# EXAMINING THE SOCIO-ECONOMIC FACTORS INFLUENCING SUSTAINABLE FOOD PRODUCTION IN ARID AND SEMI-ARID LANDS OF ELGEYO MARAKWET COUNTY IN KENYA

**BY**

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**A RESEARCH PROJECT REPORT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF ENVIRONMENTAL STUDIES (COMMUNITY DEVELOPMENT) IN THE SCHOOL OF ENVIRONMENTAL STUDIES OF KENYATTA UNIVERSITY.**

**NOVEMBER 2021**

## DECLARATION

**Declaration by candidate:**

This research project report is my original work and has not been presented for award of degree in any other university.

Signature……. Date ……

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**Declaration by supervisor:**

This research project report has been submitted for examination with my approval as the University Supervisor.

Signature..... Date.....

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## DEDICATION

I dedicate this research project report to my dear wife Sheilla, son Myles and my parents Mr. and Mrs. Shadrack Chemweno for giving me immense support during my studies and research work.

## ACKNOWLEDGEMENTS

Special thanks to the institutions and people who made my research project report successful. Many thanks to my University Supervisor, Dr. Felix Ming'ate of Kenyatta University, who has immensely guided me through this research project report from its inception to completion.

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| | |
|---|---|
| **ASDSP** | Agricultural Sector Development Support Programme |
| **CADSAL** | Community Agricultural Development Project in Semi-Arid Lands |
| **CIP** | Community Initiated Project |
| **CPTD** | Community Participatory Technology Development |
| **DFID** | Department For International Development |
| **ECPAFS** | European Commission Policies and Actions for Food Security |
| **EDF** | European Development Fund |
| **GDP** | Gross Domestic Product |
| **GOK** | Government of Kenya |
| **IPMA** | International Project Management Association |
| **IRD** | Integrated Rural Development |
| **JICA** | Japan International Cooperation Agency |
| **NAAIAP** | National Accelerated Agriculture Input Access Programme |
| **NALEP** | National Agriculture and Livestock Extension |
| **ODI** | Overseas Development Institute |
| **OECD** | Organization for Economic Co-operation and Development |
| **PMU** | Project Management Unit |

## ABSTRACT

Food insecurities remain a major challenge to many developing countries. The Food and Agricultural Organization estimates that 811 million people experienced hunger in 2020. In Kenya, the arid- and semi-arid (ASAL) Humanitarian Network estimates indicate that one in 10 people in ASAL areas faced high levels of food insecurity. Although some ASAL counties such as Elgeyo Marakwet have benefited from several famine interventions projects to reduce food insecurities, poverty, hunger, and food insecurities remain high. Consequently, this study examined the socio-economic, management practices, and capacity-building factors that affect production of food in ASAL areas, learning from implementing the Community Agricultural Development for Semi-Arid Lands project. The study employed a cross-sectional survey to collect data from various farmer groups that benefited from the program. A sample of 136 determined using Krejcie and Morgan's table was randomly selected from the list of farmer beneficiaries. Data was analysed using the Statistics Software Package for Social Scientists (SPSS) version 21. Data presentation was conducted by use of cross-tabulated tables, percentages and frequency distribution tables. From this study, Marital status $(p = 0.006)$, Family type $(p = 0.038)$, Family size $(p = 0.018)$, land ownership $(p = 0.021)$And land size $(p = 0.006)$ had a significant association with overall sustainable food production. The study found a statistically significant relationship between management practices $(F(1,134) = 321.94, p < 0.0005)$, capacity building $(F(1,134) = 1239.91, p < 0.0005)$ and overall sustainable food production.Consequently, programs aiming to improve food production in these areas and other similar settings should prioritize capacity building among farmers and deploy sustainable food production approaches while considering the socio-economic factors such as family type, family size and marital status that significantly influence food production. Besides, other factors such as land ownership must be urgently addressed if increased food production in the areas has to be realized.

# CHAPTER ONE: INTRODUCTION

## 1.1 Background Information

Globally, more than 811 million individuals are chronically hungry (FAO, 2020). The largest number of malnourished people live in Pacific and Asian areas, while Sub-Saharan Africa's (SSA) population remains the largest concentration block of hungry people globally (E. FAO, 2018). According to Food and Agriculture Organization (FAO), food security is explained as a scenario existing where individuals have efficient access to socio-economic and physical needs. For instance, sufficient, nutritious and safe, food which meets individuals' dietary needs and food preferences for an active and healthy life is essential (FAO, 2020).

Hunger in Sub-Saharan Africa (SSA) is dominant within the African narrative (Ejide, 2012). International Food Policy Research Institute reported hunger cases in DRC Congo, Chad, Eritrea and Burundi as "alarming" based on the Global hunger index score (Von Grebmer et al., 2011). Other Sub-Saharan Africa,'s parts such as the Horn of Africa or southern Madagascar, have reached catastrophic dimensions (Sasson, 2012). Development indicators report, Sub-Saharan Africa has been the second-most region to be affected severely by climatological disasters amongst the world's developing regions (World Bank, 2003). This is due to high temperatures where most inhabitants in the region are dependent on rain-fed agricultural production fit for their livelihoods (Hawkes & Ruel, 2008).

According to the International Food Research Institute (2002), about one hundred and twenty-one individuals living in Sub-Saharan Africa survived on less than 0.50 US dollars on daily basis in 2004. Decreasing rates in the production of food crops do not meet current population growth. An annual average rate of 2.4% reflects in Africa. Even

though part of the population lives in abject poverty in Sub-Saharan Africa, declining rates were reflected from 48% to 10% between 1999 and 2008 (International Food Policy Research Institute, 2002).

KARI (2011) explains that decreasing crop production per capita has been experienced in Kenya where crop on-farm agricultural production is lagging annually. Food insecurity has therefore been experienced in the country. Hazel and Poulton (2007) suggest on increasing food crop production and surpassing population growth to achieve food security within households (Hazel & Poulton, 2007).

Together with donors and NGOs, the Kenyan government has put in place initiatives and implementations mechanism to mitigate the current food situation, broadly described as formulated policies and programs favour individuals' needs and influence food security within the country. Some of the long-term interventions include targeted food security programs such as National Accelerated Agriculture Input Access Programme (Kipng'eno, 2012), Orphaned Crop Programme (Nduta, 2012), Njaa Marufuku Kenya (Njoroge, Ombati, & Oywaya-Nkurumwa, 2013), and Traditional High-Value Crop (THVC) Programme (Wittich, 2015).

The larger part of Elgeyo Marakwet County undergoes classification as a Semi-arid and Arid Land (ASAL) zone. Food crops production has, on several occasions, been hampered by extreme weather conditions leaving the residents there vulnerable to hunger (Kipkorir *et al.*, 2013). In response to this, the Government and other stakeholders have initiated several food security programs in the region like furrow irrigation to attain food sufficiency (Kipkorir & Kareithi, 2013). One of such programs included Community Agricultural Development Project in Semi-Arid Lands (CADSAL), which the research aims to investigate on factors influencing food production sustainability in Elgeyo Marakwet County.

Addressing the issues of food security such as those experienced Elgeyo Marakwet and Semi-arid and arid areas in the country, studies have shown that organizational management and structure, access to land, capacity building are fundamental (Gervais, 2004; Neupane, Sharma, & Thapa, 2002; Okoth, Odunga, & Oduke, 2013). Proper management practices aim at the existence of sustainable local resources and ensure capacity building for continuity of projects without external resources.

As Espinosa *et al.* (2000) and Cheung *et al.* (2000) suggest, a project manager should take on the leadership role concerning managing the project and leading the technological initiatives (Cheung & Lai, 2000; Espinosa, Slaughter, Kraut, & Herbsleb, 2007). Leadership skills are thus important in ensuring the sustainability of community projects. Management is planning, organizing, staffing, directing, and controlling (Neupane et al., 2002). Therefore, leadership and management differ because a manager has formal authority, while leaders primarily deal with influence. Wolf et al., notes that structure directly affects the success of an organizational operation strategy because it shapes both competencies and processes that shape performance (Wolf & Egelhoff, 2002).

A high-level task force of United Nations explains further about crisis in food security globally. Agricultural production increase directly affects nourishment and food security within households. An increase in production of food used for consumption indirectly influence income rates through increase in food purchase and permition of better-quality food resources (UN, 2010). Therefore, secured land rights positively impacts vitality and volatility of food prices in rural and poor households.

Hanstad and Nielsen (2009), conducted studies on the impact of land ownership in India through surveys in rural households of five countries of the Asian Continent (Hanstad, Nielsen, Vhugen, & Haque, 2009). Skoet and Stamoulis, (2006) showed that people

who had access and owned land were more food secure than those who did not have access (Skoet & Stamoulis, 2006).

The same observations were made in another study that was conducted in China, indicating the number of individuals facing undernourishment reduced significantly between the year 1969 and mid-2000s from three hundred and eighty-seven million to one hundred and fifty million and an attributed reduction to agricultural reforms related to improved land rights (Skoet & Stamoulis, 2006). Therefore, the process of empowerment, performance strengthening as per one's potential amongst members of the community in marginalized and providing opportunities of resource accessibility is known as capacity building. Implementation of projects for food security, the recipients should have the ability to participate in multi-functions and guarantee that food is available and accessible to all. Recipients should ensure efficient use of their technical assets such as farming skills and agricultural knowledge base to produce nutritious food (Webb & Rogers, 2003).

### 1.2 Problem Statement

According to Food and Agricultural Organization (FAO, 2020), up to 811 million people went hungry in 2020 and this number is expected to increase with the likely effect of climate change and unreliable rainfed agriculture (Parry, Evans, Rosegrant, & Wheeler, 2009). Besides, recent global estimates on undernourishment estimate that over 55 million people will be undernourished as a result of climate change by 2050 (Janssens et al., 2020). While ending hunger has been enshrined as one of the top goals to achieve under the Sustainable Development Goals (SDGs) by 2030 (Assembly, 2015), progress towards achieving the target remains slow and is further exacerbated by the effects of climate change the COVID-19 pandemic (Laborde, Martin, Swinnen, & Vos, 2020). Ending hunger in all its forms requires sound strategies that shall bolster the

performance and sustainability of food production systems globally, but particularly in developing countries such as Kenya.

Although the Kenyan government has developed several development blueprints to improve food security such as the Kenya Vision 2030 (Ndung'u, Thugge, & Otieno, 2011), food production remains unsustainable as recently highlighted increase in food prices, hunger cases of hunger and undernourishment in the country (Emongor, 2014). To move towards achieving Kenya Vision 2030, there has been a focus on programs that increase livestock production, crop production and tree planting. Policy formulation on proper land use and market accessibility, add value to farm production (Mohajan, 2014). To hasten the achievement of Vision 2030 objectives, the Kenyan Government in 2018 came up with The Big 4 Agenda, which recognizes food security as the main support system for the achievement of dreams and objects of the vision.

With the low rainfall annually in ASAL setting such as Elgeyo Marakwet county, rainfed agriculture remains an unviable food production option, however, it remains unclear to what extent and what specific factors may be influencing sustainable food production within the county (Kipkorir & Kareithi, 2013). Inadequate precipitation, especially in Kerio valley, leaves the County vulnerable to hunger due to frequent crop failures. In recent years, the Marakwet region was periodically plagued with hunger (Kipkorir & Kareithi, 2013).

Despite the existence of many community programs to boost food security in Elgeyo Marakwet County, available academic evidence shows the influence of organizational structure, leadership, and management, the impact of land accessibility, and capacity building on agricultural production (Neupane *et al.*, 2004; Skoet and Stamoulis, 2006; UN, 2010). Few studies have investigated how community projects influence food security in Kenya's semi-arid and arid areas. In this light, therefore, this study sought to

understand the socio-economic factors that influence sustainable food production in Elgeyo Marakwet County.

These shortcomings highlight a need for designing appropriate interventions that targets the factors that influence food production in ASAL areas to improve food production and security in the country. Therefore, this study is central to understanding the interventions for enhancing food production by evaluating the socio-economic factors affecting the sustainable food production in ASAL areas, learning from Elgeyo MaraKwet County.

### 1.3 Research Questions

The study intends to answer the following questions: -

1. To what extent did demographic characteristics affect the implementation of sustainable food production programs in Elgeyo Marakwet?
2. To what extent did the organizational structure and management of the CADSAL community project influence the implementation of sustainable food production in Elgeyo Marakwet?
3. To what extent did capacity building influence the implementation of sustainable food production programs in Elgeyo Marakwet?
4. To what level did land size, access and ownership impact the implementation of sustainable food production programs in Elgeyo Marakwet?

### 1.4 Research Objectives

The following objectives guided the study: -

1. To determine the extent to which demographic characteristics affect the implementation of sustainable food production programs in Elgeyo Marakwet.

2. To assess the influence of organization management and structure of CADSAL community project in implementing sustainable food production in Elgeyo Marakwet.
3. To evaluate the effects of capacity building in the implementation of sustainable food production programs in Elgeyo Marakwet.
4. To examine the impact of the land characteristics (i.e., size, ownership, accessibility) on the implementation of sustainable food production programs in Elgeyo Marakwet.

### 1.5 Significance of the Study

Agriculture remains the largest employment sector in most developing countries, and international agriculture agreements are crucial to a country's food security. Unfortunately, over the past two decades, the number of food emergencies has risen from an average of 15 annually in the 1980s to more than 30 annually from 2000 onwards, where the vast majority of protracted crises are in Africa (E. FAO, 2018).

Therefore, this study's findings and recommendations hope to help the government implement policies that can revitalize agriculture-related projects and private sector participation in food security initiatives. The study aims to provide information to project management and implementation teams to identify the strengths and weaknesses of program implementation and take corrective measures. Empirical findings and recommendations in the subject hope to offer practical importance for stakeholders of related programs within the country and even beyond.

The research will also provide important lessons to replicate or enable development practitioners to pay attention while designing and implementing development and food security programs. This research study will provide a base for further research on the

projects' encompassing implementation issues. The research aims to document social and economic factors that influence project implementation for planners and implementers. Key assumptions of food-based projects will be redefined to ensure the achievement of food security country-wide and consequently hasten the realization of the SDGs and Kenya's vision 2030.

### 1.6 Conceptual Framework

The overall objective of the CADSAL project is to ensure the sustainable food security of the people of Elgeyo Marakwet County. A dependent variable was directly linked and largely influenced by independent variables, e.g., the extent to which project beneficiaries were supported, i.e., Management of the entire CADSAL program during implementation, demographic characteristics such as age, sex, and the education level, including successful involvement of various stakeholders and capacity building of the program beneficiaries for the project beneficiaries for sustainability purposes. Other factors include the intervening variables, such as community perception, weather conditions, and government policies; dependency syndrome, even if not included in the research study, influences the dependent variable (Figure 1). This conceptual framework is informed primarily by the Food System Wheel which describes the economic, social and environmental factors that influence the sustainability of food systems (Keener, 2003). A further description of the food system wheel framework has been described elsewhere (Nguyen, 2018).

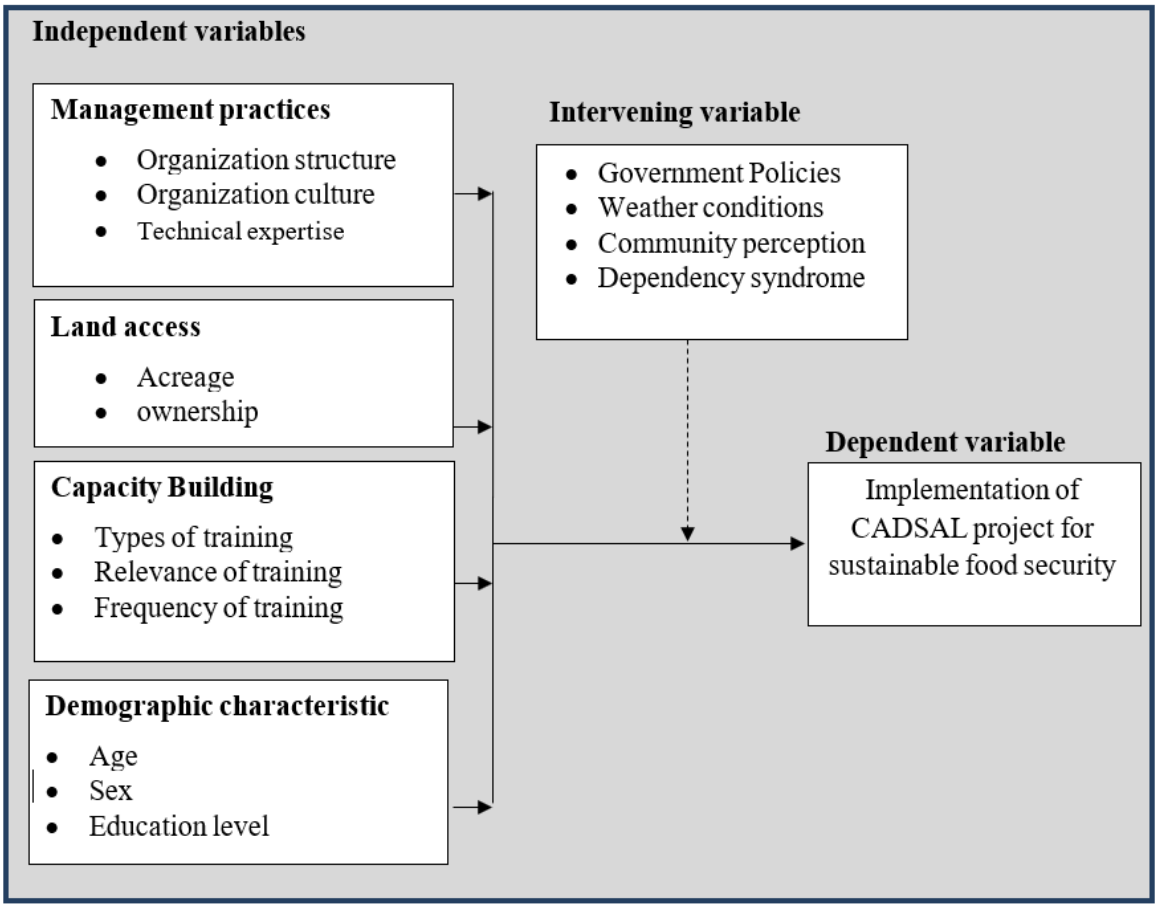


**Figure 1.1: Conceptual framework**

### 1.7 Definition of Terms

Below are the definitions of some of the key terminologies used in this research.

**a) Civil society**

Kaldor (2008) defines civil society as the medium through which social contracts or bargains are negotiated between the individual and political and economic authority centers. Non-Governmental Organizations (NGOs) and Civil Society Organizations (CSOs) were treated as civil society representatives in this work. Therefore, the terms CSO/NGOs were interchangeably used throughout this research.

### b) Empowerment

For this research, empowerment is defined as the expansion of assets and capabilities of poor people to participate in, negotiate with, influence, control, and hold accountable institutions that affect their lives (World Bank, 2002).

### c) Sustainability

Sustainability is an ethical ideal and normative ethical principlefor other developing societies (Parker, 1993; Kothari, 1994). For this research, sustainability is defined as the ability of donor aided programs to create systems that continue to connect and impact on the beneficiaries and to support present and future generations by creating and maintaining the conditions under which humans and nature can exist in a productive harmony even after the programs are wound up (EPA, 2008)

# CHAPTER TWO: LITERATURE REVIEW

## 2.1 Global Status on Food Security

An approximate population of 811 million individuals are a representation of 13% of the world population faced hunger in 2020 (FAO, 2020). This number remains unacceptably high. A large number of the population lives in developing African countries which are prevalent to undernourishment (FAO, 2020).

## 2.2 Food security Status in Africa

According to Food Agricultural Organization (2008), accessibility of food in many African countries is closely related to the production of food locally. To date, food insecurity remains a huge challenge globally as over 1 billion people suffer from malnutrition, undernutrition, and starvation (Bruinsma, 2009). Food insecurity is encountered by countries with poor agricultural systems due to changes in temperature and climate. Populations in Sub-Saharan Africa and Asia are highly vulnerable to food insecurity. Changes in rainfall and temperature influence crop growth and crop yields hence impacting general agricultural production and supply (FAO, 2020).

Addressing food insecurity requires wisdom and vision especially when African countries face doubling population growth to approximately 1.3 billion in 2020. Africa has the potential to feed itself if governments can focus on innovative strategies towards achieving sustainable food security (Bremner, 2012).

Food insecurity in Africa has reached catastrophic dimensions, especially in southern Madagascar. The situation is not only about insufficiency but also about the poor nutritional content of the available food. In addition to the catastrophe, women and children suffer as the male counterparts receive more food than they do because of the patriarchal culture in the African society (Galiè et al., 2019). The prevailing food

insecurity is signalled by the food riots and the tremendous increment of food prices in the market. The inadequacy to produce enough food has been the key to food insecurity. There was an increased awareness of the need to produce more globally since the 2007-2008 food crisis, and it should be our main goal to achieve food security. Commitments between the African Union and African presidents were made to increase national budgets for agriculture by 10% from 2010 to 2011 (Sasson, 2012). This commitment led to sustainable agriculture and higher yielding in the nations that fulfilled the commitment with technological advancements. However, there is a need for the whole continent to adopt good practices and political will if food security is to be achieved.

There have been many initiatives to improve the food situation across the globe as well as in Africa. Among the projects is the Feed the Future initiative by the USAID in partnership with nations across the globe to combat hunger through an opportunity for improvement, resilience, and nutrition and boosting agricultural-led growth. Feed the Future has helped nations improve nutrition among children and mothers, create new markets and new opportunities, increase production, and increase technological and ideological exchanges (Du, Pinga, Klein, & Danton, 2015). Other initiatives include the FoodAfrica program funded by the government of Finland to curb food insecurity in Uganda, Ghana, Benin, Senegal, Cameroon, and Kenya, and Climate Smart Livestock (PCSL) which purposes to ensure the livestock stakeholders adopt climate change mitigation and adaptation in their farming practices among other projects.

### 2.3 Food security Status in Kenya

The Kenyan agricultural sector makes a 24% contribution to the country's Gross Domestic Product (GDP). A 27% contribution to the GDP is made through sectors in manufacture, distribution and service delivery (GoK, 2010). The agricultural sector makes 50% contribution towards exportation, 75% towards industrial raw materials and

45% contribution is directed towards government revenue (Ouma-Onyango, 2014). Approximately, 80% of Kenya's population survive from agricultural-related activities in rural areas. In that case, agriculture has been made a priority by the Kenyan government in order to enhance national development (Mabiso, Pauw, & Benin, 2012).

FAO's vision is to accomplish reduced hunger and ensure Kenya is free from malnutrition guided under Kenya United Development Assistance Framework (UNDAF) and Country Programming Framework (CPF) to respond to Kenya's priorities well stipulated in the National Development Blueprint Vision 2030 and the Big Four Agenda. However, FAO is more interested in the third Agenda, which is inclusive and sustainable growth for a reproductive nation and the core principle of "leaving no one behind" in the Vision 2030 document. The CPF program is a short-term program being implanted between 2018 and 2022. The principles of the program are to improve resilience in food systems and community's livelihoods, formulate policies and governance improvement for natural resource management in value-added chains (FAO, 2020).

To enhance poverty alleviation, food security, and the creation of employment opportunities, the government of Kenya, in partnership with other stakeholders, has managed to implement specific projects across the country. These projects include; East African Agricultural Productivity Project (EAAPP), Njaa Marufuku Kenya (NMK), NALEP-SIDA, Kenya Agricultural Productivity and Agribusiness Project (KAPAP), Traditional High-Value Food Crops Promotion Project (THVC), and Promotion of Private Sector Development in Agriculture (PSDA) among others. Despite the projects having different approaches and objectives, the end product was to increase food security and reduce poverty (Mwencha, 2013).

In the Kerio Valley-Kenya, Community Agricultural Development Project in Semi-Arid Lands (CADSAL) has been implemented to disseminate and adopt the NERICA rice growing in Kerion Valley. Implementation was done by providing agricultural extension services such as informing, advising, and training farmers and other stakeholders on the best technological approaches to improve their yields and alleviate poverty among the community. Technology has been the back born of improving farm yields and increasing the farmer's income globally.

To enhance the promotion of new technologies in agriculture among the people of Kerio Valley, CADSAL adopted two extension approaches, namely, Community Initiated Project (CIP) and the Community Participatory Technology development (CPTD) (Lagat, Bunyatta, & Rop, 2021). Lagat, Bunyatta & Rop, (2021) research on NERICA Rice Technology Acquisition through CADSAL found community participatory extension approach positively impacted NERICA technology acquisition by the community. The approach was efficient because it provided preliminary information and clarification.

## 2.4 Organizational management and structure on sustainable food production programs

With capacity existence and sufficient local resources, good management of resources ensures continuity of planned projects without external resources. As Espinosa *et al.* (2000) and Cheung *et al.* (2000) suggest, a project manager should take on the leadership role concerning managing the project and leading the technological initiatives (Cheung & Lai, 2000; Espinosa et al., 2007).

To ensure management skills establishment and sustainable community projects, there is a need for differentiation between management and leadership (Neupane et al., 2002).

Leadership involves influence while management involves the performance of functions with formal authority. Andriessen and Drenth (2007) note that leaders influence others based on factors rather than formal authority and position whereas managers organize, plan, direct and control through their position.

Wolf (2002) argues that structure directly affects the success of an organization's operation strategy (Wolf & Egelhoff, 2002). A successful operation strategy is achieved through the performance and competencies of an organization. The idea of a successful operation strategy involves good performance even in poor structures (Clemmer, 2003).

### 2.5 Access and size of the land on sustainable food production programs

Increased production of food for consumption enhances food security within households and high agricultural productivity. Indirect causes of food security and nutrition involve increased income earnings and producing quality food (Olofin, Olufolahan, & Jooda, 2015). The volatility of food prices in poor households is improved when land rights are secured.

Agriculture is the pillar of Kenya's economy which accounts for a 33% Gross Domestic Product. Additionally, about 40% of the Kenyan population and 70% living in rural households directly depend on agriculture for their survival. Kenyans hold land dear to their lives and sometimes have led to fights. However, the total Kenyan land is 582,646 $km^{2,}$ with about 20% suitable for farming receiving above 1200mm rainfall annually, and only 8% is fully utilized for farming (Musa & Odera, 2015). The other 80% comprises Arid and Semi-arid lands (ASALs) and is home to over 14 million individuals who engage in pastoralism and dryland farming.

Elgeyo Marakwet in Kerio Valley is partly highland (49%) and partly semi-arid (40%). 11% is the escarpment region where beans, millet, sorghum, and maize are grown at

high risk. The highland (49%) area is utilized for both livestock and crop farming. The semi-arid land (40%) is mainly utilized for growing climate-resistant crops such as sorghum and millet (G.O.K, 2013). Most farmers in this region are small-scale farmers owning about 1.36 ha, and just a few are engaged in large-scale farming owning about 17.3 ha. The region mainly depends on agriculture for revenue generation, with about 78% engaged in crop and livestock husbandry activities. However, 73.3% of the population experiences food and nutritional insecurity. The semi-arid region does not receive enough rains to engage in suitable farming; however, irrigation has highly been used to enable farming which has been majorly initiated by donor funding to alleviate poverty in the region. Davies and Moore (2016) found that despite the Marakwet and Pokot communities being subjected to adverse agricultural interventions and land use, their farming is still rooted in deeper historical methods (Davies & Moore, 2016).

### 2.6 Influence of Capacity Building on sustainable food production programs

Empowerment of community members from marginalized areas through equality, strengthening their performance and providing access to resources is known as capacity building. During the implementation of projects for food security, recipients should perform their functions to make sure that food is available and accessible to all. Recipients should use their knowledge base and skills of farming to produce nutritious food (Webb & Rogers, 2003).

In Rwanda, as Malinga (2008) noted, the government came to a realization of capacity building which meant more than addressing multi-sectoral approaches and training (Malinga, 2008). Establishing a Multi-sector Capacity Building Program (MSCBP) by Rwanda Government influenced developmental changes such as designing initiatives in private and public sectors and improve the effectiveness, efficiency and transparency of organizations.

In Botswana, the Botswana National Productivity Center (BNPC) represents a good example of an institution being used for facilitating the country's capacity development and ongoing productivity enhancement (Hope Sr, 2009). Likewise, the Technical Assistant Unit (TAU) in South Africa was established to undertake capacity development skills. It is demand-driven and focuses on developing indigenous capacity using international technical expertise and support for the success of community-based projects.

Project leaders of Kenya Green Growers in Eldama Ravine are given formal education opportunities while community project implementers undertake demonstrations due to their low education levels (KOECH, 2011).

## 2.7 Influence of Demographic Characteristics on sustainable food production programs

The United Nations Economic and Social Council report of 2007 states that the female gender overrepresents those facing undernourishment globally. For instance, about 60% of women and girls are food insecure. World Food Programme (2009) calls for initiatives to address gender-based discrimination and makes moves on food prioritization. Women empowerment approach gives them the freedom to gain social welfare and improve society.

De Schutter (2013) explains that in Asian and Pacific areas, women in the rural areas conducted duties that pertained to availability, accessibility and utilization of food resources to curb food insecurity (Agarwal, 2018; De Schutter, 2013). According to World Bank (2014), Gender-specific interventions are key in this area since women account for the majority of smallholder farmers—up to 70% in Africa alone. A woman's role is very significant in food production procedures throughout an

agricultural value addition chain. For instance, family plot agricultural production, food preparation and food distribution within households are roles played by women (Balakrishnan, 2005). Female-headed households (FHH) are on the rise in many African countries over the years. Though women in African countries are responsible for providing food for their families, they are granted less accessibility and control of agricultural assets as compared to men (Kassie, Ndiritu, & Shiferaw, 2012). Women and girls face more challenges in socio-cultural and political issues because they are responsible for childcare and house chores compared to men (FAO, 2020). Barriers imposed influence food security, adoption of agricultural technologies and market accessibility. Improving accessibility of assets such as land, livestock and job opportunities empowers women, therefore, boosting agricultural production (Mikalitsa, 2010). According to the World Development Report (2012), gender equality through recognition of gender-based roles without discrimination improves agricultural production.

### 2.8 Summary of Literature and Knowledge Gaps

Food and Agriculture Organization (FAO) explains that about 852 million people representing 12.5 % of the global population, were considered chronically undernourished in 2010–12 (FAO, 2012). To date, food insecurity remains a huge challenge globally as over 1 billion people suffer from malnutrition, undernutrition, and starvation. Climate change directly enhances response supply and agricultural production through rainfall variations and temperature changes. The mentioned conditions impact crop growth and crop yields (FAO, 2011).

There have been many initiatives to improve the food situation across the globe as well as in Africa. Among the projects is the Feed the Future initiative by the USAID in partnership with nations across the globe to combat hunger through an opportunity for

improvement, resilience, and nutrition and boosting agricultural-led growth. To enhance alleviation of poverty, creation of job opportunities and food security, the government of Kenya, in partnership with other stakeholders, has managed to implement specific projects across the country. In the Kerio Valley-Kenya, projects such as the Community Agricultural Development Project in Semi-Arid Lands (CADSAL) have been enacted to reduce food insecurity in the region. However, this is a knowledge gap on how such community projects have influence food security in Kenya's semi-arid and arid areas.

# CHAPTER THREE: RESEARCH METHODOLOGY

## 3.1 Introduction

This section presents the research methodology of the study. It highlights the study area, research design, sample size and procedure, methods of data collection, and data analysis techniques.

## 3.2 Study Location

Elgeyo Marakwet County borders West Pokot County on the Northern side, Baringo County on the Eastern side, Trans Nzoia County on the Northwest side and Uasin Gishu County on the Western side (Figure 2). Elgeyo Marakwet County is divided into three topographic zones such as; the escarpments, Kerio Valley, the Highlands.The study area covered divisions of Tot,Tunyo,Soy and Tambach which lie in the Kerio Valley. There is a known rainfall variation within the three topographic zonations where, escarpments and Kerio valley receive rainfall range of 1000mm to 1400mm annually while the highlands receive a rainfall range of 1200mm to 1500mm annually (Integrated County Development Plan, 2018).

Economically, the county depends on agriculture (crop production and livestock rearing) which contributes over KES. Three billion of the county's income, 69%, is from crop production (ASDP, 2013).

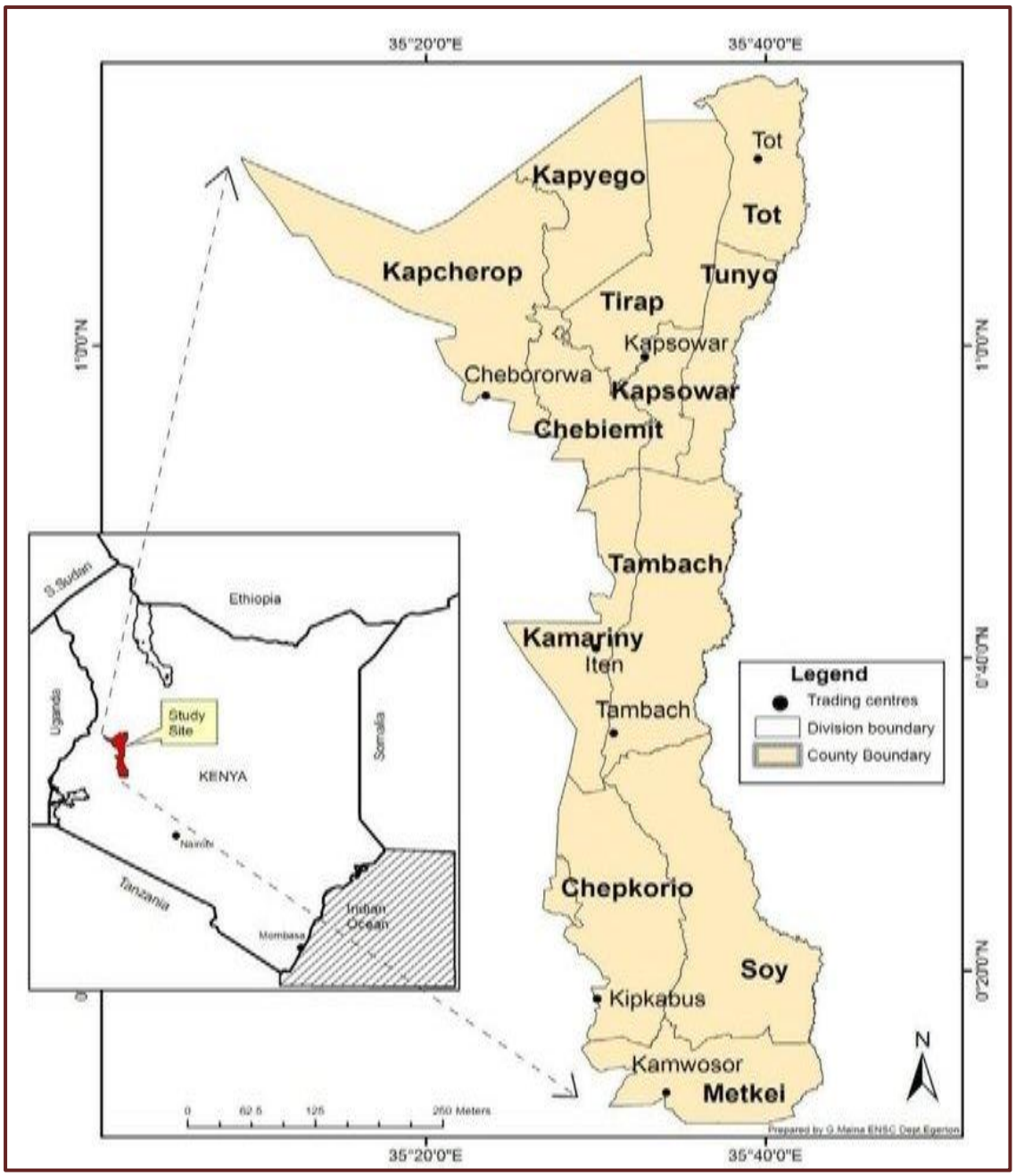


**Figure 3.1: Map of Elgeyo Marakwet County**

**Source: (Kenya National** Bureau of Statistics and Society for International Development 2013)

### 3.3 Research design

The study used a descriptive research design where it takes in a representation of a large population through a sample for data collection and analysis. This research design chosen presents facts about the nature and status of a situation existing during the study (Thompson & Panacek, 2007). Descriptive research entails the identification of attributes based on observation, specified phenomena and conducting a correlation analysis between two or more phenomena (Christensen, Johnson, Turner, & Christensen, 2011; Gravetter & Forzano, 2018). The study intends to capture information on factors influencing the implementation of food production sustainability in arid lands such as Elgeyo Marakwet County. The scientific method of analysis is conducted by collection and analysis from main respondents such as Government officials in a study locale and through focus group discussions with project beneficiaries. A descriptive research design is considered due to ease of obtaining factual information and cost-effectiveness (Lans & Van der Voordt, 2002).

### 3.4 Sampling

The sample population for this study was drawn from a list of direct beneficiaries of CADSAL implemented projects in Elgeyo Marakwet county. The sum of the targeted population was thousand eight hundred and sixty-six (1,866).

The data sampling procedure involves a collection of a few units from the whole population. Obtained data and results give a generalization of a whole population (Mweshi & Sakyi, 2020).

This study determined a sample size of 136 households, including main informants and participants from focused group discussions. Use of Krejcie and Morgan's method of determine a sample size for a given population size

$$s = \chi^2 NP(1-P) \div d^2 (N-1) + \chi^2 P(1-P).$$

**Where:**

**s** = Required Sample Size.

$\chi^2$ = table value of Chi-Square for 1 degree of freedom at the desired confidence level (3.841).

**N**= Population Size.

**P**= population proportion (assumed to be .50 since this would provide the maximum Sample size).

**d**= degree of accuracy expressed as a proportion (.05).

The sample size also satisfied the sampling condition. According to Mulusa (1990), at least 30% of the target population should be enough representation to generalize characteristics under investigation. The Central Limit Theorem explains that when the sample size is large enough (N > 30), data follows a normal distribution curve (Gilbert and Churchill, 2001).

A list of beneficiaries was obtained from CADSAL, and farmers were randomly selected from the list. Identified farmers were then convened for a meeting where they also completed the study questionnaire.

### 3.5 Research Instruments

The study used questionnaires as the main research instrument for data collection. The study used structured questionnaires to CADSAL project beneficiaries. Their responses were noted down and used to generate the final report for this study.

### 3.6 Validity and reliability

Definite measures were taken to guarantee the validity and reliability of the study. First, the data collection questionnaire was piloted by sending it to representatives of farmer groups in Elgeyo Marakwet county to gauge the respondents' level of understanding the questions, ability to answer the questions and identify areas to further enrich the tool.

### 3.7 Data analysis procedure

Data collected from the survey was analysed quantitatively. Quantitative data from questionnaires were analysed following both descriptive and inferential analyses, Descriptive analyses involved the tabulation of the sample distribution and presentation of the percentages for the responses to the Likert scale data. Besides, this also involved statistical correlation analysis to know the relationship of independent variables on the dependent variable and determine the strength of variables and through frequency tables.

The dependent variable used in these analyses was Sustainable Food Production that was assessed across five areas on a Likert scale (1 strongly disagree to 5 strongly agree). Respondents indicated their level of agreement with these statements:

a) Whether county has managed to feed itself by integrating innovative farming strategies

b) Food production in the county has generated positive value economically, socially and environmentally

c) There has been a transformation of the food production system through the creation of an enabling environment by country leadership commitment and ownership of the programs

d) The county through a multi-stakeholder initiative has adopted an adaptive process of system changes to a food production system that is driven by market forces and aligned with national food security strategies

e) Sustainable food production in the county has been possible due to continuous systematic risk assessment and development of solutions for risk mitigation and prevention through the food supply chain

Then the sustainable food production variable was generated by averaging the scores across each of the five areas highlighted above.

The dependent variable was then examined across several independent variables depicting the farmers' socio-demographic factors such as age, gender, marital status, land size among others using Chi-square tests ($\chi^2$). These independent variables were included in this analysis as they have been previously associated with sustainable food production in other settings (Erokhin, 2017; Vassallo, Scalvedi, & Saba, 2016). Then, a multivariable linear regression model was fitted to examine the influence of all the factors on sustainable food production. Data analysis using Statistical Package for Social Sciences Version 21.0.

### 3.8 Ethical Considerations

Ethical approval was obtained from Kenyatta University before conducting the study. Besides, the researcher also explained the purpose of the study to participants and obtained informed consent prior to administering the questionnaire. Participation in this research was voluntary. Participants' identities were anonymised while questionnaires and data were kept in locked drawers or password-protected computers.

# CHAPTER FOUR: RESULTS AND DISCUSSIONS

## 4.1 Introduction

This section includes detailed descriptive analysis and inferential analysis of the collected data using the questionnaires. This section is organized to articulate the different aspects of this research comprehensively. This section is separated into different sub-sections that include response rate, research subject's socio-demographic characteristics, and three separate sections assessing the different objectives of the study. The collected data in questionnaires were analysed using the statistical package for social science version 21.0, and results tables and their consecutive interpretations were presented below.

## 4.2 Response Rate

The research sample size target was one hundred and thirty-six participants. It is essential to calculate the response rate as it helps evaluate if the results are generalizable to the population. Additionally, our results can be totalled to the population depending on and representativeness lack of response of the sample. Mugenda and Mugenda (2003) articulates that for results to be generalized to the population, then an adequate response rate of 50% should be reflected (Mugenda, 2003). However, a 70% response rate is admirable for generalization.

Consequently, the study managed a 100% response rate, which is perfect for us to generalize the research results to the population under study (Table 4.1).

**Table 4.1: A summary of the response rate**

| | Questionnaires Administered | Questionnaires filled & Returned | Percentage |
|---|---|---|---|
| Respondents | 136 | 136 | 100 |

(Source: Author, 2021)

### 4.3 Social and Demographic Attributes of Respondents

Demographic attributes are a function of food production sustainability thus, the research examined the demographic characteristics of the study participants (Table 2). The demographic factors that were measured include respondent's gender, age, marital status, family type, family size, education level, land ownership, and size of land in acres currently under cultivation. The counts and percentages of the levels of different demographics were exhibited in the table below.

**Table 4.2: Demographic Factors Disaggregated at different factor levels.**

| Demographic Factor | Factor Levels | Count | Percentages |
|---|---|---|---|
| **Gender** | Male | 67 | 49.3% |
| | Female | 69 | 50.7% |
| **Age** | 20 years and below | 34 | 25.0% |
| | 21-30 years | 40 | 29.4% |
| | 31-40 years | 29 | 21.3% |
| | 41 and above | 33 | 24.3% |
| **Marital status** | single | 39 | 28.7% |
| | Married | 90 | 66.2% |
| | widowed | 7 | 5.1% |
| **Family type** | Female-headed | 80 | 58.8% |
| | Male headed | 46 | 33.8% |
| | Child headed | 10 | 7.4% |
| **Family size** | 1-5 members | 43 | 31.6% |
| | 6-10 members | 51 | 37.5% |
| | 11 and above | 42 | 30.9% |
| **level of education** | Primary level | 24 | 17.6% |
| | Secondary level | 26 | 19.1% |
| | College level | 28 | 20.6% |
| | University level | 29 | 21.3% |
| | Never attended school | 29 | 21.3% |
| **What is the ownership of the land you cultivate?** | Self-owned | 29 | 21.3% |
| | Family-owned | 38 | 27.9% |
| | Rented | 37 | 27.2% |
| | Others(specify) | 32 | 23.5% |
| **What size in acres of your land is currently under cultivation?** | Less than 1 acre | 29 | 21.3% |
| | 1-3 acres | 24 | 17.6% |
| | 4-6 acres | 25 | 18.4% |
| | 7-9 acres | 28 | 20.6% |
| | more than 9 | 30 | 22.1% |

(Source: Author, 2021)

The study depicts the frequency and percentage distribution of the different demographic factors across different levels, and the results were as the above table shows. From the demographic table above, 49.3% of the study participants were males, while 50.7% were female. The age distribution of participants portrayed a majority (29.4%) aged between 21 and 30 years while 25% were aged below 21, 21.3% of

respondents were aged between 31 and 40 years, and 24.3% were aged above 41 years old. The findings were consistent with Tangui (2014), who reported a majority of respondents aged 21-40 years at (74.6%) in a study conducted to determine Community-Based Organization roles in environmental conservation within Kenya (Tangui, 2014).

Furthermore, 66.2% of the studies participants self-reported to be married, 28.7% were single, while 5.1% were widowed. The education level distribution of the respondents exhibited that more than half the study participants (61%) attained secondary as their highest level of education. Basic knowledge among group members was a prerequisite for selecting CADSAL project beneficiaries because some technologies required training before implementation. About 17.6% of the respondents received primary education, while 20.6% had attained some college courses. The level of education is critical in enhancing food security in a country. Educational level is important because exposure to knowledge helps households manage available resources, that play an important role in food production and security. A majority of respondents with secondary education corresponds with a study conducted to ascertain the transition rate from primary to secondary school and the gross enrolment rate in secondary schools by province and gender. A positive transition rate growth took place from 32.9% to 41.7% between 1999 and 2004 in this study's large Rift Valley Province. The Gross secondary enrolment rate in the region grew from 22.3% in 1999 to 26.8% in 2004 with a gender parity index of 0.85% in favour of boys than girls, which meant more male students obtained secondary education than females students (Onsomu, Muthaka, Ngware, & Manda, 2006). Education accessibility for women directly correlates to food security within households; hence lack of education handicaps millions of women leading to

poor agricultural development and food insecurity in developing countries (Walingo, 2006).

The majority of families (37.5%) had 6-10 members on average, and 31.6% had 1-5 members. Large families with more than eleven members constituted 30.9%. Therefore, the households in this region agreed with the country's 2009 statistics, which averaged families in Kenya at five. Out of these families under study, 58.8% were female-headed compared to 33.8% and 7.4%, male and child-headed, respectively. According to Kassie (2014), Female-headed houses (FHH) are more food insecure compared to Male-headed homes (MHH) in various parts of the world. The vulnerability of FHH to food security is connected to inequality in access to land, livestock and other assets, credit, education, health care, market and extension services (Kilic, Winters, & Carletto, 2015; Odame, Hafkin, Wesseler, & Boto, 2002). Based on the demographics data, it can be concluded that the respondents who took part in this study were mainly married women aged between 21 and 30 years with secondary levels of education and large families of 6-10 members.

The study sought to establish the land size distribution among the key population. It was observed that the majority of the respondents (61.1%) cultivated more than 4 acres of land compared to 38.9% who cultivate at most 3 acres of land. However, land ownership is a key factor of food production besides the size of the land as it accords the owner the freedom to plant what they want and when they want it. Therefore, there's limited freedom of use in a rented or community-owned piece of land compared to individual-owned. Therefore, this study needed to find out the land ownership status of the respondents to establish whether they had any restrictions while using it. From the demographic results, the respondents self-reported that the majority (27.9%) of the land

they use for their daily farming practices is family-owned, while 21.3 is individually owned.

Additionally, 27.2% reported renting the land. Land ownership or access to land to rural populations has been linked to employment opportunities directly related to food production and income generation. Access to land affects food security through two common channels (1) Power of purchase and (2) Availability of food. This is because the land size operation and land accessibility positively correlate with income generation and welfare of rural households in agricultural regions (Chamberlin & Ricker Gilbert, 2016). Another study argued that land security was linked to food security. Under an imperfect food market, families could produce food on their land, hence having a cheaper food source than market-purchased food (Burgess, 2001). Our study establishes rented land to be quite high, which concurs with other parts of the country household rented lands that have been on an increasing trajectory, with data showing 22.3% of household rented land in 2007 in Kenya. This data is from a study carried out by Jin & Jayne (2013), which showed that the proportion of households renting land increased from 18% to 20% between 1999 to 2007 (Jin & Jayne, 2013). This proportion has increased further to 38.7% as indicated in the 2019 population census (Kenya, 2019).

### 4.4 Sustainable food production

The study inquires how respondents perceive sustainable food production in Semi-Arid and Arid Lands of Elgeyo Marakwet County. Individuals' responses are captured in Table 4.3.

**Table 4.3: Level of agreement with some sustainable food production approaches**

| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | | |
|---|---|---|---|---|---|---|---|
| | Row N % | Row N % | Row N % | Row N % | Row N % | Mean | Standard Deviation |
| The county has managed to feed itself by integrating innovative farming strategies | 0.0% | .7% | 0.0% | 1.5% | 97.8% | 4.96 | .28 |
| Food production in the county has generated positive value economically, socially and environmentally | .7% | 0.0% | 0.0% | 97.8% | 1.5% | 3.99 | .29 |
| There has been transformation of the food production system through creation of an enabling environment by country leadership commitment and ownership of the programs | .7% | 0.0% | 0.0% | 22.1% | 77.2% | 4.75 | .53 |
| The county through a multi-stakeholder initiative has adopted an adaptive process of system changes to food production system that is driven by market forces and aligned with national food security strategies | 0.0% | .7% | 0.0% | 97.8% | 1.5% | 4.00 | .21 |
| Sustainable food production in the county has been possible due to continuous systematic risk assessment and development of solutions for risk mitigation and prevention through the food supply chain | .7% | 0.0% | 0.0% | 94.9% | 4.4% | 4.02 | .33 |

(Source: Author, 2021)

From the results, the majority of the respondents (97.8%) strongly agreed that Elgeyo Marakwet County has managed to feed itself by integrating innovative farming strategies compared to 0.7% who disagreed ($M = 4.96, SD = 0.28$). In addition, 97.8% of the study participants agreed that Food production in Elgeyo Marakwet County had generated positive value economically, socially, and environmentally compared to 0.7% who strongly disagreed ($M = 3.99, SD = 0.29$). The majority of the respondents

(77.2%) strongly agreed to the existence of transformation of the food production system by creating an enabling environment by the Elgeyo Marakwet county leadership commitment and ownership of the programs compared to 0.7% who strongly disagreed ($M = 4.75, SD = 0.53$). Additionally, 97.8% agreed that Elgeyo Marakwet County, through a multi-stakeholder initiative, adopted an adaptive process of system changes to the food production systems. Finally, 94.9% of the study participants agreed that Sustainable food production in Elgeyo Marakwet county has been possible due to continuous, systematic risk assessment and development of solutions for risk mitigation and prevention through the food supply chain to 0.7% who strongly disagreed.

### 4.5 Influence of demographic factors on food sustainability.

This section sought to establish any influence of the demographic factors such as gender, age, marital status, family type, family size, and level of education on the overall food sustainability. This was achieved through the use of cross-tabulations of demographic factors and overall food sustainability. Chi-Square results are given in the following tables.

#### 4.5.1: Gender

Table 4.4 shows that the Pearson chi-square p-value is greater than 0.05; thus, we reject the claim of association between the two variables. Therefore, there is no association between gender and overall food sustainability ($\chi 2(3) = 1.674, p = 0.643$). This does not concur with Beuchelt& Badstue (2013) research

**Table 4.4: Gender and Sustainable food production**

| Chi-Square Tests | | | |
|---|---|---|---|
| | **Value** | **df** | **Asymptotic Significance (2-sided)** |
| Pearson Chi-Square | 1.674[a] | 3 | .643 |
| Likelihood Ratio | 2.067 | 3 | .559 |
| Linear-by-Linear Association | 1.392 | 1 | .238 |
| N of Valid Cases | 136 | | |

a. 4 cells (50.0%) have expected count less than 5. The minimum expected count is .49.

### 4.5.2 Age

Table 5 shows the Pearson's Chi-Square P-Value is greater than 0.05; thus, we reject the claim of association between the two variables. Therefore, there is no association between age and overall food sustainability ($\chi 2(9) = 12.272, p = 0.198$). This does not concur with Godfray et al., (2010) research that found a significant relationship between age and food production.

**Table 4.5: Age and Sustainable food production**

| Chi-Square Tests | | | |
|---|---|---|---|
| | **Value** | **df** | **Asymptotic Significance (2-sided)** |
| Pearson Chi-Square | 12.272[a] | 9 | .198 |
| Likelihood Ratio | 13.697 | 9 | .134 |
| Linear-by-Linear Association | .064 | 1 | .800 |
| N of Valid Cases | 136 | | |

a. 8 cells (50.0%) have expected count less than 5. The minimum expected count is .21.

### 4.5.3 Marital status

Table 4.6 shows that the Pearson chi-square p-value is less than 0.05; thus, we do not reject the claim of association between the two variables. Therefore, there is an association between Marital status and overall food sustainability ($\chi 2(6) =$

$18.266, p = 0.006$). This concurs with Aidoo, Mensah & Tuffour, (2013) research that found a significant relationship between marital status and food security (Aidoo, Mensah, & Tuffour, 2013). Those in marriage are more sustainable in food production compared to the widowed.

**Table 4.6: Marital Status and Sustainable food production**

| Chi-Square Tests | | | |
|---|---|---|---|
| | **Value** | **df** | **Asymptotic Significance (2-sided)** |
| Pearson Chi-Square | 18.266[a] | 6 | .006 |
| Likelihood Ratio | 20.793 | 6 | .002 |
| Linear-by-Linear Association | .405 | 1 | .525 |
| N of Valid Cases | 136 | | |

a. 7 cells (58.3%) have expected count less than 5. The minimum expected count is .05.

### 4.5.4 Family type

From the results in Table 4.7, Pearson's Chi-Square P-Value is less than 0.05; thus, we do not reject the claim of association between the two variables. Therefore, there is an association between Family type and overall food sustainability ($\chi 2(6) = 13.331, p = 0.038$). This agrees with Kassie's (2012) study that found a significant relationship between family type and sustainable food production (Kassie et al., 2012). Additionally, the research found that female-headed houses (FHH) are more food insecure than male-headed homes (MHH) in many parts of the world.

**Table 4.7: Family type and Sustainable food production**

| Chi-Square Tests | | | |
|---|---|---|---|
| | **Value** | **df** | **Asymptotic Significance (2-sided)** |
| Pearson Chi-Square | 13.331[a] | 6 | .038 |
| Likelihood Ratio | 15.551 | 6 | .016 |
| Linear-by-Linear Association | .724 | 1 | .395 |
| N of Valid Cases | 136 | | |

a. 7 cells (58.3%) have expected count less than 5. The minimum expected count is .06.

### 4.5.5 Family size

The results from Table 4.8 shows that Pearson's Chi-Square P-Value is less than 0.05; thus, we do not reject the claim of association between the two variables. Therefore, there is an association between Family size and overall food sustainability ($\chi 2(6) = 15.356, p = 0.018$). However, this relationship might be influenced by other factors such as land size under production and occupation of household breadwinners. This concurs with Aidoo, Mensah & Tuffour, (2013) research that found a negative and significant relationship between food security and family size (Aidoo et al., 2013). Therefore, we can conclude that the size of the family negatively impacts food sufficiency.

**Table 4.8: Family size and Sustainable food production**

| Chi-Square Tests | | | |
|---|---|---|---|
| | **Value** | **df** | **Asymptotic Significance (2-sided)** |
| Pearson Chi-Square | 15.356[a] | 6 | .018 |
| Likelihood Ratio | 18.796 | 6 | .005 |
| Linear-by-Linear Association | .427 | 1 | .513 |
| N of Valid Cases | 136 | | |

a. 8 cells (66.7%) have expected count less than 5. The minimum expected count is .04.

### 4.5.6 Education level

The results from Table 4.9 highlight that the Pearson's Chi-Square P-Value is greater than 0.05; thus, we reject the claim of association between the two variables. Therefore, there is no association between Educational level and overall food sustainability ($\chi 2(12) = 11.470, p = 0.489$). This does not concur with Godfray et al.'s (2010) research that found a significant relationship between education and food production.

**Table 4.9: Educational level and Sustainable food production**

| Chi-Square Tests | | | |
|---|---|---|---|
| | **Value** | **df** | **Asymptotic Significance (2-sided)** |
| Pearson Chi-Square | 11.470[a] | 12 | .489 |
| Likelihood Ratio | 11.366 | 12 | .498 |
| Linear-by-Linear Association | 1.011 | 1 | .315 |
| N of Valid Cases | 136 | | |

a. 12 cells (60.0%) have expected count less than 5. The minimum expected count is .18.

## 4.6 Impact of land Characteristics on the implementation of sustainable food production programs in Elgeyo Marakwet.

This section sought to establish the impact of land ownership, land ownership, land size, land accessibility, and the number of times one plants in years on the overall food sustainability. This was achieved through the use of cross-tabulations of land characteristics and overall food sustainability. The chi-square results are given in the following tables.

### 4.6.1 Land ownership

The results in Table 4.10, the Pearson chi-square p-value is less than 0.05; thus, we do not reject the claim of association between the two variables. Therefore, there is an association between land ownership and overall food sustainability $(\chi 2(9) = 19.527, p = 0.021)$. Land ownership or access to land to rural populations has been linked to employment opportunities and a direct relationship to food production and income generation. Access to land affects food security through two common channels (1) power of purchase and (2) availability of food. This is because the land accessibility and land size operation positively correlate to income generation and welfare of rural livelihoods in agricultural regions (Chamberlin & Ricker Gilbert, 2016). Another study

argued that land security was linked to food security. Under an imperfect food market, families could produce food on their land, hence having cheaper food sourced relatively to market-purchased food (Burgess, 2001).

**Table 4.10: Land ownership and Sustainable food production**

| Chi-Square Tests | | | |
|---|---|---|---|
| | **Value** | **df** | **Asymptotic Significance (2-sided)** |
| Pearson Chi-Square | 19.527[a] | 9 | .021 |
| Likelihood Ratio | 16.139 | 9 | .064 |
| Linear-by-Linear Association | .018 | 1 | .894 |
| N of Valid Cases | 136 | | |

a. 10 cells (62.5%) have expected count less than 5. The minimum expected count is .07.

### 4.6.2 Land size

Table 11 shows that the Pearson Chi-Square P-Value is less than 0.05. Thus, we do not reject the claim of association between the two variables. Therefore, there is an association between land size and overall food sustainability ($\chi 2(12) = 27.919, p = 0.006$). Land being an important factor of production, challenges in accessing a good piece of it for food production purposes can at times cause a food crisis. Sub-dividing it further to grow various crops as is the norm with small-scale farmers in the country often renders the land uneconomically viable. Land size has been directly linked to food security; a study conducted by Amwata (2015) was found to have a positive and significant influence on food security in Makueni County (D. A. Amwata, Nyariki, & Musimba, 2016). Food security depends on land size, implying that households with large landholdings tend to be more food secure due to more farm production; however, this is concluded assuming that other factors remain constant. The findings of this study

were hence consistent with previous studies which have directly linked land size and food security (A. D. Amwata, 2004).

**Table 4.11: Land size and Sustainable food production**

| Chi-Square Tests | | | |
|---|---|---|---|
| | **Value** | **df** | **Asymptotic Significance (2-sided)** |
| Pearson Chi-Square | 27.919[a] | 12 | .006 |
| Likelihood Ratio | 22.828 | 12 | .029 |
| Linear-by-Linear Association | .003 | 1 | .954 |
| N of Valid Cases | 136 | | |

a. 14 cells (70.0%) have expected count less than 5. The minimum expected count is .02.

### 4.6.3 Land accessibility

Table 4.12 shows that the Pearson Chi-Square P-Value is greater than 0.05; Thus, we reject the claim of association between the two variables. Therefore, there is no association between land accessibility and overall food sustainability $(\chi 2(3) = 5.512, p = 0.138)$. This disagrees with Ngugi & Nyariki (2008) that found land accessibility as a significant factor in food security (Nyariki & Ngugi, 2008). Low land accessibility is systematic in many parts of the country, as reported by Ngugi & Nyariki (2008), who reported that women rarely own land in African cultures, and this inequitable access to productive resources and decision-making to be influenced by men. In Kenya, though women are high contributors of agricultural labour, studies have shown that women's spirit of command is poor over a wide range of productive resources, such as financial resources, land, information and education hence hampering food security in arid semi-arid areas (Kassie et al., 2012).

**Table 4.12: Land accessibility and Sustainable food production**

| Chi-Square Tests | | | |
|---|---|---|---|
| | **Value** | **df** | **Asymptotic Significance (2-sided)** |
| Pearson Chi-Square | 5.512[a] | 3 | .138 |
| Likelihood Ratio | 6.240 | 3 | .100 |
| Linear-by-Linear Association | .018 | 1 | .893 |
| N of Valid Cases | 136 | | |

a. 4 cells (50.0%) have expected count less than 5. The minimum expected count is .27.

### 4.6.4 Number of times one plants

The table shows that the Pearson Chi-Square P-Value is greater than 0.05 and reject the claim of association within the two variables. Therefore, there is no association between the number of times one plants and overall food sustainability $(\chi 2(9) = 14.586, p = 0.103)$. This does not concur with Sonnino et al. (2014) that the amount of food production is influenced by the number of times one plants in a year when all conditions are favourable.

**Table 4.13: Number of times one plants and food sustainability**

| Chi-Square Tests | | | |
|---|---|---|---|
| | **Value** | **df** | **Asymptotic Significance (2-sided)** |
| Pearson Chi-Square | 14.586[a] | 9 | .103 |
| Likelihood Ratio | 13.015 | 9 | .162 |
| Linear-by-Linear Association | .189 | 1 | .664 |
| N of Valid Cases | 136 | | |

a. 10 cells (62.5%) have expected count less than 5. The minimum expected count is .17.

## 4.7 Influence of organization management and structure of CADSAL community project in implementing sustainable food production in Elgeyo Marakwet.

The research ought to establish how the organization management and structure of CADSAL were of influence to sustainable food production.

### 4.7.1 CADSAL Organization structure

CADSAL programs were funded by JICA through the support of the Japanese government and implemented in Keiyo and Marakwet districts in collaboration with the GOK ministry of agriculture working with the community (Figure 3). The programs ran for five years, starting from the year 2005. They aimed to support communities' livelihoods in the semi-arid lands to become food self-sufficient and economically empowered. CADSAL used two approaches as follows (i) community initiative project (CIP), which assists community groups in formulating and implementing a plan, (ii) community participatory technology development, which allow communities to introduce better techniques, varieties, and breed, e.g., NERICA rice and dairy goats both of which contribute directly to food security demands of the community. The communities were able to own the projects because, under CIP, CADSAL supported the initiated project at about 80% of the project unit while the beneficiaries provide 20%. This support saw the number of CIP in the area rise to about 150 after the project ended. The success of the CIPs is connected to the group's emphasis on the improvement of management skills and inculcation of a sense of ownership for the group's sustainability. To grow the knowledge and skill of CIPs groups, the members were given opportunities of training these activities, which also encompassed other community members of Kerio valley. The success of these CIPs leads to the formation of the Kerio Valley Dairy Goats Association (KVDGA) in 2007 to improve dairy goat rearing technology such as disease control and buck services (JICA, 2008).

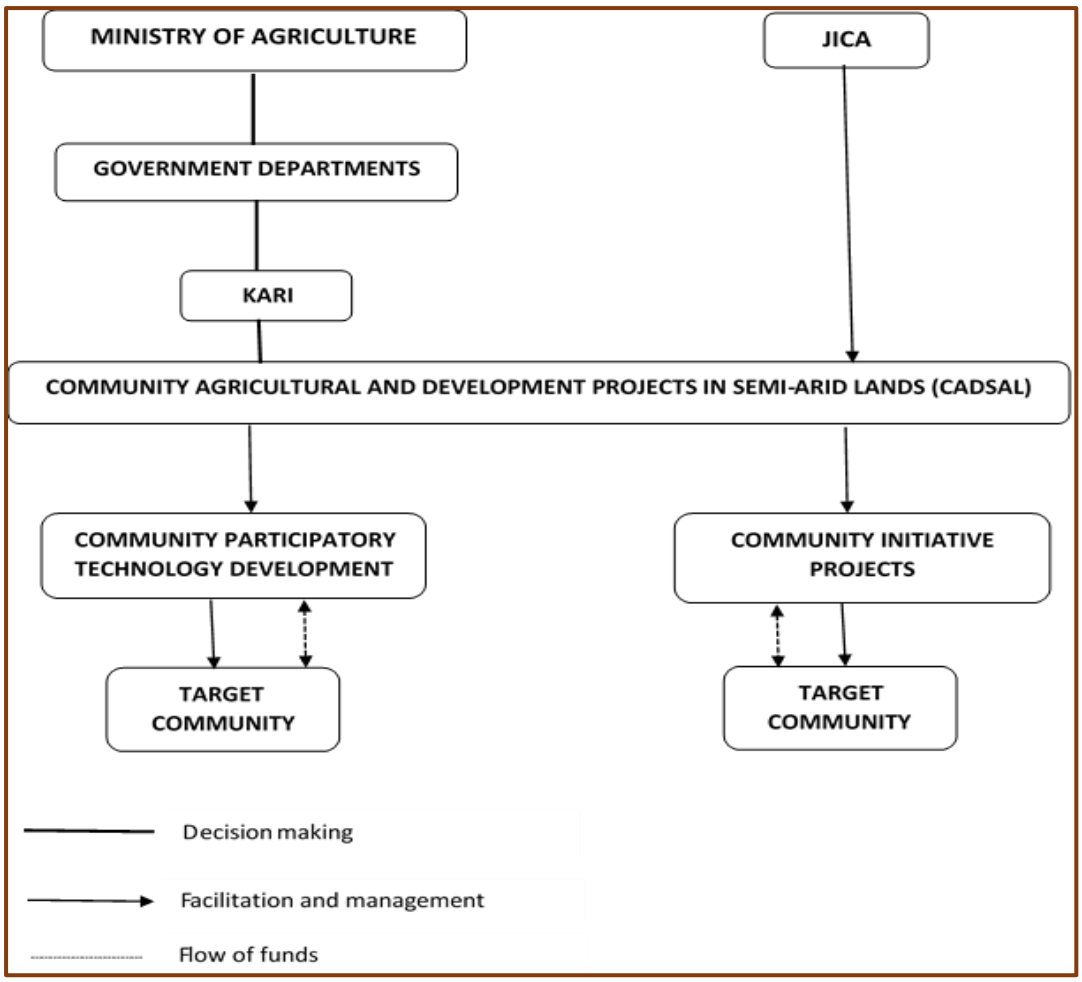


**Figure 4.1: Community Agricultural Development Project in Semi-Arid Lands (CADSAL) Organization**

### 4.7.2 Management Practices

This research also enquired on how CADSAL management practices enhance the county's potential to attain a sustainable food production system, and the results were as shown in Table 14.

The results indicated 75% of individuals agreed, while 22.8% strongly agreed on the success of farming projects in the county aided by effective communication between the CADSAL project team and other stakeholders ($M = 4.18, SD = 0.57$). 72.1% of the respondents strongly agreed, while 25.7% agreed the county sustainable food programs by CADSAL are executed after detailed planning and coordination($M = 4.68, SD =$

0.58). 97.1% strongly agreed that CADSAL sustainable food projects were effectively managed in the county($M = 4.95, SD = 0.37$). 70.6% of the study participants strongly agreed, while 28.7% agreed that the projects were organized to be all-inclusive as all stakeholders were involved in participating in decision making($M = 4.69, SD = 0.51$). Finally, 75% of the study participants strongly agreed, while 24.3% agreed that the organizational culture in the CADSAL project supported the adoption of new techniques which enhanced productivity and adhered to the expectations of climate-smart agriculture ($M = 4.74, SD = 0.46$).

**Table 4.14: CADSAL Management practices**

| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | Mean | Standard Deviation |
|---|---|---|---|---|---|---|---|
| | Row N % | Row N % | Row N % | Row N % | Row N % | | |
| The success of farming projects in the county is aided by effective communication between the project team and other stakeholders | .7% | 1.5% | 0.0% | 75.0% | 22.8% | 4.18 | .57 |
| The county sustainable food programs by CADSAL are executed after detailed planning and coordination | .7% | 0.0% | 1.5% | 25.7% | 72.1% | 4.68 | .58 |
| CADSAL sustainable food projects were effectively managed in the county | .7% | 0.0% | 0.0% | 2.2% | 97.1% | 4.95 | .37 |
| The projects were organized to be all inclusive as all stakeholders were involved to participate in decision making | 0.0% | .7% | 0.0% | 28.7% | 70.6% | 4.69 | .51 |
| The organizational culture in the CADSAL project supported the adoption of new techniques which enhanced protectivity and adhered to the expectations of climate-smart agriculture | 0.0% | 0.0% | .7% | 24.3% | 75.0% | 4.74 | .46 |

Source: Author 2021

### 4.7.3 Management practices and sustainable food production

The study sought to determine how management practices influenced sustainable food production in Elgeyo Marakwet County. Linear regression analysis was done, and the results were as presented in Table 15.

In summary, the R-value (0.84) from the model summary table designates a high correlation between organization management and sustainable food production. Additionally, 70.4% of sustainable food production can be explained by the organization's management. The ANOVA table depicts organization management to statistically significantly predict sustainable food production ($F(1,134) = 321.94, p < 0.0005$). Organization management practices were significant predictors of sustainable food production ($t = 17.943, p < 0.0005$). Vertical and horizontal communication among project team members and the stakeholders is an essential management characteristic that determines the ultimate success of projects of any nature (Tott, 2013). The communication referred to constant monitoring and guidance of the CADSAL team to all its beneficiaries through physical visits or phones. The outcome gives a general indication that CADSAL effectively monitored and guided all its project beneficiaries to the extent of resolving any emerging problem in its early stages (Tott, 2013). Additionally, planning activities is an element of good management practice. CADSAL beneficiaries, especially those who participated in rain-fed crop projects, required good planning and timing under the guidance of CADSAL experts to attain optimum yields. Although planning was rated lower than other management variables in this study, all CADSAL project beneficiaries practiced it to some level. Inability to undertake detailed planning may be directly related to the level of education of the participants. The issue of planning in CADSALs has also been found to have some gaps; Mati (2008) findings concluded that NGOs funded were poorly planned this is because the projects had a

timespan which were inflexible and hence some projects folded and left farmers vulnerable to the shock of changing production and marketing trends of new products hence making the community food insecure.

**Table 4.15: Management practices and Sustainable food production**

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | | | Collinearity Statistics | |
|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | t | Sig. | Tolerance | VIF |
| 1 | (Constant) | 1.267 | .172 | | 7.361 | .000 | | |
| | MPS_Overall | .662 | .037 | .840 | 17.943 | .000 | 1.000 | 1.000 |

a. Dependent Variable: SFP_Overall

## 4.8 Capacity building effects on implementation of sustainable food production in Elgeyo Marakwet.

The study inquiring on capacity building of the program beneficiaries was considered important in this study because it directly influenced the sustainability of the initiated projects soon after CADSAL withdrew its support. Therefore, it was CADSAL's responsibility to ensure that the project beneficiaries are imparted with knowledge and technical skills to ensure continuity. To determine capacity building influence on the implementation of sustainable food production, a regression analysis was done, and the results are shown in the tables below.

### 4.8.1 CADSAL Capacity building.

The study enquired to understand the respondent's perception on how developing capacity building by CADSAL has enhanced the capability of the county to attain a sustainable food production system. The results were as follows (Table 16).

The results showed that most respondents (77.2%) agreed, while 22.1% strongly agreed that CADSAL capacity-building initiatives for farmers have made them more effective and efficient in food production ($M = 4.21, SD = 0.46$). 75% of the respondents strongly agreed, while 24.3% agreed that capacity building initiatives in the county by CADSAL had developed indigenous farming capacity through integration of international technical expertise and machinery to enhance food productivity($M = 4.73, SD = 0.54$). 79.4% of the respondents agreed, while 19.9% strongly agreed that CADSAL has made Elgeyo Marakwet county establish a strong information system capable of providing reliable and timely information to agricultural policymakers and stakeholders($M = 4.18, SD = 0.49$). 77.2% of the respondents strongly agreed, while 22.1% agreed that the CADSAL program and the county had enhanced the county's capacity of agricultural experts to sufficiently respond to changes necessary for sustainable agriculture ($M = 4.75, SD = 0.53$). Finally, 73.5% of the respondents strongly agreed. In comparison, 24.3% agreed CADSAL and the Elgeyo Marakwet county had adopted the best practices in the supply chain of food production, enabling farmers to use technologies to expand their productivity and connect with marketer produce ($M = 4.70, SD = 0.58$).

**Table 4.16: CADSAL's Capacity building**

| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | Mean | Standard Deviation |
|---|---|---|---|---|---|---|---|
| | Row N % | Row N % | Row N % | Row N % | Row N % | | |
| Capacity building initiatives for farmers has made them more effective and efficient in food production | 0.0% | .7% | 0.0% | 77.2% | 22.1% | 4.21 | .46 |
| Capacity building initiatives in the county has developed indigenous farming capacity through integration of international technical expertise and machinery to enhance food productivity | .7% | 0.0% | 0.0% | 24.3% | 75.0% | 4.73 | .54 |
| The county has established a strong information system capable of providing reliable and timely information to agricultural policy makers and stakeholders | .7% | 0.0% | 0.0% | 79.4% | 19.9% | 4.18 | .49 |
| The CASDAL program and the county have enhanced the county's capacity of agricultural experts to sufficiently respond to changes necessary for sustainable agriculture | .7% | 0.0% | 0.0% | 22.1% | 77.2% | 4.75 | .53 |
| The county has adopted the best practices in supply chain of food production which has enabled farmers use technologies to expand their productivity and connect with markets for their produce | .7% | 0.0% | 1.5% | 24.3% | 73.5% | 4.70 | .58 |

(Source: Author, 2021)

### 4.8.2 Capacity building and sustainable food production

The study sought to determine how capacity building influenced sustainable food production in Elgeyo- Marakwet County. Linear regression analysis was done, and the results were as follows (Table 17).

The R-value (0.95) from the model summary table designates a high correlation between capacity building and sustainable food production. Additionally, 90.2% of sustainable food production can be explained by capacity building. The ANOVA table illustrates capacity building to statistically significantly predict sustainable food production ($F(1,134) = 1239.91, p < 0.0005$).Capacity building was a significant predictor of sustainable food production ($t = 35.212, p < 0.0005$).

The above results show CADSAL enhanced capacity building initiatives through technical training on agronomy, construction of structures e.g., greenhouses and dairy sheds, pests and disease control, environment conservation, proposal writing, value addition, record keeping, and marketing farm produce influenced sustainable food production in Elgeyo Marakwet. These initiatives have had a tremendous effect on effective and efficient food production. Additionally, the integration of international technical expertise and machinery in indigenous farming has enhanced food productivity.

Capacity-building initiatives have existed in Kenya ever since from colonial governments; the ministry of agriculture is mandated by law to carry out capacity-building programs to assist farmers in acquiring skills and knowledge about food production. For instance, Training and Visits (T&V), through the funding of the World Bank, trained smallholder farmers using model farms on how to improve production, which saw an improvement in food production compared to the inheritance of traditional extension system from the colonial government, failed on mandates (Gautam, 2000; Pickering, 1989). The Ministry of

Agriculture and Rural Development packaged another set of extension services dubbed the National Agricultural and Livestock Extension Programme (NALEP); this program was designed with a bottom-up stakeholder participation to spearhead decision-making and implementation of activities. Furthermore, supervision, monitoring and evaluation and reporting, make the extension service more effective for farmers (Ong'ayo, 2017). To ensure a smooth transition of innovative ideas and technologies on food security matters, the Agricultural Technology and Information Response Initiative (ATIRI), through participatory research program, was implemented and developed by Kenya Agricultural and Livestock Research Organization (KALRO) (KARI, 2001).

**Table 4.17: Capacity building and sustainable food production**

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | | | Collinearity Statistics | |
|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | t | Sig. | Tolerance | VIF |
| 1 | (Constant) | .608 | .106 | | 5.719 | .000 | | |
| | CB_Overall | .828 | .024 | .950 | 35.212 | .000 | 1.000 | 1.000 |

a. Dependent Variable: SFP_Overall

### 4.9 Multivariable linear regression

Table 18 presents the findings from the multivariable linear regression model taking into account all factors independently examined above. The findings highlight five factors that are significantly (p-value<0.005) associated with sustainable food production. First, compared to respondents from female headed households, respondents from male headed households had a 0.255 [95% CI: 0.035 – 0.475; p-value=0.023] higher agreement score on sustainable food production. This indicates the cultural beliefs and structures available to men may hinder women's contribution towards sustainable food production. For instance, the variable becomes significant only after accounting for the other factors but was not

independently associated with sustainable food production. Perhaps other factors such as land ownership may explain this and thus reflect the cultural issues for land ownership in these settings. Second, accessible land was positively associated with sustainable food production. This may explain the reduction in logistical costs such as transport to inaccessible lands that may increase the cost of production and therefore influence on the sustainability of the production. Third, although not expected, management practices were negatively associated with sustainable food production score. Perhaps future studies can investigate this further. Last, capacity building was the most important positive factor influencing sustainable food production. A unit increase in the capacity building score resulted in 1.143 increase in sustainable food production score on average. These findings align with previous studies emphasizing the role of capacity building/training among farmers to improve food production (Nyongesa & Olala, 2018; Tambi, 2019).

**Table 4.18: Multivariable linear regression of the factors influencing sustainable food production in Elgeyo Marakwet County**

| | Coefficient | Std Error | P-value | 95% CI | |
|---|---|---|---|---|---|
| | | | | Lower | Upper |
| **Age (Ref. 18-20 years)** | | | | | |
| 21-30 years | 0.015 | 0.019 | 0.437 | -0.022 | 0.052 |
| 31-40 years | -0.017 | 0.020 | 0.401 | -0.057 | 0.023 |
| 41 and above | 0.021 | 0.020 | 0.304 | -0.019 | 0.060 |
| **Marital status (Ref. Single)** | | | | | |
| Married | -0.114 | 0.079 | 0.152 | -0.271 | 0.043 |
| widowed | -0.051 | 0.127 | 0.687 | -0.302 | 0.200 |
| **Family type (Ref. Female Headed)** | | | | | |
| Male headed | **0.255** | **0.111** | **0.023** | **0.035** | **0.475** |
| Child headed | -0.031 | 0.101 | 0.760 | -0.230 | 0.168 |
| **Family size (Ref. 1-5 members)** | | | | | |
| 6-10 members | **-0.210** | **0.086** | **0.016** | **-0.379** | **-0.040** |
| 11 and above | 0.066 | 0.099 | 0.507 | -0.130 | 0.261 |
| **Education (Ref. Primary)** | | | | | |
| Secondary level | -0.012 | 0.023 | 0.598 | -0.057 | 0.033 |
| College level | 0.011 | 0.022 | 0.612 | -0.033 | 0.055 |
| University level | 0.022 | 0.022 | 0.320 | -0.022 | 0.067 |
| Never attended school | -0.011 | 0.022 | 0.622 | -0.054 | 0.033 |
| **Land ownership (Ref. Self owned)** | | | | | |
| Family owned | 0.046 | 0.057 | 0.421 | -0.067 | 0.160 |
| Rented | -0.022 | 0.048 | 0.642 | -0.117 | 0.072 |
| Others(specify) | -0.016 | 0.067 | 0.816 | -0.148 | 0.117 |
| **Land size (Ref. <1 acre)** | | | | | |
| 1-3 acres | -0.031 | 0.056 | 0.576 | -0.142 | 0.079 |
| 4-6 acres | 0.000 | (omitted) | | | |
| 7-9 acres | -0.042 | 0.070 | 0.549 | -0.180 | 0.096 |
| more than 9 | -0.021 | 0.062 | 0.737 | -0.144 | 0.102 |
| **Whether land is accessible (Ref. No)** | | | | | |
| Yes | **0.039** | **0.016** | **0.018** | **0.007** | **0.072** |
| **Number of planting times per year (Ref. Once)** | | | | | |
| Twice | 0.001 | 0.018 | 0.946 | -0.035 | 0.038 |
| Thrice | 0.027 | 0.021 | 0.208 | -0.015 | 0.069 |
| Irregular | 0.035 | 0.020 | 0.081 | -0.004 | 0.075 |
| **Management Practices** | **-0.296** | **0.058** | **0.000** | **-0.412** | **-0.180** |
| **Capacity Building** | **1.143** | **0.062** | **0.000** | **1.021** | **1.265** |
| **Number of Observations** | 136 | | | | |
| **Adjusted R-squared** | 0.925 | | | | |

# CHAPTER FIVE: SUMMARY, CONCLUSION, AND RECOMMENDATIONS

## 5.1 Introduction

This chapter presents the summary, conclusions, and recommendations of the study. The presentation of results and discussion are based on previous chapters of this study.

## 5.2 Summary

This study aimed to examine socio-economic factors influencing sustainable food production in arid and semi-arid lands of Elgeyo Marakwet County of Kenya. Production of food crops in Elgeyo Marakwet County, just like other ASAL zones, is often hampered by severe climatic conditions. Furthermore, residents in extreme cases depend on the government and humanitarian organizations for food supply. Although there have been consolidated efforts to rectify the situation, several recent reports indicate that food insecurity is still a reality in Kenya, even with high potential areas. This was attributed to climate change, urban development and population growth, limited diversification in agriculture, unproductive land, agriculture disease, and pests, among other reasons (Government of Kenya, 2010).

Since food production is the ultimate solution to self-sufficiency, this study sought to investigate socio-economic factors influencing sustainable food production in the study area by undertaking a survey. The study was based on an NGO named Community Agricultural Production in Semi-Arid Lands (CADSAL), which initiated numerous agricultural community projects and operated in the area for five years, covering 2005 to 2010. Research questions on management, size of land, capacity building, and demographics were set out. Their association with food production was determined for each variable. The government and its partner organizations can use the study outcomes to improve food security initiatives in the country.

The study began with a review of existing literature to establish academic gaps on the subject of study that this research sought to bridge. Literature review involved going through methodologies, analysis techniques, study populations, findings, and recommendations of all reviewed studies.

This study employed a descriptive research design with a target population of 1,866, including previous CADSAL staff, line county ministries, and CADSAL project beneficiaries. The study sample size of 136 was calculated using the Krejcie and Morgan 1970 formula. Data was collected using study questionnaires. Data was cleaned and analysed using SPSS and presented in tabular, graphical, and frequency formats.

The study respondents were 50.7% women and 49.3% men who were mainly married and with secondary education as their highest academic levels. The majority reported that their households comprised 6-10 members and were dominantly (58.8%) female headed. All the study participants practiced both crops and livestock farming as their source of livelihood, but they had to choose either crop or livestock farming to get supported by CADSAL. The analysis also showed that Marital status ($p = 0.006$), Family type ($p = 0.038$), and family size ($p = 0.018$) were significant demographic factors that affected sustainable food production in Elgeyo Marakwet.

After receiving mentorship, input, and capacity building from CADSAL, the majority of the respondents (97.8%) strongly agreed that Elgeyo Marakwet County has managed to feed itself by integrating innovative farming strategies. Also, 97.8% of the study participants agreed that Food production in the Elgeyo Marakwet County had generated positive value economically, socially, and environmentally

Regarding land size as a variable that influences food production, the study establishes that 36% of the study respondents who were the majority were small-scale farmers with

an average land size of between 1 – 6 acres. Being mixed farmers, the size of the land was found to be too small to sustain any meaningful production considering the household sizes. Further analysis on land characteristics for food production revealed that land ownership ($p = 0.021$) and land size ($p = 0.006$) are significant factors in realizing sustainable food production.

Management was another variable in this study whereby communication, planning, and organization of activities were investigated. From the results, it was established that lateral and horizontal communication of CADSAL, which included constant updating, monitoring, and appraisal of activities, was very good, according to 75% of the respondents. On planning and coordination, 72.1% of study participants acknowledged that county sustainable food programs by CADSAL are executed after detailed planning and coordination. 70.6% of the study participants agreed that the projects were organized to be all-inclusive as all stakeholders were involved in decision-making. 75% of the study participants strongly agreed that the organizational culture in the CADSAL project supported the adoption of new techniques which enhanced productivity and adhered to the expectations of climate-smart agriculture. The study depicted organization management to predict sustainable food production statistically significantly.

On capacity building, CADSAL was very effective in imparting technical skills of production to all its program beneficiaries. The majority of the respondents (99.3%) agreed that CADSAL capacity building initiatives for farmers have made them more effective and efficient in food production. 99.3% agreed that capacity-building initiatives in the county by CADSAL had developed indigenous farming capacity through the integration of international technical expertise and machinery to enhance food productivity. 77.2% of the respondents strongly agreed that the CADSAL program

and the county had enhanced the county's capacity of agricultural experts to respond sufficiently to changes necessary for sustainable agriculture. The study illustrated capacity building to predict sustainable food production statistically significantly.

### 5.3 Conclusion

The study's examined the social and economic factors impacting the production of food in ASAL areas, particularly Elgeyo Marakwet County. The study explored the demographics, organization management, land characteristics, and capacity building variables in relation to sustainable food production.

From the analysis of demographic characteristics, the study found that women play a critical role in feeding the nation, especially among small-scale farmers. Therefore, their contribution can no longer be assumed if the country needs to produce enough food for its population. The study also concludes that family stability influences food production. The majority of married men and women were more productive and considered themselves more food secure than those of single or widowed status.

The study shows a weak relationship between land size and productivity. The majority of the respondents, however, had between 1 and 6 acres. Although those with larger pieces of land could produce more because of low production costs due to mechanization, production per unit also varies with crops grown. Greenhouse tomatoes, for instance, have higher returns per acre per season compared to maize as another example. Therefore, the study concludes that land size is not an ultimate measure of food production but rather how the available land is utilized. Additionally, the number of women who can access and freely utilize land in Elgeyo Marakwet County is very low, and sensitization is perhaps required.

On capacity building, this study finds it necessary for farmers to learn new farming techniques on agronomic matters such as seeds sourcing, fertilizer, and chemical application, harvesting and preservation techniques, value addition, and eventually marketing of farm produce. This makes them perceive and undertake farming as a profession and increases availability in the country. From the study, farmers who underwent such training admitted to being very useful and can implement them.

For institutions undertaking agriculture-related projects, organization management, especially close monitoring, communication, and activities are critical. Based on the finding of this study, adequate planning saves on resources while close monitoring helps avert possible problems that can cost the organization time and resources. Good working relations between parties have a bearing on the success of any project. Chauvet, Collier, & Duponchel (2010) also shared similar findings (Chauvet, Collier, & Duponchel, 2010).

### 5.4 Recommendations

Food is a basic human need, and each country, including Kenya, strives to ensure none of its citizens faces starvation regardless of their geographical location. ASAL areas are worst hit, and this study recommends the following as a corrective measure:

1. Farming is regarded as a profession, and those practicing it should be empowered academically and technically so that they are ably equipped with entrepreneurial skills. Importantly, farmers should be trained on latest technologies that are in line with the changing climatic conditions to improve food production.
2. Because of harsh climatic conditions of the ASAL zones, Members of the community should also be assisted in identifying crops with high returns per unit

area so that they can concentrate on utilizing water which is a scarce resource on small pieces of land, for maximum returns.

3. Organizations undertaking food-related projects should draw clear attention to the significance of planning, monitoring, and communication during the implementation phase for a good working relationship and saving resources.
4. The manifestations of climate change will have repercussions on food security, hence the government's need to adopt climate-smart agriculture to cushion farmers from crop losses and thus food insecurity.

### 5.5 Suggestions

The study identified various gaps in its findings and review and suggested further research, particularly in the following areas.

1. Same case studies should be conducted on an area with high production capacity and compare the outcome.
2. Same case studies should be conducted on another ASAL area of the country to ascertain these findings.
3. Future studies should aim to include farmers that do not benefit from these sustainable food production programs to adequately assess the impact of these programs.

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# APPENDICES

## Appendix I: Questionnaire

The purpose of this questionnaire is to collect data to examine the socio-economic factors influencing sustainable food production in arid and semi-arid lands of Elgeyo Marakwet County, Kenya. The research is a partial requirement for the completion of a degree of Masters in Environmental Studies (Community Development).

The information you provide will be confidential and will only be used for this research. Responding to this questionnaire confirms your full consent to participate in this process.

Kindly answer all the questions by filling in the space provided.

Date: ……..

**Part A: Background Information**

1. Gender:

   Male [ ] Female [ ]

2. **Age bracket in years**

   20 years and below [ ] 21 -30 [ ] 31 -40 [ ]

   41 and above [ ]

3. **Marital Status:**

   Single [ ] Married [ ] Widowed [ ]

4. **Type of the family**

   Female headed [ ] Male headed [ ] Child-headed [ ]

5. **Size of the family members**

   1- 5 [ ] 6- 10 [ ] 11 and above [ ]

6. **What is your highest level of education?**

   Primary level [ ] Secondary level [ ]

   College-level [ ] University level [ ]

   Have never attended any school [ ]

7. **What is the ownership of the land you cultivate?**

Self-owned [ ] Family owned [ ]

Rented [ ] others (specify) []

8. **What size in acres of your land is currently under cultivation?**

Less than 1 [ ] 1-3 acres [ ] 4-6 acres [ ]

7-9 acres [ ] more than 9 [ ]

**Part B: SUSTAINABLE FOOD PRODUCTION**

9. Is the land accessible adequate for food production?

Yes [ ] No [ ]

10. How many times do you plant in one year?

Once [ ] Twice [ ] Thrice [ ] Irregular [ ]

11. The following are statements related to the state of sustainable food production in arid and semi-arid lands of Elgeyo Marakwet County. Kindly indicate your level of agreement with the statements below. Use a scale of 1-5, where 1- Strongly disagree, 2- Disagree, 3- Neutral, 4- Agree, 5- Strongly agree.

| **Statements** | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|
| The county has managed to feed itself by integrating innovative farming strategies | | | | | |
| Food production in the county has generated positive value economically, socially and environmentally | | | | | |
| There has been a transformation of the food production system through the creation of an enabling environment by country leadership commitment and ownership of the programs | | | | | |
| The county through a multi-stakeholder initiative has adopted an adaptive process of system changes to a food production system that is driven by market forces and aligned with national food security strategies | | | | | |
| Sustainable food production in the county has been possible due to continuous systematic risk assessment and development of solutions for risk mitigation and prevention through the food supply chain | | | | | |

**Part C: CAPACITY BUILDING**

12. To what extent has the capacity building by CADSAL enhanced the county's capability to attain a sustainable food production system?

    To a very low extent [ ] To a low extent [ ]
    To a moderate extent [ ] To a great extent [ ]
    To a very great extent [ ]

13. The following are statements related to how developing capacity building by CADSAL has enhanced the capability of the county to attain a sustainable food production system. Kindly indicate your level of agreement with the statements below. Use a scale of 1-5, where 1- Strongly disagree, 2- Disagree, 3- Neutral, 4- Agree, 5- Strongly agree.

| **Statements** | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|
| Capacity building initiatives for farmers has made them more effective and efficient in food production | | | | | |
| Capacity building initiatives in the county has developed indigenous farming capacity through the integration of international technical expertise and machinery to enhance food productivity | | | | | |
| The county has established a strong information system capable of providing reliable and timely information to agricultural policymakers and stakeholders | | | | | |
| The CADSAL program and the county have enhanced the county's capacity of agricultural experts to sufficiently respond to changes necessary for sustainable agriculture | | | | | |
| The county has adopted the best practices in the supply chain of food production which has enabled farmers to use technologies to expand their productivity and connect with markets for their produce | | | | | |

**Part C: MANAGEMENT PRACTICES**

14. To what extent do management practices enhance the potential of the county to attain a sustainable food production system?

    To a very low extent [ ] To a low extent [ ]
    To a moderate extent [ ] To a great extent [ ]
    To a very great extent [ ]

**15.** The following are statements related to how management practices enhance the county's potential to attain a sustainable food production system. Kindly indicate your level of agreement with the statements below. Use a scale of 1-5, where 1- Strongly disagree, 2- Disagree, 3- Neutral, 4- Agree, 5- Strongly agree.

| **Statements** | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|
| The success of farming projects in the county is aided by effective communication between the project team and other stakeholders | | | | | |
| The county sustainable food programs by CADSAL are executed after detailed planning and coordination | | | | | |
| CADSAL sustainable food projects were effectively managed in the county | | | | | |
| The projects were organized to be all-inclusive as all stakeholders were involved to participate in decision making | | | | | |
| The organizational culture in the CADSAL project supported the adoption of new techniques which enhanced protectivity and adhered to the expectations of climate-smart agriculture | | | | | |

**THANK YOU FOR YOUR PARTICIPATION!**