with EABL. The hottest months in this region are January, February, September, and October. However, the average temperature is between 17 and 35 degrees Celsius (Kaua, 2020). The county receives unreliable and poorly distributed rainfall ranging between 300 and 500 mm annually, which occurs in a bimodal pattern. While the short rains fall between October and December, the long rains fall between March and May (Gioto *et al*., 2016). According to Njiru *et al*. (2022) and Wawire *et al*. (2021), ferralsols, alfisols (acrisols, luvisols), and vertisols are the most common soil types in Tharaka Nithi County that are prone to erosion and compaction attributing to poor crop production. Most residents of the study region are small-scale farmers who cultivate food crops for their consumption; there are very few large-scale commercial farmers in the county (King-Okumu *et al*., 2018)

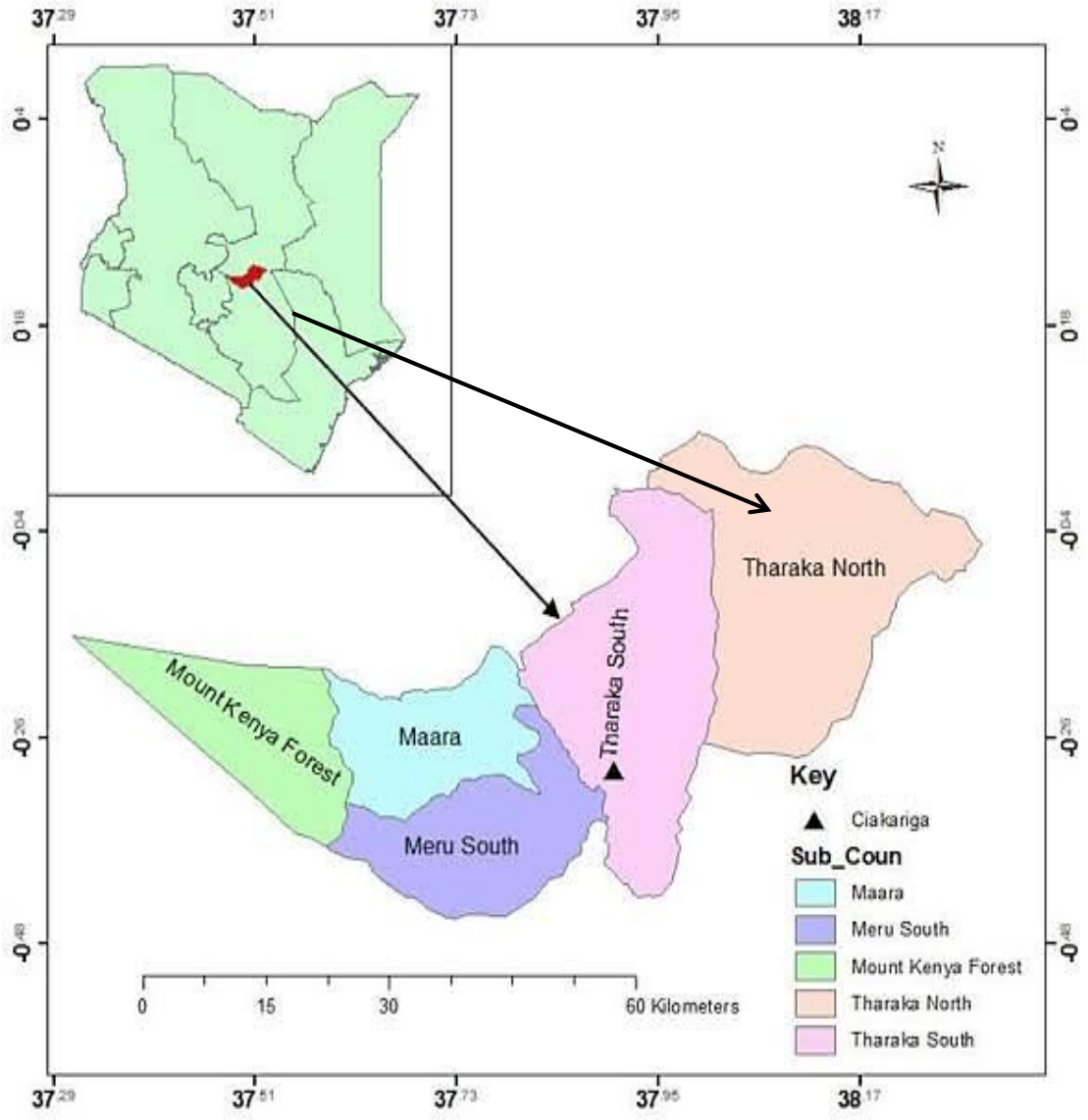

Figure 2: Map of Tharaka Nithi County

Source: Topographic Maps of Kenya (2019).

3.2 Research Design

A correlational research design was employed in this study. The correlational research design allowed the description of the sorghum farmers' characteristics. The research design allows for the observation of two or more variables simultaneously and helps define a relationship between two or more variables (Seeram, 2019). The research design was suitable since the study intended to examine the relationship among farm characteristics, farming systems, contract terms, and the sustainability of contract farming.

3.3 Target Population

This study's population was 17,000 farmers contracted to produce sorghum by the EABL. The farmers were both small and large-scale, although a majority produced the crop on small pieces of land. According to Mugenda and Mugenda (2008), the target population should have some observable characteristics to which study results will be generalized.

3.4 Sample Size and Sampling Procedure

3.4.1 Sample Size

The sample size was drawn from sorghum contracted farmers in Tharaka North and South sub-counties in the Tharaka constituency. Krejcie and Morgan's (1970) sample size determination formula was used to establish the number of sorghum farmers to be engaged in the research. Based on this formula, a sample of 375 farmers was drawn from a population of 17,000 at a 95% level of significance.

$$n = \frac{X^2 NP(1-P)}{d^2(N-1)+X^2P(1-P)} \quad \ldots\ldots 1$$

$$= \frac{3.841*17000*0.5*0.5}{((0.05)^2*(17000-1))+(3.841*0.5*0.5)} = 375 \quad \ldots\ldots 2$$

Where,

N = Population (17,000), n = required sample size, X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841), P = the population proportion (assumed to be .50 since this would provide the maximum sample size), and d = the degree of accuracy expressed as a proportion (.05) (Kofoworola & Ojo, 2022).

3.4.2 Sampling Procedure

The research used a cluster sampling procedure to select a representative sample from the target population. Cluster sampling was used since the population was organized into two clusters (Tharaka North and Tharaka South sub-counties). The participants were selected randomly and proportionately depending on the contracted farmers in every sub-county to achieve a representative sample. Table 1 shows the number of sorghum farmers selected from the two sub-counties.

Table 1: Sample Size by Sub-County; In Tharaka Nithi County

Sub-county	Population	Sample
Tharaka North	8,600	190
Tharaka South	8,400	185
Total	17,000	375

Source: Researcher (2023)

3.5 Research Instrument

A semi-structured questionnaire was utilized for data collection (Appendix I). The questionnaire contained both open-ended and close-ended questions. Questionnaires offer a cost-effective method for surveying respondents spread across extensive geographical areas, and they provide a convenient means of collecting information over a brief period within a large region. The structured questions conserve time and money. The unstructured questions were included in the questionnaire to encourage the respondents to give an in-depth response without feeling held back from giving any kind of information. A majority of the structured questions were Likert-type scaled at a five-point. The questionnaire comprised of five sections. Section A covered the farmer's characteristics; section B comprised of items on farming systems; section C, contract terms; section D, farm characteristics; and section E, the sustainability of contract farming.

3.6 Pilot Study

Piloting was carried out in Mitunguu ward, South Imenti constituency, Meru County. According to Hazzi and Maldon (2015), 10% of the final sample is appropriate for the pilot. Therefore, questionnaires were administered to 10 % (n = 38) of the sample size for piloting. In Meru County, sorghum-contracted farmers have similar characteristics to those in the study area. After piloting, the information collected helped restructure the questionnaire's items and identify areas needing improvement. The pilot study data was used to test the instrument's reliability. The questionnaires were edited to check for completeness, clarity, and consistency.

3.6.1 Reliability of Research Instrument

The instrument's consistency in producing similar results when administered several times was tested before the actual data collection. Data from the Pilot study was used to compute Cronbach alpha values, which helped estimate the instrument's reliability.

A minimum reliability coefficient of 0.7 was considered acceptable (Wilson, 2010). Less than 0.7 reliability coefficients would result in the revision of the instrument and it's retesting. The pilot data analysis yielded reliability coefficients ranging from 0.76 to 0.84 for all the study variables surpassing the minimum acceptable value of 0.70. Consequently, the research instruments demonstrated consistency and reliability. The reliability coefficients of instrument items are shown in Table 2.

Table 2: Reliability Coefficient of the Study Variables

Study variable	No. of items	Reliability coefficient (α)
Farmers characteristics	9	0.76
Farm characteristics	6	0.74
Farming systems	7	0.76
Contract terms	15	0.84
Sustainability of contract farming	17	0.72

3.6.2 Validity of Research Instrument

Prior to data collection the appropriateness, correctness, and meaningfulness of the questionnaire items were checked. The validity of the questionnaire was examined to ensure that the researcher used questions that truly measured the issues of importance in the study. In this study, research instrument items were validated by checking their content to ensure that the data collected appropriately addressed the objectives. Experts, peers, and supervisors from the area of agribusiness management helped to validate the research instruments in which validity elements, including content, construct, and face aspects, were checked.

3.7 Data Collection

Data was collected only from the selected contracted sorghum farmers in Tharaka South and Tharaka North sub-counties, Tharaka Nithi County, Kenya using online data kit tool. The data collection exercise was done for a period of four weeks, from June 2023 to July 2023. Questionnaires containing Likert-type scaled items were used to collect data that was used to address research questions. Research assistants conversant with the local dialect were recruited to assist in data collection. Before the actual data collection exercise, the research assistants were trained on the contents and administration of the questionnaire. The questionnaire was filled out at the farmer's homestead, where the household head in charge of making farm decisions was

requested to respond to the questions. This provided an opportunity for the researcher to make observations and probe the respondents.

3.8 Data Analysis

Mugenda and Mugenda (2008) define data analysis as bringing meaning to the raw data obtained from the questionnaires. The study employed a descriptive statistical method to analyze the collected data. The data was first divided into themes and sub-themes before being analyzed. The data was coded, tabulated, and analyzed using Statistical Package for Social Science (SPSS) version 29 and stata version 15. Frequency distribution tables were used to organize the study findings. Means and percentages were used to summarize data to determine the factors associated with the sustainability in contract farming among sorghum farmers. Multiple regression and Pearson's correlation were utilized to determine the relationship between dependent and independent variables.

3.8.1 Sustainability of Contract Farming

Sustainability is the key dependent variable and it was measured by elements such as number sorghum of contracted farmers, volume of sorghum delivered and number of acreages put under sorghum contract farming where summated Likert-scale items were utilized to construct a sustainability score for each farmer. The Likert items were scored on a five point ranging from strongly agree to strongly disagree.

3.8.2 Farmer, Farm Characteristics, and Sustainability of Contract Farming

The first and second research questions were addressed using multiple regression model. The relationship between farmer's characteristics (age, gender, household size, and education) and the sustainability of contract farming involved the following model;

$$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \beta 5X5 + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3$$

Where,

Y= sustainability of contract farming, $\beta 0$ = Constant, β1, β2, β3, β4, β5 = coefficients of independent variables, $X1$= Age, $X2$= Education, $X3$= Gender, $X4$=household size, $X5$= off-farm income, and ε= error term.

To analyze the relationships between farm characteristics (land size, ownership, off-farm income, and farm location) and the sustainability of contract farming, the following model was utilized.

$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \varepsilon$……..….4

Where,

Y = sustainability of contract farming,

β0= Constant, β1, β2, and β3 = coefficients of independent variables, $X1$= land size, $X2$= land ownership, $X3$= land location, and ε= error term.

3.8.3 Farming System, Contract Terms and Sustainability of Contract Farming.

The third and fourth research questions involved relationships between farming systems, contract terms and sustainability of contract farming. The variables namely farming systems and contract terms were measured quantitatively using summated likert-scale items. Pearson's correlation was utilized to determine the relationship between contract terms, farming system, and sustainability of contract farming.

Pearson's Product Moment formula used was as follows: -

$$r = \frac{n\sum XY - (\sum X)(\sum Y)}{\sqrt{[n\sum X^2 - (\sum X)^2][n\sum Y^2 - (\sum Y)^2]}} \quad \ldots\ldots 5$$

Where;

n= number of scores, X=First set of scores, Y=Second set of scores, $\sum XY$= sum of the first product of the first and second scores, $\sum X$= sum of the first set of scores, $\sum Y$=sum of the second set of scores, $\sum X^2$= sum of the square of the first set of scores, and $\sum Y^2$= sum of the square of the second set of scores (Kumar *et al.*, 2016)

3.8.4 Model Diagnostics

Diagnostic tests are applied for model specification since the consequences of failing to adhere are adverse. Mis-specification in regression adversely affects the sampling properties of both estimation and tests (Khan, 2021). This results in wrong implications for forecasts and other inferential measures.

3.8.4.1 Normality Test

One of the assumptions of ordinary least squares (OLS) is that the error terms should be normally distributed for an accurate and reliable conclusion. Data is unbiased and normal when the skewness statistic is between the ranges of ±3 (Liu, 2022). Skewness and kurtosis tests were used to determine the normality of the data. The skewness and kurtosis coefficient ranged from -1.97 to 1.06 and 2.78 to -1.53 respectively. Therefore, the data was normally distributed since skewness values are within -3 to +3.

3.8.4.2 Heteroscedasticity Test

Heteroscedasticity is a condition in which the error terms do not have a constant variance. It may occur as a result of subpopulation differences and error measurement. One of the fundamental assumptions of classical linear regression models is that the error term has a constant variance (Astivia, 2019). The assumption guaranteed the reliability of each observation, thereby ensuring that the estimates of the coefficient of determination and the test of hypothesis are unbiased. Heteroscedasticity could arise if certain critical variables were overlooked. The Breusch-Pagan test was employed to assess heteroscedasticity in this investigation. The issue was resolved at the primary stage as a result of the accurate model specification.

3.8.4.3 Multicollinearity Test

Ordinary Least Square estimation requires no correlation of the independent variables in the given regression. Multicollinearity is a violation of this assumption. In the presence of multicollinearity, the results would be spurious. Multicollinearity presence was checked through collinearity diagnostics, Variance Inflation Factors (VIFs), and Tolerance values (Field, 2017). The tolerance values ranged between 0.78 and 0.99 while the VIF values ranged from 1.00 to 1.29 indicating no multicollinearitly was present.

Table 3: Description of Variables

Variable	Definition	Measurement	Expected Sign
Dependent Variable Sustainability of Contract Farming	Number of contracted farmers/Volume of sorghum delivered/Number of acreages	Ratio/interval	-/+
Independent Variables			
Age	Number of Years	Ratio	+/-
Gender	Male=1, Female=0	Nominal	+/-
Education	Education level	Ratio	+/-
Household size	Number of family members	Ratio	+/-
Provision of Inputs	Yes=1, Otherwise=0	Nominal	+/-
Oral Contracts	Number of oral contracts	Ratio	+/-
Written Contracts	Number of written contract	Ratio	+/-
Extension services	Yes=1, Otherwise=0	Nominal	+/-
Land Size	Acres under Contract Farming	Ratio	+/-
Land Ownership	Type of Land Tenure	Ratio	+/-
Land Location	Distance From Collection Centers	Ratio	+/-
Off-farm income	Yes=1, Otherwise=0	Ratio	+/-
Monoculture	Yes=1, Otherwise=0	Ratio	+/-
Intercropping	Yes=1, Otherwise=0	Ratio	+/-

Table 4: Summary of Data Analysis

Research questions	Independent variables	Dependent variables	Statistical tests
What is the relationship between the farmers' characteristics and sustainability of contract farming among sorghum farmers?	Farmers' characteristics	Sustainability of contract farming	Descriptive statistics, Multiple regression
What is the association between farm characteristics and sustainability of contract farming among sorghum farmers?	Farm characteristics	Sustainability of contract farming	Multiple Regression
What is the relationship between farming systems and the sustainability of contract farming among sorghum farmers?	Farming systems	Sustainability of contract farming	Pearson's correlation
What is the association between contract terms and the sustainability of contract farming among sorghum farmers?	Contract terms	Sustainability of contract farming	Pearson's correlation

3.9 Ethical Considerations

An introductory letter from the Chuka University ethics review committee (Appendix III) was obtained before the data collection process that aided in acquiring a research permit from the National Council of Research Technology and Innovation (NACOSTI) (Appendix VI). The study ensured voluntary participation, where the farmers could pull out of the research at will. Informed consent was sought from the farmers before the data collection process. The study ensured that farmers' responses were confidential and anonymous by asking them not to reveal their identities on the questionnaire. The research instrument was designed in a manner that it did not expose the participants to any psychological, emotional, or social harm.

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Response Rate

During data collection, all the 375 contracted farmers who had been sampled from Tharaka North and Tharaka South Sub-counties were engaged in the research. Table 5 shows the distribution of sorghum farmers in the two sub-counties who responded to the questionnaire.

Table 5: Survey Return Rate (N =375)

Sub-county	Frequency (f)	Percent (%)
Tharaka North	190	50.7
Tharaka South	185	49.3

As presented in Table 5, all the 375 questionnaires that had been administered were fully completed and returned. This shows that the return rate was 100%. The high return rate may have been attributed to the excellent assistance that was offered by the field guides, simplicity of the research instrument, in-person questionnaire administration, and the upstanding relationship that existed between the field guides and the farmers. This confirms the findings by Farnsworth *et al*. (2019) who reported that strong interpersonal relationships and in-person questionnaire administration can contribute to a high return rate. The response rate was above the minimum recommended for population generalizability. The return rate was also above the minimum suggested as being suitable for analysis, interpretation, and drawing conclusions (Fraenkel *et al*., 2015).

4.2 Famers Characteristics

The study had hypothesized that the characteristics of the sorghum farmers are likely to influence the sustainability of contract farming. These characteristics were examined and documented in order to determine their degree and magnitude of association with sustainability of contract farming. The farmer characteristics that were studied included educational level, age, gender, household size, and off-farm income of the sampled contracted sorghum farmers.

4.2.1 Respondents' Levels of Education

The educational level of the farmer has been associated with adoption and sustainability of farm innovations by past studies. Therefore, it was assumed that the level may also be connected to the sustainability of contract farming. Table 6 shows the distribution of respondents based on their educational levels.

Table 6: Distribution of Respondents by the Educational Levels (N =375)

Education level	Frequency (f)	Percent (%)
None	9	2.4
Primary	153	40.8
Secondary	150	40.0
undergraduate	46	12.3
postgraduate	3	0.8
College	14	3.7

As shown in Table 6, very few respondents (*n* = 9, 2.4%) had not gone to school for formal education. This implied that most of the sorghum farmers in both sub-counties had attained some level of formal education. This also indicated that many of the farmers in the county were literate. This may have resulted from the increasing number of educational institutions in the county. The findings agree with those of Kimetto (2022) who argued that the high level of elementary education attainment was attributed to the large number of learning institutions strategically located and close to the respondents' homes.

The number of respondents who had primary school education (*n* = 153, 40.8%) were more less equal to those who had secondary school education (*n* = 150, 40.0%). A few others had university education (*n* = 49, 13.1%). Overall, over half of the respondents (*n* = 213, 56.8%) had secondary school education and above. This meant that most of the farmers were able to clearly understand the importance and dynamics of contract farming. Sustaining the contractual arrangements would require a thorough comprehension of the quality and quantity requirements, consequences of violating the terms of agreements, and the benefits thereof. Therefore, there was a high likelihood of the educated farmers to sustain the contractual arrangement better than those who had no formal education. The findings are in line with those of Kozhaya (2020) who reported that the education level of the farmer was positively correlated with participation in contract farming.

4.2.2 Age of the Respondents

The study also sought to describe the ages of the contracted sorghum farmers as such the respondents were asked to indicate their ages in years. Table 7 shows the frequencies and percentages of contracted sorghum farmers who participated in the research.

Table 7: Distribution of Respondents by Age (N =375)

Age (years)	Frequency (f)	Percent (%)
21-30	28	7.5
31-40	93	24.8
41-50	104	27.7
51-60	86	22.9
61-80	64	17.1

Note. $M = 47.49$; $SD = 11.74$

As presented in Table 7, there were very few sorghum farmers ($n = 28$, 7.5%) who were aged between 21 and 30 years. This indicated that the number of young farmers who had been contracted by EABL were few. This may have resulted from the declining number of youthful farmers who are engaged in farming due to the negative attitude and desire to seek for white collar jobs. In addition, many of the elderly farmers were not willing to pass over their farms to the new generations. This confirms the findings of May *et al.* (2019) who reported a decreasing number of young farmers over the recent years.

About half of the respondents ($n = 190$, 50.6%) were aged between 41 and 60 years. This showed that many of the farmers producing sorghum under contract farming in the county were middle aged. This may have resulted from the fact that many of the farmers will have inherited the land from their parents or acquired an additional piece at that age. Hence, they are able to make farm decisions relating to the kind of enterprises they would want to engage in. The findings confirm those of Koshuma *et al*. (2023) implying that senior farmers were more aware of farming activities, and had more experience and resources to participate in contract farming than junior and elderly farmers.

The choice of the farm enterprises also varies with age. Young farmers are more likely to go for more lucrative enterprises than their elderly counterparts. The number of

elderly farmers (*n* = 64, 17.1%) was more than that of the young farmers (*n* = 28, 7.5%). This is because elderly farmers are more likely to possess the resources needed for sorghum production as compared to the young ones. These findings are supported by the claims made by Johnny *et al.* (2019) and Vamuloh *et al.* (2019), who argued that the active involvement of older farmers in contract farming can be attributed to their ownership of crucial resources, such as land, as well as their enhanced confidence derived from their extensive experience in agriculture.

4.2.3 Gender of the Respondents

The respondents engaged in the research were household heads involved in making farm decision. To establish which gender was involved in farm activities and contract sorghum farming more than the other, the respondents were asked to indicate their gender. Table 8 shows the gender of the contracted sorghum farmers who were involved in the research.

Table 8: Distribution of Respondents by Gender (*N* =375)

Gender	Frequency (f)	Percent (%)
Female	126	33.6
Male	249	66.4

As indicated in Table 8, the study established that the number of male respondents (*n* = 249, 66.4%) was more than their female counterparts (*n* =126, 33.6%). This implies that the majority of the farmers who participated in sorghum contract farming were men. The high number of male farmers may be attributed to the fact that most farm enterprises are decided upon by men. The results agree with those of Dubbert, (2019) and Meemken and Bellemare (2019) who found that the participation of women in contract farming is notably low primarily attributed to their household responsibilities, which limit their ability to engage extensively in contract farming activities. As reported by a majority of the farmers, dominance by men, illiteracy, and the Ameru culture that prohibits women from participating in decision-making also accounted for the disparity. In most cases women have a little say about the major income generating enterprises although they participate in farm activities (Njoni, 2022).

4.2.4 Respondents' Household Size

The study also assumed that the number of family members had a bearing on the likelihood of the household to sustain sorghum contract farming. Therefore, the respondents were asked to indicate the sizes of their households. Table 9 shows the distribution of respondents based on their household sizes.

Table 9: Distribution of Respondents' Household Size (*N* =375)

Household size	Frequency (f)	Percent (%)
1-4	120	32.0
5-8	229	61.1
9-12	22	5.9
13-16	4	1.1

Note. M= 5.32, SD= 2.10

As indicated in Table 9, 32% (*n* = 120) of the respondents belonged to families of between 1 and 4 household sizes, 61.1% (*n* = 229) were from family sizes of between 5 and 8 members, 5.9% belonged to households of sizes of between 9 and 12 people, and a few (*n* = 4, 1.1%) were from families of between 13 and 16 people. The results clearly demonstrated a variation in family sizes among the contracted sorghum farmers. However, a majority of the sorghum farmers belonged to household sizes of between 5 and 8 members. This showed that many of the families in the county were of average household sizes as reported by the United Nations (2017). Nevertheless, some farmers noted that the family sizes have been on the decline due to the increasing cost of living. Additionally, improvement in wealth status, the dying child bearing tradition, and the need for women to pursue further education also accounted for diminishing household sizes as noted by a few of the farmers. The results agree with a report by Ivanova and Buchs (2022) that household sizes were shrinking.

4.2.5 Distribution of Respondents by Off-farm Income

To meet the cost of living, many farmers engage in off- farm activities in order to supplement the income generated from the farm. Therefore, off-farm income represents an important source of livelihood for many poor farmers. Hence, the study sought to determine if the contracted sorghum farmers sourced livelihoods from non-farm activities. Table 10 indicates percentage of contracted sorghum farmers who engaged in non-agricultural activities to generate income.

Table 10: Distribution of the Respondents by Off-Farm Income (*N* =375)

Off-farm income	Frequency (f)	Percent (%)
No	233	62.1
Yes	142	37.9

The study revealed that among the contracted sorghum farmers surveyed, a significant majority, specifically (*n* =233, 62.1%), relied solely on income generated from farm activities. However, more than thirty percent, (*n* =142, 37.9%) of the farmers had additional sources of income generated from non-farm activities as shown in Table 10. This showed that most of the farmers in the county relied on farm agriculture as their main source of livelihood. This may have been contributed to by the rurality of the county. Most parts of the county are rural therefore; many of the farmers had limited income generating opportunities outside the farm. The few who reported some level of off-farm income lived close to urban areas or engaged in agricultural wage employment. The findings confirm an argument advanced by the FAO (2017) that agriculture is a critical source of livelihood to most people in the rural areas.

4.2.6 Farmer Characteristics and Sustainability of Contract Farming

The first objective sought to determine the association between the farmers' characteristics and sustainability of contract farming. The relationship between the farmers' characteristics and sustainability of contact farming was first examined through the use of Likert-type scaled items where 1 represented strongly agree, 2 agree, 3 neutral, 4 disagree, and 5 strongly disagree. Table 11 shows the levels at which the respondents agreed with statements relating farmer characteristics to sustainability of sorghum contract farming.

Table 11: Respondents' Perceptions on the link between Farmers' Characteristics and Sustainability of Contract Farming

Statement	M	SD
Male-headed households are more likely to sustain sorghum contract farming than female-headed households	2.31	1.21
Youthful farmers participate and sustain sorghum contract farming than the elderly farmers	2.26	1.10
Much of the labour in sorghum contract farming comes from women	2.05	0.89
Farmers with formal schooling have been reported to sustain sorghum contract farming than those with non-formal schooling	1.91	1.11
The larger the household size, the more sustainable contract farming is.	2.40	1.07
I can read and understand the agreement terms	2.20	0.98
My age doesn't limit me from sustaining sorghum contract farming	1.91	1.00
Inadequate labour supply discourages the sustainability of contract farming	1.96	0.95
Farmers who engage in agriculture as the main source of their livelihood are likely to sustain contract farming	1.98	0.99

Note: [a]1=strongly agreed, 2 =agreed, 3 =neutral, 4 =disagreed, 5 =strongly disagreed

As presented in Table 11, many of the farmers agreed with the claim that contract farming is more likely to be sustained by male-headed households (M = 2.31, SD = 1.21). The respondents felt that the sustainability of sorghum contract farming was dependent on the gender of the farmer, even though the participation of the women was much lower than that of men. The finding confirmed a report by Schneider and Gugerty (2010) that women's direct participation in contract farming is limited. The limited participation was as a result inadequate access to land and control over resources. When asked to indicate whether youthful farmers participated in and sustained sorghum contract farming than the elderly, many of the respondents acknowledged the fact (M = 2.36, SD = 1.10), indicating that they are keen on increasing their production through improved and modern technologies. Moreover, young farmers are more motivated to be involved in all links of the value chain, entrepreneurial, and look for new and better ways of making a living as part of a social network.

The results further indicated that much of the labour in sorghum contract farming came from women (M = 2.05, SD = 0.89). The respondents pointed out that although women had a limited role in the farm decision making process, they were the main source of labour in sorghum production. Most of the sorghum production activities like planting,

weeding, and harvesting were undertaken by women. This confirms the assertion that a majority of people who are engaged in agricultural activities are women (Akter *et al.*, 2017). The respondents strongly agreed with the claim that farmers with formal schooling were more likely to sustain sorghum contract farming than those with non-formal schooling (M = 1.91, SD = 1.11). This is due to the knowledge, skills, and experiences that they possess. These are crucial in adopting and sustaining sorghum production innovations. These findings are supported by Loquias (2021) who argued that Contract farming can present challenges for less educated farmers. According to a majority of the contracted sorghum farmers, the sustainability of contract farming depended heavily on the household size since most farmers depended on family labour to cut the cost of production (M = 2.40, SD = 1.07). They also noted that inadequate labour supply discouraged the sustainability of contract farming (M = 1.96, SD = 0.95). The adequacy of labour in sorghum production depended largely on the family sizes. Therefore, it was highly probable that large sized families would sustain contract farming more than the small-sized ones. The findings agreed with a report by FAO (2015) that a majority of the smallholder farms depend predominantly on family labour.

Most of the farmers acknowledged the importance of being able to read and understand the agreement terms (M = 2.20, SD = 0.98) as this would help minimize the breach of the agreed upon conditions and requirements in the contractual arrangements. However, Faure and Luth (2011) observed that many consumers have the tendency to sign agreements or contracts without thoroughly reading them, even when appropriate information is provided. It also emerged from most of the respondents that age did not limit the sustainability of the contractual arrangement (M = 1.91, SD = 1.00). All the sorghum farmers were legible for contract farming irrespective of their ages. The claim that farmers who engage in agriculture as the main source of their livelihood are likely to sustain contract farming was also strongly supported by many of the respondents (M = 1.98, SD = 0.99). The findings were supported by Ducastel *et al.* (2023). They argued that farmers who considered agricultural production as their main source of income invested a lot of time and other resources to ensure success and this ensured the sustainability. This is because sustainable agricultural production is crucial to the development of livelihoods to these farmers.

To address the first research question, multiple regression was run with sustainability of contract farming as the dependent variable and farmer characteristics which included gender, age, education, household size and off-farm income as the independent variables. Table 12 shows the results of regression analysis for farmers' characteristics and sustainability of contract farming

Table 12: Regression Analysis for Farmers Characteristics and Sustainability of Contract Farming

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	55.17	2.48		22.29	<0.00
Gender	0.75	0.97	0.04	0.77	0.44
Age	0.06	0.04	0.09	1.57	0.12
Education level	0.29	0.47	0.03	0.62	0.53
Household size	-0.62	0.23	-0.15	-2.73	0.01
Off-farm income	-1.03	0.99	-0.06	-1.12	0.26

Note: [a]1=strongly agreed, 2 =agreed, 3 =neutral, 4 =disagreed, 5 =strongly disagreed; F (5, 369) = 2.54, p=0.00 R^2=0.03, R^2Adjusted=0.02; N=375

As presented in Table 12, there was a statistically significant association between farmers characteristics and sustainability of contract farming F (5, 369) = 2.54, p = 0.00, R^2= 0.03. All the five independent variables added significantly to the association, p < 0.05. The coefficient of determination, R^2 for farmers' characteristics and sustainability of sorghum contract farming was 0.03. Thus farmers' characteristics explain about 3% of total variation observed in sustainability of sorghum contract farming. The study also established that gender was a statistically insignificant ($\beta 1 = 0.04, t = 0.77, p = 0.44$) predictor. The regression coefficient (β) 0.75 showed that a unit variation in gender would not affect sorghum contract farming sustainability. Regardless of gender, sorghum contracted farmers would continue to sustain contract farming. The fact that gender may not play a significant role in predicting the sustainability of sorghum contract farming does not undermine the significance of addressing gender disparities and promoting gender equity in agriculture. This study's findings agree with the findings of Koshuma *et al.* (2023), who also found that gender insignificantly influenced smallholder sugarcane farmers' participation in contract farming. However, the results contradicted those of Hung

(2019), who reported a significant and positive relationship between the gender of the farmer and their adaptive behavior within the contract farming arrangement, suggesting that men are more likely to engage in contract farming arrangements.

The results further indicated that there was a positive but statistically insignificant ($\beta 1 = 0.09, t = 1.57, p = 0.12$) relationship between age and the sustainability of sorghum contract farming. This indicated that age was not related with sustainability of contract farming. The coefficient (β) of 0.06 suggests that for each unit increase in age there was no any impact on the sustainability of contract farming. While there was a positive trend observed, indicating that middle age may be associated with slightly higher sustainability, this relationship was not strong enough to reach statistical significance. Mixed results have been observed previously relating to the association between age and sustainability of contract farming. For instance, the results of this study are in agreement with the findings of Pandey (2016) who revealed an insignificant relationship between age and adaptation behavior of the contract growers. These findings were contrary with the results of Koshuma *et al.* (2023) who discovered that farmer's age was significantly positively associated with participation in contract farming. The findings may be attributed to the fact that older farmers as a result of declining energy levels are less active compared to their middle-aged counterparts. Furthermore, it was noted that the younger generation shows limited involvement in farming, either due to lack of interest or the scarcity of production resources, particularly land.

There was a positive insignificant ($\beta = 0.03, t = 0.62, p = 0.53$) relationship between level of education and sustainability of contract farming. This showed that education level was not a significant predictor in sustainability of contract farming. The findings indicated that a unit variation in education level by (β) 0.29 would not have any impact on sorghum contract farming sustainability. While education is generally considered important in enhancing knowledge and skills, it may not directly translate into improved sustainability outcomes in the context of contract farming for sorghum. The findings align with those of Sinaga *et al*. (2022), who determined that the level of education does not exert a significant influence on the success of contract farming. However, the findings of the current study were contradictory to those of Thabethe

(2013), who reported that farmers with formal education possess the capability to analyze information regarding sustainable production strategies in agriculture. Nazifi and Hussain (2021) also revealed the decision of participation in maize contract farming was found to be significantly determined by level of education.

The findings of the current study revealed that the household size was negatively and statistically significant ($\beta = -0.15, t = -2.73\ p = 0.01$) related to the sustainability of sorghum contract farming. This implies that farmers with less household size sustains sorghum contract farming more. This finding highlights the importance of considering household size as a factor influencing the long-term viability and success of sorghum contract farming initiatives. A larger household size may introduce additional challenges and complexities in managing agricultural activities such as resource allocation, labor availability, and decision-making processes. These factors can potentially hinder the sustainability of sorghum contract farming.

The negative relationship between household size and sustainability may be attributed to several factors. Larger households may require more resources and labor to meet the needs of all family members, which can strain the available resources and limit investment in agricultural activities. Additionally, decision-making processes within larger households may become more complex, leading to delays or conflicts that could impact the efficient operation and management of sorghum contract farming. However, these findings contradicted Pandey (2016) who found in his study that household size was not significantly related to the decision to engage in contract farming. Furthermore, Koshuma *et al.* (2023) findings showed that household size insignificantly influenced smallholder sugarcane farmers' participation in contract farming.

The study found that there was a negative statistically insignificant ($\beta = -0.06, t = -1.12\ p = 0.26$) relationship between off-farm income and the sustainability of contract farming. This indicated that a unit negative variation in off-farm income would not have any impact on the sustainability of contract farming. This may be attributed to the fact that off-farm income may lead to reduced focus on agricultural production, diversion of resources away from farming activities, potential lack of expertise and failure to meet contractual requirements, dependency on external factors for off-farm

income, and limited opportunities for agricultural innovation and adoption of new practices. These findings were concurrent with those of Pandey (2016) who found out that the off-farm income of the farmers was not significantly related to contract farming decisions for contract growers. In contrast, Kimbi *et al*. (2022) findings showed that off-farm income positively influences contract farming participation among sorghum farmers.

4.3 Farm Characteristics

This research had assumed that among the characteristics of the farm, three were highly likely to be responsible for the sustainability of sorghum contract farming. These characteristics included farm sizes, land ownership, and the location of the farm that were involved in the production of sorghum through contract farming. Therefore, the study assessed these characteristics to establish their relationship with the sustainability of contractual arrangements.

4.3.1 Farm Sizes of the Respondents

Land is one of the main factors of production, and its role in the adoption of agricultural technologies cannot be overemphasized. Since land plays a crucial role in the adoption of practices, then it is likely to take a central part in the sustainability of contract farming. The results of the assessment of the land sizes of the respondents are shown in Table 13.

Table 13: Land Sizes of the Respondents (N =375)

Land size (acres)	Frequency (f)	Percent (%)
Below 3	184	49
3.1-6	136	36.3
6.1-9	21	5.6
Above 9	34	9.1

Note. M= 4.44, SD= 3.54

The results showed that the majority of the contracted sorghum farmers (*n* = 184, 49%) owned 3 acres of land or less, as presented in Table 13. This indicated that a significant proportion of farmers in the county operated on limited land resources. The findings were in line with those of Deininger and Byerlee (2011), who observed that the average farm size is relatively small in most countries in the Sub-Saharan Africa, regardless of

their economic status. The land sizes are likely to shrink even further owing to the continued sub-division and the growing urbanization, as mentioned by some of the farmers. Even though the shrinking land sizes discouraged farmers from mechanizing farm operations, smaller land sizes encouraged efficient use of resources and adoption of appropriate farming techniques among sorghum farmers since they are easier to manage with minimal resources. The findings confirm the argument put forth by Liu *et al*. (2023) that small-scale farming is crucial due to its association with estimated variability that leads to improved resource use efficiency, productivity, profitability, quality, and sustainability of agricultural production.

Additionally, a significant number of respondents (*n* = 136, 36.3%) owned land ranging from 3.1 to 6 acres. These farmers might have a slightly higher capacity to produce sorghum compared to the smaller landholders. Based on the results, many of the respondents (*n* = 320, 85.4%) practiced farming on 6 acres and less. This implied that many of the farmers in the county were small-scale. Other than urbanization and increasing sub-division, the growing population may have also contributed to the county's high number of smallholder farmers. The findings were confirmed by Nuwagira *et al*. (2023), who reported that the expansion of the population is a primary catalyst for land fragmentation. A few farmers (*n* = 55, 14.7%) owned more than six acres of land. This group represented a relatively limited number of farmers with moderately larger land size, potentially contributing to increased sorghum production. Farmers with larger land sizes may have had the advantage of scalability, enabling them to cultivate larger areas and potentially achieve higher yields. Larger farms exhibit a higher propensity to embrace various precision farming techniques and technologies when compared to smaller farms. The findings by Koshuma *et al.* (2023) confirmed that farmers with large land sizes were more likely to get more yields due to economies of scale.

4.3.2 Land Ownership

Understanding the specific dynamics of land ownership and its relationship with contract farming is crucial for designing policies and interventions that promote the sustainability of contract farming. To determine the form of land ownership in the county, the respondents were asked to indicate the kind of land tenure system they

operated on. Table 14 shows the distribution of respondents as regards the form of land ownership.

Table 14: Distribution of Respondents by Land Ownership (N =375)

Land tenure	Frequency (f)	Percent (%)
Own land	105	28
Family land	263	70.1
Leasehold land	7	1.9

The findings in Table 14 showed that some (*n* = 105, 28%) of the respondents operated on land purchased from the natives, most of them (*n* = 263, 70.1%) produced sorghum on land owned by their families and very few farmers (*n* = 7, 1.9%) had leased land for the production of the crop. The study findings indicated that sorghum farmers who had inherited the land were more compared to those who had bought land and those who rented land. This implied that the majority of the farmers in the county had inherited family land. Since most of the contracted farmers were operating on either their own or inherited land, it was possible for them to produce perennial crops like sorghum as well as adopt sustainable agricultural practices. The sorghum farmers were capable of making long-term investments in their land due to the security of tenure. These findings were in line with those of Zhang *et al.* (2022) and Daniel *et al.* (2023) who reported that farmland rights encouraged farmers to have a heightened enthusiasm for farming and making long-term agricultural investments.

4.3.3 The Location of Sorghum Farms

The study also sought to assess the distance from sorghum farms to the contracting firms and its likely influence on sustainability of contract farming. The proximity or distance between farmers and contracting firms is likely to affect the feasibility, efficiency, and overall success of contract farming initiatives. Table 15 shows the distance between sorghum farms and the location of the contracting firms.

Table 15: Distribution of Land Location by Respondent (N =375)

Distance (kilometers)	Frequency (f)	Percent (%)
Below 5	203	54.1
6-10	89	23.7
11-15	26	6.9
16-20	43	11.5
Above 20	14	3.7

Note. M= 7.33, SD= 6.34

As shown in Table 15, the study revealed that (*n* = 203, 54.1%) of the farmers were situated within a distance of less than five kilometers from the local company sector. Additionally, a significant proportion (*n* = 89, 23.7%) of farmers were located between 6 and 10 kilometers away. The findings also indicated that (*n* = 26, 6.9%) of sorghum farmers were situated at a distance ranging from 11 to 15 kilometers, while (*n* = 43, 11.5%) were located between 16 and 20 kilometers. Furthermore, a smaller group (*n* = 14, 3.7%) of farmers were located more than 20 kilometers away from the local company sector. The findings of the study observed that most of sorghum farmers contracted specifically (*n* = 292, 77.8%) were situated within a distance of less than ten kilometers from the local company sector office. The concentration of farmers near the local company sector office indicated a potential clustering effect in contract farming. This proximity offered various advantages in terms of logistics and coordination. The reduced distance between the farmers and the company facilitated efficient transportation, leading to cost savings and improved timeliness in delivering the harvested sorghum. It also allowed for better quality control, ensuring that the produce meets the company's standards and maintaining the competitiveness of the final product in the market. Furthermore, the close proximity enhanced communication and collaboration between the farmers and the company, enabling effective knowledge transfer, technical support, and the adoption of sustainable farming practices. The findings were in line with those of Ouma *et al*. (2009) who observed that reduced distance to the sector office enhances the likelihood of farmers to participate in contract farming with limited challenges.

The findings of the study also shed light on the challenges faced by farmers (*n* = 83, 22.2%) located more than ten kilometers away from the local company sector office. These farmers likely encountered higher transportation costs due to the longer distances involved in delivering their produce. This impacted their profitability and financial sustainability. Additionally, longer transportation times posed challenges in maintaining the freshness and quality of the sorghum, potentially affected market value and customer satisfaction. Moreover, the distance limited the accessibility of support services and technical assistance, making it more difficult for farmers to access knowledge, resources, and sustainable farming practices. This is supported by the literature Saroj *et al*., (2023), which indicated the large distance between the farm and

the contracting firm deterred farmers from adopting contract farming and complying with contractual rules, causing them to become willing to sell their produce in adjacent grain markets through intermediaries, even at a low price.

4.3.4 Farm Characteristics and Sustainability of Contract Farming

Objective two sought to assess the association between farm characteristics and the sustainability of contract farming. The association between the variables was assessed using a Five-Point Likert type scale where 1 signified strongly agree, 2 agree, 3 neutral, 4 disagree, and 5 strongly disagree. Table 16 indicates the mean and standard deviations of the statement responses relating farm characteristics to the sustainability of contract farming.

Table 16: Farm Characteristics and Sustainability of Contract Farming

Statement	M	SD
Sorghum farmers who own title deeds are more likely to sustain contract farming as compared to those producing the crop on leased land	2.05	1.11
The size of the land influences the sustainability of contract sorghum farming	2.47	1.14
The location of land from collection centers influences the sustainability of sorghum contract farming	2.12	1.06
Individual land ownership allows sorghum farmers to adopt and sustain sorghum contract practices as compared to other farmers operating on other forms of ownership	1.97	1.03
Sorghum farmers whose farms are accessed by road are more likely to sustain contract farming compared to those whose farms are inaccessible by road	2.31	1.07
Farmers with large sizes of land are able to produce more sorghum as compared to farmers with a small size of land hence sustaining contract farming.	2.19	1.08

Note [a]1=strongly agreed, 2 =agreed, 3 =neutral, 4 =disagreed, 5 =strongly disagreed: N= 375

As shown in Table 16, the mean responses ranged between 1.97 and 2.47 implying that almost all the respondents agreed with the statements. The standard deviations were small and they ranged from 1.03 to 1.11. This showed that the responses were close to the mean score, indicating only slight variation among the individual farmer's responses. The study revealed that sorghum farmers who owned title deeds (M = 2.05, SD = 1.11) as well as those operating under individual land ownership (M = 1.97, SD = 1.03) were more likely to sustain contract farming. This is because farmers who

owned their land through title deeds had a stronger sense of ownership and long-term commitment to their property. This increased investment security led to a greater willingness to engage in sustainable contract farming that yield benefits over an extended period. The finding corroborated the report by Sifundza (2019) that farmers lacking land title deeds face challenges in investing adequately in farm infrastructure, which can result in crop failure and ultimately impact their productivity negatively.

The results further showed that many of the farmers confirmed that the size of land (M = 2.47, SD = 1.14) influenced the sustainability of contract sorghum farming. It was reported that those with large pieces of land (M = 2.19, SD = 1.08) were able to produce more sorghum as compared to farmers with a small parcels of land. This implied that those with larger land sizes had the capacity to invest more in their farms to produce larger quantities of sorghum that would meet the demand by the contracting firm. This would also prevent the contract breach on the part of the farmers as they would supply the contractor with the agreed upon quantity of the produce, thus enhancing the sustainability of the contractual arrangements. However, these findings contradicted those of Qiu *et al*. (2021) who reported that land size does not have an impact on farm productivity. A majority of the farmers also acknowledged that accessibility of farms by roads (M = 2.31, SD = 1.07) and location of the land (M = 2.12, SD = 1.06) influenced the sustainability contract farming. Areas which had better roads eased the transportation of the produce after harvest. These enabled farmers in these areas to promptly fulfill their contractual obligations. The findings agree with those of van der Lee *et al* (2020) report that farmers located in easily accessible areas experienced reduced transaction costs when accessing the market, likely due to their inclination to relocate closer to well-connected roads.

To address the second research question, multiple linear regression was run to establish the association between farm characteristics and sustainability of contract farming. Prior to the analysis the model diagnostics were checked and none of the assumptions had been violated. Table 17 shows the regression analysis results involving the two variables.

Table 17: Regression Analysis for Farm Characteristics and Sustainability of Contract Farming

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	60.97	1.54		39.71	<0.00
Land ownership	-2.28	0.78	-0.14	-2.92	0.00
Size of land	-0.03	0.14	-0.01	-0.20	0.84
Location of land	-0.02	0.00	-0.20	-3.53	0.00

Note: [a]1=strongly agreed, 2 =agreed, 3 =neutral, 4 =disagreed, 5 =strongly disagreed; F (3, 371) =8.86, p=0.01 R^2=0.07, R^2Adjusted=0.06; N=375

According to the results presented in Table 17, there was a significant relationship between farm characteristics and the sustainability of contract farming,$F(3, 371) = 8.86, p = 0.01, R^2 = 0.07$. The three independent variables combined had a significant impact on this relationship($p < 0.05$). The coefficient of determination ($R^2 = 0.07$) indicated that farm characteristics accounted for approximately 7% of the total variation observed in the sustainability of sorghum contract farming. The study revealed that there was negative statistically significant relationship ($\beta = -0.14, t = -2.92, p = 0.00$) between the land ownership and sustainability of contract farming. This showed that an improvement in land ownership would reduce the level of sustainability of contract farming. This is because farmers who owned the land temporarily worked so hard to adopt the recommended sorghum production practices to attain better crop yields. These farmers were likely to make higher short-term investments on the leased land to maximize the output. Producing the required amount of sorghum helped prevent a breach of the contract, thus improving the system's sustainability. The finding is in line with that of Ooga and Gikunda (2021) that the leased land tenure system has a significant effect on adoption of practices.

The findings of the study also showed that there was negative though insignificant ($\beta = -0.01, t = -0.20, p = 0.84$) relationship between land size and the sustainability of contract farming. This indicated that a unit change in the size of land would not have any influence on the sustainability of contract farming. While larger land sizes may offer certain advantages such as economies of scale and resource availability, sorghum farmers who owned smaller land parcels would still achieve

sustainability of the contractual arrangements through the adoption of modern technologies, and efficient resource utilization that enhanced productivity and profitability. The findings of the study were in line with the results of Hoang and Nguyen, (2023) who reported that land size does not determine the success of contract farming.

The research demonstrated that the location of the land had a statistically significant negative impact ($\beta = -0.20, t = -0.20, p = 0.00$) on predicting the sustainability of contract farming. This implied that for every additional distance in kilometer away from the sector office would have a negative impact on the sustainability of contract farming by 2%. This negative significance aroused from various factors such as unfavorable climatic conditions, limited access to markets or infrastructure, higher production costs, or challenges related to transportation and logistics. The unfavorable land location hindered the profitability and efficiency of contract farming arrangements, making them less sustainable in the long run. Furthermore, remote locations resulted in reduced access to essential inputs such as seeds, fertilizers, and machinery. This limited access hindered the farmers' ability to optimize their production, impacting the overall productivity and success of the contract farming arrangement. Moreover, being situated in remote areas limited the access of contract farmers to extension services and technical support. Extension services play a crucial role in disseminating knowledge about modern agricultural practices, pest and disease management, and sustainable farming techniques. Without adequate support and guidance, contract farmers faced challenges in improving their farming practices and maximizing yields. These findings were in line with those of Kokeyo, (2013) who revealed that farmers located far away from the contracting firms are likely not to participate in contract farming as compared to those located closer to the contractor.

4.4 Farming Systems

In order to establish the relationship between farming systems practiced in the county and sustainability of sorghum contract farming, the respondents were asked to indicate the kind of cropping systems and agricultural systems they were engaged in.

4.4.1 Cropping Systems

The study assessed the cropping systems undertaken by the sorghum farmers in order to determine the likelihood of the farmers to sustain the production crop. This is due to the fact that the cropping patterns are valuable in enhancing soil fertility, thereby, increasing the yield of the crops. The patterns would also help improve crop protection against pests and diseases. Table 18 shows the cropping patterns that were undertaken by farmers contracted to produce sorghum in Tharaka North and South Sub-counties.

Table 18: Cropping System Used by the Contracted Sorghum Farmers (N =375)

Cropping Pattern	Frequency (f)	Percent (%)
Monocropping	278	74.1
Intercropping	88	23.5
Other	9	2.4

The findings in Table 18 showed that many (*n* = 278, 74.1%) of the contracted sorghum farmers adopted a monocropping pattern where they grew only one crop in a given season. Based on these findings, it can be inferred that a significant majority of the contracted sorghum farmers preferred the mono-cropping system over intercropping. According to the farmers, monocropping facilitated easier management of the crop and familiarity with the traditional farming system. By concentrating on cultivating a single crop, the farmers directed their efforts towards comprehending that specific crop's particular needs and demands. This specialized approach allowed for better resource allocation, as farmers could more precisely apply fertilizers, irrigation, and pest control measures. Additionally, mono-cropping simplified logistical aspects such as planting, harvesting, and post-harvest processing since only one type of crop was involved. It also streamlined tasks like storage and transportation, as there was only one type of product to handle. The findings are in line with those of Khanal *et al.* (2021) who argued that mono-cropping is easier to handle than intercropping because it demands no additional skills, knowledge, and adjustments to machinery and infrastructure, thereby increasing the cost of producing intercrops compared to mono-crops. Additionally, Dubbert *et al*. (2021) found that contracted farmers exhibit a tendency to engage in mono-cropping rather than intercropping.

About 24% (*n* = 88) of the respondents practiced intercropping involving a mix of crops on the same piece of land while 2.4% (*n* = 9) combined monocropping and

intercropping cropping patterns. Sorghum farmers who practiced intercropping cited benefits such as enhanced land use efficiency, reduced pest and disease pressures, and increased biodiversity. The farmers also chose to intercrop in their farms in order to diversify their crop outputs. These findings were concurrent with those of Tilman (2020) who recommended the adoption of intercropping patterns due to the numerous benefits associated with it.

4.4.2 Agricultural Systems

The study examined various agricultural systems to understand how they influence sorghum crop sustainability and production. It aimed to understand how specific farming practices and methods could affect the feasibility and success of contract farming agreements for sorghum production. The agricultural systems under review were intensive and extensive farming systems as shown in Table 19.

Table 19: Agricultural Systems Used by the Contracted Sorghum Farmers (N =375)

Farming system	Frequency (f)	Percent (%)
Intensive farming system	119	31.7
Extensive farming system	256	68.3

The findings in Table 19 showed that majority (*n* = 256, 68.3%) of the contracted sorghum farmers adopted extensive farming where they grew sorghum in large land areas using lower inputs per unit of land. The farmers in Tharaka North and Tharaka South have relatively large land areas and used traditional farming practices due to unlimited access to inputs such as certified seeds, fertilizer and pesticides. Adoption of extensive farming systems is a clear indication that the study area had favorable conditions for sorghum growing, such as ample arable land and potentially low population density. The choice of extensive farming was also influenced by market demand for sorghum. There was a stable demand for sorghum products in the local by EABL where, farmers chose to cultivate larger areas to meet this demand. Extensive farming can be beneficial for farmers with access to vast land areas and is often associated with lower production costs. The findings of this study were confirmed by Nemecek *et al*. (2011) who argued that extensive farming systems are associated with low input utilization.

About 32% (n = 119) of the respondents practiced intensive farming which involved output maximization of sorghum production by using high inputs of labor, fertilizers, pesticides, and water on limited arable land. The adoption of intensive farming by 32% of the respondents suggested that was land constraints into these. Limited land availability made the farmers choose to maximize their yields by using high inputs of labor, fertilizers, pesticides, and water on a smaller land area. This finding indicated that a smaller portion of sorghum farmers in the study area prioritized productivity and economic efficiency in their farming operations.

By adopting intensive practices, sorghum farmers aimed to achieve higher yields and, consequently, greater economic returns. The findings were in line with Amadori and Zanotti (2016) who observed that intensive farming is associated with benefits such as higher yields per unit of land, increased productivity, better resource utilization, and the ability to meet higher market demands efficiently.

4.4.3 Farming Systems and Sustainability of Contract Farming

The third objective sought to determine the relationship of farming system and the sustainability of contract farming. Five-point Likert-type scaled items were used to assess farmers' perceptions relating to the connection between the two variables; where 1 signified strongly agree, 2 agree, 3 neutral, 4 disagree, and 5 strongly disagree. Table 20 indicates the means and standard deviations of study participants' responses regarding the link between farming systems and sustainability of sorghum contract farming.

Table 20: Farming Systems and Sustainability of Contract Farming

Statement	M	SD
Mono-cropping promotes the sustainability of contract farming	1.91	0.93
Inter-cropping increases the likelihood of sustaining contract farming	2.81	1.17
Farmers engaged in intensive farming systems are more likely to sustain contract farming than those producing sorghum under extensive systems	1.89	1.01
A majority of the sorghum farmers practice mixed cropping to increase crop yields and reduce pest infestation	2.28	1.06
Most of the farmers producing sorghum under contract farming utilize row intercropping	2.23	0.98
Land conservation methods promote the sustainability of contract farming	2.08	0.95
Sorghum husbandry practices promote the sustainability of contract farming	1.99	0.90

Note: [a]1=strongly agreed, 2 =agreed, 3 =neutral, 4 =disagreed, 5 =strongly disagreed

As presented on Table 20, most farmers strongly agreed that adopting mono-cropping (*M* = 1.91, *SD* = 0.93) promoted the sustainability of sorghum contract farming. This is because sorghum monoculture demanded less efforts, and resources than cultivating various kinds of crops. Additionally, the adoption of the monocropping pattern streamlined production and enhanced the uptake of the modern management practices. This resulted in higher yields due to optimized resource allocation. The higher yields helped to fairly meet the sorghum quantity target set by the contractor and also resulted in increased income which led to somewhat stable contracts. The findings concur with those of Mattalia *et al*. (2022) who observed that monocropping systems enhance agricultural sustainability through improved yield.

The results further showed that intercropping increased the likelihood to sustain sorghum contract farming (*M* = 2.81, *SD* = 1.17) even though most of the contracted farmers had adopted monoculture. The farmers noted that those who grew a mixture of crops on the same piece of land, reported better yields than the ones practicing monoculture (*M* = 2.28, *SD* = 1.06). This is due to better management of pests and diseases, better nutrient use efficiency, and improved soil fertility. This helped them sustain the production of sorghum. The findings agree with those of Mousavi and Eskandari (2011) who reported that intercropping was more beneficial than monoculture. It also emerged from the study that most sorghum farmers who practiced intercropping used row patterns (*M* = 2.23, *SD* = 0.98). The use of row intercropping

pattern facilitated easier management of weeds. According to the majority respondents' farmers who were engaged in intensive farming systems were more likely to sustain contract farming than those producing sorghum under extensive systems (*M* = 1.89, *SD* = 1.01). Many of the farmers indicated that the intensive systems enabled farmers to continuously apply the recommended sorghum husbandry practices (*M* = 1.99, *SD* = 0.90) and land conservation methods (*M* = 2.08, *SD* = 0.95) that resulted in sustained production. The farmers reported advantages such as higher productivity, increased profitability, efficient land use, adoption of advanced agricultural technologies; improved food security and economic viability were associated with intensive farming systems. The findings are in line with those of Barasa *et al*. (2021), who reported that adopting proper crop husbandry practices is crucial to attain the projected yield and meet the required qualities of crops as specified in the contractual agreement.

Pearson's correlation test was conducted to determine the association between farming systems and the sustainability of sorghum contract farming. Table 21 presents the correlation test results involving the two variables.

Table 21: Pearson's correlation Analysis between Farming Systems and Sustainability of Contract Farming

Variable[a]	1	2
1 Sustainability of Contract Farming	1	0.27**
2 Farming Systems	0.27**	1

Note: [a] 1=strongly agreed, 2 =agreed, 3 =neutral, 4 =disagreed, 5 =strongly disagreed N=375, p<0.05

As presented in Table 21, there was weak positive correlation (Rhaffora *et al*., 2019) between farming systems and the sustainability of contract farming, $r = 0.27, p < 0.05$. However, the correlation was significant at 95% level of significant. An adoption of improved farming systems by one unit would result to an increase in the sustainability of contract farming by 0.27 units. This study aligns with the findings reported by Kangwiria (2017), which revealed a robust, positive, and statistically significant correlation between farming systems and contract farming. The implementation of improved farming practices, encompassing precision agriculture and modern technologies, yielded higher crop yields and improved resource utilization within the cohort of contracted sorghum farmers. Concurrently, sustainable methods,

such as crop rotation, cover cropping, and judicious use of agrochemicals, prioritized soil health, water conservation, and biodiversity preservation. These strategies effectively enabled contract farmers to sustain long-term land fertility and productivity, thus mitigating potential soil degradation and resource depletion. Consequently, these advancements facilitated an augmented production of sorghum, effectively catering to the prevailing market demand for this crop. The findings were confirmed by Paramesh *et al.* (2022) who reported that integrated farming systems hold the potential to enhance farm productivity and profitability.

4.5 Contract Terms

At the core of sorghum contract farming is an agreement between farmers and EABL. Both parties agreed in advance on the terms and conditions for the production and marketing of sorghum. This research therefore sought to establish the kinds of contracts and conditions binding sorghum farmers in the county and EABL. The conditions evaluated included provision of inputs such as seeds, fertilizers, and technical advice.

4.5.1 Type of Contractual Arrangements

The research assessed the type of contracts that existed between sorghum farmers and EABL in order to establish the extent to which they would be sustained. Table 22 presents the types of contracts that were practiced in the production of sorghum.

Table 22: Distribution of Respondents by Contract Type (*N* =375)

Type of contact	Frequency *(f)*	Percent *(%)*
Written contract	99	26.4
Oral contract	276	73.6

As shown in Table 22, there were two kinds of contracts that were utilized by EABL in the production of sorghum namely oral and written. Out of 375 farmers who had been engaged in the research, 99 farmers (26.4%) had been contracted using written arrangements while 276 farmers (73.6%) were contracted informally through oral contracts. This implied that many of the contractual arrangements that were utilized by EABL were informal. According to the respondents, the informal contracts involved verbal agreements between the sorghum farmers and EABL. These contracts lacked clarity and led to frequent misunderstandings between the sorghum farmers and the

company as pointed out by many of the farmers. The misunderstanding arose mainly from the violation or breach of contractual agreements either by the sorghum farmers or the company. In some instances, the EABL failed to purchase the produce at the agreed prices while other times the farmers failed to deliver the required quantity of sorghum to the company. In cases where the company offered a lower price than the prevailing prices in the market, some farmers would breach the contract and sell their produce to those who were willing to purchase it at a better pay. The findings confirmed those of Ihli *et al*. (2022) who observed that oral contracts led to uncertainty for the farmer and exposed them to the risk of opportunistic behavior from the seller due to the lack of clear and formalized terms in oral agreements.

Although many of the farmers were contracted informally, a significant percentage of farmers (26.4%) produced sorghum through formal or written contracts. The contracts involved written conditions or requirements that were legally binding. The formal contracts offered several advantages to the sorghum farmers which included clear terms, reduced ambiguity, legal protection, and recourse in case of disputes. The findings agree with those of Mishira *et al.* (2022) who reported that written contracts are favored because they provide provisions for legal action in case of disputes or breaches. The conditions of agreement included provision of inputs, technical advice and delivery of produce at the agreed time and price. The respondents pointed out that written contracts were associated with minimal breaches due to their nature. Therefore, in most cases both the contracted farmers and EABL met the terms of contract. The respondents were further asked to indicate the type contract they preferred among the two kinds. Table 23 shows the preferred kind of contract among the sorghum farmers.

Table 23: Distribution of Respondents by the Preferred Contract Type (N =375)

Type of contact	Frequency (f)	Percent (%)
Written contract	219	58.4
Oral contract	156	41.6

As shown in Table 22, a substantial proportion of the contracted sorghum farmers, precisely (n = 219, 58.4%), indicated a preference for written contracts over oral contracts. The preference for written contracts among sorghum farmers was attributed to the clarity, specificity, and legally binding nature that they offered. Written contracts

provided detailed terms and conditions, minimizing misinterpretation and ambiguity. The legal security and formal framework for dispute resolution provided by written contracts also contributed to their popularity among farmers, as they felt more assured of their rights and obligations when documented in writing. The findings confirmed the results by Ihli *et al*. (2022) and Goyal *et al.* (2022) who observed that in legal matters, written contracts have historically held a favored position compared to oral contracts.

The results also showed that almost half of the respondents (*n* = 156, 41.6%), showed an interest in oral contracts. These farmers exhibited a preference for such contracts owing to the informal nature and flexibility inherent in oral agreements. Some of those who favored oral contracts were driven by the anticipation of securing better prices from alternative buyers outside of the contracting company, as these farmers believed they could obtain more favorable prices elsewhere; moreover, since oral agreements lack legal enforceability, intentionally breaching the contract could have been perceived as a viable option. The results of this study align with the findings reported by Abebe (2013), which indicated that oral contracts are favored as the preferred contractual mode due to their informal characteristics.

4.5.2 Provision of Inputs

One of the main purposes of contracting arrangements in agriculture is to provide support, resources, and inputs to the contracted farmers to ensure a successful and mutually beneficial agricultural production process. The study sought to determine if the contracted sorghum farmer were provided with inputs such as fertilizers and seeds by the contracting firm. Table 24 indicates the percentage of sorghum farmers who were/weren't provided with farm inputs by the contractor.

Table 24: Distribution of Contracted Sorghum Farmers by Inputs (*N* =375)

Provision of inputs	Frequency (f)	Percent (%)
No	275	73.3
Yes	100	26.7

As shown in Table 24, the majority of the contracted sorghum farmers (*n* = 275, 73.3%) did not receive any input for sorghum growing from the EABL. This may have resulted from the nature of contracts that existed between the company and the farmers. Most of the contracts did not include the provision of inputs, especially the verbal ones. In

some other cases, the contracting firm did not fulfill their promises. The lack of quality inputs, especially for resource-poor farmers, resulted in reduced yields, lower profitability, and economic losses. This negatively affected the sustainability of sorghum contract farming. In instances where EABL had promised to offer the inputs, the absence diluted the trust and the quality of relationships between the firm and the sorghum farmers. The findings supported those by Fahad and Wang (2018), who reported that the main risk to optimal production to a farmer was lack of access to inputs.

The study results also showed that 26.7% (n = 100) of the contracted sorghum farmers received inputs such as seeds and fertilizers from EABL. By supplying necessary inputs, contracting firms supported farmers in maximizing sorghum production. This ensured that farmers had the necessary resources to cultivate their land effectively and efficiently. Moreover, the provision of inputs contributed to the overall success of the contract farming arrangement by helping these farmers achieve higher yields and better quality produce. The provision of inputs not only served as a catalyst but also acted as a powerful source of encouragement and motivation for farmers. These findings are in line with Guo *et al.* (2009) results which indicated that smallholder farmers are attracted to contract farming due to the benefits it provides, such as access to input supply arrangements.

4.5.3 Provision of Extension Services

The provision of extension services is critical in optimizing the production of sorghum not only through contract farming but also in non-contractual systems. Extension services play a crucial role in agriculture as they provide farmers with information, knowledge, and technical assistance to improve their farming practices, crop yields, and overall productivity. This study sought to find out whether or not the contracted farmers were provided with technical advice. Table 25 shows the percentage of contracted farmers who received extension services from EABL.

Table 25: Distribution of Contracted Sorghum Farmers by Extension Services

Provision of extension services	Frequency (f)	Percent (%)
No	272	72.5
Yes	103	27.5

The findings (Table 25) indicated that a considerable proportion of contracted sorghum farmers (n = 272, 72.5%) did not receive extension services from the firm. Conversely, (n = 103, 27.5%) of the contracted sorghum farmers had received extension services. Most of the farmers who received technical advice were those who had a legally binding contract with EABL. Apart of those who had access to technical advice from EABL chose not to attend some of the training programs. This was due to the training programs being conducted in places far away from their homes. The lack of farmer participation in training programs and failure of EABL to provide adequate technical advice to the farmers reduced access to modern sorghum production practices, their adoption rates, and consequently yields. The inability of the farmers to produce the expected yields prevented them from delivering the agreed quantities of sorghum to EABL. This compromised the sustainability of the contractual arrangements. The results align with the study by Mazwi *et al.* (2019), which indicated that insufficient and delayed input supply, coupled with side marketing, resulted in reduced production and an inability to achieve and deliver the desired output.

The results also indicated that 27.5% (n = 103) of the contracted farmers had received extension services. The extension agents provided advice regarding sorghum farming, while also delivering continuous technical support to farmers across the farming cycle, addressing concerns such as pests, diseases, and agronomic challenges. This advice resulted in higher sorghum production practices adoption rates resulting to improved production. This aligns with the findings of Evaline (2015) who suggested that having access to extension services is considered a valuable incentive for farmers, as it assists them in enhancing their productivity levels.

4.5.4 Contract Terms and Sustainability of Contract Farming

The fourth objective sought to determine the association between contract terms and the sustainability of contract farming. The association was assessed through a set of Likert-type questions whose scale ranged from 1 (strongly agree) to 5 (strongly disagree). The purpose of these questions was to evaluate the perception of farmers regarding the connection between contract terms and the sustainability of contract farming.

Table 26: Contract Terms and Sustainability of Contract Farming

Statement	M	SD
There is timely provision of seeds	4.44	1.09
The quality of the seed provided was good	4.33	1.20
Adequate level of advice provided	4.44	1.10
The training provided was adequate	4.43	1.05
Collection of the product after harvest was timely	4.51	0.98
Timely Payment for the sorghum supplied to the contractor	2.61	1.30
The price of sorghum is satisfactory	4.45	1.08
I delivered all sorghum quantities as agreed	2.54	1.15
There is side selling by some farmers	2.35	1.20
I delivered the quality of sorghum as agreed	2.38	1.18
Provision of extension services by EABL sustains contract farming	2.15	1.24
The provision of inputs by the contractor enhances contract sustainability	2.46	1.22
With reliable market farmers can sustain the production of the crop	2.29	1.19
Quality specifications for quality parameters are clear	2.74	1.08
Specifications of the quality parameters are achievable	2.40	1.09

Note: [a]1=strongly agreed, 2 =agreed, 3 =neutral, 4 =disagreed, 5 =strongly disagreed

The study's findings in Table 26 showed that seeds were not provided at the right time (*M* = 4.44, *SD* = 1.09). Other farmers indicated not receiving any seeds from the contracting company at all. The delays in the provision of and unavailability of seed disrupted the crop production schedule and this affected timely execution of the sorghum management practices. Many respondents noted that farmers often planted uncertified seeds due to lack of access to good quality planting materials (*M* = 4.33, *SD* = 1.20). Although, in an ideal situation, contractual arrangements whether verbal or written involves the provision of inputs including seeds. The cultivation of poor-quality seeds resulted in poor germination rates, subsequently leading to diminished sorghum yields, especially in the second harvest since sorghum is a perennial crop. The findings are in line with those of Elmasry *et al.* (2019), that high-quality seeds are crucial for agriculture and seedling progression as they strongly impact resistance to biotic and abiotic stresses, germination rate, and plant performance.

The farmers also expressed dissatisfaction with the level of advice (*M* = 4.44, *SD* = 1.10) and training (*M* = 4.43, *SD* = 1.05) that was offered by EABL. Many of the farmers reported that they had little or no access to extension services as it would have been expected in contract farming. Adequate advice and training was needed to help the farmers improve their knowledge and skills in agronomic practices, pest and disease

management, and crop optimization as noted by the respondents. The findings were confirmed by Boateng *et al.* (2023) and Zhai *et al*. (2020) who reported that adequately advising and training farmers can optimize agricultural operations, minimize investments, maximize working efficiency, and ultimately increase agricultural productivity, meeting the requirements of Agriculture.

A majority farmers felt that there were delays and inefficiencies in the process of collecting sorghum after harvest (*M = 4.51, SD* = 0.98). The farmers pointed out that EABL was not obligated to collect the produce from the farms, although they would have wanted the company to help do it. As a result of the rising transportation and production costs, many farmers made very little profit from the sale of the produce. The respondents noted that if EABL was to provide transport services to the farmers, many more sorghum farmers would have been attracted to the contractual arrangements. The farmers agreed that there was timely payment of sorghum supplied to the contractor (*M* = 2.61, *SD* = 1.30) even though they were not satisfied with the price of sorghum offered (*M* = 4.45, *SD* = 1.08). The farmers indicated that the price offered did not adequately cover their production costs, including inputs such as seeds, fertilizers, and labor. A better price would have been an incentive to the farmers to improve the production of the crop and also expand the acreage. The findings of this study were concurred with those of Ba *et al.* (2019), who observed that contract farming participation is more likely among farmers who view their buyers as reliable and trustworthy, especially when they receive quality and timely payments.

According to the study findings, the farmers not only ensured the delivery of the specified quantity of sorghum as stated in the contract (*M* = 2.54, *SD* = 1.15), but they also gave careful consideration to the quality of the produce (*M* = 2.38, *SD* = 1.18). The farmers argued that they grew high-quality sorghum to get higher prices since the price of sorghum varied based on its quality. They observed that white sorghum varieties like Sila and Gadam fetched better prices compared to other varieties such as Kari Mtama 1. However, the farmers highlighted that they encountered numerous challenges, such as lack of certified seeds, fertilizer and other resources while striving to meet these specific requirements. Compliance with the contractual terms regarding quantity and quality helped sustain the arrangements as it ensured that the contractor received the

expected quantity and quality of sorghum. Even though there was compliance by a majority of the farmers, a few sold some of their sorghum outside of the contract terms to brokers (*M* = 2.35, *SD* = 1.20). Financial constraints also forced some of the contracted farmers to sell their produce in nearby markets, sometimes at lower price than that offered by EABL. This decision was driven by the lengthy and complicated logistics involved in selling their produce to the contract market. This is a clear indication that some farmers kept on breaching the contractual agreement between them and EABL. These findings were in line with those of Alemu and Hermanson (2021) who reported that side selling by contracted farmers is a breach of contractual agreement. The violation of the agreement through side selling compromised the sustainability of the contractual arrangement.

The respondents acknowledged the importance of the statement that the provision of inputs (*M* = 2.46, *SD* = 1.22) and extension services (M = 2.15, SD = 1.24) to contracted farmers would sustain the contract farming system. However, most of the contracted farmers had reported not being provided with these essential resources. Adequate and timely provision of inputs would have helped the farmers to optimize the production of the crop, leading to higher yields and improved sorghum quality. On the other hand, extension services would help the farmers enhance their knowledge and skills, adopt best practices, and overcome challenges, ultimately contributing to more successful and productive contract farming operations. The findings of this study confirmed the results of Mazwi *et al.* (2020) that the primary motivations for farmers to participate in contract farming are access to inputs, improved extension services, and higher producer prices.

The respondents agreed that with a reliable market for their produce, majority of the sorghum farmers would be able to sustain the production of the crop (*M* = 2.29, *SD* = 1.19). The primary motivation in contract farming is consistently having a dependable market and obtaining favorable prices for the produce. The farmers indicated that a reliable market would ensure that they have a consistent outlet for selling the crops and reducing uncertainties, and financial risks associated with unsold produce. The findings were ascertained by those of Kangile *et al.* (2020) that market access holds significant importance for farmers. Farmers believed the quality specifications (*M* = 2.74, *SD* = 1.08) outlined in the contract were clear, well-defined and achievable (*M* = 2.40, *SD* =

1.09). The ability of farmers to attain the set standards motivated the sorghum farmers to continue participating in contract farming with EABL. Since the quality of the produce was a key determinant of the price of sorghum, many farmers worked towards producing high-quality sorghum to fetch a better price. These findings were in line with those of Gao *et al.* (2022) who argued that achievable quality requirements foster farmers to have a positive attitude toward contract farming. Pearson's correlation was utilized to determine the association between contract terms and the sustainability of contract farming. The correlation test results for the two variables are presented in Table 21.

Table 27: Association between contract terms and Sustainability of Contract Farming

Variables[a]	1	2
1 Sustainability of Contract Farming	1	0.75**
2 contract terms	0.75**	1

Note: [a]1=strongly agreed, 2 =agreed, 3 =neutral, 4 =disagreed, 5 =strongly disagreed
N=375, p<0.05

The correlation analysis results (Table 27) showed a strong positive correlation between contract terms and the sustainability of contract farming, r =0.75, p< 0.05. The correlation was significant at 95% level of significant. The findings implied that an improvement in contract terms would result in increased sustainability of contract farming. An improvement in contract terms by one unit would result to an increase in the sustainability of contract farming by 0.75. Well-defined and enforceable contract terms that are devoid of being violated would be beneficial to both farmers and contractors; the terms would foster a sense of commitment and compliance from the farmers. Compliance from the contracting company involving the provision of necessary inputs like fertilizer, certified seeds, extension services, along with ensuring a reliable market and competitive prices, would have served as a powerful incentive for farmers to remain engaged in contract farming. On the other hand, farmers are obligated to meet the specified quantity and quality of sorghum as outlined in the contractual agreement and refraining from side selling. This commitment would result in a more consistent and dependable supply of produce which would have benefitted both the EABL and the farmers. Favorable contract terms would lead to stronger and longer-lasting relationships between farmers and contractors. These finding are supported

by Zheng *et al*. (2022) who observed that sustainable contract farming involved good contract terms that ensure the terms are carried out without the need for intermediaries.

4.6 Sustainability of Contract Farming

The research was mainly intended to assess the sustainability of sorghum contract farming. The assessment involved a determination of the period under which the sorghum farmers had produced the crop under contracts and the level of sustainability of the contractual arrangements. This was intended to identify the extent to which the arrangements would be maintained since the production of the crop is one among the main sources of livelihoods in the county.

4.6.1 Period under Contract Farming

The period under contract farming was assessed in terms of the number of years that the farmers had produced the crop under contractual arrangements. Longer engagements would foster trust, learning, investment, and commitment, all of which contribute to contract farming arrangements' overall viability and long-term success. Both verbally and written contracted respondents were asked to indicate the number of years they had produced sorghum for EABL through the arrangements. Table 28 shows the ranges of years of sorghum production in the county through EABL contractual arrangements.

Table 28: Distribution of Respondents by Period under EABL Contract (*N* =375)

Period under contract (Years)	Frequency (f)	Percent (%)
1-3	266	70.9
4-6	99	26.4
7-10	10	2.7

The results in Table 28 showed that a significant majority of farmers, comprising 70.9% (*n* = 266), had been involved in contract farming for less than three years, 26.4% (*n* = 99) had been on the arrangement for between 4 and 6 years, and 2.7% (*n* = 10) had been contracted for between 7 and 10 years. The fact that the contractual arrangement had been in existence for a period of 10 years and a majority of farmers had joined recently implied that the arrangements had not been previously been attractive until three years ago. Many of the sorghum farmers may have been uncertain about the benefits of the contractual arrangements. According to respondents, some of those who had been

initially been contracted to produce the crop had dropped out as a result of being dissatisfied with the arrangements. As a result, many farmers transitioned to different agricultural models without renewal of their contracts. However, these findings contradict the research by Ruml and Qaim (2021), who observed that choosing not to re-sign a contract does not always indicate dissatisfaction with contracts.

A minority of the contracted sorghum farmers had participated in contract farming for durations exceeding seven years. This was a demonstration of the faith they had on the contractual arrangement. Many of those who had been contracted for that long had legally binding agreements with EABL. They were assured of a ready market and a predetermined price. As a result, they were able to sustain the arrangements for that period. This finding suggested the presence of farmers who had established enduring relationships with contract farming and concentrated their efforts on this approach due to its acknowledged benefits. The experience these farmers gained from engaging in contract farming for such an extended period has significantly contributed to their prosperity within these contractual arrangements since they know how to handle the challenges they face. These findings confirm the results of Quddus and Kropp (2020), who discovered that farmers with greater experience encountered fewer obstacles in terms of marketing limitations.

4.6.2 Level of Contract Farming Sustainability

The study also assessed the extent to which contract farming arrangements could be maintained, succeed, and provide long-term benefits for all parties involved. The sorghum contracted farmers were asked to indicate their perception of the level of sustainability as illustrated in Figure 3. A five-point scaled Likert-type item where 1 signified very low, 2 low, 3 neutral, 4 high, and 5 very high was used to determine the level of contract farming sustainability between EABL and the sorghum contracted farmers

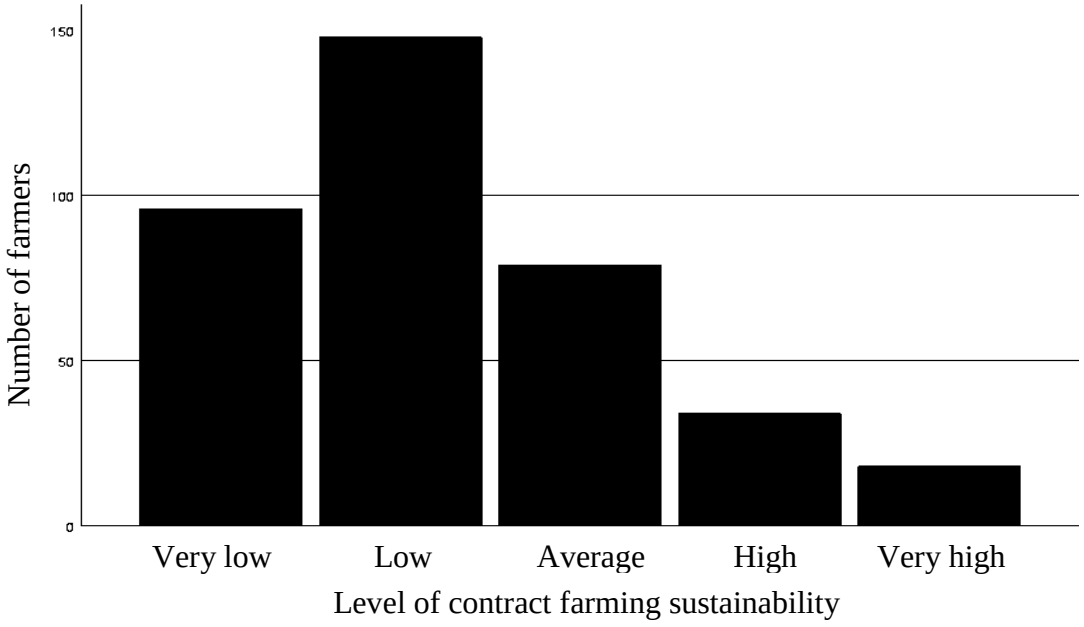

Figure 3: Level of Sorghum Contract Farming Sustainability

As shown in Figure 3, most contracted farmers (*n* = 148, 39.5%) felt that the sustainability of the contractual arrangements was low. A low level of contract farming sustainability indicated that the arrangement could not be maintained effectively over time and a clear indicator that the arrangements faced various challenges. This may have been contributed by the breach of the contractual arrangements where some farmers sold their produce to the nearby markets to fetch better prices or to solve an immediate need. Many of the contractual arrangements were also not legally binding. Legalizing the arrangements through written agreements would have enhanced the sustainability. These findings confirm the findings of Erma and Siregar (2023) who reported that most contracts are documented in writing due to clear evidence and their ability to ensure legal certainty for the involved parties. The farmers also expressed the difficulties in the terms and conditions of the contracts and the pricing mechanism used in contract farming. Very few farmers felt that sorghum production under contracts was highly sustainable (*n* = 55, 14.7%). This may have been an opinion of the farmers who enjoyed the benefits of written contracts whose violation was limited.

The assessment of sustainability also involved a set of Likert-type items. The summated Likert-scale items were utilized to construct a sustainability score for each farmer, transforming them into a continuous dependent variable used in subsequent analyses.

Table 29: Sustainability of Sorghum Contract Farming (*N* = 377)

Statement	M	SD
I will renew my contract between me and EABL	2.05	0.96
Good Contract terms	3.44	1.50
Quality inputs are offered by EABL	4.47	1.07
Timely delivery of inputs by contracting company	4.44	1.09
The price offered by EABL for sorghum is satisfactory	4.07	1.36
The price is not delayed	2.89	1.23
Reliable extension services offered by the contracting company	4.41	1.16
Quality extension services offered by the contracting company	4.26	1.26
Reliable sorghum market offered by the contracting company	2.62	1.19
Price offered by other contracting company is good	3.07	1.48
The credit offered by the contracting company is helpful	4.39	1.07
The EABL offers a mode of transport	4.34	1.14
The relationship between me and the contracting company is good	2.44	1.09
There has been a great increase in the number of contracted farmers	2.13	0.99
The acreages under contract farming have greatly increased	2.02	0.96
The volumes of sorghum sustain contracts	2.56	1.25
The quality of sorghum sustains contracts	2.22	1.10

Note: [a]1=*strongly agreed,* 2 =*agreed,* 3 =*neutral,* 4 =*disagreed,* 5 =*strongly disagreed*

As shown in Table 29, the farmers expressed willingness to renew their contracts with EABL (*M* = 2.05, *SD* = 0.96). Most farmers emphasized that their relationship with the contracting company was good (*M* = 2.44, *SD* = 1.09), just like the contract terms were good (*M* = 2.46, *SD* = 1.22). The respondents pointed out that the conditions of agreement had been improved and this has attracted more farmers to the system. A positive relationship between farmers and the contracting company was crucial for the success and sustainability of contract farming. A good relationship fosters trust, communication, and cooperation. These findings were in line with those of Yeshitila *et al*. (2020), who reported that good linkages between the company and the farmer help foster the viability and sustainability of contract farming.

The results further indicated that a majority of the farmers disagreed that the inputs provided by EABL were of high quality (*M* = 4.47, *SD* = 1.07), delivered on time (*M* = 4.44, *SD* = 1.09), and that extension services were reliable (*M* = 4.41, *SD* = 1.16) and of good quality (*M* = 4.26, *SD* = 1.26). The findings suggested that the quality, timeliness, and reliability of inputs and extension services provided by EABL were sources of dissatisfaction among contracted sorghum farmers. These issues had affected the efficiency of the contractual arrangement resulting to low crop yields, reduced farmer commitment to the contract, and drop outs from the system. This compromised

the sustainability of contract farming. The farmers pointed that if EABL had honored the conditions of agreement, they would have reported better yields and higher income levels which would have served as incentives to maintain the contractual arrangements. These findings agree with a report by Kimbi *et al.* (2022) that providing reliable inputs and extension services encourage farmers' participation in contract farming.

Regarding the price offered by EABL, farmers disagreed that it was satisfactory (*M* = 4.07, *SD* = 1.36) even though they were not delayed *(M* = 2.89, *SD* = 1.23). The sorghum farmers were not sure if the prices offered by other contracting companies were good (*M* = 3.07, *SD* = 1.48) even though the sorghum market offered by EABL was reliable (M = 2.62, *SD* = 1.19). The dissatisfaction of farmers with prices prompted them to explore other sorghum markets, engaged in other enterprises and alternative sources of income. This resulted in the violation of the agreements and inability to sustain the system. The sorghum farmers emphasized that EABL should consider engaging in price negotiations and providing them with a clearer understanding of the pricing structure. Such measures would incentivize the farmers to remain loyal to the contract, especially if they received competitive prices, thus discouraging them from resorting to side selling of the crop. The findings agree with those of Amare *et al.* (2019) that stable prices and market accessibility are key advantages to farmers in contract farming.

The farmers also disagreed with the statement that the credit offered by the EABL was helpful (*M* = 4.39, *SD* = 1.07) and that they were offered a mode of transportation (*M* = 4.34, *SD* = 1.14). Farmers revealed that they received limited credit support from EABL, primarily in the form of improved seeds. However, they complained that the seeds were received late and, in some instances, not provided at all. Nevertheless, farmers expressed interest and recognized that access to credit facilities would greatly facilitate their engagement in contract farming. The findings were confirmed by Yu *et al.* (2023) that credit can help mitigate moral hazards within the contract.

The farmers agreed that there had been a great increase in the number of contracted farmers (*M* = 2.13, *SD* = 0.99) and the number of acreages (*M* = 2.02, *SD* = 0.96)

utilized under contract farming. The growth in the number of contracted farmers and acreage indicated that more individuals participated in contract farming. This contributed to the economic viability and sustainability of the farming model as it generated income for a larger segment of the farming community. The farmers also recognized that there has been a significant increase in both the volume (M = 2.56, SD = 1.25) and quality (M = 2.22, SD = 1.10) of the sorghum they deliver to EABL. The increased volume and quality of sorghum delivered indicated improved productivity among contracted farmers. This benefited the farmers and EABL, leading to higher quality yields and increased supply to meet market demands. The improvements in both the volume and quality of sorghum delivered to EABL helped enhance the sustainability of contract farming. It reflected the potential of contract farming to boost production and improved livelihoods. These findings confirm by a report by Kanana and Mbugua (2019) that the volume and quality of produce delivered to the contracting company and the number of acreage utilized under contract farming determine the performance of contract farming.

CHAPTER FIVE
SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of the Findings

This study was intended to determine the relationship between the attributes of farmers, contract terms, farm characteristics, farming systems, and the sustainability of contract farming among sorghum farmers in Tharaka Nithi County. Descriptive and inferential tests were applied to generate statistics that would help to address the research objectives.

Objective one sought to determine the relationship between farmers' characteristics and the sustainability of sorghum contract farming. The results indicated that a majority of the contracted sorghum farmers were men. Most of them were fairly learned as many had attained a secondary level of education. The age of the contracted sorghum farmers ranged from 41 to 50 with a mean of 47.49 years. The study revealed that most sorghum farmers had household sizes ranging from 5 to 8 members. Many of the farmers depended on agriculture as their main source of livelihood, although some had diversified sources of income. Multiple regression was used to determine if a set of farmer characteristics specifically education level, gender, age, household size, and off-farm income were associated with sustainability of contract farming. The study revealed that a combination of the aforementioned farmer characteristics significantly predicted the sustainability of sorghum contract farming F (5, 369) = 2.54, p = 0.00, R^2 = 0.03. However, household size ($p < 0.05$) was the only factor that significantly correlated with the sustainability of contract farming. On the other hand, education, gender, age, and off-farm income, were found to be statistically insignificant ($p > 0.05$), hence not influencing the sustainability of contract farming.

The second objective sought to determine the association between farm characteristics and the sustainability of contract farming. The farm characteristics that were assessed included land sizes, land ownership, and the location of the land. The study revealed that a considerable number of farmers possessed land sizes ranging from 3 to 5 acres most of which was family owned. An assessment of the location of sorghum farms in relation to the contractor’s produce collection centers revealed that most of them were situated within distances of less than 10 kilometers from those centers. The study used

multiple regression analysis to determine the relationship between the farm characteristics (acreage, land ownership, and distance from the collection center) and the sustainability of contract farming. A combination of the three variables was found to significantly predict the sustainability of the sorghum contract farming $F(3, 371) = 8.86, p = 0.01, R^2 = 0.07$. Among the three variables, land ownership ($p < 0.05$) and the location of the land ($p < 0.05$) were significantly correlated with the sustainability of contract farming, while land size was not.

The third objective involved a determination of the relationship between farming systems and the sustainability of contract farming. The study findings indicated that most contracted sorghum farmers adopted mono-cropping although some practiced intercropping or both. It was also found that extensive farming systems were more adopted than intensive farming systems. Most farmers argued that adopting mono-cropping (M = 1.91, SD = 0.93) contributed to the sustainability of contract farming. Additionally, the study observed that intercropping (M = 2.81, SD = 1.17), particularly row intercropping (M = 2.23, SD = 0.98), increased the likelihood of sustaining contract farming. A significant number of sorghum farmers practiced mixed cropping (M = 2.28, SD = 1.06) to enhance crop yield. According to a majority of farmers, intensive farming (M = 1.89, SD = 1.01), land conservation methods (M = 2.08, SD = 0.95), and sorghum husbandry practices (M = 1.99, SD = 0.90) promoted the sustainability of sorghum contract farming since the practices enhanced the productivity of the crop. Pearson's correlation results showed a significant weak correlation between the farming systems and the sustainability of contract farming, r = 0.27, $p < 0.05$.

The fourth objective sought to determine the association between the contract terms and the sustainability of contract farming. The terms of the sorghum production contracts encompassed the type of contract, provision of inputs, and of extension services to the contracted sorghum farmers. The study observed that most of the contracted sorghum farmers were orally contracted even though they preferred written contracts. Additionally, it was also found that many farmers were neither provided with agricultural inputs nor extension services. A majority of the farmers expressed disagreement with the claims that the seeds were provided on time (M = 4.44, SD = 1.09), the quality of the provided seed was good (M = 4.33, SD = 1.20), the level of

advice provided was adequate (*M* = 4.44, *SD* = 1.10), the training provided was sufficient (*M* = 4.43, *SD* = 1.05), and the collection of the product after harvest was timely (*M* = 4.51, *SD* = 0.98).

However, the farmers confirmed that there was timely payment for the sorghum supplied to the contractor (*M* = 2.61, *SD* = 1.30), although they were dissatisfied with the price offered for the sorghum (*M* = 4.45, *SD* = 1.08). According to the respondents, a majority of the farmers delivered the agreed quantities of sorghum (*M* = 2.54, *SD* = 1.15) and paid attention to the quality of produce (*M* = 2.38, *SD* = 1.18) they delivered, although, a considerable number was engaged in side selling (*M* = 2.35, *SD* = 1.20). Additionally, the farmers agreed that provision of inputs (*M* = 2.46, *SD* = 1.22), extension services *(M* = 2.15, *SD* = 1.24), and a reliable market (*M* = 2.29, *SD* = 1.19) would have helped sustain the production of sorghum under contractual arrangement. Regarding contract terms, the study indicated that the quality specifications were clear (*M* = 2.74, *SD* = 1.08) and achievable (*M* = 2.40, *SD* = 1.09). Pearson's correlation analysis revealed a strong significant correlation between the contract terms and the sustainability of contract farming, $r = 0.75$, $p < 0.05$.

The sustainability of contract farming was found to be generally low as noted by a majority of farmers (*n* = 148, 39.5%). Most sorghum farmers have been contracted for a period of less than three years. However, a majority of the farmers expressed willingness to renew their contracts with EABL (*M* = 2.05, *SD* = 0.96), indicating that their relationship with the contracting company was good (*M* = 2.44, *SD* = 1.09) even though they had different opinions on whether the contract terms were good (*M* = 2.46, *SD* = 1.22). However, many farmers expressed dissatisfaction with the quality (*M* = 4.47, *SD* = 1.07), and timeliness (*M* = 4.44, *SD* = 1.09) of inputs provided by EABL, as well as the reliability (*M* = 4.41, *SD* = 1.16) and quality (*M* = 4.26, *SD* = 1.26) of extension services. They also disagreed with the satisfaction of the prices offered by EABL (*M* = 4.07, *SD* = 1.36) despite there being no significant delays (*M* = 2.89, *SD* = 1.23. Farmers were uncertain about the fairness of prices offered by other contracting companies (*M* = 3.07, *SD* = 1.48), but they found the sorghum market offered by EABL to be reliable (M = 2.62, *SD* = 1.19). Farmers did not find the credit offered by EABL to be helpful (*M* = 4.39, *SD* = 1.07), and they were also dissatisfied with the

transportation options provided (M = 4.34, SD = 1.14). On a positive note, farmers acknowledged a significant increase in the number of contracted farmers (M = 2.13, SD = 0.99) and the acreage utilized under contract farming (M = 2.02, SD = 0.96). They also recognized an increase in both the volume (M = 2.56, SD = 1.25) and quality (M = 2.22, SD = 1.10) of the sorghum they delivered to EABL.

5.2 Conclusion

The sustainability of sorghum contractual arrangements in Tharaka Nithi County was low. This was attributed to the use of unenforceable agreements, violation of arrangements, and to a large extent the delivery of low quantity of sorghum than the agreed levels. A majority of the farmers in Tharaka South and North were contracted by EABL verbally even though they favored written agreements. The attributes of the sorghum farmers were also found to contribute to the sustainability of the contractual arrangements. Among the farmer characteristics examined, the size of the farmers' households was highly likely to affect the sustainability of the contractual arrangements. Farmers whose household sizes were larger were more likely to sustain the contracts since they required much more resources to meet the needs of their members. Although the education level of the sorghum farmers, their gender, age, and off-farm annual incomes were not likely to affect the sustainability of the arrangements individually, these factors together with the household size were found to contribute significantly towards sustainable contract farming. This is due to the ability of the factors to enhance the adoption of appropriate sorghum production practices.

Farm characteristics including land size, ownership, and the location of the farm together too contributed immensely to a sustainable contract farming system. Out of the three farm characteristics that were studied, land ownership and the location of the farm were found to have the highest likelihood to enhance the sustainability of the contractual arrangement between sorghum farmers and EABL. Sorghum farmers who owned land with title deeds were more likely to sustain contract farming than those who operated under leased tenure. Additionally, farmers whose farms were located closer to the produce collection centers sustained the contractual arrangements much more. This is due to the reduced costs of transportation of the inputs and the produce. However, it's

worth noting that the land size did not substantially relate to the sustainability of contract farming.

The contractual sorghum production systems involved a variety of farming systems, including monocropping, intercropping, extensive, and intensive systems. Although monocropping was the most popular, both intensive and extensive systems were also practiced by the sorghum farmers. Although the sorghum farming systems had a weak relationship with the sustainability of contract farming, its effect was likely to be substantial. Monocropping facilitated easier management of the sorghum crop, while it was confirmed that extensive farming was frequently associated with reduced production expenses, offering potential benefits.

The sustainability of contract farming was also highly likely to be influenced by the terms of contracts. Although many of the arrangements were oral in nature, most of the farmers preferred written contracts that were legally binding to prevent the breach of the agreements. The oral contracts were characterized by extensive breach of agreements, especially involving side selling. The breach of contracts witnessed and the inability to enforce control in oral agreements compromised the sustainability of the sorghum contract arrangements. Most of the terms of the contractual arrangements were not implemented effectively owing to the nature of the contracts. Farm inputs, technical advice, and agreed prices were not offered to the contracted farmers as stipulated in the contracts. These factors were key to the continued farmer participation in the contractual arrangements.

5.3 Recommendations

The following recommendations are proposed;

i. To enhance the sustainability of contract farming, EABL should target farmers with large-sized households, well educated, those with high off-farm annual incomes, and highly experienced in the production of sorghum.
ii. EABL should support farmers in acquiring land or securing land ownership rights and consider offering transportation services to farmers located far from the collection centers.

iii. The county extension staff together with EABL needs to plan, design, and implement training programs on suitable farming systems that can be adopted to enhance the productivity of sorghum. The training programs should also focus on the adoption of appropriate sorghum husbandry practices, soil and water conservation.

iv. EABL and any other firm involved in the system should strive to formalize contractual arrangements, provide farmers with timely and quality inputs, extension services, fair pricing, and clear quality specifications to enhance the sustainability of contract farming.

5.4 Suggestions for Further Studies

The study recommends that;

i. Since this study was only limited to Tharaka South and North Sub-counties in Tharaka Nithi County, a similar study should be undertaken in other regions producing sorghum through contractual arrangements. This should be undertaken in areas with the same conditions as those of the study area.

ii. A further study is needed to determine the relationships between other farm and farmers' characteristics and the sustainability of contract farming. Such factors include credit access, group membership, quality inputs, and transport networks.

REFERENCES

Abbasi, I., Ashari, H., Jan, A., & Ariffin, A. (2021). Contract farming towards social business: A new paradigm. *Sustainability*, *13*(22), 12680. https://doi.org/10.3390/su132212680

Abebe, G., Bijman, J., Kemp, R., Omta, O., & Tsegaye, A. (2013). Contract farming configuration: Smallholders' preferences for contract design attributes. *Food Policy, 40*, 14-24. https://doi.org/10.1016/j.foodpol.2013.01. 002

Adjei, C., Karakostas, A., & Monteiro, D. (2022). Contract breaching in agricultural markets: An experiment on double moral hazard. *Agricultural Economics Society - AES*. https://www.researchgate.net/profile/Alexandros-Karakostas/publication/356508752_Contract_breaching_in_agricultural_markets_An_experiment_on_double_moral_hazard/links/61b8031da6251b553ab8228c/Contract-breaching-in-agricultural-markets-An-experiment-on-double-moral-hazard.pdf

Adnan, K., Ying, L., Ayoub, Z., Sarker, S., Menhas, R., Chen, F., & Yu, M. (. (2020). Risk management strategies to cope catastrophic risks in agriculture: The case of contract farming, diversification and precautionary savings. *Agriculture, 10*(8), 351. https://doi.org/10.3390/agriculture10080351

Adugna, A. (2014). Analysis of in situ diversity and population structure in Ethiopian cultivated sorghum bicolor (L.) landraces using phenotypic traits and SSR markers. *SpringerPlus*, *3*(1). https://doi.org/10.1186/2193-1801-3-212

Ahmad, H., Shah, S., Latada, F., & Wahab, M. (2019). Teacher identity development in professional learning: An overview of theoretical frameworks. *Bulletin of Advanced English Studies, 3*(1), 1-11. https://doi.org /10.31559/baes2019.3.1.1

Akoglu, H. (2018). User's guide to correlation coefficients. *Turkish Journal of Emergency Medicine*, *18*(3), 91-93. https://doi.org/10.1016/j.tjem.2018.08.001

Akter, S., Rutsaert, P., Luis, J., Htwe, N. M., San, S. S., Raharjo, B., & Pustika, A. (2017). Women's empowerment and gender equity in agriculture: A different perspective from Southeast Asia. *Food policy*, *69*, 270-279.

Akumu, J., Odongo, W. & Mugonola, B. (2020). Determinants of Contract Farming for Smallholder Sunflower Producers in Northern Uganda. *African Crop Science Journal, 28*(4), 585-594. https://dx.doi.org/10.4314/acsj.v28i4.8

Alemu, D., Guinan, A., & Hermanson, J. (2021). Contract farming, cooperatives and challenges of side selling: malt barley value-chain development in Ethiopia. *Development in Practice, 31*(4), 496-510.

Alulu, J. (2017). *Participation in Contract Farming and Its Effects on Technical Efficiency and Income of Vegetable Farmers in Western Kenya* [Master's thesis]. http://erepository.uonbi.ac.ke/bitstream/handle/11295/153099/Alulu_Participation% =y

Amare, M., Mariara, J., Oostendorp, R., & Pradhan, M. (2019). The impact of smallholder farmers' participation in avocado export markets on the labor market, farm yields, sales prices, and incomes in Kenya. *Land use policy*, *88*, 104168.

Arumugam, N., Arshad, F., Chiew, F., & Mohamed, Z. (2011). Determinants of fresh fruits and vegetables (FFV) farmers' participation in contract farming in Peninsular Malaysia. *International Journal of Agricultural Management and Development (IJAMAD)*, *1*(1047-2016-85471), 65-71.

Astivia, O., & Zumbo, B. (2019). Heteroskedasticity in Multiple Regression Analysis: What it is, how to Detect it and How to Solve it with Applications in R and SPSS. *Practical Assessment, Research, and Evaluation*, *24*(1), 1.

Ba, H., de Mey, Y., Thoron, S., & Demont, M. (2019). Inclusiveness of contract farming along the vertical coordination continuum: Evidence from the Vietnamese rice sector. *Land use policy*, *87*, 104050.

Baghdadi, A., Paknejad, F., Golzardi, F., Hashemi, M., & Ilkaee, M. (2021). Suitability and benefits from intercropped sorghum–amaranth under partial root-zone irrigation. *Journal of the Science of Food and Agriculture*, *101*(14), 5918-5926. https://doi.org/10.1002/jsfa.11244

Bajari, P., & Tadelis, S. (2001). Incentives versus transaction costs: A theory of procurement contracts. *The RAND Journal of Economics*, *32*(3), 387. https://doi.org/10.2307/2696361

Barasa, P., Botai, C., Botai, J., & Mabhaudhi, T. (2021). A review of climate-smart agriculture research and applications in Africa. *Agronomy*, *11*(6), 1255.

Beinah, A., Kunyanga, C., & Ngugi, K. (2020). Utilization and processing of sorghum by small holder farmers in drought prone agro-ecological zones of Kenya. *Advances in Social Sciences Research Journal*, *7*(10), 116-121. https://doi.org/10.14738/assrj.710.8540

Bellemare, M., & Bloem, J. (2018). Does contract farming improve welfare? A review. *World Development*, *112*, 259 271. https://doi.org/10.1016/j.worlddev.2018.08.018

Bendickson, J., Muldoon, J., Liguori, E., & Davis, P. (2016). undefined. *Management Decision*, *54*(1), 174-193.

Beulen, E., & Ribbers, P. (2003). IT outsourcing contracts: Practical implications of the incomplete contract theory. *36th Annual Hawaii International Conference on System Sciences, 2003. Proceedings of the 35th Annual Hawaii International Conference on System Sciences*. https://doi.org/10.1109/hicss. 2003.1174788

Bidzakin, J., Fialor, S., Awunyo-Vitor, D., & Yahaya, I. (2020). Contract farming and rice production efficiency in Ghana. *Journal of Agribusiness in Developing and Emerging Economies*, *10*(3), 269-284. https://doi.org/10.1108 /jadee-11-2018-0160

Birthal, P., Joshi, P., & Hazrana, J. (2020). Making contract farming work in smallholder agriculture. *Transforming Agriculture in South Asia*, 101-115.

Boateng, K., Dankyi, E., Amponsah, I., Awudzi, G., Amponsah, E., & Darko, G. (2023). Knowledge, perception, and pesticide application practices among smallholder cocoa farmers in four Ghanaian cocoa-growing regions. *Toxicology Reports*, *10*, 46-55.

Cao, Y., Bai, Y., & Zhang, L. (2022). Plot size, adjacency, and farmland rental contract choice. *Land*, *11*(4), 558. https://doi.org/10.3390/land11040558

Chadalavada, K., Kumari, B., & Kumar, T. (2021). Sorghum mitigates climate variability and change on crop yield and quality. *Planta*, *253*(5). https://doi.org/10.1007/s00425-021-03631-2

Chamahwinya, J. (2016). An assessment of the suitability of contract farming models being implemented in Zimbabwe and their impact on agricultural growth (2010 to December 2014) (Doctoral dissertation, Midlands State University).

Chazovachii, B., Mawere, C., & Chitongo, L. (2021). Sustainability of centralized contract farming among tobacco smallholder farmers in Makoni north district, Zimbabwe. *Cogent Social Sciences*, *7*(1). https://doi.org/10.1080/23311886.2021.1921324

Chepng'etich, E., Nyamwaro, S., Bett, E., & Kizito, K. (2015). Factors that influence technical efficiency of sorghum production: A case of small holder sorghum producers in lower eastern Kenya. *Advances in Agriculture, 2015*, 1-11. https://doi.org/10.1155/2015/861919

Dabija, A., Ciocan, M., Chetrariu, A., & Codină, G. (2021). Maize and sorghum as raw materials for brewing, a review. *Applied Sciences*, *11*(7), 3139. https://doi.org/10.3390/app11073139

Daniel, A., Dworkin, S., McDonough, A., Hatcher, A., Burger, R., Weke, E.,… & Cohen, C. (2023). The Impact of Land Tenure Security on a Livelihood Intervention for People Living with HIV in Western Kenya. *AIDS and Behavior*, *27*(1), 245-256.

Daou, A., Ahamadoun, B., Boubacar, A., Maïga, A., & Diallo, A. (2022). Intercropping effect on sorghum yield under Sahel zone climate condition of Mali: Case study of cinzana. *International Journal of Agriculture and Environmental Research*, *07*(06), 1057-1074. https://doi.org/10.51193/ijaer. 2021.7613

Davana, T., Revanna, M., & Yatnati, S. (2020). Development of beer from malted sorghum (Sorghum bicolor). *International Journal of Current Microbiology and Applied Sciences*, *9*(12), 704-710.

Deininger, K., & Byerlee, D. (2011). The rise of large farms in land abundant countries: Do they have a future? *World Bank Policy Research Working Paper*, (5588).

Duan, H., Li, J., Fan, S., Lin, Z., Wu, X., & Cai, W. (2021, October). Metaverse for social good: A university campus prototype. In *Proceedings of the 29th ACM International Conference on Multimedia* (pp. 153-161).

Dubbert, C. (2019). Participation in contract farming and farm performance: Insights from cashew farmers in Ghana. *Agricultural Economics (United Kingdom),* 50(6), 749–763. https://doi.org/10.1111/agec.12522.

Dubbert, C., Abdulai, A., & Mohammed, S. (2021). Contract farming and the adoption of sustainable farm practices: Empirical evidence from cashew farmers in Ghana. *Applied Economic Perspectives and Policy*, *50*(6), 749-763.

Ducastel, A., Bourblanc, M., & Adelle, C. (2023). Why development finance institutions are reluctant to invest in agriculture and why they keep trying. *Financializations of Development*, 19-33. https://doi.org/10.4324/9781003039679-3

Dzulkarnain, Santoso, I., & Mustaniroh, S. A. (2020). Strategi Pengembangan Kemitraan Agroindustri Nilam Di Kabupaten Konawe Selatan Menggunakan Metode Analisis Swot Dan Ahp. Teknologi Industri Pertanian, 30(1), 53–62.

East Africa Brewery Limited (EABL) (2022). Report on KBL project benefits over 47000 sorghum farmers. [https://www.ab-inbev.com] visited on 14/12/2022.

Eggen, M., Ozdogan, M., Zaitchik, B., Ademe, D., Foltz, J., & Simane, B. (2019). Vulnerability of sorghum production to extreme, sub-seasonal weather under climate change. *Environmental Research Letters*, *14*(4), 045005. https://doi:10.1088/1748-9326/aafe19

Einfalt, D. (2021). Barley-sorghum craft beer production with Saccharomyces cerevisiae, Torulaspora delbrueckii and Metschnikowia pulcherrima yeast strains. *European Food Research and Technology*, *247*(2), 385-393.

ElMasry, G., Mandour, N., Al-Rejaie, S., Belin, E., & Rousseau, D. (2019). Recent applications of multispectral imaging in seed phenotyping and quality monitoring—An overview. *Sensors*, *19*(5), 1090.

Erma, Z., & Siregar, Y. (2023). Legalization of Electronic Business Contracts with the Use of Electronic Stamps. *International Journal of Educational Review, Law and Social Sciences (IJERLAS)*, *3*(1), 223-234.

Evaline, S. (2015). Factors that influence Technical Efficiency of sorghum production: A case of small holder sorghum producers in Lower Eastern Kenya. *Research Article*, p. 11.

Fahad, S., & Wang, J. (2018). Farmers' risk perception, vulnerability, and adaptation to climate change in rural Pakistan. *Land use policy*, *79*, 301-309.

FAO. (2013). *Food and Agriculture Organization of the United Nations*. https://www.fao.org/land.water/databases.and.software/crop%20information/sorghum/en/ (Accessed 10 December 2022)

FAO. (2015). *Food and Agriculture Organization of the United Nations*. https://www.google.com/url?q=https://www.fao.org/3/i5251e/i5251e.pdf&sa=D&source=docs&ust=1689996399755500&usg=AOvVaw1UjvkETR5wM7fWilu9ekS-

FAO. (2017). *Food and Agriculture Organization of the United Nations*. https://www.fao.org/3/i6583e/i6583e.pdf

FAOSTAT (2021). *Production/Yield Quantities of Sorghum in the World* (Rome). https://www.fao.org/faostat/en/#home (Accessed 22 March 2023)

Farnsworth, D., Clarks, J., & Cothran, H. (2019). Business Retention and Expansion (BRE) Programs: *Developing a Business Retention and Expansion Survey, FE654.* Gainesville: University of Florida Institute of Food and Agricultural Sciences. https://edis.ifas.ufl.edu/fe654.

Faure, M., & Luth, H. (2011). Behavioural economics in unfair contract terms: Cautions and considerations. *Journal of Consumer Policy*, *34*, 337-358.

Field, P., & Wilcox, R. (2017). Robust statistical methods: A primer for clinical psychology and experimental psychopathology researchers. *Behaviour Research and Therapy*, *98,* 19-38. https://doi.org/10.1016/j.brat.2017.05.013

Fraenkel, J., Wallen, N., & Hyun, H. (2015). *How to Design and Evaluate Research in Education Columbus*. OH: McGraw- Hill Education

Fresco, L., & Westphal, E. (1988). A hierarchical classification of farm systems. *Experimental Agriculture*, *24*(4), 399-419. https://doi.org/10.1017/s0014479700100146

Fuller, D., & Stevens, C. (2018). Sorghum domestication and diversification: A current Archaeobotanical perspective. *Plants and People in the African Past*, 427-452. https://doi.org/10.1007/978-3-319-89839-1_19

Gagliardi, A., Brouwers, M., Palda, V., Lemieux-Charles, L., & Grimshaw, J. (2011). How can we improve guideline use? A conceptual framework of implementability. *Implementation Science*, *6*(1). https://doi.org/1 0.1186/1748-5908-6-26

Ganewo, Z., Balguda, T., Alemu, A., Mulugeta, M., Legesse, T., Kaske, D., & Ashebir, A. (2022). Are smallholder farmers benefiting from malt Barley contract farming engagement in Ethiopia? *Agriculture & Food Security*, *11*(1).

Gano, B., Dembele, J., Tovignan, T., Sine, B., Vadez, V., Diouf, D., & Audebert, A. (2021). Adaptation responses to early drought stress of West Africa sorghum varieties. *Agronomy*, *11*(3), 443.

Gao, Y., Yao, X., Chen, C., & Niu, Z. (2022). Can farmers' participation in contract farming promote the application of organic fertilizer? Empirical evidence from a sample of vegetable farmers in Shandong province of China. *Renewable Agriculture and Food Systems*, *37*(5), 479-489.

Getachew, F., Bayabil, H., Hoogenboom, G., Teshome, F., & Zewdu, E. (2021). Irrigation and shifting planting date as climate change adaptation strategies for sorghum. *Agricultural Water Management*, *255*, 106988.

Gioto, V., Wandiga, S., & Oludhe, C. (2016). Climate change detection across all livelihood zones in Tharaka Nithi County. *Journal of Meteorology and Related Sciences*, *9*(2), 11-17. https://doi.org/10.20987/jmrs.2.08.2016

Government of Kenya, (GOK) (2013). *National Climate Change Response Strategy*, Ministry of Environment and Mineral Resource. Nairobi

Goyal, Y., Choudhury, P., & Ghosh, R. (2022). Informal land leasing in rural India persists because it is credible. *Land Use Policy*, *120*, 106299.

Hambloch, C. (2022). Contract farming and everyday acts of resistance: Oil palm contract farmers in the Philippines. *Journal of Agrarian Change*, *22*(1), 58-76.

Hazzi, O., & Maldaon, I. (2015). A pilot study: Vital methodological issues. *Verslas: Teorija ir Praktika*, *16*(1), 53-62. https://doi.org/10.3846/btp.2015.437

Hirpesa, M., Legesse, B., Haji, J., & Bekele, K. (2020). Determinants of participation in contract farming among smallholder dairy farmers: The case of north Shewa zone of Oromia national regional state, Ethiopia. *Sustainable Agriculture Research*, *10*(1), 10. https://doi.org/10.5539/sar.v10n1p10

Hoang, V., & Nguyen, V. (2023). Determinants of small farmers' participation in contract farming in developing countries: A study in Vietnam. *Agribusiness*, *39*(3), 836-853. https://doi.org/10.1002/agr.21795

Hoang, V. (2021). Impact of contract farming on farmers' income in the food value chain: A theoretical analysis and empirical study in Vietnam. *Agriculture*, *11*(8), 797. https://doi.org/10.3390/agriculture11080797

Hong, Y., Heerink, N., Zhao, M., & van der Werf, W. (2019). Intercropping contributes to a higher technical efficiency in smallholder farming: Evidence from a case study in Gaotai County, China. *Agricultural Systems*, *173*, 317-324.

Huffman, W., & Just, R. (2004). Implications of agency theory for optimal land tenure contracts. *Economic Development and Cultural Change*, *52*(3), 617-642.

Hung Anh, N., Bokelmann, W., Thi Thuan, N., Thi Nga, D., & Van Minh, N. (2019). Smallholders' preferences for different contract farming models: Empirical evidence from sustainable certified coffee production in Vietnam. *Sustainability*, *11*(14), 3799. https://doi.org/10.3390/su11143799

Hung, A., Bokelmann, W., Thi, T., Thi, N., & Van, M. (2019). Smallholders' preferences for different contract farming models: Empirical evidence from sustainable certified coffee production in Vietnam. *Sustainability*, *11*(14), 3799. https://doi.org/10.3390/su11143799

Ihli, H., Seegers, R., Winter, E., Chiputwa, B., & Gassner, A. (2022). Preferences for tree fruit market attributes among smallholder farmers in Eastern Rwanda. *Agricultural Economics, 53*(1), 5-21.

Ikeda, S., & Natawidjaja, R. (2022). The sustainability of contract farming with specialized suppliers to modern retailers: Insights from vegetable marketing in Indonesia. *Agriculture, 12*(3), 380. https://doi.org/10.3390/agriculture1203038

Ivanova, D., & Büchs, M. (2022). Implications of shrinking household sizes for meeting the 1.5 °C climate targets. *Ecological Economics, 202*, 107590. https://doi.org/10.1016/j.ecolecon.2022.107590

Johnny, E., Kabubo-mariara, J., Mulwa, R., & Ruigu, G. (2019*). African Journal of Economic Review*, Volume VII, Issue 2, July 2019. VII(2), 91–112.

Johnny, E., Mariara, J., Mulwa, R., & Ruigu, M. (2019). Smallholder avocado contract farming in Kenya: determinants and differentials in outcomes. African Journal of Economic Review, 7(2), 91-112.2021-493), 10-19pp. https://doi.org/10.19044/esj.2019.v15n22p31

Kagwiria, F., & Gichuki, N. (2017). Factors influencing contractual farming in Kenya: A case of Buuri Constituency, Meru County, Kenya. *International Academic Journal of Information Sciences and Project Management, 2*(1), 161-178.

Kalamkar, S. (2012). Inputs and services delivery system under contract farming: a case of broiler farming. *Australian Journal of Agricultural Economics, 10*(2), 158-168. https://doi.org/10.1111/j.1467-8489.1966.tb00019.x

Kale, E. (2022). Public-Private Partnerships and Agriculture: A Review of Sorghum Production in Meru County, Kenya. *Journal of Public Policy and Governance, 2*(1), 1-16.

Kanana, M., & Mbugua, J. (2019). Factors influencing performance of contract farming in Kenya: A case of sorghum smallholder farmers in Imenti North, Meru County, Kenya. *International Academic Journal of Information Sciences and Project Management, 3*(4), 104-130:

Kangile, R., Mgeni, C., Mpenda, Z., & Sieber, S. (2020). The determinants of farmers' choice of markets for staple food commodities in Dodoma and Morogoro, Tanzania. *Agriculture, 10*(5), 142.

Kaua, C. (2020). Determinants of adoption of Indigenous strategies for climate change adaptation among the Tharaka people in Tharaka Nithi County, Kenya. *East African Journal of Environment and Natural Resources, 2*(1), 31-41. https://doi.org/10.37284/eajenr.2.1.139

Kenya Agricultural and Livestock Research Organization, (KALRO). (2021). *Sorghum*. Retrieved November 18, 2022, from Agricultural Mechanization Research Institute: https://www.kalro.org/amri/?q=node%2F166

Kenya Nation Bureau of Statistics (KNBS), (2019). Kenya Population and Housing Census. https://housingfinanceafrica.org/app/uploads/VOLUME-II-KPHC-2019.pdf

Key, N., & Runsten, D. (2013). Contract farming, smallholders, and rural development in Latin America: the organization of agroprocessing firms and the scale of outgrower production. *World development*, *27*(2), 381-401. https://doi.org/10.1016/s0305-750x(98)00144-2

Khan, F., Urooj, A., Ullah, K., Alnssyan, B., & Almaspoor, Z. (2021). A comparison of Autometrics and penalization techniques under various error distributions: Evidence from Monte Carlo simulation. *Complexity, 2021*, 1-8. https://doi.org/10.1155/2021/9223763

Khan, F., Nakano, Y. & Kurosaki, T. (2019). Impact of contract farming on land productivity and income of maize and potato growers in Pakistan. Food Policy, (April), 1–12. https://doi.org/10.1016/j.foodpol.2019.04.004

Khanal, U., Stott, K.., Armstrong, R., Nuttall, J., Henry, F., Christy, B., Mitchell, M., Riffkin, P., Wallace, A., McCaskill, M., Thayalakumaran, T., & O'Leary, G. (2021). Intercropping—Evaluating the advantages to Broadacre systems. *Agriculture*, *11*(5), 453. https://doi.org/10.3390/agriculture 11050453

Khapayi, M., Van Niekerk, P., & Celliers, P. (2018). Challenges of Contract Farming among Small-Scale Commercial Vegetable Farmers in Eastern Cape, South Africa. *Journal of agricultural extension*, *22*(3), 195-206.

Kilambya, D., & Witwer, M. (2019). Analysis of incentives and disincentives for sorghum in Kenya. *Gates Open Research*, *3*(441), 441.https://gatesopenresearch.org/documents/3-441

Kimbi, T., Mishili, F., Magomba, C., Sieber, S., & Akpo, E. (2022). Factors influencing brewery contract farming participation among sorghum farmers in selected districts in Dodoma, Tanzania: A Logit analysis approach. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4243576

Kimetto, J. (2022). Factors Affecting Adoption of Manure on Banana Yields in Smallholder Farms in Maara Sub County, Tharaka Nithi County, Kenya (Doctoral dissertation, Chuka University).

King-Okumu, C., Jillo, B., Kinyanjui, J., & Jarso, I. (2017). Devolving water governance in the Kenyan arid lands: From top-down drought and flood emergency response to locally driven water resource development planning. *International Journal of Water Resources Development*, *34*(4), 675-697. https://doi.org/10.1080/07900627.2017.1357539

Kipchumba, J. (2021). *Role of Production and Market Innovations on the Competitiveness of Sorghum Agri-Enterprises in Tharaka Nithi County, Kenya*. (Doctoral dissertation, Egerton University).

Kisilu, R., & Ngugi, K. (2021). Micro-satellite diversity in Kenyan sorghum landraces. *Cutting-edge Research in Agricultural Sciences Vol. 12*, 51-62.

Kofoworola, O., & Ojo, A. (2022). Influence of Performance Expectancy and Government Regulations on Electronic Commerce Adoption in Nigeria. *International Academic Journal of Management and Marketing*, *7*(1), 1-11.

Koima, I., Kilalo, D., Orek, C., Wagacha, J., & Nyaboga, E. (2022). Survey of fungal foliar and panicle diseases in smallholder sorghum cropping systems in different agro-ecologies of lower eastern Kenya. *Microbiology Research*, *13*(4), 765-787. https://doi.org/10.3390/microbiolres13040055

Kokeyo, P. (2013). *An Assessment of the factors affecting contract farming: The case of sugarcane production in Migori County, Kenya* (Doctoral dissertation, University of Nairobi).

Koshuma J., Machimu, G., & Panga, F. (2023). Social economic determinants of sugarcane farmers' participation in contract farming through Agricultural Marketing Co-operative Societies in Kilombero Valley, Tanzania. *Journal of Co-operative and Business Studies,*7(1), 4-19.

Kozhaya, R. (2020). A systematic review of contract farming, and its impact on broiler producers in Lebanon. https://doi.org/10.20944/preprints202003. 0359.v1

Krejcie, R., & Morgan, D. (1970). Determining sample size for research activities. *Educational and psychological measurement*, *30*(3), 607-610.

Kumar, A., Bezawada, R., Rishika, R., Janakiraman, R., & Kannan, P. (2016). From social to sale: The effects of firm-generated content in social media on customer behavior. *Journal of Marketing*, *80*(1), 7-25.

Le, N. (2018). Contract farming in Vietnam: Empirical research on marketing determinants, farm performance and technical efficiency of the export-oriented rice sector in the Mekong River Delta. https://doi.org/10.53846/ goediss-7250

Lee, C. (2022). The onset of agriculture and Northeast Asian Neolithic farm culture. *Korean Food and Foodways*, 51-70. https://doi.org/10.1007/978-981-19-0023-5_3

Liang, Y., & Wang, C. (2022). How to design an incentive mechanism of enterprises to farmers in contract farming considering reciprocity preference. *Journal of Industrial and Management Optimization*, 0-0.

Liu, Y., Lu, F., Xian, C., & Ouyang, Z. (2023). Urban development and resource endowments shape natural resource utilization efficiency in Chinese cities. *Journal of Environmental Sciences*, *126*, 806-816.

Liu, S. (2022). A comparative study of four normality tests: Anderson-darling, Shapiro-Wilk, jarque-bera, and Rsj (Poster 13). *AERA 2022*. https://doi.org/10.3102/ip.22.1882502

Loquias, M., Digal, L., Placencia, S., Astronomo, I., Orbeta, M., & Balgos, C. (2021). undefined. *Agricultural Research*, *11*(1), 146-154. https://doi.org/10.1007/s40003-021-00544-0

Losch, B., Freguin-Gresh, S., White, É., Bélières, J., & Giordano, T. (2011). *Rural transformation and late developing countries in a globalizing world* (Doctoral dissertation, World Bank).

Maertens, M., & Vande Velde, K. (2017). Contract-farming in staple food chains: The case of rice in Benin. *World Development*, *95*, 73-87. https://doi.org/10.1016/j.worlddev.2017.02.011

Mango, L., & Kugedera, A. (2022). Pitfalls and prospects of contract farming to smallholder tobacco farmers in Shamva district, Zimbabwe. *International Journal of Agriculture Environment and Food Sciences*, *6*(1), 189-196. https://doi.org/10.31015/jaefs.2022.1.24

Mattalia, G., Wezel, A., Costet, P., Jagoret, P., Deheuvels, O., Migliorini, P., & David, C. (2022). Contribution of cacao agroforestry versus mono-cropping systems for enhanced sustainability. A review with a focus on yield. *Agroforestry Systems*, *96*(7), 1077-1089.

May, D., Arancibia, S., Behrendt, K., & Adams, J. (2019). Preventing young farmers from leaving the farm: Investigating the effectiveness of the young farmer payment using a behavioural approach. *Land use Policy*, *82*, 317-327.

Mazwi, F., Chambati, W., & Mudimu, G. (2020). Tobacco contract farming in Zimbabwe: power dynamics, accumulation trajectories, land use patterns and livelihoods. *Journal of Contemporary African Studies*, *38*(1), 55-71.

Mazwi, F., Chemura, A., Mudimu, G., & Chambati, W. (2019). Political economy of command agriculture in Zimbabwe: A state-led contract farming model. *Agrarian South: Journal of Political Economy*, *8*(1-2), 232-257.

Meemken, E., & Bellemare, M. (2019). *Smallholder Farmers and Contract Farming in Developing Countries.* 28. Https://doi.org/10.1073/pnas.1909501116.

Melesse, B. (2018). A review on factors affecting adoption of agricultural new technologies in Ethiopia. *Journal of Agricultural Science and Food Research*, 9(3), 1-4.

Mishra, Y., Singh, J., & Kumar, S. (2022). Constraint analysis of flower seed production under contract farming system in Punjab. *Journal of Agricultural Development and Policy*, *32*(2), 284-296.

Mousavi, S., & Eskandari, H. (2011). A general overview on intercropping and its advantages in sustainable agriculture. *Journal of Applied Environmental and Biological Sciences*, *1*(11), 482-486.

Mugenda, O., & Mugenda, A. (2008). *Research Methods: Quantitative Approaches.* Nairobi: ACT Press.

Mukherjee, S. (2022). Contract Farming in West Bengal: Patterns, Determinants and Policy Implications. *The Indian Economic Journal*, *70*(4), 670-684. https://doi.org/10.1177/00194662221118310

Mulatu K. (2018). *Perceived Risks and Impacts of Vegetables Contract Farming on Production Efficiency and Household Income in Central Rift Valley of Ethiopia* (Doctoral dissertation, Haramaya university).

Mundia, W., Secchi, S., Akamani, K., & Wang, G. (2019). A regional comparison of factors affecting global sorghum production: The case of North America, Asia, and Africa's Sahel. *Sustainability*, *11*(7), 2135.

Muriithi, W., Mburu, J., & Ngigi, M. (2010). Constraints and determinants of compliance with EurepGap standards: A case of smallholder French bean exporters in Kirinyaga district, Kenya. *Agribusiness*, *27*(2), 193-204. https://doi.org/10.1002/agr.20261

Musa, K., Van Niekerk, P., & Retief, C. (2018). Challenges of contract farming among small-scale commercial vegetable farmers in eastern cape South Africa. *Journal of Agricultural Extension*, *22*(3), 195-206.

Musara, J., Zivenge, E., Chagwiza, G., Chimvuramahwe, J., & Dube, P. (2011). Determinants of smallholder cotton contract farming participation in a recovering economy: Empirical results from Patchway district, Zimbabwe. *Journal of Sustainable Development in Africa*, *13*(4), 1-12.

Muui, C., Muasya, R., & Kirubi, D. (2013). Baseline survey on factors affecting sorghum production and use in eastern Kenya. *African journal of food, agriculture, nutrition and development*, *13*(1), 7339-7353.

Mwadalu, R., & Mwangi, M. (2013). The potential role of sorghum in enhancing food security in semi-arid eastern Kenya: A review. *Journal of Applied Biosciences*, *71*(1), 5786. https://doi.org/10.4314/jab.v71i1.98826

Namoi, N. (2014). Assessment of soil nutrient balances in organic based cassava (Manihot esculenta Crantz) and sorghum (Sorghum bicolor (L.) Moench) cropping systems of Yatta Sub-county, Kenya. *American Journal of Experimental Agriculture*, *4*(12), 1557-1578. https://doi.org/10.9734/ajea/2014/10230

Nazifi, B., & Hussain, Y. (2021). Determinants of participation in contract farming among smallholder maize farmers in North-Western Nigeria. *Acta Scientiarum Polonorum. Agricultura*, *20*(4). 147–160. https://doi:org/10.37660/aspagr.2021.20.4.2

Nazifi, B., Bello, M., Suleiman, A., & Suleiman, M. (2021). Impact of contract farming on productivity and food security status of smallholder maize farmer's households in Kano and Kaduna states, Nigeria. *International Journal of Agriculture, Environment and Food Sciences*, 571-579. https://doi.org/10.31015/jaefs.2021.4.17

Ncube, D. (2020). The importance of contract farming to small-scale farmers in Africa and the policy implications: A review scenario. *The Open Agriculture Journal*, *14*(1).

Ndossi, J., Akpo, E., Ojiewo, C., Ringo, J., Kongola, E., Vernooy, R. & Varshney, R. (2021). Delineating investment opportunities for stakeholders in sorghum seed systems: a logit model perspective. *Agriculture & Food Security*, 10(1), 1-13. https://doi.org/10.1186/s40066-021-00306-9.

Nemecek, T., Huguenin-Elie, O., Dubois, D., Gaillard, G., Schaller, B., & Chervet, A. (2011). Life cycle assessment of Swiss farming systems: II. Extensive and intensive production. *Agricultural systems*, *104*(3), 233-245.

Njagi, T., & Opiyo, J. (2021). *Unfavourable Policies Constrain Post-Pandemic Recovery and the Long-Term Success of the Sorghum Value Chain*. Tegemeo Institute. https://www.team.shirt.com/images/_tegemeo_institute/Technical Report August_2021_.pdf

Njagi, T., Onyango, K., Kirimi, L., & Makau, J. (2019). *Sorghum Production in Kenya: Farm-level Characteristics, Constraints, and Opportunities*. Tegemeo Institute. https://www.tegemeo.org/

Njinju, S., Gweyi, J., & Mayoli, R. (2022). Drought-resilient climate-smart sorghum varieties for food and industrial use in marginal frontier areas of Kenya. *Agriculture, Livestock Production and Aquaculture*, 33-44. https:// doi.org/10.1007/978-3-030-93262-6_3

Njiru, M., Koske, J., & Kitur, E. (2022). Knowledge and Perceptions of Small-Scale Farmers on Climate Variability in Millet and Sorghum-Growing Areas in Tharaka Nithi, Kenya. *East African Agricultural and Forestry Journal*, *86*(1-2), 6-6. https://doi.org/10.37284/eajenr.2.1.139

Njoni, N. (2022). *Assessment of Women Participation in Church Leadership: A Case of National Independent Church of Africa (NICA), Kenya* (Doctoral dissertation, KeMU).

Nsimbila, P. (2021). Determinants of Contract Farming Adoption and its Impact on Productivity of Smallholder Cotton Producers in Tanzania. *International Journal of Social and Administrative Sciences*, *6*(2), 55-69. https://doi.org/ 10.18488/journal.136.2021.62.55.69

Nuwagira, U., Yasin, I., & Nasasira, P. (2023). Interrogating the Impact of Land Use/Land Cover Dynamics in Mbarara City in Southwestern Uganda. *East African Journal of Environment and Natural Resources*, *6*(1), 1-14.

Odunze, D., Van Niekerk, J., & Ndlovu, S. (2015). Assessment of factors that impact on the viability of contract farming: A case study of maize and soya beans in Mashonaland west and Central provinces in Zimbabwe. *South African Journal of Agricultural Extension*, *43*(2). https://doi.org/10.17159/2413-3221/2015/v43n2a358

Ojo, M., Saleh, D., Coker, A., & Ojo, A. (2019). Effect of improved seed technology adoption on small-scale sorghum farmers' productivity in Kebbi state, Nigeria. *Agricultural Science and Technology*, *11*(1), 41-48. https://doi.org/10 .15547/10.15547/ast.2019.01.007

Omoro, W. (2013). *Factors for low sorghum production: a case study of small-scale farmers in East Kano sub-location, Nyando District, Kenya*. (279062). (Master's Thesis dissertation, Van Hall Larenstein University of Applied sciences).

Ooga, D., & Gikunda, M. (2021). Influence of Land Tenure and Farmer Income on Adoption of Indigenous Agricultural Practices in Chuka Sub-County, Kenya. *Journal of Environmental Sustainability Advancement Research*, *7*.

Opiyo, J. (2020). Effect of excise duty on sorghum beer and implication on the welfare of sorghum growers. *Tegemeo Institute of Agricultural Policy and Development, Egerton University, Mimeo, 23pp*.

Orr, A., Schipmann-Schwarze, C., Gierend, A., Nedumaran, S., Mwema, C., Muange, E., Manyasa, E., & Ojulong, H. (2020). Why invest in research & Development for sorghum and millet? The business case for east and Southern Africa. *Global Food Security*, *26*, 100458. https://doi.org/10.1016/j.gfs. 2020. 100458

Ouma, E., Jagwe, J., Obare, A., and Abele, S. (2009). Determinants of Smallholder Farmers' Participation in Banana Markets in Central Africa: The Role of Transaction Costs. *Agricultural Economics*, 41 (2010) 111–122.

Panda, B., & Leepsa, N. (2017). Agency theory: Review of theory and evidence on problems and perspectives. *Indian Journal of Corporate Governance*, *10*(1), 74-95.

Pandey, A. (2016). Socio-Economic Factors of Contract Farming: A Logistic Analysis. *Social Sciences*, *3*(03).

Pandian, B., Sexton-Bowser, S., Prasad, P., & Jugulam, M. (2022). Current status and prospects of herbicide-resistant grain sorghum (Sorghum bicolor). *Pest management science*, *78*(2), 409-415.

Paramesh, V., Ravisankar, N., Behera, U., Arunachalam, V., Kumar, P., Solomon Rajkumar, R., ... & Rajkumar, S. (2022). Integrated farming system approaches to achieve food and nutritional security for enhancing profitability, employment, and climate resilience in India. *Food and energy security*, *11*(2), e321.

Poku, A., Birner, R., & Gupta, S. (2018). Making contract farming arrangements work in Africa's bioeconomy: Evidence from cassava Outgrower schemes in Ghana. *Sustainability*, *10*(5), 1604. https://doi.org/10.3390/su10051604

Prasetyo, R., Rustinsyah, R., & Adib, M. (2022). Determining sustainability in contract farming: An evidence of melon farmers from Klotok Village, Plumpang District, Tuban Regency, Indonesia. *Masyarakat, Kebudayaan dan Politik*, *35*(1), 121-133.

Praveen, N., Sudharani, J., Yamuna, C., Maheshwaramma, S., Sandeep, S., Manikya Minnie, C., & Shekar, K. (2022). Impact of front-line demonstration of millet red gram intercropping under the rain-fed situation in Rangareddy district. *International Journal of Current Microbiology and Applied Sciences*, *11*(1), 412-417. https://doi.org/10.20546/ijcmas.2022.1101.050

Prowse, M. (2012). Contract farming in developing countries: a review. *Journal of Southern African Studies*, *48*(2), 355-374. https://doi.org/10.53846/goediss-6569

Qiu, T., He, Q., Choy, S., Li, Y., & Luo, B. (2021). The impact of land renting-in on farm productivity: Evidence from maize production in China. *China Agricultural Economic Review*, *13*(1), 78-95.

Quddus, A., & Kropp, J. (2020). Constraints to agricultural production and marketing in the lagging regions of Bangladesh. *Sustainability*, *12*(10), 3956.

Quinter, N., Ng'eno, K., & Victoria, A. (2021). Farm Production Factors Affecting Malt Sorghum Production among Contracted Sorghum Farmers in Homa Bay County, Kenya. *African Journal of Education, Science, and Technology*, *6*(4), 144-153.

Rantlo, A., & Bohloa, M. (2022). Factors influencing broiler farmers' participation in contract farming in Lesotho. *African Journal of Food, Agriculture, Nutrition and Development*, *22*(114), 21437-21453. https://doi.org/10.18697/ajfand.114.21050

Research Institute (IFPRI), I. F. (2011). Trends and spatial patterns in agricultural productivity in Africa, International *Journal of Agriculture Environment and Food Sciences*, 1961–2010. https://doi.org/10.2499/9780896298019

Resnik, B. (2010). Scientific research and the public trust. *Science and Engineering Ethics*, *17*(3), 399-409. https://doi.org/10.1007/s11948-010-9210-x

Rhaffora, K., Azizula, N., Jamiana, R., & Shukora, J. (2019). The Adoption of 5S Practice and its Impact on Safety Management Performance: A Case Study in a University Environment. *Journal of Occupational Safety and Health*, *16*(1), 9-17.

Rondhi, M., Aji, J., Hasan, A., & Yanuarti, R. (2020). Factors affecting farmers' participation in contract farming: The case of broiler sector in Indonesia. *Tropical Animal Science Journal*, *43*(2), 183-190.

Ruheni, G., & Wambugu, L (2022). Resource Utilization Planning and Resilience in Food Security Projects in Kenya. *East African Journal of Agriculture and Biotechnology*, *5*(1), 128-137.

Ruml, A., Ragasa, C., & Qaim, M. (2021). Contract farming, contract design, and smallholder livelihoods. *Australian Journal of Agricultural and Resource Economics*, *66*(1), 24-43. https://doi.org/10.1111/1467-8489.12462

Ruml, A., & Qaim, M. (2021). Smallholder farmers' dissatisfaction with contract schemes in spite of economic benefits: Issues of mistrust and lack of transparency. *The Journal of Development Studies*, *57*(7), 1106-1119. https://doi.org/10.1080/00220388.2020.1850699

Saigenji, Y., & Zeller, M. (2009). *Effect of contract farming on productivity and income of smallholders: The case of tea production in north-western Vietnam* (No. 1005-2016-79177). https://doi.org/10.1007/s11842-012-9201-7

Sambuo, D. (2013). Tobacco contract farming participation and income in Urambo; Heckma's selection model. *Contract Farming and the Development of Smallholder Agricultural Businesses*, 129-142. https://doi.org/10.4324/9781315651422-8

Saroj, K., & Jena, P. (2023). Does contract farming enhance farm efficiency? A case of wheat growers of Haryana, India. *Heliyon*, *9*(4), e15222. https://doi.org /10.1016/j.heliyon.2023.e15222

Schlemper, T., Leite, M., Lucheta, A., Shimels, M., Bouwmeester, H., van Veen, A., & Kuramae, E. (2017). Rhizobacterial community structure differences among sorghum cultivars in different growth stages and soils. *FEMS Microbiology Ecology*, *93*(8).

Schmitz, P. (2001). The hold-up problem and incomplete contracts: a survey of recent topics in contract theory. *Bulletin of Economic Research*, *53*(1), 1-17.

Schneider, K., & Gugerty, M. (2010). Gender and contract farming in sub-Saharan Africa–Literature review. *Seattle USA: Evans School of Public Affairs, University of Washington.* https://doi.org/10.7176/dcs/9-12-01

Seeram, E. (2019). Digital radiography: An overview of correlational research. *Digital Radiography*, 1-19. https://doi.org/10.1007/978-981-13-3244-9_1

Setboonsarng, S., Leung, P., & Cai, J. (2018). Contract farming and poverty reduction: The case of organic rice contract farming in Thailand. *Poverty Strategies in Asia*. https://doi.org/10.4337/9781847203168.00016

Sifundza, B. (2019). Contract farming and access to formal credit in South Africa: A case of small-scale sugarcane growers in the Felixton Mill area of KwaZulu-Natal (*Doctoral Dissertation, University of Pretoria*).

Sinaga, A., Gayatri, S., & Prasetyo, S. (2022). Facility and Technological Support and Information Transparency to Improve the Success of a Contract Farming between Farmers Group and Company. *Agriecobis: Journal of Agricultural Socioeconomics and Business*, *5*(1), 59-72.

Sita, K., Rosyadi, A., & Aji, T. (2018). Contract farming through tea-horticulture intercropping system: a case study of Gambung Estate and horticultural farmers in Bandung, Indonesia. *Asian Journal of Agriculture and Development*, *15*(13 62-2018-3542), 75-85.

Smale, M., Assima, A., Kergna, A., Thériault, V., & Weltzien, E. (2018). Farm family effects of adopting improved and hybrid sorghum seed in the Sudan Savanna of West Africa. *Food Policy*, *74*, 162-171.

Sokchea, A., & Culas, R. (2015). Impact of contract farming with farmer organizations on farmers' income: A case study of Reasmey Stung Sen agricultural development Cooperative in Cambodia. Australasian Agribusiness Review, 23, 1-11. https://doi: 10.22004/ag.econ.262469

Srivastava, A., Kumar, S., & Aggarwal, P. (2010). Assessment on the vulnerability of sorghum to climate change in India. *Agriculture, Ecosystems & Environment*, *138*(3-4), 160-169.

Suguna, M., Aruna, C., Deepika, C., Ratnavathi, C., & Tonapi, V. (2021). Genetic analysis of semolina recovery and associated traits- A step towards breeding for specific end uses in sorghum (Sorghum bicolor (L.) Moench. *Journal of Cereal Science*, *100*, 103226. https://doi.org/10.1016/j.jcs.2021.103226

Susilowati, K., Rachmi, A., & Riwajanti, N. (2020). Creating Sustainable Supply of Sugarcane through Contract Farming Partnership (A Case Study at Sugar Factory "Kebon Agung", Malang–Indonesia). *Int. J Sup. Chain. Mgt Vol*, *9*(3), 945.

Tadesse, A., Adicha, A., & Yoseph, T. (2023). Cluster-based improved sorghum production and commercialization in Nyangatom Woreda of south Omo zone, Southern Ethiopia. *Research on World Agricultural Economy*, *4*(1), 62.

Tapsoba, F., Samandoulougou, S., Compaore, H., Ouedraogo, A., Yenouba, T., Bieogo, E., & Sawadogo-Lingani, H. (2021). Characterization of technological properties of sorghum and millet malt produced under control conditions in Burkina Faso. *International Journal of Biological and Chemical Sciences*, *15*(6), 2261-2271.

Taylor, J. (2019). Importance of Sorghum and millets in Africa. *Sorghum and Millets*, 1-21. https://doi.org/10.1016/b978-0-12-811527-5.00001-0

Teressa, T., Bejiga, T., Semahegn, Z., Seyoum, A., Kinfe, H., Nega, A., & Ayalew, T. (2021). Evaluation of advanced sorghum (Sorghum bicolor L. Moench) hybrid genotypes for grain yield in moisture-stressed areas of Ethiopia. *International Journal of Agricultural Science and Food Technology*, *7*(2), 212-219.

Thabethe, L. (2013). Estimation of technical, economic and allocative efficiencies in sugarcane production in South Africa: A case study of Mpumalanga growers (*Doctoral dissertation, University of Pretoria*).

Thurber, C., Ma, J., Higgins, R., & Brown, P. (2013). Retrospective genomic analysis of sorghum adaptation to temperate-zone grain production. *Genome Biology*, *14*(6). https://doi.org/10.1186/gb-2013-14-6-r68

Tilman, D. (2020). Benefits of intensive agricultural intercropping. *Nature Plants*, *6*(6), 604-605.

Timu, A., Mulwa, R., Okello, J., & Kamau, M. (2014). The role of varietal attributes on adoption of improved seed varieties: the case of sorghum in Kenya. *Agriculture & Food Security*, *3*(1), 1-7.

United Nations (2017). Department of Economic and Social Affairs, Population Division (2017). Household Size and Composition Around the World 2017 – Data Booklet (ST/ESA/SER.A/405).

USDA, (2022). World agricultural production. United States Department of agriculture. Foreign Agricultural Service. *Livestock and poultry: World Market and Trade*. https://scholar.google.com/

Vamuloh, V., Panwar, R., Hagerman, S., Gaston, C., & Kozak, R. (2019). Achieving Sustainable Development Goals in the global food sector: A systematic literature reviews to examine small farmers engagement in contract farming. *Business Strategy and Development*, 2(4), 276–289. https://doi.org/10. 1002/bsd2.60.

van der Lee, J., Oosting, S., Klerkx, L., Opinya, F., & Bebe, B. (2020). Effects of proximity to markets on dairy farming intensity and market participation in Kenya and Ethiopia. *Agricultural Systems*, *184*, 102891.

Wang, C., & Liang, Y. (2022). Designing incentive mechanisms in contract farming considering reciprocity preference. *PloS one*, *17*(6), e0269167.

Wawire, A., Csorba, Á., Tóth, J., Michéli, E., Szalai, M., Mutuma, E., & Kovács, E. (2021). Soil fertility management among smallholder farmers in Mount Kenya east region. *Heliyon*, *7*(3), e06488. https://doi.org/10.1016 /j.heliyon.2021 .e06488

Winchell, F., Stevens, C., Murphy, C., Champion, L., & Fuller, D. (2017). Evidence for sorghum domestication in fourth millennium BC eastern Sudan: Spikelet morphology from ceramic impressions of the Butana group. *Current Anthropology*, *58*(5), 673-683. https://doi.org/10.1086/693898

Yeshitila, M., Bunyasiri, I., & Sirisupluxana, P. (2020). The role of trust and transaction cost attributes to reduce side selling in sesame contract farming in Ethiopia. *Journal of the Austrian Society of Agricultural Economics*, *16*(05), 97-109.

Yu, L., Song, Y., Wu, H., & Shi, H. (2023). Credit Constraint, Interlinked Insurance and Credit Contract and Farmers' Adoption of Innovative Seeds-Field Experiment of the Loess Plateau. *Land*, *12*(2), 357.

Zhai, Z., Martínez, J., Beltran, V., & Martínez, N. (2020). Decision support systems for agriculture 4.0: Survey and challenges. *Computers and Electronics in Agriculture*, *170*, 105256. https://doi.org/10.1016/j.compag.2020.105256

Zhang, Q., Tian, J., Zheng, J., Abdullahi, M., & Huo, X. (2022). How does land tenure security affect farm succession? Evidence from Apple growers in China. *Land*, *11*(7), 1036. https://doi.org/10.3390/land11071036

Zhao, J., Yin, X. J., Li, J., Wang, S., Dong, Z., & Shao, T. (2022). Effects of developmental stage and store time on the microbial community and fermentation quality of sweet sorghum silage. *Italian Journal of Animal Science*, *21*(1), 1543-1557.

Zheng, Z., Xie, S., Dai, H., Chen, W., Chen, X., Weng, J., & Imran, M. (2020). An overview on smart contracts: Challenges, advances and platforms. *Future Generation Computer Systems*, *105*, 475-491.

APPENDICES

Appendix I: Introductory Letter

Dear Sir/Madam,

My name is Albunas Tito Kasina, a Chuka University student registration number NM24/57618/22 pursuing a Master's degree in Agribusiness Management. I am carrying out an academic research on **"Factors Associated with the Sustainability of Contract Farming among Sorghum Farmers in Tharaka Nithi County, Kenya".** The main goal of this study is to fulfill the requirements for the award in Master of Agribusiness Management. You are one of the respondents in my research. I humbly request you to fill out the questionnaire with honesty. All responses will be treated with confidentiality, and no names or personal information will be published. The information obtained will only be used to meet the study's objectives.

Yours Faithfully,

Albunas Tito
(Researcher)

Appendix II: Research Questionnaire

Factors Associated with the Sustainability of Contract Farming Among Sorghum Farmers in Tharaka Nithi County, Kenya

Questionnaire Serial number……..

Date of Interview……

Part A: Farmers' Characteristics and Sustainability of Contract Sorghum Farming.

1. Which ward do you come from? .....
2. Please tick your age brackets
   21-30 [ ] 31-40 [ ] 41-50 [ ] 51-60 [ ] 61-70 [ ] 71-80 [ ]
3. What is your highest level of education attained?
   None [ ] Primary [ ] Secondary [ ] University [ ] College [ ]
4. What is your gender?
   Male [ ] Female [ ]
5. What is the household size in this homestead…….
6. Is there any other activity (occupation) that you do apart from contract farming
   Yes [ ] No [ ]
   If yes please indicate……
7. On a scale of five, rate the following statements where (Strongly agree=1, agree=2, neutral=3, disagree=4, strongly disagree=5)

Statement	1	2	3	4	5
Male-headed households are more likely to sustain sorghum contract farming than female-headed households					
Youthful farmers participate and sustain sorghum contract farming more than the elderly farmers					
More of the labour comes from the female households					
The large the household size the more sustainable contract farming is.					
Farmers with college and university education are more like to sustain contract farming					
My age doesn't limit me from sustaining sorghum contract farming					
Inadequate labour supply discourages the sustainability of contract farming					
Farmers who engage in agriculture as the main source of their livelihood are likely to sustain contract farming					

Part B: Farm Characteristics and Sustainability of Contract Sorghum Farming.

1. Land holding of the household during the season ended 1st June 2022- 30th June 2023

Description	Acres
Total farmland operated	
Land rented or borrowed in (for the season)	
Land leased or lent to others (for the season)	
Land (either owned or otherwise) under sorghum contracted by EABL	

2. What kind of land tenure do you carry sorghum contract farming?
   Own land [ ] Family land [ ] Leasehold [ ]
3. Indicate the number of acres that were under sorghum production in the following years

Year	2018	2019	2020	2021	2022
Acreage					

4. Please indicate your annual sorghum yield in bags

Year	2018	2019	2020	2021	2022
Yield in Bags					

5. Please indicate the volume of sorghum delivered to EABL in bags

Year	2018	2019	2020	2021	2022
Yield in Bags					

6. How far is your land under contract farming from the EABL collection centers in kilometers?
   Below 3km [ ] 4-7km [ ] 8-11km [ ] Above 12km [ ]
7. What is your main source of income?
   Contract Farming [ ] Formal Employment [ ] Informal Employment [ ] Other [ ]
8. On a scale of five, rate the following statements where (Strongly agree=1, agree=2, neutral =3, disagree=4, strongly disagree=5)

Statement	1	2	3		5
Sorghum farmers who own title deeds are more likely to sustain contract farming as compared to those producing the crop on leased land					
The size of the land influences the sustainability of contract sorghum farming					
The location of land from collection centers influences the sustainability of sorghum contract farming					
Individual land ownership allows sorghum farmers to adopt and sustain sorghum practices as compared to other farmers operating on other forms of ownership					
Sorghum farmers whose farms are accessed by road are more likely to sustain contract farming compared to those whose farms are inaccessible by road					
Farmers with large sizes of land are able to produce more sorghum as compared to farmers with a small size of land					
The income generated from agricultural enterprises other than those undertaken in the farm helps in sustaining contract farming.					

Part C: Contract Terms and Sustainability of Contract Sorghum Farming.

1. What type of contract have you entered with EABL in sorghum production?
   Written contract [ ] Oral contract [ ]

2. What type of contract is most preferred by contracted farmers?
   Written contract [ ] Oral contract [ ]
3. How long have you contracted with EABL for sorghum production? …….

4. What are the terms of the contract?

Service	Yes	No
Provision of inputs (seeds, fertilizer, chemicals)		
Provision of extension services (knowledge and skills)		
Reliable sorghum market		
Collection and transportation of produce		
Quality Pre-testing services		

5. Where do you sell your sorghum?
   EABL only [ ] Brokers only [ ] EABL & Brokers [ ] Other Contract markets [ ]
6. What is your view regarding the statements below on the contract terms? Where, (Strongly agree=1, agree=2, neutral=3, disagree=4, strongly disagree=5)

Terms	1	2	3	4	5
The seeds were provided on time.					
The quality of the seed provided was good.					
The level of advice provided was adequate.					
The training provided was adequate.					
Collection of the product after harvest was timely					
Payment for the sorghum supplied to the contractor were made in timely manner					
The price of sorghum is satisfactory					
I delivered all products as agreed					
There was side selling by some farmers					
I delivered the quality of sorghum as agreed					
The provision of extension services by EABL has resulted in sustained contractual arrangements in sorghum production					
The provision of inputs by the contractor enhances the sustainability of sorghum contract farming					
A majority of the sorghum farmers are able to sustain the production of the crop since there is a reliable market					
Quality specifications for quality parameters are clear					
Specifications of the quality parameters are achievable					

Part D: Farming Systems and Sustainability of Contract Sorghum Farming.

1. Which farming system do you use on your farm?
   Intensive Farming [ ] Extensive Farming [ ] Small Scale [ ] Large Scale [ ]
2. Area under sorghum production in acres ……
3. Which cropping patterns do you utilize in sorghum production?
   Mono-cropping [ ] Intercropping [ ] Mixed Cropping [ ]
4. If intercropping
   Strip Intercropping [ ] Row Intercropping [ ] Relay Intercropping [ ]
5. Which of the farming methods results in more/higher sorghum yields?
   Monoculture [ ] Intercropping [ ] Other …….
6. What is your level of agreement with the following statements on the relationship between farming systems and the sustainability of contract farming? Where (Strongly agree=1, agree=2, neutral =3, disagree=4, strongly disagree=5)

Aspects of farming systems	1	2	3	4	5
Mono-cropping promotes the sustainability of contract farming					
Inter-cropping increases the likelihood of sustaining contract farming					

Farmers engaged in intensive farming systems are more likely to sustain contract farming than those producing sorghum under extensive systems					
A majority of the sorghum farmers practice mixed cropping to increase crop yields					
Most of the farmers producing sorghum under contract farming utilize row intercropping					
Land conservation methods promote the sustainability of contract farming					
Sorghum husbandry practices promote the sustainability of contract farming					

7. Is there a farming system recommended for use by EABL?
   Yes [ ] No [ ] Give a reason for your answer …….

Part E: Sustainability of Contract Farming

1. Please indicate (by ticking) the year when you were contracted to produce sorghum for EABL

Year	2017	2018	2019	2020	2021	2022	2023

2. Has your contract with EABL ever been terminated?
   Yes [ ] No [ ]
   If yes, what was the cause of the contract termination……..
3. How would you describe the level of sustainability of sorghum contract farming?
   Very low [ ] Low [ ] average [ ] High [ ] Very High [ ]
4. On a scale of five, rate the following statements where (Strongly agree=1, agree=2, neutral =3, disagree=4, strongly disagree=5)

Statement	1	2	3	4	5
I am willing to renew my contract between me and EABL					
Contract terms involved in the contract are good					
The inputs offered by EABL are of quality					
The inputs are offered and delivered on time					
The price offered by EABL for sorghum is satisfactory					
The price is not delayed					
The extension services offered by the contracting company are reliable					
The extension services offered by the contracting company are quality					
The sorghum market offered by the contracting company is reliable					
The price offered by other contracting companies is good					
The credit offered by the contracting company is helpful					
The EABL offers a mode of transport					
The relationship between me and the contracting company is good					
There has been a great increase in the number of contracted farmers					
The acreages under contract farming have greatly increased					
The volumes of sorghum sustain contracts					
The quality of sorghum sustains contracts					

The end, Thank you for your participation

Appendix III: Chuka University Ethics Review Letter

CHUKA UNIVERSITY

Knowledge is Wealth *(Sapientia divitia est)* Akili ni Mali

CHUKA UNIVERSITY INSTITUTIONAL ETHICS REVIEW COMMITTEE

Telephones: 020-2310512/18
Direct Line: 0772894438
Email: info@chuka.ac.ke,
P. O. Box 109-60400, Chuka
Website: www.chuka.ac.ke

21st June, 2023

REF: CUIERC/ NACOSTI/393
TO: **Albunas Tito**

RE: Factors Influencing the Sustainability of Contract Farming Among Sorghum Farmers in Tharaka Nithi County, Kenya.

This is to inform you that *Chuka University IERC* has reviewed and approved your above research proposal. Your application approval number is *NACOSTI/NBC/AC-0812.* The approval period is 21st June, 2023 – 21st June, 2024.

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by *Chuka University IERC.*
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to *Chuka University IERC* within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to *Chuka University IERC* within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to *Chuka University IERC.*

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely

Dr. Benjamin Kanga
SECRETARY

Appendix IV: Research Permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 599533

Date of Issue: 17/July/2023

RESEARCH LICENSE

This is to Certify that Mr.. ALBUNAS TITO KASINA of Chuka University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Tharaka-Nithi on the topic: FACTORS ASSOCIATED WITH SUSTAINABILITY OF CONTRACT FARMING AMONG SORGHUM FARMERS IN THARAKA NITHI COUNTY, KENYA for the period ending : 17/July/2024.

License No: **NACOSTI/P/23/27651**

599533

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

See overleaf for conditions