EFFECT OF CLIMATE RESILIENT AGRICULTURE PROGRAMS ON FOOD SECURITY IN BAIDOA DISTRICT, SOUTHWEST STATE, SOMALIA

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A RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF ARTS DEGREE IN DEVELOPMENT STUDIES OF

MOUNT KENYA UNIVERSITY

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DECLARATION AND APPROVAL

Declaration

This project is my original work and has never been presented for any academic award in any institution.

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Approval

This project is being submitted for examination with our approval as University supervisor.

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DEDICATION

I am dedicating this research project to my family for psychological collaboration. I also dedicate the work to my university colleagues for their motivational support

ACKNOWLEDGEMENT

I wish to offer my sincere gratefulness to my supervisor, Dr. Charles Mogote, for his invaluable support and guidance throughout the development of my research proposal. Furthermore, I would like to convey my heartfelt thanks to the instructors in the Department of Social Science and Developmental Studies for equipping me with the essential knowledge that enabled me to successfully complete this project. My gratitude also goes out to the non-teaching staff whose significant contributions and efforts have been immensely helpful in these endeavors. Additionally, I acknowledge MKU for permitting me the occasion to hound this academic journey, as well as my fellow students from whom I gained valuable insights during our classes, and all the respondents who contributed to this investigation. Finally, I am deeply thankful to Allah for granting me life, resources, clarity of mind, and the strength to pursue my studies

ABSTRACT

Increasing temperatures and altered precipitation patterns present major obstacles to global food and nutritional security, underscoring the necessity for agriculture that can withstand climate change. This research focused on the impact of climate-resilient agricultural programs on food security in the Baidoa District of Southwest State, Somalia. It specifically explored the contributions of climate-smart agriculture (CSA) programs to food security, the role of drought-resistant crop cultivation, the effect of educating farmers about climate-smart practices, and the impact of providing drought-resistant seeds on food security in the region. With climate change adversely affecting farming—over 70% of production hindered by drought—the need for resilient agricultural practices becomes clear. The study used a descriptive research design, targeting households within Baidoa District, and sampled 423 households across 10 administrative villages through the process of stratified sampling. Collection of data was done through questionnaires and also Key Informant Interviews (KIIs). Analysis was then done using inferential and descriptive statistics.The results revealed a important link relating to climate-resilient agricultural initiatives and food security in Baidoa District. The results indicated that 89.5% of the changes in food security in Baidoa District are explained by the distribution of drought-resistant seeds to farmers. The study indicated a statistically significant relationship between all four-climate resilient agriculture program factors Climate Resilient Agricultural, cultivation of drought-resistant crops, farmers' sensitization to climate-smart agriculture, and distribution of drought-resistant seeds to farmers) and food security in Baidoa District. This means that enhancing climate-resilient agriculture the cultivation of drought-resistant crops, increased farmers' sensitization to climate-smart agriculture, and the distribution of water scarcity-resilient seeds to farmers would significantly contribute to the increased food security in Baidoa District. If Baidoa District is to increase its food security, then it needs to enhance climate resilient agriculture programs that include initiatives in Climate Resilient Agricultural, cultivation of drought-resistant crops, farmers' sensitization to climate-smart agriculture, and distribution of drought-resistant seeds to farmers to increase food production. The results indicate that effective distribution of drought-resistant seeds to farmers in good time and quantities can highly contribute to food security support findings by Cho (2018) that there is a need to consider effective distribution of seedlings referred to as traditionally organic to subsistence farmers, which may contribute to effective and sustainable crop yielding. The availability of drought-resistant seeds to farmers in good time and quantities as a solution to food insecurity supports findings by Aryal (2021), who established that distribution of short-term yielding seeds has been applied to encourage food production among farmers in the area.These findings can inform how organizations enhance their programs to better achieve food security in drought-affected areas and assist in formulating agricultural policies that promote climate-resilient practices. The study advocates increased education on climate-smart agriculture for farmers, the cultivation of drought-resistant crops, and effective seed distribution to boost food security in the region. These insights are relevant for the development of agricultural policies and can steer future research in the areas of climate-resilient agriculture and food security.

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BT	Bacillus thuringiensis
CSA	Climate-smart agriculture
KIIs	Key Informative Interviews
SD	Standard Deviation
USA	United States of Africa
WBG	The World Bank Group

CHAPTER ONE : INTRODUCTION

1.1 Background of the Study

Climatic shifts, random rainfall together with warmth patterns have affected production of agriculture and heightened the weakness of families that rely on farming for their existance, that is home to most global poverty. Changes in climate change have interfered with food markets, presenting danger of food insecurity to millions of people worldwide (ACTED ,2022). These dangers have minimized the increased capability of farmers to adapt in addition to multiplying flexibility and efficient use of agricultural resources and systems (Effland, Saavoss, Capehart and McBride, 2022). While climate-induced food insecurity continues to be a major challenge in the developing countries, the danger is being experienced across the world. Mwongera, Shikuku and Twyman (2017) observed that a good number of poorest global countries are disproportionately reliant on agriculture, unavailability of resources to address challenges associated with climate changes that have affected agricultural productivity and population growth has changes over time impacting on the food systems and population health. There are several climates resilient agriculture initiatives that, if properly managed, are able to increase food productivity and ultimate security. Wichern (2019) highlighted business-as-usual' approaches through stressing the capacity to achieve flexible, context-specific solutions, combined with innovative policy and financing actions.

Global population and changing eating habits pushing the demand for food. There is a challenge with food production with the inability to live up to crop production level across the world. The ocean health dwindled, and natural resources such as soil, water, and biodiversity are strained with many at risk. A 2020 report established that close to a population of 690 million persons or nine-point nine percent of the world's population have severe hunger while close to 60 million in five years. The challenge of food security is feared to present even more problems, given that the world is required to produce close to seventy percent more food by the year 2050 to so as to feed close to nime billion people (Acevedo et al, 2020).

Additionally, the problem may be heightened through agriculture's optimum vulnerability to changes in climate. The painful effect of changes in climate are currently being experienced in ways that include increased climatic and environmental, pest and diseases factors have created unbearable patterns. Somalia farms just like many other parts in Africa, changes in climate continue to minimize crop production, the nutritional standards of primary cereals, and decreasing livestock yields (World Bank, 2022). Therefore, there is a need for deliberate resource focus if current production is to be sustained and if manufacture and quality of food is increased to meet requirement.

The current temperatures rise and changing precipitation patterns continue to contribute to food and nutritional insecurity across the world, thereby putting the global population at risk of starvation. Studies have emphasized the significance of climate effects on crop production and food supplies.

Following four back-to-back inadequate rainfall seasons and the anticipated fifth, Somalia could again be facing bad drought that may affect some portion of the nation with such regions like Baidoa, in Southwest state being more affected. The population in these areas is in danger of famine. Currently, one million people have been forced to move out of their homes searching for food and water. Additionally, Somalia the country experienced a triple shock of COVID-19, desert locust infestation, and the effect of the 2019-2020 floods that further contributed to food insecurity in most parts of the country (Care, 2022).

The World Bank Group (WBG) scaled up climate-smart farming and in its first Climate Change Action Plan (2016-2020), in addition to the future update covering 2021-2025, the World Bank is focused on collaborating with nations to implement climate-smart farming that can attain the triple win of heightened productivity, improved resilience, and minimize emissions. In 2020, 52 percent of World Bank financing in agriculture additionally focused on climate adaptation and mitigation (World Bank, 2022).

In China, an initiative costing US$755 million has been investment in projects that are meant to support the growing of drought resilient crops and lower-emissions agriculture practices. The objective of this project was to assist in the extension of climate-smart agriculture using improved water-use efficiency on 44,000 hectares of agriculture and modern technologies which have enhanced soil conditions, and improved production of rice by twelve percent and maize by percent. Additionally, more than 29,000 farmers' cooperatives attained increased earnings and improved climate resilience when this project was implemented (World Bank, 2020).

Noticeably, as climatic change continues to affect agricultural production across the world, from 2014, climate smart agriculture is being employed on 2,946,000 hectares and 5,139 farmers also helped employ farms with climate-smart approaches through enhancing energy efficiency and soil-management capabilities (Effland, Saavoss, Capehart and McBride, 2022).

On the other hand, Malawi through its CSA programs has enhanced the pliability of agriculturalists to increasing and obstinate droughts by enhancing soil capabilities for improved farming production and climate alteration implementation and improvement. At the end of 2020 close to 140,000 farmers had employed several climate smart agriculture practices, as the health of the soil close to 28,000 ha has been enhanced (Acevedo, Pixley and Zinyengere, 2020).

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The circumstances remain unchanged, with drought posing a significant challenge for rain-fed agriculture, particularly in the ASAL regions of Kenya. Involving 2020 and 2023, East Africa faced its worst drought since the 1980s. In this area, small-scale farmers account for 80 percent of food production. With three consecutive years of below-average rainfall, families have suffered losses in cattle, crops, and their overall livelihoods (Jernberg, 2023).

1.2 Statement of the Problem

Climatic changes, unpredictable precipitation and high temperature patterns have affected production of agriculture and heightened the vulnerability of families that rely on farming for their incomes, that is home to most global poverty. Climate change presents real and significant challenges to global food security in many countries. Many Somalis are food insecure due to loss of livestock and poor crop productions and the traditional solutions capabilities are not adequate in mitigating and adapting to such interruptions and hence needs of new resilient techniques for communities in more affected region such as Baidoa District among others.

Understanding the effect of climatic smart agriculture may help in attaining food security in a country that many are in danger of starvation and therefore sustainable food production is crucial. While the above studies covered climate resilient agriculture and food security there are no studies on the effect of climate resilient agriculture programs on food security. Furthermore, there are no adequate studies on how climate resilient agriculture programs have contributed to food insecurity in Baidoa. In addition to global climatic changes that have affected agricultural activity across the world, the district is one of the areas that was mostly affected by prolonged civil war that was experienced in Somalia. Poor policies and unstable government in the region have expounded the problem. Although, there are initiatives to support farming in the area, there is need to found the influence of climate resistant agriculture programs on food security in the area. Therefore, this study seeks to evaluate the effects of climate resistant agriculture programs on the extent to which people have access to sufficient nutritious, safe food generally christened as food security in Baidoa District, Southwest State, Somalia.

1.3 Purpose of the study

The purpose of this study was to assess the effects of climate-resilient agriculture programs on food safety in Baidoa District, Southwest State, Somalia.

1.4 Study Objectives

1. To verify the consequence of Climate Resilient Agricultural (CRA) Programs on food security in Baidoa District.
2. To establish how cultivation of drought resistant crops contributes to food security in Baidoa District.
3. To find out the effect of farmers' sensitization on climate-smart agriculture on food security in Baidoa District.
4. To establish the extent to which distribution of drought resistant seeds to farmers has contributed to food security in Baidoa District.

1.5 study Questions

1. What are the consequences of Climate Resilient Agricultural (CRA) Programs contribute on food security in Baidoa District?
2. To what extent does cultivation of drought resistant crops contribute to food security in Baidoa District?
3. What does the farmers' sensitization on climate-smart agriculture contribute to food security in Baidoa District?

4. To what extent does distribution of drought resistant seeds to farmers contribute to food security in Baidoa District?

1.5 Justification of the Study

Climate change presents real and significant challenges to global food security in many countries. To attain food security globally, there is a need for reducing environmental impacts on food and dietary security. Many Somalis are food insecure due to loss of livestock and poor crop productions and the traditional solutions capabilities are not adequate in mitigating and adapting to such interruptions and hence needs of new resilient techniques for communities in more affected region such as Baidoa District among others. Although there are initiatives to support farming in the Baidoa District, there is need to establish how effective these programs may affect the food security in the area are. By assessing the effects of climate resilient agriculture programs may assist the stakeholder identify whether these initiatives are impactful and areas that require more resources to solve the food security challenges in the district.

1.6 Scope of the study

Main objective of the research was to analyze the effect of climate-resilient agriculture programs on food security in Baidoa District, Southwest State, Somalia. The study focused on farmers in the area that are the beneficiaries of these climate resilient agriculture programs. In addition to this category, the study also sought from the other stake holders if the climate resilient agriculture programs that they have implemented have been impactful in achieving food security in the area.

1.6.1 Topographical scope

This research will be carried out in Baidoa District. Southwest State, Somalia. Baidoa is the temporary capital of the federal Southwest State, fundamentally is the node in Central Somalia and considerably in normal times is referred to as the breadbasket of the country. Comparably, the region has the highest number of IDP because of drought: The number of IDPs in Baidoa close to 600,000 persons.

1.6.2 Time scope

The study was carried out between November 2003 to March 2024. The researcher anticipates that the provided time was adequate to complete the whole study. Where the researcher feels that the allocated time is not enough, then the researcher allocated more time and ensure that the research is completed as required.

1.6.3 Content Scope

The analysis seeks to evaluate the effects of climate resilient agriculture programs on food security in Baidoa District, Southwest State, Somalia. The study confined itself to the content described and established how Climate-smart agriculture (CSA) Programs, cultivation of drought resistant crops, farmers' sensitization on climate-smart agriculture and distribution of drought resistant seeds to farmers have impacted food security in Baidoa District.

1.7 Significance of the study

The purpose of this study is to determine the effects of climate resilient agriculture programs on sufficient nutritious, safe food generally christened as food security in Baidoa District, Southwest

State, Somalia. The findings may aid the targeted farmers in identifying the challenge that affect climate resilient agriculture programs that are meant to improve their farm productivity and overall food security. It will also assist the farmers in how they can use climate resilient agriculture to improve their yields.

The findings of the study may also assist the non-governmental organization and government agencies in establishing the extent to which the climate resilient agriculture programs impacted the targeted farmers in achieving the desired productivity and ultimate food security. The study may shed light on how these organizations can be more impactful in their programs in achieving food security in the drought-stricken area. The outcomes of the study may support the regional and the federal government in developing appropriate agricultural policies that support the production of climate resilient agriculture. The findings are also anticipated to contribute to accessible information in the climate resilient agriculture programs and food security, particularly in terms of how it can fill empirical and contextual gaps. The results of this research may contribute to the growth of research literature with evidence that may be used in future studies. It is highly anticipated that this study may not only provide new insight but encourage renewed discussion and further studies on the effects of climate resilient agriculture programs on food sufficience, nutrition and safety in Baidoa District, Southwest State, Somalia.

1.9 Assumptions of the study

a. Baidoa District was facing food security and the conditions in the field remained the same at the time of the project.

b. The targeted population for the study was willing to provide the information sought out and the findings may still be considered useful for the study.

c. Climate change was still presenting a challenge in the field that was affecting food security in Baidoa District by the time of the data collection.

1.11 Operation Definition of Terms

Climate-smart agriculture	Agricultural methods that are adaptive to climatic changes.
Drought-resistant-crops	Crops that perform well with less rainfall and in dry conditions.
Drought resistant seeds	Seeds that perform well with less rainfall and in dry condition.
Distribution of Drought resistant seeds	giving farmers drought resistant seeds cultivation of drought resistant crops
Farmers' sensitization	Educating farmers on climatic smart agriculture
Food Security	is the capacity of citizens to access a sufficient amount of secure and nutritive food to meet their needs.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter of the research project discusses various literature related to the effects of climate resilient agriculture programs on food security. The chapter examines what past research has documented on the subject matter. It also elaborates on various theories that underpin this area of research. Lastly the section presents the conceptual framework displaying the interrelations of independent and independent variable quantity.

2.2 Observed Literature Review

Climatic shifts, random rainfall together with warmth patterns have affected production of agriculture and heightened the weakness of families that rely on farming for their existance, that is home to most global poverty. Changes in climate change have interfered with food markets, presenting danger of food insecurity to millions of people worldwide (ACTED ,2022). These dangers have minimized the increased capability of farmers to adapt in addition to multiplying flexibility and efficient use of agricultural resources and systems (Effland, Saavoss, Capehart and McBride, 2022). While climate-induced food insecurity continues to be a major challenge in the developing countries, the danger is being experienced across the world. Mwongera, Shikuku and Twyman (2017) observed that a good number of poorest global countries are disproportionately reliant on agriculture, unavailability of resources to address challenges associated with climate changes that have affected agricultural productivity and population growth growth has changes over time impacting on the food systems and population health. There are several climates resilient agriculture initiatives that, if properly managed, are able to increase food productivity and ultimate security. Wichern (2019) highlighted business-as-usual' approaches through stressing the capacity to achieve flexible, context-specific solutions, combined with innovative policy and financing actions.

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2.2.1 Climate Resilient Agricultural (CRA) Programs and food security in Baidoa District

Lipper, Thornton, Campbell (2018) evaluated the effects of CSA in tackling food insecurity. The study through review of related projects across the world established that CSA encourages combined initiatives by different stakeholders such as farmers, researchers, policymakers and civil society in climate-resilient pathways. Sain, Loboguerrero, Corner Dolloff and Lizarazo (2017) assessed the costs in comparison to gains in relation to climate-smart farming. The study through the case of the thirsty passage in Guatemala collected data from farmers, project sponsors and other stakeholders through questionnaires, Key interviews and FGDs to assess the costs in comparison to gains in relation to climate-smart farming. The study established that through climate-smart agriculture the government was on its way to attaining food security. A study by Brown, Chaudhary and Sharma (2023) assessed the diversity of farming systems in the Eastern Gangetic Plains of South Asia affected crop yield amid the adoption of new Climate Resilient Agriculture. The established that fast-yielding crops can significantly improve food security by enabling farmers to produce larger quantities of food in a shorter time frame, leading to increased food availability, particularly in regions facing food shortages or experiencing unpredictable weather patterns, thereby enhancing the resilience of food systems and potentially reducing hunger levels. The study however advised that it is important to consider potential downsides like reliance on specific varieties, potential environmental impacts, and the need for balanced crop diversification to maintain long-term food security. Mwongera, Shikuku and Twyman (2017) weigh up the effects of climate smart agriculture on the food security in Malaysia. The findings used CSA-RA as a instrument for ordering context-specific CSA technologies and how it would have an impact of food security in Malaysia. The study established that the areas that had adapted climate smart agriculture had increased their yields and if they continued then they would achieve food security at household level.

A study by Paul, Frelat, Birnholz and Gahigi (2017) evaluated the Agricultural intensification scenarios using modern farming methods and its effect on household food availability in Rwanda. The study through primary data was collected from household farmers from various regions in Somalia established that although modern farming methods such as greenhouse that had gas emissions, these new methods had a great impact on food production in Rwanda.A study by ACTED (2020), evaluated ways on how climate resilient farming can be enhanced to assist in dealing with food insecurity. The study used secondary data to assess the various country initiative to respond to the paraphernalia of Climate-smart agriculture on agricultural production across in

Somalia established that sustainable and modern farming initiatives to deal with the challenges related to climate change, enhance crop productions and minimize hunger and poverty.

2.2.2 Cultivation of drought resistant crops and food security in Baidoa District

Sibhatu and Qaim (2018) assessed the effects of production methods on diets, and nutrition among subsistent farmers. The study reviewed the studies of farmers' production differences and nutrition among subsistent farmers. The study through Meta-analysis established that there was a significant association between production diversity of drought resistant crops, diets, and nutrition in smallholder farm households. Enahoro, Parsons, Silvestri and Valdivia (2014) Farm household modelling and how it influences developing climate-resilient agricultural systems in Nigeria. The study assessed farm household modelling and how it influences the development of climate-resilient agricultural systems. The study established cultivation of drought resistant crops at household level was the solution to food security in Nigeria. The study also highlighted that focus should be directed to cultivation of drought resistant crops at household level with smallholder farmers supported with the right farm inputs.

A study by Wichern (2019) straighten out the multiplicity of rural livelihood approaches through Uganda. The study employed descriptive study design that employed both qualitative and quantitative study methods focused on farmers, ministry of agriculture officers and other stakeholders that support farming in Uganda. The study through descriptive data analysis, analyzed diversity of rural livelihood strategies among subsistence farmers across Uganda, established that these farmers had resorted to the cultivation of a variety of drought resistant crops in a bid to become food reliant at household level.

Mugo and Mugalavai (2017) carried out an investigation on the impacts of droughts on food sufficiency, nutrition and safety security in Kenya. The research through the review of related data evaluated the impact of Emergency Operation Programme (EMOP) on food insecurity caused by droughts. The study established that there have been changes in climate in Kenya's arid and semi-arid lands (ASAL), given that droughts that take a longer period minimizes the region's agriculture and livestock production as much as the employment of climate smart agriculture is currently enhancing women's resilience to climate disruption in the area. This seems to be a possible solution in providing food security, water security and required incomes.

Global population and changing eating habits pushing the demand for food. There is a challenge with food production with the inability to live up to crop production level across the world. The ocean health dwindled, and natural resources such as soil, water, and biodiversity are strained with many at risk. A 2020 report established that close to a population of 690 million persons or nine-point nine percent of the global population are faced with severe hunger while close to sixty million in five years. The food security challenge is feared to present even more problems, given that the world is required to produce close to 70 % more food by 2050 to feed close to 9 billion people (Acevedo et al, 2020).

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2.2.3 Farmers' sensitization on climate-smart agriculture and contribute to food security in Baidoa District

Park, Marshall and Jakku (2018) assessed the informing adaptation responses to climate change in Africa. The study through the theories of transformation framework evaluated a few Africa and assessed the extent to which increased knowledge on CSA would increase food production in

Africa. The study established that the more the farmers are informed on there is need for more sensitization on the Climate Smart Agriculture (CSA); the more they are able to produce more.

Pelster, Rufino, Rosenstock and Mango (2017) evaluated the use modern Smallholder farms including climate-smart agriculture in eastern African tropical highland. The study evaluated the whether the climate-smart agriculture has low soil greenhouse gas fluxes. The study through interviews of small holder farmers in eastern African tropical highland established that while modern farming method such as greenhouse had its own negative impact, the advantages outweighed the disadvantage and therefore was an option for food security in Africa. Jelagat (2023) evaluated the effect of climate smart agriculture on food security among small holder farmers in Kaboi Ward in Nandi County.

Another study Gichure, R.W (2024) Effect of draught resistant crops adaptation on copping mechanism undertaken by small scale farmers in Makweni County. A cross-sectional descriptive study design was employed by the study and targeted small-scale farmers in Makweni County. Questionnaires were used to gather the research information. When farmers are aware of drought-resistant crops, it significantly improves food security by enabling them to produce reliable crop yields even in dry conditions, leading to increased food availability, reduced vulnerability to famine during droughts, and improved household income, particularly in regions prone to erratic weather patterns; essentially acting as a critical adaptation strategy to climate change in agriculture. The study also established that increased knowledge of Climate-Smart Agriculture (CSA) has significantly improved food security by enabling farmers to adapt to changing climate conditions, leading to more resilient crop yields, improved resource management, and ultimately, greater access to food for communities, especially in vulnerable regions affected by climate change

Another study by Agesa, Onyango, Kathumo and Onwonga (2019) evaluated climate change effects on crop production in Kenya. The study survey that was conducted in two wards of Yatta, Kenya collected data on farmer perceptions and adaptation strategies in the two villages. The data was analyzed through SPSS and the findings indicated that even though climate change is understood by farmers in Yatta sub–county, several initiatives and approaches to crop yield enhancement continues experience a downward trend. In view of this farmer's capacity needs to be improved to mitigate the challenges related to climate alteration to achieve sustainable agricultural yielding and enhanced food safety, sufficiency and nutritional content.

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2.2.4 Distribution of drought resistant seeds to farmers and contribute to food security in Baidoa District.

Effland, Saavoss, Capehart, McBride (2022) conducted a study on the innovations in seed and farming technologies contribute to yielding benefits and costs on corn farms in Northern Great Plains region, USA. An analysis of responses to the ARMS survey of corn farms from 1996 to 2016 showed that providing improved seeds and extended technologies in the last decades factored into acreage and yield changes. Specifically, the use of genetically modified seed types has steadily increased. The study also established that focusing on one -pest resistant seed type that has proteins from Bacillus thuringiensis (BT), a bacterial insecticide, increased from 2% of corn acres in 1996 to 21% in 2001 and to 78 at the end of the year 2016.

Cho (2018) evaluated ways of improving seeds to meet future challenges in Malawi. The study through both qualitative and quantitative methods evaluated how to improve seeds to meet future demands. The study while employing descriptive analysis established that availability and proper distribution of more producing, high nutrition, and drought and climate resilient to mitigate the perceived effect. The study established that while several professional trusts that genetically engineered varieties to be a possible remaining mitigation to the challenge; evidence indicates effective distribution of seedlings referred to as traditionally organic to sub-subsistence farmers may contribute to effective and sustainable crop yielding.

Acevedo, Pixley and Zinyengere (2020) carried out a scoping review of adoption of climate-resilient crops by subsistence farmers in poor countries. The study through Preferred Reporting Items for Systematic review and Meta-Analysis Protocols assessed the situation that contributed to the implementation of climate-resilient farming in the last 30 years in poor and developing countries. The results indicated that the significant factors in deciding the adoption of climate-resilient farming include availability seeds, dependable distribution structures for seeds and efficiency of extension support and advocacy, household education levels, farmers' access to required inputs and in addition to this, the socio-economic levels of farming households.

Aryal, Sapkota and Rahut (2021) carried out a study on the climatic challenges and initiatives for mitigation of farmers in East Africa and South Asia, the study focused on 175 poor small-holder farmers that included the beneficiaries of the distribution of improved drought resistant seeds program in Salbuy, Bonkai, Boqo-iitar and Reebay. The data collected included structured questionnaires and key interviews. The results of the investigation recognized that distribution of short-term yielding seeds has been applied to encourage food production among farmers in the area. The objective of this initiative is to ensure that poor and marginalized families become more resilient to challenges related to climate change and that the families are encouraged to adopt more sustainable livelihood approaches. This in essence may lead to long-time achievement of development goals emphasized in the national development plan. Drought-resistant seeds are distributed to farmers in South America through a variety of channels, including seed companies, agricultural supply stores, and agricultural cooperatives

Muluka (2020) evaluated the extent to which distribution of drought resistant seed varieties have boosted food production and made communities resilient to climate change. The study targeted small scale farmers in Yatta area of Kitui. The case study collected data from small scale farmers and interviewed players in the Agricultural sector to establish the effects of the distribution of drought resilient seeds in the area. The results indicated that distribution of drought resistant maize seeds variety to small-scale farmers is one of the strategies that organization support farmers in Lower Yatta area of Kitui are using in one of the targeted. Distribution of these drought resistant maize seeds situation is helping small scale farmers in areas that the situation has further been compounded by the desert locust that has hit the area.

Global population and changing eating habits pushing the demand for food. There is a challenge with food production with the inability to live up to crop production level across the world. The ocean health dwindled, and natural resources such as soil, water, and biodiversity are strained with many at risk. A 2020 report established that close to a population of 690 million persons or nine-point nine percent of the global population are faced with severe hunger while close to 60 million within five years. Food safety, sufficiency and nutritional value's challenge is feared to present even more problems, given that the world is required to produce close to 70 % more food by 2050 to feed close to 9 billion people (Acevedo et al, 2020). The current temperatures rise and changing precipitation patterns continue to contribute to food and nutritional insecurity across the world, thereby putting the global population at risk of starvation. Studies have emphasized the significance of climate effects on crop production and food supplies.

Following four back-to-back inadequate rainfall seasons and the anticipated fifth, Somalia could again be facing bad drought that may affect some portion of the nation with such regions like Baidoa, in Southwest state being more affected. The population in these areas is in danger of famine. Currently, one million people have been forced to move out of their homes searching for food and water. Additionally, Somalia the country experienced a triple shock of COVID-19, desert locust infestation, and the effect of the 2019-2020 floods that further contributed to food insecurity in most parts of the country (Care, 2022).

Enahoro, Parsons, Silvestri and Valdivia (2014) Farm household modelling and how it influences developing climate-resilient agricultural systems in Nigeria. The study assessed farm household modelling and how it influences the development of climate-resilient agricultural systems. The study established cultivation of drought resistant crops at household level was the solution to food security in Nigeria. The study also highlighted that focus should be directed to cultivation of drought resistant crops at household level with smallholder farmers supported with the right farm inputs.

A study by Wichern (2019) straighten out the multiplicity of rural livelihood approaches through Uganda. The study employed descriptive study design that employed both qualitative and quantitative study methods focused on farmers, ministry of agriculture officers and other stakeholders that support farming in Uganda. The study through descriptive data analysis, analyzed diversity of rural livelihood strategies among subsistence farmers across Uganda, established that these farmers had resorted to the cultivation of a variety of drought resistant crops in a bid to become food reliant at household level.

Mugo and Mugalavai (2017) carried out an investigation on the impacts of droughts on food sufficiency, nutrition and safety security in Kenya. The research through the review of related data evaluated the impact of Emergency Operation Programme (EMOP) on food insecurity caused by droughts. The study established that there have been changes in climate in Kenya's arid and semi-arid lands (ASAL), given that droughts that take a longer period minimizes the region's agriculture and livestock production as much as the employment of climate smart agriculture is currently enhancing women's resilience to climate disruption in the area. This seems to be a possible solution in providing food security, water security and required incomes.

Global population and changing eating habits pushing the demand for food. There is a challenge with food production with the inability to live up to crop production level across the world. The ocean health dwindled, and natural resources such as soil, water, and biodiversity are strained with many at risk. A 2020 report established that close to a population of 690 million persons or nine-point nine percent of the global population are faced with severe hunger while close to sixty million in five years. The food security challenge is feared to present even more problems, given that the world is required to produce close to 70 % more food by 2050 to feed close to 9 billion people (Acevedo et al, 2020).

Additionally, the problem may be heightened through agriculture's optimum vulnerability to changes in climate. Somalia farmsteads just like many other parts in Africa, changes in climate continue to minimize crop production, the nutritive quality of cereals, and livestock yields (World

Bank, 2022). Therefore, there is a need for deliberate resource focus if current production is to be sustained and if making and meal quality is increased to see need.

The current temperatures rise and changing precipitation patterns continue to contribute to food and nutritional insecurity across the world, thereby putting the global population at risk of starvation. Studies have emphasized the significance of climate effects on crop production and food supplies.

2.3 Literature Review Summation

Table 2. 1: Summation of Literature Review

uthor	Study	Methodology	Findings	Study Gap
ACTED (2020),	Ways of improving climate-resilient agriculture assist in tackling food insecurity	Secondary Data	Sustainable and improved agricultural techniques are able to assist in dealing with climate change effects, enhance crop productions and minimize hunger and poverty	The study is general and not specific to Somalia
Sibhatu and Qaim (2018)	Ways of improving climate-resilient agriculture assist in tackling food insecurity	Meta-analysis	Production differences of drought resistant farming affects diets, and nutrition among subsistence farmers	The study used a different method and was not specific to Somalia
Mugo and Mugalavai (2017)	The use modern Smallholder farms including climate-smart agriculture in eastern	Review of related data	Climate smart farming are building resilience to climatic challenges.	The study was not focused on specific variables
Pelster, Rufino, Rosenstock	The use modern Smallholder farms including climate-smart agriculture in	Interview	While modern farming method such as greenhouse had its own negative impact, the advantages	Although the study was carried in Africa, the

and Mango (2017)	eastern African tropical highland		outweighed the disadvantage and therefore was an option for food security in Africa	study was not specific to Baidoa, Somalia
Effland, Saavoss, Capehart, McBride (2022)	The use modern Smallholder farms including climate-smart agriculture in eastern	Survey	Distribution of new seeds and extended innovations in the 20 years factored into acreage and yield changes	The study was carried in USA and cannot be generalized to Baidoa, Somalia
Cho (2018)	Ways of improving seeds to meet future challenges in Malawi.	Qualitative and Quantitative methods	While some professionals consider genetically engineered farming is the remaining solution to the problem, others claim effective distribution of traditionally organic seedling to small-scale farmers can lead to more effective and sustainable production	Although the study was carried in Africa, the study was not specific to Baidoa, Somalia

2.4 Recap of literature review

Pelster, Rufino, Rosenstock and Mango (2017) established that while modern farming methods such as greenhouse had its own negative impact, the advantages outweighed the disadvantage and therefore was an option for food security in Africa. Despite emphasis on Climate-smart agriculture, the above literature has not addressed the impacts of climate resistant agriculture programs on food safety and sufficiency and especially in Baidoa District, Southwest State, Somalia. Understanding the effect of climatic smart agriculture may assist in attaining food security in a country that many are in danger of starvation and therefore sustainable food production is crucial.Additionally, the problem may be heightened through agriculture's optimum vulnerability to changes in climate. The painful effect of changes in climate are currently being experienced in ways that include increased climatic and environmental, pest and diseases factors have created unbearable patterns. Somalia farms just like many other parts in Africa, changes in climate continue to minimize crop production, the nutritional standards of primary cereals, and decreasing livestock yields (World Bank, 2022). Therefore, there is a need for deliberate resource focus if current production is to be sustained and if manufacture and quality of food is increased to meet requirement.The current temperatures rise and changing precipitation patterns continue to contribute to food and nutritional insecurity across the world, thereby putting the global population at risk of starvation. Studies have emphasized the significance of climate effects on crop production and food supplies.

The current temperatures rise and changing precipitation patterns continue to contribute to food and nutritional insecurity across the world, thereby putting the global population at

risk of starvation. Studies have emphasized the significance of climate effects on crop production and food supplies.

2.5 Theories Applied in the Study

The study reviewed the following theory

2.5.1 Malthusian Optimism Theory of Food Security

The theory posits that a faster increase in population is more than the food supply and if not managed or controlled it may contribute to food insecurity. The theory explains that this infinite increase in population contributes to negative disparities in society. In view of this, the supply of crucial food items in addition to agricultural inputs (fast growing crops, drought resistance crops) at a reduced rate is effective and provide solutions dealing with food shortages. The significance of proper support of the food production systems through climate smart farming is to avoid these insecurities as an approach to equal availability of food to all. Malthus considers food as an indispensable need in human beings' life and the inevitably need to be limited through supply in situations where Climate Smart farming is applicable in providing the solution. With the proper implementation of Climate-smart agriculture (CSA), it can reduce famine, hunger and lead to ultimate food security, especially to the populous poor in each area

2.6 Conceptual Framework

Below is a graphic representation of the interrelationship between variables under enquiry.

Standalone Variables **Moderating Variable** **Dependent var**

Climate-Resilient agriculture (CRA) Programs

1. Climate Change agriculture

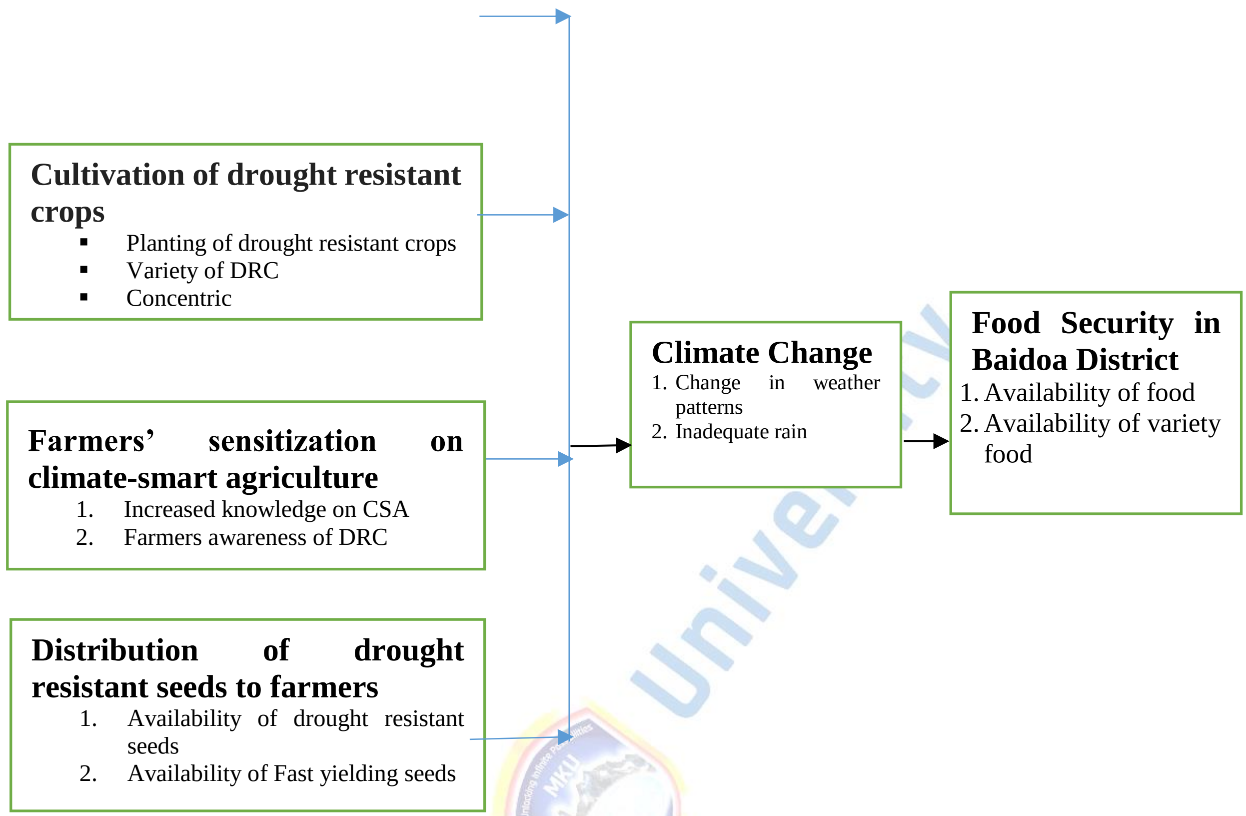

Figure 2. 1 : Conceptual Framework

From the above figure, the effects of climate resilient agriculture programs on food security in Baidoa District, Southwest State, Somalia. The independent variables are Climate-smart agriculture (CSA) Programs, cultivation of drought resistant crops, farmers' sensitization on climate-smart agriculture and distribution of drought resistant seeds to farmers while the dependent variable is food security in Baidoa District. Moderating variable on the other hand was climate change.

2.7 Operationalization of the Variables

Table 2. 2: Operational of Study Variables

Variable Type	Variable Description	Sub-Variable	Source of Data	Method of Analysis
Independent Variable	Climate Resilient Agricultural (CRA)	Climate Change agriculture	Primary	Descriptive Statistics, Quantitative Analysis (Percentage and Average ratios)
		Fast yielding crops	Primary	
	Cultivation of drought resistant crops	Planting of drought resistant crops	Primary	Descriptive Statistics, Quantitative Analysis (Percentage and Average ratios)
		Variety of DRC	Primary	
	Farmers' sensitization on climate-smart agriculture	Increased knowledge on CSA	Primary	Descriptive Statistics, Quantitative Analysis (Percentage and Average ratios)
		Farmers awareness of DRC	Primary	
	Distribution of drought resistant seeds to farmers	Availability of drought resistant seeds	Primary	Descriptive Statistics, Quantitative Analysis (Percentage and Average ratios)
		Availability of Fast yielding seeds	Primary	
Dependent Variable	Food Security in Baidoa District	Availability of food	Primary	Pearson Correlation, Linear Regression Analysis
		Availability of variety food	Primary	Descriptive Statistics, Quantitative Analysis

Moderating Variable	Climate Change	Change in weather patterns	Primary	(Percentage and Average ratios)
		Inadequate rain	Primary	

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This segment of this research project outlines the methods and steps followed in data collection and information gathering during the study. The section presents the research design used, target population, sampling procedures and methods, data analysis and the ethical procedures observed during fieldwork.

3.2 Research Design

The study applied descriptive research design in studying the effects of CRA programs on food security in Baidoa District. Descriptive studies are more applicable in situations where the variable under the study is not quantifiable but can only be described in statistical form (Schindler, 2001). This helped to evaluate qualitative and quantitative variable. Statistically, mean, standard deviation, percentages and frequencies were used for this study. The study evaluated how independent variables: workforce diversity management (Climate-smart agriculture (CSA) Programs, cultivation of drought resistant crops, farmers' sensitization on climate-smart agriculture and distribution of drought resistant seeds to farmers) influence Dependent Variable: the impact of climate resilient agriculture programs on food safety and suffiency in Baidoa District, Southwest State, Somalia.

3.3 Locale of the study

The investigation was based in Baidoa which is in the central part of Somalia, approximately 250 Kilometers from Mogadishu. Baidoa town is divided into Hawl Wadaag, Isha, Horseed and Berdaale.It is one of the strategic economic hubs og the country dominated by trading on food items like cereals, livestock products and imported processed food items. The map of the study area is attached in Appendix IX.

3.4 Target population

The investigation targeted 10,656 households in Baidoa District, Southwest State, Somalia. This included the head of each household. Additionally, the study also collected data from community leaders, non-community groups, experts in agriculture and religious leaders Baidoa district.

Table 3. 1: Population aimed at

Division	House Holds	Sample Size Spreading
Isha	1,342	12.6
Horseed	1,062	9.97
Berdaale	1,354	12.71
Howlwadaag	819	7.69
Daru salaam	1,013	9.51
Salaamey	791	7.43
Towfiiq	1,300	12.20
Wadajir	1,114	10.46
Waaberi	1,030	9.67

Ideedi	831	7.76
Total	10,656	100.0

Source: Field Study (2024)

3.5 Sampling procedures

3.5.1 Sample size fortitude

The size of the sample was calculated by applying the formula below.

The Cochran formula is:

$$n_0 = \frac{Z^2pq}{e^2}$$

From the formular, p is the estimated population that is attributed to the question. While e is the desired precision range, or the marginal error ad q is calculated by 1-q.

Therefore:

((1.96)2 (0.5) (0.5)) / (0.05)2 = 385.

This means that 385 households within the study area were considered appropriate enough to give us the confidence levels we need.

no =approx. 385 households (desired sample size)

The sample size was calculated proportionately to each of the six counties depending on their population strength. A total of 385 respondents (households) were estimated as minimum sample proportions for the consideration. 10% of 423 households stayed added to cover for cases of non-response. A sampling size was proportionately distributed according to the population strength in the 10 administrative villages in Baidoa District.

3.5.2 Sampling Method

Stratified sampling method: The study employed stratified sampling method to select the households as per their sample strength and distribution. Denscombe (2014) defines stratified sampling as one in which every member of the population has an equal chance of being selected in their proportion within the subcategory or strata. The first step in this process was to determine the proportion of households in the research region, from which the study sample was drawn proportionately as indicated in table 3.1 above. Additionally, the sample was proportionately distributed as per the population strength of the 10 villages. The sampling was based on household population in the study area.

The sampling method is not only representative but also non-bias by ensuring that respondents (households) from each sub-village unit are properly represented and therefore the information collected on the use of high-quality seeds for farming is as representative and accurate as possible. The method also provides an equal chance for respondents from all the 10 villages to participate in the study. Mugenda and Mugenda (2003) denote that sample size is the sum of items chosen from a sample frame or a selected population for the study. Systematic sampling method: Additionally, the study used systematic sampling method to determine starting points of sampling and sequence of this in each of the 10 sub-unit villages. The population was first divided into strata (10 villages), and then a random start point is picked for individual stratum. The unit at the start point is picked, and then every kth unit was selected until the required sample size in each of the 10 regions is reached as shown in the Table 3.1 above. Sampling method of this type is applicable in situations where population units are located in an administrative or geographical area, such as when sampling from different regions.

3.5.3 Sample Population

Table 3. 2: Sampling and its distribution

Division	House Holds	Sample Size Distribution	Percentage Distribution
Isha	1,342	53	12.6
Horseed	1,062	42	9.97
Berdaale	1,354	54	12.71
Howlwadaag	819	33	7.69
Daru salaam	1,013	40	9.51
Salaamey	791	32	7.43
Towfiiq	1,300	51	12.20
Wadajir	1,114	44	10.46
Waaberi	1,030	41	9.67
Ideedi	831	33	7.76
Total	10,656	423	100.0

Source: Field Study (2024)

3.6 Development of Research Tools

The major source of data for this inquiry was gathered directly from the local respondents, encompassing both qualitative and quantitative information. To facilitate data collection, the study utilized questionnaires and interview schedules.

3.6.1 Questionnaire

The primary instrument for data collection was a structured questionnaire designed for farmers across various regions. As noted by Mugenda and Mugenda (2003), a questionnaire consists of a sequence of inquiries posed to respondents to obtain relevant information on a specific subject of interest. The questionnaire incorporated a five-point Likert scale to gauge the respondents' agreement with different statements aligned with the study's objectives (1- Strongly Disagree, while 5 - Strongly Agree). The questions were crafted to be comprehensive and mutually exclusive.

3.6.2 Consultation / Interview Guide

Non-numeric data was gathered through Major Informer Interviews, specifically targeting Non-Governmental Organizations involved in promoting climate-resilient agricultural initiatives in the region. This approach aimed to enhance the insights gained from other respondent groups regarding the impact of workforce diversity management on climate-resilient agricultural programs and their implications for food security in Baidoa District, Southwest State, Somalia.

3.7 Validity and Reliability Testing

3.7.1 Pilot Study

A pilot study was conducted using the questionnaires, which were distributed to a subset of the target population, consisting of one respondent from each identified stratum, representing 10% (42) of the overall sampled farmers. The pilot test aimed to assess the validity and reliability of the data collection tools. Orodho (2003) emphasized the importance of pilot studies for verifying the consistency of data collection instruments. Given the study's focus on a diverse population, the pilot testing involved participants from all relevant demographic segments (Coopers & Schindler, 2006).

3.7.2 Validity

Validity refers to the degree to which a research instrument measures what it intends to measure and fulfills its designed purpose (Kerlinger, 2006). It assesses how well the findings derived from data analysis reflect the phenomenon under investigation. The validity of the research instruments was evaluated by experts from the School of Business Studies at Mount Kenya University, whose feedback was integrated into the final versions used in the study.

3.7.3 Reliability

To establish the consistency of the investigation tools, Cronbach reliability evidence was accomplished using SPSS software. An elevated Cronbach's dominant coefficient, closer towards 1, indicates better internal consistency of the questionnaire. Reliability scores below 0.6 are deemed poor, scores between 0.7 and 0.8 are acceptable, and scores above 0.8 are considered good (Sekaran, 2003).

3.8 Data Collection Methods

The researcher secured an introductory letter from the university, which authorized data collection from the targeted farmers. Prior to engaging with the sampled respondents, permission was also obtained from relevant local authorities in Baidoa District. Additionally, a request letter was sent to the identified Key Informants, including government officials responsible for agricultural policy, local NGOs that assist farmers with climate-resilient agriculture, as well as UN agencies and other international organizations involved in agricultural support in the district. Because many farmers may not be proficient in English, the researcher administered the questionnaires in person, providing translations where necessary. Direct questions were also directed to Resolution Informers to gather perspectives on the consequences of climate-resilient agriculture programs on food security within Baidoa District, Southwest State, Somalia.

3.9 Data Analysis Techniques and Procedures

Both mathematical and non-numeric analysis techniques were employed to the data. For quantitative data, descriptive and inferential statistics were utilized. Descriptive statistics included mean, standard deviation, and percentages to assess the impact of standalone variable star on the subject variable. Inferential statistics were employed to explore relationships between variables using multi-linear regression and Pearson correlation, allowing conclusions to be drawn about these relationships at a 95% confidence level.

SPSS facilitated the quantitative data analysis, with results presented through tables, percentages, and charts using Microsoft Excel.

For qualitative data analysis, thematic analysis was conducted based on the study's objectives. Interview responses were categorized according to each research question, enabling the identification of themes and connections among them to provide analytical insights. This approach also facilitated comparisons among participants. The analysis results were presented in various formats, including narratives, tables, charts, and graphs.

Furthermore, a linear regression model ($Y1 = \beta o + \beta 1X1 + \beta 2X2 + \beta 3X3 + e$) was utilized to investigate the relationship between the variables at a critical level of $P < 0.05$, corresponding to a 95% confidence level. ANOVA tests were conducted to evaluate hypotheses, where $P < 0.05$ indicated the refusal of the null proposition in favor of the substitute, while $P > 0.05$ suggested retaining the insignificant proposition.

3.10 Ethical Consideration

The researcher prioritized confidentiality, informed consent, and maintaining originality throughout the study. To protect confidentiality, random letters were assigned to participants instead of using their names or specific descriptions. The information shared by participants, along with their departmental affiliations, was disclosed to external parties in an anonymous manner, specifically to guide policy development regarding pandemic-related disruptions in the public sector and for academic analysis as outlined in the study. Informed consent was obtained from participants, and they were given the option to withdraw from the study at any time during the questionnaire process. Participation was strictly voluntary, with no coercion involved. Participants were encouraged to take part in the study of their own accord. Recognizing the importance of research integrity, the researcher refrained from any dishonest practices, including fabrication, plagiarism, or unethical behaviour, and ensured that consent was acquired whenever necessary. Additionally, the researcher secured ethical approval from Mount Kenya University and obtained permission from the local authorities in Baidoa district prior to starting data collection.

CHAPTER FOUR: PRESENTATION OF RESEARCH FINDINGS, AND DATA ANALYSIS

4.1 Introduction

This research aimed to investigate how climate-resilient agriculture programs impact food safety in the Baidoa District of Southwest State, Somalia. This chapter presents the findings and discussions derived from questionnaire data, which captured participants' perspectives on the influence of these agricultural initiatives on food security in the region. The chapter is structured into five sections: the response rate, general information about the respondents, descriptive statistics of the examined variables, diagnostic analysis, and inferential statistical analysis of the gathered data.

4.2 Response Rate

The investigation sought to establish the participation of the study, the reply rate and the response per category of the respondents. The following were the responses.

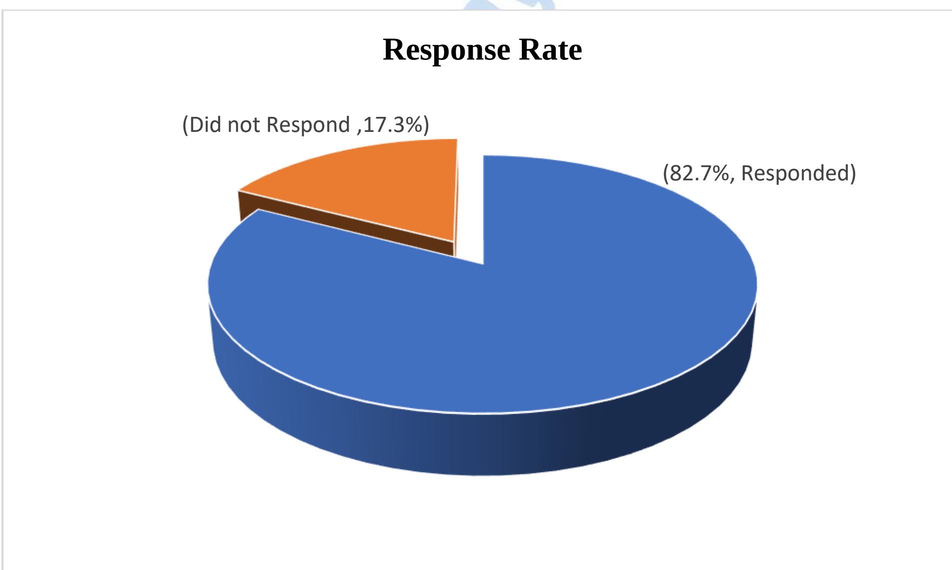

Figure 4. 1: Response Rate

The study established that there was 82.7% response from the sampled 423 farmers drawn from 10 Divisions in Baidoa District, Southwest State. The response rate of 96.9% was considered very adequate. Arora, (2003), stated that a questionnaire-based study that produces above 65% response, is rated as a well participated study.

Table 4. 1: Response rate per category

Farmers Location Division	Sample Population	Respondents	Response Rate
Isha	53	42	79.2
Horseed	42	34	80.9
Berdaale	54	45	83.3
Howlwadaag	33	20	60.6
Daru salaam	40	37	92.5
Salaamey	32	30	93.7
Towfiiq	51	49	96.1
Wadajir	44	27	61.4
Waaberi	41	38	92.7
Ideedi	33	28	84.8
Average Response Rate	423	350	82.7

The study had sought to establish how many of the sampled respondents from each division from the covered divisions participated in the study, the response indicated that the highest participants were drawn from Towfiiq at 96.1%, followed by Salaamey at 93.7% and then Daru salaam at 92.5% while the lowest response was from Howlwadaag at 60.6%, followed by Wadajir at 61.4% and Isha District at 79.2%. The results indicated that the study was well responded. This was made possible due to the researchers' commitment and involvement of local data collectors from each of the districts.

4.3 Demographic Information

Table 4. 2 : Demographic Information

Category	
Gender	
Men	128(36.6)
Women	222(63.4)
Total	350(100.0)
Education Level	
Untrained (No formal Education)	339 (96.8)
Secondary	9 (2.6)
College	2(0.6)
Undergraduate Degree	0(0.0)
Total	350(100.0)
Duration that the respondents had been farming	
Less than 2 years	24 (6.9)
2-5 Years	74(21.1)
Above 5 Years	252(72.0)
Total	350(100.0)

The study's outcome showed that 82.7% of the sampled population took part in the research. Among them, 36.6% were male and 63.4% were female, suggesting a higher number of female farmers compared to their male counterparts. Additionally, the study revealed that 96.8% of the respondents lacked formal education or training, while 2.6% held Secondary Education Certificates. Only 0.6% had obtained a college certificate, and none possessed undergraduate degrees. This highlights that the majority of the farmers had little to no formal education. Furthermore, the research found that 6.9% of the participants had been farming for less than two years, while 21.1% had been in the profession for two to five years. This implies that most respondents had at least six years of farming experience, equipping them with sufficient knowledge about the issues being studied, thus ensuring the reliability of their responses.

4.3 Descriptive Statistical Analysis

Descriptive statistics provide a quantitative summary of a dataset, highlighting its key features (Mann, 1995). Unlike inferential statistics, which aim to make conclusions about a larger population based on sample data, descriptive statistics focus solely on summarizing the characteristics of the sample itself. This approach typically does not rely on probability theory, often leading to the use of nonparametric statistical methods (Trochim, 2006). In this research, a 5-opinion Likert scale was engaged to evaluate responses, with values ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The analysis produced means and standard deviations derived from the participants' responses. The mean values were interpreted as follows: scores from 1 to 1.8 indicated strong disagreement, 1.9 to 2.6 indicated disagreement, 2.7 to 3.4 represented a neutral or somewhat agreeable stance, 3.5 to 4.2 signified agreement, and scores from 4.3 to 5 indicated strong agreement (Wandili, 2022).

4.3.1 The Impact of Climate Change on Agriculture and Food Security in Baidoa District

The first objective was to determine the influence of climate change on agricultural practices and food security in the Baidoa District. In this section, respondents were presented with six statements related to agriculture, climate change, and food insecurity. The average scores and standard deviations of their answers are shown below in Table 4.3.

Table 4. 3 : Agriculture, Climate change and food insecurity in Baidoa District

Climate Change agriculture	N	Mean	Std. Deviation
Climate Change agriculture contributes to food security in the area	350	4.67	.617
The farmers in the area have already adapted Climate Change agriculture	350	4.49	.866
Farmers in the area are resorting to fast yielding crops compared to the traditional crops that took longer	350	3.80	1.078
There farmers are now considering fast yielding crops that are more drought resistant.	350	4.75	.828

The results indicated that climate change agriculture contributes to food security in the area with a mean of 4.67 and standard deviation of .617 indicating that climate change agriculture has critically affected food security in Baidoa. The results show that the farmers in the area have already adapted to climate change agriculture (Mean= 4.49, Standard Deviation= .866). The findings also show that the project deliverables are well set for effective implemnetation (Mean=3.80, Standard Deviation= 1.078). Additionally, the findings also indicate that proper project planning is crucial from the start and end of development projects (Mean= 4.75, Standard Deviation= .828). This indicated that changes in climate Baidoa District in Somalia have led to farmers adapting climate change agriculture and are also resorting to fast yielding crops compared to the traditional crops that took longer and are also now considering fast yielding crops that are more drought resistant.

4.3.2 The consequence of cultivation of drought on food safety in Baidoa District

The primary goal was to assess the impact of cultivating drought-resistant crops on food security in Baidoa District. To achieve this, participants were presented with six statements regarding the relationship between the cultivation of these crops and food security in the area. The average scores and standard deviations of their responses are summarized in the table below.

Table 4. 4 : Effect of cultivation of drought on food security in Baidoa District

Cultivation of drought resistant crops	**N**	**Mean**	**Std. Deviation**
Cultivation of drought resistant crops affect food security	350	4.24	.933
Farmers in the area are encouraged to plant drought resistant crops	350	4.37	1.141
There are a variety of DRC that are being planted by farmers in the area	350	4.51	.866
Planting of drought resistant crops has contributed to high yields	350	3.91	1.033

The results indicated that cultivation of drought resistant crops affect food security with a average of 4.24 and typical variation of .933 implying that growing of drought resistant crops can assist in dealing with food insecurity in Baidoa. The results show that farmers in the area are encouraged to plant drought resistant crops (Mean= 4.37, Standard Deviation=

1.141). The findings also show that there are a variety of DRC that are being planted by farmers in the area (Mean=4.51, Standard Deviation= .866). Additionally, the findings also indicate that planting of drought resistant crops has contributed to high yields (Mean= 3.91, Standard Deviation= 1.033). This indicates that cultivation of drought resistant crops can assist in dealing with food insecurity in Baidoa, farmers in the area are encouraged to plant drought resistant crops and that there are variety of DRC that are being planted by farmers in the district that can contribute to food security. Lastly, farmers in Baidoa district can get high yields by planting drought resistant crops.

4.3.3 The consequence of cultivation of drought on food safety in Baidoa District

The second aim of the analysis was to measure how farmers' awareness of climate-smart agriculture impacts food safety, sufficiency, and nutrition in the Baidoa District. In this part of the study, participants were given six statements related to their knowledge of climate-smart farming practices and their effects on food security in the region. The mean scores and SD of the responses are displayed in the chart below.

Table 4. 5 : Effect of cultivation of drought on food security in Baidoa District

Farmers' sensitization factors	N	Mean	Std. Deviation
Farmers' sensitization on climate-smart agriculture effects food security	350	4.01	1.079
The government agencies and development partners have not carried out enough sensitization on climate-smart agriculture	350	4.25	1.160
Farmers are still not aware of the climate-smart agriculture options available to them.	350	3.60	1.043
The farmers are still suspicious of the new drought resistant crops	350	4.16	1.136

The results indicated that farmers' sensitization on climate-smart agriculture affect food security with a average of 4.01 and SD of 1.079 indicating that by farmers' sensitization on climate-smart agriculture, the country can achieve food security in Baidoa. The results show that the government agencies and development partners have not carried out enough sensitization on climate-smart agriculture (Mean= 4.25, Standard Deviation= 1.160). The findings also show that farmers are still not aware of the climate-smart agriculture options available to them (Mean=3.60, Standard Deviation= 1.043). Additionally, the findings also indicate that the farmers are still suspicious of the new drought resistant crops (Mean= 4.16, Standard Deviation= 1.136). This indicated that enhanced farmers' sensitization on climate-smart agriculture can assist a country to achieve food security in districts such as Baidoa where they have faced a number of major droughts. Additionally, government agencies and development partners have not carried out enough sensitization on climate-smart agriculture. Lastly, the farmers in the district are still not aware of the climate-smart agriculture options available and therefore there is a need for increased sensitization on climate-smart agriculture. Noticeably, efforts should be enhanced in educating the farmers in climate-smart agriculture who are still suspicious of the new drought resistant crops.

4.3.4 The effect of distribution of drought resistant seeds to farmers on food security in Baidoa District

The objective number in this research was aimed assessing the impact of distributing drought-resistant seeds to farmers on food security in Baidoa District. This portion of the study included six statements regarding the distribution of these seeds and their relevance to food security. The mean responses and SD are summarized in the table below.

Table 4. 6 : Effect of Distribution Of Drought Resistant Seeds To Farmers On Food Security In Baidoa District

Distribution of drought resistant seeds factors	N	Mean	Std. Deviation
Effective distribution of drought resistant seeds to farmers affects food security.	350	3.99	1.153
The availability of drought resistant seeds is crucial for increased food production	350	3.74	.920
Fast yielding crops are distributed to farmers in good time to increase their farming productivity	350	3.93	1.251
The government and the agencies that support food production have created effective distribution to increase farmers productivity	350	3.81	1.196

The results indicated that effective distribution of drought resistant seeds to farmers affects food security with a mean of 3.99 and standard deviation of 1.153 indicating that effective distribution of drought resistant seeds to farmers in good time and quantities can highly contribute to food security with food insecurity in Baidoa. The results show that the availability of drought resistant seeds is crucial for increased food production (Mean= 3.74, Standard Deviation= .920). The findings also show that Fast yielding crops are distributed to farmers in good time to increase their farming productivity (Mean=3.93, Standard Deviation= .1.251). Additionally, the government and the agencies that support food production have created effective distribution in order to increase farmers' productivity (Mean= 3.81, Standard Deviation= 1.196). This indicates that effective distribution of drought resistant seeds to farmers in good time and quantities can highly contribute to food security with food insecurity in Baidoa given that the availability of drought resistant seeds is crucial for increased food production. Additionally, the government agencies that effective distribution of fast yielding in critical in order to increase farmers productivity.

4.3.4 The food security factors in Baidoa District

The four objectives were to establish food security factors in Baidoa District. This section provided the respondents with 6 statements on food security in Baidoa District. The means and standard deviations of the reactions are exhibited in the table below.

Table 4. 7: Food Security Factors In Baidoa District

Climate-smart agriculture (CSA)	N	Mean	Std. Deviation
Climate-smart agriculture (CSA) has improved food security in the area	350	3.50	.859
CSA has made food available in the district	350	2.86	.907
Farmers are now producing enough to feed their household and some to sell	350	3.46	1.447
Climate-smart agriculture has solved food insecurity in the district	350	3.78	1.102

The results indicated that effective distribution of drought resistant seeds to farmers affects food security with a mean of 3.99 and standard deviation of 1.153 indicating that effective distribution of drought resistant seeds to farmers in good time and quantities can highly contribute to food security with food insecurity in Baidoa district. The results show that the availability of drought resistant seeds is crucial for increased food production (Mean= 3.74, Standard Deviation= .920). The findings also show that Fast yielding crops are distributed to farmers in good time to increase their farming productivity (Mean=3.93, Standard Deviation= .1.251). Additionally, the government and the agencies that support food production have created effective distribution in order to increase farmers' productivity (Mean= 3.81, Standard Deviation= 1.196).

4.4 Diagnostic Analysis

Prior to performing the regression analyses, a diagnostic test was conducted to confirm that the model assumptions were satisfied. The research employed collinearity tests, outlined in the section below.

4.4.1 Multicollinearity Test

To measure the absence of linear relationships between the predictor variable quantity, the survey utilized Variance Inflation Factors (VIF). A VIF of 1 signifies no correlation among the predictor variables, whereas a VIF exceeding 5 indicates a significant correlation between them (Frost, 2020).

Table 4. 8 : Collinearity Test

Model	Collinearity Statistics	
	Tolerance	VIF

1	(Constant)		
	Climate Resilient Agricultural (CRA)	.183	3.471
	Cultivation of drought resistant crops	.165	4.055
	Farmers' sensitization on climate-smart agriculture	.355	2.821
	Distribution of drought resistant seeds to farmers	.388	2.578
	Climate Resilient Agricultural (CRA)	.178	3.536

According to the data presented in Table 4.8, the variables related to Climate Resilient Agriculture (CRA)—including the cultivation of drought-resistant crops, farmer education on climate-smart practices, and the provision of drought-resistant seeds—exhibit Variance Inflation Factors (VIF) of 3.471, 4.055, 2.821, 2.578, and 3.536, respectively. These findings suggest that there is no significant correlation among the independent variables, allowing for appropriate regression analysis of the data. Furthermore, the estimated regression coefficients for all variables with values below 5 indicate that collinearity is not a concern.

4.5 Inferential Analysis

Inferential statistical methods were employed to assess hypotheses and generate estimates. The study presupposed that the collected data reflected the characteristics of the broader population. This approach utilized parametric statistical techniques to form conclusions about population parameters and the underlying distributions of the data. The analyses included correlation and regression assessments, as well as Analysis of Variance (ANOVA), Model Summary, and Regression Coefficient (Kimeu, 2018).

4.5.1 Correlation Analysis

The research conducted a correlation analysis, which is a statistical technique aimed at evaluating the strength of the linear relationship between two variables and measuring their association (Senthilnathan, 2019). This analysis facilitated the evaluation of how changes in the Independent Variable—climate resilient agriculture initiatives—affect the Dependent Variable, which is food insecurity in the Baidoa district. This included aspects such as the CRA, the cultivation of drought-resistant crops, farmer education on climate-smart agriculture, and the provision of drought-resistant seeds.

Table 4. 9: Correlation Analysis

Correlation Analysis		**Food Security**	**Climate Resilient Agricultural (CRA)**	**Cultivation of drought resistant crops**	**Farmers' sensitization on climate-smart agriculture**	**Distribution of drought resistant seeds**
Food Security	Pearson Correlation	1				
	Sig. (2-tailed)					
	N	350				
Climate Resilient Agricultural (CRA)	Pearson Correlation	.533**	1			
	Sig. (2-tailed)	.000				
	N	350	350			
Cultivation of drought resistant crops	Pearson Correlation	.519**	.848**	1		
	Sig. (2-tailed)	.000	.000			
	N	350	350	350		
Farmers' sensitization on climate-smart agriculture	Pearson Correlation	.760**	.818**	.799**	1	
	Sig. (2-tailed)	.000	.000	.000		
	N	350	350	350	350	
Distribution of drought resistant seeds	Pearson Correlation	.575**	.600**	.732**	.439**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	350	350	350	350	350
**. Correlation is significant at the 0.01 level (2-tailed).						

The association analysis results reveal a moderately positive association between climate resilient agriculture (CRA) and food security in the Baidoa District, with a correlation coefficient of r = .533. Furthermore, CRA was determined to have a significant impact on food security in this region, as indicated by a significance value of Sig = .000 (less than .05). Similarly, the analysis demonstrated a moderately positive correlation between the cultivation of drought-resistant crops and food security, with a correlation coefficient of r = .519, and again, this cultivation was shown to significantly influence food security (Sig = .000 < .05).

The correlation analysis also highlighted a strong positive relationship between farmers' awareness of climate-smart agriculture and food security in Baidoa District, with a correlation coefficient of r = .760. This awareness was shown to significantly affect food security in the area (Sig = .000 < .05). Lastly, the analysis reaffirmed a moderately positive correlation between the cultivation of drought-resistant crops and food security, with a correlation coefficient of r = .575, indicating a significant effect on food security (Sig = .000 < .05).

4.5.2 Regression Analysis

Regression analysis is a statistical technique that examines the relationship between two or more variables. It assists in assessing how independent variables influence a dependent variable. As the independent variables change, they affect the dependent variable, enabling the regression analysis to identify which factors are most significant in causing that change (Sarstedt and Mooi, 2014). The conclusions of the linear recession analysis are showed as follows:

Table 4. 10 : Effects of Climate Resilient Agricultural (CRA) on food security in Baidoa District.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.533[a]	.284	.282	.78185

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	84.369	1	84.369	138.017	.000[b]
	Residual	212.730	348	.611		
	Total	297.099	349			

a. Dependent Variable: Food security in Baidoa District

b. Predictors: (Constant), Climate Resilient Agricultural (CRA)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.208	.275		.755	.451
	Climate Resilient Agricultural (CRA)	.721	.061	.533	11.748	.000

The R^2 value of 348 indicates that 34.8% of the variations in food security within Baidoa District can be attributed to factors related to Climate Resilient Agriculture (CRA). The remaining 65.2% is linked to other influences that are not addressed in this research, aside from the CRA factors. Additionally, the research employed the Consideration of Variance (ANOVA) test to determine the statistical implication of the going backward model. The results from the ANOVA revealed a p-value of less than 0.05 (Sig= .000< .05), indicating that the model significantly explains the relationship between Climate Resilient Agricultural (CRA) factors and food security in Baidoa District. The F-statistic (F=138.017; 1, 348) also confirmed that the model is well-suited to assess the relationship between CRA factors and food security in the area.

Regression equation derived from the coefficients in Table 4.14 is:

Y = .208 + .721X

This equation suggests that a one-unit increase in Climate Resilient Agricultural (CRA) factors corresponds to a one-unit increase in food security in Baidoa District. Moreover, the calculations imply that the regression model (ß= .208) is statistically substantial (sig=.000< .05). Additionally, the analysis shows that the Climate Resilient Agricultural (CRA) factors are statistically significant (Sig= .000< .05).

Table 4. 11: Effects of Cultivating Drought-Resistant Crops on Food Security in Baidoa District

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.519[a]	.270	.268	.78958

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	80.144	1	80.144	128.553	.000[b]
	Residual	216.955	348	.623		
	Total	297.099	349			

a. Dependent Variable: Food security in Baidoa District

b. Predictors: (Constant), Cultivation of drought resistant crops

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.023	.214		4.779	.000
	CULTIVATION	.559	.049	.519	11.338	.000

The R^2 of 0.268 indicates that 26.8% of the deviations in food security within Baidoa District can be accounted for by the factors associated with the cultivation of drought-resistant crops. The remaining 73.2% is due to other variables not considered in this study apart from those related to drought-resistant crop cultivation. Additionally, the study employed an ANOVA to determine the statistical consequence of the retrogression model. The ANOVA results show a p-value of less than 0.05 (Sig = 0.000 < 0.05), indicating that the model significantly elucidates the connection between factors related to drought-resistant crop cultivation and food security in Baidoa District. The F-statistic value of 128.553 (1, 348) further confirms the model's suitability for measuring the relationship between these variables.

The regression equation derived from the coefficients provided in Table 4.11 is:

$$Y = 1.023 + 0.559X$$

This equation implies that a one-unit increase in the cultivation of drought-resistant crops corresponds to a 0.559 unit change in food security in Baidoa District. The results also reveal that the regression model (ß = 1.023) is statistically significant (sig = 0.000 < 0.05). Furthermore, the significance of drought-resistant crop cultivation (Sig = 0.000 < 0.05) is evident in the findings.

Table 4. 12 : Effects of farmer education on climate-smart agricultural practices on food security in Baidoa District

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate

1	.760[a]	.577	.576	.60078

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	171.494	1	171.494	475.137	.000[b]
	Residual	125.606	348	.361		
	Total	297.099	349			
a. Dependent Variable: Food security in Baidoa District						
b. Predictors: (Constant), Farmers’ sensitization on climate-smart agriculture						

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.699	.128		5.453	.000
	Farmers’ sensitization on climate-smart agriculture	.675	.031	.760	21.798	.000

The R fitted value of 0.576 proposes that 57.6% of the variations in food security within the Baidoa District can be attributed to farmers' awareness of climate-smart agricultural practices. The remaining 42.4% is due to other factors outside the scope of this study, beyond just the farmers' awareness of climate-smart agriculture. Additionally, the study employed ANOVA to evaluate the statistical consequence of the recession model. The results from the ANOVA revealed a p-value of minus than 0.05 (Sig= .000 < .05), representing that the prototypical is statistically noteworthy in demonstrating the connection concerning farmers' awareness of climate-smart agriculture and food security in the Baidoa District. The F-statistics of 171.494 with degrees of freedom (1, 348) further confirmed that the model is well-suited for assessing the association between farmers' knowledge of climate-nifty systems and food security in the area.

The regression equation derived from the coefficients shown in Table 4.12 is as follows:

Y = 0.699 + 0.675X

This equation can be interpreted to mean that a one-unit increase in farmers' awareness of climate-smart agriculture corresponds to a 0.675 unit change in food security in the Baidoa District. Furthermore, the analysis reveals that the regression coefficient (β = 0.699) is statistically significant (sig = 0.000 < 0.05). Additionally, the results indicate that farmers' awareness of climate-smart agriculture (Sig = 0.000 < 0.05) is also statistically significant.

Table 4. 13 : Impact of providing drought-resistant seeds to farmers on food security in the Baidoa District.

Model	R	R Square		Adjusted R Square		Std. Error of the Estimate
1	.575[a]	.330		.328		.75624
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	98.079	1	98.079	171.497	.000[b]
	Residual	199.021	348	.572		
	Total	297.099	349			
a. Dependent Variable: Food security in Baidoa District						
b. Predictors: (Constant), Distribution of drought resistant seeds to farmers						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.449	.154		9.382	.000
	DISTRIBUTION	.515	.039	.575	13.096	.000

The coefficient of determination (R^2) at 0.328 suggests that 32.8% of the variations in food security within Baidoa District can be attributed to the allocation of drought-resistant seeds to farmers. The remaining 42.4% relates to other influences not examined in this study, beyond the distribution of these seeds. Additionally, the research employed the ANOVA to determine the statistical consequence of the regression demonstrate. The ANOVA results revealed a p-value of less than 0.05 (Sig = 0.000 < 0.05), indicating that the prototypical is statistically noteworthy in clarifying the relationship between the distribution of drought-resistant seeds to farmers and food security in Baidoa District. Furthermore, the calculated F-value of 171.497 (with degrees of freedom 1 and 348) confirmed that the model is a good fit for assessing the connection between these factors.

The regression equation derived from the coefficients in Table 4.13 is as follows:

$Y = 1.449 + 0.515X$

This equation suggests that a one-unit increase in the distribution of drought-resistant seeds to farmers corresponds to a 0.515 unit increase in food security in Baidoa District. The analysis indicates that the regression model (β = 1.449) is statistically significant (sig ≤ 0.000 < 0.05). Additionally, the results underscore that the distribution of drought-resistant seeds to farmers (Sig = 0.000 < 0.05) holds statistical significance.

Table 4. 14: Impact of climate-resilient agricultural programs on food security in Baidoa District, located in the *Southwest* State of Somalia.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate

1	.947[a]	.897	.895	.29840

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	266.379	4	66.595	747.896	.000[b]
	Residual	30.720	345	.089		
	Total	297.099	349			

a. Dependent Variable: Food security in Baidoa District

b. Predictors: (Constant), Climate resilient agriculture programs (Climate Resilient Agricultural (CRA), cultivation of drought resistant crops, farmers' sensitization on climate-smart agriculture and distribution of drought resistant seeds to farmers).

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.807	.113		16.001	.000
	Climate Resilient Agricultural (CRA)	.434	.050	.321	-8.754	.000
	Cultivation of drought resistant crops	1.044	.047	.971	-22.183	.000
	Farmers' sensitization on climate-smart agriculture	1.265	.031	1.424	41.210	.000
	Distribution of drought resistant seeds to farmers	.765	.025	.853	31.129	.000

The coefficient of determination (R squared) recorded at 0.895 indicates that 89.5% of the variability in food security within the Baidoa District can be attributed to the distribution of drought-resistant seeds to farmers. The remaining 10.5% is linked to other factors not addressed in this research, aside from those associated with climate-resilient agriculture programs, which include Climate Resilient Agricultural (CRA) initiatives, the cultivation of drought-tolerant crops, education of farmers on climate-smart practices, and the distribution of these seeds. Furthermore, the study employed the ANOVA test to determine the statistical impact of the regression model. The ANOVA results reveal a p-value less than 0.05 (Sig = 0.000, which is <0.05), confirming that the model significantly captures the relationship between the factors of climate-resilient agriculture (including Climate Resilient Agricultural (CRA) initiatives, the cultivation of drought-resistant crops, farmer education on climate-smart agriculture, and seed distribution) and food security in the Baidoa District. The F-value of 747.896 with degrees of freedom (4, 345) further suggests that the model is statistically appropriate for analyzing the relationship between these agricultural factors and food security in the district.

The results from the multiple regression analysis demonstrate that all four climate-resilient agriculture factors examined (Climate Resilient Agricultural (CRA): $\beta 1 = 0.434$, $P < 0.000$; cultivation of drought-resistant crops: $\beta 2 = 1.044$, $P < 0.000$; farmers' awareness of climate-smart agriculture: $\beta 3 = 1.265$, $P < 0.000$; and seed distribution: $\beta 4 = 0.765$, $P < 0.000$) significantly impact food security in Baidoa District, Somalia. This implies that enhancing initiatives related to climate-resilient agriculture, increasing the cultivation of drought-resistant crops, improving farmer awareness of climate-smart practices, and facilitating seed distribution can all lead to improved food security in the region.

The equation presented as $Y = 1.807 + 0.434X1 + 1.044X2 + 1.265X3 + 0.765X4 + e$ can be interpreted to mean that a unit increase in Climate Resilient Agricultural (CRA) factors (0.434), the cultivation of drought-resistant crops (1.044), the enhancement of farmer awareness regarding climate-smart agriculture (1.265), and the distribution of drought-resistant seeds (0.765) will lead to a corresponding increase in food security in the Baidoa District. The model's regression coefficient ($\beta = 1.807$) also holds statistical significance ($sig \leq 0.000 < 0.05$), reinforcing that all included factors also exhibit statistical relevance ($Sig = 0.000 < 0.05$).

4.6 Results from Qualitative Data

The findings revealed that most respondents believe that climate-smart agriculture plays a significant role in enhancing food security in the region. Many farmers have started to adopt these practices and are shifting towards faster-yielding crops instead of traditional varieties that require more time to mature. Overall, the cultivation of drought-resistant crops positively influences food security. Additionally, the results indicated that awareness initiatives regarding climate-smart agriculture impact food security. However, government agencies and development partners have not provided sufficient awareness campaigns, leaving many farmers unaware of the available climate-smart options. The findings also emphasized the importance of effectively distributing drought-resistant seeds to farmers, as their availability is vital for boosting food production, with timely access to fast-yielding varieties enhancing farming efficiency. The analysis shows that the government and related agencies have established effective distribution systems to support farmers' productivity. Lastly, farmers in the area are being encouraged to plant drought-resistant crops, and various types of such crops are currently being cultivated by local farmers.

4.7 Chapter Summary

This chapter presents the overall information concerning the respondents, including descriptive statistics, collinearity tests, and inferential statistics such as correlation analysis and multiple linear regression. It additionally includes an analysis of both qualitative and quantitative data.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This section shows an overview of the answers stemmed from various respondents, incorporates the conclusions drawn from the research, and offers suggestions relevant to the study's subject. The researcher assesses the results and provides suggestions where needed. Ultimately, this study outlines its findings, recommendations, and proposals for future research on the role of climate-resilient agricultural programs in enhancing food security in the Baidoa District, located in the Southwest State of Somalia.

5.2 Summary of the Result

5.2.1 The Impact of Climate Resilient Agricultural (CRA) Programs on Food Security in Baidoa District

The primary objective was to determine the impact of climate-resilient agricultural (CRA) initiatives on food security in Baidoa District. The research aimed to answer whether CRA programs influence food security in this region. The findings revealed a moderately positive correlation between climate-resilient agricultural programs and food security in Baidoa District ($r = .533$). Additionally, CRA programs were shown to have a statistically significant effect on food security within the district ($Sig = .000 < .05$). The study further indicated that changes in climate in Baidoa District in Somalia have led to farmers adapting to climate change agriculture and are also resorting to fast-yielding crops compared to the traditional crops that took longer and are also now considering fast-yielding crops that are more drought-resistant.

The results indicate that climate smart agriculture would contribute to food security support findings by Sain et al. (2017), who established that through climate-smart agriculture, the government was on its way to attaining food security. The results also support evidence of climate change application ins solving food security challenges from previous studies such as Mwongera et al. (2017), who found out that the areas that had adapted climate-smart agriculture had increased their yields, and if they continued, they would achieve food security at the household level; and Paul et al. (2017), who established that new methods had a great impact on food production in Rwanda.

5.2.2 The Impact of Growing Drought-Resistant Crops on Food Security in Baidoa District

The second objective was to assess how the cultivation of drought-resistant crops influences food security in the Baidoa District. The primary inquiry was whether the growth of these crops positively affects food security in the area. The findings revealed a moderately positive correlation between the cultivation of drought-resistant crops and food security in Baidoa District ($r = .519$). Additionally, it was determined that cultivating drought-resistant crops significantly impacts food security in this region ($Sig = .000 < .05$). The study also established that the cultivation of drought-resistant crops can assist in dealing with food insecurity in Baidoa, that farmers in the area are encouraged to plant drought-resistant crops, and that there are a variety of DRC that are being planted by farmers in the district that can contribute to food security. Additionally, farmers in Baidoa district can get high yields by planting drought-resistant crops. The results support findings by Enahoro et al. (2014), who advised that focus should be directed to the cultivation of drought-resistant crops at the household level, with smallholder farmers supported with the right farm inputs. This indicated that cultivation of drought-resistant crops can assist in attaining food insecurity. These results also support findings by Wichern (2019), who cited that farmer in Uganda had resorted to the cultivation of a variety of drought-resistant crops in a bid to become food-reliant at the household level.

5.2.3 The Influence of Farmers' Education on Climate-Smart Agriculture and Food Security in Baidoa District

The third objective was to evaluate how educating farmers about climate-smart agriculture affects food security in the Baidoa District. The central question examined whether increased awareness among farmers leads to improvements in food security in the region. The results revealed a moderately strong positive relationship ($r = .760$) between farmers' education in climate-smart practices and food security. Furthermore, this awareness was found to have a significant impact on food security in the Baidoa District, with a significance level of ($Sig = .000 < .05$). The study also established that enhanced farmers' sensitization to climate-smart agriculture can assist a country achieve food security in districts such as Baidoa, which have faced a number of major droughts. Additionally, government agencies and development partners have not carried out enough sensitization on climate-smart agriculture. Lastly, the farmers in the district are still not aware of the climate-smart agriculture options available, and therefore there is a need for increased sensitization on climate-smart agriculture. Noticeably, efforts should be enhanced to educate the farmers in climate-smart agriculture who are still suspicious of the new drought-resistant crops. The need for farmer sensitization has been emphasized by Wijk et al. (2020), who highlighted that there is still a lack of information on climate-smart agriculture and that this data is promptly required in enhancing production and food security globally. Park et al. (2018) found that the more farmers are sensitized to climate-smart agriculture (CSA), the more they are able to produce more. This is consistent with the results findings that farmers' sensitization on climate-smart agriculture on food security and also supports results by Agesa et al. (2019), who also advised that farmers' capacity needs to be improved in order to mitigate the challenges related to climate change and achieve sustainable agricultural yielding and enhanced food security.

5.2.4 The effects of distribution of drought resistant seeds to farmers on food security in Baidoa District

The fourth goal was to determine how distributing drought-resistant seeds to farmers impacts food security in the Baidoa District. The study aimed to investigate whether this distribution affects food security in the area. The findings revealed a moderately positive correlation between the growing of drought-resistant crops and food security in Baidoa District (r = .575). Furthermore, it was established that cultivating these crops significantly influences food security in the region (Sig = .000 < .05). The study established that the effective distribution of drought-resistant seeds to farmers in good time and quantities can highly contribute to food security in Baidoa, given that the availability of drought-resistant seeds is crucial for increased food production. Additionally, government agencies believe that effective distribution of fast yields is critical to increase farmer productivity. The results indicate that effective distribution of drought-resistant seeds to farmers in good time and quantities can highly contribute to food security support findings by Cho (2018) that there is a need to consider effective distribution of seedlings referred to as traditionally organic to subsistence farmers, which may contribute to effective and sustainable crop yielding. The availability of drought-resistant seeds to farmers in good time and quantities as a solution to food insecurity supports findings by Aryal (2021), who established that distribution of short-term yielding seeds has been applied to encourage food production among farmers in the area.

Additionally, the increased focus on agricultural inputs (fast growing crops, drought resistance crops) is critical in providing solutions that help in dealing with food shortages. Therefore, as highlighted by Malthusian Optimism Theory of Food Security, proper implementation of Climate-smart agriculture (CSA), can help in the reduction of famine, hunger and lead to ultimate food security especially to the populous poor in a given area.

5.3 Conclusion

The results indicated that 89.5% of the changes in food security in Baidoa District are explained by the distribution of drought-resistant seeds to farmers. The study indicated a statistically significant relationship between all four-climate resilient agriculture program factors (Climate Resilient Agricultural (CRA), cultivation of drought-resistant crops, farmers' sensitization to climate-smart agriculture, and distribution of drought-resistant seeds to farmers) and food security in Baidoa District. This means that enhancing climate-resilient agriculture (CRA), the cultivation of drought-resistant crops, increased farmers' sensitization to climate-smart agriculture, and the distribution of drought-resistant seeds to farmers would significantly contribute to the increased food security in Baidoa District. If Baidoa District is to increase its food security then it needs to enhance climate resilient agriculture programs that includes initiatives in Climate Resilient Agricultural (CRA), cultivation of drought-resistant crops, farmers' sensitization to climate-smart agriculture, and distribution of drought-resistant seeds to farmers in order to increase food production.

5.4 Recommendation

5.4.1 Main Recommendations

There is need for more evaluation of what are the crops that are drought resistant and perform better in the area to increase crop production among farmers in the area. This will ensure that the right crops that can perform in the area are identified, how long they take and if short term and long-term yielding crops are plated concurrently to provide short term and long-term food security intervention. There is a need for increased focus on climate-resilient agricultural (CRA) programs in order to increase food production and food security in Baidoa District.

There is a need for increased cultivation of drought-resistant crops especially among the small farmers in order to increase food production and address food security in Baidoa District. Increased cultivation of drought-resistant crops on food security. There is need to encourage the growing drought-resistant crops especially among small scale farmers in the district in order improve food security in Somalia by helping farmers produce food in unfavorable weather conditions.

On the farmers' sensitization to climate-smart agriculture on food security in Baidoa District, there is need for increased sensitization of farmers in Somalia to climate-smart agriculture (CSA) practices in order to significantly improve food security by enhancing crop yields, mitigating the negative impacts of climate change like drought, and promote more resilient farming systems, ultimately leading to increased food availability and reduced vulnerability to food insecurity, especially in regions such Baidoa which is prone to erratic weather patterns and extreme climate even. Additionally, there is need for a study on what are the levels of knowledge of climate resilient farming and its effects on climate resistance farming if the food insecurity is going to be dealt with in Baidoa district Somali.

There is need for increased distributing of drought-resistant seeds to farmers in Somalia which can help in improved food security through increased crop yields and diversifying farming practices. Distribution of drought resistant seeds will help in growing a wider variety of crops, including sorghum, millet, and pulses in addition to using water-harvesting techniques, crop diversity, and kitchen gardening.

5.4.2 Recommendations to various stakeholders

i) To the Authorities for implementation

The government agencies and development partners need to enhance their sensitization activities on climate-smart agriculture for farmers to understand the importance of climate-smart agriculture. The government agencies that support smart climate should expand their network to enhance the distribution of fast-yielding and drought-resilient crops. The Ministry of Agriculture needs to invest in value addition and promote agribusiness to support. Additionally, there is a need to dig boreholes for the farmers and assist the farmers in the purchase of water tanks to assist in water harvesting to support farming during dry seasons. These recommendations will ensure that there is available water to support fast-yielding and drought-resilient crops

ii) To main Beneficiaries

The farmers should be encouraged to cultivate drought-resistant crops to solve the issue of food insecurity in Baidoa. They need to be encouraged to plant drought-resistant crops and many varieties of DRC that can perform better in the district and provide food security to the many citizens of Baidoa district. The farmers in Baidoa district should explore how they can get high yields by planting drought-resistant crops and enhancing farming field schools to educate farmers on climate-smart agriculture. There is a need to understand how the changes in climate in Baidoa District, Somalia, have led to farmers adapting to climate change agriculture. Additionally, there is a need for the farmers to consider fast-yielding crops and change from growing traditional crops that take longer and are slow-yielding and cannot support the farmers today.

There is a need to increase farmers' sensitization to climate-smart agriculture and how they can use it to achieve food security in districts such as Baidoa, which have faced several major droughts in the recent past. Farmers need to be committed to the timely planting of climate resistant seedlings. For this to happen, the local and international partners supporting need to enhance the timely availability and distribution of climate resistant seedlings in order to ensure that farmers plant right seedlings at the time to improve crop production and ultimate food security. These recommendations will ensure that farmers have the right knowledge on Climate Smart Agriculture (CSA), they are supported with the correct seeds for fast-yielding and drought-resilient crops in order to increase crop production leading to food security. There are several climates resilient agriculture initiatives that, if properly managed, are able to increase food productivity and ultimate security. The CSA varies from one another thereby employing a 'business-as-usual' approaches through stressing the capacity to achieve flexible, context-specific solutions, combined with innovative policy and financing actions.

Global population and changing eating habits pushing the demand for food. There is a challenge with food production with the inability to live up to crop production level across the world. The ocean health dwindled, and natural resources such as soil, water, and biodiversity are strained with many at risk.

iii) Other Stakeholders

Other stakeholders, such as the UN, development partners and NGOs that support Climate Smart Agriculture (CSA), should be able to employ effective ways of distributing drought-resistant seeds to farmers in good time and quantities, which can highly contribute to food security and food insecurity in Baidoa, given that the availability of drought-resistant seeds is crucial for increased food production. These recommendations will advise on ways that the UN, development partners, NGOs and other partners that support Climate Smart Agriculture (CSA) can enhance their assistance in supporting climate resilient agriculture in order to increase crop production and contribute to food security in the area.

5.5 Limitations of the study and Suggestion for Further Research

The study was limited to Baidoa District despite the phenomenon cutting across Somalia there is need to increase sample inclusivity to include respondents from other parts of Somalia. Additionally, the study was limited in terms of the respondents targeted and therefore there was need to cover federal government and federal state to establish the existing policies on climate smart agriculture. Lastly, the study was not specific to the policies applied both at the district, states and federal government levels and therefore there is need to establish what the existing federal government and federal state policies on climate change adaptation agriculture meant to enhance food production and security across and especially the ones targeting Baidoa District. Additionally, the problem may be heightened through agriculture's optimum vulnerability to changes in climate.

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APPENDICES

APPENDIX I: RESEARCH QUESTIONNAIRE

SECTION A : BACKGROUND INFORMATION

1. Sex :

2. Age:

3. Highest Education level:

4. How long have you been a farmer in Baidoa, Somalia?

6 and above years

5.What is your location

SECTION B: CLIMATE-SMART AGRICULTURE (CSA) PROGRAMS

Point out the degree to which you agree on the extent to which Climate-smart agriculture (CSA) Programs affect food security in Baidoa, Somalia.

Climate-smart agriculture (CSA) Programs	1(SD)	2	3	4	5(SA)
Climate Change agriculture contributes to food security in the area					
The farmers in the area have already adapted Climate Change agriculture					
Farmers in the area are resorting to fast yielding crops compared to the traditional crops that took longer					
There farmers are now considering fast yielding crops that are more drought resistant.					

SECTION D: CULTIVATION OF DROUGHT RESISTANT CROPS.

Verify the degree to which you agree that cultivation of drought resistant crops modify food security in Baidoa, Somalia.

Cultivation Of Drought Resilient Crops	1(SD)	2	3	4	5(SA)
Cultivation of drought resistant crops affect food security					

Farmers in the area are encouraged to plant drought resistant crops					
There are variety of DRC that are being planted by farmers in the area					
Planting of drought resistant crops has contributed to high yields					

SECTION E: FARMERS' SENSITIZATION ON CLIMATE-SMART AGRICULTURE

Confirm the magnitude to which you agree that farmers' sensitization on climate-smart agriculture impact food security in Baidoa, Somalia.

Farmers' Sensitization on Climate-Smart Agriculture	1(SD)	2	3	4	5(SA)
Farmers' sensitization on climate-smart agriculture affect food security					
The government agencies and development partners have not carried out enough sensitization on climate-smart agriculture					
Farmers are still not aware of the climate-smart agriculture options available to them.					
The farmers are still suspicious of the new drought resistant crops					

SECTION F: DISRUPTION OF GOVERNMENT OPERATIONS

Verify the degree to which you agree on whether distribution of drought resistant seeds to farmers affect food security in Baidoa, Somalia.

Distribution of Drought Resistant Seeds to Farmers	1(SD)	2	3	4	5(SA)
Effective distribution of drought resistant seeds to farmers affect food security.					
The availability of drought resistant seeds is crucial for increased food production					
Fast yielding crops are distributed to farmers in good time to increase their farming productivity					

The government and the agencies that support food production have created effective distribution in order to increase farmers productivity					

SECTION G: FOOD SECURITY IN BAIDOA DISTRICT

Determine the scope to which you approve on Food Security in Baidoa District, Somalia.

Food Security Factors	1(SD)	2	3	4	5(SA)
Climate-smart agriculture (CSA) has improved food security in the area					
CSA has made food available in the district					
Farmers are now producing enough to feed their household and some to sell					
Climate-smart agriculture has solved the food insecurity in the district					

APPENDIX II: INTERVIEW GUIDE

Section A: General Information

What is your position ……………………………………………………………………………...

Please, how long have worked in the area……………………………........................

Section B: Climate-smart agriculture (CSA) Programs

Can you say that climate Change agriculture contributes to food security in the area…………………………………………………………………………………………………

Do think that farmers in the area have already adapted Climate Change agriculture……………….

In your opinion, can you state that farmers in the area are resorting to fast yielding crops compared to the traditional crops that took longer………………………………………………………………….

Section C: Cultivation of Drought Resistant Crops

Do you think that cultivation of drought resistant crops affect food security………………………………………………………………………………………………..

Can you say that farmers in the area are encouraged to plant drought resistant crops………………………………………………………………………………………………..

In your opinion can you say that there are variety of DRC that are being planted by farmers in the area…………………………………………………………………………………………..

Section D: Farmers' Sensitization on Climate-Smart Agriculture

Can you say that farmers' sensitization on climate-smart agriculture affect food security…………

Do you think that the government agencies and development partners have not carried out enough sensitization on climate-smart agriculture…………………………………………………

In your opinion do you think that farmers are still not aware of the climate-smart agriculture options available to them…………………………………………………………………………

Section E: Distribution of Drought Resistant Seeds to Farmers

Can you say that effective distribution of drought resistant seeds to farmers affect food security………

…….

In your opinion can you say that the availability of drought resistant seeds is crucial for increased food production ……..

Do you think that fast yielding crops are distributed to farmers in good time to increase their farming productivity……………………………………………………………………………………

Can you say that the government and the agencies that support food production have created effective distribution in order to increase farmers' productivity…………………………………………………………………………….

Section F: Food Security Factors

Do you think that climate-smart agriculture (CSA) has improved food security in the area…………………………………………………………………………………………

Can you say that CSA has made food available in the district……………………………………..

In your opinion can you say that farmers are now producing enough to feed their household and some to sell ……………………………………………………………………………………...

Do you think that climate-smart agriculture has solved the food insecurity in the district……………………………………………………………………………………… ………?

APPENDIX III: RESEARCH BUDGET

CYPHER	THINGS	AMOUNT	COST ($)	TOTAL ($)
1	Stationeries (Pencil, Erasers, Papers)	Lump sum	50	50
2	Typed and printed proposal	Lump sum	20	20
3	Transport	Lump sum	200	200
4	Type and print report	Lump sum	50	50
5	Type, Printing and Photocopying of interview schedule	Lump sum	50	50
6	Data Collection	10	30	300
7	Data Analysis	Lump sum	100	100
	TOTAL ($)			770

APPENDIX IV: ERC LETTER

Mount Kenya University

REF: **MKU/ISERC/3313**
TO: **MOHAMED WARSAME MOHAMED**

Date: 02 November 2023

REG: **MDS/2020/67673**

Dear Sir/Madam,

RE: EFFECT OF CLIMATE RESILIENT AGRICULTURE PROGRAMS ON FOOD SECURITY IN BAIDOA DISTRICT, SOUTH WEST STATE, SOMALIA

This is to inform you that **Mount Kenya University** has reviewed and approved your above research proposal. Your application approval number is **2357.** The approval period is **02/11/2023 - 01/11/2024.**

This approval is subject to compliance with the following requirements;

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

Prior to commencing your study, you will be expected to comply with any additional requirements from the relevant authorities in the country where this study will be conducted

Yours sincerely,

The Chairman
Mount Kenya University
Ethics Review Committee
P. O. Box 342 - 0100, Thika

Dr. Alfred Owino, PhD
Chairman, Mount Kenya University ISERC

Main Campus, General Kago Road, P.O. Box 342-01000 Thika. Tel: +254 67 2820 000,
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APPENDIX V: INTRODUCTION LETTER FROM MKU

Mount Kenya University

DIRECTORATE OF GRADUATE STUDIES

MDS/2020/67673

10th November, 2023

TO WHOM IT MAY CONCERN

Dear Sir/Madam,

RE: MOHAMED WARSAME MOHAMED – REGISTRATION NO. MDS/2020/67673

The purpose of this letter is to introduce the above named student who is pursuing **Master of Arts in Development Studies** in the department of **Social and Development Studies** in the school **of Social Sciences.**

The title of the thesis is **"Effects of Climate Resilient Agriculture Programs on Food Security in Baidoa District, South West State, Somalia."** It has been cleared by the University's Ethics Review Committee (Certificate attached) and now has to proceed to the field to collect data between **November, 2023 and January, 2024.**

Any assistance accorded to the student will be highly appreciated.

Thank you.

Mount Kenya University
P.O. Box 342 - 01000, THIKA
Office of the Director,
Graduate Studies

Dr. Samuel M. Karenga, Ph.D
Director, Graduate Studies
Enc.

Main Campus, General Kago Road, P.O. Box 342-01000 Thika.
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APPENDIX VI: RECOMMENDATION LETTER

DOWLAD GOBOLEEDKA KOONFUR GALBEED EE SOOMAALIYA
WASAARADA BEERAHA IYO WARAABKA

ولاية جنوب غرب الصومال
وزارة الزراعة والري

SOUTHWEST STATE OF SOMALIA
MINISTRY OF AGRICULTURE AND IRRIGATION
Office of the Director General

Ref: MoAI-1740/2024 **21/1/2024**

To: Mohamed Warsame Mohamed

Reg No: MDS/2020/67673

Mount Kenya University

Ref: Clearance for Data Collection

I, the undersigned authority on behalf of the Ministry of Agriculture and Irrigation of South West State, hereby grant clearance to the above-mentioned MKU student to undertake data collection for his academic research as part of his Master of Arts in Development Studies program.

The planned data collection exercise is scheduled to take place from January to February 2024. His research topic, titled Effect of Climate Resilient Agriculture Programs on Food Security in Baidoa District, South West State," is both timely and relevant. It aims to contribute to policy development within the federal member states.

We wish him success in his research endeavors.

Sincerely,

Ali Mohamed Ibrahim

Minister of Agriculture and Irrigation

Southwest State of Somalia

DOWLAD GOBOLEEDKA KOONFURGALBEED SOMALIA
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APPENDIX VII: TURNITIN REPORT

Page 1

Mohamed Warsame

Research Project

Thesis

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APPENDIX IX: MAP OF THE STUDY AREA