THE IMPACT OF A CHANGE IN CLIMATE ON SMALL-SCALE FARMERS: CASE STUDIES OF THE KHOKHWANE, SIZANENJANA AND RICHMOND COMMUNITIES IN KWAZULU-NATAL, SOUTH AFRICA.

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DECLARATION

I, Simone Elvina Pillay, student number 210514750, hereby declare that the dissertation entitled, 'The impact of a change in climate on small-scale farmers: Case studies of the Khokhwane, Sizanenjana and Richmond communities in KwaZulu-Natal, South Africa' is the work of my own research investigations and that it has not been submitted in part or full for any other degree, to any other University. Where the work of others has been used, it has been duly acknowledged in the text.

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DEDICATION

To my parents, for always teaching me the value of education.

ABSTRACT

A large percentage of land use in South Africa is used for agricultural purposes, as this sector serves as the economic backbone of the country. A change in climate is likely to result in an increase in the frequency and intensity of natural disasters, such as floods and droughts. This has the potential to place strain on land, water resources and food security in rural areas, where small-scale subsistence farmers are dependent on agriculture to sustain their livelihoods.

The objectives of this study were to establish small-scale farmers' perception of a change in climate, and investigate the perceived impact a change in climate had on their agricultural production and food security. This research explored the current coping strategies small-scale farmers are adopting to build resilience to these impacts, as well as the potential mitigation strategies that could be implemented to improve their standard of living and ensure sustainable agricultural practices. Research was undertaken in three small-scale farming communities. The communities were: Khokhwane, Sizanenjana, and Richmond. The study employed a mixed-method approach using both quantitative and qualitative techniques. Quantitative methods consisted of structured questionnaire surveys and statistical analysis. The responses from the questionnaires were inputted and analysed using Statistical Package for Social Science version 23. Qualitative approaches consisted of participatory exercises, observations and focus group discussions.

The findings revealed that the majority of the respondents residing in the community households were women and children who carried out daily chores and upkeep of farm plots. Without environmental education and training, small-scale farmers have limited knowledge about a change in climate and its projected impact on food security. Overall, a change in climate is understood to have impacts on agricultural production in the three communities. On the one hand, results obtained illustrated that the Khokhwane and Richmond community experienced an improved standard of living and access to services compared to the Sizanenjana community. This was due to the assistance they are receiving from the local municipality and Non-Governmental Organisations through community upliftment, which supported farmers in establishing food gardens. This has aided them in achieving a favourable food security status and provided many employment opportunities for local small-scale farmers. On the other hand, the Sizanenjana community has received very little assistance from the local municipality. Thus, results from the Sizanenjana community reveal that small-scale farmers suffer greatly from the impact of a change in climate, especially on their crop production. Many households have ceased crop production and suffer from poverty and food insecurity. The findings demonstrate that in the future, environmental education and training programmes need to be carried out in communities in small-scale rural farms. Farmers should be educated on the projected impact of a change in climate and trained in sustainable agricultural practices, as a way in which to build resilience towards these changes. This can be achieved through increased stakeholder interaction, especially local government involvement, and the continued support from Non-Governmental Organisations. This has proven to be extremely helpful in improving the livelihoods of the rural poor.

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ABBREVIATIONS

ACT: African Conservation Trust

ARC: Agricultural Research Council

BFAP: Bureau for Food and Agricultural Policy

AIDS: Acquired Immunodeficiency Syndrome

CH_4: Methane

CO_2: Carbon Dioxide

COGTA: Department of Cooperative Governance and Traditional Affairs

CWP: Community Work Programme

DAEA: Department of Agriculture and Environmental Affairs

DAFF: Department of Agriculture, Forestry and Fisheries

DEAT: Department of Environmental Affairs and Tourism

DLGTA: Department of Local Government and Traditional Affairs

DUCT: Duzi-Umgeni Conservation Trust

EMF: Environmental Management Framework

EMP: Environmental Management Plan

EPA: Environmental Protection Agency

FAO: Food and Agricultural Organisation

FIES: Food Insecurity Experience Scale

GCM: Global Climate Model

GDP: Gross Domestic Product

GECFS: Global Environmental Change and Food Systems

GHGs: Greenhouse Gasses

GIS: Geographic Information Systems

GPS: Global Positioning System

HIV: Human Immunodeficiency Virus

IDP: Integrated Development Plan

IPCC: Intergovernmental Panel on Climate Change

KZN: KwaZulu-Natal

LCA: Life Cycle Assessment

LFS: Local Food System

MDGs: Millennium Development Goals

NEPAD: New Partnerships for Africa's Development

NGOs: Non-Governmental Organisations

NO_2: Nitrogen Dioxide

PPPs: Public-Private Partnerships

PRA: Participatory Rural Appraisal

PRM: Problem Ranking Matrix

RRA: Rapid Rural Appraisal

SANBI: South African National Biodiversity Institute

SAWS: South African Weather Services

SDF: Spatial Development Plan

SDGs: Sustainable Development Goals

SLA: Sustainable Livelihoods Approach

SLF: Sustainable Livelihoods Framework

SPSS: Statistical Package for Social Sciences

SSA: Statistics South Africa

SSA: Sub-Saharan Africa

UNICEF: United Nations Children's Fund.

UNFCCC: United Nations Framework Convention on Climate Change

WCT: Wildlands Conservation Trust

WFGP: Wildlands Food Garden Programme

WfW: Working for Water

WWF: World Wildlife Fund

CHAPTER 1:
INTRODUCTION

1.1 Introduction

A large percentage of land use in Africa is used for agricultural purposes as the agricultural sector serves as the economic backbone of the continent accounting for approximately thirty-two percent of the Gross Domestic Product (GDP) (Kearney, 2016; KPMG, 2015; Medany et al., 2006). Additionally, majority of the people residing in Africa and specifically South Africa, depend on the land to sustain their daily livelihoods (Boko et al., 2007). In South Africa, land has a variety of uses as with agriculture being most dominant land use in rural areas (Benhin, 2008; Tshuma, 2014). Rural areas in South Africa contain high levels of poverty and increasing unemployment (Tshuma, 2014). Thus creating the importance for small-scale agriculture within rural areas. Small-scale farmers are defined as non-commercial, subsistence farmers who reside in the rural areas, known as the former homelands (Kirsten and Van Zyl, 1998; Tshuma, 2014). These small-scale farmers use the land to grow agricultural crops for household consumption and do not have the means to access the markets to sell their produce (Kirsten and Van Zyl, 1998). In rural areas in South Africa, small-scale farmers' reliance on the land to produce household crops for their daily sustenance. In recent years, the changes in climatic conditions being experienced, has increased small-scale farmers vulnerability towards the impacts that a change in climate may have on their agricultural production. It is important to note that a characteristic of small scale farmers is that of limited access to training and formal education due to their remote location and access to opportunities (Boko et al., 2007; Tshuma, 2014). These limitations reduce small-scale farmer's ability to adapt to changes in climate. This is seen in the case studies presented in this research which will be discussed in detail in this thesis. The following section will outline the motivation behind this research.

1.2 Motivation for the study

Ringler et al. (2010) affirm that due to Sub-Saharan Africa's (SSA) decreased ability to adapt to climate change, this increases their vulnerability to the impacts of climate change especially in the agricultural sector. Livingston et al. (2011:4) emphasise that many people residing in SSA are poor and reside in rural areas which are home to seventy-five to eighty percent of the poor in SSA. The agricultural sector in Africa contributes to approximately

sixty percent of jobs on the continent, making it a vital sector in employment and household stability (Ojukwu et al., 2016; Yosef and Asmamaw, 2015).

Ringler et al. (2010) contend that world prices are a vital indicator of the impacts of a change in climate on the agricultural sector, food production and food security. SSA produces many staple crops and cereals that are exported to other countries. As changes in climate intensify, additional strain is placed on food production and global food prices, thus making affordability and accessibility of food challenging for people living in developing countries (Porter et al., 2014). In addition to fluctuating food prices, the impact of a change in climate will have disastrous impacts on malnutrition and health of individuals living in SSA (FAO, 2011b). In Africa, the majority of rural households depend on agriculture and land to sustain their livelihoods (Boko et al., 2007). Especially regions that have a lack of food security that rely on locally produced food for household consumption as they cannot afford to buy food from local markets and shops.

Liverman and Kapadia (2010) suggest that the majority of people living in Africa reside in rural areas and are dependent on agriculture for their livelihoods. There is a connection that exists between food production and the environment as food production is heavily reliant on its surrounding environment. Thus, climatic conditions are important aspects to consider when dealing with food production, as human livelihoods depend greatly on the environment they inhabit. Wlokas (2008) states that Africa is one of the most vulnerable continents to environmental and climate change thus, making it more difficult as poor people depend on the environment and are influenced greatly by the impacts that a change in climate may cause. A change in climatic conditions may decrease their standard of living even further, through changes in rainfall and temperature, resulting in extended periods of drought or floods (Nelson et al., 2010; Rosenzweig et al., 2001). Red Cross Climate Guide (2007) illustrates that one of the major impacts of a change in climate, is the effect on water resources especially in Africa. It is estimated that up to 250 million individuals will experience water stress by the year 2050. The stress on water resources will ultimately result in drought conditions being experienced, thus negatively affecting food production and food security in Africa. This is due to many agricultural activities which rely on water resources for irrigation purposes.

South Africa's agricultural sector is an important one, as it plays a pivotal role in ensuring household food security, food stability, employment and foreign income (Greyling, 2012).

This sector is also an important sector outside South Africa's borders. This is, as a result of South Africa being a large exporter of various crops and associated products. The Department of Agriculture, Forestry and Fisheries (DAFF, 2015) contend that South Africa is a major exporter of crops such as citrus fruits, grapes, pears, and maize which are some of the most important exported agricultural produce with reference to value. It is therefore vital to understand the changes that are occurring with respect to climate and to further investigate the impacts these changes in climate have on South Africa's agricultural sector. The current drought conditions experienced in South Africa has the ability to negatively affect exports of maize and other crops, as well as negatively affect food prices (ARC, 2015; Bureau for Food and Agricultural Policy (BFAP, 2016).

FAO (2016a:30) emphasise that extreme weather events have already caused much damage to agricultural crop production in small holder farms, affecting 226583 small holder farms in South Africa, who are already experiencing drought conditions. This highlights the need to undertake research to establish the problems that these small-scale female farmers encounter, thus uncovering possible solutions and adaptation strategies to aid them in dealing with the impacts that a change in climate poses on their daily lives.

Brown and Funk (2008) maintain that one of the extreme effects of a change in climate in the future will be on agricultural land and food resources. Increased weather phenomenon such as intense droughts and floods will reduce the yields of primary agricultural crops. Approximately ninety percent of the country consists of semi-arid or sub arid land, and only fourteen percent of South Africa's land is arable (SANBI, 2014). Most of the agricultural activities depend largely on climatic conditions and are reliant on rainfall. However, with the increase in climate change and global warming, these agricultural activities are being threatened. Furthermore, most agricultural produce is irrigated, and the dependence on this water resource increases as the impacts of a changing climate intensify, resulting in drought conditions. The projected changes according to SANBI (2014) in respect to agricultural crops will affect small-scale rural farmers the most, decreasing their water supply and crop yield, ultimately sending them deeper into the cycle of poverty.

Research undertaken by Carter and Gulati (2014) reveal that the western parts of South Africa have already been experiencing an increase in temperatures, and climate models predict that these temperatures will continue to rise as rainfall is expected to decline. However, in the eastern parts of the country, rainfall is expected to intensify, bringing with it

floods that will ultimately have a negative impact on crops and crop yield. Nelson et al. (2010) contend that the change in climate has the potential to decrease state of food insecurity. In addition, a change in climate has the potential to bring about an increase of 8.5 percent of the number of undernourished children in developing countries by 2050 (Nelson et al., 2010).

Climate change is now seen as a contentious and serious issue globally. The scientific evidence behind this statement is considered to be unalterable and is backed up by an increase in atmospheric and sea temperatures as well as an increase in the amount of GHG in the atmosphere, especially carbon dioxide (FAO, 2011a). According to the Intergovernmental Panel on Climate Change (IPCC, 2014) impacts of this change in climate can already be seen in the rising of the sea temperatures, melting of the glaciers, as well as an increased frequency in weather phenomenon. It is noted that these changes will be experienced by developing countries that will bear approximately 80 percent of the impacts of climate change, as agriculture is their main source of income (FAO, 2010; United Nations Childrens Fund (UNICEF, 2007). A change in climate will affect the agricultural sector the most as changes in rainfall and increased temperatures will affect the crop yield (FAO, 2010). These changes will impact small-scale female farmers the most as this will increase their vulnerability to food insecurity and poverty (Bob, 2008; Tibesigwa and Visser, 2015).

Water resources also play an important role in the agricultural sector. Wani et al. (2009) claim that a correlation exists between water, poverty and hunger. A change in climate will ultimately place strain on water resources during periods of drought, especially in areas that are dependent on rain for the irrigation of crops, thus resulting in poverty and hunger (FAO, 2016a; United Nations Framework Convention on Climate Change (UNFCCC, 2007). Research undertaken by Carter and Gulati (2014) claim that projections made for rainfall in South Africa estimate that there will be less frequent low-intensity rains and longer periods of dry spells between each rainfall event. This is further reiterated by statistics revealed in BFAP (2016) which indicated that the year 2015 experienced the lowest recorded rainfall in South Africa.

Climate models also predict that rainfall will intensify in the eastern parts of South Africa, and less rain will be experienced in the western parts of South Africa. These predictions are of great concern as South Africa is already a water scarce country, and increased pressure on water resources will place major strain on rural small-scale farmers. Carter and Gulati (2014)

explain that water resources can be divided into ‘green water’ and ‘blue water’. On one hand, most rainfall is known as green water. This is the rainfall that is absorbed by the vegetation and soil. Blue water on the other hand, is the rainfall that is stored within water bodies and underground reserves (groundwater). Blue water is important for agriculture as it is usually the water source used for irrigation through natural springs and boreholes, and forms an integral part of other food processing activities such as cleaning of crops and cooking.

A change in climate is likely to result in an alteration in global and regional climatic conditions. Subsequently resulting in a higher frequency of extreme events such as floods, droughts, cyclones and hurricanes. These extreme events have the potential to cause fluctuations in crop yields and food availability, negatively affecting small-scale farmers the most (Carter and Gulati, 2014; Culllis et al., 2015; IPCC, 2014; Schmidhuber and Tubiello, 2007). These changes will place strain on food and water resources which are important factors in food security (UNFCCC, 2007). A change in climate will not only affect food production, but will also have impacts on food availability as well as food accessibility, especially for small-scale farmers who are reliant on these crops for daily consumption. Some indirect impacts that will affect small-scale farmers include changes in the productivity, the quality of crops produced, and various farming costs to eradicate these changes as well as direct impacts on weather conditions which will ultimately affect agricultural procedures and livelihoods (IPCC, 2014; Porter et al., 2014).

This study is also of great importance as the agricultural sector plays an important role in South Africa’s economy and provides livelihoods for the majority of the country’s population. In South Africa, wheat and maize are two of the staple crops that sustain rural livelihoods. It is clear that a change in climatic conditions will ultimately affect the crop yields of these staple foods. Research undertaken by Akpalu et al. (2009) revealed a ten percent decrease in mean precipitation reduces the maize yield by four percent. The study suggested that an increase in mean temperature and decrease in mean rainfall would negatively impact maize yield and will have adverse effects on food security in South Africa, as well outside South Africa’s borders. Additionally, this study is of importance as South Africa is a large producer of staple crops. A decrease in exports will ultimately have negative consequences on the economy of the country (Carter and Gulati, 2014).

There is also a need for this study as the majority of small-scale farmers are undernourished; hence the intensification in a change in climate will exacerbate their condition making them

more vulnerable to food insecurity and diseases related to malnutrition (Nelson et al., 2010). New Partnership for Africa's Development (NEPAD, 2014) explains that Africa is the only continent where the number of malnourished people has increased. Food insecurity continues to be a rural phenomenon with many households going extended periods with little or no food, especially during the periods between harvests where food stocks and income are low (FAO, 2014). In most rural communities suffering from food insecurity, the children and the women are the ones who suffer the most (FAO, 2014; Tibesigwa and Visser, 2015). This is as a result of the best food being kept for the men or the heads of the households, leaving the children and women to suffer from nutritional deficiencies (Bob, 2008; FAO, 2013a).

The final motivation to undertake this study is to highlight the importance that government, both at a national and local level should play in ensuring food security at a rural household level. The Department of Rural Development and Land Reform (DRDLR) has put forward a strategic plan for the years 2015-2020. One of the aims of this strategic plan is aimed at improving small-scale farmers livelihoods through service delivery, education and financial support across the country (DRDLR,2015). At a local level, the KwaZulu-Natal Department of Agriculture and Rural Development (DARD) has established a strategic plan for the year 2015-2022. This strategic plan is aimed at increasing agricultural production in the province thus ensuring increased food security through development of subsistence farmers into commercial farmers. However, there is limited literature found on the initiatives that government has put forward to achieve its goals of strategic plans. It is therefore necessary to undertake this research to highlight the lack of government involvement on a ground level, in alleviating poverty at a household level.

1.3 Aim of study

The aim of this study is to investigate the impacts of a change in climate on food production, and to establish current and potential mitigation strategies in Sizanenjana, Khokhwane and Richmond communities in KwaZulu-Natal (KZN) South Africa.

1.4 Objectives of study

- To investigate small-scale farmers' perceptions towards a change in climate in Sizanenjana, Khokhwane and Richmond communities in KwaZulu-Natal.
- To examine the perceived impacts that a change in climate has on food security in Sizanenjana, Khokhwane and Richmond communities in KwaZulu-Natal.

- To examine the current mitigation measures taken by small-scale farmers in Sizanenjana, Khokhwane and Richmond communities in KwaZulu-Natal, to deal with the impacts of a change in climate.

1.5 Scope and limitations of study

With the intention of meeting the objectives of this study, triangulation consisting of both qualitative and quantitative methodology approaches, was used for data collection. The use of both qualitative and quantitative approaches helped gain a thorough understanding of the impacts of a change in climate that these communities in KZN are faced with. Quantitative approaches included the administration of three hundred questionnaires and responses were captured and analysed using Statistical Package for Social Sciences version 23 (SPSS). Examples of qualitative approaches included participatory techniques such as problem ranking matrix, observations and focus group discussions.

The three communities that were researched in this study were the Khokhwane community within the uMsunduzi municipality, the Sizanenjana community in the Ingwe local municipality and the Richmond community in the Richmond local municipality. One-hundred questionnaires were administered to small-scale farmers in each of the communities using a purposive sampling technique. The three communities were chosen using a purposive sampling technique, based on the notion that the communities consisted of households which practice small-scale agriculture.

A detailed description of each community will be discussed in the methodology chapter of this thesis. A conceptual framework consisting of political ecology, a food systems approach, the sustainable livelihoods approach and sustainability science were chosen based on the relevance each concept has to this study. A political ecology approach relates to the uneven distribution of resources and power experienced across all three communities, as well as within each community. A food system approach was chosen as this study involves small scale agriculture, which is impacted by a change in climate and ultimately affects food systems as a whole. When agriculture is affected by changes in climate, food production decreases, thus, affecting food systems at a local level. The sustainable livelihoods approach was chosen as many principles of this approach are seen in the Richmond and Khokhwane community presented in this research. The concept of sustainability science was used through transdisciplinary approaches in achieving sustainable agricultural practices was seen in the Richmond and Khokhwane communities, and can be used as a positive example of adopting

this way of thinking in communities that lack upliftment and assistance, such as that of the Sizanenjana community.

Limitations of this study include firstly, the fact that the findings from this study are from selected small-scale farmers. Therefore, this may limit the generalisation of the study in a sense that not the entire KZN province was sampled. Secondly, this research was undertaken in only one region in KZN, thus does not give an accurate understanding of the impacts of a changing climate on all small-scale farmers across the entire province. Lastly, the language barrier was seen as a limitation, as the mother tongue of the small-scale farmers is IsiZulu. Therefore, problems were encountered with translation from English to IsiZulu.

1.6 Thesis outline

This thesis comprised of six chapters. This chapter focused on the motivation to undertake this study, focusing on the need for this study and the importance of researching the impact of a change in climate on food production in rural communities in KZN, South Africa. Thereafter, the aim and objectives of this study were discussed. Subsequently, the scope, delimitations and limitations of this study were identified in this chapter. Chapter two will look at a review of the relevant literature related to this research study, and will focus on issues such as the importance of agriculture in South Africa, as well as the vulnerability of this sector to a change in climate, stresses and shocks. This chapter will also attempt to discuss the mitigation and adaptation techniques that can be adopted by small-scale rural farmers to mitigate and manage the impact of a change in climate especially on agricultural production. The conceptual framework underpinning this research will be presented in chapter three. Concepts and frameworks that will be discussed include: political ecology, the sustainable livelihoods approach, sustainability science, and a food systems approach. Henceforth, chapter four will review the description of the study area as well as the selection and procedure for choosing the case study sites. Additionally, chapter four will also delve into the research methodology and the sampling strategy which was utilised for the data collection, as well as the methods and processes used in the analysis of the data obtained. Chapter five will examine the presentation of the results obtained from the questionnaires and participatory exercises, together with an analysis and discussion of these results. Chapter six will then conclude with a summary of the research presented, drawing on the key findings obtained and will suggest recommendations for future research niches.

1.7 Conclusion

The agricultural sector plays a pivotal role in the livelihoods of many rural communities. Many rural poor are dependent on agriculture as a means to sustain their livelihoods and rely on resources such as agricultural land and water (Livingston et al., 2011; Ojukwu et al., 2016; Yosef and Asmamaw, 2015). However, as a change in climate intensifies, the impacts can be seen across SSA and will affect poor people residing in rural areas the most. It is therefore important to gain a thorough understanding of the impacts that a change in climate has on small-scale farmers and their food production, and how this affects the status of food security in their community. By gaining a deeper understanding of the social, economic and environmental impacts of climate change on these small-scale farmers, it is then possible to recommend future mitigation measures and suggest ways in which their livelihoods and food production can be improved in a sustainable manner.

CHAPTER 2:
LITERATURE REVIEW

2.1 Introduction

This chapter will outline the relevant existing literature related to a change in climate and food security issues. This chapter will begin by looking at the key concepts related to climate change and food security. It is important to note that research on climate change has increasingly become more accessible to society, as the change in climate is continuing to intensify bringing with it disastrous consequences. This literature review will look at the threat that a change in climate poses on developing countries, especially South Africa, and the impact that a change in climate has on agricultural productivity. This chapter will then discuss the concepts related to poverty, food insecurity, and the link between climate change and food insecurity in the South African context, bringing it down to a local scale. As established earlier by Boko et al. (2007) South Africa is a developing country and is vulnerable to the impacts of a changing climate especially on agricultural production. Additionally, livelihoods of rural farmers who reside in rural areas are also at risk as they are dependent on agriculture and land for basic sustenance and wellbeing (FAO, 2010; Kearney, 2016).

2.2 Defining rural

There is no clear definition of a rural area, as the term signifies many things to different individuals, thus rendering no universally accepted definition (Madu, 2016; Novotny and Hruska, 2015). Rural areas are characterised by their vast open landscapes, strong traditional beliefs, agricultural activities and dependence on nature (Madu, 2016; Ward and Brown, 2009). These characteristics differ as opposed to an urban area which is more industrialised, and constantly undergoing change (Ward and Brown, 2009). However, Chigbu (2013) argues that rural areas do undergo change, just not at the same rate as urbanised cities. Due to the difficulty of researchers to define rural, there are many discrepancies and uncertainties which lie in the understanding and perception of what a rural area is. Novotny and Hruska (2015) argue that it is due to these inconsistencies that many definitions of rural interconnect with that of peripheral. This uncertainty is seen in the case study presented in this research of the Richmond community. This community, although characterised by reliance on agriculture,

low unemployment and poverty rates, is situated within close proximity to the built up town of Richmond.

South Africa's agricultural sector is of great importance to rural areas as it serves as a key source of livelihoods and income (Agricultural Research Council (ARC, 2015); Boko et al., 2007). Knot et al. (2014) contend that South Africa consists of different climatic regions. Variable rainfall and eco regions allow for a variety of crops to be farmed, as well as two types of farming to exist in South Africa, such as subsistence farming, which is undertaken on a small scale and commercial farming, which is undertaken on a much larger scale. (Sebopetji and Belete, 2009; South African National Biodiversity Institute (SANBI, 2014). Kirsten and van Zyl (1998) differentiate commercial and subsistence farming by stating that small-scale farmers are non-commercial, growing produce for their own consumption and to feed their families and neighbours. Whereas commercial farmers in South Africa, grow produce on a larger scale and have access to modern and efficient technology which aids them in producing the best quality crop yields. Sebopetji and Belete (2009) further state that commercial farms are much larger than small-scale farms. Small-scale farmers usually possess small food gardens in which they produce their household crops, while commercial farmers grow crops on large plots of land from which the crops are sold on the market.

Rural areas in South Africa consist mainly of small-scale farmers who reside in the homelands and outskirts. The majority of these small-scale farmers that are dependent on agriculture to sustain their livelihoods, is comprised of female headed households (Tibesigwa and Visser, 2015). This can be seen in the case studies presented in this research whereby the Sizanenjana and Khokhwane community reside in a rural area. These two communities rely on small-scale agriculture to sustain their livelihoods. Crops are mainly produced for household consumption in these communities, while a small percentage may sell their crops to gain an income. The concept of rural is important to understand in this context of this research as the communities chosen for this study reside in rural areas and are subject to the negative issues associated with rural areas such as a lack of service delivery, poverty, lack of basic care and decreased access to educational facilities. In recent years, the increased intensity of changes in climate has hindered crop production in rural areas and has negatively affected small-scale farmer's livelihoods.

2.3 What is climate change?

Climate change can be defined as a change in the mean of the climate over a prolonged period of time, that is, decades or even longer (Hergerl and Zwiers, 2007; IPCC, 2014). Climate change can occur due to internal processes or external forces. Internal being natural causes such as volcanic activity and other natural processes (Stern and Kaufmann, 2014). External forces that cause changes in the climate however, are anthropogenic influences such as changes in the atmosphere due to the industrial revolution and population growth (Gemeda and Sima, 2010; Stern and Kaufmann, 2014; Riebeek, 2010). The first IPCC report contained minimal information regarding the climate, however, six years later in the 1996 IPCC report, there was talk about anthropogenic forces altering the climate. Subsequently, in 2001, the IPCC report suggested that there was a noticeable human influence on the climate which had contributed to the climate change during the twentieth century.

According to the IPCC (2014), research undertaken by scientists has revealed that over the last century, climatic and atmospheric conditions have been at their worst, with carbon dioxide increasing from 278 parts per million to 379 parts per million. Scientists have further stated that the past decade has witnessed some of the hottest years and an increase in global average temperatures (Hergerl and Zwiers, 2007; IPCC, 2014). The IPCC (2007) argues that during the preindustrial era, there had been an increase of approximately seventy percent in emissions of GHGs, mainly due to human activity. The IPCC (2014) further states that the rate of Carbon Dioxide has increased an estimated twenty-eight percent between 1990 and 2004. Rosenzweig et al. (2001) suggest that there have been many Global Climate Models (GCMs) that have predicted an increase in the amount of GHG emissions released into the atmosphere. There has been a prediction of a warming of 1.5^{o} C – 5.8^{o} C as well as an increase in the mean global precipitation (Misra, 2014; Rosenzweig et al., 2001). In addition to this, climate change and global warming will bring about extreme weather events such as severe drought and intense periods of frequent floods which have the potential to destroy agricultural yields (Venkatatamanan and Smitha, 2011).

There is evidence to imply that the sea level has risen about 25cm within the last 100 years (IPCC, 2007). This demonstrates that climate change and global warming is not a recent phenomenon and is something that has been occurring for many decades, and will continue to intensify in years to come (IPCC, 2007; Misra, 2014). Ziervogel et al. (2014) emphasise that in South Africa, climate change continues to be of great concern as we have experienced a one and a half time increase of the global average temperature which is 0.65^{o}C in the past

decade. Additionally, South Africa has experienced an increased frequency in natural phenomenon such as droughts and floods (IPCC, 2014).

2.4 Impacts of climate change

Changes in climate have the potential to impact on natural and human systems, and vice versa (Stone et al., 2013). The impacts of climate change are ones that are experienced globally. For example, changes in precipitation, extreme weather events and melting ice caps result in increasing sea levels (Campbell et al., 2016; Cullis et al., 2015; Misra, 2014). It is estimated that by the year 2100, the sea level is expected to rise by 0.59 metres (Rosenzweig et al., 2001). This increase in sea levels has the potential to influence oceanic circulation patterns, ultimately affecting sea currents, temperature and rainfall patterns worldwide. Changes in temperature and rainfall patterns will ultimately bring about an increased frequency of natural disasters such as droughts, floods and tropical cyclones which have the potential to cause much physical damage to property and most importantly crops (Brown and Funk, 2008; Campbell et al., 2016; IPCC, 2014). The impact of climate change on rainfall patterns is expected to result in either severe drought or flooding conditions, depending on the area affected. Severe drought conditions will impact negatively on small-scale farmers situated in areas already experiencing water scarcity (Carter and Galati, 2014; Nelson et al., 2010). whereas a change in temperature is likely to result in alterations in growing seasons of various crops or a shortage of crop production overall, thus affecting the status of food security especially in developing countries (FAO, 2011b; Porter et al., 2014; Rosenzweig et al., 2011). Additionally, increased intensity of climate change is likely to result in increased pest infestations, negatively affecting crop production (Lal, 2013).

2.4.1 Impact of climate change on agricultural productivity

Globally, climate change will inevitably affect agricultural production and instigate sever damage to both crops and livestock (Rosenzweig et al., 2001). Rosenzweig et al. (2001) further emphasise that the continued increase in intensity of climate change and predicted trends will have extreme effects on the agricultural environment globally, as well as on the availability of good quality food. In addition, increased climate change, is influenced greatly by an increased global population growth as a result of increased industrialisation. According to the FAO (2011b) statistics reveal that the world population is growing at an alarmingly high rate. By the year 2050, the global population is estimated to be approximately 9 billion, with much of the growth emanating from SSA (Lal, 2013). In order to meet these demands,

agricultural production will need to increase by seventy percent (FAO, 2010). This strain on agricultural production has the potential to cause many ripple effects within the agricultural sector globally.

2.4.2 Impact of climate change on Africa's food security and agriculture

The impacts of climate change are diverse and experienced globally. However, it is unfortunate that developing countries who contribute the least to climate change are the ones are most vulnerable to the impacts of climate change (Tol, 2009). SSA is most vulnerable to food insecurity due to ninety-five percent of its land is dependent on rain (Wani et al., 2009:1). The impacts of a change in climate faced by Africa include increased temperatures and decreased rainfall, which will ultimately reduce the small-scale agricultural productivity and yields, threatening food security especially in rural households (Lal, 2013). Cullis et al. (2015) argue that Global Climate Models (GCMs) have predicted an overall warming over the SSA, with the East becoming more wet, while the West is predicted to experience hotter drier conditions. Small-scale farmers food security status in Africa is under various threats such as poverty, increased urbanisation, escalating growth rates, environmental degradation and climate change (IPCC, 2014). The spikes in food commodities between 2007/2008, are spikes that affected rural household farmers too (Nawrotzki et al., 2014). The IPCC (2014) expresses considerable concern towards African countries due to the fact that if climate change continues to intensify, staple food prices will be likely to increase which could have tremendous consequences for food security in developing African countries. If climate change continues to intensify, impacts could worsen in the future, thus leading to potential global price increases of basic cereals and staple crops.

Reddy (2011:11) states that:

> *Environmental problems have reached unprecedented levels to the extent that few would disagree that our planet is on the brink of ecological disaster. Many environmental problems such as climate change transcend national borders, but the effects thereof are felt by local communities.*

2.4.3 Impacts of climate change on South Africa and Kwazulu-Natal

The agricultural sector is a key sector in South Africa, contributing greatly to the county's GDP as well as at a local level, contributing to household food security (Benhin, 2008). Over the past few decades, a change in climate has been observed through increased temperatures and changes in rainfall patterns in South Africa (Benhin, 2008; Joubert, 2011; Ziervogel et

al., 2014). These changes in climate will result in increased frequency of extreme events such as droughts and floods as well as issues such as poverty and low education rates, limits the ability of people living in rural areas to acclimatise to changes. The impact of a change in climate on South Africa will have disastrous consequences on food security. A decrease of essential crop yields in South Africa, as well as a change in the length of growing season is likely to occur. Maize, a staple crop for many subsistence farmers, is likely to be most vulnerable to the effects of climate change (FAO, 2009). The impact of changes in climate, especially at a rural household level will have significant consequences on rural women, as many households within rural areas are run by females (Boko et al., 2007; FAO, 2011b).

Water resources act as an important variable in South Africa's agricultural sector. The uneven distribution of rainfall in the country allows for various crop types to be grown (Benhin, 2008). The Western parts of the region are drier and desert while the east displays characteristics of wet and humid conditions. Small-scale agriculture is reliant on rainfall for agricultural production. The changes in climate such as reduction in rainfall patterns in South Africa, acts as a hindrance to agricultural production in rural areas (Benhin, 2008; Joubert, 2011; Ziervogel et al., 2014). Ziervogel et al. (2014) assert that over the past five decades, there has been a 1.5 time increase in mean annual temperatures of 0.65^{o}C in South Africa.

The agricultural sector in KwaZulu-Natal contributes significantly to the GDP and produces a large percentage of staple crops. A change in climate would result in disastrous effects on small-scale agriculture, impacting their produce. Studies undertaken by Ziervogel et al. (2014), suggest that changes in climate are likely to result in negative impacts on crop production especially in regions dependent on rainfall for agricultural production such as in KwaZulu-Natal where the study areas presented in this research study were undertaken. The KwaZulu-Natal Provincial Growth and Development Strategy (2016), states that due to KwaZulu-Natal having high rates of poverty, density and land degradation, this has contributing in the province experiencing the highest human vulnerability to changes in climate. Additionally, in the Eastern parts of KwaZulu-Natal, communities are prone to extreme flooding and drought spells. Erosion and associated land degradation will also occur during extreme events, resulting in damages to agricultural crops thus hindering small-scale agricultural production. Climatic changes in KwaZulu-Natal will bring about agricultural opportunities in some areas, while in other areas agricultural losses will occur (KwaZulu-Natal Provincial Growth and Development Strategy, 2016). Food security in municipalities such as uMgungundlovu, where two of the case studies in this research, are located, will be

exacerbated by changes in climate. Additionally, the KwaZulu-Natal Provincial Growth and Development Strategy (2016) stated that two areas of concern in KwaZulu-Natal, are the Midlands, where the Sizanenjana community is located, and areas that contain high levels of poverty and densities. All three case studies presented in this research, fit this criteria.

2.5 Millennium Development Goals and beyond

In order to address the issues of poverty and food insecurity in the light of the challenges faced by climate change, the Millennium Development Goals (MDGs) were derived to aid people residing in developing countries to achieve improved livelihoods. The United Nations Declaration (2000) explains that as individuals we have individual responsibilities to our families and households, but as a society we have a collective responsibility to maintain the values and principles of human equality and equity globally. The reason for discussing the MDGs in this research, was to highlight the need to undertake more studies on small-scale farmers in helping them alleviate poverty.

The MDGs main goal was to eradicate poverty in developing countries, but also focused on improving the livelihoods of rural women and children, especially young girls. This relates closely to this research as many of the respondents interviewed were women. Improvement of access to education and employment and was also set out to strengthen the empowerment of these females (FAO, 2013a). The MDG's consisted of eight time-bound goals to be accomplished by the year 2015. There were eight MDGs proposed which targeted issues such as poverty, education, environment and gender equality, issues which were relevant to this research study.

The FAO (2014) indicates that global hunger has continued to decrease slowly. Over the last decade, global hunger has decreased by 100 million and since 1990 by 209 million. Statistics show that globally, hunger and undernourishment have decreased by 7.4 percent, and in developing countries, such as South Africa, by 9.9 percent. However, there remain a large percentage of people who suffer from malnutrition and insufficient food resources as seen in this research study. FAO (2014) states that approximately one in nine people worldwide still do not have access to adequate food. The aim to reach the MDGs has been within reach according to the FAO (2014) but has not been achieved. Additionally, it is argued that in the rush to try and achieve the MDGs, countries focused more on communities which were easier to reach, relating to urban bias, forgetting about communities and people who need help the most.

2.5.1 Beyond 2015

In the year 2015, the MDGs expired, with less than half of the targets being met. It is therefore important for delegates and countries not to give up hope in meeting the targets of halving poverty. In an effort to address the shortcomings of the MDGs, the Sustainable Development Goals (SDGs) were put into place in September 2015.

2.6 Sustainable Development Goals (SDGs)

The MDG's have acted for 15 years as the guiding path for the fight against poverty, and have been an indicator of the standard of living in developing countries. Even though many developing countries have made a considerable amount of progress in achieving the MDGs set out by the UN in 2000, it is now 2016, and the MDGs have not been fully met, thus leaving poverty high on the list of concerns in the future. In 2012, world leaders met for the "Rio+20" summit where progress of the MDGs were deliberated. It was stated that over the past 15 years, MDGs have played an important role in the progress towards alleviating poverty and that once the MDG's have expired, the fight to alleviate poverty should continue (Pisano et al., 2015). Therefore, in 2002 the sustainability panel issued the repost that at the end of the MDG's, a new set of goals will be adopted to help developing countries alleviate poverty. These are known as the SDGs, an outcome of the 2012 "Rio+20" summit and will be carried out for a 15 year period September 2015-2030 (Griggs, 2013; Pisano et al., 2015).

The SDGs are a continuation from the MDGs, however they differ slightly. While the MDGs looked at developing countries and their need to alleviate poverty, the SDGs are a new set of targets aimed at all countries across the world. The SDGs differ from the MDG as they feed into sustainable development along the triple bottom line (Pisano et al., 2015). SDG suggests goals and targets that are not only for the poor, but are for the wellbeing for the entire world, rich or poor, and is focussed on integration. The SDGs relate closely to this research project, as one of the emerging themes of the SDGs is to focus on partnerships geared towards sustainable development. This issue is an important issue that emerged from this research and which was observed in two of the case studies presented. The SDGs, similar to that of the MDGs, aim to address the challenges of poverty, especially at a rural level where 80% of the world's poor and hungry reside. There are seventeen SDGs and one-hundred and sixty-nine targets to help achieve these goals. Below are a list of the seventeen SDGs (Pisano et al., 2015:5). The SDGs not only address the need to alleviate poverty, but also seek to include the

security and safety of people and the planet as a whole (Griggs, 2013). The SDGs that relate closely to this research are:

SDG1- To end poverty in all its forms everywhere.

SDG2- To end hunger, achieve food security and improved nutrition and promote sustainable agriculture. This goal links closely with the case studies presented in this research

SDG5- To achieve gender equality and empower all women and girls; and

SDG13- To take urgent action to combat climate change and its impacts.

These goals relate closely to this research as the communities presented in this research study succumb to a great deal of poverty. Majority of the small-scale farmers are women who assume the role of caregivers and play an important role in ensuring household food security. The impacts of climate change, as discussed earlier in this chapter, are ones that are experienced greatly by small-scale farmers, especially in the case studies presented in this research study. The achievement of the SDGs in the years to come, will be favourable for small-scale farmers residing in rural areas who need the assistance and guidance that the SDGs seek to provide.

2.7 What is poverty?

Woolard (2002) describes the term poverty as being multi-faceted as it may refer to various things from a lack of access to resources, unemployment, vulnerability to shocks and homelessness. Globally it is estimated that there are approximately 1.2 billion people living in poverty, and of that, seventy-five percent reside in rural areas (Gustavo and Stamoulis, 2007). With the population rate increasing, the number of people living in extreme poverty has increased in the last two decades by 100 million people (Beegle et al., 2016). Biyase (2012) argues that poverty is a phenomenon more common to rural areas rather than urban areas. This is further emphasised by Beegle et al. (2016) who states that the occurrence of poverty is evident in developing countries where many of the poor people reside in rural areas. This is evident in the case studies presented in this research study whereby community members in the Sizanenjana and Khokhwane community suffer a great deal from poverty in terms of insufficient income and resources to sustain their livelihoods. These individuals, many of whom are women, are reliant on agriculture to support their livelihoods. Dhembo (2014) emphasises that unemployed women residing in rural areas are most vulnerable to poverty. Poverty is a trait that has always, and will continue to be associated with rural people

in developing countries, especially female-headed households (Chigbu, 2013; Schatz et al., 2011).

In South Africa, poverty has been a great concern since the apartheid era whereby Black locals were forced to reside in the homelands and rely on the land and its surrounding resources to support them. However, post-democracy interventions have tried to address the issues of land reform and poverty through policies, legislation and partnerships. These interventions were aimed at reducing poverty, with the agricultural sector playing a vital role in the alleviation of poverty. The Reconstruction and Development Programme (RDP) is an example of such an intervention. The RDP, (1994:9) emphasises: "No political democracy can survive and flourish if the majority of its people remains in poverty, without land, without their basic needs being met and without tangible prospects for a better life".

According to Statistics South Africa (SSA, 2014), three national poverty lines were published by the South African government in 2012. The three poverty lines are the Food Poverty Line (FPL), the Lower Bound Poverty Line (LBPL), and the Upper Bound Poverty Line (UBPL). A definition of these poverty lines as stated by SSA (2015:1):

> *These lines capture different degrees of poverty and are defined as follows: the FPL is the Rand value below which individuals are unable to purchase or consume enough food to supply them with minimum per-capita-per-day energy requirement for good health (which is about 2 100 kilocalories). The LBPL and UBPL include a non-food component. However, individuals at the LBPL do not have command over enough resources to consume or purchase both adequate food and non-food items and are therefore forced to sacrifice food to obtain essential non-food items. Individuals at the UBPL on the other hand can purchase both adequate food and non-food items.*

The purpose of the poverty lines is to distinguish the poor from the non-poor using a well-defined standard which is accepted by society (SSA, 2015). Additionally, the rationale of having multiple poverty lines is to differentiate between the different levels of poverty experienced as individuals experience different levels and types of poverty.

2.8 Food security

There is one thing that people worldwide have in common, and that is the need for sufficient and nutritious food. According to the South African constitution (Act 108 of 1996) all people have the right to adequate food. It seems easy enough to provide food for every human being.

Despite the progress made to ensure this through the MDGs and SDGs, hunger and starvation continue to be the fate of millions of people worldwide, especially in developing countries such as South Africa (Ballard et al., 2013). Ballard et al. (2013) state that the FAO has estimated approximately one in eight people worldwide are malnourished, and that social inequities are the root of the problem, with new external influences such as climate change and price spikes having begun to intensify the issue of malnutrition, leading to severe food security issues in developing countries such as South Africa (Bain et al., 2013; Ballard et al., 2013).

2.8.1 What is food security?

Food security is a broad term which refers to the definition of people obtaining nutritious food on a daily basis (FAO, 2008). There are many definitions of food security, as it is a very broad term, and means different things to different people and organisations. Migotto et al. (2005) suggest that there have been over two-hundred definitions of food security. The majority of these definitions all focus around the same point - that food security exists when all people have access to nutritious food in order to lead a good enough lifestyle. Godfrey and Garnett (2014) argue that in recent years there has been an increased acknowledgment that a clearer definition of the term food security is needed. The most well-known definition of food security was defined at the World Food Summit in Rome 1996, as "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 an active and healthy life" (FAO, 2008:1). Food insecurity is now viewed as a global concern, however it is an issue that is seen to affect the African continent the most severely (Nawrotzki et al., 2014).

According to the IPCC (2014) food security is composed of four dimensions. These dimensions are: Firstly, the *availability of food* - is there sufficient food being produced? Secondly, *food access* - if there is food available, can people easily access this food? Thirdly, *food utilisation* - based on the influence of people's surroundings, how satisfactory is the intake of this food? And lastly, *food stability* - how constant is the access to and the supply of food? These dimensions will be discussed in the section to follow. It is important to note that climate change will negatively affect all four dimensions of food security (Campbell et al., 2016).

Du Toit (2011) maintains that there is often a distinction between food security at a household level, and food security at a national level. Food security at a household level

exists when all members within that household have access to safe and healthy food and do not experience extended periods of time suffering from starvation. Food security at a national level refers to a nation's ability to manufacture and import enough nutritious food to sustain its countries' needs. For the purpose of this research, this study will be looking at food security from a rural household level.

2.8.2 Dimensions of food security

There are four dimensions of food security as mentioned above. These are: food availability, access to food, food stability and the utilisation of food (Burke and Lobell, 2010; FAO et al., 2014). The introductions of a suite of indicators around these dimensions were formulated in the *state of food insecurity in the world 2013.* These suite of indicators measures food security across these four dimensions so to give precedence to food security needs. The four dimensions of food security will be discussed below:

2.8.2.1 Food availability

Food availability looks at the quantity, quality, as well as the diversity of food. Indicators that assess food availability consist of looking at the share of calories from cereals and other roots. Additionally, food availability looks at the average protein supply, sufficiency of dietary energy and average value of food produced (FAO et al., 2014). Food availability refers to a countries ability to have sufficient food and meet the needs of its people on a continuous basis, both at a national and household level (Burke and Lobell, 2010; du Toit, 2011). Additionally, the dimension of food availability looks at adequate supply of appropriate and nutritious food either via locally produced or imported food supply. Given the present climate change status, food availability is threatened by the direct impacts of climate change such as extreme events of droughts and flooding as well as the change in rainfall patterns and the increased temperatures that are drying out crops (du Toit, 2011).

2.8.2.2 Food accessibility

Indictors of food accessibility consist of both physical and economic access. Physical access includes infrastructure such as roads and railways that hinder or help people in reaching a food source. Economic access can be represented by the domestic food price index as well as the predominance of malnutrition and undernourishment. Food accessibility refers to the ability of people at a household level, and as a nation, to successfully acquire sufficient food to sustain their livelihoods on a continual basis (du Toit, 2011; FAO et al., 2014). Food

accessibility is affected and influenced by climate change through extreme events such as floods and other natural disasters. These natural disasters cause delays or lack of transport of food, as well as impacts on productivity and production. These delays make it difficult for rural people to access *safe* and *nutritious* food. Additionally, the increase in globalisation has also led to inequalities with respect to food availability. The reason being the access to technology and science has increased food accessibility for some, whilst others in developing nations have limited access to technological advancements and food (Charles et al., 2010).

2.8.2.3 Food utilisation

Indicators for food utilisation also fall into two categories. The first category deals with factors that affect a person's ability to utilise food, such as access to proper sanitation and water sources. Whereas the second category focuses on the consequences resulting from improper utilisation of food, looking at issues such as malnutrition, wasting of food and the nutritional value of food (Campbell et al., 2016; du Toit, 2011). Food utilisation explained by du Toit (2011) refers to the appropriate use of food which stems from the knowledge of basic nutrition and care. Climate change negatively affects food utilisation, thus impacting on the quality of food produced (Burke and Lobell, 2010). Climate change brings with it an increase in disease infested crops and less nutritious intake of food (FAO, 2011a).

Climate change has the potential to decrease standards of living of people especially in rural areas, making it harder for them to grow safe and nutritious crops due to the conditions surrounding them (IPCC, 2014). It is important to note that there is a difference between food security at a national level, and food security at a household level. At a national level, food security refers to a nation's ability to manufacture, import and maintain the food needed to sustain its population. (du Toit, 2011). However, at a household level, food security is a community's ability to attain food that is nutritious and culturally acceptable in order to live a healthy lifestyle. In other words, a household is considered to be food secure when the household does not suffer from starvation for constant periods of time.

2.8.2.4 Food stability

Indicators of food stability can be divided into two groups: the first group deals with the measurement of exposure to food security risk. Indicators of this include the cereal dependency ratio, the value of the imported staple foods, and the area under irrigation. The second group focuses on issues such as shocks. For example, the fluctuations in domestic food as well as the instability of political factors regarding food (FAO, 2014). Another shock

outlined by Campbell et al. (2016) is that of pressures placed on ecosystems. Such as decreases in biodiversity as well as shifts in species migratory routes. An example is that off pests. The geographic location in pests, leads to a decrease in crop production, instability of a food system. These factors affect the utilisation of crops and pose a risk for people residing in rural areas to have access to adequate nutritious food *at all times* - something which is necessary in order to be deemed food secure. Therefore, the notion of food stability is directly dependent on the availability and accessibility of food (FAO et al., 2014).

It is important to note that all four dimensions of food security are influenced greatly by education (du Toit, 2011; Ilaboya et al., 2012). An individual's access to education influences the food security status of a household. The higher the education received, the more skills and expertise an individual gains aiding them in getting a job and earning an income thus accessing food and utilising it in a sustainable manner. Education is also a vital part of maintaining a food garden. If individuals are taught how to manage and plant crops in accordance to the changes in climate and to plant in a sustainable manner, the chances of achieving a good food security status increases (du Toit, 2011; Ilaboya et al., 2012).

2.8.3 Status of food security

There is sufficient food to sustain the majority of the people living on the planet and to achieve food security globally (IPCC, 2014; Nawrotzki et al., 2014). However, it is unfortunate to note that the percentage of people that do not fall under this category, are found in developing countries. In the year 1996 to 2010, the number of undernourished individuals in the world had increased from 840 million to 925 million (Abdu-Raheem and Worth, 2012; FAO, 2011b). Bremner (2012) maintains that one in every four people do not have access to adequate food. Furthermore, the majority of these undernourished individuals reside in developing countries (Abdu-Raheem and Worth, 2012). According to the IPCC (2014) research undertaken by Smith et al. (2006) reveal that there is approximate a fifty-nine percent food insecurity rate in twelve African countries. This evidence states that SSA has the highest percentage of food insecure people worldwide (IPCC, 2014). Bremner (2012) further argues that the changes in climate are placing strain on limited resources, thus increasing the number of food insecure people in Africa.

2.8.4 Status of food security in South Africa

According to du Toit (2011) South Africa is seen to be a fairly food secure country as it produces staple foods, and imports enough food which meets the basic nutritional requirement of its population. Abdu-Raheem and Worth (2012) agree with du Toit (2011) by stating that South Africa produces sufficient crops to sustain its population. However, at a local scale, it is unfortunate that the same status cannot be shared in rural households. Food security is a severe problem that is still faced by many South Africans two decades after democracy. Even with South Africa's food secure status, approximately thirty-five percent of the country's population resides in rural areas and are vulnerable to food insecurity (du Toit, 2011). Abdu-Raheem and Worth (2012) state that efforts to increase food security status in South Africa have not been enough. For example, the country has seen increased employment rates in the last few years, however this increase has not reached the level of satisfaction necessary to alleviate poverty (Abdu-Raheem and Worth, 2012). Furthermore, the increase in food prices of staple crops in the world markets has also negatively impacted rural South Africans. It is unfortunate that the majority of the rural households that experience the brunt of these increases are female-headed households, the elderly and children (UNICEF, 2007). Due to the increased rates of land degradation, and soil erosion on agricultural landscapes in South Africa, food security is threatened as a result of unsustainable land use and unsuitable farming methods (Yosef and Asmamaw, 2015; UNEP, 2013).

2.8.5 The history and root cause of poverty in South Africa

The practice of farming dates back centuries ago as evident in the late 1800's when the Khoi and San locals co-existed on the land. Mazibuko (2000) states that these locals relied on hunting and traditional subsistence farming until the early twentieth century, when the British and Dutch colonies occupied South Africa. The colonies owned the land and the locals worked as farm labourers. An important point to note is that Black South Africans had access to land, even though owned by the colonies South African History Online (SAHO, 2013). However, access involved the locals becoming tenants of the land which saw the exchange of hard labour for minimal wages. Land, power and labour is all that mattered to the colonies. Thus arose the beginning of poverty and inequality in the late nineteenth century (Stapelton, 2015).

Poverty and social inequality are rooted in pre-apartheid and apartheid policies such as the migrant labour system in the late nineteenth century with the discovery of gold and diamonds

(Modise and Mtshiselwa, 2013; Stapelton, 2015). Black locals were recruited to work as cheap labour and forced to live near the mines, giving rise to the migrant labour system (Harrington et al., 2004). Rural people were forced to migrate to the cities in search of employment to alleviate poverty**.** These mine workers were forced to stay in single-sex hostels, leaving their families behind in the rural areas. This act of not allowing men to bring their families is the epitome of gender discrimination and gender inequality. The men would return home with income much awaited by their families, once their work was complete (Harrington et al.; 2004; Mazibuko, 2000).

Life for the locals worsened during the early twentieth century, when the Boers and British fought for sovereignty and the Natives Land Act was passed in 1913 (Modise and Mtshiselwa, 2013). The Natives Land Act saw eighty percent of the local people excluded from buying, growing and selling on ninety-three percent of the land (Modise and Mtshiselwa, 2013). Black locals were forced to occupy outlying areas known as the homelands or reserves where the land and soil were infertile and the populations per square km were dense (SAHO, 2013). Therefore, a situation arose whereby many individuals occupied a single plot of land. The implications of this were repetitive farming in one plot of land causing land degradation and further exacerbating their poverty. These unsustainable farming techniques are still practiced presently as seen in the case studies presented in this research. Unsustainable farming techniques such as overcrowding cause land degradation and depletion of natural resources faster than the land can rejuvenate (Mazibuko, 2013).

Segregation and poverty intensified in the mid twentieth century with the Group Areas Act being passed in 1950 (SAHO, 2013). This act deepened racial segregation as locals were forced out of urban areas. Non-whites were not allowed to enter or reside in urban areas and were required to carry with them their identification book to prove that they were entering the urban areas for work. The Black locals were forced to reside in the outlying areas known as the Bantustans or Homelands (SAHO, 2013). The apartheid policies and regimes were meant to divide and rule (SAHO, 2013).

It is therefore concluded that the Natives Land Act of 1913, as well as pre-apartheid and apartheid policies were intended to divide and rule. Additionally, these policies can be seen as the root cause of socio-economic injustice and the sole cause of the poverty being experienced presently. This is evident in the case studies presented in this research whereby many locals reside in the outlying rural areas, kilometres away from built up cities and towns.

The land remains infertile in some areas, and the lack of sustainable farming knowledge and resources makes it difficult for rural farmers to produce a healthy yield.

Therefore, the men and youth are required to migrate to the cities in search of employment whilst the women stay behind and look after the food gardens and take care of the children. It is here where the women grow, manage and sell the produce from the food gardens, and partake in other activities such as bead work in order to make ends meet (Bob, 2008; FAO, 2014). Rural women are left behind to solely reproduce the next generation, and farm. Dasgupta et al. (2014) state that this act of men migrating to the cities often places strain on the women left behind as the burden of work increases. Women dominated the rural areas in the past, and continue to do so presently in the rural areas. Even though the laws and policies of land dispossession and migratory labour system have been lifted, the patterns of rural urban migration are still practiced presently in rural homelands.

2.8.6 The link between food security and poverty

Abdu-Raheem and Worth (2012) note that there is a strong correlation between food security and poverty, and are issues which should be discussed in unison. FAO (2015a) argues that it is common to find high levels of food insecurity within developing countries such as South Africa, experiencing high unemployment and poverty rates. Botha et al. (2015) emphasise that poverty and food security are issues that are faced by many rural South African people who experience declining failures with their crop production due to climatic variability. As a result, this decreased crop production sends them deeper into the cycle of poverty. Furthermore, du Toit (2011) and the IPCC (2014) maintain that the concept of food insecurity is strongly linked to the concept of poverty. Du Toit (2011) contends that poverty occurs when people do not have access to the means to afford basic necessities such as clothes, proper sanitation and healthcare, clean drinking water, nutritious food and a proper education. Du Toit (2011) further states that even though some households may suffer from poverty, they may experience food insecurity as a result of their own shortage of food production. Poverty and food insecurity are interrelated and will inevitably impact one another. Food security often stems from the fact that people live in poverty and cannot afford access to basic nutritious food. Food insecurity and poverty often leads to a vicious cycle of social, environmental and economic problems.

Wight et al. (2014) claim that often, households which suffer from extreme poverty will suffer from food insecurity. In most cases, it is found that the women, children and elderly

bear the cost of inadequate access to nutritious food. In rural households it is found that low food security is common among children. This is as a result of children suffering through infrequent meals and nutritious intake of food which is less than what is required to be considered healthy. FAO (2015b: 27) emphasise:

> *The hungry are the poorest of the poor; they have limited or no access to physical and financial assets, little or no education, and often suffer from ill health. Poor agricultural households lack access to sufficient, high-quality land and other natural resources or to remunerative sources of income. At the same time, hunger creates a trap from which people cannot easily escape. Hunger and under nutrition mean less-productive individuals, who are more prone to disease and thus often unable to earn more and improve their livelihoods. This in turn, hinders progress in alleviating extreme poverty and fighting hunger-particularly as labour is the principle asset held by the poor.*

Males who have migrated to the cities in search of work may often be seen as a safety net for rural households. These males send remittances to the household, which has the ability to reduce poverty (Ratha, 2013). Unlike loans, remittances incur no debt and are seen as an immediate source of income (Mishi and Mudziwapasi, 2014). This income can be used for children's education, health care and food. Studies undertaken in KZN by Worku and Marangu (2015) revealed that households which received remittances improved their standards of living and decreased household poverty by ten percent during the period 1993-1998. Similarly, studies undertaken by Mishi and Mudziwapasi (2014) reveal that remittances received by households in Ecuador were able to send their children to school and improve the household's standard of living. Whilst on the idea of households receiving remittances to improve their standards of living, Mishi and Mudziwapasi (2014) argue that the rate at which rural household poverty can decrease is dependent on the amount of remittances received by that household.

2.8.7 The link between climate change and food security

There are many challenges being faced in terms of a change in climate and food security in South Africa. As seen in both the MDGs and SDGs, the alleviation of poverty is unlikely to be achieved soon. This, coupled with the increased intensity of climate change, poverty in rural households is likely to increase (Cullis et al., 2015). Nelson et al. (2010) note that agricultural production is reliant and determined by climatic factors such as temperature and rainfall. The major restraint that farmers face with regards to agricultural production in rural

areas is climate change (FAO, 2009; Nelson et al., 2010). Thus this change in rainfall patterns has a negative impact on agricultural yields. A low and erratic rainfall pattern due to climate change has made it difficult for rural farmers to grow crops on their plots of land, as agricultural production is rain-fed. If climate change continues to intensify and alter rainfall and temperature patterns, it is likely to affect agricultural production and ultimately impact on food security (FAO, 2011b; Nelson et al., 2010).

2.9 Gender issues

2.9.1 Women, land and climate change

The importance of researching gender issues is pertinent to this study as majority of the small-scale farmers residing in the communities interviewed, were female. A discussion below will indicate the important role small-scale female farmers play in small-scale agriculture and ensuring household food security.

Gender plays a vital role in the distribution and access to land as well as other resources within a rural household. Land can be categorised into many uses such as land for grazing purposes, land for the growing crops, land for utilisation of its natural resources, land for residential purposes or land to boost the social status of that household. The different types of land use is seen in the case studies presented in this research, whereby land is used for agricultural production, grazing of cattle, residence and utilisation of natural resources. Land in rural areas means a great deal to its inhabitants in terms of socially, environmentally, politically, traditionally and economically. Land is an important commodity and is unevenly distributed between women and men as women's access to land is half of that of men (Ojukwu et al., 2016). Plots of land belonging to men tend to be larger than plots belonging to women even though women are the primary users of the land (Bob, 2008; Ojukwu et al., 2016). Statistics show that globally women own less than fifteen percent of land, with this figure showing no indication of increasing in the near future (Bob, 2008). Gender inequalities exist especially in rural households where access and control over assets and services such as land, transport and education is given preference to men (Dassanayake et al., 2015; International Forum for Rural Transport and Development (IFRTD, 1999). Tibesigwa and Visser (2015) further state that households in rural areas headed by females are much more vulnerable to the impacts of a changing climate and food insecurity in comparison to male headed households.

Alam et al. (2015) contend that much focus around climate change has been on the scientific and economic aspects. There has not been much focus on the impacts of climate change on women and their daily lives (Mehra and Rojas, 2008). In a society where much focus is on men and the work they do, not much attention is paid to women and the effects climate change may pose on their wellbeing. Society's influence on the manner in which people perceive men and women is evident in the distinct tasks performed by men and women, as well as the differentiated access to education, skills, technology and other resources (Karl, 2009; Raidimi, 2014; Tibesigwa and Visser, 2015). This is evident in the case studies presented in this research whereby men have more power and control over resources and finances, whilst women are the ones who are required to oversee the food gardens and upkeep of the homesteads.

World Health Organisation (WHO, 2014) further emphasise that the roles of men and women are different according to society thus differently affecting their vulnerability to climate change depending on the roles and responsibilities they hold. Women are perceived as the care giver, cook, and cleaner, consequently placing an extra burden on them during times of changes in climate. These roles and responsibilities of women according to the FAO (2014) go unpaid, as women do not receive any remuneration for the labour that they perform in the household. This limits women's ability to increase agricultural production, as access to opportunities are restricted. Whilst the men, whose roles and responsibilities as perceived by society to be the providers and bread winners, may be compromised and effected during and after climatic events. Dhembo (2014) argues that employment of women in rural areas has the potential to uplift their standard of living and alleviate poverty.

2.9.2 The role of small scale-female farmers in food security

The role of women in small-scale agriculture has not been focussed on much (Mehra and Rojas, 2008). However, Raidimi (2014) states that in most recent years, there have been a few organisations that have recognised the role which women play in small-scale agriculture. Some organisations include The World Bank, as well as The Food and Agriculture Organisation.

According to FAO (2014) women play a pivotal role in ensuring food security within a rural household. It is important to note that the majority of the rural households in Africa are headed by women. This is as a result of the high rural-urban migration rate, whereby many youth and men leave their rural home and migrate to the cities in search of food and

employment. Often men do not return home until the end of the month, leaving the women to fulfil both the roles of men and women within the household and community (Fedha et al., 2015). Many studies have revealed that female headed households are more vulnerable to food insecurity and poverty than households headed by men (Dassanayake et al., 2015; Woolard, 2002).

Women carry out many of the responsibilities within the household such as planting of crops, managing the food gardens, collection of wood and water, house chores and seeing to the children and elderly (Bob, 2008; Dhembo, 2014; Tibesigwa and Visser, 2015). In addition to this, Raidimi (2014) states that women not only oversee the planting and harvesting of crops, but also the processing, storage and marketing of the crops as well. Every decision made regarding the crops is undertaken by the women of the household, and therefore the women play a vital role in ensuring food security. This is presented in the case studies in this research. The majority of the respondents were female, and head of their household. Integrated Development Plan (IDP, 2015/2016) maintains that in the Ingwe municipality, one of the communities in which this research was undertaken, female headed households constitute for 56.5 percent of the population. This is attributed to rural-urban migration whereby the men leave the rural areas in search of work in the cities.

In addition to these rural women carrying out most of the activities in and around the household, the work they perform is unpaid (Bob, 2008; Dhembo, 2014; FAO, 2013a). Therefore, in addition to making sure that their household has sufficient food and water, these rural women have to do so with the little or no money that has been left for them by their spouses or that which they receive from their social grants. In some instances, money is spent solely on school fees and school clothes, relying on the crops being produced to feed their household. If crop yields are low, then the household survives on the minimal crops that have grown, sometimes going extended periods without sufficient or nutritious food (Bob, 2008; FAO, 2013a; Tibesigwa and Visser, 2015).

Bonthuys (2010) emphasise that HIV and AIDS is a common ailment among rural households. The death of the mother of the household often leaves with it the burden of the children or elders running the household. Without the females running the household, poverty increases resulting in food insecurity (Nawrotzki et al., 2014). Additionally the lack of resources and access to services further exacerbates their standards of living (Mokgatle-Nthabu et al., 2011).

2.9.3 Women and the future

Women are the main drivers of food security and ensuring food security within rural households. In future scenarios, the work that women do need to be more recognised (Raidimi, 2014). Allowing women and children access to more opportunities has the potential to increase the amount of opportunities that both women and children have access to, for example, the training of women in rural areas. Training workshops and skills development workshops should be undertaken in these rural areas to educate women about the impacts of climate change as well as ways in which to minimise these impacts. With proper education and training, women can produce good quality nutritious food for themselves and their household. Furthermore, the empowerment of women is an important approach in the fight against poverty (FAO, 2013a).

It is vital to educate women about the importance of decision making at local and household levels, as rural women are important in ensuring food and nutrition security (FAO, 2013a; Raidimi, 2014). Moreover, educating women about family planning and pregnancies is important, as it will help reduce the growth rate and will enable women to seek employment without having the burden of remaining home-bound and taking care of their children. The encouragement of women to get married at a later age will aid in achieving this, according to the FAO (2013a). Rural women need to become more independent and decrease their reliance on men to provide for them. The way forward is through educational training programmes and assistance from local governments and Non-Governmental Organisations (NGOs). Raidimi (2014) further states that these training programmes should also be inclusive of men. However, this inclusion should not dominate and make decisions rather to educate men in working alongside with women and to make decisions collectively.

2.10 Adaptation techniques

Due to South Africa's vulnerability towards climate change impacts, adaptive responses are required in order to mitigate climate change impacts. Campbell et al. (2016) suggests that in order to address the challenges of climate change and food security, a multidisciplinary approach is needed. The mitigation and adaptation to a change in climate is not something that is new to South Africa. Due to our country's high emissions compared to other African countries, mitigation strategies have been a focus for many years introducing policies, documents and conferences to help reduce and manage the impacts of climate change (Ziervogel et al., 2014). Koch et al. (2006) argue that adaptation techniques are irrevocably

linked to development since climate change affects development sectors the most. Thus adaptation techniques need to focus on sectors such as agriculture.

With the growing threat of a change in climate on agricultural production in South Africa, it is vital that rural female farmers begin to apply adaptation techniques to deal with and reduce the impacts of a change in climate on their agricultural production. Wilk et al. (2012) suggest that the exchange of knowledge and expertise between farmers has the potential to allow for adaptation techniques to be adopted easily, as it is more likely that rural farmers will trust other farmers rather than outsiders or authority figures. Rural farmers are also more likely to adopt new techniques, if these techniques have been used and tested by superior ranked farmers and have proven to be successful. Furthermore, it is also important to note that rural small-scale farmers, especially female farmers, lack financial capital making them more resilient to the notion of adaptation techniques. Ziervogel et al. (2008:20) argue:

> *A key component of climate adaptation involves building resilience, where resilience is the capacity of a system to tolerate disturbance without collapsing into a qualitatively different state that is controlled by a different set of processes: a resilient system can withstand shocks and rebuild itself when necessary.*

An example of a resilient adaptive technique could be that of climate-smart agriculture.

2.10.1 Climate-smart agriculture

Preserving and improving food production encompasses a change in current agricultural patterns and methods of small-scale farmers. A transformation in these agricultural practices will not only improve the food security status, but address other socio and environmental issues such as poverty reduction, protection of natural resources and protection of land through sustainable farming (Campbell et al., 2016). The FAO (2014) terms these types of changes, Climate Smart Agriculture (CSA) as they have the potential to manage social, economic and environmental challenges. Some examples of climate-smart agricultural systems include soil and nutrient management, water harvesting, introducing more resilient ecosystems and efficient harvesting and supply chains. In South Africa, there are no policies on CSA, however a study undertaken by Mnkeni and Mutengwa (2014) have revealed that National governments are beginning to apply climate smart principles into farming practices. One of which includes the use of climate resistant crops, appropriate crop rotation to farm in relation to the climate as well as water harvesting techniques.

2.10.1.1 Soil and nutrient management

Nutrients such as nitrogen, phosphorus and potassium are important in producing good yields of crops. It is important to note that many small-scale farmers' soil lack basic nutrients. It is therefore vital that small-scale farmers know how to efficiently manage the nutrients within the soil. This can be achieved through organic composting and creating organic manure filled with nutrients required. This in addition, decreases the need to buy synthetic fertilisers which are costly to small-scale farmers (FAO 2010).

2.10.1.2 Harvesting and storage

Small-scale farmers need to be taught how to efficiently harvest crop yields to ensure minimum waste and loss. According to the FAO (2010) this will help increase the quantities of crop yields and aid in food security. In addition, proper storage facilities can be introduced to farmers to store their crops in a more convenient and safe silo-like place. A grain warehouse for communities can be built, funded by governments and willing organisations.

2.10.2 Sustainable agricultural practices

There are many challenges being faced by rural small-scale farmers, mainly external. However, these are not out of their control. Meyer (2014) believes that if managed in the correct manner, these small-scale and commercial farms have the potential to overcome these external forces and thrive in the new conditions being presented to them. This control comprises a blend of both traditional indigenous knowledge coupled with modern-day techniques. This is known as sustainable agricultural practices (FAO, 2016a). An example of a sustainable agricultural practice is the use of water harvesting.

2.10.3 Water harvesting

Water is an important resource in the agricultural sector as mentioned earlier. However, it is unfortunate that South Africa is a water scarce country and many small-scale rural farmers lack this essential resource. Water is used by many female rural farmers for various activities around the household such as: cooking, cleaning, washing of clothes and consumption. However, decreased water supplies hinder the daily activities of female headed households, and impact negatively on crop production (Kahinda et al., 2007).

It is therefore important to educate small-scale farmers about the importance of water harvesting and the efficient use of water. Yosef and Asmamaw (2015:18) suggest that there is no universally accepted definition of water harvesting, however it involves the "capturing and

storing of seasonal excess runoff and diverting it for household and agricultural uses". Everson et al. (2011) maintain that the use of water harvesting by small-scale rural farmers has the potential to increase agricultural production, thus improving rural livelihoods. Water harvesting techniques include the installation of rainwater tanks, which are usually supplied by the municipality. Once these tanks are filled with rainwater, this water can be used for the irrigation of crops.

Other forms of water harvesting include *in situ* water harvesting techniques include pot-holing, mulching, ridging and pit planting (Mudatenguha et al., 2014; Yosef and Asmamaw, 2015). These techniques increase the infiltration of water into the soil and decrease surface runoff and soil erosion. This technique of water harvesting is seen in the case studies presented in this research study. The Khokhwane, Sizanenjana and Richmond communities all use rainwater tanks to store water. This water is used for irrigation purposes and is useful in periods of no rain. Furthermore, in situ water harvesting techniques such as mulching is practiced in the Richmond community which has contributed to management of water resources and improved agricultural yields.

Bob and Bronkhorst (2014) contend that the use of water harvesting techniques by small-scale farmers has the potential to help alleviate poverty and increase their food security status. Water harvesting techniques involve the sustainable use of water resources and can serve as a source of water for irrigation purposes during times of water shortages. This agricultural method has been implemented in many rural communities in provinces across South Africa such as KwaZulu-Natal, Limpopo, Eastern Cape and Free State. These methods have proven to be successful in increasing agricultural yields as a result of the efficient use of rainwater for agricultural activities. Other environmental advantages of water harvesting techniques include decreased surface runoff and reduced amount of evaporation of surface water. Studies undertaken by Yosef and Asmamaw (2015) in Ethiopia reveal that in situ rain water harvesting has improved agricultural yields and improved food security. Similarly, studies undertaken in Rwanda by Mudatenguha et al. (2014) reveal an increase of maize yields and economic productivity through efficient use of in situ water harvesting techniques.

For adaptation techniques to be a success, it is important that a good grounding of environmental education be established, especially at a local rural household level. Abdu-Raheem and Worth (2012) assert that 'agricultural extension', is a term used to describe adult based educational programmes which were established and run in English Universities in the

late 1860's. Agricultural extension or environmental programmes are important steps in adapting to a change in climate as well as to ensure maximum use of resources to produce a healthy yield, leading to food security. Collett and Gale (2009) further state that agricultural extension projects can be offered in different forms such as demonstrations, training courses or workshops. The ultimate goal of agricultural extension programmes is the transfer of knowledge and skills. Thus, educating small-scale farmers to ensure sustainable agricultural practices are performed to ensure increased crop yields. Provincial and local governments of agriculture play a vital role in the implementation of extension programmes in rural areas. It is important for government to become involved in the education and training of rural individuals to improve their livelihoods.

2.10.4 Public Private Partnerships

The establishment of Public Private Partnerships (PPPs) encourage both the sharing and gaining of knowledge by all stakeholders involved. This is further iterated by Ghosh (2016:38) who argues:

> *In order to achieve the global, regional and national development goals, the participation of actors well beyond the agricultural sector is required, broadening the range of stakeholders and competing views and interests. Academia in particular can play an important role in promoting critical thinking and research and innovations for developing sustainable food systems. In partnership with national governments as well as with the regional and global organisations, academia can provide the much-needed evidence-based data, strengthen skills and demonstrate novel practices that can bring about the transition. From an institutional perspective, strategic alliances with universities, research organisations and networks can add yet another important dimension to multi-stakeholder engagements – they can not only leverage comparative advantages, share knowledge and increase capacities, but also broaden outreach among youth and open possibilities to embed sustainable food system in the wider context of academic pursuits.*

The establishment of PPPs has the potential to increase small-scale farmer's resilience to the impacts of climate change. Successful PPP is seen in the Richmond community. The Partnership established between Wildlands Conservation Trust, African Conservation Trust and the local community has helped them in achieving household food security. Another successful example of PPPs, is the Working for Water (WfW) programme. The WfW programme recognises the importance of water resources especially and the threat that alien species pose on water supplies. The programme consists of many stakeholders such as

government (funder), scientists, municipalities, public and local rural people. The aim of the programme was to create employment while educating local people about the importance of water conservation and the long term goal of poverty alleviation. Local rural people are educated about alien invasive plants in their water systems, and their removal. They are then compensated for removing the alien species, gaining an income and education at the end of it all. Aliber (2002) asserts that the WfW programme has allowed rural individuals to improve their livelihoods by paying off debts, eating healthy and nutritious food, and using the income gained from the programme to buy farming equipment and see to certain needs. The social benefits of the WfW programme are further highlighted by Turpie et al. (2008:794):

> *The programme has created thousands of jobs, with a strong emphasis on gender equity, and provides considerable benefits such as skills training and health and HIV/ AIDS awareness programmes…24,000 previously unemployed people, 52% of whom are women, were employed in 2000. It also generates further income through the development of value adding industries, such as furniture, fuel wood, and charcoal that use alien vegetation as inputs.*

2.11 Conclusion

It is vital to understand the changes that are occurring with respect to the climate and to come up with possible solutions to aid rural small-scale female farmers. These small-scale female farmers have to deal with the impacts of a change in climate on a daily basis. Impacts of a change in climate in South Africa, and specially KwaZulu-Natal, are seen in decreased quality and quantity of crop yields due to extreme weather events such as droughts and floods. Research shows that many rural farmers lack environmental knowledge and skills to adapt to the changes that are occurring, or to ensure that their yields are not negatively affected. Environmental education and training workshops through the establishment of PPPs need to be carried out in these remote rural areas to educate these small-scale farmers about sustainable agricultural practices and the threats of climate change.

CHAPTER 3:
CONCEPTUAL FRAMEWORK

3.1 Introduction

A theoretical framework is an important part of research as it lays the foundation and grounding of the research to be undertaken; setting out a vision for the entire research (Grant and Oanloo, 2014). This chapter will present the conceptual framework underpinning research undertaken in Sizanenjana, Khokhwane and Richmond communities in KZN. This research focuses on the impact of a change in climate on small-scale farmers. Emphasis is placed on a change in climate, farmers, food security and rural communities. The frameworks and approaches that will be looked at are: political ecology; a food systems approach; the sustainable livelihoods approach; as well as sustainability science and stakeholder involvement. These frameworks and approaches will be discussed in order to understand the effects that a change in climate poses on food security within rural small-scale households in the Sizanenjana, Khokhwane and Richmond communities in KZN. These theories and frameworks underpin the notions of sustainable development and poverty within the rural context, focussing on the importance of integration and the interconnectedness between different systems in achieving sustainability.

3.2 Political ecology

Political ecology is not an entirely new paradigm, but it is an evolved path (Mathevet, et al., 2015; Greenburg and Park, 1994). Watts and Scales (2015) argue that since its emergence, the field of political ecology has concerned itself with the relationship that exists between society and the environment, with a strong focus on agriculture. Walker (2005) asserts that in recent years, the field of political ecology has increasingly become a dominant field of study within the discipline of geography. There are two theories that have influenced the evolution of the term political ecology. These are political economy and ecological analysis. Political economy focuses on the concept that power distribution is linked to productivity, whereas ecological analysis specifically focuses on bio-environmental relationships. Greenburg and Park (1994) maintain that political economy was a field that tended to focus on social constructions, while excluding anything that was *not* human, such as the environment. Political ecology however, addressed these issues, and is a field that is inclusive of all that is not human. Additionally, political ecology makes inclusion for the environment as well as cultural political factors and activities (Watts and Scales, 2015).

Over the past 20 years, the field of political ecology has evolved into many research areas across a variety of disciplines, some of which include geography, biology, political science and anthropology to name a few (Paulson and Gezon, 2005; Watts and Scales, 2015). The definition of political ecology dates back as early as the 1970's when anthropologist Eric Wolf and environmentalist Grahame Beakhurst defined the concept of political ecology as the study of the relationship that exists between political economy and ecology in the context of environmental movement (Benjaminsen and Robbins, 2015; Khan, 2013; Paulson and Gezon, 2005; Robbins, 2004). Presently, political ecology covers similar principles and explores the social relations of power within the context of a changing and degraded environment. Political ecology looks at the unequal distribution of power and resources, and the conflict that is a consequence of the unequal distribution of power and resources (Zimmer and Bassett, 2013). Robbins (2004) further states that political ecology is research that is centred on the theory that any disturbance to the global interconnected web of the human-environment relationship can cause ripple effects throughout an entire system.

According to Adams (2001) many of the world's poor reside in developing countries, usually rural areas where they are forced to live in and suffer degraded environments and impoverishment. Their cycle of poverty as well as their limited access to resources worsens their condition and standard of living. The decreased standards of living as seen in the communities presented in this research affect their daily livelihoods and influence the manner in which crops are produced. Decreased crop production affects food systems and associated processes, which will be discussed later in this chapter. Adams (2001:204) asserts "poverty and environmental degradation often form a trap from which there is little chance of escape". This refers to the poor having insufficient resources to relocate thus they are forced to continue working and living in those degraded environments. Peet and Watts (1996) present a case study in Cochabamba, whereby uneven economic development has resulted in small-scale farmers having no alternate measure, thus continue to use the land in an unsustainable manner. Due to a lack of distribution of resources and knowledge, farmers further degrade the land, exacerbating living conditions, thus increasing poverty and food insecurity. This is seen particularly in the Sizanenjana community presented in this research study. The community continue to suffer and reside in this area where there are limited and uneven distribution of resources which has resulted in small-scale farmers farming in degraded conditions, within minimal resources and knowledge. Furthermore, the hilly terrain creates soil erosion and land degradation which, Adams (2001) states, forms a trap that they cannot escape from.

Adams (2001) further states that, by no fault of the poor, they are sometimes the cause of their own suffering. Due to the extreme poverty they experience, the poor do not have the proper resources, environmental knowledge and education to minimise their impact on the environment in their daily activities. The lack of access to resources and education result in land being used in unsustainable manners. This results in decreased agricultural production, which has ripple effects of food systems, both locally and globally (Galt, 2016). It is evident that there is a distinct relationship that exists between people and the environment (Mathevet et al., 2015; Greenburg and Park, 1994).

Political ecology involves the understanding of the dynamics that exists between social groups and the environment within the context of the global environment, focusing on climate change (Ferguson and Derman, 2005; Zimmer and Bassett, 2013). Research and observations reveal that environmental change and impacts of climate change are felt unevenly between different cultural and social groups (Ferguson and Derman, 2005). Thus inequality leads to the issue of power. Examples of such inequalities include stakeholders with higher authority or power who receive more benefits and resources, leaving the minority, that is the people residing in rural areas, with little or no access to basic services and resources to sustain their livelihoods. Such inequalities are known to exist due to the urban bias. Assistance and resources are given first preference to urban cities as they are situated in prime locations thus receiving assistance, sources and good policies. However, due to the locality of rural areas, rural individuals lack access to resources creating inequalities among social groups (Chigbu, 2013; Dixon and Mcmichael, 2015).

Political ecology aims to incorporate all justifications across temporal and spatial scale (Adams, 2001; Anderson, 2016). For example, the phenomenon of soil erosion at a local scale can be viewed as an environmental problem and can be said to be as a result of incorrect farming practices by small-scale farmers. However, political ecology will argue that soil erosion can arise due to other political aspects such as an increased shortage of farm labourers during peak periods bringing about the increased migration of men seeking work, thus leaving the women to fend for themselves and manage the farm without improper knowledge and expertise.

On the one hand Adams (2009) reiterates the importance which political ecology portrays in that environmental problems occur not only because of environmental processes, but due to political economy. For example, it is known that soil erosion is a process that occurs when

heavy rains wash away top soil that has been dug or is exposed. On the other hand, Adams (2009) suggests that there could be another reason that the soil has washed away. This is owing to the shortages of labourers, due to the men migrating to the urban areas in search of work or unsustainable intensification of agricultural practices (Anderson, 2016).

Political ecology is therefore a concept that aims to merge the social and environmental aspects, thus creating a more equal distribution of power and resources among society, instead of the existing hierarchal system of power and dominance (Anderson, 2016). For example in the rural areas, the chiefs and inkosi of the community with power, receive more resources and benefits such as basic necessities while their communities which they are meant to lead suffer in poverty. The same can be said for local government systems and authority figures that do not provide sufficient resources and opportunities for their communities (Adams, 2009). The lack of government involvement and placing communities at the centre of decision and planning, results in unsustainable use of land and resources as seen in the Sizanenjana case study. Unsustainable use of land results in unsustainable food systems resulting in a decreased food security status.

3.3 Food systems approach

According to Ingram (2011) in the late 1990's, the notion of a food systems approach surfaced due to the increased relationship between global environmental change and food security. A new approach was needed; therefore, a food systems approach was developed. This new approach differed from previous approaches as the focus was on the integration of different disciplines with the introduction of the project Global Environmental Change and Food Systems (GECFS) (Eriksen et al., 2010a). A sustainable food system can be defined as one that is able to produce nutritious healthy food and achieves food security without compromising environmental, social and economic aspects (Ghosh, 2016). Overall, the application of a food system results in minimal waste being produced as well as a decreased carbon footprint. Additionally, a sustainable food system involves farmers using resources wisely and more efficiently resulting in a circular use of resources rather than a linear system (Anderson, 2016; Ghosh, 2016). Additionally, Anderson (2016:6) asserts:

> *Sustainable food systems require healthy soil and clean water; skilled farmers and other food producers; secure intergenerational transfer of resources and knowledge and dispersed, decentralized food and energy production. This set of attributes is most likely to be found in rural areas.*

The wise use of resources, however, is not a concept which many small-scale farmers are aware of as this is seen in the case studies presented in this research. The uneven distribution of resources and knowledge as discussed in political ecology above, results in unsustainable food systems. These unsustainable food systems are witnessed in the case studies of the Sizanenjana and Khokhwane communities where lack of access to resources has resulted in the community using the land in an unsustainable manner. This has resulted in degradation and erosion which has negatively influenced food systems in the communities.

A food systems approach can be used to assess the access to food security by exploring biophysical resources. Additionally, this approach can be used to understand the manner in which different food systems interrelate to global environmental change, globalisation and the impacts thereof on food security, especially in developing countries (Eriksen et al., 2010a). Porter et al. (2014) claim that countries in Africa are experiencing an increased rate of urbanisation. As a result, there has been transformation of its food systems to adapt to the changes in food production, food processing and food consumption patterns. As the change in climate and its associated impacts intensifies, there has been an increased reliance on food purchased from urban areas. In order to address the issue of climate change and food security, a food systems approach needs to be assessed.

The idea of food security has always been centred on the notion of producing sufficient food to feed a given population to maintain a healthy lifestyle. However, Grant (2015) advocates that food security should not only be centred on notions of food production, but also the quality and nutritious value of the food being produced. For example, in Africa there are many individuals who presently suffer from malnutrition and related sicknesses. The implementation of a food systems approach to address food security and malnutrition issues could be beneficial in alleviating poverty.

Eriksen et al. (2010b) states that a food system covers a variety of activities from the planting of the seeds, to the disposal of the waste at a household level. A food systems approach encompasses and is shaped by many variables such as political, economic, environmental and social. These aspects can influence the way in which a food system can function in a particular place. This means that different food systems will thrive and be successful in different places depending on the various driving factors (Eriksen et al., 2010b; Grant, 2015). For example, the types of crops grown in a particular area are affected not only by social aspects but also climatic conditions. Over a period of time these aspects can also be

influenced and affected by climatic changes. Thus confirming that food systems are highly dynamic and dependent on a variety of aspects.

La Valle (2008) indicates that food is linked to human welfare, health, as well as livelihoods, and is an important factor in influencing social, cultural and economic theories. The access to resources influences the preparation and consumption of food which in turn affects the well-being and health of an individual. A food system comprises of many components and variables. Eriksen et al. (2010a) agree with La Valle (2008) and maintain that there are many activities associated with food systems. Some of which include; the production of food, processing of food, distribution of food and the consumption of food. The idea of a good food system links to the notion of food security which ensures safe production, access and utilisation of food. There are many drivers that influence food systems. These are Global Environmental Change drivers; socio-economic drivers and natural drivers.

3.3.1 Application of a food systems approach

In more recent times, Eriksen et al. (2010a) state that the adoption of a food systems approach or a Local Food System (LFS) has become increasingly popular. Consumers are becoming more conscious about the whereabouts of where their food is produced, and are seeking to acquire food that has been produced closer to them to create a lower environmental footprint. There are many aspects of a food systems approach that have influenced the thinking of a LFS. The idea behind the LFS is the shorter time and distance between production and consumption, as food is locally produced decreasing major production, manufacturing and transport costs. The food system approach is trying to decrease the carbon footprint of a product. If one looks at the amount of greenhouse gasses that the entire supply chain of a product from farm to fork produces, the carbon footprint of that product will be great, as compared to the carbon footprint of a product that is produced locally. The use of Life Cycle Assessments (LCA) has been instrumental in calculating the footprint of products and minimising environmental risk. The notion of the application of LFS, can be beneficial to small-scale farmers. Many small-scale farmers, for example in the case studies presented in this research, do not have access to markets and therefore produce is utilised for household consumption. However, if a market arises for crops produced at a small-scale level, local farmers residing in rural areas would be able to gain an income from crops produced and improve their livelihoods while simultaneously decreasing the carbon footprints of those consumers purchasing crops from a supermarket.

3.3.2 The vulnerability to shocks affecting food systems

According to Eriksen et al. (2010b) it is important to understand why livelihoods and ecosystems are vulnerable to, and find it difficult to adapt and recover from, shocks and stresses. The notion of vulnerability differs from discipline to discipline. Eriksen et al. (2010b) indicates vulnerability to be a certain harm or shock from which it is difficult to recover. Vulnerabilities and shocks experienced in the case studies include changes in climate and rural-urban migration. These vulnerabilities impact negatively on crop production, affecting food systems at a local level. Prakash and Gilbert (2011) contend that vulnerability of food systems are influenced by factors such as changes in climate which affect harvesting of crops, exporting zones, as well as trade of agricultural goods. La Valle (2008:70) indicates that vulnerability and food security go hand in hand by stating "Food insecurity increases along a vulnerability spectrum, with increasing wealth degradation". Many rural livelihoods' vulnerability to food insecurity stems from the deep-rooted cycle of poverty in which they are born, as well as decreased opportunities such as limited access to markets and resources. La Valle (2008) states that food security is linked to poverty especially in rural households where individuals are unable to keep up with food prices, and access to markets is weak.

3.3.3 Dimensions of vulnerability

La Valle (2008) asserts that resilience can be described as a system's (livelihoods and surroundings) ability to remain stable in the presence of change and shocks. Eriksen et al. (2010a) state that resilience is the ability of a system to take in change and shocks without shifting into a different environmental state. There are four dimensions to food system resilience. Each pillar related to each of the food security dimensions. These are: social resilience, ecological resilience, economic resilience and consumption resilience (Eriksen et al., 2010a; La Valle, 2008). These four dimensions will briefly be discussed in the paragraphs to follow.

Ecological resilience is related to food availability and can be influenced by climatic conditions. Usually the conversion of land from natural ecosystem to agricultural land brings with it negative ecological consequences affecting soil erosion, nutrient cycles and soil fertility. Changes in land can occur through natural causes such as droughts, erosion, and changes in climate. Anthropogenic changes include the physical alteration or conversion of land for human gain. The altering of land has the potential to increase a systems vulnerability to land degradation and ultimately food insecurity (La Valle, 2008).

Economic resilience is related to food accessibility. The economic resilience of a system is usually reflected in the financial capital and wealth of a system. If a system or livelihood does not have sufficient financial wealth to obtain food or access to markets, then the economic resilience is low and the livelihood has a decreased capability to deal with shocks and disturbances. La Valle (2008) notes that areas which have greater access to markets, have a greater resilience towards changes, shocks and food insecurity. In addition, households that have a more diverse income, that is not only relying on rain-fed agriculture to bring income into the household, stand a greater chance at resilience and overcoming shocks and changes, as compared to those who only rely on agricultural produce as their only source of income.

Consumption resilience differs from the rest of the dimensions as the nutritional status depicts the position of the individual in the adaptive cycle. This dimension also asserts that even though a household may be food insecure, they do not necessarily suffer from food insecurity. Food is understood and consumed in different ways among different households according to different beliefs about preparation, health, diet and what is deemed healthy or unhealthy. In some households, gender equality plays a huge role and is the factor determining food utilisation and consumption. In some instances, men, the breadwinners and heads of the households, get preference over nutritious food leaving the women to eat last. In the case of pregnant women this may lead to deficiencies in their offspring.

Social resilience is related to food stability in the food security pillars. Social resilience is indicated to represent the human, political, and cultural wealth of the system (La Valle, 2008:80). The notion underpinning social resilience is that of educational and institutional stability. The increased stability in terms of education and political standards and norms, the more socially resilient a system becomes and the more adapted it is to recover from changes and shocks it is faced with. Political regimes, also known as ‘social safety nets’, can also aid in increasing individuals resilience and ability to cope with changes. These may take the form of programmes and training workshops, or transfer schemes aimed at improving the livelihoods and systems on a whole.

According to Ingram (2011) poverty and food insecurity is a growing concern among communities residing in developing countries. An increase in food production has been focused on when looking at solutions to alleviate poverty. However, the issue of food availability is of no concern as statistics in 2010 depict that approximately 925 million people

suffered from food insecurity despite the fact that there was enough food being produced to adequately feed the global population (Ingram, 2011:2).

The dimensions of resilience mentioned above, are not ones that are seen in the Sizanenjana and Khokhwane case studies. This is as a result of lack of resources, knowledge and skills. This can be addressed by adopting a more people centred approach that allows for training and education of individuals in communities to overcome the challenges of improving their food systems. An example of such an approach is the sustainable livelihoods approach. The principles of sustainable livelihoods approach can be adopted to ensure communities and individuals maintain a healthy food system and good food security status.

3.4 Sustainable livelihoods approach

The Sustainable Livelihoods Approach (SLA) was first established in 1992 by the Brundtland Commission on Environment and Development as an end goal towards achieving poverty eradication (Krantz, 2001). Chambers and Conway (1991) define a livelihood as that which comprises people; their abilities and experiences; their accessibility to food, income and other assets; and their means of living. A livelihood is socially sustainable when it can provide resources for future generations and has the ability to recover from shocks and stresses while ensuring the protection and conservation of a natural resource base. Livelihoods comprise the daily activities, capabilities of individuals, and assets they possess in order to lead a good life and respectable standard of living. Livelihoods, in order to be successful, should also contribute towards the success of other livelihoods both in the present and in the future (Chambers and Conway, 1991; Serrat, 2008). Carney (2002) suggests that an adoption of a SLA has the potential to reduce poverty in rural areas.

According to Scoones (1998) sustainable livelihoods are difficult to establish as the definition means different things to different individuals. During intervention processes, it is important for stakeholders to define a sustainable livelihood, and thereafter develop plans and programmes that meet that definition of a sustainable livelihood. Negotiations and discussions are therefore extremely important between stakeholders. Key to defining a sustainable livelihood is to understand the principles of a sustainable livelihood as well as indicators which will be discussed in the paragraphs to follow.

3.4.1 Principles of a sustainable livelihood

This approach looks at the way of thinking about development activities around the poor and develops policies and programmes around principles. The principles of the SLA as outlined by Carney (2002); Chambers and Conway (1991); Scoones (1998) and Mazibuko (2013) are as follows:

3.4.1.1 People centred approach

In order to eradicate poverty, policies and programmes should be for the people, taking into account local people's opinions and beliefs. A people-centred approach develops development strategies and plans that are compatible with their current livelihoods, and are beneficial to the people.

3.4.1.2 Participatory and responsive

Exercises, policies and programmes needs to be inclusive of local people, and participation should be encouraged. Roles need to be reversed in that outsiders and experts need to take a step back and let the poor locals be at the forefront. Outsiders need to learn how to listen and respond instead of delegating and informing.

3.4.1.3 Multi-level

Poverty eradication is a challenge that can not only be achieved through local level. Many levels need work, such as policies in terms of implementation and development strategies, at a national or senior level, as well as local projects at a local level.

3.4.1.4 Partnerships

Through working with different levels, partnerships between different stakeholders begin to develop. Partnerships between different stakeholders are vital. Local poor people have indigenous knowledge and expertise that people in government and scientists do not possess. Likewise, scientists have knowledge, expertise and technology that local people do not possess. A partnership between these two stakeholders can be mutually beneficial in poverty eradication and environmental conservation.

3.4.1.5 Sustainable

In order for a livelihood to be sustainable, a balance needs to be found between all four pillars of sustainability. That is social, environmental, economic and political.

3.4.1.6 Dynamic

Outside support systems need to realise that the nature of livelihoods is one that is dynamic and constantly changing to adapt to the stresses and shocks been thrown at it. It is therefore vital that policies and development plans are developed to take into account the flexible nature of people's livelihoods and develop plans accordingly.

Many of these principles outlined above are seen in the environmental programmes implemented in the Richmond and Khokhwane communities researched in this study. The programmes are focused on the upliftment of the community and take into account what they require, allowing them to have a say in decisions being made. Additionally, the programmes are implemented with the key theme being the promotion of sustainability and allows for integration through partnerships between stakeholders. These partnerships formed, benefit all involved especially the local communities.

3.4.2 The sustainable livelihoods framework

The Sustainable Livelihoods Framework (SLF) is a tool that aids in implementing the SLA. The SLF consists of assets, vulnerability, livelihood strategies, policies, institutions and practices (Brocklesby and Fisher, 2003). The main aspect of the SLF which is applicable to this research study are the assets and therefore, the assets pentagon will be discussed below in relation to the communities researched in this study. Individuals inhibit five assets which contribute to their livelihood. These assets are outlined in Mazibuko (2013:178):

Financial capital - income earned, savings and inheritances. Within the context of this research, financial assets within the communities researched include income received from grants, domestic services, and remittances received from males who have migrated to the cities in search of work.

Social capital - relationships built with one another, friendships, communications and relations of trust built. Social capital is witnessed in the case studies presented in this research, through relations between neighbours and family members and with programme facilitators which help the local communities.

Natural capital - natural resource base found within their community such as the indigenous forests and medicinal plants. There is abundant natural capital found in the communities researched. This natural capital consists of water, firewood and the land. These resources are used for daily household activities.

Physical capital - consists of transportation devices, communication technologies, energy and infrastructure belonging to an individual. Physical capital observed in the communities researched are limited to households, with a few households consisting of cell phones, in the Khokhwane and Richmond community as well as energy and infrastructure such as roads. While in the Sizanenjana community, physical capital is limited.

Human capital - consists of the knowledge systems and indigenous knowledge passed on from generation to generation; skills and labour. Human capital is seen throughout all three communities presented in this research study. Human capital, consisting of indigenous knowledge has been integrated with the human capital of training and environmental programmes presented in the Richmond community. The integration of this indigenous knowledge with scientific knowledge can help in the achievement of a sustainable livelihood.

Cooper et al. (2008) assert that the assets mentioned above, are the basis on which livelihoods of communities are built. The greater diversity of assets a community contains, the less vulnerable they are to risks and contain increased adaptive capacity to adapt to climatic changes. In the context of this research study, the Richmond community contained a greater variety of assets as compared to the Sizanenjana and Khokhwane communities. Thus, the adaptive capacity of the Richmond community is illustrated to be much higher than the remaining two communities.

3.4.3 Advantages and disadvantages of the sustainable livelihoods appraoch

3.4.3.1 Advantages

The SLA is aimed at focussing on the assets and skills individuals possess, as well as the importance of the assets that they do not possess. Mazibuko (2013) asserts that the SLA is an approach that is strengths based, meaning that it focuses on individuals key strengths instead of what they need. This is seen as a fundamental advantage when dealing with rural individuals. It empowers people and builds on what they have rather than focusing on what they do not have.

The key element in this approach is the emphasis on sustainability and the need for integration between stakeholders at different levels which is important for growth as a community. In addition, unlike other approaches to reducing poverty which only deal with health and education, the SLA is an approach dealing with a range of issues from financial,

social, health and any other aspect an individual may suffer in. Norton and Foster (2001) further argue that the SLA is a learning approach and encourages joint efforts by multi disciplines by reaching a common ground. Ashley and Carney (1999: 11) argue that "inter-sectoral collaboration" allows for a holistic analysis where links and connections can be made between activities across different sectors and levels.

3.4.3.2 Disadvantages

The main limitation of the SLA, is that it focuses more on micro level than macro level. In the sense that emphasis is placed on local individuals and not enough emphasis is placed on power and authority. The approach does not address political issues, according to Norton and Foster (2001) which weakens the holistic analytical approach.

3.4.4 Sustainable livelihoods approach in achieving poverty alleviation

According to Ashley and Carney (1999) the SLA has been used by many policy makers in many countries, to help assess poverty. The SLA can be used to identify room for new projects and initiatives, or to re-assess existing policies or programmes aimed at eradicating poverty. The SLA applied in many countries has proven to be successful as it analyses livelihoods and daily lives of poor households. This analysis helps policy makers understand the circumstances and areas of concern of which policy makers need to take into consideration. Thereafter, programmes and plans can be developed around these priority areas. For example, the application of the SLA in the Richmond case study can be used as a positive example for other NGOs and government to inform implementation programmes for other communities that need assistance in alleviating poverty. An approach that can be used to apply the principles of a SLA could be through stakeholder involvement and integration of various stakeholders to ensure that the local community has an input in decision making and planning.

3.5 Sustainability science and stakeholder involvement

Komiyama and Takeuchi (2006) have the viewpoint that sustainability science is a form of discipline that can be used to achieve a sustainable society as a whole. The authors look at sustainability science as a system which consists of three levels. These are: global, social and society. These three levels or systems are important when integrated and are vital to the coexistence that occurs between society and nature.

The global system is inclusive of the entire atmosphere and its fauna and flora. The global system recognises that the earth goes through periods of climatic change and fluctuations, which ultimately have an impact on society and its survival. However, anthropogenic activities have become a major catalyst in increasing the intensity of climatic fluctuations and can have negative impacts on the global system.

The social system is that which consists of desires and needs in order to fulfil a human livelihood, such as political, economic and industrial structures. A social system is an important aspect in any livelihood as it is needed for growth and survival. However, with such advancement and development comes environmental degradation and pollution, thus impacting negatively on the global system as a whole. These are the structures which create an inequality between the rich and the poor (Kajikawa, 2008).

The human system is irrevocably linked to the social system as it affects the existence of society and their lifestyle, choices and safety, in order to live a healthy and fulfilled life. However, it is not that simplistic as humans are subject to emotional and physical ailments, which ultimately places strain on all three systems (Kajikawa, 2008; Komiyama and Takeuchi, 2006). For example, in developing countries people are susceptible to extreme poverty and lack basic necessities such as food and shelter. A strain is not only placed on the social system, but also on the global system. An increased strain on a social system places additional stress on the receiving environment, thus threatening sustainability of the entire system.

Komiyama and Takeuchi (2006) state that there are many problems that arise between the interactions among these three systems. A relevant example of this interaction could be that of global warming and the problem of generation of waste arising from global warming. The solution to this problem requires a change in mindset through environmental education and implementing the actions of the waste hierarchy which is: reduce, reuse, and recycle. Interactions that occur between global and human systems include illnesses and other diseases such as skin cancer, which is further exacerbated by the depletion of the ozone layer (an environmental concern). In accepting that all three systems are interlinked, a holistic approach such as sustainability science needs to be undertaken, thus addressing the problems faced across all disciplines. This should be achieved bearing in mind the common goal of ensuring a sustainable future for all of mankind and the environment, which underpins the notion of sustainable development.

In order to achieve the goal of sustainability, the notion of a transdisciplinary approach is crucial in dealing with complex issues which require more than one solution. Brandt et al. (2013) suggest that in recent years, there has been an increase in socio-ecological challenges which have threatened sustainable development. It is therefore required that a holistic view be taken into consideration when addressing these transdisciplinary issues. This is where the notion of sustainability science is useful. Guiding socio-ecological systems onto a sustainable pathway in the face of global environmental change requires support and assistance from a variety of stakeholders and scientific spheres ranging from government, scientists and locals (Kauffman and Arico, 2014). Lang et al. (2012) define transdisciplinary research as a scientific principle that is reflective and integrative which allows for the integration of knowledge between different scientific and societal structures, thus gaining a holistic solution to a problem. The use of transdisciplinary approach was seen in the Richmond case study presented in this research. The integration of knowledge between the community and scientists, allowed for the sustainable use of environment and maximum agricultural production while achieving sustainability.

Komiyama and Takeuchi (2006) discuss two additional challenges facing sustainability science which are complexity of issues and fragmented research. The complexity of issues refers to socio-environmental problems which tend to be multifaceted and dynamic in nature. Therefore, researchers find it difficult to attain a thorough view of these problems and to attain solutions. Kauffman and Arico (2014) argue the reason for this may be that scientists have not gained enough knowledge and expertise on transdisciplinary research and integration. Thus, leading to fragmented research.

Pollution is an example of a complex issue presently being faced in society. When pollution first emerged, it used to be specific to the location in which it originated. However, due to globalisation, pollution has transformed into a global complex problem. This not only affects the region in which it originated, but has the potential to cause environmental and social harm to other regions globally. Beder (2000) argues that developing countries are usually the ones who suffer the most from such misfortunes as social and environmental inequalities exist in many countries.

3.5.1 Challenges to sustainability science

Brandt et al. (2013) outline a few key challenges that hinder cooperation between different stakeholders in dealing with trans-disciplinary problems. These are:

Lack of coherent framing*:* this problem may arise when different stakeholders have different opinions on the same problem. This is due to the nature of their respective fields however; conflict may arise when there is a lack of interaction and communication between different stakeholders. Brandt et al. (2013) assert that public participation, trans-disciplinary and participatory research usually involves the interaction between different stakeholders thus achieving coherent solutions.

Integration of methods: apart from integration between different stakeholders, there also needs to be integration between these stakeholders from various disciplines. However, integration of different disciplinary methods may become time consuming and conflicts may arise between stakeholders.

Generating impact: transdisciplinary research has not been researched and is extensively concentrated in developed nations, even though the scale of the problems at hand extends to the developing countries who are in need of such an approach. Sustainability problems are not limited to developed countries only.

Sustainability science can be successful through the integration of different practitioners, professionals and public, all from different sectors who work together towards a common goal which is education and implementation (Komiyama and Takeuchi, 2006; Turner et al., 2003). Lang et al. (2012) further state that sustainability science requires the involvement of many actors from various disciplines.

Presently, the complex social and environmental problems faced by society, require constructive input from various stakeholders and disciplines (Kauffman and Arico, 2014; Kajikawa, 2008; Lang et al., 2012). This will ensure a holistic approach and gain maximum information required to address issues which will establish sustainable solutions. In order for these solutions to be sustainable, they should take into account many multifaceted issues and not be only one directional in thought, as this has the potential to increase the accountability and effectiveness of the solution put forward by stakeholders (Lang et al., 2012). Often it is found that stakeholders from different structures can integrate their knowledge and learn from each other to work in conjunction with one another to create sustainable solutions. On the one hand, in poverty alleviation programmes and natural resource management, scientists and researchers can share their resources and expertise with local communities, thus aiding in improving their livelihood. On the other hand, local communities can contribute by sharing local indigenous knowledge which plays a crucial role in natural resource management and

sustainability on a whole (Lang et al., 2012). This integration of knowledge from different stakeholders is applicable to the Khokhwane and Richmond communities presented in this research study. The use of a sustainability approach was useful in improving the livelihoods and decreasing poverty in these communities and can be applied in other communities such as the Sizanenjana community, experiencing uneven distribution or lack of resources and knowledge which is hindering their agricultural productivity.

3.6 Conclusion

The processes and inequalities which drive small-scale agricultural practices influence the ways in which food systems are altered and developed. Constraints and inequalities in terms of land and distribution of resources influence the manner in which small-scale farmers utilise the land thus influencing food systems (Galt, 2016). Additionally, these challenges faced by small-scale farmers can be improved upon by government and other stakeholders applying a transdisciplinary and people based approach which feed into the notions of the SLA as well as sustainability science.

This chapter discussed theories related to addressing food security and sustainability. The theory on political ecology was used to establish that a connection exists between society and the environment. Additionally, political ecology looked at the power relations that exist within communities, and how this affects access to resources ultimately affecting the food security status and affecting food systems as a whole. This was relevant to the case studies presented in this research study as the Sizanenjana community and Khokhwane community suffered greatly from the uneven distribution of resources which has degraded their standards of living.

A food systems approach highlighted the processes involved in achieving food security as well as the connection between different systems, global and local, and the influences these systems have on one another. The drivers of food systems were then examined as well as the vulnerability and shocks which influence food systems. Shocks and vulnerabilities experienced in the case studies are that of changes in climate and lack of assets such as income, tools and skills. These vulnerabilities affect the agricultural production in the communities, which affect the food system and associated processes. The chapter then focussed on the SLA. This approach looked at the different principles of the SLA and the importance of this approach in alleviating poverty and addressing inequalities that exist from a political ecology. Many principles of the SLA were seen in the Richmond community and

can be used as a tool to be implemented in communities such as the Sizanenjana and Khokhwane. The chapter then concluded with the sustainability science and stakeholder involvement approach. This approach emphasised the need for integration between various stakeholders in order to overcome poverty, inequalities and achieve food security. The combination of scientific knowledge and indigenous knowledge is key to poverty alleviation at a rural household level.

CHAPTER 4:
RESEARCH METHODOLOGY

4.1 Introduction

This chapter presents the research methodology used for this study which explores the impact that a change in climate has on small-scale farmers in three rural communities in KZN, South Africa. This chapter will be categorised into the following sections: research questions, research instruments, description of primary and secondary data sources, a background and description of the study areas, the qualitative and qualitative methods that were used in this study, the process of capturing and analysis of data collected as well as fieldwork experiences. The case studies that were researched were that of the Sizanenjana community within the Harry Gwala District and Ingwe local municipality; the Khokhwane community within the uMgungundlovu district and uMsunduzi local municipality, and the Richmond community within the uMgungundlovu district and Richmond local municipality, all within the province of KZN. This study was conducted in various phases over a two-year period during 2014 and 2015. A triangulation method consisting of both qualitative and quantitative data was used.

4.2 Research questions

Bhattacherjee (2012) indicates that the first step of any research is exploration. Exploration involves the formulation of research questions for the study. Research questions are derived from the objectives of the study, and extend the studies purpose (Tashakkori and Teddlie, 2010). Research questions are more defined and are usually the questions that the researcher aims to answer directly, as opposed to the objectives which refer to the overall purpose of the study. Bhattacherjee (2012) further states that research questions need to be broad, as narrow research questions with definite answers tend to be uninteresting and unsuccessful.

This research study looked at the impact that a change in climate change has on small-scale farmers in Sizanenjana, Khokhwane and Richmond communities in KZN, South Africa. Furthermore, this study also looked at the perceptions that farmers had towards issues of a change in climate, food insecurity as well as current and future mitigation strategies. In order to address all these issues in the best way possible, a set of research questions were formulated to help guide the researcher in achieving the objectives of this study which were outlined in chapter one. The following research questions were formulated:

1. **What are small-scale farmers' perception towards a change in climate in Khokhwane, Sizanenjana and Richmond in KwaZulu-Natal?**

    - What do small-scale rural farmers perceive climate change to be?
    - What do small-scale rural farmers know about climate change and food insecurity?

2. **What are the perceived impacts of a change in climate on small-scale farmers' in Khokhwane, Sizanenjana and Richmond in KwaZulu-Natal?**
    - Do small-scale farmers perceive a change in climate has impacted their food production?
    - How does a perceived change in climate affect small-scale rural farmers' socio-economic aspect of their livelihoods?
    - How does a perceived change in climate impact on small-scale farmers' agricultural productivity?
    - Will a perceived change in climate further degrade small-scale rural farmers standard of living?
    - Will a perceived change in climate increase small-scale farmers' vulnerability to the effects of a change in climate?

3. **What are the current measures taken by small-scale farmers' in Khokhwane, Sizanenjana and Richmond in KwaZulu-Natal, in dealing with those impacts due to a change in climate?**

    - What knowledge do these small-scale rural farmers have about mitigation and coping strategies?
    - Do small-scale farmers receive assistance and guidance in implementing mitigation measures?
    - Do small-scale farmers rely on traditional knowledge systems to guide them in mitigation of impacts of climate change?
    - What future coping strategies would small-scale farmers like to see being implemented?
    - Would small-scale farmers like to see more involvement from other stakeholders such as National and Local governments to assist in coping with these changes?
    - Would small-scale farmers be willing to learn more about future coping strategies?

4.3 Research instruments

Hox and Boeije (2005) state that social scientists employ a variety of data collection methods in their research, so as to get a better understanding and a more credible outcome. There are many instruments used for many purposes. A research instrument is a method in which data is collected, measured and recorded (Colton and Covert, 2007). In social research, social scientists may use a number of research instruments to obtain data, some of which include questionnaires, observations, participatory exercises and interviews. For the purpose of this research, both primary and secondary data sources were used.

4.3.1 Primary data

Hox and Boeije (2005) indicate that primary data is physically collected by the researcher. Primary data is an accurate means in addressing the main research problem. When primary data is collected, it then adds to existing data of knowledge available in that particular field. Primary data sources include experiments and interviews or surveys, where the researcher is the first person to come into contact with this data (Bhattacherjee, 2012; Driscoll, 2011). The advantage of primary data is that it is first hand data which is reliable and relevant (not outdated and old). However, the main disadvantages of primary data sources are that it is extremely time consuming, expensive, and at times contains much ethical consideration, especially when working with people (Hox and Boeije, 2005). The primary sources that were conducted in this research study were questionnaire surveys, focus group discussions, observations and participatory techniques. These primary sources of data aided the researcher in gathering first-hand information regarding the communities and their perceptions. Primary data collected was demographics which also helped the researcher understand the demographics of the communities as literature suggests that many small-scale farmers are female.

4.3.2 Secondary data

Secondary data is data that has already been collected, stored or tabulated by other researchers or sources (Bhattacherjee, 2012). Thus, secondary data is readily and easily available for the researcher to use at any given time. Secondary data sources vary and include books, internet sources, journal articles, newspaper articles among others (Johnston, 2014). For the purpose of this research, two main secondary data sources were used. These are journal articles and books. In addition to this, temperature and rainfall data from the South African Weather Services (SAWS) was used to enhance the accuracy of this study.

Measurements were taken using rainfall and temperature instruments monitored by SAWS. The reason for choosing this secondary data in a perception based research study was as a form of triangulation. Thus, the perceptions acknowledged by the respondents were then backed up with statistics from the South African Weather Service to enhance the accuracy.

Two weather stations were chosen for this study. These were the Ixopo weather station, and the Pietermaritzburg Airport Station. The Ixopo weather station was chosen as it is the nearest station to the Sizanenjana community and is within close proximity to the Khokhwane community. The Pietermaritzburg weather station was chosen as it serves as the closest station to the Richmond community and can also serve as a reliable source of data for the Khokhwane community. Average maximum and minimum temperatures for both Ixopo and Pietermaritzburg stations were assessed. These temperatures were measured daily at 08h00. In addition, mean monthly rainfall and total annual rainfall for both Ixopo and Pietermaritzburg stations, measured at 08h00 daily, were reviewed.

4.4 Background to study areas

KZN is the third smallest province in South Africa (Tibane and Vermeulen, 2014)as illustrated in Figure 4.1 and covers an area of approximately 92 100km^2. During the summer, the province experiences rainfall with hot and humid temperatures in the high thirties, while in winter, cold and dry conditions are experienced. KZN is well known for its rich natural resources and high conservation status as it boasts many nature reserves. Situated along the coast of South Africa, KZN is known for its good agricultural potential and vast agricultural land. For the purpose of this research, three communities were chosen. These communities are:

- The Sizanenjana community within the Ingwe Local Municipality in the Harry Gwala District municipality;
- the Khokhwane community within the uMsunduzi Local Municipality in the UMgungundlovu District Municipality; and
- wards 1, 2 and 7 within the Richmond Local Municipality in the UMgungundlovu District Municipality.

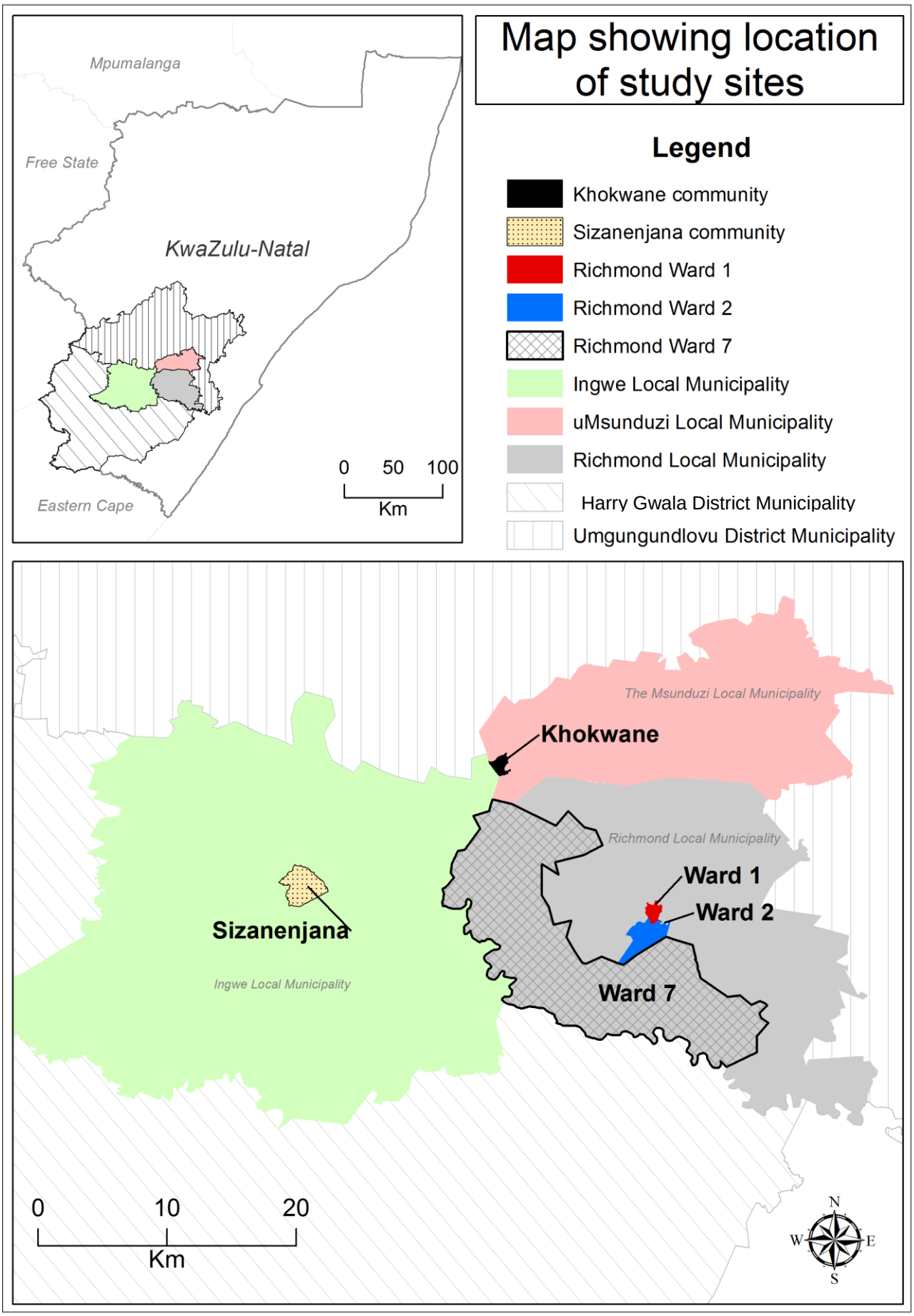

Figure 4.1: Study sites chosen for this research.

4.4.1 Integrated Development Plan

According to Coetzee et al. (undated) the Integrated Development Plan (IDP) is a document that all district and local municipalities within South Africa are required to complete. The purpose of the IDP is to set out a vision of the municipality in terms of development and growth of the municipality. The lifespan of an IDP is five years. However, it requires an evaluation on a regular basis. For the purpose of this research, the IDPs for the Ingwe local municipality, uMsunduzi local municipality and Richmond local municipality were reviewed. The Ingwe local municipality IDP was reviewed due to Sizanenjana community falling within this municipality. The uMsunduzi local municipality IDP was reviewed as both the Khokhwane and Richmond community are situated within the uMsunduzi local municipality.

4.4.2 uMsunduzi municipality – IDP (2011)

The uMsunduzi municipality, more commonly referred to as Pietermaritzburg is the second largest city within KZN. Pietermaritzburg is one of the nine main contributors towards the GDP and is the home for many cultural and social activities (IDP, 2011).

Part of the IDP process is to develop a Spatial Development Framework (SDF). The SDF indicates a spatial representation of the developments that the municipality will undertake in the future. The SDF contains the land use patterns for that particular municipality, and sets out specific guidelines and management systems that a municipality will be required to adhere to if they wish to undertake a proposed development or other projects. The SDF for the uMsunduzi municipality aims to achieve a level of integration and consistency in terms of development processes and proposed projects. The uMsunduzi SDF aims to improve roads and infrastructure in and around the city, as well as to improve access to roads that were previously inaccessible to marginalised groups during the apartheid era (IDP, 2011). Additionally, this municipality is experiencing many challenges such as poverty, hunger, gender inequalities and unsustainable development and use of land (IDP, 2011). These challenges have the ability to be overcome through partnerships between stakeholders and the inclusion of public and communities in decision making and policy processes. Public participation and involvement is key in addressing issues faced by this municipality. Rural communities faced by challenges such as lack of service delivery and infrastructure can be remedied through increased service delivery, infrastructure development such as roads and facilities and increased training and education in rural communities can increase skills and access to markets, improving the livelihoods of many communities within the municipality.

The Khokhwane community, situated in the Elandskop area within the uMsunduzi local municipality lies approximately 97km from the Pietermaritzburg town, 101km from Edendale and a further 197km from Impendle. These neighbouring towns are accessed through transport services as the Khokhwane community is situated adjacent to the main road, making it easy for local community members to access taxis. Generally, the Elandskop area receives high summer rainfall and is dry in winter. Average daily maximum and minimum temperatures for summer are approximately 22^{o}C and 10^{o}C respectively, and average maximum and minimum temperatures for winter are 15^{o}C and -3^{o}C respectively.

4.4.2.1 Environmental Health and wellbeing

Every person has the right to a clean and healthy environment (IDP, 2011; South African Constitution, 1996). In terms of the environmental health of the community within uMsunduzi municipality, the uMsunduzi municipality has many environmental programmes in place to ensure that the environment is safe. There are many environmental legislations and policies in place to ensure sustainable use of resources to keep the city clean and environmentally sustainable. In the hope of complying with the environmental legislation, the city has designed an Environmental Management Plan (EMP). In 2007, the uMsunduzi municipality partnered with the Department of Environmental Affairs and Tourism (DEAT), The Department of Agriculture and Environmental Affairs (DAEA) and the Department of Local Government and Traditional Affairs (DLGTA). The Environmental Management Framework (EMF) was developed as a policy framework and an environmental tool for efficient planning and use of natural resources.

4.4.3 Ingwe local municipality IDP (2015/2016)

IDP (2015/2016) states that the Ingwe local municipality is one of the municipalities that fall under the Harry Gwala District Municipality (previously known as the Sisonke District municipality), in KZN. The main towns (nodes) that are within the Ingwe Local Municipality are the Donnybrook, Creighton and Bulwer towns. Each node is in charge of a particular area. The Donnybrook node is predominantly a commercial area, the Creighton node is where the head municipal office is located, and the Bulwer node contains the commercial and services node.

The climate experienced in this municipality differs from one area to the other. The IDP (2015/2016) suggests that the western parts of Ingwe are much cooler than the Eastern parts. During winter, temperatures are known to fall below 0^{o}, however, during summer they rarely

fall below 0^{o}. During summer, the western parts of the municipality experience temperatures in the low thirties and high thirties in the eastern parts. Rainfall for this region is between 700mm and 1200mm per annum (IDP, 2015/2016).

Donnybrook in particular receives high summer rainfall and is dry in winter. Average daily maximum and minimum temperatures for summer are approximately 31^{o}C and 19^{o}C respectively, and average maximum and minimum temperatures for winter are 24^{o}C and 6^{o}C respectively.

The total land area of this municipality is 1976.km^2 (IDP, 2015/2016). There are 11 wards within the Ingwe local municipality and three nodes which supply these areas with services; these are Donnybrook, Creighton and Bulwer. It is important to note that all three of these nodes are severely underdeveloped. The underdevelopment of neighbouring areas makes it unlikely that service delivery and infrastructure development will occur in the Sizanenjana community.

The population census conducted in 2011 stated that the population of the Ingwe municipality consisted of 100548 individuals living in approximately 23 000 households (IDP, 2015/2016). Statistics from the census shows that only ten percent of the population within this municipality are employed. The reason for this may be due to the fact that the population consists of a majority of females and children, who are economically inactive (IDP, 2015/2016). FAO (2014) argue that the high percentage of females residing in rural areas is attributed to rural-urban migration whereby the men migrate to the cities in search of employment. This can be seen in the Ingwe municipality. The women are left behind to look after the children and food gardens, thus playing a vital role in household food security (Dhembo, 2014; Raidimi, 2014). These statistics are reflected in the Sizanenjana community. Many respondents interviewed were women and majority were unemployed. These challenges faced by this municipality should be addressed by local government through training and educational programmes as well as provision of services and development and maintainable of infrastructure and facilities.

4.4.3.1 Challenges faced by the Ingwe local municipality

According to the IDP (2014/2015) there are many challenges faced by this local municipality, some of which are extreme poverty, poor food security status, service delivery, lack of skilled personnel, HIV and AIDS, high levels of crime, lack of healthcare facilities, lack of

environmental education training, poor agricultural practices, and lack of proper waste disposal. However, the municipality does have some assets such as natural capital, vast agricultural land with the potential to alleviate food insecurity, cooperative communities and a predominantly youthful population. These assets can aid in uplifting the community through joint interventions and programmes.

Due to the spatial locality of the Ingwe local municipality, it is difficult to develop these areas situated within the municipality. This is the main reason for the challenges faced by the surrounding communities. Since this municipality falls outside the boundaries of the district municipality, it is not identified as a priority area that needs to be developed. In addition, the lack of economic centres inhibits investors. "The scattered underdeveloped small towns coupled with a relatively small population, with low incomes limit the growth potential of all nodes" (IDP 2014/2015:24). Chigbu (2013) argues that in many areas, urban bias exists whereby preference and resources are given to urban centres, without much attention to rural households who require assistance. Due to the locality of rural households, assistance is poor and resources are scarce, further exacerbating small-scale farmers living conditions (Dixon and Mcmichael, 2015).

4.4.3.2 Environmental factors

The Ingwe local municipality has a number of different land uses which include but are not limited to urban, conservation, traditional and agriculture (IDP 2014/2015: 25).

There are two major rivers that pass through Ingwe local municipality; these are the Umkhomazi River in the east and the uMzimkhulu River in the south west of the province. These two rivers are important for KZN as they form catchments and supply vast amounts of water to residents downstream. In addition to these two rivers and associated catchment areas, Ingwe Local Municipality also contains seven wetlands which have been listed as high conservation status by Ezemvelo KZN Wildlife. Ingwe local municipality also contains many endemic vegetation and other fauna and flora some of which have been identified as conservation importance (IDP, 2015/2016). These rivers serve as important natural capital for the community members. In times of drought, when the river levels are low, this has negative impacts on community members who rely on this water resource for their daily activities such as cooking, cleaning and drinking.

4.4.3.3 Social factors

Due to the majority of the people in Ingwe local municipality residing in rural areas, they suffer greatly from poverty (IDP, 2015/2016). They rely on subsistence and livestock farming for food. Due to their spatial location which is far away from any built up areas, there is poor service delivery. These communities therefore rely solely on natural water resources for irrigation and household activities and firewood for energy. This unsustainable use of natural resources is a great concern as many of the residents have not received any environmental education. Apart from environmental consequences, the reliance of firewood for energy also has negative health consequences for households. The use of fuel wood for heating and cooking results in indoor air pollution. When inhaled this causes respiratory diseases such as asthma and pneumonia (Laxmi et al., 2003; Ndwiga et al., 2014.).

4.4.3.4 Small-scale farming

Sixty-four percent of the land is used for commercial farming while thirty-six percent of the land is used by small-scale farmers and is communally owned by the twelve traditional councils (IDP 2015/2016). Minimal crop farming is practiced due to poor topography such as hilly landscapes resulting in soil erosion and infertile soils. These hilly terrains and erosion scars are indicated by Plate 4.1. Yosef and Asmamaw (2015) argue that increased soil erosion has the potential to increase food insecurity and poverty. Many of the farms are small plots of land which are community gardens or small food gardens for household consumption. Some of the crops that are grown include maize, potatoes and spinach (IDP, 2015/2016).

Plate 4.1: Hilly terrain and erosion scars in the Sizanenjana community.

4.4.4 Richmond local municipality IDP (2012/2013)

Richmond Local Municipality is situated within the southern parts of the uMgungundlovu District of KZN, and is made up of seven wards. Richmond local municipality is the fourth smallest local municipality within the uMgungundlovu District. The land area in the Richmond Local Municipality is approximately 1 232km^2, and the population is estimated to be 56 772 people, residing in 12 679 households, according to the Richmond IDP (2012/2013:8).

Richmond receives high summer rainfall and is dry in winter. Average daily maximum and minimum temperatures for summer are approximately 31^{o}C and 19^{o}C respectively, and average maximum and minimum temperatures for winter are 24^{o}C and 6^{o}C respectively.

A large portion of the population that live in Richmond, reside in rural areas (IDP 2012/2013). These areas are characterised by low levels of service delivery and high unemployment rates. Youth account for thirty-eight percent of the municipality population (IDP 2012/2013). The only urbanised ward is ward 1, which is the built up town of Richmond which contains services, infrastructure and healthcare. A large percentage of the land is used for agricultural purposes. There is therefore a great need to conserve and protect this land to ensure a good agricultural yield and a good food security status. Due to Richmond being situated a mere 40 km away from the province's capital city, Pietermaritzburg, there has been

an increase in rural-urban migration to the capital city. This results in a brain drain in the local municipality and an increase in unemployment within the Richmond area.

As the case in many rural areas, the women are then left to look after the young while the men move away to the city in search of stable jobs and to experience the city life. This is known as rural-urban migration. Stapleton (2015) asserts that rural-urban migration is the internal migration of individuals from rural areas to the city. The majority of the individuals that migrate to urban areas are youth and men in search of work. In addition to seeking work, individuals often migrate to the cities to escape the cycles of poverty experienced in the rural areas. Tacoli et al. (2015) further state that, when individuals lack support and government fails to provide for the communities, it is where we find rural individuals trying to provide for themselves. This leads to them leaving the rural areas in search of work and increased opportunities in order to uplift the lives of their families.

Richmond is supplied with electricity from Eskom, however, the majority of the rural areas do not receive grid electricity due to their spatial location (hilly topography), or insufficient funding. These individuals residing in the rural areas therefore rely on paraffin, candles and coal as a source of energy. All of which have detrimental consequences to their health and the environment in the form of air pollution.

According to the IDP (2012/2013) this area is predominantly known for sugar cane farming. The burning of sugar cane is a great environmental issue as it causes visual impairment as well as chemical pollution resulting in health issues (Chagas et al., 2013; Mnatzaganian et al., 2015). Another environmental issue faced by the municipality is the lack of allocation of burial land (IDP, 2012/2013). Due to the increased mortality rates due to HIV and AIDS, there is a need for more burial grounds within these rural communities. The improper use of land for burial grounds has resulted in pollution of underground water supplies which is detrimental to the health of many individuals within the Richmond rural communities. The lack of funding from governments for local environmental projects and programmes is also an issue which needs to be addressed (IDP, 2012/2013).

4.4.4.1 Challenges and opportunities faced by Richmond Local Municipality

4.4.4.1.1 Challenges

There are many challenges faced by the Richmond Local Municipality. Some of which include: economic challenges, old buildings which need to be upgraded; housing issues

especially among the rural poor; the inadequate supply of basic services such as water and electricity; the uneven distribution of social facilities; and the spread of HIV and AIDS (IDP 2012/2013).

The Richmond local municipality contains vast areas of agricultural land and is located on a secondary agricultural corridor, making the agricultural sector the largest sector in this municipality. (IDP, 2012/2013). Many of the poor that reside in the rural areas rely on subsistence farming to sustain their livelihoods. Without subsistence farming, poverty levels will increase in the future. It is therefore pertinent that these small-scale farmers receive education on sustainable agricultural practices to ensure that agricultural yields are high and of good quality. IDP (2012/2013) states that a reason for the high levels of poverty is due to a high rate of illiteracy within the municipality. "Education has a major bearing on the quality of life" (IDP, 2012/2013:23.) Poor educational facilities and low levels of competency result in a decreased pool of skilled individuals entering the professional sector. This makes it difficult to find permanent employment, contributing to a cycle of poverty.

4.4.4.1.2 Opportunities

Being situated within close proximity to two good municipalities that is: eThekwini Municipality and uMsunduzi municipality, the Richmond Municipality has the potential to create its own niche market, as well as the potential to capitalise on projects occurring in these two municipalities. Another opportunity for growth and development could stem from the tourism industry. The town of Richmond has much to boast amidst the beautiful scenic hills and picturesque scenery. Attractions include Beaulieu Dam and the Highover Nature Reserve which is also a Heritage site. In addition, there is also a bird watching spot at the Umkomazi Gorge which is home to over one-hundred recorded bird species including the endangered Blue Swallow (IDP, 2012/2013). Historic attractions in the area include the Byrne and District Museum which was established in 1882. These attractions are opportunities for increased tourist activities within the area and have the potential to contribute a large amount to the economy of the municipality.

4.5 Wards chosen for this study

For the purpose of this research, wards one, two and seven were sampled due to these wards being within close proximity to one another, therefore experiencing similar climatic and social conditions. The reason for wards being chosen for this community and not the other two communities is the fact that this community case study was chosen by Wildlands as a

positive case study and therefore facilitators were chosen to assist the researcher in carrying out the questionnaires. The facilitators then chose wards within close proximity to each other to allow for easy interaction and communication between facilitators.

The main reason for the choice of the Richmond community was due to the installation and implementation of food gardens in this community. This was funded by the National Lottery Distribution Trust Fund, and in partnership with Wildlands Conservation Trust (WCT), Duzi-Umgeni Conservation Trust (DUCT) and Worlds View Conservancy Trust, a programme was implemented to train individuals to grow their own produce in a sustainable manner. Once established, WCT took over the project, training 130 individuals and installing over 197 food gardens African Conservation Trust (ACT, 2015). The installation of food gardens and the training and environmental education of individuals was the main aim for choosing this community.

A summary of the key issues raised by community members in wards one, two and seven are: poor spatial planning and maintenance which has resulted in damaged storm water pipes as well as poor conditions of roads and paving. Service delivery is poor with waste not collected regularly, thus resulting in illegal dumping in open vacant land. Social facilities are needed such as sports, educational and health. Some wards lack electricity thus rely on firewood for energy.

4.6 Methodological approaches

4.6.1 Quantitative and qualitative methods

The use of both quantitative and qualitative methods in research is known as a triangulation approach. Driscoll (2007) argues that the use of both quantitative and qualitative methods is used to avoid the weaknesses of using either approach by itself. Kaur (2016) asserts that quantitative approach is used to determine the extent of the problem at hand, while the use of qualitative approach further explores the deeper meaning and understandings of the problem identified in the quantitative approach. The integration of these two approaches to form a mixed method approach will therefore complement one another in an effort to best address the research questions (Kaur, 2016). For the purpose of this research, both quantitative and qualitative methods were used.

4.6.2 Quantitative methods

4.6.2.1 Questionnaire surveys

Hox and Boeije (2005) indicate that a questionnaire survey is an effective method of collecting data required for a large representative sample of a predefined target population. Three-hundred structured questionnaires were administered in this research study. The questionnaire template can be seen in Appendix 2. One-hundred questionnaires were administered in each of the three communities. The structured questionnaire was used as a tool in gaining data from respondents pertaining to their feelings, attitudes, behaviours and perceptions of a change in climate and its impact on their agricultural production. An additional questionnaire survey (Appendix 3) was administered to only the Richmond community. The reason for the additional questionnaire administered to the Richmond community was due to their involvement in the Wildlands Food Garden Programme (WFGP) which was not applicable to the Khokhwane and Sizanenjana community. The reason for applying a quantitative approach to this study was that the nature of this research required a triangulation approach consisting of both qualitative and quantitative techniques. A triangulation approach is useful in research that deals with human phenomenon (Sewell and Desai, 2016). Therefore the researcher considered it useful to use questionnaire surveys to capture useful information that informed the study. Colton and Covert (2007) maintain that in social science research, questionnaires are also an effective way to gain factual and demographic information of the desired target population. Questionnaires provide support for observations made by the researcher and is used to acquire a good representative sample of the population. Thus, the representative sample should ensure the validity of the responses attained.

On the one hand, quantitative methods are used to discern patterns and trends and are easy to gain information such as demographics. The Qualitative method, on the other hand, is used to gain in-depth knowledge, beliefs and attitudes about participants, and is a good method in perception studies (Bird, 2009; Harris and Brown 2010).

Bird (2009) asserts that a questionnaire is a research tool that is used to gather information about a specific research question. A questionnaire contains a list of structured questions which is administered to respondents. When conducting questionnaires, it is important to respect the respondent's anonymity and views. Respondent's anonymity should be respected and participants need to be made aware of what the research entails as well as the purpose of

the particular study (Driscoll, 2011). It is for this reason that the University of KwaZulu-Natal has a process of ethical clearance which was carried out in this study. A consent form was drafted in English and translated into isiZulu, as this is the indigenous language of the respondents interviewed. Respondents were asked to read and sign the consent form before answering the questionnaire, allowing their participation. The researcher and field workers mentioned to the respondents that they may withdraw from the study at any point and that their responses would remain anonymous.

At times, questionnaires can be difficult to design as well as to analyse. In addition, some questions may be ambiguous to the respondent therefore resulting in inconsistent data (Wilkinson and Birmingham, 2003). Some of the disadvantages of using questionnaires include the issue that it is time consuming for both the researcher and the respondent. The administration of questionnaires also involves the use of trained fieldworkers, and in situations where language is a barrier, the use of translators is necessary which adds to extra expenses. Harris and Brown (2010) further state that questionnaires may be seen as a tool that creates an inaccurate measurement of everyday life. Another limitation of using questionnaires for social research is that people differ in their understanding and interpretation of the questions. Therefore, different respondents may have different opinions and beliefs. This results in conflicting responses and inconsistent data. Additionally, people may respond to questions based on their knowledge and what they believe is socially appropriate, rather than what is really true (Wilkinson and Birmingham, 2003).

4.7 Selection of samples

Harrell and Bradley (2009) assert that there are many sampling techniques available for researchers to use; however it is important to select the appropriate sampling approach for the research at hand. Due to the Khokhwane, Sizanenjana and Richmond communities being situated in rural areas in KZN, it was difficult to determine a set sampling strategy as the households are situated far apart from one another. The sparsely populated households of the Sizanenjana community can be seen in Plate 4.2. With respect to location, the households were sparsely populated therefore the researcher had to search for respondents that carry out farming. Thus, a purposive sampling approach was used as a sampling technique.

Plate 4.2: Sparsely populated households in the Sizanenjana community.

4.7.1 Purposive sampling approach

Dolores and Tongco (2007) indicate that data collection is an important part of a research study. It is important to choose the correct methods in which data will be collected as there is no amount of analysis that can make up for incorrect information. Purposive sampling is also known as judgement sampling whereby the researcher deliberately chooses the participants who exhibit certain traits and characteristics that the researcher is looking for (Palys, 2008). These participants add value to the study and aid in achieving the research objectives (Dolores and Tongco, 2007). Bryman and Cramer (2001) further agree by stating that a random and purposive selection is critical as it is rare that a researcher finds all participants that are willing. Not every respondent will be willing to partake in the study in order to gain accurate data, therefore a purposive sampling approach should be used which is a representative sample of the population.

The three communities presented in this research as well as the respondents, were chosen using the purposive sampling approach. The communities that were chosen were areas in which subsistence agriculture is practiced, while the respondents were chosen for the reason that they carry out farming for daily sustenance. This trait was extremely difficult to find amongst households, as many households have discontinued farming due to various reasons. The Water Research Council (2012) assert that the reason why many households have discontinued farming is due to their reliance on social grants as a form of income. Furthermore, households that receive social grants are less likely to suffer from food insecurity as the money received is used to purchase food.

One-hundred questionnaires were administered at Khokhwane, Sizanenjana and Richmond communities respectively. Since the researcher is unable to speak isiZulu, translators were hired to assist the researcher in relaying information to the community. For the Khokhwane and Richmond community, facilitators from local community upliftment programmes were hired to assist in data collection and translation. For the Sizanenjana community, isiZulu speaking undergraduate students assisted the researcher in data collection and translation.

Additionally, these isiZulu speaking undergraduate students also assisted the researcher in translation during participatory exercises in the Khokhwane, Sizanenjana and Richmond communities. Each questionnaire took approximately half an hour to forty-five minutes to complete, depending on the respondent. An example of the administration of questionnaires can be seen in Plate 4.3.

Plate 4.3: Administration of questionnaires in the Sizanenjana community.

4.7.2 Procedure for analysis of data

4.7.3 Statistical Package for Social Science (SPSS)

There are many techniques that can be used to analyse social science research. As mentioned, this study used both quantitative and qualitative methods. Miles et al. (2014) argue that quantitative researchers often use various software packages to assist in the creation of descriptive statistics, graphs and tables for analysis. For the purpose of this research Statistical Package for the Social Sciences version 23 (SPSS) was used. SPSS is statistical software that is used to manipulate, analyse and present statistical data (Landau and Everitt, 2004).

For the purpose of this research, descriptive statistics were used to analyse the data obtained. According to Greasley (2008) descriptive statistics are used to easily summarise data

obtained from questionnaires by performing tests, calculations, formulating tables and graphs. The use of SPSS was an easy and efficient way to capture the large dataset. There are three types of data. These are Interval or Ratio, Ordinal, and Categorical or Nominal. Interval or Ratio data is data that includes a scale range (Bryman and Cramer, 2001; Field, 2009; Greasley, 2008). An example of Interval or Ratio could be that of an Age category. Ordinal data refers to data that contains responses that are ranked or in an ordered sequence (Garth, 2008; Hall, 2014). An example of ordinal data in this research is "Has the status of your crops worsened, remained the same or improved over the past five years?". Nominal or categorical data is data which has set categories of responses. It differs from interval and ordinal as it does not contain an order or range. An example of categorical data could be that of 'Gender', where the set response would either be male or female (Field, 2009; Greasley, 2008).

Before the data was inputted, a template was created on SPSS. The template consisted of the complete questionnaire, with each question's response coded. Once the data was inputted onto SPSS, frequencies and cross-tabulations were created using the following steps as outlined by Garth (2008):

Analyse→Descriptive Statistics→Crosstabs.

Greasley (2008) indicates that frequencies are the first step which researchers undertake when analysing data. Frequencies involve the researcher looking at the percentages of the data obtained which may also be referred to as *variables.* The reason why the data is referred to as variables is that the data obtained from each respondent varies from respondent to respondent (Field, 2009; Greasley, 2008). Cross-tabulation is therefore undertaken in order to understand the relationships that exist between variables (Field, 2009).

Variables were then chosen and cross-tabulated against each other for each site, indicating a clear comparison of the data in the Sizanenjana, Khokhwane and Richmond communities respectively. For example, a variable such as "How much environmental education have you received?" was analysed against "Do you think climate change is a problem?". Once tables were formed, these outputs were exported onto excel where graphs were formulated.

In addition to descriptive statistics, Chi Square tests were undertaken in SPSS. Chi Square tests are a statistical test undertaken through cross-tabulation of actual observed frequencies against expected frequencies. An expected frequency is a frequency one would expect if the

data were to be randomly distributed. To undertake Chi-square tests, the following steps were followed:

Analyse→ Descriptive Statistics→Crosstabs→Statistics→Chi-square.

4.8 Qualitative research

Qualitative research as stated by Hox and Boeije (2005) is aimed at assessing people's attitudes and feelings. Qualitative research is a much more personal and interactive method of collecting the desired data. Many social studies should be quantified as there have been many studies where qualitative research has made a great contribution to quantitative research (Mayoux, 2001). Qualitative research was undertaken in the three communities. The use of observations and participatory exercises was helpful in obtaining additional data which was not obtained using the questionnaire survey. The qualitative research approaches were useful, and complemented the results obtained from the quantitative method.

4.8.1 Participatory Rural Appraisal (PRA)

According to Chambers (1994) there has been a major shift within rural development, from a top-down approach to a bottom-up approach. In the past, rural communities' voices and opinions were not taken into consideration during decision making. However, in recent decades, there has been an attempt to include rural communities in decision making and make them inclusive. These changes began with the concept of Rapid Rural Appraisal (RRA) in the late 1970's and thereafter evolved into PRA in the early 1990's (Chambers, 1994). Mikkelsen (1995) asserts that PRA and RRA came about at a time when outsiders believed that there was something missing or wrong in the way that development was carried out. It was believed that the involvement of community would enhance development projects as they contained valuable knowledge. PRA is an approach which is inclusive of all people, locals and outside stakeholders, with the aim of sharing knowledge and expertise (Bhandari, 2003; Cavestro, 2003; Chambers, 1994; Mikkelsen, 1995). These participatory approaches are also an effective way in gaining useful data and are known as data optimising approaches (Mikkelsen, 1995).

PRA focussed on placing rural people at the forefront of decision making and encouraged them to utilise their indigenous knowledge for conservation (Cavestro, 2003). Chambers (1995a) argues that PRA has been defined as an approach that is used to attain information and expertise about communities and their rural livelihoods *from*, *with*, and *by* rural people.

PRA exercises often serve as a preliminary exercise that allows for a detailed analysis to follow. PRA exercises involve encouraging local people to share their ideas and thoughts. PRA requires the researcher to listen, observe and be respectful of their opinions (Chambers, 1994; Mikkelsen, 1995).

Chambers (1995b) outlines a few principles of successful PRA. These are:

- facilitating needs to be carried out *by* rural people, not outsiders. This encourages local communities to think for themselves;
- encouraging engagement and participation. In this way, local people's opinions are voiced;
- transect walks enables the researcher to engage with local community members. The informant talks while the researcher listens and observes the surroundings;
- trend analysis. This involves the researcher asking the local people to disclose any patterns or trends they have noticed within their area over a period of time; this could be land use changes to changes in the climate; and
- diagrams and exercises. These exercises are useful in engaging the minds of the local people and allowing them to think about issues and concerns they are faced with in their environment. The problem ranking matrix is a useful exercise.

As helpful and important as verbal discussions and observations are; diagrammatic representations of community's feelings and opinions are just as useful (Rietbergen-McCracken and Narayan, 1998). Mikkelsen (1995) indicate that a combination of both visual and verbal methods, are powerful tools in gaining valuable and reliant information. Dey (2005) argues that while text and discussions are useful mediums through which information can be gathered and presented, it is important to note that pictures or diagrammatic representations spark an interest on a level that corresponds to how a person thinks. Diagrams allow people "to think more systematically, more logically and even more imaginatively" (Dey, 2005:201). Mikkelsen (1995) further states that visual methods are a useful way to convey local people's attitudes and beliefs and are also a way for communities to share their knowledge. Often, a discussion is followed due to certain topics surfacing. Dey (2005) further states that diagrammatic representations can often be used by researchers to gain information about complex issues, relationships or problems that respondents may otherwise not disclose in questionnaires. Examples of visual exercises include venn diagrams, mental maps and a problem ranking matrix (Rietbergen-McCracken and Narayan, 1998). In this research

context, observations, focus group discussions and a problem ranking matrix were used to obtain qualitative data in the Khokhwane, Sizanenjana and Richmond communities.

4.8.2 Observations

According to Miller and Dingwall (1997) there are two ways of conducting social research; by 'asking questions' and 'hanging out'. The former could relate to questionnaires whereas the latter could be observations and informal discussion. Wilkinson and Birmingham (2003) contend that observations are an effective method to gain information about the respondent's surroundings and immerse oneself in their daily routine and lives. Marshall and Rossman (2006) state that observations involve the efficient recording of behaviours, actions and experiences at a specific study site. This can be referred to as detailed field notes of what the researcher has observed during time spent in the field. Additionally, Wilkinson and Birmingham (2003) assert that observations aid the researcher in gaining valuable information about respondents in their natural environment. This will help the researcher understand the respondent much better. Miller and Dingwall (1997) maintain that observations are techniques that reveal the everyday life patterns and routines of the respondents to the researcher. However, it does not reflect how the respondent is feeling or what the respondent is thinking.

Observation, as stated by Marshall and Rossman (2006) is a technique often conducted during a preliminary visit to a study area, where the researcher enters the research site with a broad perspective and idea. During the observation period, a deeper understanding of recurring patterns and trends in behaviours and daily activities will be gained. Observations can thereafter be used in the actual study for data collection (Marshall and Rossman, 2006; Silverman, 2010).

According to Silverman (2010) when conducting research for a large sample size, observations are not a reliable technique. The reason being, different observers document different observations. Marshall and Rossman (2006) emphasise that observations often require a lot of effort, patience and understanding from the researcher. In addition, issues surrounding ethics and invasion of privacy may arise, causing much discomfort and difficulty for the researcher and the respondent.

Observations were carried out in the Khokhwane, Sizanenjana and Richmond community. This aided the researcher in understanding the behaviours and routines of individuals in the

community. Observations in this research study proved to be useful to the researcher in the Sizanenjana community. This is due to the fact that many respondents do not understand the term climate change and were unaware of the impacts. The use of observations, guided the researcher in understanding many of the unusual responses gained in that community. For example, the researcher observed a patch of dried up crops. However, when asked if the respondent is experiencing any problems with their crops, the respondent mentioned that there were no problems with their crops. Therefore, this observation of dried crops aided the researcher in gaining valuable knowledge that may not have been disclosed in the questionnaire survey. Plate 4.4 depicts the observed patch of dried crops.

Plate 4.4: Observed dried crops in the Sizanenjana community in winter 2015.

4.8.3 Focus group discussions

Freitas et al. (1998) contend that focus group discussions are a type of in-depth interview which is undertaken in a small group rather than individually. The number of participants in focus group discussions is an important issue to consider. Harrell and Bradley (2009) argue that having too few individuals may decrease the flow and dynamism of the session, while having too many individuals partake in the focus group discussion may not allow all opinions

and voices to be heard. The optimum number of individuals partaking in a focus group discussion should be between 6 and 11 (Dilshad and Latif, 2013; Harrell and Bradley, 2009; Gill et al., 2008). However, researchers do not have to stick to this number as focus group discussions may work successfully in some cases, with a minimum of three participants and a maximum of fourteen participants (Gill et al., 2008).

Focus group discussions are similar to that of an unstructured interview. However, the intention of a focus group discussion is to gather information pertaining to views, beliefs and attitudes, sometimes collective, towards a designated topic (Dilshad and Latif, 2013; Freitas et al., 1998; Gill et al., 2008). These discussions are usually facilitated by a mediator or researcher (Dilshad and Latif, 2013; Gill et al., 2008). Issues at hand are unfolded in the view of the participant, not the researcher. Thus, the researcher is a facilitator in the process led by the participant (Marshall and Rossman, 2006). The main component that encompasses a successful focus group discussion is the interaction between participants which allow for further questions and follow-on discussions (Freitas et al., 1998; Gill., et al 2008).

Focus group discussions can be time consuming as discussions may go on for lengthy periods of time. In rural households participants are known to voice their concerns to outsiders in the hope that they are going to assist them. In addition, there may be some extent of bias surrounding responses, especially when upliftment programmes are involved. Participants could be biased to a certain project and answers may be exaggerated due to their stake in the project. Additionally, participants may not disclose their true feelings if they do not conform to the rest of the group (Dilshad and Latif, 2013; Harrell and Bradley, 2009).

Focus group discussions took place in the Donnybrook, Elandskop and Richmond communities. The groups consisted of both females and males, of five to six people, aged between twenty-five and sixty-five. Participants of a group discussion undertaken in the Sizanenjana community can be seen in Plate 4.5. A Problem Ranking Matrix in conjunction with focus group discussions were used as an effective method of obtaining extensive information regarding the social, environmental and economic issues experienced by all three communities.

Plate 4.5: Focus group discussion participants in the Sizanenjana community.

4.8.4 Problem ranking matrix

According to Mikkelsen (1995) problem ranking and scoring exercises are an easy and quick way of learning about the problems faced by a community. A problem ranking matrix has been used by researchers for a long time. People, problems or things can be ranked and scored depending on the focus of the research. There are many different scoring techniques, some of which include differential ranking, summated ranking, and cumulative ranking. All these ranking methods give the respondent a choice between two or more variables which are then weighted. Ranking and scoring exercises are an effective way to gain personal and sensitive information that would not usually be asked directly in the form of a questionnaire (Rietbergen-McCracken and Narayan, 1998).

Matrices are a useful technique not only in gaining insight about problems faced by respondents, but can also be used to identify patterns and trends that may exist across data sets (Dey, 2005). In this research context, a problem ranking matrix was used as a method of gaining data, and used to identify common problems faced within the Khokhwane, Sizanenjana and Richmond communities, respectively.

Within the context of this research, a group of six to ten people from the Khokhwane, Sizanenjana and Richmond community were gathered. The researcher then asked the respondents to list the problems they encountered within the area. The group then compiled a

list of problems which they experienced in the respective areas. A ranking matrix was utilised to weight each problem against another. The problems identified were listed, scored and thereafter ranked. The problems were ranked according to the focus group and the community involved. An important note made to the community by the researcher was that each problem ranking exercise carried out throughout the community would yield different results as some groups of the community were wealthier than others. The problem ranking exercise was an effective exercise as it yielded additional information to the researcher. The researcher was made aware of the additional problems faced by the Khokhwane, Sizanenjana and Richmond communities. This additional information was useful as these problems were not reflected in the structured questionnaire.

Once the problems were listed and given an acronym, the problems were written horizontally and vertically. Thereafter the problems were weighted against each other to determine which problem was more problematic. Subsequently, each problem was counted to see how many times it appeared, this is known as the scoring. Once scored, the problems were then ranked depending on what score they received. The highest scored problem received the first ranking; the second highest score received the second ranking and so on. The end result showed a list of problems ranked from most to least severe. An example of a problem ranking exercise undertaken in the Khokhwane community is seen in Plate 4.6.

Plate 4.6: Problem Ranking Matrix exercise in the Khokhwane community.

4.9 Fieldwork experiences

Before fieldwork could be undertaken, the researcher had to undergo a process of ethical clearance. The ethical clearance procedure required the researcher to fill in forms regarding the nature and the desired outcome of the research. Additionally, a consent form, indemnity form and complete questionnaire had to be submitted. The process of ethical clearance was extremely frustrating for the researcher as it was a lengthy process and research could only commence once ethical clearance was granted. Ethical clearance was granted in February 2015 (Appendix 4) which allowed the researcher to initiate data collection in the three communities respectively. Fieldwork experiences in each of the communities are highlighted below.

4.9.1 Sizanenjana community

The researcher's first language is English, thus the main obstacles faced by the researcher was the language barrier as the indigenous language of the respondents interviewed was isiZulu. A preliminary visit was undertaken in the Bulwer and Donnybrook area within the Ingwe Local Municipality. Upon visit, different communities were taken into consideration depending on factors such as topography and access to the community. After much deliberation, the Sizanenjana community within the Donnybrook area was chosen as an ideal research community. It was fortunate that the researcher was accompanied by a representative from the community. Permission was requested and granted with no problems.

Due to the spatial location of this community, it took an approximately one and a half hours drive to Donnybrook, thereafter a forty-five minute drive on a gravel road into the community. Fieldwork was carried out over 10 days between February 2015 to June 2015. Research assistants whose first language is isiZulu, were taken to the communities as translators. These translators assisted in administering the questionnaires to the respondents. Each respondent was asked the questions in isiZulu and could not fill in the questionnaire, as the questionnaire was in English. This contributed to the questionnaire taking longer to complete. Due to the fact that the Sizanenjana community is a rural area, many of the respondents were women who were busy with chores. Many female respondents requested that we come back later on in the day to complete the questionnaire. This was a huge disadvantage as it was time consuming.

Another issue faced in Sizanenjana community was the topography as it does not allow for houses to be situated within close proximity of one another. Households are scattered across

the community and it was difficult to locate many respondents in one area at a time. This was also found to be extremely time consuming.

Another obstacle faced by the researcher was the lack of knowledge and environmental education received by the community itself. Many of the respondents rely on indigenous knowledge systems, as seen by the responses from the questionnaire. Many of the respondents viewed a change in climate as experiencing water shortages and increased drought periods. Many respondents had not heard about the phenomenon of climate change. Therefore, the responses from the questionnaire were unreliable to some extent. How can you answer a question about a concept you know little to nothing about?

It was noted that on the one hand, many of the respondents portrayed a negative image of the government as they do not provide basic services and needs for them. It was for this reason that many of the respondents felt that by participating in the research, the researcher would address their concerns and assist them. On the other hand, while some respondents were willing to participate, others were hesitant to sign the consent form. They feared that local government would find out and they would get into trouble.

4.9.2 Khokhwane community

The Khokhwane community within the Elandskop area in the uMsunduzi Local Municipality was chosen as a second site. A preliminary visit was undertaken to meet the facilitators in charge of that community. This community received help from the Department of Co-operative Governance and Traditional Affairs (COGTA) who employed facilitators to help the community establish food gardens. These Facilitators belong to an organisation called Community Work Programme (CWP). Upon visit to the community, there were two facilitators who were willing to help the researcher distribute the questionnaires among the households. Contact was made and a second meeting held one week later. The researcher then interviewed the facilitators and held a focus group discussion.

Once again, language was a barrier as the researchers first language is English. The facilitators were extremely helpful and therefore fewer problems were encountered in the Khokhwane community than in the Sizanenjana community.

4.9.3 Richmond community

A preliminary visit was undertaken to the Richmond town where the researcher met with Sandile, a member from the African Conservation Trust (ACT) and WCT, who were responsible for installing food gardens within the Richmond area. Sandile explained that the Richmond town was divided into seven wards, and that each ward comprised two facilitators who would assist the community with any needs. Sandile further elaborated that for the purpose of the research study it would be best to sample in wards one, two and seven due to their close proximity to one another. Sandile suggested that two facilitators per ward would assist me, a total of six facilitators.

Upon the second site visit, Sandile introduced the researcher to six facilitators who agreed to assist the researcher in handing out questionnaires to the community. This third research site was established later in the study, due to the researcher receiving a bursary from the WCT. One of the requirements of the bursary was to undertake research in a Wildlands site. The facilitators were well versed in the administration of the questionnaires as they had undertaken environmental education and sustainable agricultural training programmes. This expertise and knowledge gained was beneficial in establishing and maintaining the food gardens that were installed in these communities.

The researcher then proceeded to ward two where the facilitators introduced the researcher to recipients of the Wildlands food gardens initiative. Group discussions were held, and an overall sense of gratitude and appreciation was received by the researcher. The respondents were delighted to show the researcher their food gardens and the healthy yield it produces. A sense of well-being as well as a more stable environment was identified compared to the Sizanenjana and Khokhwane community.

A point to note is that across all three communities, the researcher was welcomed by friendly and hospitable respondents. Almost every respondent interviewed, invited the researcher and fieldwork enumerators into their household and were willing participants. In one instance, in the Richmond community, a respondent invited the researcher and fieldwork enumerators to take home fresh produce from the garden as depicted in Plate 4.7. The warmth and humbleness of respondents in the Khokhwane, Sizanenjana and Richmond communities will always be remembered by the researcher.

Plate 4.7: Fieldwork enumerators with the fresh vegetables harvested.

4.10 Conclusion

This chapter looked at the methods and instruments used in this research. The research questions were discussed in detail. The instruments used for this study were then discussed including both primary and secondary data. Primary data methods included both quantitative methods of questionnaires whereas qualitative methods were comprised of observations, focus group discussions and PRA. Secondary data consisted of books and historical climatic data. The chapter then went on to discuss the sampling method used to collect the data, thereafter the procedure that was used to analyse the data collected. Data analysis techniques and the use of SPSS were then discussed in detail. Firstly, the background into the study areas used for this research was looked at in detail. Secondly, the IDP's for all three communities

were reviewed, highlighting the opportunities and challenges faced in each community. Lastly, the researcher's fieldwork experiences at each community was highlighted, focussing on the challenges faced and the experiences overall, so as to aid other researchers in their research endeavours.

CHAPTER 5:
DATA PRESENTATION, ANALYSIS AND DISCUSSION

5.1 Introduction

This research study investigated the impacts of a change in climate on small-scale farmers in the Khokhwane, Sizanenjana and Richmond communities in KZN. This chapter presents the findings and analysis of this research study using the data that was captured and analysed using Statistical Package for Social Science version 23 (SPSS). Frequency tables and graphs were formulated using SPSS and Excel. Thereafter Chi-Square tests were undertaken using SPSS to address objective 2. In addition, PRA exercises were used to complement the quantitative data collected from the questionnaires as Mikkelsen (1995) asserts that participatory exercises are an effective way to gain information that would usually not be disclosed in questionnaires. This chapter will be divided thematically based on the themes of the questionnaire survey. The outline of the chapter will be as follows:

1. Demographic and personal details.
2. Climate Change and Environmental Education.
3. Agricultural Patterns and Methods.
4. Food Security.
5. Water and electricity
6. Coping Strategies.
7. Wildlands Food Gardens Project.
8. Participatory exercise findings.

5.2 Demographics and personal details

Figure 5.1 illustrates that the majority of the respondents interviewed in the Khokhwane, Sizanenjana and Richmond communities were female. The reason for this is that there are many female headed households in rural areas (Grainger-Jones, 2011; Schatz et al., 2011). This is due to rural-urban migration whereby the men and youth leave their homes in the rural area and move to the city in search of employment opportunities (FAO, 2014). This is further emphasised in the IDP (2015/2016), whereby 53.3% of the population consist of female, as the men migrate to the cities in search of work. The IDP (2013/2014) states that the Richmond population consists of 51% female and 49% male. This explains the reason for the high percentage of female respondents (61%) in the Richmond community. All respondents across all three sites were African from South Africa with isiZulu being their home language.

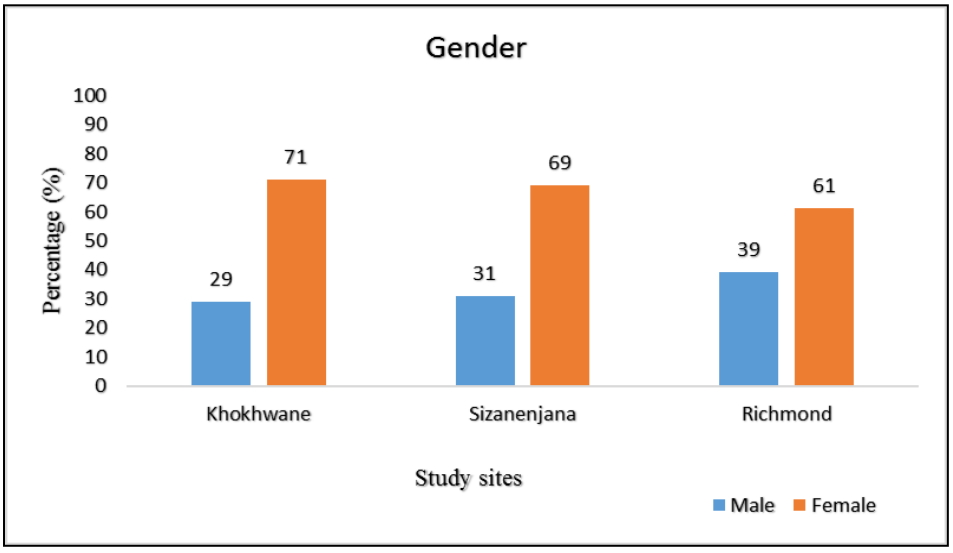

Figure 5.1: Gender of respondents (n=100 in each community).

Table 5.1 shows the age of respondents in the Khokhwane, Sizanenjana and Richmond communities. It is evident that within the Khokhwane community, 35% of the respondents belonged to the age group 46-55 years followed by 28% of the respondents of more than the age of 65. Twenty-seven percent of the respondents were between the ages of 56-65 years. In the Sizanenjana community, the majority of the respondents were from the age group 46-55 (29%) whereas the rest of the age groups had a similar percentage of distribution of respondents. The IDP (2013/2014) states that the population of Ingwe Local Municipality has decreased contributing to a negative growth rate. This can be attributed to rural-urban migration where many individuals migrate to the cities in search of better employment opportunities (Nelson Mandela Foundation, 2010).

More than half of the respondents from the Richmond community (52%) belonged to the age group between the years of 26-35. Followed by 26% belonging to the age group 36-45. The IDP (2013/2014) states that the Richmond community is largely dominated by youth with 72% of the population being below the age of 35. This is the reason why 52% of the respondents fell into the age category 26-35 years. Youth headed households are increasing. Either the parents have migrated to the cities in search of work, or the parents have contracted HIV and AIDS, thus leaving the children to run the household (Bonthuys, 2010; Mokgatle-Nthabu et al., 2011). Mokgatle-Nthabu et al. (2011) further argue that communities with a high number of youth headed households are more prone to criminal activities. In the absence of elders in the household, cultural traditions, values and norms are not instilled in the younger generation, thus leading to delinquency behaviours.

Table 5.1: Age of respondents (in %).

Age	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=300
<25	-	19	13	32
26-35	3	15	52	70
36-45	7	12	26	45
46-55	35	29	7	71
56-65	27	16	2	45
>65	28	9	-	37

Table 5.2 illustrates the marital status of respondents in Khokhwane, Sizanenjana and Richmond communities. Forty-five percent of the respondents in the Khokhwane community are married, followed by 26% being single and 25% widowed. Fifty-four percent of the respondents in the Sizanenjana community are married and 38% are single. In the Richmond community, due to the predominantly youthful population, majority of the respondents (83%) are single while 14% are married.

Table 5.2: Marital status of respondents (in %).

Marital Status	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=300
Single	26	38	83	147
Married	45	54	14	113
Separated	2	-	-	2
Widowed	25	6	1	32
Living with partner	2	2	2	6

Table 5.3 depicts the occupation of the respondents in the Khokhwane, Sizanenjana and Richmond. Thirty-six percent of the respondents from the Khokhwane community are pensioners while thirty-three percent of the respondents are unemployed. The IDP (2011) for uMsunduzi indicates that out of a total of 2 945 employees only 648 are female. In the Ingwe Local Municipality, the IDP (2014/2015) states that only 10% of people on this municipality are employed. This is the reason for the high percentage (53%) of unemployed respondents in the Sizanenjana community. The large percentage of youth in Richmond contributes to the high percentage (83%) of unemployed individuals. Furthermore, the IDP (2013/2014) indicates that 53% of the Richmond population receives no income. This can be attributed to the high rate of unemployment. High rates of unemployment have the potential to result in poverty as there is less income coming into the household.

Table 5.3:Occupation of respondents (in %).

Occupation	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=300
Unemployed	33	53	84	170
Domestic worker	21	-	5	25
Farm labourer	3	4	3	10
Pensioner	36	22	2	60
Student/learner	2	5	3	10
Other	1	2	1	4
CWP worker	3	-	-	1
Grant	1	2	-	3
Casual work	-	5	1	6
Self employed	-	5	-	5
Teacher	-	2	1	3

Blease and Candy (2014) assert that a major obstacle exists in rural areas with regards to education and learning which hinder the capability of both learners and teachers to achieve good literacy skills. A study undertaken by Muhwava et al. (2010) reveals that individuals with an educational level greater than secondary are more likely to migrate to urban areas in search of employment and other opportunities, while individuals with a primary level education or lower tend to remain in the rural areas. More often than not, it is the women who remain behind to run the household and look after the children (Raidimi, 2014). In many households due to financial challenges, it is found that the children do not attend school. The money received in the household is used for household maintenance, food and other costs while little is left for schooling expenses. Woolard (2002) argues that a correlation exists between a household's standard of living and educational achievements. The poorer a household is, the less likely that educational attainment will be high. Woolard (2002) further emphasises that poverty is likely to decrease if an individual completes secondary or a tertiary qualification.

Additionally, it is important to note that many of the teachers employed at rural schools are poorly trained and have limited resources to work with. This was seen in the case studies presented in this research study. Due to the rurality and location of these schools, they do not

have access to many resources. Thus, the quality of education received by learners is not of good quality compared to education received at an urban school. The lack of access to education and resources is linked to the ideas of political ecology, discussed in chapter 3 of this research. The uneven distribution of resources has resulted in decreased education received by some community members. This is further emphasised by Knox and McCarthy (2005) who contend that leaders who possess power, often implement policies which are advantageous to urbanised areas. This is seen through allocation of basic services as well as resources for learning institutions concentrated in the cities, leaving rural areas with minimal resources to provide the same outcome of education as received in the urban areas. Chigbu (2013) terms this urban bias, whereby power and resources are given preference to urban centres due to the locality.

With respect to the quality of education received in rural areas, Nelson Mandela Foundation (2005:138) states:

> *Poorly-trained teachers with few incentives to live in the areas where they teach, as well as startling limited facilities and resources to assist them in their task, compromise the rights of children within education. Early childhood development programmes are virtually non-existent.*

Additionally, Lotz-Sisitka (2011) asserts that many schools in rural areas do not contain adequate and hygienic facilities, thus influencing the quality of education received at rural schools. Furthermore, many children in attendance emerge from deep rooted poverty homes, which also have an influence on their participation and level of understanding and learning. Access to education is also heavily influenced and dependent on access to infrastructure such as roads and transport (Donnges, 2003; Porter 2011). Porter (2014) emphasises the importance of infrastructure in educational attainment. In many rural areas road infrastructure is poor acting as a hindrance for children to attend school. As a result of poor infrastructure, many children cross rivers and walk far distances to attend school which endangers their lives. In other instances, poor road infrastructure prevents children from attending school, depriving them of an education. Arethun and Bhatta (2012) maintain that improving road infrastructure allows children living in rural households better access to educational facilities thus improving their standards of living. However, Porter (2011) argues that access to transport is usually given preference to men, leaving the women and children with limited access to the outside world. Once more, the concepts of political ecology and uneven power distributed to men and women are have surfaced. Additionally, due to the terrain of the

landscapes during periods of heavy rains, the river banks collapse, making it a safety hazard for children who cross rivers to get to their schools.

Table 5.4: Level of education received by respondents (in %).

Level of education	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=300
None	18	22	4	44
Primary	56	31	7	94
Secondary	24	43	63	130
Tertiary	2	4	26	32

Tables 5.5 indicates the number of children and number of dependents respondents have in the Khokhwane, Sizanenjana and Richmond communities. It was noted that the number of dependents may be higher than the number of children. This is as a result of the head of the households providing for their immediate and extended family. These are seen by the large percentage of dependents greater than five in the Khokhwane (27%) and Sizanenjana community (35%). De Sherbinin et al. (2008) suggest that as a household's dependency for resources increases, the rate of fertility increases. This implies that women tend to have more children as they are seen as human capital who provide a source of labour in the form of farm labourers; collectors of water and fuel wood; and eventually earning an income to help support their family. Apart from direct income received by the household, remittances sent from males, who have migrated to the cities, aid in supporting the household. These remittances have the potential to aid in poverty alleviation (Mishi and Mudziwaspasi, 2014; Ratha, 2013; Worku and Marangu, 2015). However, Worku and Marangu (2015) suggest that the size of the household has a direct influence on the amount of remittance received by that household. Larger households tend to receive less remittance than households with fewer individuals.

Table 5.5: Number of children and dependents (in %).

Number of Children	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=300
None	1	16	8	25
1	7	10	19	36
2	21	13	19	53
3	21	9	26	56
4	19	14	11	44
5	10	9	10	29
7	21	29	7	57
Number of dependents	**Khokhwane n=100**	**Sizanenjana n=100**	**Richmond n=100**	**Total n=300**
None	-	18	5	23
1	4	12	20	36
2	8	10	16	34
3	13	6	23	42
4	27	12	12	51
5	21	7	13	41
>5	27	35	11	73

5.3 Climate change and environmental education

The term 'climate change' is a well known concept and has been considered a controversial, concept in recent years. However, rural small-scale farmers, situated in a remote area with limited access to technology, may find it difficult to become aware of issues such as climate change. There are many aspects that individuals residing in urban areas take for granted such as access to education and technology. This is assuming that everyone experiences the same things that people residing in urban areas do, and are exposed to the same circimstances and ideas as everyone else. However, that is not the case. Many individuals residing in rural areas have limited access to technologies and educational facilities, and are therefore ignorant and unaware of many phenomenons that are affecting their everyday lives. One such phenomenon is climate change. Hassel and Dean (2015) assert that technology in rural areas has the potential to connect both learners and teachers to the global world and broaden their knowledge. Reddy (2011) argues that due to South Africa's past and the change brought

about post apartheid, many teachers have not received environmental education. Therefore, there is a need for teachers to further devlop and expand their knowledge on environmental issues. This will enable them to teach learners about environmental issues.

As seen in Figure 5.2 many respondents in the Sizananjana community have not heard of the term climate change (62%). Maddison (2007) notes that it is unlikely that farmers residing in rural areas perceive changes in climate. This is due to limited access to education as well as technologies which has lagged them behind. Only 75% of the respondents in the Khokhwane community have heard of the term climate change, and this is due to the assisstance received from the CWP workers who have gone through environmental educational training and have passed on some of that knowledge to fellow community members. The high response rate of 97% in the Richmond community can likewise be attributed to the help received by WCT whereby the majority of the respondents, if not all, went through environmental educational and sustainable agricultural training workshops where they were taught about the issues of climate change and food insecurity.

This question was aimed at determining whether the term climate change was understood by respondents in the Khokhwane, Sizanenjana and Richmond communities, respectively. The respondents in the respective communities were questioned whether they understood the term climate change after a definition was provided to them. Figure 5.2 illustrates the results obtained from this question. For those respondents that had not heard about climate change, the translators had briefly explained the concept of climate change to the respondent. The respondents were then asked what they understood by the term climate change. Seventy-five percent of the respondents in the Khokhwane community had heard of the term climate change, while 25% of the respondents had not heard of the term. Results obtained from the Sizanenjana community revealed only 38% of the respondents had heard of the term climate change, while a large percentage (62%) had no understanding of the term. The large positive response received by the Richmond community (97%) was perceptive. This can be attributed to the WFGP on environmental education.

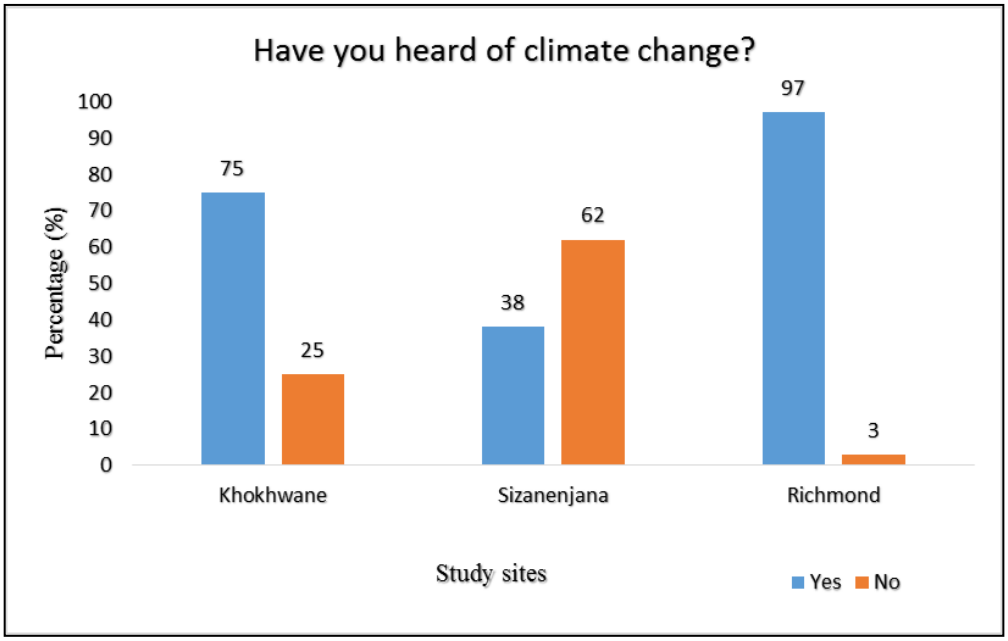

Figure 5.2:Percentage of respondents that have heard of climate change (n=100 in each community).

Table 5.6 illustrates 54% of respondents in the Khokhwane community understand climate change to be a change in weather conditions. Twenty-one percent of the respondents have noticed extreme temperatures: when it is cold it is extremely cold, and when it is hot, it is extremely hot. Eighteen percent of the respondents did not know how to answer the question.

The responses from the Sizanenjana community about their understanding of climate change were vague and similar for many of the respondents. Eleven percent of the respondents understood climate change to be a rise in temperatures and 23% of the respondents understood climate change to be extreme weather conditions. For example, very hot temperatures and decreased rainfall. Sixteen percent of the respondents stated climate change to be the continuous change in climate, with 12% of the respondents stating that the seasons have become harsher. Twenty-two percent of the respondents did not know what they understood by the term climate change.

The responses from the Richmond community were similar to that of Khokhwane and Sizanenjana. Majority (80%) of the respondent felt that climate change was a continuous changing of weather patterns. Respondents in Richmond community understood climate change to be the changes in weather conditions with increased temperatures (29%) and increased drought conditions (11%). It is important to note that all respondents answered this question with none stating they do not know. This shows the level of environmental awareness and education in this community.

Table 5.6: What respondents understand by the term climate change (in %): Multiple responses

Understanding of climate change	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=300
Rising temperatures	-	11	29	40
Continuous changing of weather patterns/climate	54	16	80	150
Seasons are harsh	6	12	-	18
Droughts and less rain	9	15	11	26
Extreme weather conditions	21	23	-	44
Windy conditions and increased fires destroys crops	-	5	-	5
I don't know	18	22	-	40

Figure 5.3 pertains to objective 1 of this study to determine the perception small-scale farmers have towards a change in climate. Figure 5.3 reveals that the majority of the respondents across all three communities, 84%, 80% and 96% for Khokhwane, Sizanenjana and Richmond respectively, felt that climate change was affecting their agricultural production. The eighteen percent of the respondents in the Sizanenjana community that stated that climate change was not affecting their agricultural production, can be attributed to the low percentage of environmental education received in the Sizanenjana community.

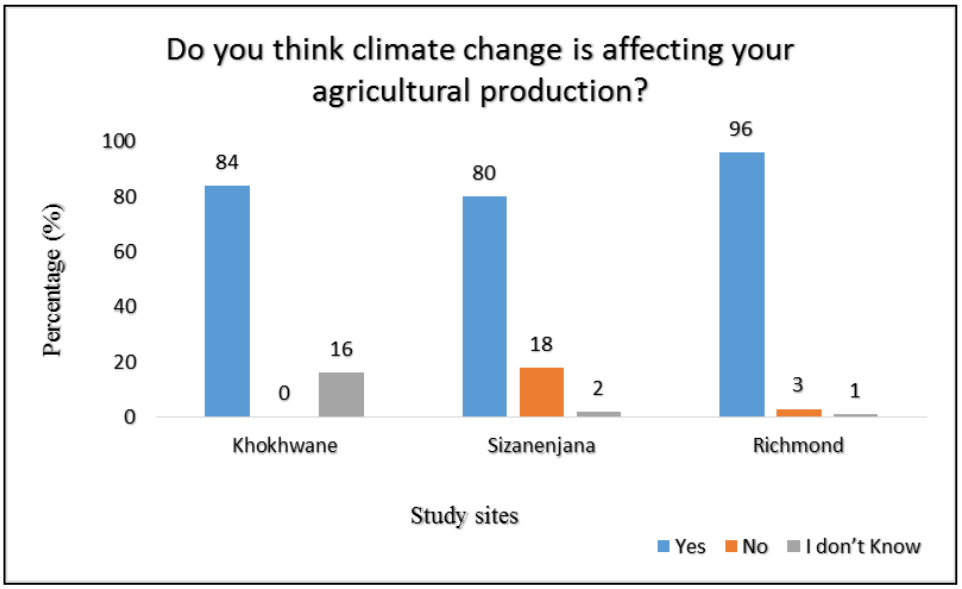

Figure 5.3: Percentage of respondents that feel climate change is affecting their agricultural production. (n=100 in each community).

Figure 5.4 illustrates the percentage of respondents that perceive climate change to be a problem. The majority of the respondents in the Khokhwane, Sizanenjana and Richmond communities (80%, 87% and 97% respectively) perceive climate change to be a problem. Table 5.7 indicates the reason for respondents perceiving climate change to be a problem. This question tried to establish in what manners the respondents perceived climate change to be a problem. The majority of the respondent across all three communities started off by stating that climate change is a problem as their crops have dried up or have been destroyed due to extreme weather conditions.

Eighty percent of the respondents in the Khokhwane community felt that climate change is a problem due to the following reasons: drought conditions (32%); decreased quality of crops being produced (21%); crops are disturbed due to extreme weather conditions making it difficult to grow crops (18%); and increased temperatures are hindering agricultural activities (9%). A respondent stated, "I cannot grow crops the way I used to because most of the time I don't produce what I was expecting". Twenty percent of the respondents stated they do not know if climate change is a problem or not and could therefore not answer the follow up question. This indecisiveness can be attributed to a lack of environmental education.

The majority of the respondents in the Sizanenjana community feel decreased rainfall (41%) has contributed to decreased yield (19%) and has also affected (killed) livestock (17%). Drought conditions experienced by 41% of the respondents are the main reason why respondents feel climate change is a problem. Drought conditions signify that there is no water for irrigation of crops as well as for cattle with one respondent stating "It disturbs and destroys my crops and kills my cattle". A few respondents (12%) felt that climate change was not a problem and stated that they detected no changing in the climate and that if there was, it was just a slight change and it was natural. This is what has been occurring for many years and for them it is normal and therefore not a problem. This can also be due to the lack of environmental education as seen by the high percentage of respondents.

Sixty percent of the respondents in the Richmond community feel that climate change is a problem as increased temperatures have dried up and destroyed their crops while heavy rains have caused soil erosion thus removing their crops in the past. Twenty-six percent of the respondents have also experienced a shortage of water and increased drought conditions which have also negatively impacted on their agricultural production in the past. Research undertaken in Zimbabwe by Nhemachena et al. (2014) reveal similar results that rural farmers only know and perceive climate change to be what they witness and are heavily influenced by their experiences and knowledge. In many instances, merely noticing climate change and perceiving it to be a problem is not enough for farmers to actually do something about it as they lack resources and skills required to adapt to climatic changes.

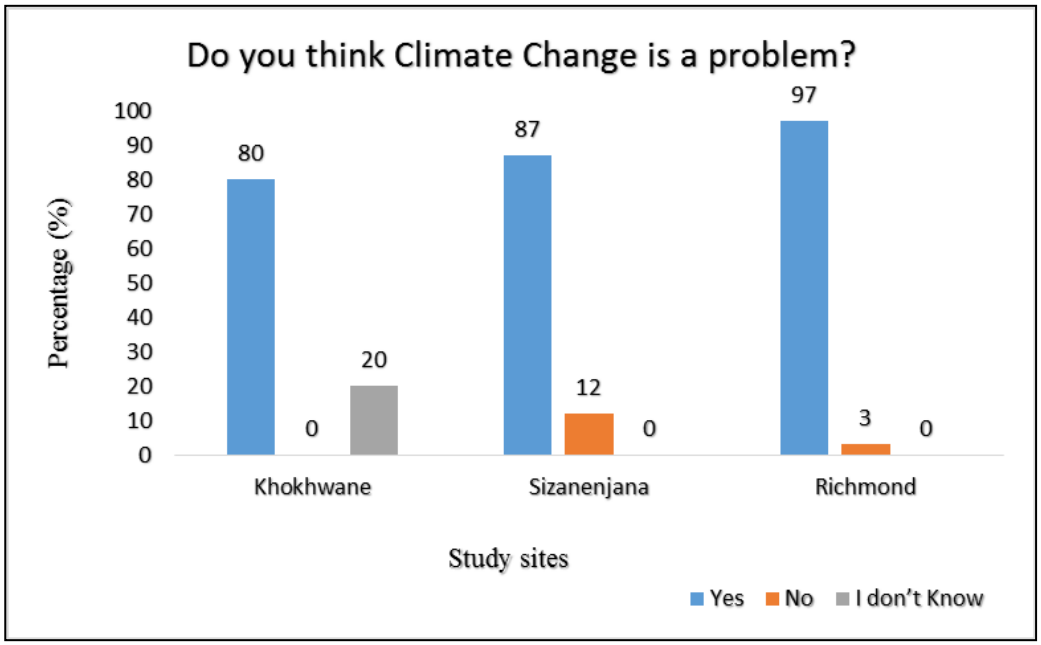

Figure 5.4: Percentage of respondents that feel climate change is a problem. (n=100 in each community).

Table 5.7: Why respondents think climate change is a problem (in %): Multiple Responses.

Problems	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=300
It disturbs and destroys crops	18	14	60	92
No water/ less water	32	41	27	100
Extreme temperatures hinder agricultural activities	9	19	27	55
Abrupt changes in temperatures	-	16	-	16
No change detected	-	5	-	5
Kills cattle	-	17	-	17
Floods in summer	-	6	-	6
Decreased crop production	12	19	58	89
Decreased quality crops	21	-	0	21
Doesn't produce the way it should	24	-	34	58
Causes erosion	2	-	-	2
Soil has become dry	-	-	11	11
Decreased rainfall	-	-	26	26
I do not know	16	13	-	29

Table 5.8 indicates the percentage of respondents that have received environmental education and how much. Environmental education across the Khokhwane and Sizanenjana community is low, whereas there are a much higher percentage of respondents that have received environmental education in the Richmond community. Only 4% of the respondents in the Khokhwane community have received environmental education of which 2% stated it was very little and the other 2% stated that they did not receive much. They received this environmental education through NGOs as well as from listening to the news. Ninety-six percent of the respondents in the Khokhwane community have not received environmental education.

Twenty-five percent of the respondents in the Sizanenjana community have received environmental education. Nine percent of the respondents stated that they received a little, 8% stated they received a lot, 6% not very much and 2% received a satisfactory amount of environmental education. It is important to note that the majority of the respondents (74%) have not received environmental education. This may be attributed to urban bias whereby rural areas do not receive the same attention and assistance due to their locality (Chigbu, 2013; Dixon and Richards, 2015). This is evident in the Sizanenjana community whereby factors such as the remote location, lack of educational facilities and lack of access to

technologies to help them keep in touch with current news, have placed them at a disadvantage of receiving assistance.

Sixty-two percent of the respondents in the Richmond community have received environmental education with 25% stating they have received a little, 4% stating they have received a lot, 29% indicating that they have received not much and 6% have received a sufficient amount of environmental education. The reason for the high percentage in respondents that have received environmental education is due to the fact that many of the respondents were participants of the WFGP. Many respondents went through environmental education and training, and were well equipped with the knowledge regarding climate change issues.

Table 5.8: Environmental education received and amount (in%).

Environmental Education	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=300
Yes	4	25	64	93
No	96	74	35	205
No response	-	1	1	2
Amount	**Khokhwane n=100**	**Sizanenjana n=100**	**Richmond n=100**	**Total n=300**
A little	2	9	25	36
A lot	-	8	4	12
Not much	2	6	29	37
Sufficient	-	2	6	8
N/A	96	74	35	205

Figure 5.5 and 5.6 relate to objective 1 of this study, and indicate the number of respondents that have perceived changes in rainfall and temperature over the past 10 years. The majority of the respondents in the Khokhwane, Sizanenjana and Richmond communities have noticed changes in rainfall and temperature patterns over the past 10 years. Ninety-five percent of respondents in the Khokhwane community have noticed changes in rainfall patterns and 97% have noticed changes in temperature patterns over the past 10 years. In the Sizanenjana community only 74% and 76% of the respondents have noticed changes in rainfall and temperature patterns respectively. Twenty-six percent and 24% of the respondents in the Sizanenjana community have not noticed changes in rainfall and temperature in the past 10

years and have stated that for them the weather conditions have remained constant, and are 'normal'. Sixty-eight percent of the respondents in the Richmond community stated that they have noticed a change in rainfall and temperature, whereas 32% indicated they have not noticed a change in rainfall and temperature. This can be due to the issue that many of the respondents interviewed in the Richmond community were young. They would not remember experiencing changes in rainfall and temperatures as young teenagers, or would not necessarily have noticed the changes that were occurring, compared to the age group of respondents in the Khokhwane and Sizanenjana community who are much older and could therefore remember experiencing changes in rainfall and temperature over the past decade. Similarly, research undertaken by Maddison (2007) reveals that rural farmers in Africa have experienced changes in rainfall and temperature that have affected their crop production.

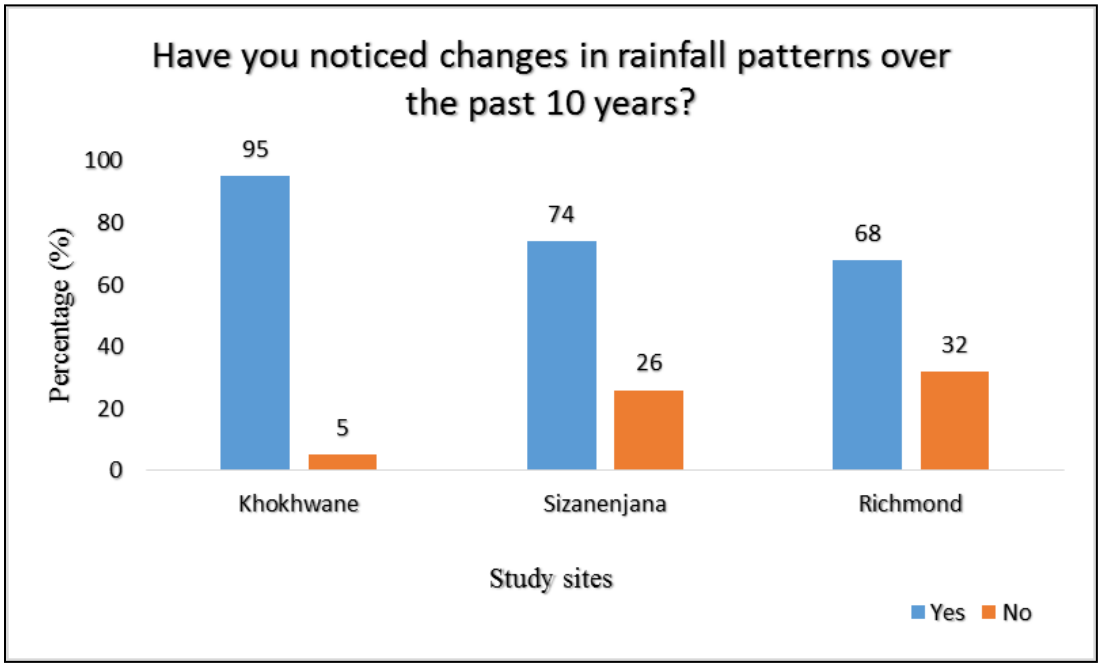

Figure 5.5: Respondents that have noticed changes in rainfall over the past 10 years. (n=100 in each community).

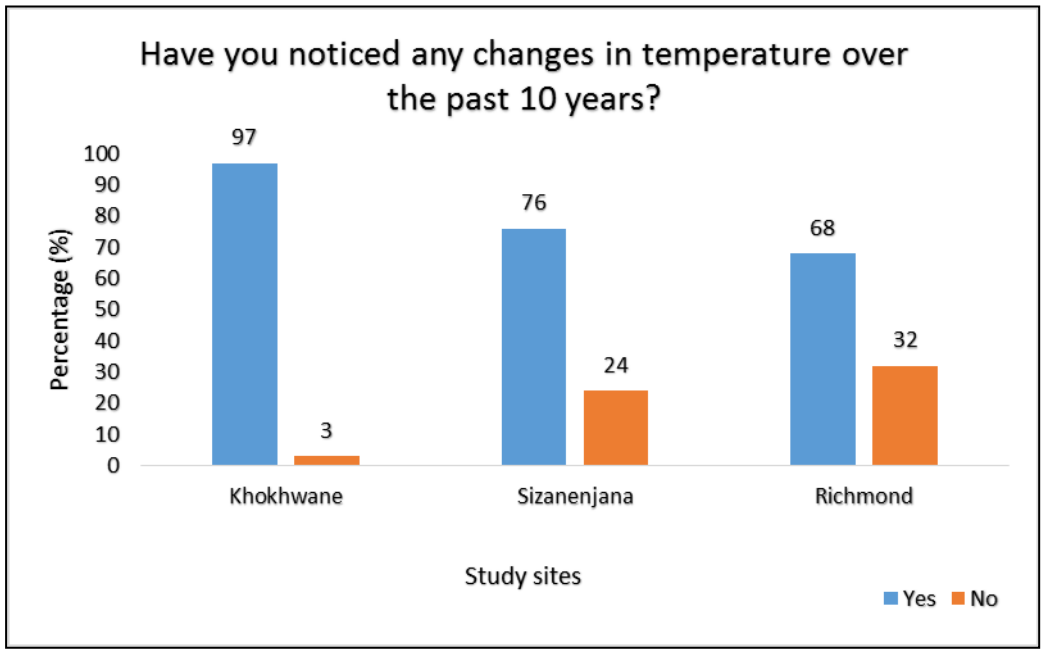

Figure 5.6: Respondents that have noticed changes in temperature over the past 10 years (n=100 in each community).

5.4 South African Weather Service temperature and rainfall data:

Statistics from SAWS were used in this research study to enhance the responses obtained for these two particular questions. Figure 5.7 depicts the average daily maximum and minimum temperatures measured at 08h00 for the Ixopo station for periods 2001-2015. While Figure 5.8 indicates the average daily maximum and minimum temperatures measured at 08h00 for the Pietermaritzburg station for periods 1993 to 2015. It is evident that there has been a gradual increase in average temperatures at these two weather stations. As discussed in chapter 4, the research methodology, the reason why only these two weather stations were chosen was due to the Ixopo weather station being the closest station to the Sizanenjana community with a distance of (37km), and the Pietermaritzburg weather station was the closest station to the Khokhwane and Richmond communities (96km and 43km respectively). The results obtained regarding changes in rainfall and temperature are similar to findings obtained by Nhemachena et al. (2014) on perceptions of climatic change of rural farmers in Zimbabwe. Small-scale farmers in the study conducted by Nhemachena et al. (2014) indicated a perceived increase in temperature and decrease in rainfall which were perceived to influence their agricultural productivity.

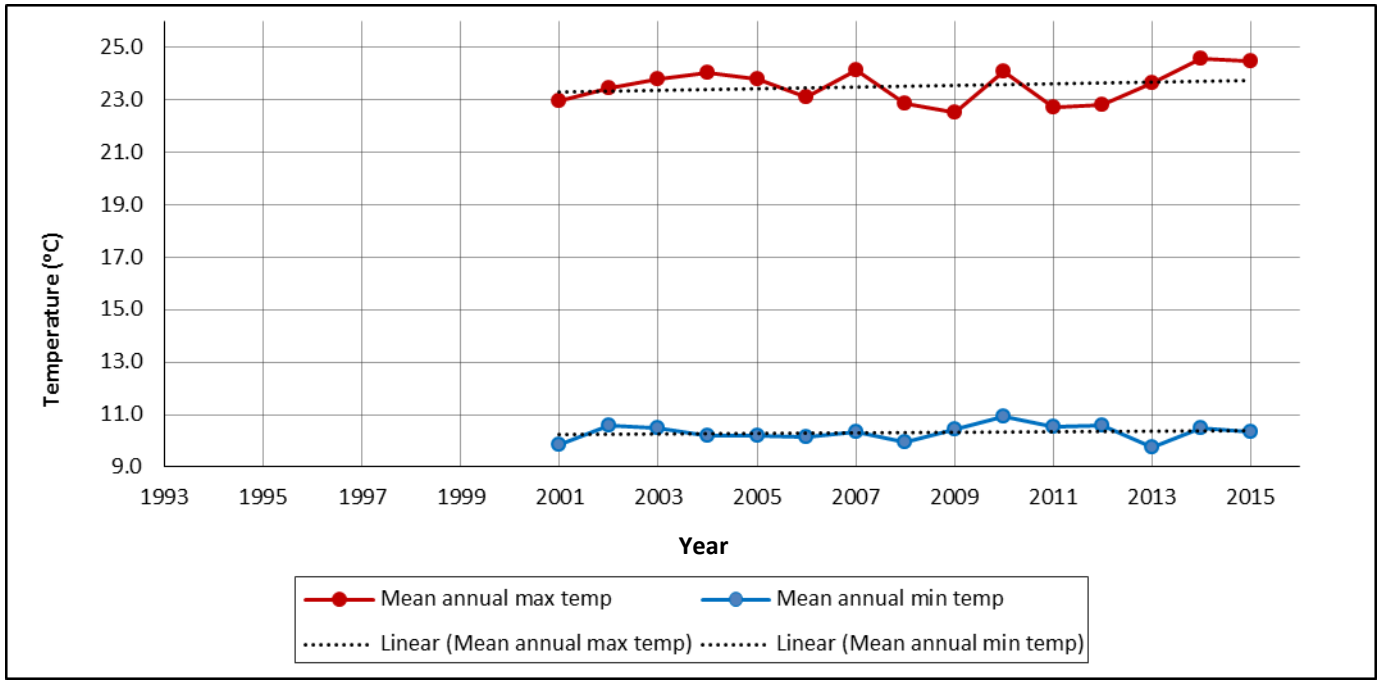

Figure 5.7: Mean Annual Maximum and Minimum temperatures for Ixopo Station (0210099A7) for period 2001-2015.

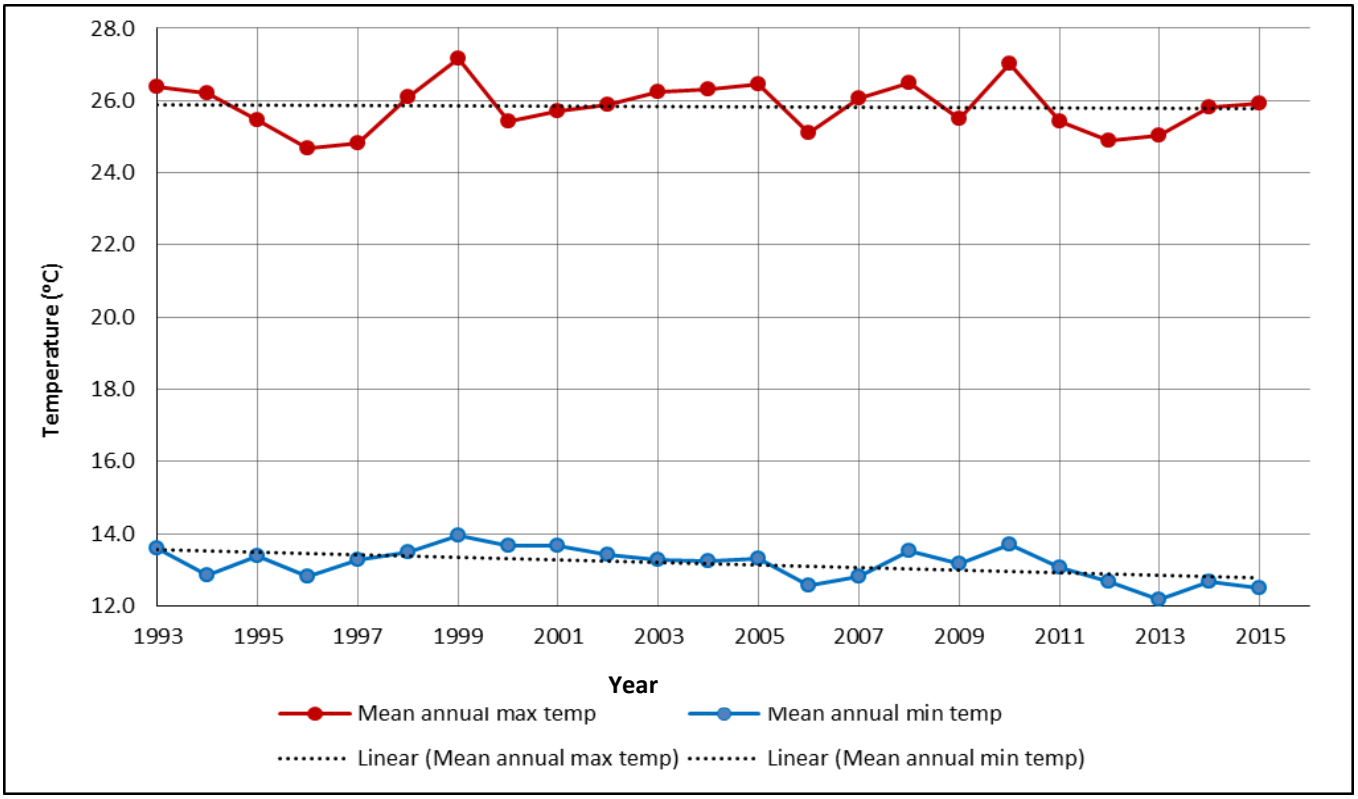

Figure 5.8: Mean annual Maximum and Minimum temperatures for Pietermaritzburg Station (0239698 5) for period 2001-2015.

Table 5.9 illustrates rainfall statistics for the period 2001 to 2015 for the Ixopo Station. The trend of decreased rainfall can be seen in Figure 5.9. It is evident to see from the trend line that there has been a gradual decrease in rainfall over the period 2001 to 2015. Table 5.10 illustrates statistics for rainfall over the period 1993 to 2015 for the Pietermaritzburg station. Figure 5.10 depicts a gradual decrease in rainfall for this period. Water plays a crucial role in agricultural activities in rural households (Wani et al., 2009). However, decreased rainfall during periods of drought have already caused agricultural yields to decrease in some parts in South Africa (Dalin and Conway, 2016; Funk and Brown, 2009). Additionally, drought conditions further exacerbate poverty in areas experiencing soil erosion and land degradation. This is as a result of a relationship that exists between land degradation and drought (Wani et al., 2009). The effects of the current drought are seen in the Sizanenjana community. The lack of water resources in this community have resulted in low agricultural yields which have hindered farming activities in some households. Other households have sized production of certain crops which intake much water such as spinach and cabbage. Due to extreme temperatures and decreased rainfall in the area, the river illustrated in Plate 5.1 has dried up.

Table 5.9: Monthly, mean monthly and total annual rainfall for Ixopo station (0210099A7) for periods 2001-2015.

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean monthly rainfall (mm)	Total annual rainfall (mm)
2001			41	93.5	72	0	0	55	79.5	136.5	254	194.6	92.6	926.1
2002	138	63.5	59	36.5	53	0	94	86.5	38	49	66	80.6	63.7	764.1
2003	161	90	62.4	79.8	23.2	8	0	31	33.2	19	61.8	50.8	51.7	620.2
2004	96.8	75.4	44.8	12	0	3.8	44.4	5.6	54	56.6	91.8	146.8	52.7	632
2005	135.8	98.8	36.6	13.6	4.2	6.2	0	12.2	38.8	34.8	59.4	38.6	39.9	479
2006	115.2	68.2	20	50.2	21.6	5.8	2.8	55.6	77	126.2	122	142.2	67.2	806.8
2007	95.8	50	90	50.8	18	61	0.6	12.4	39	137.8	109	69.6	61.2	734
2008	81	52		126.6	7.6	47.6	0.2	12.2	55.8	75	112.4	137.6	64.4	708
2009	155.8	130.6	58	21.2	2.6	6.6	0.4	40.4	40.6	139.8	88.8	138	68.6	822.8
2010	111.8	30.4	57.6	23.4	12	10.6	8	3.2	9.4	116.8	107.6	118.8	50.8	609.6
2011	144.6	72.2	82.8	80	42.8	98.2	49.6	28.4	17.4	47.2	104.6	157.4	77.1	925.2
2012	59.2	53.8	160.6	34.2	10	10.8	8.6	150.8	151.8	150.4	116.2	111	84.8	1017.4
2013	84.8	111	88.4	11.8		4.4	6.4	11.4	7.4	97.8	56.6	87.6	51.6	567.6
2014	132.8	43	68.4	26.2	1.4	7.6	0.6	29.4	34.6	135.2	71.4	98	54.1	648.6
2015	77.8	136.6	44.2	55	1	2.2	28.8	3.2	25.8	36			41.1	410.6

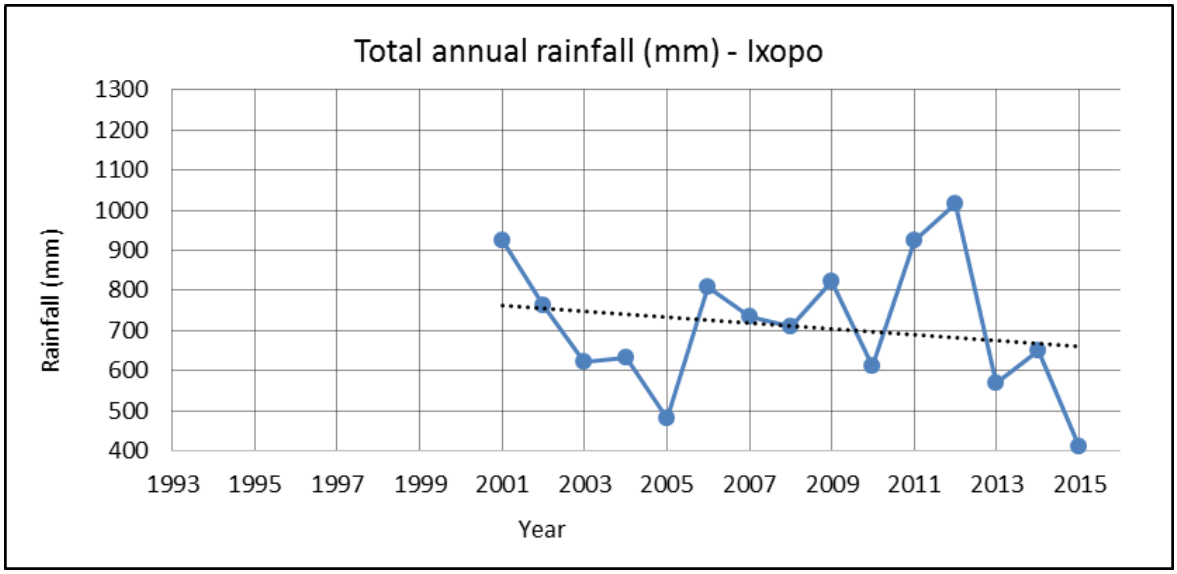

Figure 5.9: Total annual rainfall for Ixopo station (0210099A7) for periods 1993-2015.

Table 5.10: Monthly, mean monthly and total annual rainfall for Pietermaritzburg station (0239698 5) for periods 1993-2015.

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean monthly rainfall (mm)	Total annual rainfall (mm)
1993							0	22.4	38.8	113	67.6	209	75.1	450.8
1994	135.4	65.2	176.2	29.4	22.8	11.6	51.4	8.2	6.6	77.4	30.8	102.2	59.8	717.2
1995	61.4	43.4	243.4	76.2	25.6	37.4	2.6	4.2	36.2	136.4	134.2	425.8	102.2	1226.8
1996	196.6	187	127.4	9.6	36	29.8	141.6	7.6	11.8	96.4	116.6	216.6	98.1	1177
1997	114.8	95.2	90	131.8	26.6	66.6	30.8	24.6	44.4	63.8	181	79.6	79.1	949.2
1998	149.8	231.2	125.4	7.8	26	0	3	26.2	16.2	32.8	121	112.8	71.0	852.2
1999	146.6	128.2	49.4	12	29.6	1.4	0.2	2	21.6	111.1	98.8	358.8	80.0	959.7
2000	157.2	69.2	97.6	0	83.8	7.2	0	0	81	72.8	94.8	158.6	68.5	822.2
2001	74.4	101	47.6	139.6	12	1	0.2	9.8	132.4	152.4	156.6	137.5	80.4	964.5
2002		35.2	34.6	75.8	16.4	20.4	82	93.2	56.8	39	64.2	145	60.2	662.6
2003	76.4	53.8	130.2	83.6	45	8.2	0	23.6	35.8	17.6	83	49.4	50.6	606.6
2004	54.2	191	59.6	11.8	0.2	22.6	38.2	15.2	70	70	183.4	189.8	75.5	906
2005	180.4	84	121.2	8.2	0.8	3.2	1	22.9	24.4	67	71.4	102.2	57.2	686.7
2006	185.6	54.8	98.6	109.2	68	1.4	0.4	52.2	54.2	81.6	101	177.2	82.0	984.2
2007	69.8	38	192.8	24.6	7.4	60.6	0	14	33	171.2	159	58.2	69.1	828.6
2008	178.2	78.6	77.4	86.2	0	17	0	4	53.6	37	78.6	169.8	65.0	780.4
2009	174.6	126	73.2	15	26.4	0.8	0.2	46.4	14.8	114.4	51.6	149.4	66.1	792.8
2010	162	83.4	30	79.8	4.6	9.2	0.8	2.4	2.8	97.2	93.6	140	58.8	705.8
2011	103.8	33.4	41	93.8	35.8	34.4	49.6	18.2	36.4	48.6	105.2	134.6	61.2	734.8
2012	86.6	28.8	146.6	31.6	6.6	0.6	0	1	58.2	129.4	77.8	70	53.1	637.2
2013	114.6	144.6	26.2	85.6	27	21.6	4.2	12.4	18	123.8	85.2	78	61.8	741.2
2014	61.2	60.6	109.8	14	2.2	5	1.2	5.6	16.2	42.2	67.2	92	39.8	477.2
2015	93	152.4	86.6	34.4	4.4	0.4	35	1.4	35.4	12.6			45.6	455.6

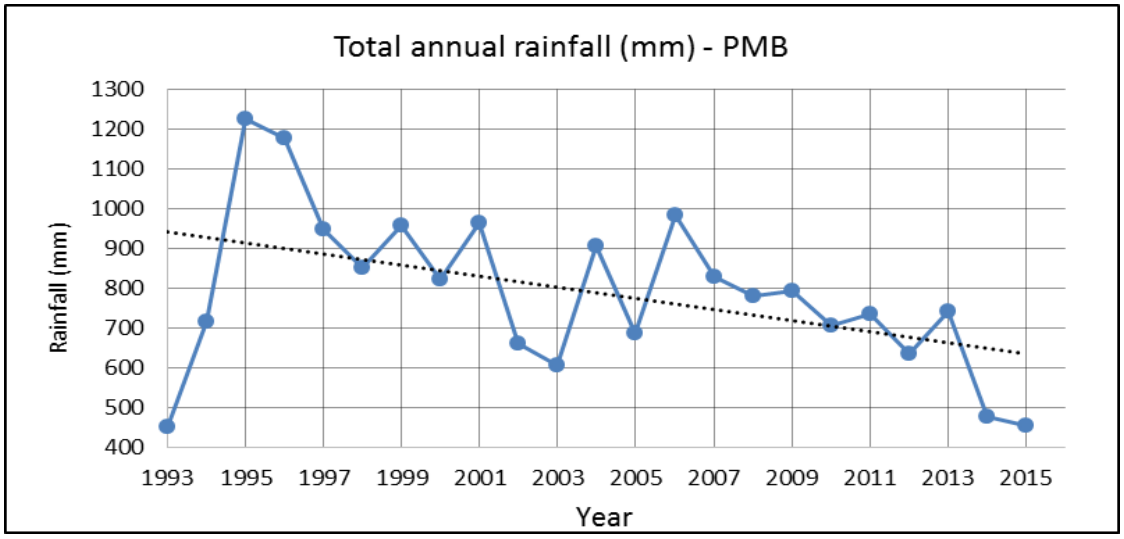

Figure 5.10: Total annual rainfall for Pietermaritzburg station (0239698 5) for periods 1993-2015.

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Plate 5.1: Dried up river in the Sizanenjana community in winter 2015.

Figure 5.11 demonstrates that in the Khokhwane, Sizanenjana and Richmond community, the majority of the respondents have felt that changes in rainfall and temperature have affected their agricultural production. That is, 97% in Khokhwane community, 74% in Sizanenjana community and 63% in the Richmond community respectively. Rosenzweig et al. (2001) assert that climate change has the potential to negatively affect crop production through intensified periods of drought and increased temperature (Carter and Galati, 2014). The implications of these effects of climate on agricultural production are seen in dry lands resulting in low agricultural yields.

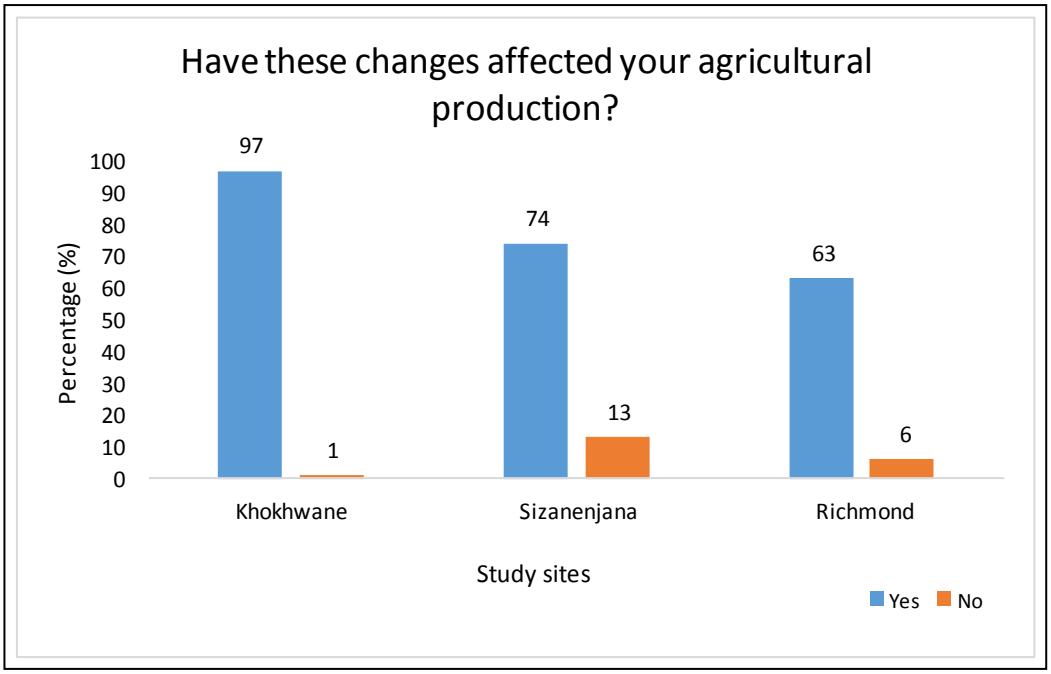

Figure 5.11: Respondents that have felt changes in rainfall and temperature have affected their agricultural production (n=100 in each community).

Table 5.11 illustrates the manner in which changes in rainfall and temperature have affected respondents' crop production. This question was intended to establish how changes detected in rainfall and temperature over the past few decades have affected crop production. Changes in rainfall and temperatures have affected respondents in the Khokhwane community the same way as in the Sizanenjana community. Seventy-two percent of respondents in the Khokhwane community feel that there has been a decrease in agricultural production and the land is dry and infertile (18%). One respondent from the Khokhwane community stated “My vegetables are not healthy and green enough and are always requiring more water (which I don’t have)”. Fourteen percent of the respondents in the Khokhwane community complained about their crops requiring more water intake (14%). Many respondents in the Khokhwane community stated that due to a lack of water, they had to stop growing spinach as spinach utilises a lot of water; water which they do not have.

In the Sizanenjana community, 43% of respondents stated that their crops have died or been destroyed (decreased crop production). This is due to the increase in temperature and the decrease in rainfall. Seventeen percent of the respondents stated that the land is dry and 15% of the respondents stated that they have experienced extreme weather conditions with one respondent stating “When it is hot it is extreme, and when it is cold it is extreme” with another respondent stating that “no rainfall equals no food”. Nineteen percent of the

respondents stated that their crop size has decreased, while 16% of the respondents have detected no change in the climate. Again, this can be attributed to a lack of environmental knowledge. Due to the low amount of environmental education received, respondents are ignorant towards the changes in climate being experienced. They believe that these conditions are normal as this is what they have been experiencing for a long period of time. This is the reason for 19% of the respondents perceiving no change in climate.

In the Richmond community 67% of the respondents felt that these changes in rainfall and temperature have negatively affected the amount of agricultural yield being produced. However, due to the WFGP, their agricultural production has improved since its installation in 2015. Twenty-two percent of the respondents felt that the land has become drier with changes in temperature and rainfall, and 33% stated that the sizes of their crops have decreased. Similar research undertaken by Wandaka (2013) reveals that changes in rainfall and temperature in Kenya have negatively impacted maize production. While another study carried out by Omoyo et al. (2015) indicate a change in climate having negative impacts on agricultural production - especially maize production in Kenya.

Table 5.11: How rainfall and temperature have affected crop production (in%): Multiple responses.

How have changes in rainfall and temperature have affected crop production	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=300
Less production, quality and quantity of crops	72	43	67	182
Land and crops are dry	18	17	22	57
Crops are requiring more water which I don't have	14	-	-	14
Extreme weather conditions	-	15	-	15
Sicknesses from waterborne diseases	-	2	-	2
No change detected	-	16	-	16
Crop size decreased	11	19	33	63

Table 5.12 illustrates the perceived relationship that exists between a shortage of food and changes in rainfall, and Table 5.13 illustrates the relationship that exists between a shortage of food and changes in temperature, as indicated by the Chi-Square test of independence. Since the p-value is less than the level of significance that is, .000 <0.05 in both cases, H_0 is rejected and it is concluded that there is a relationship that exists between a shortage of food and changes in rainfall and temperature. This indicates that a change in rainfall and

temperature has an impact on, and influences the shortage of food. A change in rainfall and temperature experienced in the three communities has affected food production, impacting negatively on food supplies resulting in food shortages.

Table 5.12: Chi-Square test on the perception of shortage of food versus changes in rainfall.

CHI-SQUARE TESTS					
	Value	**df**	**Asymptotic Significance (2-sided)**	**Exact Sig. (2-sided)**	Exact Sig. (1-sided)
Pearson Chi-Square	48.975	1	.000		
Continuity Correction	46.702	1	.000		
Likelihood Ratio	44.039	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	48.810	1	.000		
N of Valid Cases	298				

H0: Shortage of food is NOT related to or dependent on changes in rainfall.

H1: Shortage of food is related to or dependent on changes in rainfall.

Table 5.13: Chi Square test on the perception of shortage of food versus changes in temperature.

CHI-SQUARE TESTS					
	Value	**df**	**Asymptotic Significance (2-sided)**	**Exact Sig. (2-sided)**	**Exact Sig. (1-sided)**
Pearson Chi-Square	42.574	1	.000		
Continuity Correction	40.401	1	.000		
Likelihood Ratio	38.101	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	42.431	1	.000		
N of Valid Cases	298				

H0: Shortage of food is NOT related to or dependent on changes in temperature.

H1: Shortage of food is related to or dependent on changes in temperature.

Table 5.14 illustrates the Chi-square test of independence between changes in rainfall versus drought while Table 5.15 illustrates the Chi-square test of independence between changes in temperature versus drought. Since the p-value is less than the level of significance in both Tables, that is 0.000<0.05, H0 is rejected and it is concluded that a relationship exists between drought and changes in rainfall and temperature. This signifies that changes in rainfall and temperature influences drought conditions in Khokhwane, Sizanenjana and Richmond communities.

Table 5.14: Chi Square test on the perception of drought versus changes in rainfall.

CHI-SQUARE TESTS					
	Value	**df**	**Asymptotic Significance (2-sided)**	**Exact Sig. (2-sided)**	**Exact Sig. (1-sided)**
Pearson Chi-Square	19.689[a]	1	.000		
Continuity Correction	17.881	1	.000		
Likelihood Ratio	16.677	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	19.623	1	.000		
N of Valid Cases	299				

H0: Drought is NOT related to or dependent on changes in rainfall.

H1: Drought is related to or dependent on changes in rainfall.

Table 5.15: Chi square test on the perception of drought versus changes in temperature.

CHI-SQUARE TESTS					
	Value	**df**	**Asymptotic Significance (2-sided)**	**Exact Sig. (2-sided)**	**Exact Sig. (1-sided)**
Pearson Chi-Square	22.914[a]	1	.000		
Continuity Correction[b]	20.911	1	.000		
Likelihood Ratio	19.019	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	22.838	1	.000		
N of Valid Cases	299				

H0: Drought is NOT related to or dependent on changes in temperature.

H1: Drought is related to or dependent on changes in temperature.

5.5 Agricultural patterns

Table 5.16 presents the crops grown by small-scale farmers in the Khokhwane, Sizanenjana and Richmond communities. The majority of the small-scale farmers interviewed, grow crops, however, 14% overall have stopped growing crops. Four percent in the Khokhwane community, 9% in the Sizanenjana community and 1% in the Richmond community have stopped growing crops. When asked why they have stopped growing crops, respondents stated that their agricultural production is not as good as it used to be and have stopped growing crops due to a lack of water. They also state that increased temperatures have made it difficult to grow crops. Table 5.16 indicates that potatoes, maize, spinach and cabbage are the dominant crops grown in the Khokhwane, Sizanenjana and Richmond communities.

Table 5.16: Crops grown (in %): Multiple responses.

Grow crops	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=300
Yes	95	84	98	277
No	1	7	1	9
I stopped	4	9	1	14
Crops Grown				
Fruit	1	5	54	60
Tomatoes	19	7	67	93
Potatoes	85	56	77	218
Beans	43	30	78	151
Lettuce	2	1	72	75
Maize	88	52	79	219
Pumpkins	15	25	71	111
Spinach	67	61	88	216
Cabbage	75	47	89	211
Carrots	10	8	25	43
Madumbi	-	-	31	31
Beetroot	-	-	13	13
Sweet potato	-	-	13	13
Onions	-	-	17	17
Cauliflower	-	-	13	13
Broccoli	-	-	10	10
Green pepper	-	-	12	12

Table 5.17 portrays the seasons in which these small-scale farmers grow their crops. In the Khokhwane community, 34% of the farmers grow most of their crops throughout all seasons.

This may be attributed to the assistance received by the CWP workers who have helped these farmers establish and maintain food gardens. Thirty percent grow their crops in Spring, Summer and Autumn while 22% grow their crops in Summer only. In the Sizanenjana community, 32% of the farmers grow their crops in spring only, followed by 20% who grow their crops in Winter while 17% grow their crops in Spring, Summer and Autumn only. In the Richmond community, almost half of the respondents interviewed (46%) grow their crops throughout the year. The reason for the high number of small-scale farmers growing their crops throughout the year is due to WFGP which has educated farmers on how to grow their crops in the correct manner through sustainable agricultural practices (ACT, 2015). Sustainable agricultural practices when practiced at a local level, have the potential to create a green economy and achieve sustainability (Knot et al., 2014).

Table 5.17: Season in which crops are grown (in %).

Season	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=300
Spring	5	32	2	39
Summer	22	17	6	45
Autumn	-	1	-	1
Winter	4	20	5	29
All seasons	34	2	46	82
Spring and Summer	2	2	16	20
Spring, Summer and Autumn	30	17	24	71
No response	3	9	1	13

Table 5.18 indicates the respondents that use the crops they grow for household consumption. Ninety-three of the respondents in the Khokhwane community use the crops they grow for household consumption. While in the Sizanenjana community, 83% of the respondents use their crops for household consumption. Kirsten and Zyl (1998) state that small-scale farmers are usually subsistence farmers who grow produce for their own consumption and rarely to sell. Due to the fact that many of the small-scale farmers are women, they do not have access to resources and financial assistance to sell produce (Sebopetji and Belete, 2009). Additionally, due to the locality of rural communities, access to roads and infrastructure is poor, thus limiting the small-scale farmer's ability to access markets to sell their produce (Arethun and Bhatta, 2012). Furthermore, the uneven distribution of resources and skills hinders small-scale farmer’s ability to access markets and sell their produce. In the Richmond community, only 34% of the respondents use the crops they grow for household

consumption while sixty-four percent of the respondents sell their produce. The Richmond community consists of a larger percentage of small-scale farmers who sell their produce, due to the implementation of the Wildlands food garden programme. This initiative displayed characteristics of a transdisciplinary approach of sustainability science, as well as a people centred approach applying the principles of the SLA.

Table 5.18: Crops used for household consumption (in %): Multiple Responses.

Are crops used for household consumption	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=300
Yes	93	83	34	210
No	2	3	64	69
No response	5	14	2	21
Crops	**Khokhwane n=100**	**Sizanenjana n=100**	**Richmond n=100**	**Total n=300**
Fruit	1	5	47	53
Tomatoes	17	12	68	97
Potatoes	87	60	78	225
Beans	44	31	79	154
Lettuce	1	2	67	70
Maize	85	51	83	219
Pumpkins	17	24	74	115
Spinach	65	57	86	208
Cabbage	73	48	86	207
Carrots	10	6	27	43
Madumbi	-	-	3	3
Beetroot	-	-	9	9
Sweet potato	-	-	10	10
Onions	-	-	8	8
Cauliflower	-	-	7	7
Broccoli	-	-	8	8
Green pepper	-	-	7	7

Table 5.19 depicts the crops that are sold by small-scale rural farmers. It is evident that the Khokhwane and Sizanenjana respondents do not sell their produce. However, the Richmond community have a high percentage of small-scale farmers who grow and sell their produce, with Spinach (68%), Cabbage (65%) and Lettuce (57%) being the main crops sold. This is attributed to the WFGP, which has taught them valuable entrepreneurship skills and taught them how to earn a living through the selling of their produce. The selling of their produce

has aided these small-scale farmers in reducing household poverty, thus addressing goal one of the SDGs which aims to end poverty in all forms (Griggs, 2013).

Table 5.19: Crops sold (in %): Multiple responses.

Do you have a regular buyer for your crops?	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=300
Yes	2	3	53	58
No	93	53	45	191
No response	5	44	2	51
Crops sold	**Khokhwane n=100**	**Sizanenjana n=100**	**Richmond n=100**	**Total n=300**
Fruit	-	1	42	43
Tomatoes	-	-	41	41
Potatoes	-	-	50	50
Beans	-	1	44	45
Lettuce	-	1	56	57
Maize	-	-	48	48
Pumpkins	-	-	45	45
Spinach	-	-	68	68
Cabbage	-	-	65	65
Carrots	-	-	24	24
Madumbi	-	-	24	24
Beetroot	-	-	7	7
Sweet potato	-	-	7	7
Onions	-	-	6	6
Cauliflower	-	-	6	6
Broccoli	-	-	7	7
Green pepper	-	-	6	6

5.6 Food security

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 an active and healthy lifestyle" (FAO, 2008:1). There four dimensions of food security are: food availability, food accessibility, food utilisation and food Stability (FAO et al., 2014). All four dimensions become vulnerable when impacted on by climate change (IPCC, 2014), thus increasing small-scale farmers' vulnerability to food insecurity. The amount of food produced is sufficient to ensure global food security (Nawrotzki et al., 2014). However many people, especially rural poor, do not have access to the resources to ensure food security therefore

making them susceptible to a poverty trap (Adams, 2001). Small-scale farmers are vulnerable to live in degraded environments as they lack access to resources to improve their livelihoods. These inequalities result in unsustainable food systems and degradation of the environment, resulting in food insecurity (Adams, 2001; Galt, 2016).

Figure 5.12 illustrates respondents that have heard of the term food insecurity in the Khokhwane, Sizanenjana and Richmond communities. The majority of the respondents in the Khokhwane community (99%) and Sizanenjana community (80%) have not heard of the term food security which is related to the lack of environmental education received by both communities earlier in this chapter. The high response (94%) to the term food security in the Richmond community however is due to the environmental training received through the WFGP.

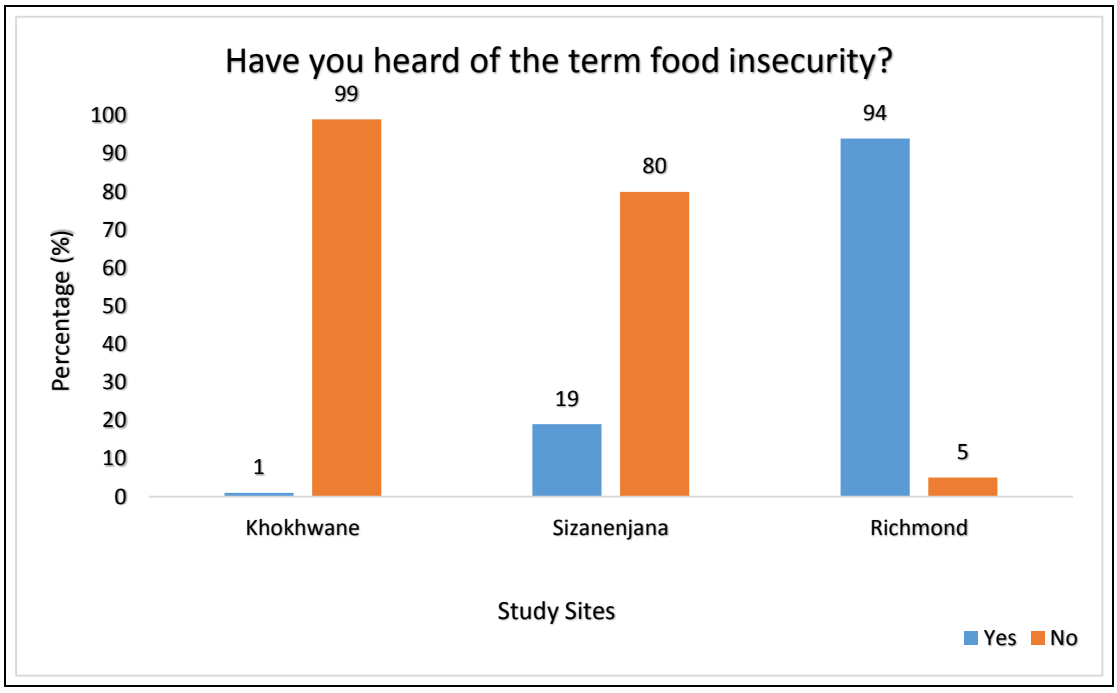

Figure 5.12: Percentage of respondents that have heard of food insecurity (n=100 in each community).

Table 5.20 portrays the percentage of respondents that have experienced food shortages and the duration. In the Khokhwane community, an overwhelming 88% of the respondents stated that they have experienced a food shortage in their household at some point in time and 46% of the respondents stated that this lasts about a month. Twenty-two percent of the respondents expressed that this period lasts one week. Sixty-seven percent of the respondents in the Sizanenjana and 64% of the respondents in the Richmond community have experienced a

shortage of food in their household. In the Sizanenjana community, 25% of the respondents have experienced a food shortage that lasted more than one month. A lack of access to food in some households may result in a shortage of food. This shortage of food may increase the rates of poverty in rural households (Crush et al., 2012).

Table 5.20: Respondents that experienced a shortage of food, and the period (in %).

Shortage of food	**Khokhwane**	**Sizanenjana**	**Richmond**	**Total**
	n=100	n=100	n=100	n=300
Yes	88	67	64	219
No	12	31	36	79
No response	-	2	-	2
Period	**Khokhwane**	**Sizanenjana**	**Richmond**	**Total**
	n=100	n=100	n=100	n=300
1 week	22	17	39	78
2 weeks	-	5	12	17
3 weeks	1	2	-	3
1 month	46	18	6	70
>1 month	19	25	7	51
N/A	12	33	36	81

Table 5.21 illustrates the occurrence of food shortage in the household. The aim of this question was to establish when the respondents experienced a food shortage with their household. Responses across all three sites were similar. Most of the food shortages occurred during winter when there is less rainfall. A large percentage of the respondents in the Sizanenjana and Khokhwane community (26% and 33% respectively) stated that food shortages occur towards the end of the month, usually the last week. This can be as a result of males who have migrated to the cities in search of work, only returning to the household at the end of the month, bringing with them food and income.

This food supply usually lasts about 3 weeks before the household runs out of food and has to wait for the breadwinner to return at the end of the month. This is the reason for many of the households experiencing food shortages towards the end of the month. During winter, conditions are harsh, and there is less rainfall. Drought conditions coupled with lack of crop production knowledge decreases agricultural yield resulting in food shortages in the

household (Carter and Galati, 2014; Rosenzweig, 2001). Before the WFGP was initiated in the Richmond community, the respondents used to suffer a great deal with food shortages. However, with the WFGP successfully being implemented, the Richmond community has been assisted on how to grow crops. As a result, they no longer suffer from food shortages.

Table 5.21: Occurrence of food shortage (in %).

When did the food shortage occur?	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=300
Whenever I am away from work	-	13	-	13
At the end of the month	26	33	40	99
During Winter	11	21	10	42
3 months ago	20	-	-	20
2 years ago	31	-	-	31
Before the WFGP	-	-	14	14
N/A	12	33	36	81

Table 5.22 describes the results obtained from the Chi-Square test of independence of drought versus shortage of food. Since the p-value is less than the level of significance that is, 0.000< 0.05, H0 is rejected and it is concluded that there is a relationship that exists between shortage of food and drought in the three communities. This indicates that a shortage of food is dependent on and influenced by drought conditions experienced in the Khokhwane, Sizanenjana and Richmond communities.

Table 5.22: Chi square test on the perception of shortage of food versus drought.

CHI-SQUARE TESTS					
	Value	**df**	**Asymptotic Significance (2-sided)**	**Exact Sig. (2-sided)**	**Exact Sig. (1-sided)**
Pearson Chi-Square	22.029[a]	1	.000		
Continuity Correction[b]	20.270	1	.000		
Likelihood Ratio	19.520	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	21.955	1	.000		
N of Valid Cases	298				

H0: Shortage of food is NOT related to or dependent on drought.

H1: Shortage of food is related to or dependent on drought.

Figure 5.13 relates to objective 3 of this study and illustrates that 57% of respondents in the Khokhwane community, 34% of respondents in the Sizanenjana community, and 18% of respondents in the Richmond community do not have routines to help them deal with food shortages. Thirty percent of respondents in the Khokhwane community, 36% of respondents in the Sizanenjana community and 46% of respondents in the Richmond community do have routines in place to help them deal with food shortages. The reason for the higher percentage of respondents not having routines in place in the Khokhwane and Sizanenjana community is due to lack of environmental education and knowledge about how to deal with food shortages. The higher percentage of respondents having routines in place to deal with food shortages in the Richmond community (46%) can be attributed to the knowledge gained from WFGP. The WFGP has applied a transdisciplinary and people centred approach in aiding small-scale farmers in the Richmond community to respond to changes that are occurring in the climate and how to farm in accordance to these changes.

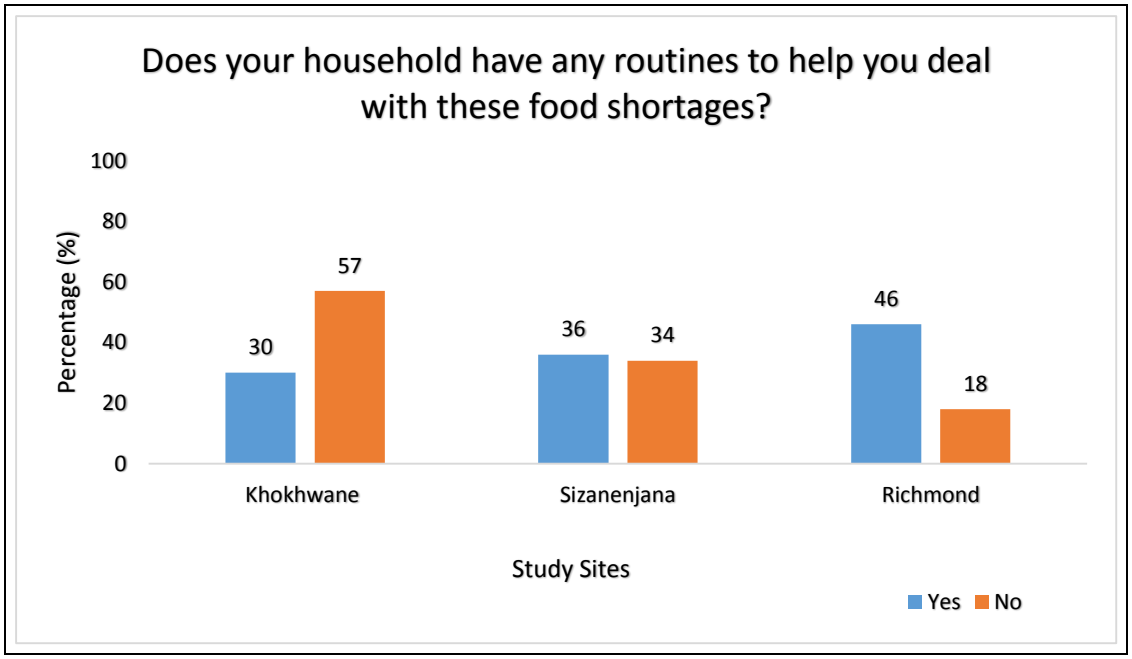

Figure 5.13: Respondents that have routines to help them deal with food shortages (n=100 in each community).

Table 5.23 illustrates the routines respondents have which assist them during times of food shortages. Fifty-seven percent of the respondents in the Khokhwane community do not have routines to help them deal with their food shortages. Nineteen percent of the respondents stated that they received food from their neighbours during food shortages, or buy food from the nearest shop (6% and 10% respectively). One respondent stated "I use my pension money to buy food". Money which can be used to pay off other expenses is being used to buy food. This is worrying as many of these small-scale farmers have large plots of land which have the ability to produce large amounts of nutritious yield with the correct agricultural techniques and tools. Twelve percent of the respondents indicate that they borrow food, 6% buy from the shop while 10% buy on credit. Two percent of the respondents stated that they sell items to earn money. Many female individuals sell items such as sweets, chips and chocolates aimed at children. Plate 5.2 reveals a female vendor sitting outside a primary school. Alarmingly 46% of respondents in the Khokhwane community do not have any strategies to help them deal with food shortages.

Thirty-four percent of the respondents in the Sizanenjana community that suffer from food shortages do not have proper routines or activities to help them deal with these food shortages. From the 36% of respondents that do have routines in place 17% stated that they buy food from the local shop or ask their neighbours (27%). Many respondents indicated that

they cannot wait until the end of the month for remittance to come from the males of the household.

Forty-six percent of the respondents in the Richmond community do have routines in place to help them deal with food shortages. It is important to note that these food shortages occurred before the WFGP was implemented. The WFGP has taught them valuable skills such as selling of vegetables for monetary gain, and growing their crops in a sustainable manner, which is shared amongst community members. This sharing of crops and practices is closely linked to the Southern African philosophy of Ubuntu whereby individuals are encouraged to practice kindness towards one another. Thirty-one percent of respondents in the Richmond community buy food from the local shop, 35% borrow from their neighbours, and 26% sell their crops during times of food shortages. Thus the neighbours become a safety net for individuals suffering from food shortages.

Table 5.23: Routines or activities respondents have to deal with food shortages (in%): Multiple Responses.

What routines or activities do you have to help you deal with these shortages?	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=100
None	46	29	-	75
Selling items	2	-	-	2
Buy from shop	6	17	31	54
Use pension money	2	-	-	2
Buy on credit	10	-	-	10
Neighbours	19	27	35	81
Borrow food	12	-	-	12
Ask my children	-	9	-	9
Sell chickens	-	6	-	6
Extra income through casual jobs	-	-	23	23
Selling vegetables	-	-	26	26

Plate 5.2: A female vendor earning an income in the Khokhwane community.

Table 5.24 portrays the sources where respondents obtain food from during periods of food shortage. Seventy-six percent of the respondents in the Khokhwane community, 24% in the Sizanenjana community and 57% in the Richmond community buy food from the nearest shop respectively. This is followed by 23% of respondents in the Khokhwane community, 25% of respondents in the Sizanenjana community and 31% of respondents in the Richmond community obtaining food from their neighbours during times of food shortages. This question was analysed to emphasise the lack of local government involvement in providing food to small-scale farmers in times of shortages.

Table 5.24: Where respondents obtain sources of food from during periods of food shortage (in %): Multiple responses.

Sources	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=100
Borrow	4	-	-	4
Nearest shop	76	24	57	157
Tuck shop	2	-	-	2
Town	14	30	12	56
Starve	3	4	-	7
Neighbours	23	25	31	79
My children	-	9	-	9
Family	-	-	18	18

In times of food shortages, it was noted that some farmers either sell or give away their produce, or both as indicated in Table 5.25. In the Khokhwane community, 18% of respondents give away their crops to family and neighbours during food shortages. Some of the crops they give away are potatoes, beans, maize and cabbage. In the Sizanenjana community, only 11% of the respondents stated that they give their crops away to households who need it. Some of the crops that are shared are potatoes, pumpkins, spinach and cabbage. An overwhelming 66% of respondents in the Richmond community sell and give away their crops during periods of food shortages. Since the small-scale farmers in the Richmond area grow a variety of different crops, these farmers sell every crop and give away to the households that are struggling for food.

Table 5.25: Respondents that sell or give away their crops to surrounding communities (in%).

Sell or give away crops.	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=300
Yes	18	11	66	95
No	80	86	33	199
No response	2	3	1	6
Crops				
Fruit	1	-	1	2
Tomatoes	-	1	-	1
Potatoes	8	8	-	16
Beans	1	-	-	1
Maize	7	-	-	7
Pumpkins	-	1	-	1
Cabbage	1	-	1	2
Potatoes, Beans and Maize	-	-	11	11
Spinach and Cabbage	-	1	9	10
Potatoes, Beans, Maize and Cabbage	-	-	18	18
All	-	-	26	26
N/A	82	89	34	205

The aim of this question was to establish when respondents suffered from hunger, which relates to an associated impact that a change in climate may have on small-scale farmers. As seen in Table 5.26, 68% of respondents in the Khokhwane community, 51% of respondents in the Sizanenjana community, and 58% of respondents in the Richmond community have not suffered from hunger. FAO (2008) asserts that an individual may suffer from food insecurity but not necessarily suffer from hunger. This is due to the fact that hunger means that there is no access to food and no food availability. However, during food shortages, respondents across all three sites obtain food from either the nearest shop or their neighbours therefore they have food. Therefore, they may suffer from a food shortage, but not necessarily suffer from hunger or starvation. However, it was noted that 30%, 48% and 41% of respondents did suffer from hunger in the Khokhwane, Sizanenjana and Richmond community respectively.

Table 5.26: Respondents that have experienced hunger (in %).

Hunger	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=300
Yes	30	48	41	119
No	68	51	58	177
No Response	2	1	1	4

Table 5.27 illustrates when respondents experienced hunger. Only 8% of respondents in the Khokhwane community, 12% of respondents in the Sizanenjana community and 4% of respondents in the Richmond community stated that hunger occurred during winter. During winter, conditions are harsh and crop yields are low. Six percent, 15% and 2% for Khokhwane, Sizanenjana and Richmond communities respectively, stated that hunger occurred at the end of the month (the last week of the month) when all their food and money had been depleted.

Table 5.27: Occurrence of hunger (in %).

When did hunger occur?	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=300
During winter	8	12	4	24
End of the month	6	15	2	23
Before the WFGP	-	-	18	18
No response	18	22	18	58
N/A	68	51	58	177

Table 5.28 illustrates the distance respondents travel to buy food in times of food shortages. The majority of the respondents in the Khokhwane community (64%) and Richmond community (85%) travel 0-5Km to obtain food during times of food shortages. This is due to the fact that both the Khokhwane and Richmond community are situated adjacent to the main road, with easy access to transport. Therefore, in times of food shortages, respondents find it easy to obtain food from the nearest shops which are either within walking distance or easily accessible via public transport. The costs of taxis in the Khokhwane community are approximately R20, and in the Richmond community it is approximately R12.

In the Sizanenjana community, more than half of the respondents (51%) travel further than 15Km to buy food during times of food shortages. This is due to the fact that the Sizanenjana community is situated in a remote area with the nearest built up town being Bulwer which is

approximately 15km away. This is also the reason for the high hunger rate of 48% of respondents in the Sizanenjana community as illustrated in Table 5.26. Table 5.28 further illustrates an example of how changes in climate may indirectly affect small-scale farmers, who now have to travel distances to buy food when their agricultural productivity is low. This relates to objective 2 of this study.

Table 5.28: Distance respondents travel to buy food (in %).

Distance	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=300
0-5 Km	64	6	85	155
5-10Km	17	6	10	33
10-15Km	12	35	1	48
>15Km	4	51	-	55
No response	3	2	4	9

5.7 Electricity and water

Table 5.29 illustrates the type of energy used across all three communities. In the Khokhwane community, Grid electricity is the main source of energy accounting for 82%, followed by Grid electricity coupled with firewood which accounts for 16% and lastly only 2% of respondents using firewood only. In contrast, the respondents from the Sizanenjana community are heavily reliant on firewood for cooking as a source of energy. Plate 5.3 shows the firewood after collection while Plate 5.4 illustrates a respondent using firewood for cooking purposes. Firewood accounts for 92% followed by paraffin 4%, grid electricity and firewood 3% and only 1 respondent stating they rely on grid electricity only as a source of energy in the Sizanenjana community. Tibane and Vermeulen (2014) argue that excessive collection of firewood in rural areas has the potential to cause soil erosion and degradation.

The respondents from the Richmond community rely on both Grid electricity and firewood as their main source of energy (73%). Only 22% of the respondents stated that they rely on grid electricity only, and only 5% of the respondents stated that they rely on firewood only. UNDP and World Bank (2003) suggest that firewood is a common source of energy used in rural areas in South Africa. Due to the locality of rural areas, energy supply is limited as the topography and access to households make it difficult to set up grid power (UNDP and World Bank, 2003).

The reliance on firewood by the Sizanenjana community displays characteristics of an unsustainable food system approach whereby natural resources are depleted and exploited by locals without the knowledge and resources to ensure sustainable use. This is closely linked to power dynamics and uneven distribution of resources whereby some small-scale farmers receive grid electricity while others due to their locality and rurality, do not.

Table 5.29: Type of energy respondents use (in %).

Type of energy	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=300
Firewood	2	92	5	99
Paraffin	-	4	-	4
Grid electricity	82	1	22	105
Grid and Firewood	16	3	73	92

Plate 5.3: Storage of firewood outside a household in the Sizanenjana community.

Plate 5.4: Respondent using firewood as a source of energy for cooking.

Table 5.30 depicts the distance and duration taken to collect firewood. In the Khokhwane community, as illustrated in Table 5.29, the main source of energy used by respondents is grid electricity. Therefore this question was not applicable to majority of the respondents. However, from those respondents who do collect firewood, 6% stated that it takes less than an hour, 9% stated approximately 1-2hours, 2% stated approximately 2-3 hours and 1% stated that it takes approximately 3-4 hours. Seven percent stated that they walk more than an hour to collect firewood, 3% stated that they walk 1 and 2 Km, 4% stated that they walk a distance of 3 Km and 1% stated that they walk 4 Km to collect firewood.

In the Sizanenjana community, as depicted in Table 5.29, the main form of energy used by respondents (92%) is firewood. Nineteen percent of respondents stated that it takes them less than an hour to collect firewood, 21% stated that it takes 1-2 hours, 17% stated that it takes 2-3 hours, 23% said 3-4 hours and 14% stated that it takes more than 4 hours to collect firewood. Twenty-one percent of respondents stated that it takes less than 1Km to collect firewood, followed by 31%, 23% and 8% stating it takes 1km, 2km and 3km respectively. Five percent of respondents stated it takes 4km and greater than 5km. The majority of the respondents (84%) that collect firewood do not plant trees at a later stage. UNDP and World Bank (2003) contend that rural individuals can spend up to six hours weekly, collecting firewood.

Seventy-three percent of the respondents in the Richmond community use a combination of both grid electricity and firewood. Thirty-two percent, 29% and 12% stated that it takes less than an hour, 1-2hours, and 2-3 hours respectively. Four percent stated it takes 3-4 hours and only 1% said it takes greater than 4 hours. Forty-eight percent of the respondents stated that they have to walk less than 1Km to collect firewood, thus suggesting that the forests are within close proximity to the households. Sixteen percent, 8% and 5% of the respondents respectively stated that they have to walk a distance of approximately1km, 2km and 3km respectively. Surprisingly, 70% of the respondents stated that they do not plant trees at a later stage.

Table 5.30 indicates the indirect impact that a change in climate may have on small-scale farmers, as time is now lost collecting water resources when it could be spent on other activities in the household.

Table 5.30: Distance and time taken to collect firewood as well as rehabilitation (in%).

Duration	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=300
<1hour	6	19	32	57
1-2hours	9	21	29	59
2-3hours	2	17	12	31
3-4hours	1	23	4	28
>4hours	-	14	1	15
N/A	82	5	22	109
Buy firewood	-	1	-	1
Distance	**Khokhwane n=100**	**Sizanenjana n=100**	**Richmond n=100**	**Total n=300**
<1Km	7	21	48	76
1Km	3	31	16	50
2Km	3	23	8	34
3Km	4	8	5	17
4Km	1	5	-	6
5Km	-	2	1	1
>5Km	-	5	-	5
N/A	81	5	21	107
Buy Firewood	-	1	-	1
Trees planted at a later stage?	**Khokhwane n=100**	**Sizanenjana n=100**	**Richmond n=100**	**Total n=300**
Yes	2	9	8	19
No	16	84	70	170
No response	-	2	-	2
N/A	82	5	22	109

Table 5.31 illustrates the members of the household who fetch water as well as the frequency. In the Khokhwane community, it is mostly the mother (20%) or daughter (35%) of the household who fetches water from the water source, up to four times a day in some households. Plate 5.5 Shows children waiting on the side of the road with containers to collect water. In the Sizanenjana community, it is also the mother (64%) and the daughter (49%) who collects water in the household. They collect water up to four times or sometimes more in some households (20%). Females collecting water in the Sizanenjana community can be seen in Plate 5.6. In the Richmond community, although many are supplied with taps, there are many households who also fetch water to use in the household. The mother (59%) and daughter (77%) ranked as the two top members of the household who fetch water.

Similarly, studies undertaken by Kanyoka (2008) reveals that it is the responsibility of the women to fetch water. Thirty-three percent of the respondents collect water twice a day. Water collected is used for a variety of household and agricultural activities such as cooking, bathing, drinking, and feeding of cattle (Kanyoka, 2008; Keshavarzi et al., 2006). The use of collected water to wash clothes is seen in Plate5.7. The distance of the water source is illustrated in Table 7.22. Thirty-four percent, 40% and 11% of the respondents in the Khokhwane, Sizanenjana and Richmond community respectively stated that the water source is far away. Sixty-two percent of respondents in the Khokhwane community, 59% in the Sizanenjana community and 92% in the Richmond community stated that they travel less than 1km to the water source.

Table 5.31: Family members that fetch water and frequency (in %): Multiple responses.

Who fetches water	**Khokhwane n=100**	**Sizanenjana n=100**	**Richmond n=100**	**Total n=300**
Mother	20	64	59	143
Father	2	14	28	44
Son	8	21	50	79
Daughter	35	49	77	161
How many times a day	**Khokhwane n=100**	**Sizanenjana n=100**	**Richmond n=100**	**Total n=300**
Once	1	14	14	29
Twice	9	12	33	54
three times	15	23	30	68
Four times	17	27	16	59
More than 4 times	1	20	-	21
N/A	57	3	7	67

Plate 5.5: Children in the Sizanenjana community waiting to collect water.

Plate 5.6: Females collecting water from a communal open water source in the Sizanenjana community.

Plate 5.7: A female washing clothes in the Khokhwane community.

Table 5.32 demonstrates the distance of the water source and whether respondents perceive the water source to be far away. Fifty-one percent, 59% and 89% of the respondents in the Khokhwane, Sizanenjana and Richmond community respectively, stated that the water source is not far away. In the cases of the Khokhwane and Richmond community, in some households, taps are provided. It is for this reason that the majority of the respondents stated that the water source is not far away. Whereas in the Sizanenjana community, they have no pipes or taps installed and have to walk a distance to collect water (Kanyoka, 2008). Jagals (2012) states that water supply services are generally not as advanced or existent in rural areas as they are in urban areas. It is for this reason that Pickering and Davis (2012) emphasise that individuals residing in rural areas use 'non-network' water supplies, meaning that they have to walk great distances in order to collect water for their everyday use. Many of these individuals who collect water are the women and children of the household, who collect water scooping water into containers and carrying it back to the household (Kanyoka, 2008). Pickering and Davis (2012) contend that water collection trips may take approximately an hour or more, depending how far the water source is, and individuals make several trips per day to collect water. When and if the water source is available, it is not always in a good condition as the water may be contaminated (Jagals, 2012). Many of these water sources are non-perennial and at times may run dry during extended periods of drought. In times like these, it is up to the local municipalities to supply the community with water.

Table 5.32: Distance of water source (in %).

Is the water source far away?	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=300
Yes	44	40	11	95
No	51	59	89	199
No response	5	1	-	6
Distance	**Khokhwane n=100**	**Sizanenjana n=100**	**Richmond n=100**	**Total n=300**
<1Km	62	59	92	213
1Km	11	22	5	38
2Km	22	12	3	37
3Km	-	3	-	3
4Km	-	1	-	1
>4Km	-	2	-	2
No response	5	1	-	6

Table 5.33 illustrates the sources of irrigation, while Table 5.34 below depicts the sources of water during periods of no rain. Rain is represented as the most common source of water amongst all three communities with 96%, 59% and 94% of respondents in the Khokhwane, Sizanenjana and Richmond community respectively, relying on rain to water their crops. In the Khokhwane community, 67% of respondents obtain their water from taps, as mentioned earlier, 46% from rainwater tanks, 45% from spring water and 33% from the local municipality. In the Sizanenjana community, 46% of respondents obtain their water from the river, followed by rainwater tanks (28%), taps (10%), the local municipality (8), spring water (5%), and only 1% from a borehole. In the Richmond community, the second most common source of water after rain (94%), is rainwater tanks (90%), followed by taps (69%), local municipality (62%), the river (27%) and lastly a borehole (2%).

Table 5.33: Sources of irrigation (in %): Multiple responses.

Sources	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=300
Rain	96	59	94	249
River/stream	-	46	27	73
Borehole	-	1	2	3
Rainwater Tank	46	28	90	164
Municipality	33	8	62	103
Tap	67	10	69	146
Spring water	45	5	-	50

Table 5.34 illustrates the sources of water during periods of no rain. During periods of no rain, respondents in the Khokhwane community obtain their water from rainwater tanks (45%), municipality (28%), a community water source (12%), or spring water (3%). In the Sizanenjana community, during periods of no rain, respondents obtain their water from spring water (34%), rainwater tanks (26%), the local municipality (18%), a local community source (1%), the river (8%) or neighbours (8%). The Richmond community's respondents perception differed from the other two communities. Twenty percent of the respondents stated that they obtain their water from their rainwater tanks, while 79% of the respondents obtain water from the municipality. An example of the use of rain water tanks in the Khokhwane community to harvest water can be seen in Plate 5.8.

Table 5.34: Sources of water during periods of no rain (in %).

Periods of no rain	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=300
Rainwater tanks	45	26	20	91
Municipality	28	18	79	124
Community water source	12	1	-	13
Spring water	3	34	-	38
River	-	8	-	8
Neighbours	-	8	-	8
No response	12	5	1	18

Plate 5.8: An installed rain water tank in the Khokhwane community.

5.8 Coping strategies and sustainable agricultural practices

At this point it is imperative to note that the questions regarding coping strategies were not asked to the respondents in the Richmond community. Thus the researcher has a lack of responses (N/A) for the Richmond respondents as shown from Table 5.35 to 5.43. The reason for this was that questions regarding coping strategies and sustainable agricultural practices were asked using a separate template as the Richmond community underwent community upliftment through the WFGP. This warranted an additional separate questionnaire survey (Appendix 3) to be administered to the Richmond community due to funding arrangements. The results indicated by Tables 5.35 to Tables 5.43 were used to answer objective 3 of this study. The researcher felt that in order to understand if small-scale farmers had any mitigation measures in place, it was important to understand if small-scale farmers felt that they were experiencing any problems with their crops. Thereafter, the current mitigation strategies identified if any, were used to inform recommendations made for future mitigation strategies.

Table 5.35 portrays the results of the percentage of respondents that are experiencing problems with their crops at the moment, and how many perceive this to be due to climate change. Table 5.36 indicates the problems being experienced with their crops at the moment.

Main problems faced in the Khokhwane community as indicated by Table 5.36 include:

- decreased quality and quantity of crops (34%) resulting in decreased production (22%);
- dry soil as a result of drought conditions making the soil infertile (14%);
- dried up crops due to increased temperatures (10%); and
- pests are a problem as they destroy crops (6%). One respondent stated that "My potatoes are small, and the quality and quantity of soil has decreased".

Main problems experienced by respondents in the Sizanenjana community are similar to that of the Khokhwane community, being:

- dried crops (22%);
- pests feed on the crops (18%);

- decreased rainfall (16%), has resulted in decreased crop production (37%); and
- the lack of fences results in cattle entering the gardens and eats the crops (20%).

An example of dried up crops due to extreme temperatures and decreased rainfall can be seen in Plate 5.9. While Pest infected crops in the Khokhwane community can be seen in Plate 5.10.

Table 5.35: Respondents that are experiencing problems with their crops at the moment and perceive it is due to climate change (in%).

Problems with crops at the moment?	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=300
Yes	95	84	N/A	178
No	2	13	N/A	15
No response	3	3	N/A	6
Is it a result of climate change?	**Khokhwane n=100**	**Sizanenjana n=100**	**Richmond n=100**	**Total n=200**
Yes	93	72	N/A	165
No	2	12	N/A	14

Table 5.36: Problems experienced (in %): Multiple responses.

Problems	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=300
Decreased quality and quantity of crops	34	-	N/A	34
Production is not good	22	37	N/A	59
Climate change	4	-	N/A	4
Potatoes are small	4	-	N/A	4
Pests	6	18	N/A	24
Not enough water (Drought)	8	16	N/A	24
Soil is dry and infertile	14	-	N/A	14
Crops have dried up due to increased temperatures	10	22	N/A	32
Cattle eat the crops (no fences)	-	20	N/A	20
No problem experienced	-	7	N/A	7

Plate 5.9: Dried crops due to changes in climate in the Sizanenjana community in winter 2015.

Plate 5.10: Withered crops affected by pests and extreme temperatures in the Khokhwane community in autumn 2015.

Table 5.37 and Table 5.38 indicate the Chi-square test results for problems of crops and changes in rainfall and temperature respectively. Since the p-value is less than the level of significance for both Tables, that is; 0.000<0.05. H0 is rejected and it is concluded that a relationship exists between problems with crops at the moment, and changes in rainfall and temperature. This means that changes in rainfall and temperature have an influence on the problems with crops in the Khokhwane, Sizanenjana and Richmond communities, respectively.

Table 5.37: Chi Square test on problems with crops versus perceived changes in rainfall.

CHI-SQUARE TESTS			
	Value	**df**	**Asymptotic Significance (2-sided)**
Pearson Chi-Square	34.933[a]	2	.000
Likelihood Ratio	24.298	2	.000
Linear-by-Linear Association	15.150	1	.000
N of Valid Cases	196		

H0: Problems with crops at the moment are NOT related to or dependent on changes in rainfall.

H1: Problems with crops at the moment, are related to or dependent on changes in rainfall.

Table 5.38: Chi Square test on problems with crops versus perceived changes in temperature.

CHI-SQUARE TESTS			
	Value	**df**	**Asymptotic Significance (2-sided)**
Pearson Chi-Square	32.794[a]	2	.000
Likelihood Ratio	21.827	2	.000
Linear-by-Linear Association	14.435	1	.000
N of Valid Cases	196		

H0: Problems with crops at the moment are: NOT related to or dependent on changes in temperature.

H1: Problems with crops at the moment are: related to or dependent on changes in temperature.

Table 5.39 illustrates the percentage of respondents that have established coping strategies to aid them in dealing with the problems they experience as well as the institutions from which they have learnt these coping strategies. While Table 5.40 indicates what strategies these small-scale farmers have in place. This question was aimed at establishing what coping strategies small-scale farmers in the Khokhwane and Sizanenjana community have in place. A large percentage of the respondents in the Khokhwane and Sizanenjana community (79% and 76% respectively), do not have coping strategies in place. Those who do have coping strategies learnt these from past generations and this was passed down through oral tradition. Ajani et al. (2013) assert that indigenous knowledge is an integral part of ensuring sustainable agricultural practices. The use of local knowledge should be used in conjunction with scientific knowledge which informs the principles of the SLA and sustainability science which were discussed in Chapter 3 of this thesis. Examples of sustainability science principles being practiced are in the Khokhwane community, where help is received from the CWP workers who assist these small-scale farmers. Many of the respondents stated that not much is done personally to address the issues they experience with their crops (76%). While 6% stated that they use more fertilisers, and 5% said that they try and save water.

Seventy-six percent of the respondents in the Sizanenjana community do not have coping strategies in place. Generally, this is due to a lack of environmental education or education. One respondent stated that when he experiences problems with his crops, he does "nothing. Everything comes to a standstill". Some small-scale farmers stated that they practice crop rotation (7%) and the use of cow dung as an organic fertiliser (6%) to address the problems they are faced with. Fifteen percent of respondents stated that they buy pesticides and a "white powder" which they use on their crops to help in combating the problems of pests.

Table 5.39: Respondents that have coping strategies in place and sources (in %).

Coping strategies	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=200
Yes	21	24	N/A	45
No	79	76	N/A	155
Sources	**Khokhwane n=100**	**Sizanenjana n=100**	**Richmond n=100**	**Total n=200**
School	-	4	N/A	4
NGOs	1	-	N/A	1
Neighbour	14	2	N/A	16
Environmental Organisation	1	-	N/A	1
Parents	5	4	N/A	9
Indigenous Knowledge	-	14	N/A	14
N/A	79	76	N/A	155

Table 5.40: Coping strategies respondents have to deal with problems encountered (in%): Multiple responses.

Coping strategies implemented	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=100
Use more fertilisers	6	-	N/A	6
Buy pesticides	-	15	N/A	15
Cow dung as fertiliser	-	6	N/A	6
Crop rotation	-	7	N/A	7
Use water from stream	-	3	N/A	3
Save water	5	-	N/A	5
No response	10	-	N/A	10
None	79	76	N/A	155

Table 5.41 indicates the strategies that respondents feel they can implement to mitigate the impact that a change in climate has on their agricultural production. The purpose of this question was to gain an understanding of what respondents felt they could do on a personal level in order to mitigate the impacts of climate change on their agricultural production.

Twenty percent of the respondents in the Khokhwane community felt that further training and education could assist them in coping with climate change impacts .A small percentage (2%) of the respondents perceived that they could plant crops based on the season in which they grow. This relates back to education and training which is needed in order for farmers to

grow sustainably. The majority of the respondents (64%) stated that they do not know what they can do to mitigate the impacts of climate change on their agricultural production.

Respondents in the Sizanenjana community shared similar sentiments with respondents in the Khokhwane community. The majority of the respondents (43%) stated that there is not much they can do or they cannot think of anything. Mitigation strategies included building walls and fences to protect their crops (10%) followed by investing in water saving systems (27%) such as rainwater tanks to store water for times of drought.

The responses gained from the above, guided the researcher in informing recommendation as to what future strategies can be implemented to aid small-scale farmers in mitigation of the impacts of a change in climate on their agricultural production. The responses gained from the Sizanenjana and Khokhwane community emphasise the lack of community involvement in decision making. A more people centred and transdisciplinary approach needs to be implemented in assisting small-scale farmers in future.

Table 5.41: List of mitigation strategies respondents can implement (in %).

Mitigation strategies	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=200
I do not know	64	43	N/A	107
I could learn more about climate change	20	-	N/A	20
Plant crops based on the season they grow	2	4	N/A	6
To gain educational knowledge about planting suitable crops	10	-	N/A	10
I could use water saving system	-	27	N/A	27
Building walls and fences	-	10	N/A	10
No response	4	16	N/A	20

Table 5.42 indicates the organisations or stakeholders which offer support and guidance o the communities. Seventy-two percent of the respondents stated that they receive help from the CWP, while 18% stated that they receive no external help. Results from the Sizanenjana community revealed that 55% of the respondents receive no help. Some respondents (10%) stated that the Department of Agriculture Forestry and Fisheries (DAFF) has assisted them a few times. A few respondents mentioned verbally that they receive help from local municipality, however, help is received sparingly and not on a regular basis. Many respondents have complained that local government does not play their part in helping these

local farmers. This was to such an extent that some respondents chose to remain anonymous during the interview in fear that they would be reprimanded for speaking ill of local government officials. The reason for low government involvement could be due to the locality of Ingwe Local Municipality as it falls outside a primary node of the District municipality. The primary node is the area where main economic activities occur. Since the Ingwe Local Municipality falls outside the primary node, it is not seen as an area of investment by government (IDP 2014/2015).

Table 5.42: Organisations or stakeholders that provide guidance (in%).

Organisations	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=300
No	18	55	N/A	73
CWP	72	-	N/A	72
Department of Agriculture	-	10	N/A	10
No response	10	35	N/A	45

Table 5.43 indicates future strategies that respondents would like to see being implemented in their communities in the future. Respondents in the Khokhwane community requested more training and educational workshops to be held (62%) and training on climate change impacts (44%). One respondent stated "Training, because this weather affects us. Otherwise I will have to stop planting crops. I plant because I want to produce good quality and quantity but because of the changes in climate I do not think I can continue planting". In addition to more training and workshops, 10% of the respondents requested that all households should have rainwater tanks installed that can be used for irrigation purposes.

There was an overwhelming response from respondents in the Sizanenjana community to this question compared to respondents in the Khokhwane community. This is due to the fact that small-scale farmers in Sizanenjana receive no assistance and would need help from local government or NGOs. The main strategies and measures these small-scale farmers would like to see implemented in their community to help them improve agricultural production and livelihoods include provision of water and electricity (38%), Tar roads (26%), farming resources (26%), government intervention (18%), rainwater tanks (16%), youth projects (15%) and fences for their plots (15%).

Table 5.43: List of future requests respondents would like to be implemented (in%): Multiple responses.

Requests	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=300
Training and education workshops	62	-	N/A	62
Training on climate change impacts	44	-	N/A	44
To get more rainwater tanks in every household	10	16	N/A	26
Government intervention	16	18	N/A	34
Community gardens	6	-	N/A	6
Provision for water and electricity	-	38	N/A	38
Tar roads	-	26	N/A	26
RDP houses	-	5	N/A	5
Crèche for kids	-	3	N/A	3
Seeds, pesticides, equipment and fertilisers	-	26	N/A	26
More projects for employment (youth)	-	15	N/A	15
Closer shops	-	10	N/A	10
Fences	-	15	N/A	15

5.9 Wildlands food garden programme (WFGP)

The WFGP was implemented in the Richmond community in 2015. It is for this reason that this additional questionnaire survey (Appendix 3) was administered to the Richmond community only. Thus, in the Tables 5.44 until 5.52, the Khokhwane and Sizanenjana communities have no responses (N/A). The WFGP can be used as a positive example to be carried out in other communities suffering from food insecurity.

Table 5.44 indicates that majority of the respondents in the Richmond community were experiencing problems with their crops before the WFGP was implemented (71%). 61% believed these problems were due to a change in climate (60%). However, after the implementation of the WFGP, 86% of the respondents have stated that they are no longer experiencing problems with their crops. This large percentage of individuals that have noticed positive changes in their agricultural production can be attributed to sustainable agricultural practices. FAO (2015b) contend that sustainable agricultural practices have the ability to increase crop yields and alleviate poverty in rural households. The 13% of respondents that have stated they are still experiencing problems with their crops attribute these problems to small size crops or harsh weather conditions.

Table 5.44: Problems with crops before the WFGP and due to climate change (in %).

Problems experienced before the WFGP	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=100
Yes	N/A	N/A	71	71
No	N/A	N/A	29	29
Problems as a result of climate change				
Yes	N/A	N/A	61	61
No	N/A	N/A	39	39
Respondents still experiencing problems with crops				
Yes	N/A	N/A	13	13
No	N/A	N/A	87	87

Table 5.45 shows the percentage of respondents in the Richmond community that feel the WFGP has improved their agricultural production and helped them achieve a good food security status. The majority of the respondents (99%) in the Richmond community stated that their agricultural production has increased. The aim of this question was to establish how agricultural production has improved since the implementation of the WFGP. The responses pertaining to how their agricultural production has improved can be seen in Table 5.46. Many respondents stated that since the implementation of the WFGP, they can now plant different crops in a smaller space (42%), with one respondent stating "I can plant different crops throughout the year instead of seasonally". An example of a food garden containing a variety of crops in a small space is seen in Plate 5.11. Forty-seven percent of the respondents stated that the shift from fertilisers to organic compost has helped improve their agricultural production. Before the WFGP was implemented, respondents used to buy fertilisers to disperse on their crops. However, the WFGP taught local small-scale farmers how to create their own organic compost which has contributed to an increased agricultural production (47%). An example of this organic compost can be seen in Plate 5.12. These are known as sustainable agricultural practices. Other techniques that respondents in the Richmond community were educated on were permaculture, mulching and crop rotation which have improved their agricultural production.

Table 5.45: Respondents that feel the WFGP has improved their agricultural production (in%).

Has the WFGP improved respondents agricultural production	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=100
Yes	N/A	N/A	99	99
No	N/A	N/A	1	1
Has the WFGP helped respondents achieve a good food security status	**Khokhwane n=100**	**Sizanenjana n=100**	**Richmond n=100**	**Total n=300**
Yes	N/A	N/A	95	95
No	N/A	N/A	5	5
Do respondents still continue with the WFGP	**Khokhwane n=100**	**Sizanenjana n=100**	**Richmond n=100**	**Total n=300**
Yes	N/A	N/A	100	100
No	N/A	N/A	-	-

Table 5.46: Ways in which WFGP has improved respondents agricultural production (in%): Multiple responses.

Ways the WFGP has improved respondents agricultural production	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=100
I can plant different crops in a small space	N/A	N/A	42	42
Save in terms of watering and saving money	N/A	N/A	17	17
The shift from fertiliser to compost (more organic)	N/A	N/A	47	47
Increased information/education/skills	N/A	N/A	41	41

Plate 5.11: A food garden with a variety of crops grown in the Richmond community autumn 2015.

Plate 5.12: Organic fertilisers in the Richmond community in autumn 2015.

Since the implementation of the WFGP, many respondents have experienced improvements regarding their food security status. A good food security status is reached when the four dimensions of food security are met. These dimensions which were mentioned in Chapter 2 of this thesis are: food availability, food accessibility, food utilisation, and food stability (Du Toit, 2011; FAO et al., 2014; IPCC, 2014). Table 5.47 indicates ways in which respondents stated a good food security status has been achieved through producing fresh food in their

garden (52%), followed by consuming healthy and organic food from the garden, with no chemicals added in the form of fertilisers and pesticides (46%). All crops grown are nutritious, organic and can be eaten straight from the garden as indicated in Plate 5.13, thus contributing to an increased food security status among households. Twenty-nine percent of the respondents felt that the WFGP has decreased poverty which has helped them become more food secure. FAO (2008) maintain that food security exists when individuals have access to safe, healthy and nutritious food in order to sustain their livelihoods. The WFGP has met this standard of producing healthy, nutritious food that has provided individuals in the Richmond community with sustenance to lead a healthy lifestyle.

Table 5.47: Manner in which Wildlands has helped respondents achieve a good food security status (in%): Multiple responses.

Manner in which Wildlands helped respondents achieve a good food security status.	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=100
Fresh food from the garden	N/A	N/A	52	52
Eating organic food- no chemicals	N/A	N/A	46	46
I know what types of food to eat and healthy food	N/A	N/A	32	32
Decreased poverty	N/A	N/A	29	29

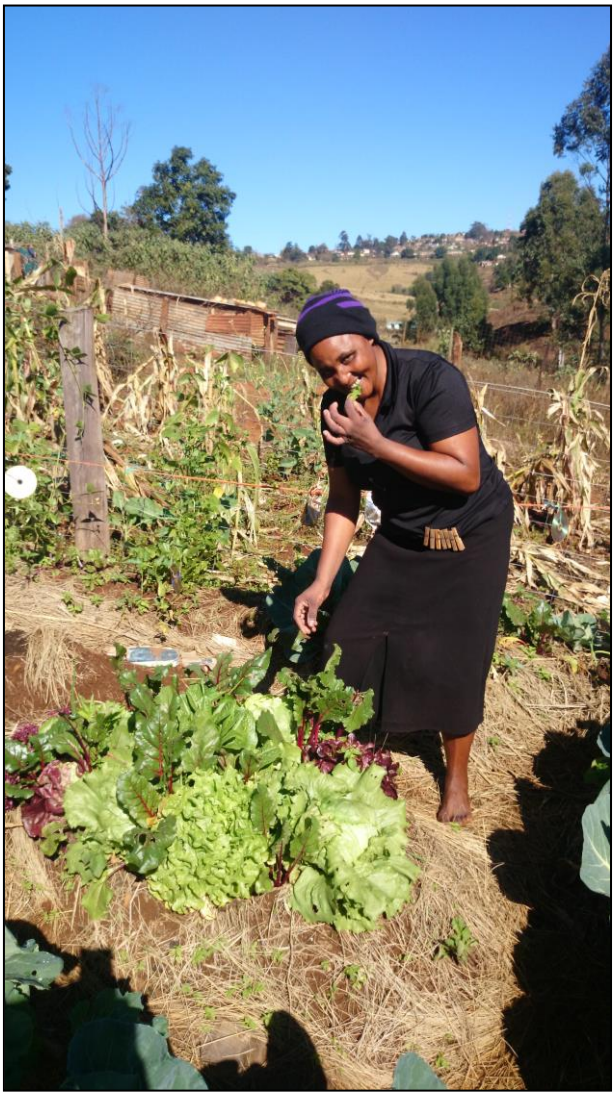

Plate 5.13: A respondent eating fresh organically fertilised lettuce from the garden.

Table 5.48 illustrates the ways in which the WFGP has improved respondents livelihoods. Sixty-six percent of the respondents stated that eating healthy organic food from their gardens has improved their livelihoods immensely. Forty percent of the respondents stated that as a result of growing their own crops, their entire family can survive on one food garden as there is now enough food to feed everyone throughout the year. This is due to the fact that the food garden project has taught them to grow crops throughout the year thus reducing hunger. The number of crops produced in one food garden in enough for respondents to feed their families and sell the remaining produce. An example of the vast number of crops produced in one garden can be seen in Plate 5.14. Many respondents (31%) stated that their livelihoods have improved, by saving money on purchasing food, as well as selling their fresh produce from their garden, earning an income. One respondent stated "I learnt how to save money and make money, improving my livelihood". Another benefit to their livelihoods was the qualification received at the end of the project (23%). Due to the fact that many community members went through environmental educational and sustainable agricultural training, they received a certificate at the end. FAO (2015c) state that empowering rural individuals and

providing them with access to resources, has the potential to make them resilient to food insecurity. Additionally, Collett and Gale (2009) suggest that by empowering individuals especially women (through training and education) will have the ability to produce healthy yields. This can be seen in the Richmond community whereby small-scale farmers, mainly women, were financially and educationally empowered thus resulting in large, healthy yields being produced.

Table 5.48: Ways in which Wildlands has improved respondents livelihood (in%): Multiple responses.

How the WFGP has improved respondents livelihood	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=100
I have a qualification through environmental training courses	N/A	N/A	23	23
Eating organic food from garden	N/A	N/A	66	66
I have crops all year round instead of seasonally	N/A	N/A	40	40
Selling produce to gain an income	N/A	N/A	31	31

Plate 5.14: Extensive amounts of organically fertilised crops produced in a food garden.

Table 5.49 indicates additional ways in which the WFGP has benefited respondents. This question was designed to establish other aspects in which the WFGP has benefited respondents besides their livelihoods. The majority of the respondents (81%) acknowledged the project has provided them with knowledge and training and given them experience in

sustainable agricultural practices. “I have now been educated about permaculture techniques and increased my skills and learnt strategies to protect my crops”. With 27% of the respondents stating that they now have a qualification which has benefited them. Forty-eight percent of the respondents have stated that they do not suffer from hunger anymore. Another benefit seen by the project were the tools and structures given to the farmers such as rainwater tanks and sprinklers. An example of a sprinkler installed in one of the food gardens can be seen in Plate 5.15. Forty-one percent of the respondents stated that the rainwater tank received has helped them save water, while 10% stated that they have received fencing tools to protect their crops from cattle. One respondent stated “I get 2200L rainwater tank, 4x4m roll of fence, poles and also garden tools. I have also gained a lot of knowledge on alien and indigenous plants as well as sustainable agricultural practices”. The project has also instilled a sense of passion and drive in some farmers (23%), with one respondent expressing “I have now developed a passion for farming and agriculture which I did not have before the project”. Environmental benefits not mentioned in the responses include a small pond to attract frogs and other species and a nitrogen fixing tree in illustrated in Plate 5.16 and Plate 5.17 respectively. These permaculture methods benefit the environment and add to sustainable practices. An example of a permaculture technique practiced in the Richmond community is mulching illustrated in Plate 5.18.

Table 5.49: Additional ways in which Wildlands has benefited respondents (in%): Multiple responses.

Additional ways the WFGP has benefited respondents	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=100
Experience/ increased skills	N/A	N/A	81	81
I don't suffer from hunger anymore. There is always food	N/A	N/A	48	48
Proper fencing for protection of crops	N/A	N/A	10	10
Education about permaculture techniques	N/A	N/A	15	15
Rainwater tanks to save water	N/A	N/A	41	41
I have a qualification	N/A	N/A	27	27
Organic farming without the use of chemicals	N/A	N/A	23	23
I have developed a passion for farming	N/A	N/A	23	23

Plate 5.15: A sprinkler installed in one of the food gardens in the Richmond community.

Plate 5.16: A small pond to attract biodiversity.

Plate 5.17: A nitrogen fixer tree.

Plate 5.18: Mulching techniques used (right) to produce healthy organically fertilised crops (left).

Table 5.50 reveals the strengths of the WFGP as indicated by the respondents. The strengths of the project according to respondents was increased education and knowledge received (25%). "Education and participation from the community. Now others in the community are helping people with their gardens". The project has brought the community together and has assisted people that were in need (47%), decreased hunger (33%), the gaining of skills and income (42%), and increased employment (21%).

Table 5.50: Strengths of the Wildlands Food Garden Programme (in%): Multiple responses.

Strengths	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=100
Education and participation from the community	N/A	N/A	25	25
Helped people gain skills and income	N/A	N/A	42	42
Assisting people in need	N/A	N/A	47	47
Increased employment	N/A	N/A	21	21
Decreased hunger	N/A	N/A	33	33

Some of the weaknesses of the WFGP according to respondents as indicated in Table 5.51 were that the project was too short and that it should not have ended at all (53%). "The ending of the projects the main weakness as we were still anxious to learn more" with another respondent stating "I wish that we received more information about planting and more

strategies needed to be taught to protect nature". Twenty-six percent of the respondents stated that more knowledge should have been given to the respondents (26%).

Table 5.51: Weaknesses of the Wildlands Food Garden Programme (in%).

Weaknesses	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=100
Project was too short	N/A	N/A	53	53
More knowledge and information should have been given	N/A	N/A	26	26
No response	N/A	N/A	21	21

Table 5.52 illustrates the assistance respondents would like to receive in the future. All respondents stated that they would like to receive future assistance. The main suggestions for the future were increased guidance and education (67%), more land and farming resources (53%), increased business opportunities (38%), short courses on how to become commercial farmers (29%), and larger plots of land (25%).

The results obtained above from the WFGP indicate principles and approaches of the SLA, such as people centred, participatory and responsive, partnerships and sustainable. These approaches taken by Wildlands Conservation Trust, have been successful in reducing poverty within the Richmond community and has resulted in an increase in skilled individuals. The establishment of partnerships between different agencies has also proven to be successful, creating a sustainable livelihood and sustainable food system.

Table 5.52: Assistance respondents would need in the future with regards to the WFGP (in%): Multiple responses.

Assistance respondents would like in the future	Khokhwane n=100	Sizanenjana n=100	Richmond n=100	Total n=100
More education and guidance	N/A	N/A	67	67
A bigger plot for my garden	N/A	N/A	25	25
Increased business opportunities such as farmers market	N/A	N/A	38	38
Short courses in commercial farming	N/A	N/A	29	29
Land, equipment, seeds and seedlings.	N/A	N/A	53	53

5.10 Participatory exercise findings

A Problem Ranking Matrix (PRM) is an exercise that is used to assess the feelings, attitudes and problems faced by individuals, which may not always be revealed in the questionnaire survey (Dey, 2005; Mikkelson, 1995). Problem ranking exercises undertaken in the Khokhwane, Sizanenjana and Richmond community were helpful in attaining additional information that respondents were reluctant to share in the questionnaire survey. The problem ranking exercise was coupled with focus group discussion of between 5 to 6 participants ranging between the ages of 25 to 65 in the three communities. All participants were welcoming, friendly and willing to participate.

Table 5.53 depicts the results obtained from the problem ranking matrix undertaken in the Khokhwane community. While Table 5.54, illustrates the scoring and ranking of the problems. Lack of Job opportunities (1), Climate change (1), Quality of education (3) and Drought (3) were ranked as the most problematic issues faced by the community. This was followed by teenage pregnancy (5), HIV and AIDS (6), Erosion (7) and waste disposal (7). The least problematic issues faced by the community were pests (9) and bad roads (10).

Table 5.53: Khokhwane community ranking matrix.

	QE	BR	HIV	D	E	CC	P	TP	WD	LJO
QE	•	QE	HIV	D	QE	CC	QE	QE	QE	QE
BR	•	•	HIV	D	E	CC	P	TP	WD	LJO
HIV	•	•	•	D	E	CC	HIV	TP	HIV	LJO
D	•	•	•	•	D	CC	D	D	WD	LJO
E	•	•	•	•	•	CC	P	TP	E	LJO
CC	•	•	•	•	•	•	CC	CC	CC	LJO
P	•	•	•	•	•	•	•	TP	WD	LJP
TP	•	•	•	•	•	•	•	•	TP	LJO
WD	•	•	•	•	•	•	•	•	•	LJO
LJO	•	•	•	•	•	•	•	•	•	•

Table 5.54: Scoring and ranking of Khokhwane community problem ranking matrix.

Problem	Scoring	Ranking
Quality of Education (QE)	6	3
Bad Roads (BR)	0	10
HIV and AIDS (HIV)	4	6
Drought (D)	6	3
Erosion (E)	3	7
Climate Change (CC)	8	1
Pests (P)	2	9
Teenage Pregnancy (TP)	5	5
Waste disposal (WD)	3	7
Lack Job Opportunities (LJO)	8	1

Table 5.55 indicates the results obtained from the PRM undertaken in the Sizanenjana community. While Table 5.56, illustrates the scoring and ranking of the problems. Food availability (1), was ranked as the most problematic issue being faced by the community, this was closely followed by health care (2), unemployment (2), clean water (4), and drought (5). Thereafter the following problems were ranked: lack of opportunities (6), insufficient resources (6), electricity (8), roads (9) and vacant land (10). Unemployment is indicated by the low employment rate indicated in the IDP (2015/2016) stating that 58% of the population in the Ingwe Local Municipality have no form of income. The IDP 2015/2016 also states the reason for the remainder of the problems being experienced could be attributed to low government involvement. This could be due to the locality of Ingwe Local Municipality as it falls outside a primary node of the District municipality and is therefore not seen as an area of investment by government (IDP 2014/2015).

Table 5.55: Sizanenjana community ranking matrix.

	R	E	CW	VL	D	U	LO	IR	AH	FA
R	•	E	CW	R	D	U	LO	IR	AH	FA
E	•	•	CW	E	D	U	LO	IR	AH	FA
CW	•	•	•	CW	D	U	CW	CW	CW	FA
VL	•	•	•	•	D	U	LO	IR	AH	FA
D	•	•	•	•	•	U	D	IR	AH	FA
U	•	•	•	•	•	•	U	U	AH	FA
LO	•	•	•	•	•	•	•	LO	AH	FA
IR	•	•	•	•	•	•	•	•	AH	FA
AH	•	•	•	•	•	•	•	•	•	FA
FA	•	•	•	•	•	•	•	•	•	•

Table 5.56: Scoring and ranking of Sizanenjana community problem ranking matrix.

Problem	Scoring	Ranking
Roads (R)	1	9
Electricity (E)	2	8
Clean Water (CW)	6	4
Vacant Land (VL)	0	10
Drought (D)	5	5
Unemployment (U)	7	2
Lack of opportunities (LO)	4	6
Insufficient Resources (IR)	4	6
Access to Healthcare (AH)	7	2
Food Availability (FA)	9	1

Table 5.57 portrays the results obtained from the problem ranking matrix carried out in the Richmond community. While Table 5.58, illustrates the scoring and ranking of the problems. Educational facilities (1) and shortage of skilled youth (1) were ranked as the most problematic. This was followed by unemployment (3), crime (4), fencing of plots (5), drugs (5), electricity (5), water accessibility (5), drought (7), transport (8). The problems faced by the Richmond community are more social than environmental. As established earlier in the chapter, the Richmond community do not face any problems with their crops since the establishment of the WFGP. The IDP (2015/2016), highlight crime and unemployment to be a serious issue faced by the municipality. The IDP (2015/2016) further states that Richmond is a predominantly youthful population, which can be attributed to problems such as unemployment and crime surfacing in the problem ranking matrix. Water accessibility (ranked 5), can be attributed to dilapidated water infrastructure in the Richmond Local Municipality (IDP, 2015/2016).

Table 5.57: Richmond community problem ranking matrix.

	U	C	FP	D	DR	T	EF	SSY	E	WA
U	•	U	U	U	U	U	EF	SSY	U	U
C	•	•	C	C	C	T	EF	SSY	C	C
FP	•	•	•	D	FP	FP	EF	SSY	FP	FP
D	•	•	•	•	DR	D	EF	SSY	D	D
DR	•	•	•	•	•	DR	EF	SSY	DR	WA
T	•	•	•	•	•	•	EF	SSY	T	WA
EF	•	•	•	•	•	•	•	EF	EF	WA
SSY	•	•	•	•	•	•	•	•	SSY	SSY
E	•	•	•	•	•	•	•	•	•	WA
WA	•	•	•	•	•	•	•	•	•	•

Table 5.58: Scoring and ranking of Richmond community problem ranking matrix.

Problem	Scoring	Ranking
Unemployment (U)	7	3
Crime (C)	5	4
Fencing of plots (FP)	4	5
Drugs (D)	4	5
Drought (DR)	3	7
Transport (T)	2	8
Educational Facilities (EF)	8	1
Shortage skilled Youth (SSY)	8	1
Electricity (E)	0	9
Water accessibility (WA)	4	5

5.11 Conclusion

This chapter discussed the results obtained from the Khokhwane, Sizanenjana and Richmond communities. Results from the quantitative and qualitative analysis depict that a change in climate does have a significant impact on small-scale farmers' agricultural productivity. Without environmental education and training, these conditions will continue to exacerbate their agricultural production and livelihoods. Findings from this chapter also revealed the importance and success of intervention from government and private sectors. This partnership can assist in achieving sustainability. The final chapter will present a further comprehensive and in-depth discussion pertaining to the main findings from this study in relation to the objectives of this study. Furthermore, a detailed account of future recommendations will be made in the next chapter.

CHAPTER 6:
SUMMARY, RECOMMENDATIONS AND CONCLUSION

6.1 Introduction

This chapter is aimed at presenting a summary of the results obtained from this research as well as recommendations to bridge the gaps which were discovered in this study. As mentioned in chapter one, this study was aimed at investigating local small-scale farmer's perceptions of change in climate, as well as the impact that this change of climate has on small-scale farmers and their food production. Additionally, the last objective of this study was to make further recommendations to address the gaps found in this study which will be addressed in detail in this chapter. This research was undertaken in the Khokhwane, Sizanenjana and Richmond communities in KZN. The key findings are summarised in the section to follow.

6.2 Summary of key findings

The key findings and results of this study are summarised and presented below in relation to the objectives of this study.

6.2.1 Objective One: To investigate small-scale farmers' perceptions towards a change in climate in Sizanenjana, Khokhwane and Richmond communities in KwaZulu-Natal.

The purpose of this objective was to establish the perceptions that small-scale rural farmers, in the three case studies, have towards a change in climate. Key questions surrounding this objective were issues relating towards what small-scale farmers understood by the term climate change, whether small-scale farmers have noticed changes in rainfall and temperature over the past 10 years, and whether or not these small-scale farmers believed that these changes had an impact on their livelihoods, food production and food security status. In the case studies presented, it is important to note that a key finding is that many of these small-scale farmers across all three communities had limited educational background and the majority of the respondents were female. It was noted that the majority of the small-scale farmers in rural areas are female (Bob, 2008). Many of these female small-scale farmers have limited access to educational opportunities and agricultural resources compared to men. This will influence their perceptions and understanding of a change in climate, and may differ

slightly to that of a male farmer or urban farmer who has access to such resources (Mehra and Rojas, 2008; Raidimi, 2014; Tibesigwa and Visser, 2015). This is illustrated in the three case studies presented whereby many small-scale farmers are not well equipped to produce healthy good quantity yields; moreover they are not educated about the phenomenon of climate change and the consequences it poses on their agricultural production.

Findings from the Khokhwane community portray that the majority of the respondents have heard of the term climate change, and perceived climate change to be a continuous change in weather. The majority of the respondents felt that they have experienced changes in rainfall and temperature over the past decade and these changes have affected their agricultural production, thus contributing to a low food security status as the dimensions of food security have not been met. The four dimensions of food security are: food availability, food accessibility, food utilisation and food stability (FAO et al., 2014; IPCC, 2014). Many of the respondents in the Khokhwane community have been involved in a food garden project, the CWP coordinated by COGTA. This programme involved the training of facilitators who established a few food gardens in the communities. Even though some community members underwent training, the majority of the community members have not received environmental education. The lack of environmental education influences small-scale farmers' perceptions and understandings towards climate change and its impacts.

Results from the Sizanenjana community revealed that majority of the respondents have not heard of the term climate change. This can be attributed to their remote location, as in this case study the community was situated approximately 20km away from the nearest built town. The lack of understanding of climate change can be attributed to respondents receiving little environmental education. Thereafter, respondents were asked what they understood climate change to be. Many of the respondents stated that it refers to extreme weather conditions and a continuous change in weather. Another key finding from this community was that government plays a small role in service delivery and provision of basic needs although more intervention and government support is needed by the local municipality in addressing the needs of the community.

Responses from the Richmond community differed significantly from the previous two case studies. The majority of the respondents in the Richmond community underwent training through the WFGP organised by ACT in partnership with WCT. This programme equipped 130 farmers with knowledge about climate change, food security, and sustainable agricultural

practices, through environmental training, thus equipping them with the necessary knowledge and skills to lead a sustainable healthy livelihood through sustainable agricultural practices. Therefore, results revealed that the majority of the respondents in the Richmond community have heard of climate change and perceive climate change to be a problem which is affecting their agricultural production. Respondents from the Richmond community further stated that they have noticed a change in rainfall and temperature conditions over the past decade and feel that this has affected their agricultural production. UNFCCC (2007) states that the changes in climate has negatively affected agricultural production through periods of drought, changes in rainfall and temperature patterns as well as frequency and intensity of drought conditions (IPCC, 2014). In addition to training, respondents in the Richmond community received materials such as tools for farming, seeds and rainwater tanks.

The WFGP has aided these farmers in the Richmond community in adapting to the changes in climate through the use of sustainable agricultural practices. This has increased their agricultural production and taught farmers to farm crops according to the climate, as well as taught them how to become entrepreneurs with many farmers starting their own businesses. Knot et al. (2014) emphasise that sustainable agricultural practices are key to achieving food security and ensuring sustainable livelihoods, although interventions need to be carried out continuously and cannot occur overnight. Even though these farmers experience a change in climate, the use of sustainable agricultural practices has benefited them. They have learnt how to adapt to the changes, improve their livelihoods and achieve a good food security status.

6.2.2 Objective Two: To examine the perceived impact that a change in climate has on food insecurity in Sizanenjana, Khokhwane and Richmond communities in KwaZulu-Natal.

The purpose of this objective was to determine the perceived impacts of a changing climate on the quality and quantity of crops and its impact on food security. Findings from the Khokhwane and Sizanenjana community revealed many of the respondents have not heard of the term food security. This can be attributed to a lack of environmental education.

A large percentage of the respondents in the Khokhwane and Sizanenjana community are experiencing decreased quality and quantity of crop yields due to extreme changes in weather conditions. The impacts of a change in climate are understood to affect crop yields, negatively affecting small-scale farmers. The decrease in crop production is perceived in the

form of decreased crop sizes, quality of crop yields decreasing, and the damage of crops due to extreme weather events such as extreme flooding and extended periods of drought. Many of the respondents experienced drought conditions in previous years which also decreased the quantity and quality of their crops, with some yields producing drier and smaller crops thus decreasing their food security status. This has resulted in many respondents experiencing a shortage of food, which usually occurs at the end of the month. The duration of this food shortage is approximately one week. This food shortage usually occurs at the end of the month or during winter when there is limited supply of water and the land is dry. Decreased rainfall coupled with continuous periods of drought spells, and lack of government involvement has contributed largely to many respondents experiencing food insecurity. This food shortage lasts until the men of the household return home at the end of the month from the cities, bringing with them money, food and other necessities. Therefore, the remittances received by men during the month, act as a safety net for rural households.

Key findings from the Richmond community reveal that the majority of the respondents have heard of the term food security. This is due to the majority of the respondents undergoing environmental training through the WFGP. The majority of the respondents have stated they have experienced a shortage of food. However, this was experienced before the WFGP and introduction of the food gardens. Before the WFGP, the change in climate had impacted their food production similarly to the impacts being experienced by the Khokhwane and Sizanenjana community. A decrease in food production resulted in a low food security status with many respondents experiencing food shortages and suffering from food insecurity.

6.2.3 Objective Three: To examine the current mitigation measures taken by small-scale farmers in Sizanenjana, Khokhwane and Richmond communities in KwaZulu-Natal.

This objective was established to determine what measures small-scale farmers in the three communities are adopting, if any. Much of the mitigation and adaptation techniques employed by small-scale farmers consist of indigenous knowledge as many small-scale rural farmers as mentioned earlier, are not educated about sustainable farming techniques and coping strategies to help them mitigate the impacts of climate change on their agricultural production.

Even though the majority of the respondents in the Khokhwane community experience problems with their crops, they do not have coping strategies in place to help them deal with

the impacts of a changing climate. Respondents have stated that they do have mitigation measures which include, buying fertilisers and conserving water which will be used during periods of no rain. When probed about what they think they can do to mitigate the impacts of a change in climate, the majority of the respondents were ignorant. Others stated that they could learn more about climate change and its impacts.

Findings from the Sizanenjana community proved to be similar to that of the Khokhwane community. The majority of the respondents experience problems with their crops however, many do not have strategies in place to help them deal with the impacts of a changing climate on their food production. A small percentage of the respondents that stated they do have coping strategies in place, consisted of indigenous knowledge which has been passed down to them from their fathers and elders. Thus, the old traditions are extremely important among African communities.

Results from the Richmond community reveal the WFGP as the main mitigation and coping strategy. The WFGP has equipped farmers in the Richmond community with farming skills and expertise to properly manage their food production using sustainable agricultural practices. One of the farming practices taught was mulching. Mulching involves the use of organic material such as leaves, cuttings, sticks and branches, which are placed around crops to allow for less water to be evaporated, and hinder the growth of weeds (Shirish et al., 2013).

Examples of sustainable agricultural practices in the Richmond community include the use of organic compost instead of fertilisers and the planting of crops in relation to the season and changes in climate.

6.3 Theoretical reflections

The conceptual frameworks of this study emphasised the theme of integration, education and partnerships. The adoption of the political ecology in understanding food insecurity, results in the understanding of power relations and control, access to resources, and inequalities that exist in rural communities. Location is key in accessing resources, aid and knowledge. Political ecology also acknowledges that there is a relationship that exists between individuals and the environment. The environment affects individuals and vice versa. Political ecology acknowledges that individuals in rural communities may not be aware of what they do in terms of impacting the environment around them, and in turn may exacerbate their living condition (Adams, 2001). The Sizanenjana community case study presented in this research study can be offered as an example of political ecology in play, whereby small-

scale farmers in this community are unaware of the impacts of a change in climate on their agricultural production due to a lack of environmental education. These farmers continue to practice farming techniques, further degrading the environment, resulting in a poor quantity and quality of crop yield. In cases like these, the importance of training and education become relevant in addressing the issues.

Chapter three also looked at the importance of food systems and its relevance, not only at a local scale, but on a global scale. The impacts rural farmers experience at a local scale has the ability to affect the food systems at a global scale (Eriksen et al., 2010a). For example, a local rural farmer, uneducated about the impacts of a changing climate and the consequences thereof, will continue to practice farming techniques in an unsustainable manner, resulting in a low crop yield, and degradation to the environment. The degradation to the environment is an aspect that affects not only the farmer, but affects sustainability as a whole, impacting the global system (Eriksen et al., 2010a).

The concept of sustainability science was discussed in relation to the issues faced by rural households in trying to mitigate the impact of a change in climate on their livelihoods and food production. The concept of sustainability science adopts a trans-disciplinary approach when dealing with issues pertaining to climate change and its consequences. This is because problems experienced by small-scale farmers are socio-ecological. Social and environmental problems should not be addressed individually as they are linked. A rural farmer facing problems with respect to agricultural production affected by a change in climate, will not have ways in which to mitigate those impacts, if not educated correctly. This is due to a lack of environmental education and sustainable farming techniques. It is therefore for this reason that sustainability science addresses socio-ecological problems as one - through a trans-disciplinary approach (Lang et al., 2012). This is achieved through PPPs between different stakeholders (Wiek et al., 2012).

The SLA which was discussed in chapter three, acknowledges that rural individuals have useful knowledge which should be used in conjunction with scientific knowledge to create a sustainable livelihood and poverty alleviation. The SLA also acknowledged that when dealing with local people, it is vital to place them at the centre of discussions to allow for maximum discussions and exchange of knowledge. In the case studies presented in this research study, successful implementation of PPPs and the SLA can be seen in the Richmond

community whereby partnerships were created between different stakeholders and rural households. These PPPs placed emphasis on rural people's needs, capabilities and strengths.

6.4 Recommendations

6.4.1 Environmental education and sustainable agricultural practices

Human behaviour is the cause of problems experienced presently such as climate change and the impacts that are associated with it (Mclusky and Sessa, 2015). Mclusky and Sessa (2015) further state that even though human behaviour is the cause of all of these problems, a change in human behaviour can be seen as a solution to these problems being faced. The driving force of this change is education. Education is key in aiding people - especially rural people - towards understanding the impacts of a changing climate assisting them to practice ways and techniques to mitigate the impacts they have on the environment. Education of how to farm sustainably, gaining nutritious produce from the land while simultaneously conserving the earth's resources, and minimising the impact an individual has on the earth, is known as sustainable agriculture (FAO2015b).

Knot et al. (2014) note that the term "sustainability" and "sustainable" are terms that are more commonly used in agriculture as of recent years. When one thinks of the term sustainable agriculture, many terms come to mind such as organic farming, CSA and conservation agriculture, to name a few. FAO (2015b) asserts that sustainable agricultural practices are important in increasing agricultural production and alleviating poverty. A key component in sustainable agriculture is environmental education. Environmental education is vital as local rural people have indigenous knowledge which, when combined with environmental education, can lead to sustainable agricultural production. Environmental education not only uses scientific knowledge, but also acknowledges that rural people have useful indigenous knowledge systems. When indigenous knowledge is combined with scientific knowledge, sustainable agricultural practices can be achieved. Sustainable agricultural practices at a local community level, has the potential to create a green economy (Knot et al., 2014). FAO and Institute National de la Recherche Agronomique (FAO and INRA, 2016) assert that in order to ensure sustainable agricultural production, the conservation of natural resources is vital.

Musvoto et al. (2014) maintain that even though South Africa (like many African countries) has been experiencing steady economic growth rates, the country is faced with many challenges. Some of which include decreased agricultural production and poverty as a result

of a change in climatic conditions. A green economy may be the solution to the problems of poverty, unemployment and hunger, acting as an opportunity to emerge from these challenges (Nhamo, 2013). Musvoto et al. (2014) further state that the agricultural sector in South Africa has the potential to become the driving force of the green economy ultimately alleviating poverty and mitigating the risks imposed by a change in climate. (UNEP, 2012:4) defines a green economy as:

> *One that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. In its simplest expression, a green economy can be thought of as one which is low carbon, resource efficient and socially inclusive.*

An example of a transition to a green economy could be that of sustainable agricultural practices. FAO (2015c) emphasise the importance of stakeholder engagement and partnerships which encourage knowledge sharing and the promotion of sustainable technological innovations. FAO and INRA (2016) assert that enhanced agricultural technology can aid in the alleviation of poverty and ensure good food security statuses are achieved. Investments in agriculture as well as government interventions are required in order to increase agricultural productivity in a sustainable manner. Efforts and programmes by government municipalities can be costly. However, municipalities can offer their services by ensuring basic service delivery of basic needs such as clean water, and electricity (Van der byl, 2014). The aid of electricity in rural areas will decrease the reliance on fuel wood as a source of energy, thus decreasing the impact on the environment. This also has the potential to decrease upper respiratory tract infections through less inhalation of smoke.

The investment in social capital is important in reducing poverty. Social capital is one of the assets in the asset pentagon of the SLF. Social capital refers to relationships, partnerships and communications built on trust between various stakeholders (Brocklesby and Fisher, 2003). Efforts of social capital initiatives include the CWP undertaken in the Khokhwane community run by the COGTA. Although not fully effective in its plight to reduce poverty and increase environmental awareness, the CWP programme can be used as a positive example for other local municipalities to learn from. Another initiative as mentioned in this research was that of the WFGP. The WFGP was a programme established by WCT and can be used as a positive recommendation for initiatives to be undertaken in other rural communities in need of environmental education and upliftment. Knot et al. (2014) assert that sustainable agricultural practices are a gradual process. With support and aid from

external stakeholders, organisations and partnerships, the transition to sustainable agricultural practices can be achieved.

CSA is an example of an approach that small-scale farmers can adopt in achieving sustainable agriculture and has the potential to contribute to achieving the SDGs. Sustainable agricultural practices and climate-smart agriculture also have the potential to educate farmers about sustainable farming practices to minimise the impact agriculture has on a change in climate. This is because agriculture is a large contributor towards greenhouse gas emissions (Godfrey and Garnett, 2014; Grainger-Jones, 2011). If emissions such as Nitrous Oxide are controlled and managed effectively, agriculture could be a key sector in biological carbon capture acting as a sink to mitigate the long term impacts of climate change (FAO, 2013b).

In order to achieve household food security while ensuring the protection of natural resources, food systems at a local level need to be reliant and efficient. An example of such is sustainable intensification which ensures the conservation of natural resources while producing healthy and large yields (Lal, 2013). This is achieved through the decreased reliance of fossil fuels and pesticides; the encouragement of efficient use of energy and water resources; sustainable land management; and crop rotation practices (FAO, 2013b; Grainger-Jones, 2011). Sustainable intensification aims to increase crop yields without disrupting ecosystems and natural resource supplies needed for future generations (Godfrey and Garnett, 2014; Pretty and Bharucha, 2014). This concept links closely to the definition of sustainable development. Grainger-Jones (2011) contends that CSA programmes are aimed at increasing the resilience of small-scale farmers to the shocks and risks associated with climate change. FAO (2013b) refers to these practices as ‘knowledge-intensive’. The proper implementation of CSA can be achieved through the support of external stakeholders such as local government and NGOs through the establishment of PPPs.

6.4.2 Local government involvement and increased partnerships

In order to achieve sustainable food systems and food security overall, a trans-disciplinary approach needs to be taken into consideration (Ghosh, 2016; Kajikawa, 2008; Kauffman and Arico, 2014). This involves PPPs formulated by various stakeholders such as government, academia, scientists, public and local rural people such as the Richmond and Khokhwane case studies whereby partnerships were established between NGOs and local community. The lack of government involvement in the three communities is an indication that in future, local

government initiatives should take place in communities, allowing for community involvement in decision making and planning processes.

In future, the promotion of partnerships in rural communities will assist in capacity building and encourage the learning and sharing of knowledge at a local level. These partnerships have the potential to alleviate poverty and assist communities in achieving a good household food security status which is achieved when all four dimensions of food security are met. Furthermore, knowledge from various sectors needs to be taken into consideration as different stakeholders from different sectors have knowledge about certain aspects, which when shared can be useful. Similarly, Dasgupta et al. (2014) assert that the sharing of knowledge from science and academia stakeholders has the ability to increase the adaptation to a change in climate and its effects. The sharing of knowledge and skills can decrease the vulnerability of small-scale farmers to climate change impacts and food insecurity through education. Thus, encouraging local people to become a part of the solution in addressing climate change issues. Ajani et al. (2013) Furthermore, the use of indigenous knowledge in future decision making and planning can be useful in achieving sustainable agricultural practices. This can be achieved through integration of indigenous knowledge into policies and programmes which can lead to initiatives that are inclusive, equitable and sustainable.

Moreover, the establishments of future PPPs has the ability to aid local people in understanding the challenges they are being faced with, and ways in which to deal with these challenges (Kauffman and Arico, 2014). This can be achieved through the development of partnerships, programmes and initiatives. Van der Byl (2014: 56) affirms that "Working in partnership has the potential to transform rural areas". Increased partnerships between the private sector and public sector are needed in order to address the challenges faced by rural communities. The agricultural sector has the potential to uplift rural people out of poverty, through partnerships and programmes aimed at educating and transferring of skills and knowledge. Examples of such initiatives is that of WFGP seen in the Richmond community, as well as the CWP undertaken in the Khokhwane community, as established in this research study. These two case studies can be used as a positive example of successful PPPs in aiding small-scale farmers alleviate poverty and achieve food security at a household level.

6.4.3 Women empowerment

Women as iterated in this study are important role players in the agricultural sector and are therefore extremely vulnerable to changes in climate and its effects on livelihoods and food security (Grainger-Jones, 2011). Thus, it is vital to train and empower women, equipping them with the skills, resources and expertise necessary in order to adapt to a change in climate and its impacts. Women empowerment begins with acknowledging that women are important. Women empowerment is vital in achieving food security as women play an equally important role in agricultural production as men do (Alam et al., 2015; Karl, 2009). This can be seen in the case studies presented in this study, especially in the Khokhwane and Richmond communities whereby women have become involved in food garden schemes. These food garden schemes have empowered rural women to become a part of the solution in addressing changing climate impacts. Empowering women and ensuring their participation in the decision making process is crucial in alleviating poverty and ensuring food security at a household level (FAO, 2014; Ghosh, 2016). FAO (2014) further states that PPPs should aim at closing the gender gap so that women have equal access to resources and opportunities. A recommendation such as social protection programmes, training and education should be considered for future in empowering women.

Social protection refers to the programmes and initiatives that are aimed at offering aid to marginalised individuals, especially those who suffer from poverty and food insecurity. Social protection can be offered in the form of cash or kind. FAO (2015c) contend that social protection is usually targeted at female headed households in rural communities. Social protection consists of cash transfer schemes and can aid in women empowerment, more specifically women's economic empowerment, through effective training.

In future, with the establishment of effective training, women could become more financially and socially independent. This can be achieved through financial training and knowledge programmes whereby programmes and courses can be set up to educate women about financial management, savings, safety nets and livelihood diversification. Thus communities and female headed households are taught to expand their livelihoods by focusing on many activities instead of relying solely on one activity. The influence of educated and empowered women is seen in the Richmond case study whereby many of the rural farmers who underwent training through the WFGP were women. The financial, environmental training and education of women in sustainable agriculture has allowed them to gain entrepreneurial

skills, grow and sell their produce as well as establish small businesses of their own, thus empowering them. These women are less dependent on men to provide for them and have expanded their knowledge and livelihood.

In future, before training is undertaken, it is vital to undertake research into the challenges women face on a daily basis, as well as their needs (Ghosh, 2016). Thereafter it is recommended to create suitable training courses based on the needs of these rural women (Collett and Gale, 2009). Collett and Gale (2009) further state that empowerment is not only focussed on educating and resourcing women, but also encouraging them, building their confidence and self-esteem. Building confidence in rural women is important as it enables rural women to put together the knowledge and skills they have accumulated into practice and enter larger markets or start their own small businesses. Confidence building and empowerment can also lead to rural women entering into PPPs with other stakeholders, maximising profits and ensuring a sustainable livelihood. Golla et al. (2011) states that women who have been economically empowered tend to invest their income in their children, leading to an educated generation and a positive path towards sustainable development.

6.5 Contributions of this thesis to the field

The contribution this thesis makes to the field is that it has provided discussions on gaps that lie within government. This thesis has illustrated the importance that environmental education, assistance and training plays in small-scale households in achieving food security. Furthermore, the key role NGOs and government can play in ensuring sustainable agricultural growth within small-scale communities. A mixed method approach of both quantitative and qualitative techniques is helpful in gaining information from communities, especially to inform decision making. For example, respondents in the Sizanenjana community felt threatened and resistant to disclose information on the survey questionnaire. Respondents perceived that if they disclose information their safety would be threatened. However, respondents were more forthcoming to disclose information during participatory exercises. This example portrays the anxiety that communities have towards government officials. This thesis encourages future studies to research more about the role various stakeholders can play in assisting rural communities. Communities should be the first stakeholders involved in decision making processes and other developments that concern them. The integration of knowledge from various stakeholders is important in achieving sustainable development along the triple bottom line, that is, social, economic and environment.

Agricultural patterns and techniques practiced by small-scale farmers presently are as a result of traditional practices and indigenous knowledge. It was therefore important to understand what techniques current small-scale farmers have in assisting them with climate change. It is important to educate farmers to farm in accordance with climatic changes, to gain maximum agricultural production. This thesis, has hopefully displayed the importance of educating farmers to plant in accordance to changes in climate, and the important role government and NGOs can have in achieving this.

6.6 Conclusion

Small-scale farmer's perception of climate change is deeply influenced by their environmental education. Small-scale farmers perceive a change in climate to be a continuous change in climate and have experienced a change in the climate over the past few years. These small-scale rural farmers perceive climate change to be affecting their agricultural production negatively. This change is recognised as extended periods of drought and extreme temperatures.

A change in climate has negatively impacted small-scale farmer's agricultural production. Small-scale farmers have indicated that their crop production has decreased due to continual changes in climate. The qualities of crop yields have also been negatively affected with some communities producing smaller sized crops, decreasing the quality of the yield. These impacts have had serious consequences on food security, resulting in many respondents suffering from food shortages and food insecurity.

Mitigation and coping strategies differ between all three communities. In the Khokhwane community, the CWP served as the main form of mitigation and adaptation to the change in climate being experienced. The establishment of a few food gardens have enabled farmers to obtain access to crops and has decreased the amount of small-scale farmers experiencing food insecurity. However, there are still a large portion of the community who have limited knowledge about climate change and its impacts on their livelihoods and land. Further interventions such as trainings and environmental educational programmes are needed.

The small-scale farmers in the Sizanenjana community do not have any successful mitigation strategies or coping mechanisms in place to aid them in dealing with the impacts of a change in climate. Many a time, small-scale farmers in the Sizanenjana community resume with their daily lives and lack coping strategies during times of food shortages. This results in food insecurity being experienced and thus a low food security status. Those few farmers, who do

have mitigation strategies in place, consist of indigenous knowledge practices which have been passed down from previous generations. This indigenous knowledge has the potential to be used in conjunction with scientific knowledge to ensure sustainable agricultural practices.

Small-scale farmers in the Richmond community have undergone environmental educational training on the impacts of climate change on their agricultural production, and ways in which to mitigate these impacts. These farmers practice coping strategies such as permaculture and mulching and have been taught to farm in accordance with the changing climate. Subsequently, these farmers have been educated with coping strategies, climate change mitigation and adaptation strategies.

Recommendations for the Khokhwane community could be that of an extension of the CWP. An extension of the programme could involve further training as well as increased environmental awareness and educational programmes for both the young and elderly. Environmental educational programmes could also be introduced at schools, targeting the youth, as well as empowerment programmes for women, educating them in becoming entrepreneurs and educating small-scale farmers about the importance of sustainable agricultural practices. In the Sizanenjana community, much intervention is needed for the small-scale farmers. Government should assist in the provision of basic services such as water and electricity which is crucial. In addition to government intervention, PPPs between various stakeholders should be looked at with the aim of initiating food gardens in the Sizanenjana community in an effort to reduce poverty and increase food security, as well as access to nutritious and healthy food contributing to a good food security status. In the Richmond community, due to the success of the WFGP, there are not many recommendations to forward regarding the small-scale farmers. The WFGP can however be used as a positive case study for NGOs and government to implement in communities in need of intervention such as the Khokhwane and Sizanenjana communities presented in this research study.

It is evident that external interventions aid in the improvement of livelihoods. The use of mitigation and adaptation techniques as well as PPPs has also proven to be successful in achieving good food security statuses through sustainable agricultural practices. The uses of sustainable agricultural practices are seen as a mechanism to aid in food security and alleviate poverty while ensuring environmental education and training of community members. The implementation of the WFGP in the Richmond community can be used as a positive case study to be implemented in other communities in need of external intervention.

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APPENDIX 1:
Consent form for participation in a research study

The impact of a change in climate on small-scale farmers and their vulnerability to food insecurity. A comparative study of four rural communities in KwaZulu-Natal.

You are requested to participate in a research study conducted by Simone Pillay, who is studying towards a Master's degree in Geography and Environmental management at the University of KwaZulu-Natal, Pietermaritzburg campus. The aim of this research is to gain information regarding the impact of climate change on the food production and consumption status of the household, as well as their livelihoods.

Your participation would be extremely beneficial to this study and is completely voluntary. If you do wish to participate, it will involve the answering of a questionnaire survey which consists of open and closed ended questions regarding the research at hand. In addition to the answering of questionnaires, other qualitative approaches such as problem ranking matrix and Venn diagrams will be conducted.

The questionnaire will take approximately an hour to complete and the problem ranking matrix approximately one and half hours per a participant. There are no known hazards and discomfort associated with this research. However, if at any point during the interview you feel uncomfortable you may withdraw from the study. In addition, your responses will be kept confidential, and a pseudonym can be used, to protect you.

Information and responses will be collected using an audio recording device with your permission. The data and information that is collected from this study will be used for the sole purpose of this research, and will thereafter be disposed of in the correct manner.

Please note that your participation in this study is completely voluntary and there is no payment or incentives will be rewarded for participation.

For any further questions or queries, please contact:

Dr Sumaiya Desai (Project Supervisor):	033 260-6568 *Or* 072 548-1410 Desai@ukzn.ac.za
Simone Pillay (researcher):	072 583 9154 *Or* 033 391-4179 pillay.simone21@gmail.com
HSSREC RO Ms Phumelele Ximba:	031 260 3587 ximbap@ukzn.ac.za

I……..(full name), hereby confirm that I fully understand the nature of this project, and the content of this research project. I consent to participate in this research project. I understand that I am at liberty to withdraw form this study at any point during the interview.

Participant signature_____

Date_____

Zulu Translation

Ifomu lokugunyaza ukuthatha iqhaza ocwaningweni.

Umthelela ekushintsheni kwesimo sezulu kubalimi bokudla kanye nabalimi abancane e Bulwer, KwaZulu-Natal.

Niyacelwa ukuba nithathe iqhaza ocwaningweni olwenziwa uSimone Pillay, owenza iMasters kwiziqu Zokuphathwa kwezeMvelo eNyuvesi yaKwaZulu-Natal, eMgungundlovu. Inhloso yalolu cwaningo wukuthola ulwazi mayelana nomthelela wokushintsha kwesimo sezulu, nomthelela kumkhiqizo wokudla nasesimeni sempilo yomphakathi, wonkana.

Awuphoqiwe, kodwa kuyoba usizo olukhulu ukuthatha kwakho iqhaza kulolucwaningo. Siyakwazisa ukuthi, kunohla lwemibuzo okubalulekile ukuthi uyiphendule ukuze lube yimpumelelo lolucwaningo.

Loluhlelo lungathatha, cishe, amahora amabili nengxenye. Siyacela ukuthi ubekezele ngoba uvo lwakho lubaluleke lakhulu. Siyethembisa ukuthi izimpendulo zakho negama lakho sizokugcina kuyimfihlo.

Izimpendulo nemibono yakho izoqoshwa bese ihlelwa ngemikhakha yohla yalolucwaningo. Siyethembisa ukuthi konke lokhu kuzokwenziwa ngemvume yakho, kuphela. Siyathembisa futhi ukuqikelela nokuvikela konke okuqoshiwe.

Awuphoqiwe ukungenela lolucwaningo, futhi, akukho nhlawulo noma umvuzo ngokuthatha iqhaza.

Uma udinga izincazelo noma imibuzo, sicela uthintane:

Dr Sumaiya Desai (Umphathi Projekthi):	033 260-6568 Noma 072 548-1410 Desai@ukzn.ac.za
Simone Pillay (Umcwaningi):	072 583-9154 Noma 033 391-4179 pillay.simone21@gmail.com
HSSREC RO Ms Phumelele Ximba:	031 260-3587 ximbap@ukzn.ac.za

I .... (Igama eligcwele), ngiyaqinisekisa ukuthi ngiyazimbandakanya ngohlobo locwaningo nangenhloso yalo. Ngiyavuma ukuthatha iqhaza kulolucwaningo. Ngiyaqonda ukuthi nginegunya lokuhoxa noma kunini uma ngingeneliswa inqubo yokuqoshwa kocwaningo.

Ukusayina kobambe Iqhaza _____

Usuku _____

APPENDIX 2:
Questionnaire Survey

School of Agriculture, Earth and Environmental Sciences

University of KwaZulu-Natal

(Please cross the applicable answer: X)

A. PERSONAL DETAILS

1. Gender

Male	
Female	

2. Age of respondent

< 25 years	26-35 years	36-45 years	46-55 years	56-65 years	>65 years

3. Race classification

African	
White	
Indian	
Coloured	
Other	

4. Nationality

South African	
Nigerian	
Zimbabwean	
Mozambiquan	
Other	

5. Home language

IsiZulu	
English	
IsiXhosa	
Afrikaans	
Sesotho	
Other	

6. Education

None	
Primary	
Secondary	
Tertiary	
Other (specify)	

7. Disability

Yes	
No	

8. Marital status

Single	
Married	
Separated	
Widowed	
Living with partner	
Other	

8.1 If married, do you live with your spouse?

Yes	
No	

9. Number of children.

0	1	2	3	4	5	>5

10. How many dependents do you have?

0	**1**	**2**	**3**	**4**	**5**	**>5**

11. Occupation

Unemployed	
Domestic worker	
Farm labourer	
Pensioner	
Student / learner	
Other	

12. How many people living in your household

0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**>10**

13. How many males, females and children are living in your household?

Males	
Females	
Children	

14. What are the sources of income in your household?

Farm labourer	
Farm owner	
Local shop assistant	
Domestic worker	
Other	

15. What are your biggest expenses for the year? i.e. What do you spend the most money on?

Farming equipment	
School fees	
Purchasing of seedlings	
Other	

16. How long have you been living in this area for?

>5 years	
6-10 years	
11-15 years	
16-25 years	
25-35 years	
>35 years	

17. Have you and your family always lived here?

Yes	
No	

17.1 If answered No to Q17, why did you move here?

_____

_____

17.2 Where did you previously live?

_____

_____

18. Does your household own any land?

Yes	
No	

18.1 If answered yes to Q18, What is the size of the plot you own? (Hectares)

0.5 -1 Hectares	
1-2 Hectares	
2-3 Hectares	
>3 Hectares	

19. Who carries out the following activities?

	Mostly men	Mostly women	Children	Every-body	Other	
Planting of crops						
Working on the farm/ garden						
Management of garden						
Collection of firewood						
Collection of water						
Selling of farm/ garden products						

20. What equipment or tools do you use when farming?

Hoe	
Plough	
Spade	
Tractor	
Pesticide	
Sprayer	
Other	

21. Do you use any fertilizers?

Yes	
No	

22. Do you keep any cattle for grazing?

Yes	
No	

22.1 If answered yes to Q22, what cattle or animals do you keep?

Cows	
Goat	
Sheep	
Pigs	
Chicken	
Other	

23. Do you generate any income from these cattle?

Yes	
No	

23.1 If answered yes to Q23, how much?

Cattle	How much
Cows	
Goat	
Sheep	
Pigs	
Chicken	
Other	

B. ELECTRICITY

24. What type of energy do you use?

Firewood	
Biofuels	
Propane	
Solar	
Charcoal	
Grid Electricity	

25. If you collect firewood, how long does it take (hours) to collect?

< 1 hour	
1-2 hours	
2-3 hours	
3-4 hours	
>4 hours	

26. How far do you have to walk to collect firewood?

<1Km	
1Km	
2Km	
3Km	
4Km	
5Km	
>5Km	

27. When collecting firewood, do you plant trees at a later stage to replace the trees that have been cut?

Yes	
No	

C. CLIMATE CHANGE AND ENVIRONMENTAL EDUCATION

Climate change refers to the warming of the atmosphere, also known as the greenhouse effect. Climate change occurs when there is a distinct change in the climate over an extended period of time.

The greenhouse Effect can be described as the earth receives radiation from the sun; this is known as solar radiation. This solar radiation warms the earth's surface. Some of this solar radiation leaves the earth's surface in the form of long wave radiation. Part of this long wave radiation is absorbed by the greenhouse gasses in the atmosphere which then creates a blanket of warmth over the earth. However, with the increased emissions of greenhouse gasses into the atmosphere, there is increasingly more long wave radiation being absorbed by the greenhouse gasses, increasing the temperatures of the earth hence resulting in global warming and climate change.

28. Have you heard of the term climate change?

Yes	
No	

29. What do you understand by the term climate change?

---

30. Do you think that climate change is a problem?

Yes	
No	

30.1. Why do you or do you not think it is a problem?

---

31. Do you think that climate change is affecting your agricultural production?

Yes	
No	

32. Have you received any environmental education?

Yes	
No	

32.1 If answered yes to Q32, how much?

A little	
A lot	
Not Much	
Sufficient	

32.2 Where did you receive this education?

School	
Local municipality	
Environmental organization	
News	
NGO	
Other	

33. Apart from food security, what other environmental issues are you faced with in your area?

Flood	
Pollution	
Water quality	
Water scarcity	
Other (specify)	

34. What other social issues are you faced with in your area?

Lack of transport	
Lack of basic services	
Shortage of electricity	
Other (specify)	

D. AGRICULTURAL PATTERNS AND METHODS

35. Do you grow crops?

Yes	
No	
I used to grow, but now I have stopped	

35.1 If answered "I used to grow, but now I have stopped", to question 35, why did you stop growing crops?

_____

_____

35.2 When did you stop growing crops?

_____

_____

36. If answered yes to question 35, what crops do you grow?

Fruit	
Tomatoes	
Potatoes	
Beans	
Lettuce	
Maize	
Pumpkins	
Spinach	
Cabbage	
Other (specify)	

37. What type of land tenure system do you have?

Owned	
Leased	
Communal land	
Other	

38. Which crops are used for household consumption, and which are sold?

Crops	Household	Sold
Fruit		
Tomatoes		
Potatoes		
Beans		
Lettuce		
Maize		
Pumpkins		
Spinach		
Cabbage		

39. How much yield do you gain per hectare?

40. Do you have a regular buyer and fixed price for your crops?

Yes	
No	

40.1 If answered Yes to Q40, Fill in the table below:

Crops	Buyer	Fixed price
Fruit		
Tomatoes		
Beans		
Lettuce		
Maize		
Pumpkins		
Other (specify)		

40.2 If answered No to Q40, are the crops you grow, used for household consumption?

Yes	
No	

41. Are there any labourers that help in the peak labour periods?

Yes	
No	

42. Do you experience shortage of labour within peak periods?

Yes	
No	

43. Have you noticed any changes in rainfall patterns over the past 10 years?

Yes	
No	

44. Have you noticed any changes in temperature patterns over the past 10 years?

Yes	
No	

44.1 When did you start experiencing these changes?

_____

_____

44.2 Have these changes affected your agricultural production?

_____

_____

44.3 If answered yes to question 44.2, how have these changes affected your crop production?

_____

_____

45. Which seasons do you usually plant crops?

December - February	
March – May	
June – August	
September - November	

46. What is done to the soil before planting crops?

Tilling	
Use of fertilizers or pesticides	
Clearing of soil	
Nothing	
Other	

E. FOOD SECURITY

Food insecurity exists when people do not have access to safe, nutritious and socially acceptable food in order to maintain a healthy lifestyle, or when there is a shortage of food availability, access and distribution.

47. Have you heard of the term "food insecurity"?

Yes	
No	

48. Is there a particular time of the year, when there is a shortage of food within your household?

Yes	
No	

48.1 If answered yes to Q48, when did this occur?

_____

_____

48.2 How long does this period last?

1 week	
1 month	
Other (specify)	

49. Does your household have a different work routine or activities that help you deal with these food shortages?

Yes	
No	

49.1 If answered yes to question 49, what are they?

_____

_____

_____

_____

50. During shortage periods, do you save crops to sell to surrounding communities?

Yes	
No	

50.1 If answered yes to Q50, which crops do you save to sell?

Fruit	
Tomatoes	
Potatoes	
Beans	
Lettuce	
Maize	
Pumpkins	
Spinach	
Cabbage	
Other (specify)	

51. If answered no to Q50, where do you obtain food from during periods of shortage?

_____

_____

52. How far do you have to travel to buy food during times of food shortages?

>1Km	
1Km	
2km	
3km	

53. Has your household ever experienced hunger?

Yes	
No	

53.1 If answered yes to question 53, when, and how long did it last?

54. How does this impact of your everyday life?

55. Socially:

56. Environmentally:

57. Economically:

F. WATER

58. Who in your household fetches water?

Mother	
Father	
Son	
Daughter	

Other (specify)	

59. How many times a day does a person have to fetch water?

Once	
Twice	
Three times	
Four times	
Other (specify)	

60. Is the water source far away?

Yes	
No	

61. How far is the water source?

< 1 km	
1 km	
2 km	
3km	
4km	
5 km	
>5km	

Irrigation

62. Is the land irrigated?

Yes	
No	

63. If yes to Q 58, how much of the land used is irrigated?

_____

_____

64. What type of irrigation system do you use for your crops?

Hose	
Pipes	
Sprinklers	
Other (specify)	

65. What are the sources of irrigation used on the crops?

Rain	
River or stream	
Borehole	
Tank	
Municipality	
Dam	
Other (specify)	

66. During periods of no rain, where do you get your water from?

Rainwater Tanks	
Municipality	
Other (Specify)	

G. SOIL EROSION

67. Is soil erosion a major problem on your farm?

Yes	
No	

67.1 If answered yes to Q63, how does this negatively affect your farming practices and crop production?

---

68. Do you have any soil conservation strategies that are in place to manage the soil erosion problem?

Yes	
No	

68.1 If answered yes to Q64, please list them.

H. WATER SCARCITY

69. Have you ever experienced a shortage of water?

Yes	
No	

70. If answered yes to Q65, when did this occur? (season)

December - February	
March – May	
June – August	
September - November	

71. Has your household ever bought water?

Yes	
No	

72. Has your household received free water during periods of water shortage?

Yes	
No	

72.1 If answered yes to Q68, who did you receive this water from?

Local municipality	
NGO	
Other (specify)	

73. Compare the following situations with what their status was five years ago:

	Worse	Much worse	No change	Better	Much Better	I don't know		
Crop production								
Fuel wood availability								
Soil erosion								
Water availability								
Income situation								
Soil fertility								

I. COPING STRATEGIES AND SUSTAINABLE AGRICULTURAL PRACTICES

74. Do you experience any problems with your crops at the moment?

Yes	
No	

75. If answered yes to Q 74, list the problems that you experience.

_____

_____

76. What coping strategies do you have in place to help you deal with these problems?

_____

_____

77. Where did you learn about these coping strategies from?

School	
NGOs	
Local municipality	
Other (specify)	

78. Do you think these problems you are experiencing, are as a result of climate change?

Yes	
No	

79. What strategies do you think you can implement to mitigate the impacts of climate change on your agricultural production?

_____

_____

80. Are there any organisations or stakeholders that provide you with guidance and coping strategies?

_____

_____

81. What future strategies or measures would you like to see be implemented to assist in continued agricultural production in your community?

_____

_____

APPENDIX 3:
Wildlands Food Garden Programme questionnaire administered in the Richmond community.

82. Did you receive any environmental education before the Wildlands food garden programme?

Yes	
No	

83. Before the Wildlands food gardens programme, were you experiencing any problems with your crops?

Yes	
No	

84. Do you think these problems were as a result of climate change?

Yes	
No	

85. Are you still experiencing problems with your crops?

Yes	
No	

86. Has the Wildlands food gardens programme improved your agricultural production?

Yes	
No	

87. In what way has Wildlands improved your agricultural production?

88. Do you think that the Wildlands food gardens programme has helped you achieve a good food security status?

Yes	
No	

88.1 Explain your answer.

89. How has Wildlands food garden programme improved your livelihoods?

90. In what other ways has the Wildlands food garden programme benefitted you?

91. Now that the Wildlands food garden programme has come to an end, do you still continue with the food garden?

Yes	
No	

91.1 If not, why have you stopped?

_____

92. What future recommendations can you make with regards to the Wildlands food garden programme?

_____

_____

93. What are the strengths of this Wildlands food garden programme?

_____

_____

94. What are the weaknesses of this Wildlands food garden programme?

_____

_____

95. Would you like to receive assistance in future? If so, what assistance would you like to receive?

_____

_____

_____

_____

APPENDIX 4:
Ethical Clearance

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

17 February 2015

Ms Simone Elvina Pillay 210514750
School of Agriculture, Earth and Environmental Sciences
Pietermartizburg Campus

Protocol reference number: HSS/1628/014M
Project title: The impact of climate change on small scale farmers, and their vulnerability to food insecurity. A comparative study of four rural communities in Bulwer, KwaZulu-Natal.

Dear Ms Pillay

Expedited Approval

In response to your application dated 12 December 2014, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol have 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.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

.....
Dr Shenuka Singh (Chair)

/px

cc Supervisor: Dr S Desai
cc Academic Leader Research: Professor O Mutanga
cc School Administrator: Ms M Manjoo

Humanities & Social Sciences Research Ethics Committee
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