An evaluation of climate change effect on community gardens crop production aimed at enhancing household food security in Dlangezwa, Umdoni Municipality.

By

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Submitted in fulfilment of the requirements for the Degree of

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ABSTRACT

In South Africa, food Security at the household level still remains a major challenge (Stats SA, 2020), despite the various initiative programmes provided by the government to help alleviate poverty among lower-income households. The" One home, one garden' initiative and the 'community gardens' introduced in 2010 have been considered as vehicles to buffer food insecurity at household level. However, lately the province has been experiencing the episodes of climate variations. For example, in 2015 the province experienced drought and flooding spells. This attack brings forth some concern, as the climate change episodes could be deterring the progression of community/household gardens, thus threatening the household food security. The aftermath and or continuing attacks of the effect of the climate variation on crop production in household/gardens, could be aggravating low crop production.

The study aimed to investigate the effect of climate change on community garden crop production and the farmers' household food security.A survey was conducted among 120 participants of the community gardens to determine their knowledge, perception, and attitude towards climate change. A series 10 focus group discussions were held to further probe on experiences, observations and the behaviors that the farmers have engaged on as the coping strategies to counteract or mitigate the effects of climate change. Key informant interviews with municipality and the Department Of Agriculture officials provided insight into the interventions and measures taken by the local Municipality to mitigate the effects of climate change. Moreover, the key informant interviews, served as the study trustworthiness enhancer, as the data collected from the participants was further verified through these interviews.

Only 38.3% of the population understood the meaning of Climate Change, which was the minority of the population. Climate change was understood to be the changes in temperature and rainfall patterns in the area. The perceived outcomes of climate change was the reduction of crops and the water supply in the area. The gardens were affected by the onset of pest , diseases and a reduction of water for irrigation. To overcome these challenges the community gardens relied on the the Department of Agriculture and Rural Development (DARD) for support. The most planted crop by the gardens was spinach, and the least planted crops were beetroot and brinjal. Crops like

spinach have a short growing period and produces large yields, and therefore it was most planted. The minority of 41.7% received enough food from the community gardens, while the majority 58.3% did not receive enough food. It was determined that the majority, 40% of the surveyed population, were moderately food insecure and only 15.8% of the population were food secure. The external help received was mainly from the Department of Agriculture and Rural Development (DARD) and not the local Municipality. They receive chemicals, seeds, training, and inputs from the DARD. The issues faced by climate change were the increase of pests and disease, change in planting seasons of crops and the change in temperatures and rainfall patterns. It was concluded that the community gardens have not been successful in alleviating food insecurity among the households. It was recommended that a study be conducted on the improvement of productivity and resistance to climate change in community gardens. They have identified the primary alterations associated with climate change as changes in rainfall patterns and temperatures. Despite their awareness, people are apprehensive and fearful of Climate Change. To overcome this obstacle, the DARD must promote active climate change awareness in the community. This will assist community people in learning about climate change and how to reduce the effects of climate change.

DECLARATION

I, Merishca Naicker declare that:

(i) The research reported in this dissertation, except where otherwise indicated, is my original research.

(ii) This dissertation has not been submitted for any degree or examination at any other university.

(iii) This dissertation does not contain other personal data, pictures, graphs or other information unless specifically acknowledged as being sourced from those persons.

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A) Their words have been re-written, but the general information attributed to them has been referenced;

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Signed [redacted] Date 29/07/2021

Miss Merishca Naicker

As the candidate's supervisor, I agree to the submission of this dissertation/thesis.

Signed [redacted] Date 29/07/2021

Mr Denver Naidoo

As the candidate's co-supervisor, I agree to the submission of this dissertation/thesis.

Signed [redacted] Date 29/07/2021

Dr Mjabuliseni Ngidi

ACKNOWLEDGEMENTS

Firstly, I would record my gratitude to God for the guidance and wisdom throughout this research. A special thank you to my pillar of strength, my parents. Thank you for all your sacrifices and support throughout my academic journey. I would not be the person I am today without the unwavering support and guidance throughout my journey. Thank you for having faith in me, and I hope that I have done you proud.

I want to express my sincere appreciation to my supervisors Mr Denver Naidoo and Dr Mjabuliseni Ngidi, for their guidance, supervision, and encouragement throughout my masters. Their exceptional supervision, comments and constructive criticism of my work are highly appreciated.

To my grandparents, sister, family, and friends, I would like to thank you'll for the reassurance and support through every step of my life.

I would like to thank Mrs P Z Mzelmu for her assistance during fieldwork and the community of Dlangezwa for their willingness to participate in the research.

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ABBREVIATIONS

DAFF	Department of Agriculture, fisheries and forestry
DARD	Department of Agriculture and Rural Development
ERA	Exclusion Restriction Approach
ESG	Environmental Social and Governance
FAO	Food and Agricultural Organization
FGD	Focus Group Discussion
GDP	Gross Domestic Product
HFIAS	Household Food Insecurity Access Scale
HIV/AIDS	Human Immunodeficiency Virus/ Acquired Immunodeficiency Syndrome
IDP	Integrated Development Plan
IMR	Inverse Mills Ratio
IPCC	Intergovernmental Panel on Climate Change
KZN	KwaZulu-Natal
MDGs	Millennium Development Goals
NGO	Non-Governmental Organisation
RSA	Republic of South Africa
SDGs	Sustainable Development Goals
SPSS	Statistical Package for Social Science

CHAPTER 1:THE PROBLEM AND ITS SETTING

1.1. Introduction

South Africa is a low-middle-income country, and food is sufficiently supplied at a national level, for many rural households, such as Kwa-Zulu Natal (KZN), this is not the case. The impact of climate change is expected to worsen throughout Africa, putting vulnerable industries such as agriculture at risk.

Although the agricultural sector faces many challenges, climate change presents a very significant threat to the agricultural system (Saxena *et al*., 2020). Climate change is found to affect all four pillars of food security, it affects the production of the food through changes in temperature and precipitation. Factors such as climate change, increasing food prices, growth in population size and economic shocks endanger food security and promote the growth of food insecurity. If these factors are not given importance, they could lead to acute food insecurity and unwelcome implications for malnutrition (Egal, 2019).

In Sub Saharan Africa hunger and poverty are prevalent and so are the effects of climate change. Therefore, as per York *et al*., 2018 climate change is a growing threat for countriesin Africa that are reliant on agriculture as the El Nino causes an increase in surface temperatures anda decrease in precipitation, which negatively impacts the yields of crops produced. In Africa, the collection of water is the job of women; therefore, if the water supply is diminished, the burden on women will increase dramatically (Tibesigwa *et al*., 2018).

As a result of climate change drivers, food systems and the livelihoods of the vulnerable are at stake (IPCC,2019). South Africa is regarded as a food-secure nation, yet food insecurity is widespread at the household level (Masipa, 2017). Food security at the household level is a significant concern in South Africa. To overcome this challenge the government has implemented several projects in KwaZulu-Natal, such as community gardens. This is amied to assit lower-income households to alleviate poverty (Ngema *et al*.,2018).Climate change consequently necessitates a greater understanding of how it affects community garden crop output and household food security. The study aims to investigate the effect of climate change on community garden crop production and the farmers' household food security.

This chapter will provide an introduction to the study by first discussing the background and context, followed by the research problem, the research aims, objectives and questions, the importance/significance, limitations and finally the assumptions.

1.2. Study background

Food security exists when people at all times have physical and economic access to safe and nutritious food to meet their dietary needs and food preferences for active and healthy life (FAO, 1996). While South Africa is a low-middle-income country and food secure at a national level, in rural and grassroots areas, this is not the case for the majority of rural households, such as Kwa-Zulu Natal (KZN). The main challenges that are associated with food security in South Africa are food availability, accessibility, and utilization; this causes an increase in adult and child malnutrition (Sunette, 2017). Innovative approaches such as community gardens are making a comeback as they help reduce food insecurity. It is found in developing countries and provides various food security functions. Community gardens benefit low-income individuals by having safe access to nutritious food. With the instability of today's economy, a percentage of the population do not have safe access to nutritious food. They may rely on food banks and humanitarian aid or other non-nutritious food such as canned food or poor nutrient quality food to meet their day-to-day lives. Community gardens allow people to grow food for personal use and to make money through the selling of the excess. Individual gardens can support their participants' mental, social, and physical well-being (Al-Delaimy & Webb, 2017).

Community gardens are affected by climate change as it brings upon higher temperatures and changes in the weather patterns. The increase in the temperatures cause an increase in irrigation , causing added pressure to the water supply (Egal, 2019). The changes in the climate bring upon the presences of pest and diseases that can be harmful to the crop in community gardens thus reducing the crop yield produced by the gardens (Clarke *et al*., 2018).

The higher temperatures and the shift in precipitation patterns due to climate change causes changes in the growth of the crops. These changes include plants blooming earlier. This causes unpredictable growing seasons and an increase in food waste (Dubová & Macháč, 2019).

Community gardens can vary in what they can offer to the community based on the needs and circumstances of the neighbourhood (Ferries *et al.*, 2001). Growing one's food locally in community

gardens saves money in grocery bills annually. Without community gardens, grocery food prices are high such that a percentage of the population would not have access to fresh food because of limited financial resources. The cost of transporting food to the supermarket from far way cities decreases the food freshness and increases transportation cost, passing on the cost to the consumer who may not be able to afford the food. With a community, garden families can grow food with very little cost. From a socio-economic perspective, these gardens also build trust, facilitate participation, improve responses to natural disasters and food security – all vital components of effective adaptation and resilience to climate change.Low agricultural production in rural areas is caused by factors such as poverty, inflation, access to arable land: climate change and the HIV/AIDS pandemic (Visser *et al.*, 2015). Poverty, inflation, access to arable land, Climate Chane, and the HIV/AIDS epidemic all contribute to low agricultural production in rural areas. People in low-income communities benefit from community gardens. Community gardens can provide to the needs of the community based on the neighbourhoods requirements.

Climate change is estimated to increase and thus causing sectors such as agriculture to become vulnerable in Africa (IPCC, 2007). The community of Dlangezwa, together with the department of agriculture, has startednumerous community gardens to improve the quality and quantity of food consumed by the households.

1.3. Problem Statement

Climate change has triggered a rise in the land surface air temperature to almost twice as much as the global average temperature ever since the pre-industrial period (IPCC, 2019). Consequently, food security and land degradation have also been negatively affected by a rise in the frequency and severity of severe events. This has caused an increase in pests, warming, and changes in precipitation patterns affecting crops. Climate change drivers are consequently causing risks to food systems and the livelihoods of the vulnerable (IPCC,2019).

In South Africa food insecurity is a major issue at the household level hene programs such as community gardens were intoducted by the government in KwaZulu-Natal to help alleviate poverty (Ngema *et al*., 2018). Climate change, therefore calls for better awareness of hoe it affects the crop production of community gardens and the household food security status of the farmers.By raising awareness about the effects of climate change on community gardens, the challenges faced by the households will be regonised and appropriate policies would be indentofoed to elp them gain better access to food, as there are a few policies that respond to climate change that aid women, even in the aspect of community gardens.Climate change drivers are consequently causing risks to food systems

and the livelihoods of the vulnerable (IPCC,2019). The concern is that what effects does it have on the crop production, perspectives and experiences of the farmers and their mitigation towards coping against the negative effects of climate change that threaten food security of the respective households.

1.4. Main Research Objective

The study aims to investigate the effect of climate change on community garden crop production and the farmers, household food security.

1.4.1. Specific Objectives

- To understand the farmers' knowledge, perceptions, and attitude of climate change and its shocks.
- To assess the effect of community gardening on the household food security status of the farmers.
- To assess the perceived effect of climate change on the crop production as aid for household food security.
- To determine the interventions and measures taken by the local municipality to mitigate the impacts of climate change.

1.5. Research Question

What is the effect of climate change on community garden crop production and the enhancement of farmers' household food security?

1.5.1 Hypothesis

- The farmers are middle-aged with adequate knowledge to mitigate the effects of climate change on their crops.
- There are various types of crops grown, and the months in which the vegetables are typically planted have been altered due to climate change.
- Due to the alteration of climate change the households are moderately food insecure.
- The local municipality provides households with irrigation, seeds, and expert assistance to produce crops according to the fluctuations brought upon by climate change and have interventions in place to mitigate challenges brought upon by climate change.

1.6. Importance Of The Study

Understanding the effect of climate change on community gardens' agricultural production is key to understanding the impacts on local food security. Initiatives such as community gardens, which are known to lower food insecurity and increase the amount of food that is available and the income that is received by rural households, will support communities by giving them access to a stable food supply.

The study is important as it provides an insight on the impact of climate change on the crop production of the community gardens. It offers an outlook on the agricultural production of the gardens which help the households provide a source of food to their families. This study will therefore assist the community gardens to identify appropriate planting periods to optimize their crop production and improve their food security status.

1.7. Study Limits

The research could be subjected to several limitations; these are identified below:

- **Fluency in the language**- the researcher did not speak the local language, which is Isizulu. This may have created a barrier when conducting focused group discussions and semi-structured interviews.
- **Access to information**- in some cases, if the respondent did not feel comfortable sharing certain information, this could have led to them withholding vital information that would have affected the research.
- **Self- reported data-** since the data was collected first-hand, the data was limited as it was collected first hand and therefore the data can not be verified independently.
- **The method used to collect data**- the limitation of random sampling in this study was not time effective (Acharya *et al*., 2013).

1.8. Definition Of Terms

Food Security – Food security exists when people at all times have physical and economic access to safe and nutritious food to meet their dietary needs and food preferences for active and healthy life (FAO, 1996).

Community gardens – an area of land to be used by a group of people to produce fruit and vegetables. This land may be within the jurisdiction of tribal authority, a local authority or it may be

on state-owned land or on private land which is communally managed (Department of Agriculture, 2011).

Household – The rural household consists of many members and is an economic unit in which the members possess specific economic ties. They may participate together in the same productive activity, earning income together (FAO, 2018).

Smallholder Farmers- In South Africa "small-scale" is often equated with a backward, non-productive, non-commercial, subsistence agriculture that we find in parts of the former homeland areas. It is generally associated with farmers in rural areas (Kirsten & Van Zyl, 1998).

Climate change -The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as a change in the composition of the global atmosphere, attributed directly or indirectly to human activities. This change is observed to be greater than natural climate variability over comparable periods.

1.9. Assumptions

It was assumed that the respondents would answer the questionnaires honestly and all were participants of community gardens. It was also assumed that all the participants have experienced a similar phenomenon.

1.10. Organization Of The Study

Chapter one introduces the research problem, the background, the problem statement, study limitations, assumptions, hypothesis, objectives, the importance of the study and ethical considerations. Chapter two provides the literature that is relevant to the study. Chapter three consists of the description of the study area as well as the methodology that was used in the study. Chapter four comprises the results and discussion about the research. The conclusions and recommendations of the study are presented in chapter five.

1.11. Summary

Community gardens are used to improve food security status in rural households. However, the impact of climatic shocks and the interventions and measures put in place to mitigate climate change needs to be understood intensively, to improve the food security status of rural households.

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CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

The population growth rate globally has increased significantly. The greatest growth has been in developing countries such as South Africa (FAO, 2019). To build on the Millennium Development Goals (MDGs) success, South Africa pledged to commit to the Sustainable Development Goals (SDGs), which addressed economic inequality, sustainable consumption, innovation and climate change amidst other priorities. The main focus was placed on "No poverty" and "Zero Hunger". These SDGs were aligned with the countries vision of 2030, which is specified in the National Development Plan (NDP). It pursues to eliminate poverty and reduce inequality by the year 2030.

South Africa is a food secure nation nationally, as it has enough food supply to feed its country, but food insecurity exists at the household level. Food and nutrition security is placed as one of the top priorities on the developmental agenda of the Republic of South Africa (RSA). The right to food is entrenched in Section 27:1 (b) of the country's Constitution. This obliges the State to take all necessary steps, including passing legislation and the development of the food and nutrition security programmes, to enable citizens to meet their basic food needs. Ensuring universal food security has been a priority policy objective in South Africa since the early nineties (DAFF, 2018).

There are numerous definitions of food security that are used, but according to FAO, 1996 "Food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food to meet their dietary needs and food preferences for a healthy and active life." Food security consists of four pillars: availability, accessibility, utilization, and stability (FAO, 1996). Food security consists of four pillars: availability, accessibility, utilization, and stability (FAO, 1996).

The availability pillar is related to the amount of physically available food and contributes to the quantity of food. It deals with the areas of national and local production, supply levels, capabilities, food aid, and the import of food (Battersby, 2013). The accessibility pillar contributes to the quantity of food and the ability to attain food by economic and physical means. It deals with political stability, infrastructure, market stability, and purchasing power. (Poppy *et al*., 2014). The stability pillar deals with the quality of food and is dependent on the stability of the system that delivers the food. It is also durable and has permanent access to food resources and the ability to alleviate adverse shocks. Stability must be present in the availability, accessibility, and utilization pillars. (Adekunle,2013). The utilization pillar deals with the quality of food and how our bodies make use of the numerous nutrients found in food. It is also about hygienic and sanitary conditions, nutritional balance, and health care to prevent contamination of food and food safety (Coates, 2013).

Food Insecurity is defined as "a situation that exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and active and healthy life." (FAO, 1996). Food insecurity is known to exist in two types, namely chronic food insecurity, which is defined as food insecurity that lasts an extended period. The second type is transitory food insecurity, known as food insecurity, which is temporary and short term (Campbell, 1991). Food insecurity was prevalent during and after apartheid in South Africa despite the political and economic advancements made by the country (Hendriks, 2005).

Agriculture is known as the main contributor to the livelihoods of the South African rural population. The South African NDP identified that rural development and agricultural productivity are essential priorities for economic growth, reduction of poverty, creating employment, and addressing food and nutrition security among the South African population (Koch, 2011). Community gardens were introduced as an effective way to combat food insecurity among the rural population in South Africa, with most of the participants being women.

The issue of household food insecurity needs attention globally as climate change, and severe economic conditions put additional stress on the food systems (Statistics SA, 2019). The consumption of vegetables provides nutrients to people who are suffering from HIV/AIDS, which is rife in South Africa. Due to the extensive presence of poverty in South Africa, there is an increase in food shortages, thus increasing the rate of food insecurity experienced in the country. Therefore, the introduction of community gardens in rural areas can help alleviate the strain that food insecurity imposes on rural households.

There is a symbiotic relationship that is shared between climate change and community gardens, as said by Librizzi,2017. The manifestation of climate change has very grave impacts on the ability of the community garden to survive; by just being stewards of greens spaces, community gardens can provide support to vulnerable households as well as women-headed households in South Africa.

2.2. Food (In)Security Status Globally

The world's population is steadily rising and thus causing global hunger to peak (Meybeck *et al.*, 2018). As stated by the FAO, 2019, access to safe and nutritious food is a growing concern, affecting about 2 billion people globally. Therefore, the lack of access to safe and nutritious food causes a spike in the food insecurity rates experienced globally, which is speculated to be 26.4% of the population. This 26.4% is made up of people who were moderately or severely food insecure. The extent of food insecurity goes beyond hunger as, and an additional 17.2% of the world's population experienced moderate levels of food insecurity.

Factors such as climate change, increasing food prices, growth in population size and economic shocks endanger food security and promote the growth of food insecurity. If these factors are not given importance, they could lead to acute food insecurity and unwelcome implications for malnutrition (Egal,2019). Recent events such as the COVID-19 Pandemic has increased the food insecurity status globally. This is because lockdowns in many countries have caused a spike in unemployment rates and therefore there is added pressure on the food supply of households globally (Dubowitz *et al*., 2021). Middle- and low-income countries are more food insecure than developed countries because they have weaker safety nets than developed countries (Ma *et al*., 2021). The increase of global hunger implicates the attempts made globally to achieve the target set by the Sustainable Development Goals (SDGs) of 'Zero hunger' by the year 2030. As reported by Meybeck *et al*. (2018) climate change is aggravating food insecurity since climate change has an adverse effect on food production. Therefore, a significant focus will be given to food security and food production in the Intergovernmental Panel on Climate Change's 6th assessment cycle.

2.3. Food (In)Security Status In Africa

Africa is home to 256 million people that are affected by hunger, although this is a slight improvement from previous years as specified by FAO, 2019 277 million people are victims of severe food insecurity and 399 million people face moderate food insecurity. This is prevalent due to factors such as poverty, urbanization, deteriorating economic situations, and adverse climatic conditions (Crush & Tevera,2011). Undernourishment is a significant issue faced by Africa, whereby 20% of the population is affected, and the highest percentage is found in western Africa (Muzawazi *et al*., 2017).

Africa has shown plodding progress in meeting the Sustainable Development Goal 2 of 'zero hunger' (York *et al*., 2018). This slow progress is due to economic slowdowns and extreme climatic conditions due to the El Nino effect on Africa. The El Nino effect has led to a decrease in agricultural production and an increase in staple food items (FAO,2019). Africa is reliant on agriculture for economic purposes. Therefore as per York *et al*., 2018 climate change is a growing threat for countries in Africa that are reliant on agriculture as the El Nino causes an increase in surface temperatures and a decrease in precipitation, which negatively impacts the yields of crops produced. In Africa, the collection of water is the job of women; therefore, if the water supply is diminished, the burden on women will increase dramatically (Tibesigwa *et al*., 2018).

It is predicated by FAO, 2019 that by the year 2050, the effect of climate change will cause approximately another 71 million people globally to become food insecure. It also speculates that

over half of the affected people will reside in Sub-Saharan Africa. Therefore, Africa is to introduce measures to become climate-resilient.

2.4. Food (In)Security Status In South Africa

As reported by Statistics South Africa, 2019 the population growth rate for South Africa is expected to rise by 1.4% annually. In developing countries such as South Africa, food access and availability is known to be a challenge. This is due to the increased demand for food according to goal 2 of WHO to end hunger, achieve food security by improving nutrition and promote sustainable agriculture; agricultural production in rural areas was promoted (Tan, 2014). Many of the rural households in South Africa face food insecurity. The right to food is entrenched in the bill of rights in South Africa (FAO, 1996). South Africa is known to be a secure food country at a national level, but food insecurity is prevalent at the household level, therefore allowing the citizens to become vulnerable to stressors and shocks. Food insecurity exists because not all households have access to an adequate supply of food (Crush & Tevera, 2011).

In South Africa, there is a broad spectrum of challenges that are faced with food security. The key challenges are:

- **Inadequate safety nets**- This poses the most significant challenge at a national level. In poor households, the income level is low, and they are dependent on social grants and remittent, which makes them vulnerable to experience food insecurity. As there are not many job opportunities and farming services available near their households, the citizens must move away for jobs. At a national level, the poor are too reliant on the government. (DAFF, 2018).
- **Weak support networks and disaster management systems**- To develop a new policy, policymakers of the country require information about the food demand and supply of the country. This information helps the policymakers to identify vulnerabilities. South Africa does not have adequate systems to deal with disasters.
- **Inadequate and unstable household food production**- Due to the unpredictable household food production, malnutrition and hunger are prevalent in South Africa. The producers of food in homelands cannot afford to provide adequate and nutritious food for their households. Therefore, they rely on purchasing food. As South Africa has a high unemployment rate, many rural households suffer from hunger.
- **Lack of purchasing power**- Since many people are unemployed in South Africa and are poor, they cannot afford to purchase food and lack purchasing power. It is found that black households in South Africa have the lowest standard of living, then Indian and coloured

households with a minority of white households. Communicable diseases and AIDS cause households to experience a higher rate of food insecurity (DAFF,2018).

- **Poor nutritional status**- In South Africa, most of the food consumed is not of nutritional value and leads to malnutrition, stunted growth, and hidden hunger among individuals. These issues cause households and individuals to become vulnerable to diseases, which can lead to households growing food insecure as the ability to work and earn an income is reduced. In South Africa, the provinces that consist of a high number of rural dwellers are KwaZulu-Natal, Eastern Cape, North West, and the Free State (DAFF,2018).

The government of South Africa has since made efforts to promote food security and to domesticate international indicators on food security to monitor the development in South Africa (Hart,2010). In agreement with Adekunle, 2013 the NDP of South Africa recognizes that rural development and agricultural productivity are essential to ensure economic growth, create employment, reduce poverty, and address food insecurity in South Africa.

Since agriculture contributes to a significant proportion of the South African GDP, the government introduced community gardens as an intervention and livelihood strategy to combat food insecurity that is faced by rural households. These community gardens create an opportunity to develop environmental awareness. (Shisanya, 2008). Poverty is known as the primary contributor to food insecurity in South Africa (Ngema *et al*., 2018). The average food basket for a male adult is R807 per month and R2,928 for a family of four members (Statistics SA, 2019). The average food basket cost R3486.23, in 2020 which increased by 13.7% from the previous years (Statistics SA, 2021).

25.2% of the population live below the poverty line; this is due to lack of employment and an increase in the population size (Statistics SA, 2019).

As claimed by Statistics South Africa, in 2019 1.7 million households experience hunger in South Africa. Hunger is known to be rife among the rural population in South Africa as they are unable to cope with poverty. South Africa experienced a decrease in the number of households that took in agricultural activities from 19.9% to 13.8% between the years 2011 to 2016 (Statistics SA, 2019). It was found that the rural areas in South Africa had a higher percentage of households involved in agricultural practices than urban households (Battersby,2012). Limpopo was the highest with 25%, followed by Eastern Cape and KwaZulu- Natal, with 20% of the households participating in agricultural activities (Statistics SA, 2019). 7.5% of the households involved in agricultural activities said that it was the main contributor to food in their respective households (Statistics SA, 2019).

Citizens of South Africa experience food insecurity due to factors such as HIV/AIDS, inflation in food prices, and climate change. In KwaZulu-Natal, there is a presence of poverty since many citizens do not know that their right to food is entrenched in the bill of rights (Ngema *et al*., 2018). In the opinion of Abewoy, 2018 rural households that consist of large household sizes are more vulnerable to experience food insecurity as the demand for food is greater. In KwaZulu-Natal, female-headed households are known as the most disadvantaged, in terms of the economy, as they lack adequate cash to obtain food and to improve their nutritional status (Abewoy, 2018).

In South Africa, due to the El Nino effect, many regions experienced droughts, which had a dire impact on the yields of the crops produced. As predicted by Statistics South Africa, 2019 since the conduction of the 2011 census, the number of households that were involved in agricultural activities has declined due to the lack of water available for irrigation and the effects of climate change on crop production.

2.5. Food Access, Availability, Utilization, And Stability In South Africa.

AS per FAO,2019 particular attention has been focused on accessibility. Although food is available in abundance at the markets for purchasing, the food may not be accessible to specific households. Rural households may not be exposed to transport or financial capabilities to purchase food. Although South Africa has been a democratic country for the last 26 years, many households do not have adequate income to maintain their households. In South Africa, many food aid schemes provide food parcels to rural households, and approximately 23% of households in South Africa have inadequate access to food. (Hart,2010). Imports supplement the domestic production of South Africa for especially wheat and meat (Hunter-Adams *et al*., 2019).

There is sufficient land available for farming, but the land available cannot be utilized due to the land terrain, lack of purchasing power by farming equipment, lack of finances, and inadequate access to water for irrigation. Therefore, many rural households do not have adequate access to food supplies (Meybeck *et al*., 2018). Since there is sufficient arable land available, small scale subsistence farming is recommended. Subsistence farming allows rural areas to produce sufficient food with very little expense (De Janvry & Sadoulet, 2011).

Since foods are exported and imported to other countries, rural households spend the majority of their incomes on purchasing food (Pereira *et al*., 2014). The stability of the food supply in South Africa is hindered by climate change, political, economic, and market forces (Meybeck *et al*., 2018). The availability of food in South Africa is disrupted by Climate change cause of the increase in pests,

weeds, diseases, and lack of water. The quality of the food produced is affected, and the access to the food is reduced (Van den Broeck & Maertens, 2016).

2.6. Poverty In South Africa

South Africa faces many problems due to the socio-economic conditions of households. Great emphasis is placed on improving the livelihoods of the citizens by targeting poverty, unemployment, and inequality in the country (Altman *et al.*, 2009). In South Africa, greater than half the population fall below the national poverty line, which consists of R992 per month (Statistics SA,2019). The leading causes of poverty among South Africans are the lack of adequate education, Female and child-headed households, unemployment, and large household sizes (Francis & Webster, 2019). The province with the highest rate of poverty is the Eastern Cape, and the wealthiest province in South Africa in Gauteng, as there are many employment opportunities in the province (Statistics SA,2019).

Unemployment is a result of inadequate education, an increase in demand for employment opportunities due to population growth, and weak economic growth (Cloete, 2015). The lack of adequate education negatively impacts employment opportunities, therefore impacting the quality of life for the individual (Misselhorn *et al.*, 2012). As suggested by literature the lack of employment results in an increase in vulnerability and therefore causes a spike in food insecurity (Kimani-Murage *et al.*, 2014).

A range of social grants received by the citizens helps alleviate the impacts of poverty and food insecurity (Chakona & Shackleton, 2019). Social grants are seen as a primary income source in rural households, this is due to the lack of education and the high levels of poverty that is prevalent (Mkhawani *et al.*, 2016). These subsidies serve as a safety net for families (Sinyolo *et al.*, 2016).

As stated by Tshuma, (2012), most rural households in South Africa lack access to basic services such as electricity, water and sanitation, and adequate healthcare. In addition, due to the high unemployment rates and big household sizes, food insecurity is prevalent in rural households as they have inadequate access to food supply (Zezza & Tascioffi, 2010). Statistics SA, 2019 specified that approximately 49.2% of the adult population in South Africa were living below the upper-bound poverty line. As a result of poverty's impact on South African citizens, many citizens resort to crime to reduce the impact of poverty on their households (Oldewage-Theron *et al.*, 2006).

Food choices are restricted in households that experience poverty, as the households prioritize quantity over quality of food (Leroy *et al.*, 2015). This is done to ensure that all household members have food, therefore the nutritional value of the food is compromised (Floro & Swain, 2013).

2.7. Food Prices In South Africa

Many of the households in South Africa are dependent on cash income to purchase food and other necessities (Mkhawani *et al*., 2016). The primary income source for rural households is social grants that the government provides. The global price surge in food that occurred between the years 2006 and 2008 has a negative impact on households and their food consumption. This leads to households purchasing food within their budgets instead of buying foods that had nutritional value (hart, 2010). As a result of the hike in food prices and inadequate access to finances, strengthening food security among the households becomes a difficult task (Baiphethi & Jacobs, 2009). The increase in food prices intensified poverty and food insecurity among rural households (Kubik & May 2018). As claimed by Verpoorten *et al*., 2013 the increase in the living cost per household adds stress to the household, as the largest proportion of the income is used to purchase food for the household (Kubik & May 2018).

Among the South African citizens, approximately 70% of the poverty-stricken population resides in rural areas, and they are dependent on Agricultural as a source of food and income to improve their livelihoods and health (Mkhawani *et al*., 2016). As per recent studies, the inflation of food prices in 2021 is 5.2%, the average food basket increased by 13.7 % (Writer, 2021). Therefore, it can be concluded that the increase in food prices causes an increase in food insecurity, as the basic food basket is unaffordable for the average household in South Africa (Nkosi *et al*., 2014). The effect of climate change such as droughts can cause a spike in food prices as farmers would have experienced a loss of crops and livestock, therefore creating an increase in the retail prices of basic foods (Verpoorten *et al*., 2013).

2.8. The Impact Of Climate Change On Agriculture Production Globally

As maintained by Randon,2019 climate change is seen as the change in the usual weather patterns in a region, this change could be associated with the precipitation the area receives annually, or it could be related to the region change in temperature for specific seasons. The region's weather could change in a few hours, but the difference in the regional climate takes a few hundred or millions of years. Climate variability is more likely to have a more significant impact on developing countries as they do not have access to adequate resources, and they cannot respond to the changes in climate. This is due to factors such as the lack of infrastructure, technology, finances, and social safety nets (Hart,2010).

Globally, agriculture gives rise to greenhouse gases, which contribute to climate change. As reported by the IPCC,2007 climate change has occurred since the 1950s. The global surface temperature is

likely to increase by 0,4 to 2,6°C in the second half of the current century. Due to the increase in demand for animal products, the greenhouse gases that are produced by agriculture is predicted to increase by 70% between 2005 and 2050. Due to the rise in temperature and extreme events in many regions globally, food production is estimated to deserve decrease during the 21st century (Bailey *et al*., 2015). IPCC, 2019 predict that food security at regional levels would be negatively affected by the impacts of climate change (Wheeler & Von Braun, 2013). It is integral for all farmers to know about climate change to help them implement effective measures to mitigate climate change on their crops (Woods *et al*., 2017). The understanding of Climate variability is important as it allows the farmer to identify changes in rainfall patterns and production risk (Wood *et al*., 2014).

In Southern Africa, food insecurity is a growing concern due to the presence of floods and droughts. These climatic events reduce the harvest in the areas, thus causing communities to go hungry (Abegunde *et al*., 2019). Climate change is said to cause chaos with the food security status globally, thus hindering regions' ability to reach their millennium goals.

2.9. The Impact Of Climate Change On Agriculture Production In South Africa

In Southern Africa, the temperatures are increasing faster than the stipulated worldwide average. Over the past 100 years, the temperature rise has been recorded as 1°C (Chapman *et al*., 2020). There have been periods of longer dry spells in the regions. This rise in higher temperatures led to increased evaporation, thus reducing the availability of water (Abegunde *et al*., 2019).

In relation to Oosthuizen & Louw, (2019) the impact that climate change has on agriculture in South Africa is determined, as the agricultural sector will salter. This will have a ripple effect on the country's food supplies. The country needs to put measures in place to migrate the impacts of climate change on farming and food production (Douglas, 2009). As concluded by the study conducted by (Adekunle,2013), Southern Africa could lose 30% of the maize by 2030. Since most agriculture is dependent on rain-fed irrigation, the lack of water will cause loss of crops and, therefore, impact food security negatively. If crops are not irrigated sufficiently it could result in stunted growth and damage of crops, this would negatively affect the food security status of the households *(*Chijioke *et al*., 2011*).*

In South Africa, women are the most affected group by climate change. It is noted that women are most vulnerable to all dimensions of food security and they suffer from macro and micronutrient deficiencies, which impacts their health and society at large (Carletto *et al*., 2013). (Chege, Ndungu & Gitonga, 2016; Yusuf, Balogun & Falegbe, 2015) argue that there is a positive and significant relationship between food security and the marital status of the household head. Women are affected from a producer and consumer aspect of food, as producers, if they farm the reduction in water will

cause them to lose crops and become vulnerable, and from a consumer side, the prices of basic food will increase due to climate change and thus the women will not be able to provide nutritionally adequate food for their families (Tibesigwa *et al*., 2018). The lack of adequate nutrients causes the health of the household members to be compromised. By not consuming sufficient nutritious food, a person's ability to perform daily tasks is reduced drastically (Martin *et al*., 2013). Therefore, small scale agriculture provides an opportunity for households that have large household sizes to become resilient to food insecurity (Regassa, 2011).

The food supply of South Africa has been affected by markets, politics, natural factors, and economic forces, as claimed by DAFF, 2018 attention will be focused on revitalizing the agricultural sector of the country. By using a food production and market strategy DAFF, 2018 clearly states that the state will provide support to farmers to improve the food security sector. The support to the farmers will be given in the form of tariffs and subsidies; these measures are put in place by the government to promote and protect the agricultural production of the country.

2.10. The Impact Of Climate Change On The Environment In South Africa.

In South Africa, the sea levels are rising, and the presence of droughts and floods are more frequent, as the continent of Africa is one of the most vulnerable continents to experience extreme weather events such as Droughts and floods and to experience climatic variability (Chapmen *et al*., 2020).

The impacts are destroying the ecosystems and decreasing food production in the country. These changes will have the highest impact on poor populations. In relation to Santra, (2020), higher levels of carbon dioxide can lead to an increase in crop production in some plants, but due to factors such as soil moisture, nutrient amounts, and water availability, the growth of plants can be reduced. The rising temperature ad extreme events lead to an increase in pressure pests, and weeds can destroy crops and reduce the amount of food produced by the country (Rosenzweig *et al*., 2001). As indicated by studies human activity such as deforestation, burning of fossil fuels and livestock farming causes high amounts of greenhouse gases that increase the greenhouse effect and the warming of the globe (Latake *et al*., 2015.). Climate change has been occurring naturally on earth which has been geologically recorded, however, these natural changes are accelerated by human activities (Trenberth, 2018). Behaviour towards climate change is important, as by reducing travel and activities that produce large amounts of greenhouse gases the effects of climate change can be reduced (Latake *et al*., 2015).

As specified by Pretty & Bharucha, 2015, the increase in pests affects the quality of the crops as the pest destroys the plants. The presence of diseases in crops and livestock can lead to the death of

livestock and loss of crops; this, in return, affects the country's food production (Pereira, 2017). The increase in weeds reduces the productivity of farms. Weeds are invasive crops and can cause harm to livestock. In agreement with Thornton & Herrero, 2014 weeds compete with the crop and livestock for nutrients, water, and sunlight, therefore leading to the production of inferior quality crops and an overall reduction in crop yield. Increased temperatures increase heat exhaustion and infectious diseases; diseases in crops and water contribute to poverty and unemployment (Woodword *et al*., 2014).

The use of fertilizer and manure helps the plants gain the nutrients needed and help the crop be healthy *(*Ndambi *et al.,* 2019). Fertilizers and manure also help to improve the soil quality for better crop production *(*Bedada *et al.,* 2014*)*

The increase in drought episodes reduces the amount of water available and as a result affects crop production negatively (Fahad *et al*.,2017). This causes an upsurge in food insecurity experienced by households. The change in rainfall pattern causes a shift in the planting seasons of crops and negatively affects the food security status of households (Connolly-Boutin & Smit, 2016)

Changes in climate change such as a change in rainfall patterns, increase in pest and diseases and a change in the growth of plants affect farming negatively, as indicated by (Rosenzweig *et al*., 2001) Farmers can plant new crops that will grow in abundance under the current weather conditions (Lamichhane *et al*., 2015.). Droughts are an effect of climate change, therefore, to mitigate this Drought resistant crops should be planted *(*Ahmed *et al*., 2013*).* Therefore, irrigation is vital for the survival of crops as it is essential for the development and the growth of the plants *(*Azanu *et al*., 2016).

2.11. The Social And Cultural Impact That Climate Change Has On South Africa

Due to the impact of climate variability in South African, the population has been forced to innovate behavioural ways to adapt to the changing food source and environment (Roberts *et al*., 2013). Climate change negatively has an effect on all four pillars of food security namely, availability, accessibility, utilization and stability (Masipa, 2017). The effects of Climate change intensifies circuses such as poverty and inequality. Many of the diseases that are present are derived from Climate change therefore climate change will have a negative impact on future generations (Mondal & Sanaul, 2019).

In line with Wu *et al*. (2016), the increase in changes to the environment results in the onset of many diseases such as HIV/AIDS that poses a challenge to the quality of life. The increase in temperatures

causes heat exhaustion and infectious diseases to rise; factors such as poverty and unemployment are brought upon by diseases in crops and water (Woodword *et al.*, 2014). As claimed by Franchini & Mannucci, 2015 the government needs to supply adequate health care services and water to the community to overcome some challenges brought upon by climate change.

The main medium that is used to gain information about important matters is the radio as televisions are seen as a luxury item in rural areas (Spaull, 2015). The radio is the main source of information as it is affordable and does not use up a lot of electricity. Radios in South Africa have radio stations in native languages thus making it is easier for the locals to understand (Jiyane *et al.*, 2012).

Many individuals believe that God is the cause of climate change, because of their belief system and religious perspectives. As in Christian, it is stated in the bible that there would be an end time and climate change is an indication of the end time (Tambo & Abdoulaye, 2013). Understanding the local perceptions and adaptive behaviour enables policymakers to make more informed decisions about how to solve agricultural development challenges in unpredictable and uncertain environments (Simane *et al.*, 2016).

Climate change's crisis triggers many feelings that are mostly associated with fear (Reser & Swim, 2011) This feeling is known as eco-anxiety or climate grief (Panu, 2020). This feeling is centred around the fact that they were scared about how it was going to affect their incomes and the supply of food in their households. Therefore, education is proven to be vital for the response to climate change globally as by educating the masses the issue of climate change will be understood and the impacts can be addressed. (Hamilton, 2011).

2.12. History And The Role Of Community Gardens

Community gardens began around the 1970s, as a way to produce food for the community, tropical vegetables were planted. Community gardens are present in both urban and rural areas (Galhena *et al.*, 2013). As reported by Henderson & Hartsfield, 2009 community gardens are now being recognized as an ingenious way to produce food and improve citizens' health. In addition, these community gardens encourage relationships between neighbours, consumption of healthy foods by households, provide a source of income for households of participants, and provide a food source for the vulnerable (Meenar & Hoover, 2012).

In heed of Smith & Harrington, (2014) community gardens are located on vacant land in communal areas, which is allocated by councillors and government. Community gardens are a space whereby food, herbs, and flowers are grown. Every garden differs based on the needs and preferences of the

community and the environmental conditions of the area (Yeager, 2020). Community gardens play a vital role in providing a source of food to areas with a low socioeconomic population, as the goal of a community garden is to provide a way to increase the household and individual's food security status. (Galhena *et al.*, 2013).

In Africa, community gardens began long ago in households, whereby vegetables were planted for household consumption. In rural areas, community gardens exist in many areas such as youth communal gardens, neighbourhood community gardens, nutritional gardens, school gardens, home gardens, therapy gardens, and entrepreneurial gardens. These community gardens help in ensuring that the elderly, children, youth, and adults are food secure (Trefry *et al*., 2014).

2.13. Benefits Of Community Gardens

As concluded by Darby *et al.* (2020), community gardens have many benefits. Community gardens may help reduce the impact of food deserts in rural areas, thus helping the citizens gain access to healthy and nutritional food. Community gardens offer rural households a chance to market and sell their products, which increases their social status and financial status. Community gardens enhance the social benefits as it equips the participants with survival strategy; it preserves the heritage and culture of the area and helps provide a social identity for the members (Vásquez *et al*., 2007).

Community gardens help to benefit women-headed households as they can sell and obtain vegetables for household consumption. It also benefits chronically ill people as they can get foods that are high in nutrients that help boost their immune systems. In addition to the vegetables grown in the community gardens, medicinal plants can be grown to help households overcome short-term illnesses such as colds and cases of flu (Smith & Harrington, 2014).

It helps to strengthen the relationship between the community members, increase citizens' physical activity, improve their dietary habits, and reduce the risk of obesity. It improves mental health and food security. Community gardens also provide a space whereby people can reconnect with nature and gain exercise, therefore promoting a healthy lifestyle (Twiss *et al*., 2003). Community gardens also allow the participants to gain knowledge on how different crops are grown and the benefits of consuming the crops. This knowledge can help them start farming on their own and therefore increase their household income (Rusciano *et al*., 2020).

2.14. Challenges Associated With Community Gardens

Although community gardens serve to help reduce food insecurity among rural households, they come with many challenges that can be detrimental to the survival of the community garden.

Problems can be present in the members' communication and the production of the community garden. The community garden's size is important as it must be able to accommodate all participants and supply adequate food to all participants (He & Zhu, 2018).

Power struggles between the members and tribal leaders can exist and thus causing conflict to arise; this causes the community garden to fail. To avoid this, there need to be power relations that exist. The lack of equipment such as spades, irrigation material, seeds, and fertilizers can make the garden unsuccessful. This can cause these households to become more vulnerable. The issue of the occupation of illegal land would lead to a conflict between the community and tribal authorities (Galhena *et al*., 2013).

As many of the participants in rural areas do not have adequate education, this leads to issues with management, as they do not have the skills to manage the gardens. Hiring external help adds extra cost to the community gardens, which reduces the income that the participants can gain from the community garden (Fox-Kämper *et al*., 2018).

Access to the source of water for irrigation is essential for the growth of crops. Therefore, the relationship with the extension officer of the area is critical for the success of the community gardens and the food security status of rural households (Ngema *et al*., 2018). Since the effects of droughts limit the water supply of households the amount of water used to irrigate crops is reduced. This causes the quality of the crop to be reduced (Hanjra *et al*., 2012).

2.15. The Role Of Community Gardens To Address Food Insecurity

Community Gardens consist of a variety of crops that provides a variety of nutrients for the human body, therefore promoting a healthy lifestyle (Galhena *et al*., 2013). Community Gardens are seen as a strategy to decrease food insecurity as community gardens can provide rural, poverty-stricken households with access to nutritious food (Baliki *et al*., 2019). Community gardens provide food such as roots, tubers, legumes, herbs, fruits, and vegetables. These foods are high in vitamins A, C, and E (Hart, 2010). It also provides nutritious food and aids in improving a person's overall health (Shisanya, 2008).

The provision of nutritious food that is available from community gardens promotes mental health and development, especially in young children (Nkosi *et al*., 2014). The participants sell the surplus of the produce; therefore, they have financial gain to support their household's income, thus making them more food secure (Trefry *et al*., 2014). In agreement with Darby *et al*. (2020) community gardens are seen as an approach that is used to enhance the food security status at a household and

community level. Community gardening has the potential to alleviate household food insecurity by ensuring that food is always available and accessible (Thorman and Dhillon, 2021). Castaeda-Navarrete (2021) assertion that having a communal garden enhances household food security by supplementing the household food basket

2.16. How Does Community Gardens Help To Accomplish The Sustainable Development Goals (SDGs)?

In September 2015, the general assembly adopted the 2030 agenda of sustainable development, which comprised 17 sustainable development goals. This new agenda highlighted using a holistic approach to achieve sustainable development for everyone (Griggs *et al*., 2013). The 17 goals are:

- GOAL 1: No Poverty
- GOAL 2: Zero Hunger
- GOAL 3: Good Health and Well-being
- GOAL 4: Quality Education
- GOAL 5: Gender Equality
- GOAL 6: Clean Water and Sanitation
- GOAL 7: Affordable and Clean Energy
- GOAL 8: Decent Work and Economic Growth
- GOAL 9: Industry, Innovation and Infrastructure
- GOAL 10: Reduced Inequality
- GOAL 11: Sustainable Cities and Communities
- GOAL 12: Responsible Consumption and Production
- GOAL 13: Climate Action
- GOAL 14: Life Below Water
- GOAL 15: Life on Land
- GOAL 16: Peace and Justice Strong Institutions
- GOAL 17: Partnerships to Achieve the Goal

Table 2. 1.How Do Community Gardens Help To Accomplish The Sustainable Development Goals (SDGs).

SDG	INTENDED GOAL OUTCOME
SDG 1: No Poverty	The surplus of the produce from the community gardens is often sold by the participants, therefore increasing their household income and helping them gradually to become resistant to food insecurity (Galhena *et al*., 2013).
SDG 2: Zero Hunger	Community gardens provide the poor with an opportunity to plant fruits and vegetables for consumption. Having food available helps them to fight hunger. The community gardens provide the poor with a safety net as the food consumed from the community garden will not affect their finances (Hart, 2010).
SDG 3: Good Health and Well-being	Community gardens allow the poor to plant fruits and vegetables for consumption, thus improving the intake of nutritious food, enabling them to become healthier and fight hunger (Sachs, 2012).
SDG 5: Gender Equality	Women often participate in community gardens. Therefore, they are allowed to earn an income. The community garden also equips the women with a livelihood strategy that they can use to improve their livelihoods (Nkosi *et al*., 2014).
SDG 8: Decent Work and Economic Growth	The community gardens allow the participants to sell the surplus, therefore strengthening the economic status of the households (Rogge *et al*., 2018).
SDG 10: Reduced Inequality	Therefore, community gardens consist of both female and male participants, promoting equality (Librizzi, 2017).
SDG 11: Sustainable Cities and Communities	The community gardens help turn vacant, unused land into a positive space for the community, where they can provide nutritious food to their families and gain an income. The positive environmental impact that community gardens have ranged from improving air quality to planting crops, which enhances sustainability (Galhena *et al*., 2013).
SDG 12: Responsible Consumption and Production	Community gardens promote sustainable produce production; food waste is minimalized as the surplus of the crops is sold to generate an income (Baliki *et al*., 2019).

2.17. The Impact Of Climate Change On Community Gardens

Community gardens are affected by climate change, and they also have an impact on climate change (Pereira, 2017). As testified by Egal,2019 climate change brings upon higher temperatures. It increases carbon dioxide levels, but the implementation of community gardens can help to reduce the island heat effect, as researchers found that the temperature outside the community gardens was higher than in the community garden. The higher temperatures imply that the crops need to be irrigated more often. This adds pressure to the water supply in community gardens. The increase in the frequency of irrigation causes an upsurge in weeds, which in return results in additional labour needed and stunting in the growth of crops in the community gardens (Smith *et al*., 2021). The nutrient content of vegetables can be compromised due to climate change, increase yields, and droughts (Nkosi *et al.*, 2014). Librizzi, (2017) claimed that climate change and community gardens have a symbiotic relationship. The growth in climate change can have a severe impact on the ability of Community Gardens to survive.

The farmers need to understand how climate change can disrupt their food supply and quality of food as it negatively impacts their food security status (Connolly-Boutin & Smit, 2016). Therefore, it is advised that smaller gardens should plant crops that have a short growing period to harvest more often to ensure a continuous supply of food (Eigenbrod & Gruda, 2015).

2.18. Interventions To Aid Food Security In South Africa By The Government

The food security policy of South Africa comprises a host of interventions that the government uses to eradicate food insecurity in the country. These interventions that are mentioned in the policy consist of both direct and indirect objectives that aim to promote agriculture and the food sector in South Africa (Department of Agriculture, 2002). It seeks to achieve this by influencing the economic and organizational environment that is responsible for the functions of the food system. The food security policy goal is to address all aspects of the food system, such as markets, production, distribution, consumption, and nutrition. The food policy interventions call for both the micro and macro issues to be addressed by making sure that they are designed to:

- Resolve conflicting objectives in the policy brought upon by urban and rural differences, producers and consumers, primary and secondary production, and budgetary prioritization between investments in agriculture and consumption.
- Aid in resolving issues that concern food security and malnutrition.
- Consider a collection of data that can be broken down to household levels.

- Involve the policy and programme design and implementation between department divisions (Department of Agriculture, 2002).

As reported by DAFF, (2018) the provision of food assistance networks that involved the nongovernmental and the governmental sectors of the country was proposed. These food assistance networks aimed to help all citizens gain better access to the food supply by improving the safety nets. These consisted of fortifying foods, implementing food kitchens, food banks, and school nutrition programmes. Another intervention by the South African government is to improve nutrition education among the citizens, this intervention included the provision of consumer literacy, assisting the citizens with improved meal planning and developing their management of food. It also included district-level nutrition services to assist with the community and household monitoring of nutritional indices.

Emphasis was placed on the alignment of investments in agriculture to promote local economic development by developing storage, distribution, and production of food and by revitalizing irrigation schemes (DAFF, 2018). The main concern in the agricultural sector of South Africa is market participation. Therefore, DAFF, 2018 aimed to improve market participation by forging partnerships between the public and private sectors, encouraging food purchasing programmes by the government that supports smallholder farmers, and implementing the Agric-BEE charter that requests agro-processing industries broaden their supply sectors which will include the agricultural sector.

Food and nutrition security risk management was used to invest in technology and research to tackle the challenges and opportunities for production, such as bioenergy, climate change, and green technologies. It was also used to protect prime agricultural land and limit the alienation of activities such as game farming, property development, and mining. Periodic reports of the food security status of the country were required, as this will help to make informed decisions on the supply of food (DAFF, 2018).

The South African government had recognized that to have a great effect on, all four pillars of food security, participation, and contribution of many government departments were required. These ranged from social development programmes like establishing community gardens, home gardens, and nutrition education that will assist the poor. It also proposed the inclusion of economic transformation initiatives. With the addition of the proposed interventions, the government hoped to achieve:

- The economic, physical, and social access to food.
- A stable food supply.
- Adequate food available.

- To ensure food is utilized properly.
- Food must be of good quality and safe for consumption.
- To address short-term concerns of hunger and malnutrition at the household level by utilizing existing food supplies.
- To increase the food supply of food in the country by improving production, implementing market interventions, and ensuring that the entire country's food supply is sustainable and enough for the nation (DAFF,2018).

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CHAPTER 3: METHODOLOGY

3.1. Introduction

The study aims to investigate the effect of climate change on community garden crop production and the farmers' household food security. This was achieved by administering conducting questionnaires, focused group discussions, and key informative interviews. Community gardens are known to improve the food security status of the locals. Thus, by acquiring an understanding of the effect of climate change on the crop production of community gardens, we can address the challenges posed by these issues.

Since community gardens help to improve the food security status of households, by gaining insight on the effect that climate change has on these crops we can address the issues found in order to improve the food security status of the households.

This chapter discussed the study's research design and methods. The study collected data on the utilisation and availability of vegetables from community gardens, farmer perspectives on climate change and interventions, and measures implemented by the local municipality to offset climate change shocks using an integrated method approach. This method approach permits both quantitative and qualitative data to be collected in concurrence, analyzed individually, and then allows for the results to be combined (Creswell, 2013).

The framework of the study is presented in chapter 3. The chapter consist of the description of the study area, research design, sampling techniques, target population, data collection tools, and analysis.

3.2. Description Of The Study Area

The study was conducted in Dlangezwa, Ward 18 of the Umdoni local municipality in KwaZulu-Natal (KZN), which is located in the northeast of the province (IDP, 2018). Due to the rural nature of this location and the absence of shopping centres, the area has just a few modest general stores. The majority of the region's inhabitants had moved in search of work, leaving the elderly to care for

their grandchildren, despite the fact that the elderly comprised the majority of the town.

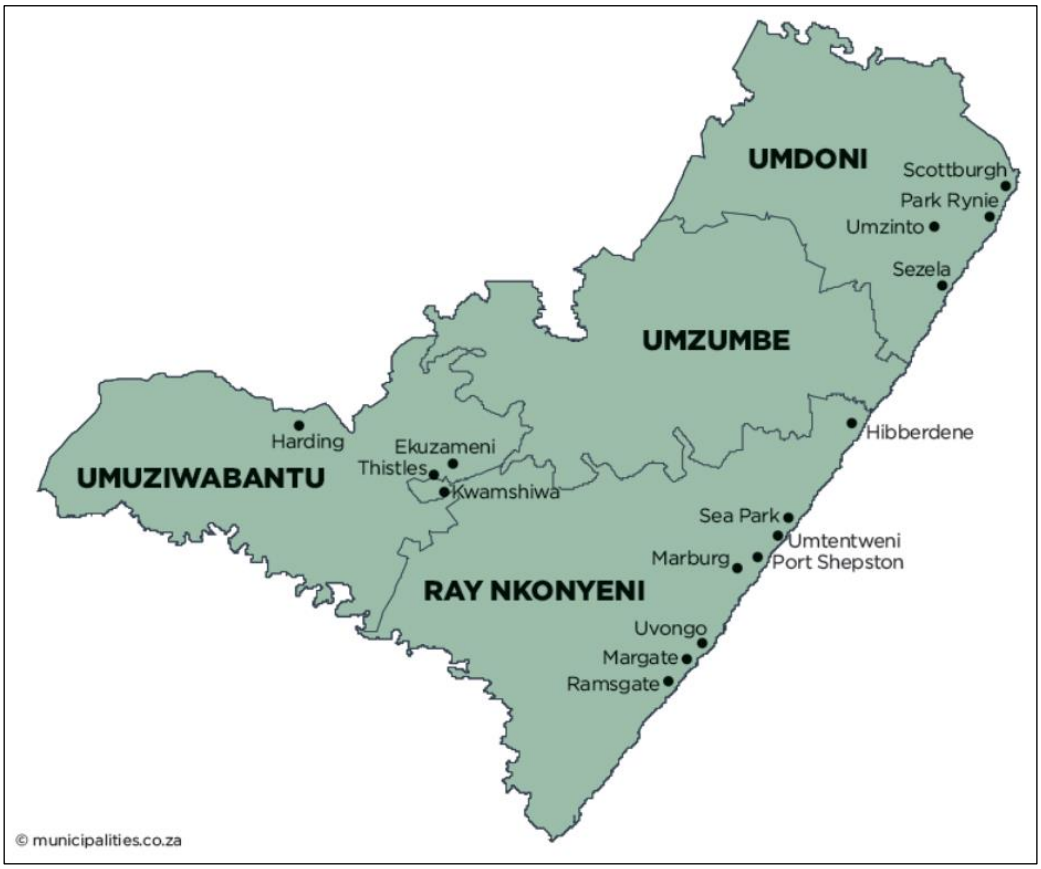

Figure 3. 1:Map of the Umdoni Municipality (Accessed from IDP, 2018/2019)

Figure 3. 2: Map Showing Dlangezwa. (Obtained from Google Maps).

There are community work projects, co-operations, and around 20 government-funded projects in the area. In the local area, there are community gardens and school garden programmes that work to help provide food to low-income households. A wide variety of agricultural practices are present in the

Dlangezwa region due to it having agricultural land. Major agricultural activities found in the region include grain, fruit, and vegetable farming as well as sugarcane production (IDP, 2018).

The area is impoverished, with no reliable infrastructure. Social grants are the primary source of income for these families. There are not many shops in the area, which means that the residents have to buy food farther out. The major source of water in the region is the Umkomaas River, which provides water to some but not all of the households in the area. Each house is responsible for collecting water and storing it in water containers or JoJo tanks. The cooking methods that households use are mainly fueled by gas and fire. The area has a range of living standards; some houses are made of bricks, while others are made of mud. The majority of the houses are only accessible by footpaths. Many households keep livestock, such as chickens, cows, and goats. Tradition and culture play a significant role in the community. On average, Dlangezwa receives 906mm of rain per year, with the bulk of that precipitation occurring during the middle of summer. The months of January and July yield the highest precipitation (128mm) with February and August having the lowest precipitation (18mm). For the Dlangezwa region, the temperature range is from 22.4°C in July to 27.8°C in February. that on average falls to 9.7°C at night in July when the temperature falls to its lowest (SA Explorer, 2020).

3.3. Research Approach

The research design is a plan that provides a framework for the research and outlines steps to take for the research to be successful. The research design is formed from the research problem, it provides insight into what the study tends to investigate (Burkholder *et al*., 2016).

As a result, a mixed-method approach was utilised to investigate the impact of climate change on crop production in community gardens, as well as the impact of climate change on household food security status. A mixed-methods approach is a methodology used for conducting research that involves collecting, integrating, and analysing quantitative and qualitative data (Creswell & Creswell, 2017). A mixed method provides strengths that counterbalance the weaknesses of both qualitative and quantitative research. By using both qualitative and quantitative data, the researcher was able to get a better understanding of the problem and to address the key objectives effectively; it also provided an in-depth understanding. The use of an integrated method allows the researcher to gain a better understanding of the situation rather than using a single approach method (Creswell, 2013) This method was useful because this study aimed to focus on the respondent’s experiences.

Exploratory or formulative research

The use of the mixed-method approach allowed the use of open-ended and closed-ended questions, this allowed for the respondent's point of view to be known. The quantitative data allowed for information such as the respondent's demographics, knowledge about climate change, perceptions, behaviour and attitude towards climate change, community garden information, the respondent's food security status and interventions put in place by the department of agriculture and the local municipality to mitigate climate change. The qualitative data allowed for the respondents to give their views on the issues faced by climate change on the community gardens as well as the problems they have in their households. Consequently, the researcher was able to gain a deeper understanding of the problem by employing a mixed-method approach in the study

The data collection period ran from the 5th of April to the 23rd of April in the year 2021. Participants completed household questionnaires; 10 focused group discussions (FGDs) were held with 12 participants in each group, and 12 key informative interviews were performed with extension officers and municipal officials. In total, 120 participants participated in the study.

3.4. Target Population

The target population is defined as "the complete aggregation of respondents who fulfil the specified set of criteria" (Burns & Grove 1997: 236). The elderly and young people made up a major proportion of the population of ward 18 of the Umdoni municipality. The majority of the population were unemployed, and a small minority were subsistence farmers. The target population for this study were people that were actively involved in the community gardens of ward 18 and were over the age of 18. The study sample consisted of the community garden participants in the ward that engaged in the study. This selection was conducted purposively and a total of 120 participants were selected, this ensured that the participants were effectively selected. The participants were interviewed based on their willingness.

3.5. Sampling

A purposeful random sample approach was chosen because it requires the researcher to select participants who have the most qualities that are representative of the population, and then select the participants systematically from that pool of participants (Etikan *et al*., 2016). The participants that fit the criteria of the study were randomly selected. This helped to reach the target of 120 participants for this research. By using purposive random sampling, the sampling population that was chosen

represented the population that was relevant to the study. Purposive random sampling helped the researcher to gather information from the data collection. This helped the researcher to conclude the major impacts that the study had on the population. By using purposive random sampling, the sample population that was chosen represented the population that was relevant to the study. The quantitative data was collected through the use of random sampling, whereby the participants were randomly chosen from the community gardens. Information that was collected from random sampling was the respondent's demographics, knowledge about climate change, perceptions, behaviour and attitude towards climate change, community garden information, the respondents household food security status and interventions put in place by the department of agriculture and the local municipality to mitigate climate change. Random sampling was the most appropriate approach for collecting the quantitative data for the study because it reduces the risk of error when data is analysed. It ensures that all participants have an equal chance of being selected, and it does not necessitate the use of considerable information (Kazimierczuk *et al*., 2009).

Purposive sampling was used to gather the qualitative information, as it is cost and time effective, it is also effective in situations whereby human society and their development is being questioned (Etikan & Bala, 2017). The information gathered consisted of the respondents' opinions on the challenges raised by climate change in relation to community gardens, the problems they are experiencing in their household in relation to food security, and the crops they were growing. The disadvantage of purposive sampling in this study was that the findings could not be generalised and there was a vulnerability to errors in judgement (Mujere, 2016).

3.6. Sample Size

The sample size of 120 farmers that were involved in community gardens in ward 18, Umdoni municipality, was used. The determination of sample size involves statistical issues and the same size of 100 participants is known as the minimum sample size when the population of an area is large (Palinkas *et al*., 2015). The sample size of 120 participants for the above study was based on the estimated response rate and the nature of the study. Purposive sampling was used as it focuses on particular characteristics that are of interest which serves to best answer the research questions (Wisdom *et al*., 2012). The sample size was deduced by using a purposive sampling method. The sample size chosen represented the entire population to ensure accurate results. 16 out of the 35 community gardens were interviewed as according to (Strydom & Venter, 2002) the sample size of 44% is within the guidelines that are representative of a population.

3.7. Data Collection Tools

The use of data collecting tools enables the researcher to collect and analyse data that is necessary for the study. The data that was collected in this study compromised both quantitative and qualitative data. The study employed a variety of instruments, including surveys/questionnaires, focus group discussions, and key informative interviews. The questionnaires were conducted with 120 community garden participants. The Focused group discussions helped gain in-depth knowledge on the topic, and the information was collected from 10 groups consisting of between 8- 12 people. 12 key informative interviews were carried out with the extension officers and local municipality officials.

3.7.1. Questionnaires

The most flexible tool to gain information about people, their feeling, and their experiences is questionnaires according to (Patten, 2016). The design of a questionnaire allows the researcher to gather information from a large population within a given time frame, it also ensures that the data collected is accurate and interpretable (Patten, 2016). Therefore the questionnaire was used in this study to ensure that the data collected is accurate and easily understood. The disadvantage of the questionnaire was it limits the personal responsibility of the individual and does not provide in-depth responses (Boynton *et al*., 2004). The questionnaires contained information that was relevant to the research topic and the respondents of the specific area. Data that was obtained from the questionnaire included, demographics of the respondents, their knowledge about climate change, their perceptions, behaviour and attitude towards climate change, information about their community garden, the HFIAS and the interventions and measures in place to mitigate the impact of climate change by the department of agriculture and the local municipality. The questionnaire was conducted by the researcher.

The Household Food Insecurity Access Scale (HFIAS) is a tool that is used to determine the food security status of a household. It compromises of 9 questions. This tool helps capture the response through the form of a survey (Castell *et al*., 2015). As a result, it was utilised in conjunction with the questionnaire to ascertain the households' food security status. According to the responses to the questions, households were classified as food secure, mildly food insecure, moderately food insecure, or severely food insecure (Coates, 2013).

3.7.2 Focused Group Discussions (FGD'S)

The purpose of an FGD is to gather a group of people that share a similar background to discuss a topic (Classen *et al*., 2011). The FGD proved to be beneficial to the study as it allowed the respondents to discuss their views on the issues of climate change and its impact on their livelihoods and

community gardens. FGD provide the platform for participants to share and compare their experiences, it also provides information that amplifies the data that is collected from the questionnaire (Grim *et al*., 2006). Seasonality charts allowed the researcher to compare the different types of crops that were planted in the community gardens. This provided insight on which months certain crops are available in the community gardens. Seasonality charts allow for the seasonal patterns to be analyzed for the same calendar timeframe (Siqueira *et al*., 2015). The disadvantage of using the FGD is that the outcomes of the discussion can not be given to the participants immediately (Grim *et al*., 2006). The focused group discussions allowed the researcher to get a deeper understanding of the issues pertaining to climate change and community gardens.

Sample Focused group discussion questions

1. What are some of the problems that your household faces that makes you worry about your family's food supply?
2. What factors hinder the quality and quantity of food that your family consumes?
3. Do you think that climate change is a concern, and does it affect the quality and quantity of food your household consumes?
4. Do you feel that the food garden helps you provide food to your family, or is it a burden to you?
5. How does the department of agriculture assist your garden with the impacts of climate change?

3.7.3 Key Informative Interviews

Interviews with key informants provide qualitative data. It is an in-depth conversation with individuals who are knowledgeable about the present state of the community. Typically, important information is from community leaders or professionals who frequently interact with the community (Boyce & Neale, 2006). The key informative interviews were conducted with the extension officers for ward 18 and the local municipality officials. The purpose of the key informative interviews was to collect information about the measures and interventions put in place by the local municipality to mitigate climate change from an extensive range of people. The questions aimed to understand the problems that the community garden participants face, what measures are put in place to help them, and are aware of the help that they can receive. The advantage of key informative interviews for this study is that the information is gathered from a knowledgeable source, is flexible and allows for new issues to be explored and is cost-effective (Opdenakker, 2006). The disadvantage of key informative interviews is that is can be biased and only allows a maximum of 15 people to be interviewed (Luo & Wildemuth, 2009). In the study 12 people were interviewed, therefore the majority of the population was only represented by 12 people.

Sample Interview questions

1. What are some of the problems that are faced by the people who participate in the community gardens?
2. What are the measures put in place to address the problems faced by the community gardens?
3. Do you think that climate change is a concern, and does it affect the quality and quantity of crops produced in community gardens?
4. Do you feel that the community garden help provide food to the participants?
5. How does the department of agriculture assist the gardens with the impacts of climate change?
6. Is the help provided by the Department of Agriculture well received by the community gardens?
7. What measures are put in place by the local municipality to help the local community gardens?
8. Is the community aware of the type of assistance provided by the local municipality?
9. Do you have any additional comments or feedback?

3.8. Validity

Validity is seen to be the foundation of a study being accurate and trustworthy (Roberts & Priest, 2006). There are two types of validity namely external validity and internal validity. The questionnaire used in the study was pretested in the pilot study on 5 respondents before the commencement of data collection. The respondents that were used in the pilot study were not used in the main study. The pilot study was conducted to find out if there were any errors or ambiguous questions in the questionnaire. The focused group discussion groups were predetermined to ensure that the participants are actively involved in the community gardens. The key informants were also pre-determined to ensure that the interviewee has been personally involved in the community gardens and is knowledgeable about the community.

The questionnaires were conducted with the help of the extension officer to ensure that the participants understood the questions in their native language which was IsiZulu. A quick overview of the discussion was given to the participants at the end so that the participants to clarify the information.

3.9. Reliability

Reliability is known to be a test where the measurement obtained has no error (Lakshmi & Mohideen, 2013). The questionnaires, focused group discussion and the key informative interviews were cross-checked to ensure that the data collected is reliable. The questionnaire allows for data to be accurately collected from a large population. The focused group discussion and key informative interviews were both qualitative data collection approaches. In qualitative data collection, the data obtained is from discussions. To ensure that the qualitative data was reliable, the study used established research

methods such as random and purposive sampling methods. This was to ensure that the study is credible. The study ensured that the data collected was reported in detail to enable future researchers to conduct the study to make the process of the study dependable. The study's method was ensured to be methodologically sound therefore the findings of the study is credible (Roberts & Priest, 2006).

3.10. Data Analysis

To understand the demographics and the Farmers' knowledge, perceptions, and attitude of climate change and its shocks. A thematic analysis, as well as frequency and descriptive statistics, was conducted. A logistic regression model was used to assess the effect of community gardening on the food security status of the farmers. It helped to understand research that involves communication. It also aided in understanding the patterns of communication. This helps systematically quantify communication patterns. Its advantage is that it helps understand social phenomena in a non-invasive way. The descriptive analysis and frequency analysis provided the researcher with insight into the population dynamics. Frequencies and descriptive statistics analysis were conducted for data collected from the questionnaire and focused group discussions. The use of this method allows the researcher to gain insight into the variability. (Vaismoradi *et al*., 2016) A logical regression model was performed to determine the household food security status of the households surveyed.

The data were analyzed using a programme called SSPS. Data from the completed questionnaires were entered into SPSS (version 27). The demographics and other data from the questionnaire were described using descriptive statistics. The general characteristics of the respondents, such as households, age, marital status, ethnic group, highest educational level, occupation and income, community garden information, knowledge, behaviour, perceptions and attitude towards climate change were generated by using frequencies and descriptive analysis. The data obtained from the FGDs were analyzed through themes and content analysis, the food security status of the surveyed households was determined, using food security categories as per the HFIAS manual. To analyze the factors such as the impact of climate change on the community gardens influencing food security of surveyed households, a logistic regression model was used. The dependent variable, in this case, food insecurity, was a binary variable that took a value of 1 if the household was food secure and 0 otherwise. The general logistic model may be written as:

$$Q_i = f(Y_i) = \frac{1}{1 + e^{-(\varphi + \sum \Psi_i X_i)}} \qquad (1)$$

Where Q_i is the probability that an individual is being food insecure given x_i, x_i represents the i^{th} explanatory variables φ and Ψ are regression parameters to be estimated? e is the base of the natural logarithm. Table 3.1 below shows the sub-problems explored in the study, type of data collected, tools used and the analytical process followed of each sub-problem.

Heckpoisson Model:

The model comprises of one equation for the count outcome, does the household receive enough food from the community garden, and one equation for a binary selection indicator does the household receive enough food from the community garden. The indicator is always observed and takes values of 0 or 1. But the outcome of food insecurity status is observed = 1, that is, we have complete information about the covariates of interest and selection status. Nevertheless, the value of the primary outcome of interest, does the household receive enough food from the community garden, is sometimes unknown. More correctly, the count outcome is assumed to have a Poisson distribution, conditional on the covariates, with a conditional mean.

The study used the Heckpoisson model to assess if the household receives enough food from the community garden and its effect on the household food insecurity status because of its ability to fit outcomes of count data and correct for sample selection biases.

The binary regression models that are employed in comparable studies (Mussa & Mwakaje, 2013), would not be suitable in the present analysis. The Heckpoisson is estimated in two stages as shown in equations (2) and (3).

The Heckpoisson model is stipulated as follows;

$$E(HDDS_i \mid X_j, \in_{1j}) = \exp(X_j\beta + \in_{1j}) \qquad \text{Poisson model} \qquad (2)$$

$$S_j = \begin{cases} 1, if\ P_j\varpi + \varepsilon_{2j} > 0 \\ 0, if\ otherwise \end{cases} \qquad \text{Selection equation} \qquad (3)$$

Where $\varepsilon_1 \sim N(0, \partial)$

$\varepsilon_2 \sim N(0,1)$

$corr(\varepsilon_1, \varepsilon_2) = \rho$

When $\rho \neq 0$, standard Poisson regression based on the observed y yields biased estimates. Heckpoisson provides consistent, asymptotically efficient estimates for the limitations in such

models. Contrasting the standard Poisson regression, the Poisson model with sample selection allows underdispersion and overdispersion.

Where, is the binary indicator showing whether the household gained enough food from the community gardens or not.

The Poisson model (equation 2) is used to assess the impact of the community gardens on the household food security status (the indicator is only observed if = 1). Although the selection model equation (3) is the selection part of the model and is applied in assessing the factors influencing participation in community gardens. The two equations of the Heckpoisson model share predictors which could introduce prejudices due to high collinearity between the inverse mills ratio (IMR) in the selection model and predictors in the outcome model. To prevail over this problem, the model was projected by applying the exclusion restriction approach (ERA) in which one or more predictors in the selection model are excluded in the second stage to yield consistent estimates (Schwiebert, 2012).

Table 3. 1.Research method procedure

Objectives	Data collected	Data collection techniques & tools	Analysis
• To understand the demographics and the farmers' knowledge, perceptions, and attitude of climate change and its shocks.	• The farmer's demographics and their perceptions of climate change. • The different crops planted in the community gardens	• Focused group discussions • Questionnaires • Seasonality charts	• Thematic analysis • descriptive statistics
• To assess the effect of community gardening on the household food security status of the farmers.	• Institutional factors	• Questionnaires • HFIAS	• Frequencies tables • logistic regression model • Heckpoisson Model
• To investigate interventions and measures taken by the local municipality to mitigate the impacts of climate change.	• Interventions and measures put in place by the extension officers	• Questionnaires • Key informative interviews • Focused group discussion	• Frequencies and descriptive analysis • Thematic and content analysis

3.11. Ethical Considerations

Creswell (2013) define ethics as "a set of accepted standards of behaviour." All researchers must be aware of ethical research practices. Ethics concerns two sets of people: those conducting research, who should be conscious of their obligations and responsibilities, and those who are being "researched," who have fundamental rights that should be respected. Ethical clearance and approval were obtained from the College Humanities and Social Science Research Ethics Committee of the University of KwaZulu Natal (APPENDIX B). Ethical considerations were taken such as to ensure that the respondents were not harmed or lack of dignity due to the study. As a result, the study was conducted fairly and impartially, avoiding any potential hazards. Respondents were informed of their legal rights. Informed consent, the right to anonymity and confidentiality, the right to privacy, fairness, beneficence, and respect for humans are all examples of ethical considerations that were observed during a study (Creswell 2013).

Before the commencement of the research, a meeting was to help the local leaders and the extension officer to gain access to the community and as well to provide a detailed description of the research that was conducted. Written consent was given to the researcher by the Department of Agriculture (APPENDIX A) The participants were told that the study was voluntary and that they could withdraw at any time. There was no discrimination or obscene language used in the questionnaires. The recommendations and findings of the study will be presented to the extension officer after the completion of the study.

3.12. Summary

This chapter provided an overview of the study area, research design, sample techniques used and how data was collected and treated. Data were collected from 120 households. The focus of the is chapter was on the research topic: What impact does climate change have on community garden crop production and determining the food security status of households. Data collection focused mainly on the community garden participants and was conducted using questionnaires, focused group discussions and key informative interviews. These were done to compare the responses of the participants in different settings. The key informative interviews and focused group discussions allowed the researcher to find out information about sensitive issues that could not have been answered in the questionnaire that only comprised of closed-ended questions. The findings of the study were discussed in detail in chapter 4.

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CHAPTER 4: RESULTS AND DISCUSSIONS

The study aimed to investigate the effect of climate change on community garden crop production and the farmers' household food security.The study had 120 participants that participated. Questionnaires, focus group discussions, and key informative interviews were employed to collect data. The Household Food Insecurity Access Scale (HFIAS) was used to determine the households' level of food security. This section summarises the study's findings. This study examined three research questions:

- What are the surveyed households' general characteristics, farmers' knowledge, perceptions, behaviour, and attitude of climate change and its shocks?
- What is the effect of community gardening on the household food security status of the farmers?
- What are the interventions and measures taken by the local municipality to mitigate the impacts of climate change?

4.1. Demographics Of The Surveyed Households

As shown in Table 4.1, the majority of respondents (64.2 %) were female, whereas the minority of respondents were male (35.8%). Women play many roles in their daily lives, they are tasked to take care of their families, provide nutritious meals and they also part take in small scale agriculture to provide for their families. It was noted that 42.5% of the respondents were single, whereas 0.8% were either divorced or cohabiting with a partner. Only 30% of the respondents were married, while 25.8% were widowed. Since the majority of the population were single this indicated that they had added pressure to solely support their households. This negatively impacted their safety nets and as a result impacted their household food security status. The majority 91.7% of the surveyed population was African, accounting for the majority of the population; 4.2% were white; 3.3% were coloured; and the minority of 0.8%were Indian.

As seen in Table 4.1, just 2.5% of the population received postsecondary education or more, 16.7% received no formal education, and 38.3% received secondary education. By contrast, the majority of the population, 42,5%, had only completed primary school. The lack of adequate education negatively impacts employment opportunities, therefore impacting the quality of life for the individual (Misselhorn *et al.,* 2012). Since the majority of the population surveyed obtained only primary level education, they were not able to gain employment, which impacted the household income adversely and lead to food insecurity becoming prevalent in their households.

Table 4. 1. Household demographics of the surveyed households, 2021

Participants	Number (n)	(%)
N=120		
Gender		
Male	43	35.8
Female	77	64.2
Marital status		
Single	51	42.5
Married	36	30
Divorced	1	0.8
Widowed	31	25.8
Living with partner	1	0.8
Ethnic group		
White	5	4.2
African	110	91.7
Indian	1	0.8
Coloured	4	3.3
Highest education level		
No formal training	20	16.7
Primary	51	42.5
Secondary	46	38.3
Tertiary & above	3	2.5

A seen in figure 4.1, The respondents ranged in age from 18 to 79 years. The most often polled age group was 28. This indicates that the majority of the surveyed population were young adults, and therefore, , they were in an active economic age. The reason for them being unemployed stems from the lack of job opportunities in the area.The reason of the unemployment stems from the lack of job opportunities and therefore causes a spike in food insecurity (Kimani-Murage *et al*.,2014).

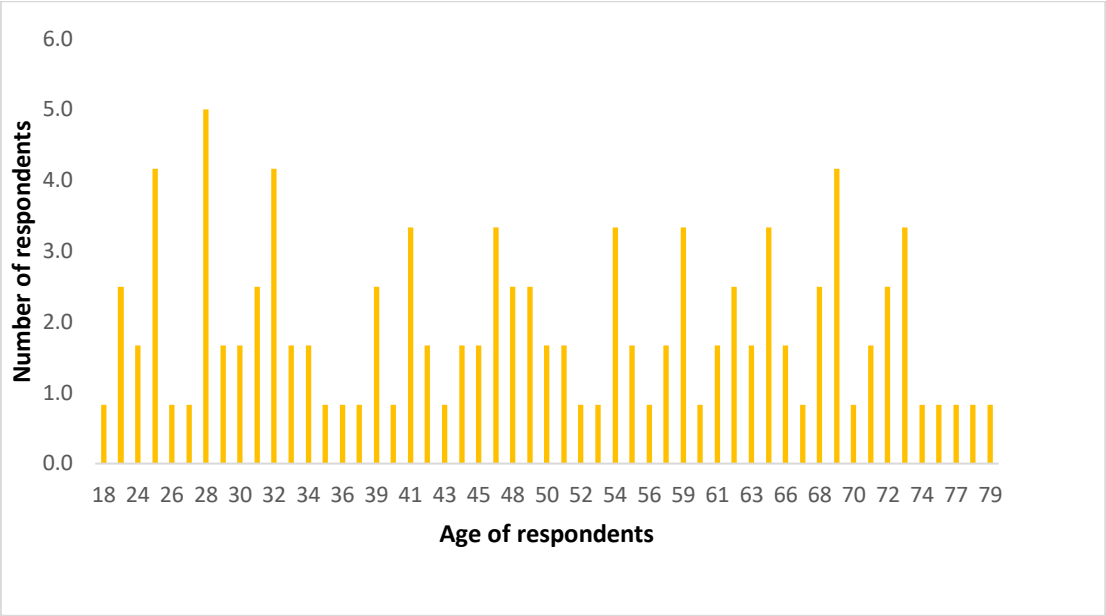

Figure 4. 1: Age of the respondents in the surveyed population.

The number of household members varied between one and sixteen, and the average household consisted of five members, as illustrated in Figure 4.2. The large household sizes make it difficult to provide sufficient food that is of nutritious value to all household members. Therefore, many of the respondents participated in small-scale agriculture to provide a source of nutritious food for their households. Small scale agriculture offers an opportunity for households that have large household sizes to become resilient to food insecurity (Regassa, 2011).

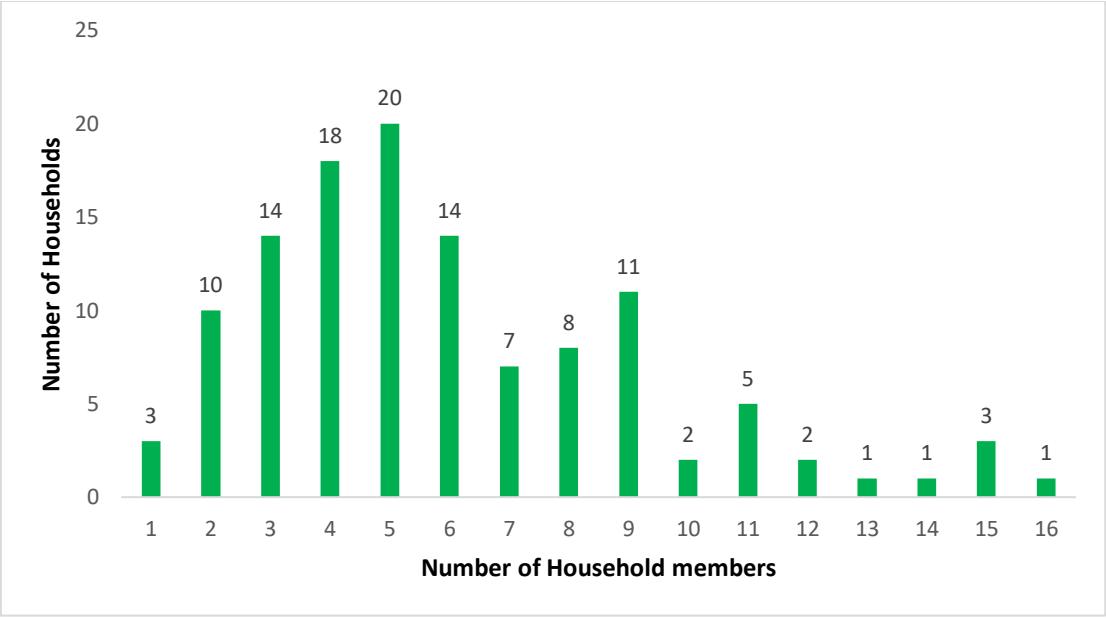

Figure 4. 2: Number of household members in the surveyed households.

In South Africa, households receive social grants from the government, which assist them in maintaining a consistent monthly income. These social grants range from grants for the elderly,

disabled, and care-dependent (R 1890) to child support grants (R460). Women over the age of 60 years and men over the age of 65 years are eligible for old age grants. Children get the child support grant until they reach the age of 18. These subsidies serve as a safety net for families (Sinyolo *et al.*, 2016). As seen in Table 4.2, approximately 80.8% of the studied population received social grants, whereas 19.2% did not receive any type of grant from the government.

Table 4. 2. Does the household collect social grants of the surveyed households, 2021

Participants	Number (n)	(%)
N=120		
	Does your household collect any social grant	
Yes	97	80.8
No	23	19.2

According to the research participants' responses, the following figure 4.3 below depicts the breakdown of grants received. The most prevalent type of social grant received by respondents (42.9%) was child support. Following that, (41.8%) of respondents receive old age grants, (10.6%) receive disability grants, (4.7%) receive care dependence grants, and none of the respondents receives a grant in aid as specified in figure 4.3. These types of grants received by the citizens help alleviate the impacts of poverty and food insecurity (Chakona & Shackleton, 2019). The grants received helped to purchase nutritious value food, payment of household expenses such as school fees, clothing, and other necessities. As indicated by the respondents the grants received helped to purchase nutritious value food, payment of household expenses such as school fees, clothing, and other necessities.

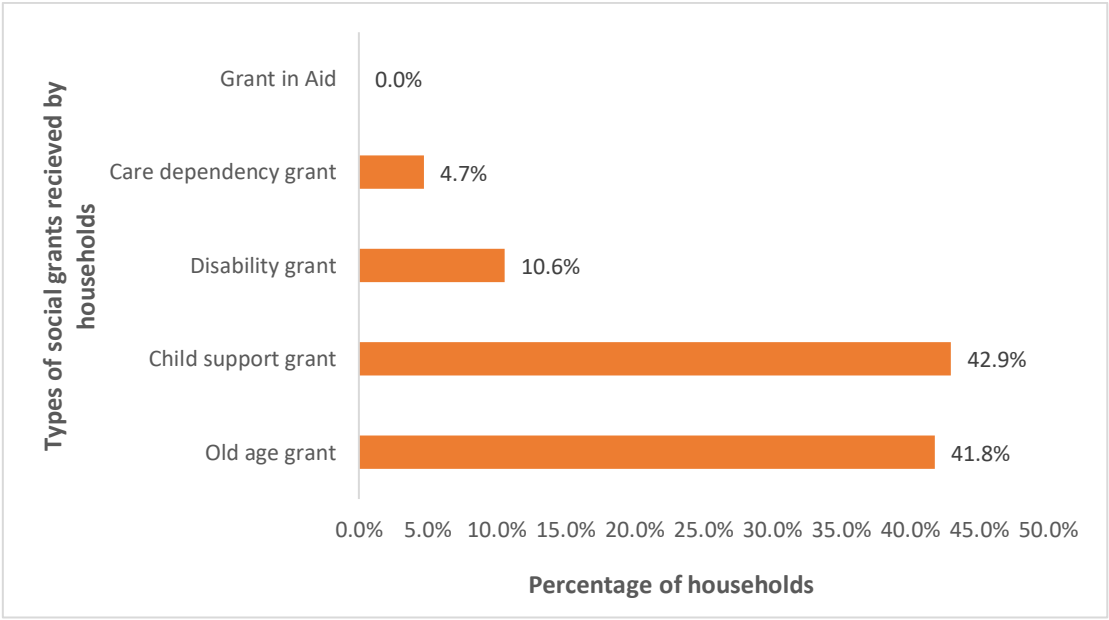

Figure 4. 3:Types of Social grants Received by the surveyed households.

The majority of South Africans live below the country's poverty level of R992 a month (Statistics SA, 2019). The primary reason for this is unemployment. Unemployment results from inadequate education, an increase in demand for employment opportunities due to population growth, and weak economic growth (Cloete, 2015). As indicated by Table 4.3, the surveyed population is dominated by unemployed respondents (79.2%) of the population. According to the focused group discussion (FGDs), the lack of employment opportunities negatively affects the lack of employment opportunities, negatively affects supply of food in the households, and hindered the quality and quantity of food consumed. This high unemployment rate could indicate that their food security status was compromised and that members of the household could have gone to bed hungry. Therefore, the majority (36.7%) relied on social grants as their main source of income. 31.7% of the population did not receive any source of income, which indicates that they were vulnerable to shocks and stressors. (9.2%) received income from part-time employment, (0.8%) gained income from full-time employment. This indicates that the minority of the population were resilient to the shocks and stressors.

According to Table 4.3, a total of (69.1%) of the population earned between R2001-R5000 a month. This is concerning as the average food basket to feed a family of 4 costs R3486.23 a month, and the households surveyed have an average of five members per household. As a result of the lack of income, the households are vulnerable to become food insecure and therefore they partake in small scale agriculture such as community gardens to close the gap that is caused by insufficient income. 3.3% of the population earn less than R500 per month which makes them the most vulnerable households. This could cause the health of the household members to be compromised. By not ingesting sufficient healthy food, a person's ability to do daily duties is lowered substantially (Martin *et al*., 2013).

Income was also earned through social grants; as shown in Table 4.3. Social grants earned per month ranged from less than R500 to more than R5000. The Majority (13.3%) of respondents gained income from social grants that ranged between R1501-R2000 a month. Social grants are seen as a primary income source in rural households, this is due to the lack of education and the high levels of poverty that is prevalent (Mkhawani *et al*., 2016). The social grants also provide a safety net for rural households to purchase the basic food supplies for the household. This helps to reduce the level of food insecurity experienced by the household.

The average food basket cost R3486.23, which increased by 13.7% from the previous years (Statistics SA, 2020). The Majority of the surveyed population's monthly income ranged between (R2001-R2500). This, therefore, indicates that the respondents cannot afford the basic food basket. By not

being able to afford the basic food basket, the respondents experienced difficulties feeding their family members. As a result, they rely on social grants, which was the surveyed respondents' principal source of income. This ranged between R1500-R2000 per month for the majority of respondents. Therefore, they partook in other activities such as farming to compensate for the lack of income. Community food gardens provide a source of food for these households. Additionally, it provides nutritious food and contributes to their household's food security (Shisanya, 2008).

During the focus group discussion (FDGs), respondents stated that their primary concern about their food supply is a lack of income, which restricts their food choices and household food security status. Food choices are restricted in households that experience poverty, as the households prioritize quantity over quality of food (Leroy *et al.,* 2015). This ensures that all household members have food, so the nutritional value of the food is compromised (Floro & Swain, 2013). The increase in food prices, distance to stores, and large household sizes contributes to reducing the amount of food consumed by household members. The increase in food prices intensifies poverty and food insecurity among rural households (Kubik & May 2018). As stated by Verpoorten *et al*., (2013) the increase in the living cost per household adds stress to the household, as the largest proportion of the income is used to purchase food for the household

Table 4. 3. Employment, Occupation, Monthly Income Status from employment and social grants of the surveyed households, 2021

Current Employment status		
	(n)	**%**
Employed	25	20.8
Unemployed	95	79.2
Occupation of respondent		
	(n)	**%**
Unemployed	38	31.7
Full-time employment	1	0.8
Part-time employment	11	9.2
Social grants	44	36.7
Housewife	3	2.5
Farming	21	17.5
Housekeeper	1	0.8
Own enterprise	1	0.8
Other (specify)	0	0
Total monthly income for the Household (ZAR)		
	(n)	**%**
<500	4	3.3
1000-1500	10	8.3
1501-2000	13	10.8
2001-2500	18	15.0
2501-3000	16	13.3
3001-3500	14	11.7
3501-4000	13	10.8
4001-4500	9	7.5
4501-5000	13	10.8
>5000	10	8.3
Total Monthly income received from social grants for the Household (ZAR)		
	(n)	**%**
<500	6	5.0
1000-1500	10	8.3
1501-2000	16	13.3
2001-2500	14	11.7
2501-3000	14	11.7
3001-3500	11	9.2
3501-4000	7	5.8
4001-4500	6	5.0
4501-5000	9	7.5
>5000	6	5.0

4.2. Farmers' Knowledge, Perceptions, Behaviour, and Attitude of Climate Change and its Shocks

Understanding local perceptions and adaptive behaviour enable policymakers to make more informed decisions about how to solve the challenge of agricultural development in unpredictable and uncertain environments (Simane *et al.* 2016). A larger proportion of the respondents (82.5 %) had heard about climate change, whilst (17.5 %) had not heard about climate change. It is integral for all farmers to know about climate change, to help them implement effective measures to mitigate the impact on their crops (Woods *et al*., 2017). By implementing effective measures, the farmers will have healthy crops and they will be able to contribute to the food security status of their community garden members households.

According to table 4.4, 38.3 % of the surveyed population comprehended the meaning of climate change, 7.5% did not, 39.2% knew to some extent, 5.0% did not know, and 10.0% did not know what climate change was. The majority of the population (71.7%) had agreed that global warming has occurred, 3.3% said that global warming has not happened, and 25% were uncertain about global warming. The Majority (74.2%) of the surveyed population had indicated that global warming has occurred in their local region. In comparison, 3.3% said it had not happened, and 22.5% of the population were uncertain. Understanding climate variability is vital as it allows the farmer to identify changes in rainfall patterns and production risk (Wood *et al.,* 2014). The respondents understood climate change and global warming to be change in rainfall patterns and the weather in the area over a period of time.

22.5% of the respondents indicated that climate change had no impact on them. 10.5% noted that it would have a positive effect on them. In comparison, 63.3% acknowledged that climate change would have a negative impact on them. 3.3% of the respondents indicated that climate change would have both a positive and negative effect on them as stipulated by table 4.4. The farmers need to understand how climate change can disrupt their food supply and quality of food as it negatively impacts their food security status (Connolly-Boutin & Smit, 2016). During the focused group discussions (FDGs) the respondents had indicated that the conduction of a workshop on climate change would benefit them and help them improve their crop production. By equipping them with comprehensive knowledge, skills, and inputs, the farmers would become resilient to climate change on their crops.

Table 4. 4. Knowledge about climate change of the surveyed households, 2021

Participants	Number **(n)**	**(%)**
N=120		
Have you heard of what 'climate change' means from any source?		
Yes	99	82.5
No	21	17.5
Would you say you understood what climate change means?		
Yes	46	38.3
No	9	7.5
To some extent	47	39.2
Not really	6	5.0
I don't know	12	10.0
Do you think that global warming has already occurred?		
Yes	86	71.7
No	4	3.3
Uncertain	30	25.0
Has climate change happened in your local region?		
Yes	89	74.2
No	4	3.3
Uncertain	27	22.5
What kind of impacts climate change will on us?		
None	27	22.5
Positive effects	13	10.8
Negative effects	76	63.3
Both positive and negative effects	4	3.3

Increased temperatures increase heat exhaustion and infectious diseases; diseases in crops and water contribute to poverty and unemployment (Woodword *et al.*, 2014). As illustrated in Figure 4.4, the most prevalent type of climatic change observed in the region was the change in rainfall patterns (42.2 %), followed by excessive heat (335 %) and excessive cold (7.5 %). (16.2%) of the participants had no idea of the previous climate changes that occurred in the region. (0.6%) had reported that waterlogging remained experienced. There were no events of frequent flooding that was observed in the region by the respondents.

As recorded by the focused group discussion (FDGs) the increase in temperature and shortage of water affects the way that meals are prepared and causes a shortage of food in the households. The increase in temperature causes the air to be warmer, therefore in warmer conditions water evaporates faster from surfaces. The occurrence of extreme weather events such as droughts causes a shortage in the water supply (Verpoorten *et al.*, 2013). This, therefore, limits the water supply of households and as a result to save water, water is reused, and the amount of water used to irrigate crops is reduced. This causes the quality of the crop to be reduced (Hanjra *et al.*, 2012).

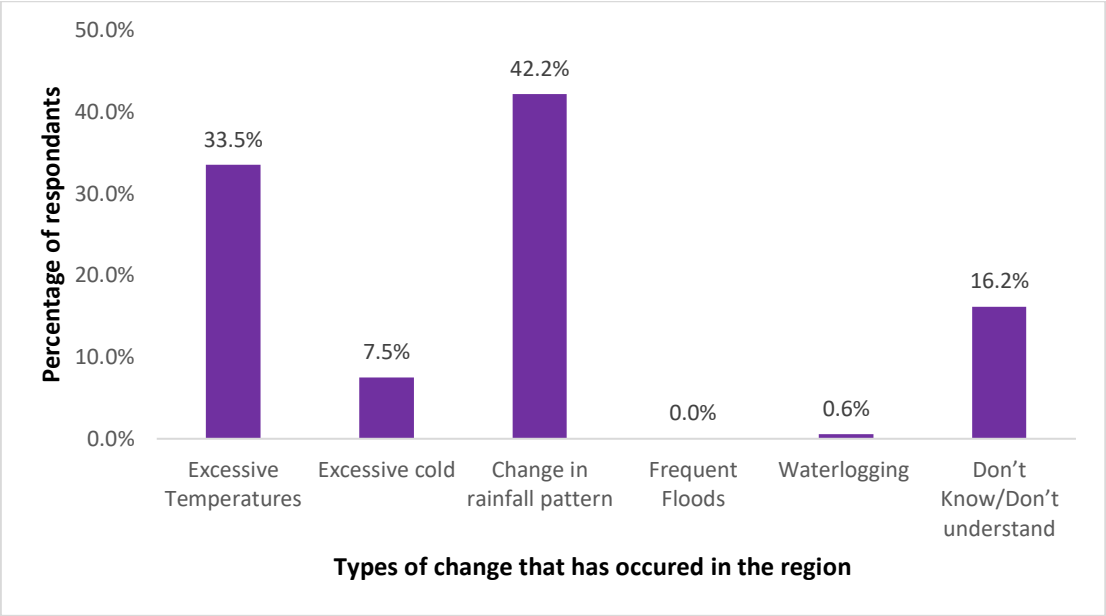

Figure 4. 4: Types of Change in a climate that has occurred in the respondent's region.

The primary information source on climate change for the respondents is the radio (26.7%) as illustrated by figure 4.5, followed by the television (15.0%) and the newspaper (10.0%). 0.8%, which is the least number of respondents gain their information from weekly magazines, which could be because not many of the households have the finances to purchase televisions, weekly newspapers, etc. (Spaull, 2015). The radio is the main source of information as it was affordable and does not use up a lot of electricity. The main language spoken by the locals were IsiZulu, radios consist of many frequencies in IsiZulu therefore it is easier for the respondents to understand (Jiyane *et al.*, 2012). The television is seen as a luxury item and many of the respondents could not afford it. The shops are at a distance and require transport to get there as a result weekly magazines and newspapers are not readily available.

Around 2.5% of the information is gained from human interaction and involvement with the environment. Around 9.2% of the population obtained information from teachers, 5.8% from Non-Governmental Organisations (NGO) employees, and 4.2% from extension officers. As many of the respondents lack adequate education they are not exposed to environmental protection programs.

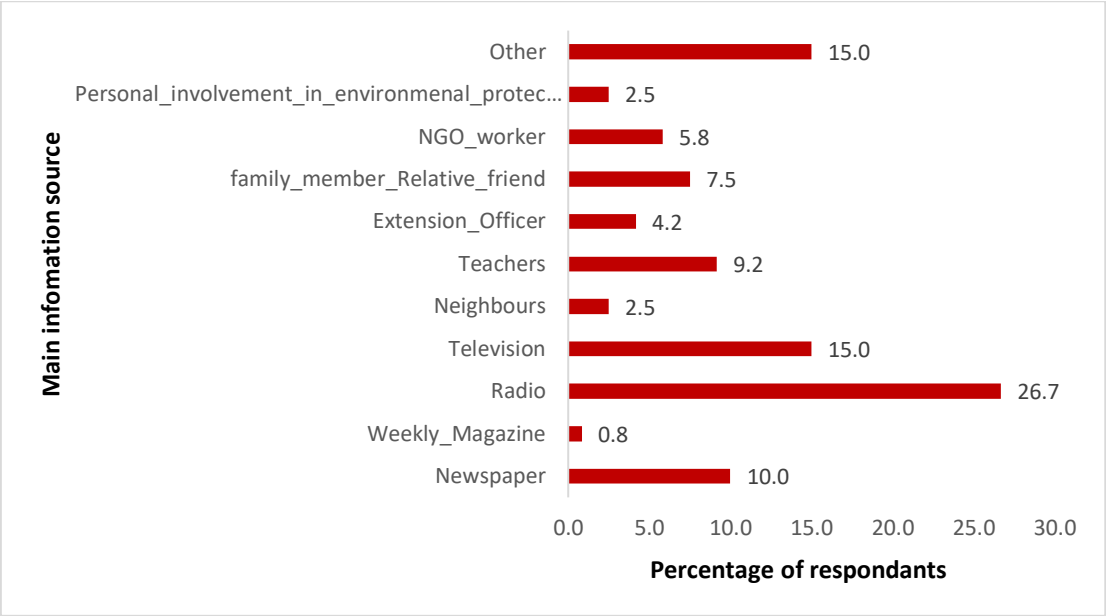

Figure 4. 5: Main information source on climate change of respondents.

There was an array of reasons and cause for climate change that the respondents acknowledged as per figure 4.6 below. The leading cause for climate change by the respondents was God (19.3%), followed by excessive carbon emissions by the developed country (18.5%) and population growth (18.5%). The reasoning behind why the majority of the respondents indicated that God was the leading cause of climate change, was because of their belief system and religious perspectives. As the majority were Christian, they had indicated that it is stated in the bible that there would be an end time and they feel that climate change is an indication of the end time (Tambo, & Abdoulaye, 2013). As per the Focused Group Discussion, the respondents indicated that God is the creator and therefore the effects of climate change are caused by God himself. This perspective about God being the reason for climate change was observed by the older generation who are very religious.

(13.4%) indicated that the cause for climate change is rapid urbanization, (12.6%) said the reason was industrial effluents, (12.2%) specified that deforestation caused climate change. The above changes were noticed by the younger generation as observed by the researcher. (5.5%) did not know what caused climate change, which indicates that there need to be climate change awareness campaigns in the community.

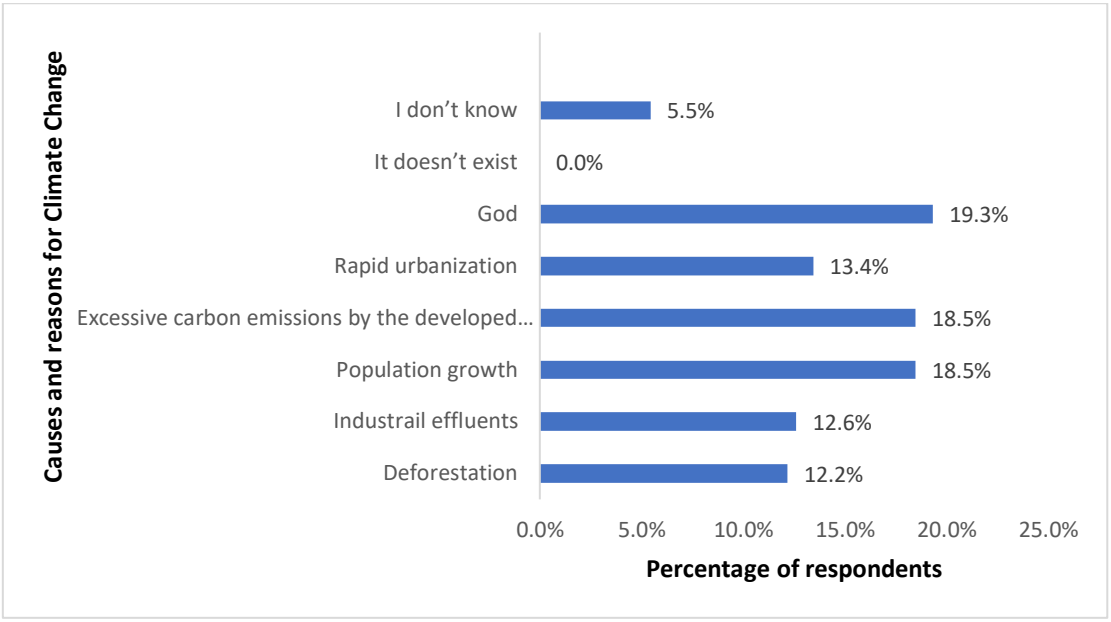

Figure 4. 6:Causes and reasons for climate change by respondents

According to Table: 4.5, 92.5% indicated an increase of drought episodes during the last decade, 2.5% stated it was unchanging, and 5.0% reported no change. The majority of 95.8% saw change in rainfall patterns in the previous ten years. The changes noticed was that less rainfall had occurred over the years and there was a drought experienced in the area. The increase in droughtepisodes reduces the amount of water available and as a result affects crop production negatively (Fahad *et al.*,2017). This causes an upsurge in food insecurity experienced by households.

29.2 % indicated a change in seawater level in the last ten years, 3.3% said it was unchangeable, and 67.5% did not see it. 24.2 % noticed Increased salinity of water in the previous ten years,3.3% said 'It was steadfast', and 72.5% did not notice. The respondents claimed that they detected a difference in the taste of the water over the years as it tasted more saltier than previous years.

17.5 % agreed on increased health risk due to increased salinity, 7.5% said unchangeable, and 75.0% said they did not see. 93.3.% said reduced food crop production in the last ten years, 0.8% said unchangeable, and 5.8% didn't notice, as noted in table 4.5.The reduction of the food crop was noticed as the amount of crop that was produced reduced due to the fact that crop was lost due to weather conditions, pest and diseases. The most noticed changes that the respondents reported were the change in rainfall patterns, reduced food crops, and droughts. This was visible to the respondents as those formed a part of their needs daily. Changes in rainfall patterns result in a shift in agricultural planting seasons, which has a detrimental effect on households' food security (Connolly-Boutin & Smit, 2016). The majority of farmers lacked in-depth knowledge of climate change and its implications, which resulted in crop loss and vulnerability. Given this complexity, understanding climate change, its

effects, and potential responses necessitate the synthesis of information from diverse fields of the social, physical, biological, health, and engineering sciences.

Table 4. 5. Perceptions of climate change by respondents of the surveyed households, 2021 (1)

Has there been:		Yes	Unchanged/Not applicable	Did not notice
Increased episode of drought in the last 10 years	(n)	11	3	6
	%	92.5	2.5	5.0
Change in rainfall pattern in the last 10 years	(n)	115	2	3
	%	95.8	1.7	2.5
Change in seawater level in the last 10 years	(n)	35	4	81
	%	29.2	3.3	67.5
Increased salinity of water in the last 10 years	(n)	29	4	87
	%	24.2	3.3	72.5
Increased health risk due to an increase in salinity	(n)	21	9	90
	%	17.5	7.5	75.0
Reduced food crop production in the last 10 years	(n)	112	1	7
	%	93.3	0.8	5.8

Perceptions vary from individuals and depend on the knowledge of the individual. As indicated in table 4.6. below, 74.2% of the surveyed population strongly agree that climate change occurs, 15.8% agree, 7.5% neither agree nor disagree 25% disagree that climate change is happening. The changes in climate change that were noticed by the repondants was the change in the rainfall patterns, increase in the presence of pest and diseases, and the change in the growth of crops. The pest that were noticed were army worms, locust and whte butterflies which cause the leaves of the plants to get damaged and thus leading to loss of crops. The diseases that were noticed was blight and rust which affects the crops such as brinjal, spinach and green beans. This diseases affect the leaves of the plants therefore causing stunted growth in plants which destroys the plants. As indicated by Rosenzweig *et al*. (2001) the rising temperature and rise in extreme events lead to an increase in diseases, pests, and weeds that can destroy crops and reduce the amount of food produced by the country. This was relevant to the findings of this study.

39.2% strongly agree that Human activity is responsible for climate change, 18.3% agree, 20.0% neither agree nor disagree, 17.5% disagree, and 5.0% strongly disagree that human activity is

responsible for climate change. As indicated by studies human activity such as deforestation, burning of fossil fuels and livestock farming causes high amounts of greenhouse gases that increase the greenhouse effect and the warming of the globe (Latake *et al.,* 2015.).

36.7% strongly agree that every individual can do something to adapt to climate change 18.3% agree, 21.7% neither agree nor disagree, 18.3% disagree, and 5.0% strongly disagree. 14.2% strongly agree. Farmers can plant new crops that will grow in abundance under the current weather conditions (Lamichhane *et al.,* 2015.). They can also seek help from the extension officer on how to overcome these challenges. The focus should not only be on increasing understanding, but also on informing solutions to problems at the local, regional, national, and global levels.

Climate change has been occurring naturally on earth which has been geologically recorded, however, these natural changes are accelerated by human activities (Trenberth, 2018). Natural changes in the environment are responsible for climate change 9.2% of the respondents agree, 23.3% neither agree nor disagree, 40.0% disagree, and 13.3% strongly disagree.

The effects of climate change intensify events such as poverty and inequality. Many of the diseases that are present are derived from climate change therefore climate change will have a negative impact on future generations (Mondal & Sanaul, 2019). 72.5% strongly agree climate change can reduce the quality of life for future generations 9.2% agree, 10% neither agree nor disagree, 5.8% disagree, and 2.5% strongly disagree.

Table 4. 6. Perceptions of climate change by respondents of the surveyed households, 2021 (2)

Has there been:		Strongly agree	Agree	Neither agree nor disagree/ unsure	Disagree	Strongly disagree
Climate change is occurring	Number	89	19	9	3	0
	%	74.2	15.8	7.5	2.5	0
Human activity is responsible for climate change	Number	47	22	24	21	6
	%	39.2	18.3	20.0	17.5	5.0
Every individual can do something to adapt to climate change	Number	44	22	26	22	6
	%	36.7	18.3	21.7	18.3	5.0
Natural changes in the environment are responsible for climate change	Number	17	11	28	48	16
	%	14.2	9.2	23.3	40.0	13.3
Climate change can reduce the quality of life for future generations	Number	87	11	12	7	3
	%	72.5	9.2	10.0	5.8	2.5

Behaviour towards climate change is important, as by reducing travel and activities that produce large amounts of greenhouse gases the effects of climate change can be reduced (Latake *et al.*, 2015). As indicated by Table 4.7, 43.3%, which was the majority of the participants, felt that it is possible to avoid climate change. 25.8% thought it could not be avoided, 21.7% could not explain clearly, and 9.2% thought climate change could be avoided by mitigating climate effect on humans through the endeavour.

57.5% were willing to join actual efforts to reduce climate change, while 23.3% said ‘no’ and 19.2% were uncertain. The willingness of the majority indicates that there should be efforts put in by NGOs and the extensions officers to educate the community about climate change.

Although the majority of the surveyed population were willing to join efforts to reduce climate change, they were not keen on sacrificing their benefits to solve existing problems. 30% were very keen to sacrifice their benefits to solve existing problems, 27.5% were not very willing, and 42.5%, which were the Bulk were not keen at all. As many of the participants were not eager to sacrifice their benefits to solve existing problems, workshops and presentations need to be conducted to show them how to reduce the impacts of climate change and improve the livelihoods of future generations.

The Bulk (84.2%) of the respondents did not participate in environmental protection activities related to climate change, and 15.8% did experience. 44.2% of the surveyed population did not know anyone that had taken any action to adapt or cope with climate change, 15.8% knew somebody, and 40.0% responded no, as seen in table 4.7. Education is proven to be vital for the response to climate change globally (Hamilton, 2011). By educating the masses the issue of climate change will be understood and the impacts can be addressed.

Climate change negatively affects all four pillars of food security: availability, accessibility, utilization, and stability (Masipa, 2017). It affects availability as crop production is reduced, food becomes less accessible as the prices increase, the supply of food becomes unstable as crops are affected by climate change and experience changes such as stunted growth and the presence of pests and diseases. The quality of food consumed is compromised as households purchase cheaper food that does not provide nutritional value to the household members.

Table 4. 7. Behaviour towards climate change by respondents of the surveyed households, 2021

Participants N=120	**(n)**	**(%)**
Can climate change be avoided?		
Absolutely possible	52	43.3
Mitigate climate effect on	11	9.2
humans through endeavour	31	25.8
Can not	26	21.7
Unable to explain clearly		
If someone called for, whether you would like to join the actual efforts to mitigate climate change?		
Yes	69	57.5
No	28	23.3
Uncertain	23	19.2
Are you willing to sacrifice some individual benefits to solve existing problems?		
Very willing	36	30
Not very willing	33	27.5
Not at all willing	51	42.5
Did you participate in some environmental protection activities related to climate change?		
Yes	19	15.8
No	101	84.2
Have you or anyone you know taken any actions to adapt/cope to climate change?		
Yes	19	15.8
No	48	40.0
I don't know	53	44.2

The crisis of climate change triggers many feelings that are mostly associated with fear (Reser & Swim, 2011), this was evident in the study as the majority of the respondents (31.7%) felt afraid and

fearful about climate change. This feeling is known as eco-anxiety or climate grief (Panu, 2020). This feeling was centred around the fact that they were scared about how it was going to affect their incomes and the supply of food in their households.

As per the finding illustrated in figure 4.7 the majority (14.2%) of the respondents were hopeful that changes can be made to slow down the effect of climate change. These changes ranged from reducing our carbon footprint and to using our natural resources sparingly. The minority of (1.7%) did not believe that climate change existed, this could be due to the lack of education or religious beliefs. The respondents feelings were an indication of their perspectives and these perspectives could have also beeb influenced by their circumstances.

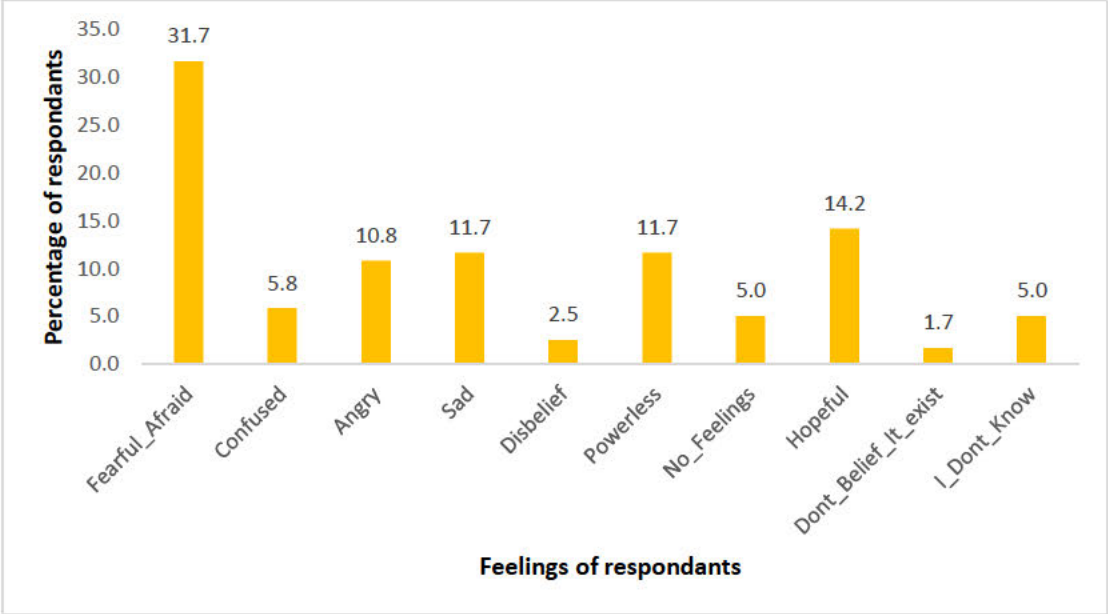

Figure 4. 7: Feelings about climate change by respondents.

As per table 4.8. (62.5%) of the population surveyed were willing to learn more about climate change, (25.8%) said 'no', (6.7%) didn't mind, and (5.0%) were not sure if they wanted to learn about climate change. The participants indicated in the focused group discussions that they were concerned about climate change as it brought about changes in the weather patterns which in return affected the growth of their crops. They stated that due to climate change damage on the crops, it is futile for them to plant as climate change brings upon droughts, floods, diseases, and pests. Therefore, by them understanding climate change and ways to mitigate climate change they can overcome the challenges faced by climate change. As per Librizzi (2017), climate change and community gardens have a symbiotic relationship. If climate change grows the impact on community gardens becomes more severe and negatively impacts the food security status. Therefore, everyone needs to be willing to

learn about climate change and make small positive changes to mitigate the challenges faced with climate change.

The key informants expressed that climate change has a range of consequences on agriculture such as:

- Climate change causes a significant impact on the farmer's produce, as the influx of the region's temperatures generates a low yield of the crop.
- It affects crop rotation and planting methods.
- Watering/ irrigation becomes uncertain due to the unreliability of rain.
- The product's quality and quantity affect the partnership with the markets as the product is inferior and results in less income.
- The seasons have changed as a result. During winter, the season for vegetables whereby farmers had to control irrigation by themselves, nowadays heavy rains are present, and scorching conditions exist, which destroys the quality of plants and the harvest.

Table 4. 8. Attitude towards climate change by respondents of the surveyed households, 2021

Participants N=120	**Number**	**(%)**
6.2. **Would you like to learn more about climate change?**		
Yes	75	62.5
No	31	25.8
I don't mind	8	6.7
Not sure	6	5.0

As illustrated by figure 4.8, the number of participants in the community gardens surveyed ranged from 2 - 12 participants. Most of the gardens (25.0%) consisted of six participants. (15.0%) had 7 and eight participants. (12.5%) of the gardens had four participants and (10.0%) had 12 participants? (3.3%) of the gardens had two participants in community gardens that have a large number of participants indicates that the income earned from the surplus sales are reduced. The surplus help increases their household income and helps them gradually to become resistant to food insecurity (Galhena *et al*., 2013).

4.3. The Effect Of Community Gardening On The Household Food Security Status Of The Farmers

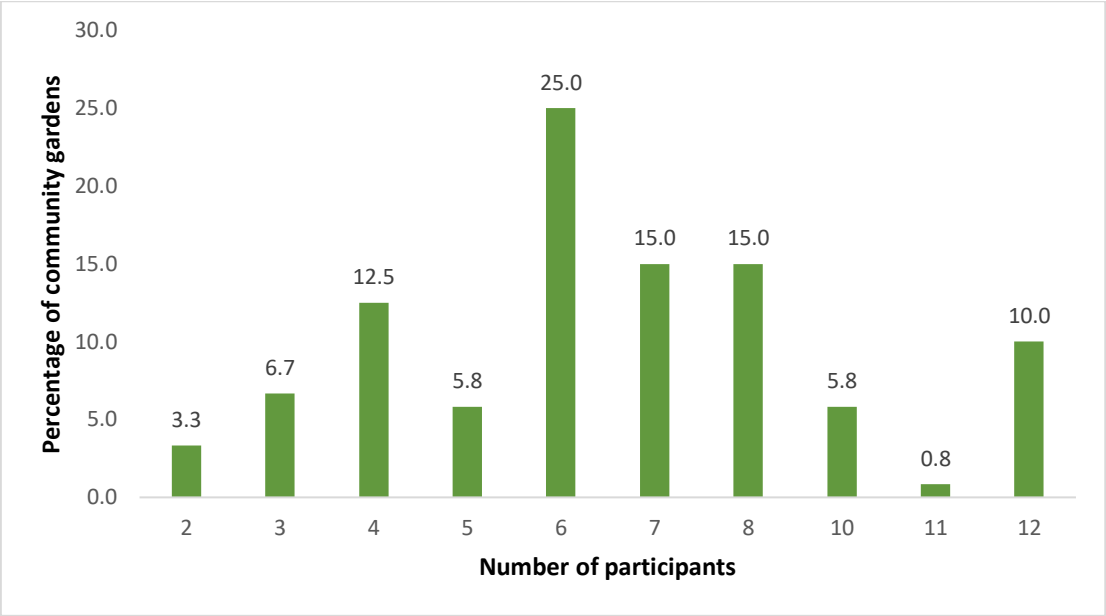

Figure 4. 8: The number of participants in community gardens.

The size of a community garden indicates the number of crops that can be planted; therefore fewer crops can be planted in smaller gardens. It is advised that smaller gardens should plant crops that have a short growing period so that they can harvest more often to ensure a supply of food (Eigenbrod & Gruda, 2015). The size of the community gardens ranged from 1 - 6 hectares. The Majority of the gardens were two hectares for (45.8%) of the respondents. 40.0% had 1 hector. (8.3%) were allocated three hectares, (3.3.%) had four hectares, and (1.7%) had six hectares. (0.8%) had 0.5 hectares of land, as presented by figure 4.9. The crops produced from the land helps to improve the food security status of the households. Crops such as maize and beans are dried and stored for use during the winter months when it is difficult to grow crops. Therefore Community gardens help provide food for the entire year to these households.

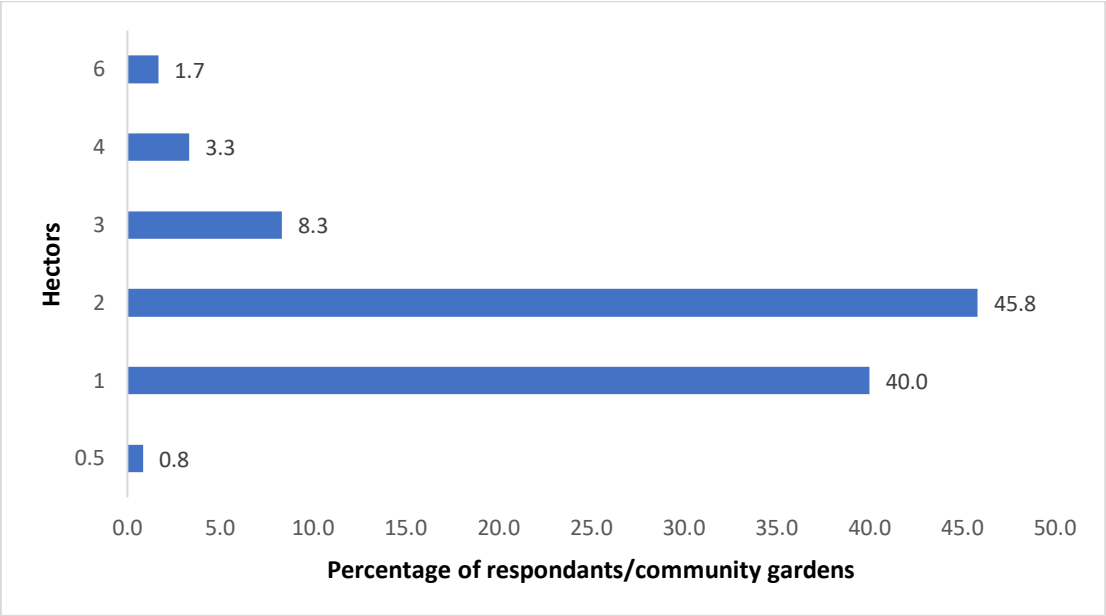

Figure 4. 9: Size in hectors of community gardens.

Irrigation is vital for the survival of crops as it is essential for the development and the growth of the plants (Azanu *et al*., 2016*)*. 29.2% of the community gardens were watered three times a week, 27.5% were irrigated two times a week. 19.2% irrigated one time a week, 10.8% irrigated seven days a week, 9.2% irrigated five times, and 4.2% irrigated four times a week as per figure 4.10. Due to the lack of financial inputs, the irrigation per week is reduced in the community gardens. If crops are not irrigated sufficiently it could result in stunted growth and damage of crops, this would negatively affect the food security status of the households (Chijioke *et al.*, 2011). Therefore the lack of irrigation affects the stability pillar of food security for the community garden members households.

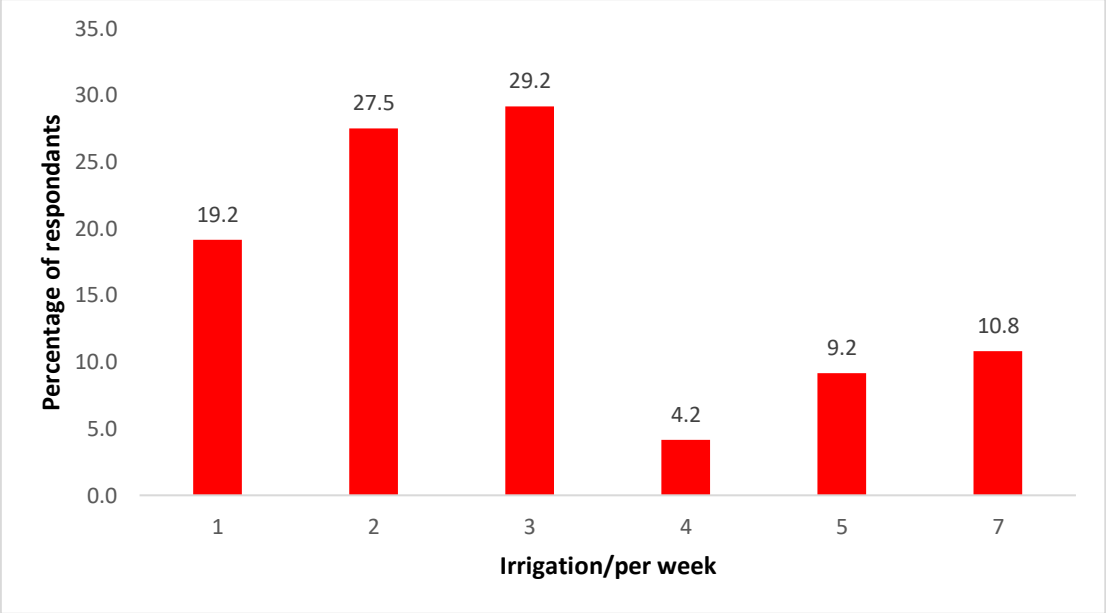

Figure 4. 10: How often per week is the crop irrigated in the community gardens.

As indicated by table 4.9 (78.3%) of the respondents indicated that the extension officer visits them frequently, and (21.7%) said that the visits were not frequent. The visits by the extension officers help the farmers, as the extension officers provide feedback on their farming methods and assist them with ways to mitigate issues that they may face in their community gardens.

The use of fertilizer and manure helps the plants gain nutrients that are needed and help the crop be healthy (Ndambi, *et al.*, 2019). The community gardens of ward 18, Umdoni municipality, use fertilizer and manure in their gardens. (88.3%) of the gardens use fertilizer in their crops while (11.7%) do not use fertilizer. (80.0%) of the gardens use manure and (20%) do not use it. Fertilizers and manure help improve the soil quality for better crop production (Bedada *et al*., 2014)

The community garden's size is important as it must be able to accommodate all participants and supply adequate food to all participants (He & Zhu, 2018). (51.7%) of the respondents, most of the participants stated that the size of the garden was enough for their participants and (48.3%) said the size was not enough.

The Bulk (99.2%) of the surveyed population experienced loss of crops, and (0.8%) did not experience loss of crops. (10.0%) loss crop due to floods could be due to poor drainage, and the terrain of the community gardens and (90.0%) didn't. (62.9%) loss crop due to theft, and (30.8%) didn't lose the crop. The larger portion experienced theft due to the lack of fencing. (90.8%) loss crop due to pests and disease, and (9.2%) didn't lose crops. The onset of pests and diseases impacts climate change and is experienced by the Bulk of the gardens. Therefore, herbicides and pesticides are an extra cost to the gardens as the majority experience pest and diseases. The increase in pests affects the quality of the crops as the pest destroys the plants. The presence of diseases in crops and livestock can lead to the death of livestock and loss of crops; this, in return, affects the country's food production (Pereira, 2017).

(34.2%) loss crop due to drought and (65.8%) didn't, drought is not a major concern for the community gardens in ward 18, Umdoni municipality. Droughts are an effect of climate change; therefore, to mitigate this, drought-resistant crops should be planted (Ahmed *et al.*, 2013). (67.5%) loss crop due to livestock damage and (32.5%) didn't. Livestock damage is due to the gardens' inadequate fencing.

According to the key informant interviews, some of the problems that the community garden members experienced were, the onset of droughts that led to the absence of water for irrigation purposes, as this is fundamental for the production of good quality crops. The presence of wild pigs

and livestock causes damage to the crop in some areas. To mitigate this fencing is recommended however there is the unavailability of fencing infrastructure, planting inputs, and ploughing mechanisms. The onset of pests and diseases cripples the harvest.There is theft and lack of participation by all members of the garden that occurs in the community gardens. The is a problem with marketing their crops to gain additional surplus income. They have insufficient knowledge of the markets, and therefore the surplus is left to get rotten and is wasted. There is a lack of storage space for produce

Although community gardens aim to produce a good crop for the participants and their households (Meenar & Hoover,2012), the Majority (58.3%) of the respondents didn't receive enough food for their households from the community garden while (41.7%) received enough. (65.0%) of the surveyed gardens do not hire external help (25%) hire help very often and (14.2%) hire help not often. The hiring of external help adds extra cost to the community gardens, which in return reduces the income that the participants can gain from the community garden (Fox-Kämper *et al.*, 2018).

The key informants mentioned that the community gardens do produce enough food for the participants, particularly the households where each works in the gardens and takes the produce from the gardens to provide food for their households. It was mentioned that the participants eat the produce and to help alleviate the poverty they sell the surplus. The key informants response was based on the fact that they provide sufficient seedlings and seeds to the gardens to be food secure. The factors such as pest and the alck of water for irrigation was not taken into consideration. The gardens also allows them to consume fresh produce without buying it. However, as seen from the questionnaire many of the respondents said that they did not receive enough food from the community gardens.

Table 4. 9. Community garden information of the surveyed households, 2021

Participants N=120	Number	(%)
How often does the extension officer visit?		
Frequently.	94	78.3
Not frequently	26	21.7
Not at all	0	0
Do you use fertilizers in your community garden?		
Yes	106	88.3
No	14	11.7
Do you use manure in your garden?		
Yes	96	80.0
No	24	20.0
Is the size of your community garden enough for all your participants		
Yes	62	51.7
No	58	48.3
Do you experience loss of crop?		
Yes	119	99.2
No	1	0.8
Floods		
Yes	12	10.0
No	108	90.0
Theft		
Yes	83	69.2
No	37	30.8
Pest and disease		
Yes	109	90.8
No	11	9.2
Drought		
Yes	41	34.2
No	79	65.8
Livestock damage		
Yes	81	67.5
No	39	32.5
7.10.6. Does your household receive enough food from the community garden?		
Yes	50	41.7
No	70	58.3
How often do you hire external help for your garden		
Very often	25	20.8
Not often	17	14.2
Not at all	78	65.0

According to the focused group discussion the crops sold from the garden are used to reduce the financial strain on the households. The variety of crops planted in these community gardens help

families to consume nutritious food. The participants sell the surplus of the produce; therefore, they have financial gain to support their household's income, thus making them more food secure (Trefry *et al*., 2014). In agreement with Darby *et al*. (2020) community gardens are seen as an approach that is used to enhance the food security status at a household and community level.

As stipulated by table 4.10 the crops planted range from spinach to beetroot. The 3 most common crops planted by the community gardens are spinach. cabbage and onions. The least planted crops are brinjal and beetroot. Although the community gardens plant a variety of crops there are times in the year where it is very little to no crop. Therefore, with crops like maize and beans, the participants can dry them and store them to feed their households when there is no crop in the gardens

Table 4. 10. Crops planted in the surveyed Community garden, 2021

Crop	**spinach**	**tomatoes**	**potatoes**	**maize**	**Green beans**	**onion**	**cabbage**	**Carrots**	**Brinjal**	**Sweet potatoes**	**beetroot**
Number of community gardens that plant the crop.	7	3	2	2	3	5	6	2	1	3	1

4.4. Household Food Security Status

Many of the rural households in South Africa face food insecurity although the right to food is entrenched in the bill of rights in South Africa (FAO, 1996). As per the HFIAS survey carried out with the respondent's Majority (84.2%) of the surveyed population was food insecure and were concerned that their households did not have enough food to consume in the prior four weeks before the survey was conducted. (15.8%) of the respondents were food secure, which indicated that the household members had access to sufficient, safe and nutritious food to meet their dietary needs, as seen in table 4.11.

Table 4. 11.Food security status of the surveyed households, 2021

Food security status of respondents		
Participants N=120	**Number**	**(%)**
Food secure	19	15.8
Food insecure	101	84.2

The categorized HFIAS determines the difficulties associated with food access of a household. As recorded in table 4.12. (15.8%) The households surveyed were food secure, which indicated that they had an adequate supply of food that was of nutritional value to consume daily. (29.2%) of the surveyed households were mildly food insecure. The majority (40.0%) of the surveyed households

were moderately food insecure, which concluded that the household's quantity or quality was compromised due to lack of money to purchase food or age. The minority (15%) of the surveyed households were categorized as severely food insecure, which infers that the households missed meals and did not consume food for days or reduced their food intake.

As indicated in the focused group discussions the respondents indicated that the community gardens provide food to feed their families and the surplus is sold to gain an extra income in their households. This is not evident in the HFIAS as the majority of the households are moderately food insecure.

Table 4. 12. HFIAS status of the surveyed households, 2021

Food security status of respondents		
Participants N=120	**Number**	**(%)**
Food secure	19	15.8
Mildly food insecure	35	29.2
Moderately food insecure	48	40.0
Severely food insecure	18	15.0

The empirical results of the Poisson model, which estimated the impact of the community gardens on the food security status, are presented in table 4.13 below. The projected correlation between the outcome and selection errors is 0.22. we can reject the null hypothesis of zero correlation based on the Wald test. The positive (0.43) indicates that the unobservable factors that affect food insecurity status tend to occur with other unobservable factors that increase the food insecurity status experienced in the households. From the seventeen predictor variables fitted in this model, six predictor variables had a statistically significant influence on household food security.

Table 4. 13. Impact of community gardens on household food security

	Coef.	Std.Err.	P>z
Household food insecurity access scale			
Gender	0.001	0.150	0.994
Age3	-0.003	0.006	0.654
Education_Level	-0.130	0.131	0.320
Household_Head	-0.097	0.148	0.510
Household_Members	0.010	0.024	0.682
Ethnic_Group	-0.442	0.220	0.045**
Martial_Status	0.048	0.011	0.000***
Household_Monthly_Income	-0.011	0.029	0.693
Occupation	-0.133	0.037	0.000***
MANURE USE	-0.889	0.222	0.000***
FERTILIZER USE	-1.284	0.447	0.004***
Old_Age_Grant	-1.473	0.390	0.000***
Child_Support_Grant	0.237	0.534	0.657
Disability_Grant	0.069	0.401	0.864
Care_Dependency_Grant	-0.934	0.491	0.057*
Grant_In_Aid	-0.405	0.384	0.291
Climate change perception	0.133	0.049	0.007***
1.COMMGARDENS	-1.136	0.369	0.002***
Constant	4.129	0.728	0.000***
COMMGARDENS			
Access to extension visits	-0.595	0.335	0.075*
Constant	-0.453	0.137	0.001***
/athrho	0.227	0.346	0.512
/lnsigma	-0.626	0.150	0.000***
rho	0.223	0.328	
sigma	0.534	0.080	
Log pseudolikelihood	-426.45783		
Prob > chi2	0.000***		
Wald test of indep. eqns. (rho = 0)	0.43		

***Significant at 1% level, **Significant at 5% level, *Significant at 10% level

A positive association was anticipated since community gardening had the potential to alleviate household food insecurity by ensuring that food is always available and accessible (Thorman and Dhillon, 2021). The variable ***Commgardens*** is statistically significant at the 1% level (p=0.000) and had a negative association with food insecurity, which is in contrast to what is expected, with a beta coefficient (β) = -1.136 and an odds ratio (Exp (β)) =0.037. The model predicts that for a one-unit increase in community garden participation, the household would be 3.7% less be likely to be food

insecure while holding all other independent factors constant. This means that participation in community gardening results in a decrease in food insecurity and allows the household to become more food secure. This indicates that increased participation of household heads in community gardening is connected with decreased household food insecurity. The likely explanation is that community gardens typically supply a variety of micronutrient-dense horticultural crops such as vegetables, fruits, and tubers. Community gardens could result in food insecurity as they do not produce enough crops to meet the dietary requirements of the households and the lack of access to markets. This finding is inconsistent with Castaeda- Navarrete (2021) assertion that having a communal garden enhances household food security by supplementing the household food basket. Additionally, Nicholson *et al.* (2021); Dizon *et al.* (2021) suggest that rural households engage in community gardening to increase household food and nutritional security, as it acts as a source of food and income.

Ethnic group of the respondent: Most of the population belonged to the African ethnic group. Respondents belonging to the African ethnic group was recorded as 1 and other ethnic groups were recorded as 0. The ethnic group variable was found to be significant at a 5% level (p = 0.045) and was therefore shown to be negatively correlated with the household food security status and with a beta coefficient (β) = -0.4482 and an odds ratio (Exp (β)) = 0.220. This suggests that the respondents that were African experienced greater food insecurity than other ethnic groups. Hadley & Patil (2008) indicate that people belonging to the African ethnic group in rural areas of South Africa experience greater food insecurity due to large household sizes and lack of adequate income.

Marital status of the head of household: the marital status of the household head was recorded as 1 for those who were married and 0 for otherwise. The variable marital status of the household head reduced the chances of the household being food secure. The coefficient of ***marital status*** was found to be statistically significant at the 1% level (p = 0.000) and was shown to be positively correlated with the household food insecurity status, as expected, with a beta coefficient (β) = 0.048 and an odds ratio (Exp (β)) = 0.011. While all other independent variables remain constant, the model predicts that marital status increases the likelihood of a household being food insecure.

This indicates that as the marital status increased, the food insecurity experienced in households increased. This is due to the fact that as people got married, the household size increased and, therefore, the need for food increased which is consistent with the findings of (Adepoju & Adejare, 2013).

The variable ***Occupation*** was found to be statistically significant at the 1% level (p=0.000) and contrary to expectations, was negatively linked with household food security status, with a beta coefficient (β) = -0.133 and an odds ratio (Exp (β)) = 0.037. The model predicts that occupation, odds of a household being food secure is less likely while holding all other independent factors constant. This implies that as the level of occupation per respondent increases, the level of food insecurity experienced reduces. This could be actuated by the fact that since the level of occupation is higher and their incomes are higher, they can afford to purchase larger quantities of food. Therefore, all members of their households will have access to food.

The variable ***manure use*** was found to be significant at the 1% level (p= 0.000*)* and had a negative correlation with the household food insecurity status and with a beta coefficient (β) = -0.889 and an odds ratio (Exp (β)) = 0.222. Also, the variable ***fertilizer use*** was found to be significant at the 1% level (p = 0.000) and a negative correlation to household food security and a beta coefficient (β) = -1.284 and an odds ratio (Exp (β)) = 0.4447. The increase in the use of manure and fertilizers causes the level of food insecurity to be reduced in households as the coefficient is negative. *Fertilizers and manure also help to improve the soil quality for better crop production (*Bedada *et al.,* 2014*).* This suggests that the use of manure and fertilizer enhances the quality of the crops producing greater yields to feed the households and thus reduces the food insecurity experienced.

The variables ***old age grant*** was found to be significant at the 1% level (p = 0.000) and a negative correlation to household food security status, which is in contrast to what was expected, with a beta coefficient (β) = -1.473 and an odds ratio (Exp (β)) = 0.390. In addition, the variable for ***care dependency grant*** was found to be significant at the 10% level (p=0.057) and a negative correlation to household food security and a beta coefficient (β) = -0.934 and an odds ratio (Exp (β)) =0.491.

The model predicts old age and care dependency grants, households had a lower probability of falling into food insecurity. The negative coefficient means that those receiving old age and care dependency grants had a lower probability of falling into food insecurity. This could be understood in the sense that for one to qualify for a grant you have to be below a certain income threshold. Thus, most of these participants are poor and hence having a higher probability of being food insecure. These grants add extra income to the households and aid the households to purchase nutritional food; hence the food insecurity experienced in these households is reduced. As suggested by Chakona & Shackleton, (2019), a range of social grants received by the citizens helps alleviate the impacts of poverty and food insecurity.

Th variable ***climate change perception*** was found to be significant at the 1% level (p = 0.000) and had a positive correlation with household food security status, as was expected, with a beta coefficient (β) = 0.133 and an odds ratio (Exp (β)) = 0.049. The model predicts that the respondents that experienced higher levels of food insecurity also had more perceptions on climate change. This indicated that the relationship between climate change perceptions and food insecurity is statistically significant.

Community gardens play a vital role in providing a source of food to areas with a low socioeconomic population, as the goal of a community garden is to provide a way to increase the household and individual's food security status. (Galhena *et al.*, 2013). There is a negative coefficient that exists with community gardens. Therefore, suggesting that the smaller the community garden, the larger the food insecurity experienced by the households. This could be due to the fact that the community garden did not produce enough food for all the households due to lack of space, pests, shortage of water, livestock damage and theft.

Ngema *et al*. (2018), indicated that the relationship with the extension officer of the area is critical for the success of the community gardens and the food security status of rural households. The coefficient in this study is negative between the access to extension visits and the food insecurity status. Hence the more visits by the extension officer result in a lower food insecurity status. This could be because the extension officer can advise them on what crop to plant and how to mitigate the impacts of climate change on the crops. Thus, resulting in a higher yield of crops and reduced food insecurity in the households.

4.5. Interventions And Measures That Are Taken By The Local Municipality And Department Of Agriculture To Mitigate The Impacts Of Climate Change

These food assistance networks developed by the government aimed to help all citizens gain better access to the food supply by improving the safety nets. These consisted of fortifying foods, implementing food kitchens, food banks, and school nutrition programs. The concept of community gardens was aimed to help alleviate food insecurity that exists among the rural population of South Africans (DAFF, 2018). As per table 4.14. the majority (66.7%) of the respondents indicated that the agriculture department provides workshops on climate change and community gardening. (33.3%) said that they do not provide workshops. The bulk (79.2%) stated that the department of agriculture often visits their garden (20.8%) said less often. The majority (99.2%) indicated that the local municipality does not assist them when facing challenges with their gardens related to climate change;

only (0.8%) said they assist. The largest part of the surveyed population (65.0%) indicated that they were supplied with herbicides and pesticides less often, and (35.0%) are supplied very often.

The majority which was (69.2%) of the surveyed population were not made aware of climate change impacts on their community gardens by the extension officer and (30.8%) were made aware. (100%) of the population surveyed indicated that the local municipality's help to their gardens was not helpful.

Table 4. 14. Interventions and measures that are taken by the local municipality and department of Agriculture to mitigate the impacts of Climate Change, 2021

Participants N=120	**Number**	**(%)**
Does the department of agriculture provide workshops on climate change and community gardening		
Yes	80	66.7
No	40	33.3
How often does the department visit your garden**?**		
Very often	95	79.2
Less often	25	20.8
Not at all	0	0
Does the local municipality officers assist your garden when you face challenges associated with climate change		
Yes	1	0.8
No	119	99.2
How often is your garden supplied with herbicides and pesticides to mitigate pests and diseases		
Very often	42	35.0
Less often	78	65.0
Not at all	0	0
Are you made aware of the impacts of climate change on your garden by the extension officers?		
Yes	37	30.8
No	87	69.2
Do you feel that the help is given to your garden by the local municipality is helpful?		
Yes	0	0
No	120	100

As mentioned in the focused group discussions the participants indicated that the Department of Agriculture (DoA) provides seeds, fertilizers and pesticides for their community gardens. They also provide training on issues that they face due to climate change and how to mitigate these changes. The extension officers guide the community gardens on which crop is best suited to be planted and the crop's time. Inclusively, the participants indicated that they receive an abundance of help from the DoA and receive very little to no help from the local municipality.

The measures that are put in place to address the problems faced by the community gardens by the municipality and the Department of Agriculture and Rural Development (DARD).

- The farmers are advised to plant during the rainy periods in the seasons, allowing them to have adequate water for irrigation.
- They are guided to use razor wire during fencing to keep thieves and wild animals away from their crops.
- The drilling of boreholes is recommended, and the farmers can get assistance from DARD (Department of Agriculture and Rural Development).
- The DARD provides information days, training, primary technical advice, and demonstrations for the community gardens by extension officers and specialists. They are supplied with tactics to avoid disaster.
- Installation of JOJO tanks and electric boreholes to conserve water is conducted because the installation of an irrigation system is costly and time-consuming.
- DARD does fence, but some opt for in-house fencing done with reeds and sticks from their bushes.
- Chemicals are bought and applied to community gardens.
- The participants must always weed and maintain their gardens.
- Products are bought in bulk to reduce costs and supplied to the community gardens.
- They request funding from the DARD and the municipality.

The DARD assist the community gardens with the impacts of climate change by providing the gardens with inputs such as seeds, seedlings and chemicals. They assist the farmers with planting information (such as which seasons are suitable for specific crops and planting methods). Training and supply of gardens inputs to cover those seasonal products are provided to the farmers. The department of Agriculture promotes household, institutional, and community food production. The seeds that are provided to the farmers by the DARD are drought-resistant seeds. Seminars and workshops are held to advise the farmers about climate change, and it also offers precautions to safeguard their projects.

The help that is offered by the DARD is well received by the community garden participants. There is a presence of an agricultural adviser in each region that aids farmers. There are certain delays caused by budgetary concerns and the budget. It does help because the majority of farmers cultivate gardens and sell their surplus to earn money. They also form co-ops to show that they can see the impact of engaging in agriculture.

Measures are put in place by the local municipality to help the local community gardens.

- Progress report on wardroom meetings

- Business plans are forwarded to the local municipality for help.
- Previously, the municipality provided projects with operational equipment such as tractors and fencing wire.

The majority of the participants are not aware of the help provided by the Municipality and therefore only the people that are aware and approach the municipality receive help from the municipality. Therefore, to overcome this the municipality should alert the community about what help they can receive via local newspapers or notices.

Additional comments from the key informant interviews were that if the government provides the community gardens with the inputs timeously, their livelihoods will change for the better. The provision of tractors by the government will be an advantage to the farmers. The municipality strengthens the partnership for the provision of mechanisation services to farmers, therefore they should be more active. A course and meeting should be conducted for awareness. Farmers must be supported to achieve quality. The department should provide production inputs and tractors when it's a season to plough and plant. The government must also provide fencing to needy community gardens and must fully fund all community gardens. It could be better if all public and private sectors roll out their sleeves, go out there and help the desperate communities regarding agricultural knowledge and funds to uplift the projects and alleviate poverty.

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CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

This study sets out to investigate the effect of climate change on community garden crop production and the farmers, household food security.

The following sub-problems were addressed:

- What are the surveyed household's general characteristics, farmers knowledge, perceptions, behaviour, and attitude of climate change and its shocks?
- What is the effect of community gardening on the household food security status of the farmers?
- What are the interventions and measures taken by the local Municipality to mitigate the impacts of climate change?

Climate change is known to cause changes in the temperatures, seasons, and quality of crops produced. It increases pests and changes in precipitation patterns, which have a detrimental effect on agriculture. Therefore, climate changes has a negative effect on food systems and the livelihoods of the poor. The government established community gardens in rural areas to aid in poverty alleviation and to improve the communities' food security status. Community gardens are designed to address the community's specific needs. Understanding the effect and influence of climate change on agricultural production in community gardens is critical for determining the impact on local food security. Community gardens help rural people overcome food insecurity by offering support and access to a steady food source.

This study employed a mixed-methods approach. The study's findings were gleaned through the use of questionnaires, focus group discussions, and key informant interviews. These instruments were used to collect data on the demographics of farmers, their knowledge and perceptions of climate change, as well as their attitudes and behaviour in response to climate change and information about their community gardens. The Household Food Insecurity Access Scale (HFIAS) was used to determine the food security status of households and the interventions and actions implemented by the Department of Agriculture and their local municipality. A total of 120 Umdoni municipality community garden participants were surveyed. Among the community garden participants, 10 focused group discussions were held. Twelve (12) key informant interviews with local community leaders, extension officers, and municipality officials were done. The surveyed population had an average household size of five individuals, and the participants ranged in age from adolescents to the elderly. The bulk of the population was unemployed, and farming was the principal source of revenue.

Social grants were the primary source of income for the household. The participants had heard of climate change, but the vast majority of them had no idea what it was. They indicated that climate change has a detrimental effect, and the primary change noted by participants as a result of climate change was a shift in rainfall patterns due to less frequent rainfall. According to the survey, the primary cause of climate change was attributed to ‘God’. The majority indicated that they would be willing to learn about climate change if given the opportunity.

The community gardens that were surveyed averaged six participants. The majority of gardens included two hectares of farmland. Pests and diseases, theft, and livestock damage were the primary causes of crop loss in gardens. The majority of community garden members responded that the gardens do not provide an adequate source of food for their households. The HFIAS assisted in assessing household food insecurity levels in terms of food access and household uncertainty over the food supply. The HFIAS revealed that a significant proportion of households were food insecure, and a larger proportion of the assessed population was moderately food insecure. This implies that the household's amount or quality of food was compromised due to a lack of funds to purchase food or the participants' advancing age.

The Department of Agriculture and Rural Development (DARD) offers workshops and training to community garden participants regarding climate change and changing planting seasons. Additionally, they supply seeds, seedlings, chemicals, fertiliser, insecticides, and inputs such as ploughing equipment to community gardens. Drought-resistant seeds are included. On request, they can also be supplied with JOJO tanks, boreholes, and fences. Extension officers are assigned to these community gardens to assist and guide them in resolving challenges. The local municipality used to aid farmers with inputs like tractors for ploughing, but they no longer do so as the DARD is now responsible for assisting farmers and community gardens. Several participants were unaware that the Municipality could assist them with their gardening.

5.1. Conclusion

The study discovered that the majority of the population surveyed was unemployed, with social grants serving as the primary source of income. The majority of community members in ward 18, Umdoni municipality, who participated in the community gardens were classified as having moderate food insecurity. Their household income was erratic, which created uncertainty about their food supply, as the social grants they got were insufficient to purchase necessary food.Climate change played a significant role in the success of the communal gardens, as the adverse change in weather patterns and the onset of pest negatively affect the crop production of the gardens. Although the majority of

the studied population had heard of climate change, most were unaware of its more serious consequences. Participants stated that God was the primary cause of climate change and that it had a detrimental effect.

They have identified the primary alterations associated with climate change as changes in rainfall patterns and temperatures. Despite their awareness, people are apprehensive and fearful of Climate Change. To overcome this obstacle, the DARD must promote active climate change awareness in the community. This will assist community people in learning about climate change and how to reduce the effects of climate change. The community gardens supplemented the homes' food supply. However, the amount of food received by the community gardens was insufficient to meet the household need. This was due to crop losses caused by pests and diseases, theft, and animal damage. The extension officer's crop production techniques should maximise the size of the community gardens.

The gardens should be fenced in, and all community gardens should have JOJO tanks placed to aid with irrigation. Participants should be advised to cultivate crops with short turnaround times and a high nutritional value. This will contribute to the participants' households achieving a higher level of food security. Community gardens were found not to significantly contribute to household food security in ward 18 in the Umdoni municipality. However, the contribution of gardens to consumption cannot be overlooked totally, particularly for low-income households and those reliant on social grants. Changes to the gardens should be made to increase productivity, and difficulties caused by climate change must be addressed to ensure that the community gardens in Ward 18, Umdoni municipality, contribute considerably to the participants' food security status.

5.2. Recommendations

- The DARD should encourage more individuals to participate in community gardens, which will contribute to a greater population's food security.
- The community should be encouraged to create their private gardens to improve their nutritional status and revenue.
- Monthly progress meetings should be held to discuss climate change issues and to learn about any new issues that the community gardens are encountering.
- Water irrigation techniques should be implemented to minimize crop loss

5.3. Recommendations For Improvement Of Study

The data collection time may have been extended and a data series analysis performed. This would have provided a more complete picture of the questioned household's food security situation and how that situation fluctuates with the seasons.

Larger sample size could have provided more insight. The study may have included two or more wards within the Umdoni municipality to determine whether the situation is similar or dissimilar in different Municipality communities.

5.4. Recommendations For Policymakers

South Africa must develop local solutions to its local problems, therefore, scalable environmental, social, and governance (ESG)-focused community programmes need to be supported. Furthermore, focuses not only on improving understanding, but helps to inform solutions for problems at local, regional, national, and global levels. And with the active cooperation and engagement of cross-sector partners, one can bring the food security dilemma a little closer to resolution.

The community gardens should be advised on what to plant and which crops provide the most nutritional value to their bodies.

The community members should be taught appropriate crop production methods to mitigate the changes brought upon by Climate Change.

Meal planning and nutritional advice should be given to the community members; this will influence the types of crops planted in their community gardens.

5.5. Recommendations For Further Research

The study focused exclusively on community garden participants in Ward 18, Umdoni Municipality. Research could be conducted to determine the disparities in food security status and the impact of climate change between community garden participants and non-garden participants.

The study concentrated on the food security pillars of availability, access, and stability. A study of the use pillar of food security should be conducted.

A study could be done to find out the impact of non-profit organizations on the community gardens, and the effects of climate change as this study focused only on the involvement of the DARD and the local Municipality.

New research themes and directions, including research in the physical, social, ecological, environmental, health, and engineering sciences, as well as research that integrates these and other disciplines.

APPENDICIES

APPENDIX A: Letter From Department Of Agriculture And Rural Development (Gatekeepers Letter)

agriculture
& rural development
Department:
agriculture
& rural development
PROVINCE OF KWAZULU-NATAL

TO/IYA KU/AAN: UNIVERSITY OF KZN PIETERMARITZBURG CAMPUS	Telephone: Ucingo: 0399740141 / 0769484758 Telefoon:
	Enquiries: Imibuzo: CS Ceshe/ P.Z Mzelemu Navrae:
	Reference: Inkomba: UKZN 214504745 Verwysing:
	Date: Usuku: 6 October 2020 Datum:

RE: - PERMISSION TO CONDUCT FIELD RESEARCH

TO WHOM IT MAY CONCERN,

THIS IS TO CONFIRM THAT MERISHCA NAICKER, WHO IS PRESENTLY STUDYING AT UKZN MASTERS OF (AGRICULTURE), PIETERMARITZBURG CAMPUS, HAVE BEEN GIVEN PERMISSION TO CONDUCT FIELD RESEARCH IN THE DLANGEZWA AREA, WHICH IS PART OF UMDONI MUNICIPALITY, WARD 18.

KIND REGARDS

P.Z MZELEMU

Agric Advisor: Ward 18 (Umdoni Local Office)

APPENDIX B: Ethical Clearance Approval Letter

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

29 March 2021

Miss Merishca Naicker (214504745)
School Of Agri Earth & Env Sc
Pietermaritzburg Campus

Dear Miss Naicker,

Protocol reference number: HSSREC/00002402/2021
Project title: The impact of climate change on crop production of community gardens, and the food security status of households in Dlangezwa, ward 18, Umdoni Municipality.
Degree: Masters

Approval Notification – Expedited Application

This letter serves to notify you that your application received on 27 January 2021 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted **FULL APPROVAL**.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

This approval is valid until 29 March 2022.
To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

All research conducted during the COVID-19 period must adhere to the national and UKZN guidelines.

HSSREC is registered with the South African National Research Ethics Council (REC-040414-040).

Yours sincerely,

[redacted]

Professor Dipane Hlalele (Chair)

/dd

APPENDIX C : Questionnaire

UNIVERSITY OF KWAZULU-NATAL

The impact of climate change on crop production of community gardens and the food security status of households in Dlangezwa, ward 18, Umdoni Municipality, Questionnaire

The information captured in this questionnaire is strictly confidential and will be used for research purposes by staff and students at the University of KwaZulu-Natal to measure the impact of climate change on crop production of community gardens and the food security status of households in Dlangezwa, ward 18, Umdoni Municipality. The respondents are not forced to answer questions – the answers are strictly voluntary. The respondent should be a participant in the community gardens.

Date and Survey Number:

Demographics

1.1. Indicate the gender of the respondent Male**(M)** or female **(F)**	1.Male**(M)** 2. Female **(F)**
1.2. Age of respondent	
1.3. Education level:	1. No formal training 2. Primary 3. Secondary 4. Tertiary and above
1.4. Are You the Household Head?	**1.** Yes 2. No
1.5. How many members are in your household?	
1.6. Ethnic group:	1. White 2. African 3. Indian 4. Coloured
1.7. Marital status:	1. Single 2. Married 3. Divorced 4. Widowed 5. Living with a Partner
1.8. Does your household collect any type of social grant	1. Yes 2. No
1.9. What type of grants does your household receive?	1. Old Age Grant 2. Child Support Grant 3. Disability Grant 4. Care, Dependency Grant,

	5. Grant in Aid
1.10. Are You Currently Employed?	1. Yes 2. No
1.11. Occupation	1=unemployed 2= full-time employment 3= part-time employment 4=social grants 5= housewife 6= farming 7= housekeeper 8= own enterprise (spaza, hawking) 9=other(specify)
1.12. total income for the household per month (in Rands)	1. less than R500 2. R1000-R1500 3. R1501-R2000 4. R2001-R2500 5. R2501-R3000 6. R3001-R3500 7. R3501-R4000 8. R4001-R4500 9. R4501-R5000 10. more than R5000
1.13. Income received from social grants for the household (Per month)	1. less than R500 2. R1000-R1500 3. R1501-R2000 4. R2001-R2500 5. R2501-R3000 6. R3001-R3500 7. R3501-R4000 8. R4001-R4500 9. R4501-R5000 10. more than R5000

Knowledge about climate change

2.1. Have you heard of what 'Climate Change' means from any source?	1. Yes 2.No
2.2. Would you say you understand what climate change means?	1. Yes 2. No 3. To some extent 4. Not really ***5.*** I don't know
2.3. Do you think that global warming has already occurred?	1. Yes 2. No ***3.*** Uncertain
2.4. Has climate change happened in your local region?	1. Yes 2. No 3. Uncertain

2.5. Types of change in climate that occurred in your region	1. Excessive temperatures 2. Excessive cold 3. Change of pattern in rainfall 4. Frequent floods 5. Waterlogging 6. Don't know/don't understand
2.6. What kind of impacts climate change will have on us?	1. None 2. Positive effects 3. Negative effects ***4.*** Both positive and negative effects
2.7. What is the main source of your information on climate change?	1. Newspaper 2. Weekly magazine 3. Radio 4. Television 5. Neighbours 6. Health workers 7. Teachers 8. Extension officers 9. Family members/relatives/friends 10. NGO workers 11. Personal involvement in Training 12. Personal involvement in environmental protection ***13.*** Others
2.8. Causes and reasons for climate change	1. Deforestation 2. Industrial effluents 3. Population growth 4. Excessive carbon emissions by the developed country 5. Rapid urbanization 6. God 7. It doesn't exist 8. I don't know ***9.*** Others

Perceptions of climate change

Has there been:	**Yes**	**Unchanged/ Not applicable**	**Did not notice**		
3.1. an increased episode of drought in the last 10 years					
3.2. Change in rainfall pattern in the last 10 years					
3.3. Change in seawater level in the last 10 years					
3.4. Increased salinity of water in the last 10 years					
3.5. Increased health risk due to an increase in salinity					
3.6. Reduced food crop production in the last 10 years					
	Strongly agree	agree	Neither agree nor disagree/ unsure	disagree	Strongly disagree
4.1. Climate change is occurring					
4.2. Human activity is responsible for climate change					
4.3. Every individual can do something to adapt to climate change					
4.4. Natural changes in the environment are responsible for climate change					
4.5. Climate change can reduce the quality of life for future generations					

Behaviour toward climate change

5.1. Can climate change be avoided?	1. Absolutely possible 2. Mitigate climate effect on humans through endeavour 3. Can not ***4.*** Unable to explain clearly
5.2. If someone called for, whether you would like to join the actual efforts to mitigate climate change?	1. Yes 2. No ***3.*** Uncertain

5.3. Are you willing to sacrifice some individual benefits to solve existing problems?	1. Very willing 2. Not very willing ***3.*** Not at all willing
5.4. Did you participate in some environmental protection activities related to climate change?	1. Yes ***2.*** No
5.5. Have you or anyone you know taken any actions to adapt/cope to climate change?	1. yes 2. no ***3.*** I don't know

Attitude toward climate change

6.1. How do you feel about climate change?	1. fearful/afraid 2. confused 3. angry 4. sad 5. disbelief 6. powerless 7. no feelings 8. hopeful (we can do some things to adapt) 9. do not believe it exists 10. I do not know 11. other _____
6.2. Would you like to learn more about climate change?	1. yes 2. no 3. I don't mind 4. not sure

To assess the effect of community gardening on the household food security status of the farmers.

COMMUNITY GARDENS

7.1. Community garden number:	
7.2. The number of participants in the community garden:	
7.3. Size of a community garden (M^2):	
7.4. How often does the extension officer visit?	1. frequently 2. not frequently 3. not at all
7.5. Do you use fertilizers in your community garden?	1. Yes 2. No
7.6. Do you use manure in your garden	1. Yes 2. No
7.7. How often do you irrigate our crops?	
7.8. Is the size of your community garden enough for all your participants	1. Yes 2. No
7.9. Do you experience loss of crop?	1. Yes 2. No
7.10. Is your crop loss due to?	
7.10.1. Floods	1.Yes 2.No
7.10.2. Theft	1.Yes 2.No
7.10.3. Pest and disease	1.Yes 2.No
7.10.4. Drought	1.Yes 2.No
7.10.5. Livestock damage	1.Yes 2.No
7.10.6. Does your household receive enough food from the community garden?	1. Yes 2. No
7.11. How often do you hire external help for your garden	1. Very often 2. Less often 3. Not at all

HOUSEHOLD FOOD INSECURITY ACCESS SCALE

No	Question	Response Options	Answer
8.1.	In the past four weeks, did you worry that your household would not have enough food?	**0= No** (skip to Q2) **1= Yes**	
8.1.a	How often did this happen?	**1= Rarely** (once or twice in the past four weeks)	

		2=Sometimes (three to ten times in the past four weeks) **3=Often**(More than ten times in the past four weeks)	
8.2.	In the past four weeks, were you or any household member not able to eat the kinds of food you preferred because of the lack of resources?	**0= No** (skip to Q3) **1= Yes**	
8.a	How often did this happen?	**1= Rarely** (once or twice in the past four weeks) **2=Sometimes** (three to ten times in the past four weeks) **3=Often**(More than ten times in the past four weeks)	
8.3.	In the past four weeks, did you or any household member have to eat a limited variety of food due to lack of resources?	**0= No** (skip to Q4) **1= Yes**	
8.3.a	How often did this happen?	**1= Rarely** (once or twice in the past four weeks) **2=Sometimes** (three to ten times in the past four weeks) **3=Often**(More than ten times in the past four weeks)	
8.4.	In the past four weeks, did you or any household member have to eat some foods that you did not want to eat because of the lack of resources to obtain other types of food?	**0= No** (skip to Q5) **1= Yes**	
8.4.a	How often did this happen?	**1= Rarely** (once or twice in the past four weeks) **2=Sometimes** (three to ten times in the past four weeks) **3=Often**(More than ten times in the past four weeks)	

8.5.	In the past four weeks, did you or any other household member have to eat a smaller meal than you felt you needed because there was not enough food?	**0= No** (skip to Q6) **1= Yes**	
8.5.a	How often did this happen?	**1= Rarely** (once or twice in the past four weeks) **2=Sometimes** (three to ten times in the past four weeks) **3=Often**(More than ten times in the past four weeks)	
8.6.	In the past four weeks, did you or any other household member have to eat fewer meals in a day because there was not enough food?	**0= No** (skip to Q7) **1= Yes**	
8.6.a	How often did this happen?	**1= Rarely** (once or twice in the past four weeks) **2=Sometimes** (three to ten times in the past four weeks) **3=Often**(More than ten times in the past four weeks)	
8.7.	In the past four weeks, was there ever no food to eat of any kind in your household because of a lack of resources to get food?	**0= No** (skip to Q8) **1= Yes**	
8.7.a	How often did this happen?	**1= Rarely** (once or twice in the past four weeks) **2=Sometimes** (three to ten times in the past four weeks) **3=Often**(More than ten times in the past four weeks)	
8.8.	In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?	**0= No** (skip to Q9) **1= Yes**	
8.8.a	How often did this happen?	**1= Rarely** (once or twice in the past four weeks)	

		2=Sometimes (three to ten times in the past four weeks) **3=Often**(More than ten times in the past four weeks)	
8.9.	In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?	**0=No**(the questionnaire is finished) **1= Yes**	
8.9.a	How often did this happen?	**1= Rarely** (once or twice in the past four weeks) **2=Sometimes** (three to ten times in the past four weeks) **3=Often**(More than ten times in the past four weeks)	

To investigate interventions and measures taken by the local municipality to mitigate the impacts of climate change.

9.1. Does the department of agriculture provide workshops on climate change and community gardening	1. Yes 2. No
9.2. How often does the department visit your garden?	1. Very often 2. Less often 3. Not at all
9.3. Does the local municipality officers assist your garden when you face challenges associated with climate change	1. Yes 2. No
9.4. How often is your garden applied with herbicides and pesticides to mitigate pests and diseases	1. frequently 2. not frequently 3. not at all
9.5. Are you made aware of the impacts of climate change on your garden by the extension officers?	1. Yes 2. No
9.6. Do you feel that the help is given to your garden by the local municipality is helpful?	1. Yes 2. No

APPENDIX D : Focused Group Disscussion Gudie

Focus Group Discussion Guide

Consent Process

Consent forms for focus group participants are completed in advance by all those seeking to participate. Below is a summary of the information in the consent form that focus group organizers and facilitators should use to ensure participants understand the information in the consent form.

Thank you for agreeing to participate. We are very interested in hearing your valuable opinion on the effects of climate change on community gardens and food security and the interventions/measures taken by the local municipality to mitigate the impact of climate change.

- The purpose of this study is to determine the impact of climate change on the crop production of community gardens and the food security status of households in Dlangezwa, ward 18, Umdoni Municipality,

- The information provided by you is entirely confidential, and we will not associate your name with anything you say in the focus group.

- we would like to record the focus group discussions to ensure that we correctly capture the group's thoughts, opinions, and ideas. No names of participants will be attached to the focus groups, and the recordings will be destroyed as soon as they are transcribed.

- You can choose not to answer any question and withdraw from the study at any time.

- We understand the importance of keeping the information provided by the participants private and confidential. Therefore we will ask participants to respect each other's confidentiality.

Introduction:

1. Welcome

Introduce yourself and the note-taker, and send the Sign-In Sheet with a few quick demographic questions (age, gender) around to the group while you are introducing the focus group.

Review the following:

- Who we are and what we're trying to do
- How this information will be utilized
- Why we asked you to participate

2. Explanation of the process

Ask the group if anyone has experienced in a focus group before. Explain that focus groups are being used more and more often in research.

About focus groups:

- We learn from you (positive and negative)
- Not trying to achieve consensus, we're gathering information
- In this project, we are doing questionnaires, focus group discussions, and key informant interviews. Using these tools is that we can get more in-depth information from a smaller group of people in focus groups. This provides us with an understanding of the context behind the answers given in the written survey and helps us discover topics in more detail than we can do in a written survey.

Logistics

- Focus group will last about one hour
- Feel free to move around
- Where is the bathroom? Exit?
- COVID-19 regulations will adhere too
    - Mask must always be worn, and sanitiser will be provided
    - Social distancing will be obeyed

3. Ground Rules

Ask the group to suggest some ground rules. After they brainstorm some, make sure the following are on the list.

- Everyone should participate.
    - Mask must always be worn
    - Social distancing must be obeyed
    - Sanitiser must be used by every participant
- Information provided in the focus group must be kept confidential
- Stay with the group and please do not have side conversations
- Turn off cell phones if possible
- Have fun

4. Turn on Tape Recorder

5. Ask the group if there are any questions before we get started and address those questions.

6. Introductions

- Go around the table: where you were born etc.

The discussion begins, making sure to give people time to think before answering the questions and not moving too quickly. Use the probes to ensure that all issues are addressed, but move on when you feel you are starting to hear repetitive information.

Questions

6. What are some of the problems that your household faces that makes you worry about your family's food supply?
7. What factors hinder the quality and quantity of food that your family consumes?
8. Do you think that climate change is a concern, and does it affect the quality and quantity of food your household consumes?
9. Do you feel that the food garden helps you provide food to your family, or is it a burden to you?
10. How does the department of agriculture assist your garden with the impacts of climate change?

Seasonality Chart- Types, The Number Of Crops That Are Grown And The Months That It Is Planted

Types of vegetables	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

KEY:

- **- PLENTY**
- **- ENOUGH**
- **- VERY LITTLE**
- **- NO FOOD**

APPENDIX E: Key Informants Interview

UNIVERSITY OF KWAZULU-NATAL

The impact of climate change on crop production of community gardens and the food security status of households in Dlangezwa, ward 18, Umdoni Municipality, Questionnaire

The information captured in this key informant interview is strictly confidential and will be used for research purposes by staff and students at the University of KwaZulu-Natal to measure the impact of climate change on crop production of community gardens and the food security status of households in Dlangezwa, ward 18, Umdoni Municipality. The respondents are not forced to answer questions – the answers are strictly voluntary.

Consent Process

Consent forms for Key informant interview participants are completed in advance by all those seeking to participate. Below is a summary of the information in the consent form that key informant interview organizers should use to ensure participants understand the information in the consent form.

Thank you for agreeing to participate. We are very interested in hearing your valuable opinion on the effects of climate change on community gardens and food security and the interventions/measures taken by the local municipality to mitigate the impact of climate change.

- The purpose of this study is to determine the impact of climate change on the crop production of community gardens and the food security status of households in Dlangezwa, ward 18, Umdoni Municipality,

- The information provided by you is entirely confidential, and we will not associate your name with anything you say in the key informant interview.

- we would like to record the Key informant interview to ensure that we correctly capture the group's thoughts, opinions, and ideas. No names of participants will be attached to the key informant, and the recordings will be destroyed as soon as they are transcribed.

- You can choose not to answer any question and withdraw from the study at any time.

- We understand the importance of keeping the information provided by the participants private and confidential. Therefore we will ask participants to respect each other's confidentiality.

Introduction:

1. Welcome

Introduce yourself

Review the following:

- Who we are and what we're trying to do
- How this information will be utilized
- Why we asked you to participate

2. Explanation of the process

Ask if the informant has participated in a key informant interview before.

About key informant interview:

- We learn from you (positive and negative)
- Not trying to achieve consensus, we're gathering information
- In this project, we are doing questionnaires, focus group discussions, and key informant interviews. Using this tool, we can get an in-depth view of the issues associated with the research. This provides us with an understanding of the context behind the answers given in the questionnaires and focused group discussions.

Logistics

- Interview would last around 30 min
- COVID-19 regulations will adhere too
  - Mask must always be worn, and sanitiser will be provided
  - Social distancing will be obeyed

The interview begins, making sure to give the participant time to think before answering the questions and not moving too quickly. Use the probes to ensure that all issues are addressed, but move on when you feel you are starting to hear repetitive information.

Questions

1.What are some of the problems that are faced by the people who participate in the community gardens?

2.What are the measures put in place to address the problems faced by the community gardens?

3.Do you think that climate change is a concern, and does it affect the quality and quantity of crops produced in community gardens?

4.Do you feel that the community garden help provide food to the participants family?

5.How does the department of agriculture assist the gardens with the impacts of climate change?

6.Is the help provided by the Department of Agriculture well received by the community gardens?

7.What measures are put in place by the local municipality to help the local community gardens?

8.Is the community aware of the type of assistance provided by the local municipality?

9.Do you have any additional comments or feedback?

Thank you for your time and participation !!

APPENDIX F: Focused Group Discussion Results

1. **What are some of the problems that your household faces that makes you worry about your family's food supply**?

Due to the scarcity of water and the increase in temperatures, there is a lack and shortage of food in the households. The lack of water affects how the meals are prepared as there isn't enough water to cook meals that require a lot of time. Many of the household members are unemployed therefore there is not enough money to buy an adequate supply of food. There is limited income in the households due to the lack of jobs. Family members that work in the city send money that helps with the household expenses. However, they only send money when they have extra which been not often. Due to the limited income, the types of food consumed by the household is limited. Food prices have increased making it difficult to purchase enough food to feed the household. The shops are too far and require the use of public transport which is an additional cost to the household. There is an absence of food stock due to the large household size. The lack of food storage, therefore, large quantities of food cannot be purchased as there is not enough money to purchase fridges and freezers.

2. **What factors hinder the quality and quantity of food that your family consumes?**

The lack of employment within the household hinders the quantity and quality of the food that we consume. There is not enough money to buy food to feed all members of the household. The onset of floods and droughts causes a decrease in the crops produced therefore the households do not get enough food from the gardens. The high financial cost of food hinders the quality of food that is purchased, as households opt for the cheaper options as it yields a larger quantity for a cheaper price. The presence of insects and pests in the crop we plant causes damage to the crops therefore there isn't enough for consumption. The existence of ants in the crops and the lack of water for irrigation purposes. High temperatures cause the food purchased to spoil easily therefore bulk purchasing of food that is cheaper is not feasible. The change in weather adversely affects the quality and quantity of crops produced.

3. **Do you think that climate change is a concern, and does it affect the quality and quantity of food your household consumes?**

Yes, it is a concern. When floods are experienced crops are damaged and when there is not enough water available the crops are compromised. Climate change is a concern as it causes changes in the weather

patterns and therefore altering the planting and growing seasons of crops. Due to the impact of climate change the consumption of crops by the household is decreased as the crops are damaged. Due to its damage to the crop, it makes it futile to plant. There is also a change in water quality which leads to the loss of crops. The changes in crops bring upon pests and diseases. There is an in the crop taste and lifespan.

4. **Do you feel that the food garden helps you provide food to your family, or is it a burden to you?**

The community garden does help the families as the crops are used to feed our families. The surplus of the crops is then sold, and the money helps to support the households. The garden helps our families a lot as the crop produced by the gardens are consumed by the families. These crops provide the families with nutritious food. The garden helps to reduce the financial strain on the households. There is a variety of crops in the garden which allows the families to eat different types of vegetables.

5. **How does the department of agriculture assist your garden and how does it help with the impacts of climate change?**

The department of agriculture provides information and training on how to plant crops. The time of year that the crops need to be planted. They also provide seeds, fertilizers, and pesticides. They offer training on how to handle situations faced with climate change. They assist us with information and how to cope with issues that are brought upon by climate change. They provide us with insecticides and pesticides to help with the pest in our garden. The department provides us with workshops and shows us ways to mitigate the changes brought upon by Climate Change. They guide us on what crop to plant and when to plant. They also inform us about the changes in planting seasons as it has changed due to Climate Change. They assist with equipment such as water tanks to irrigate the garden, tractors to plough and fencing for gardens.

1. **Seasonality Chart- Types, The Number of Crops That Are Grown and The Months That It Is Planted**

Types of vegetables	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
spinach	●	●	●	●	●	●	●	●	●	●	●	●
Tomatoes	●	●	●	●	●	●	●	●	●	●	●	●
Potatoes	●	●	●	●	●	●	●	●	●	●	●	●
Mealies	●	●	●	●	●	●	●	●	●	●	●	●
Green Beans	●	●	●	●	●	●	●	●	●	●	●	●

KEY:

- **PLENTY**
- **- ENOUGH**
- **- VERY LITTLE**
- **- NO FOOD**

2. Seasonality Chart- Types, The Number Of Crops That Are Grown And The Months That It Is Planted

Types of vegetables	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Spinach	🟠	🟠	🟠	🟢	🔵	🔵	🔵	🔵	🔵	🔵	🟠	🟠
Onion	🟠	🟠	🟢	🟢	🟠	🟠	🟠	🟠	🔵	🔵	🔵	🔵
Cabbage	🟠	🟠	🟠	🟠	🟠	🟢	🟠	🟠	🟠	🔵	🔵	🔵

KEY:

- 🟢 **-PLENTY**
- 🔵 **- ENOUGH**
- 🟠 **- VERY LITTLE**
- 🔴 **- NO FOOD**

3. Seasonality Chart- Types, The Number Of Crops That Are Grown And The Months That It Is Planted

Types of vegetables	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Spinach	🟠	🟠	🟠	🟢	🟢	🔵	🔵	🔵	🔵	🟠	🟠	🟠
Onion	🟠	🟠	🟢	🟢	🟢	🔵	🔵	🔵	🔵	🔵	🔵	🔵

KEY:

🟢 **- PLENTY**

🔵 **- ENOUGH**

🟠 **- VERY LITTLE**

🔴 **- NO FOOD**

4. Seasonality Chart- Types, The Number of Crops That Are Grown And The Months That It Is Planted

Types of vegetables	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Carrots	🔵	🟠	🟠	🟠	🟠	🟢	🟢	🟠	🟠	🔵	🔵	🔵
Tomatoes	🔴	🔴	🔴	🔴	🔴	🟢	🟠	🟠	🔵	🔵	🔵	🔴
Brinjal (Eggplant)	🟠	🔴	🔴	🔴	🔴	🔴	🔴	🟢	🟢	🔵	🔵	🔵
Cabbage	🔴	🔴	🔴	🟢	🟠	🟠	🟠	🟠	🔵	🔵	🔵	🔵

KEY:

🟢 **- PLENTY**

🔵 **- ENOUGH**

🟠 **- VERY LITTLE**

🔴 **- NO FOOD**

5. **Seasonality Chart- Types, The Number Of Crops That Are Grown And The Months That It Is Planted**

Types of vegetables	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Spinach	🔴	🔴	🔴	🟠	🟠	🟢	🟢	🔵	🔵	🔵	🔵	🔵
Tomatoes	🔴	🔴	🔴	🔴	🔵	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Cabbage	🟠	🟠	🟠	🟠	🟢	🔴	🔴	🔵	🔵	🔵	🟠	🟠
Sweet potatoes	🔴	🔴	🔴	🔴	🔴	🔴	🔵	🔵	🔵	🟠	🟠	🟢
onions	🟠	🟠	🔴	🔴	🟢	🟢	🟢	🔵	🔵	🔵	🔵	🔵

KEY:

🟢 **- PLENTY**

🔵 **- ENOUGH**

🟠 **- VERY LITTLE**

- **NO FOOD**

6. **Seasonality Chart- Types, The Number Of Crops That Are Grown And The Months That It Is Planted**

Types of vegetables	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Spinach	●	●	●	●	●	●	●	●	●	●	●	●
Potatoes	●	●	●	●	●	●	●	●	●	●	●	●
Cabbage	●	●	●	●	●	●	●	●	●	●	●	●
Sweet potatoes	●	●	●	●	●	●	●	●	●	●	●	●

KEY:

- **-PLENTY**
- **- ENOUGH**
- **- VERY LITTLE**

- **NO FOOD**

7. **Seasonality Chart- Types, The Number Of Crops That Are Grown And The Months That It Is Planted**

Types of vegetables	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Beetroot	●	●	●	●	●	●	●	●	●	●	●	●
Green beans	●	●	●	●	●	●	●	●	●	●	●	●
Onions	●	●	●	●	●	●	●	●	●	●	●	●
Cabbage	●	●	●	●	●	●	●	●	●	●	●	●
Sweet potatoes	●	●	●	●	●	●	●	●	●	●	●	●

KEY:

- **-PLENTY**

- **- ENOUGH**
- **- VERY LITTLE**
- **- NO FOOD**

8. Seasonality Chart- Types, The Number Of Crops That Are Grown And The Months That It Is Planted

Types of vegetables	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Maize	●	●	●	●	●	●	●	●	●	●	●	●
Beans	●	●	●	●	●	●	●	●	●	●	●	●

KEY:

- **-PLENTY**
- **- ENOUGH**
- **- VERY LITTLE**

- **NO FOOD**

9. Seasonality Chart- Types, The Number Of Crops That Are Grown And The Months That It Is Planted

Types of vegetables	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Spinach												
Carrots												
Cabbage												

KEY:

- **PLENTY**
- **ENOUGH**

- **- VERY LITTLE**
- **- NO FOOD**

10. Seasonality Chart- Types, The Number Of Crops That Are Grown And The Months That It Is Planted

Types of vegetables	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Spinach	●	●	●	●	●	●	●	●	●	●	●	●
onions	●	●	●	●	●	●	●	●	●	●	●	●

KEY:

- **-PLENTY**

- **- ENOUGH**
- **- VERY LITTLE**
- **- NO FOOD**

APPENDIX G: Key Informant Interview Results

1. **What are some of the problems that are faced by the people who participate in the community gardens?**
    - Droughts
    - Wild pigs and livestock cause damage to the crop in some areas
    - Unavailability of fencing infrastructure, planting inputs, and ploughing mechanisms.
    - Absence of water for irrigation purposes, as this is fundamental for the production of good quality crops
    - The onset of pests and diseases cripples the harvest.
    - The participants have a lack of knowledge.
    - There is theft that occurs in the community gardens.
    - The is a problem with marketing their crops to gain additional surplus income. They have insufficient knowledge of the markets, and therefore the surplus is left to get rotten and is wasted
    - There is a lack of storage space for produce
    - There is a lack of participation by all members

2. **What are the measures put in place to address the problems faced by the community gardens?**

- The farmers are advised to plant during the rainy periods in the seasons, allowing them to have adequate water for irrigation.
- They are guided to use razor wire during fencing to keep thieves and wild animals away from their crops.
- The drilling of boreholes is recommended, and the farmers can get assistance from DARD (Department of Agriculture and Rural Development).
- The DARD provides information days, training, primary technical advice, and demonstrations for the community gardens by extension officers and specialists. They are supplied with tactics to avoid disaster.
- Installation of JOJO tanks and electric boreholes to conserve water is conducted.
- DARD does fencing, but some opt for in-house fencing done with reeds and sticks from their bushes.
- Chemicals are bought and applied
- The participants must always weed and maintain their gardens.

- Products are bought in bulk to reduce costs.
- They request funding from the DARD and the municipality.

3. Do you think that climate change is a concern, and does it affect the quality and quantity of crops produced in community gardens?

- Climate change causes a significant impact on the farmer's produce, as the influx of the region's temperatures generates a low yield of the crop.
- Yes, as it affects crop rotation and planting methods.
- Yes, as watering becomes uncertain due to the unreliability of rain.
- The effect on the product's quality and quantity affects the partnership with the markets as the product is inferior and results in less income.
- The seasons have changed as a result. During winter used to be the season for vegetables whereby farmers had to control irrigation by themselves, nowadays heavy rains are present, and scorching conditions exist, which destroys the quality of plants and the harvest.

4. Do you feel that the community garden help provide food to the participants?

- Yes, it provides food for the participants, particularly the households where each works in the gardens and takes the produce from the gardens to provide food for their households.
- Yes, it does as they eat the produce to alleviate poverty and sell the surplus.
- Yes, it does because it produces fresh produce at a low cost used for the inputs, unlike buying from the markets.

5. How does the department of agriculture assist the gardens with the impacts of climate change?

- They provide the gardens with inputs such as seeds, seedlings, and chemicals.
- Assists the farmers with planting information (such as which seasons are suitable for specific crops and planting methods).
- They provide training and supply the gardens with inputs to cover that seasonal produce.
- The department of Agriculture promotes household, institutional, and community food production.
- They are provided with seeds that are drought resistant
- Seminars and workshops are held to advise the farmers about climate change, and it also offers precautions to safeguard their projects.

6. Is the help provided by the Department of Agriculture well received by the community gardens?

- Yes, their help is well received, as there is an agricultural advisor for each region that aids with the framers.
- Yes, they provide help, but sometimes there are some delays because of financial issues/Budget.
- It does help because most farmers engage themselves in gardens and sell their surplus to generate income. They also form co-ops to show that they can see the impact of engaging in agriculture.

7. What measures are put in place by the local municipality to help the local community gardens?

- Progress report on wardroom meetings
- Business plans are forwarded to the local municipality for help.
- They provide tractors and seeds seldomly.
- Purchases inputs
- The municipality used to provide projects with working equipment such as tractors and fencing wire etc.

8. Is the community aware of the type of assistance provided by the local municipality?

- They are not all aware of the type of assistance the local municipality provides.
- Some of them are aware. However, the municipality is no longer assisting, Only the DARD assists.
- Not everyone because not everyone will get assistance like how the DARD provides. The Municipality focuses on those lucky group projects; therefore, not everyone knows about the municipality's aid.

9. Do you have any additional comments or feedback?

- If the government provides the community gardens with the inputs timeously, their livelihoods will change for the better.
- The provision of tractors by the government will be an advantage to the farmers.
- Municipality strengthens the partnership for the provision of mechanisation services to farmers.
- A course and meeting should be conducted for awareness
- Farmers must be supported to achieve quality.
- The department should provide production inputs and tractors when it's a season to plough and plant.
- The government must also provide fencing to needy community gardens.
- The government must fully fund all community gardens.
- It could be better if all public and private sectors roll out their sleeves, go out there and offer assistance to the desperate communities regarding agricultural knowledge and funds to uplift the projects and alleviate poverty.