AN INVESTIGATION INTO THE ROLE OF IRRIGATED GARDENS IN FILLING THE FOOD GAP IN KAVANGO EAST REGION, NAMIBIA

by

Romanus K. Kawana

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College of Agriculture, Engineering, and Science
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ABSTRACT

Kavango East region is facing insufficient food for most of its community, especially in the rural areas since 2012. This is attributed to climate change which induces, in most cases, drought and floods. The Government of the Republic of Namibia has been assisting climate change affected rural communities by distributing food consignments, to minimize the negative effects. This program is costly to the national budget, and it is done at the expense of other priorities of national development. This study was centred on a livelihood based analysis of the contribution of irrigated gardens in filling food availability gap left by the rain-fed harvest in Kavango East Region, Namibia.

A study was conducted among 200 participants (100 households without gardens and 100 households with gardens) at 20 randomly selected villages and data was collected through the use of Livelihood Analysis framework, Income and Expenditure Pattern, Household Food Insecurity Access Scale Score (HFIAS), and Dietary Diversity Score (DDS). An open-ended and closed-ended questionnaire was used for data collection. The data was analysed using SPSS, while for Household Food Insecurity Access Scale Score (HFIAS), and Dietary Diversity Score (DDS) data were analysed according to the procedures developed by FANTA in SPSS. Households with a garden had more ability to fill the food availability gap left by the rain-fed harvest as compared to the households without gardens. Households with gardens were experiencing an improvement in their dietary diversity through irrigated gardening, as compared to households without an irrigated garden. However, the lack of markets and important inputs discourages the willingness to use the irrigated garden. Despite the challenges, the household with irrigated gardens was benefiting from irrigated gardens. The study recommends that the leadership of the Kavango East Region should promote the establishment of gardens by communities alongside market development, in order to enhance food availability. Therefore, further research could be carried out to investigate produce demand, market size and the role of market availability for irrigated garden produce in enhancing the socio-economic situation of irrigated gardeners in Kavango East Region.

COLLEGE OF AGRICULTURE, ENGINEERING AND SCIENCE DECLARATION 1- PLAGIARISM

I, **Romanus Kavindame Kawana**, declare that:

(i) The research reported in this dissertation, except where otherwise indicated or acknowledged, is my original work;

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As the research supervisor, I agree to submission of this dissertation for examination:

Signed_____ Date _____
Name: Dr M Mudhara

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DEDICATION

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I dedicate this study to my beloved wife, Laimi Kawana; you are the best thing that has happened in my life. To my sons and daughters, nephews and nieces this is for you, I have nothing special to offer to you but my entire youth life dedicated to my studies. Allow me to dedicate this research to Dr. Romanus Kavindame (jr.), this is for you.

I would still like to dedicate this research to my good friend and brother, Hamutenya Kristian Hamutenya, who encouraged and supported me throughout my studies.

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CSI	Coping Strategies Index
DDS	Dietary Diversity Score
FAO	Food and Agriculture Organisation
FVS	Food Variety Score
HFIP	Household Food Insecurity Access Prevalence
HFIAS	Household Food Insecurity Access Score
HH	Household
IGA	Income Generating Activities
IPCC	Intergovernmental Panel on Climate Change
KZN	KwaZulu-Natal
MT	Metric Tone
NGO	Non-governmental Organisations
N$	Namibia Dollars
REP	Rural Enterprise Promotion
SPSS	Statistical Package for Social Scientists
USAID	United States Agency for International Development
USD	United States Dollar
UNDP	United Nations Development Program
WFP	World Food Programme

CHAPTER 1: INTRODUCTION AND STATEMENT OF THE PROBLEM

1.1 Introduction

This chapter introduces the study, it outlines the background of the study, and it also brings forth the statement of the problem and discusses the objective of the study. This chapter also explains the significance of the study, highlights the limitations and the chapter ends with the delimitation of the study.

1.2 Background of the study

There were 852 million chronically hungry people (chronically 90% and acutely 10% undernourished) in the developing countries including Namibia, this number includes 37 million people living in industrialized countries under extreme poverty conditions (Food and Agriculture Organization [FAO], 2013). The FAO has highlighted a rise in the total number of undernourished over the past years which raise doubt regarding the proudly pronounced Millennium Development Goal No: 1 to halve, between 1990 and 2015, the proportion of people who suffer from hunger. This does not include the 2 billion people who suffer from hidden hunger (micronutrient deficiencies), primarily women with anaemia and iron deficiency, as well as 250 million children affected by iodine deficiency, the most common cause for mental retardation, or 250 million children suffering from sub-clinical Vitamin A deficiency, which decreases their capacity to fight disease and can lead to blindness (FAO, 2013).

According to the Government of the Republic of Namibia (2013), the Kavango East region is facing insufficient food for most of its community, especially in the rural areas since 2012. The same report indicates that this is attributed to climate change which induces in most cases drought and flood. The Government of the Republic of Namibia has been assisting climate change affected rural communities by distributing food consignment, to minimize the negative effects. This program is costly to the national budget and is done at the expense of other development priorities.

According to the Government of the Republic of Namibia (2015), food availability in Namibia is mostly affected by climate change. Farmers lack the resources to invest in irrigation or drought-resistant seeds. The lack of alternative income sources keeps the peasants in this risky activity. The lack of rain leads to harvest failure, which may result to food shortages. Some food assistance or

other safety net measures were established, but these are often irregular and inadequate (Government of the Republic of Namibia, 2016). Availability of food means the possibility of feeding oneself and one's family, this can be directly from productive land (agriculture, animal husbandry, horticulture, fruit growing) or other natural resources e.g. fishing, hunting, and food gathering; or from fresh or processed food obtained in markets and stores coming from sites both nearby and far from its production. Mendelsohn (2009), reports that results from the 1994 Income and Expenditure survey shows that only 17% of all Kavango farmers relied entirely on food that they produced themselves under dryland farming. However, low rainfall over the past years has made it very difficult for Kavango farmers to produce enough food.

Although the Government of the Republic of Namibia has been distributing food consignment to the climate change affected rural communities in the Kavango East Region, many communities have been complaining that the food consignment distributed to them is never enough, hence hunger and starvation still prevail (Government of the Republic of Namibia, 2016). Hunger can be defined in the context of energy-protein deficiency and vitamin-mineral deficiency. Lack of access to one or both of these is food insecurity. Food security has four pillars, which are: food availability; access to food; stability of food supply; and food utilization. However, this study only focused on food availability through irrigated gardening. The results of the study will be used to develop a base of knowledge from which regional and local leaders could assess the role of a garden in filling the food gap left by the rain-fed harvest in the Kavango East Region. The study will assist regional leadership to understand the mode of support needed by rural communities in order for their gardens to play a meaning food role in filling the food gap in Kavango East Region and other regions in Namibia.

1.3 Statement of the problem

According to Kawana (2016), rural communities of Kavango East Region have resorted to planting irrigated gardens along the Kavango River due to poor harvest experienced from their rain-fed crops for the past years. Some small villages such as Shighuru have established 101irrigated gardens. However, up to date, there is no scientific study conducted to investigate the role of irrigated gardens in filling the food gap left by the rain-fed harvest.

It is not known yet as to what extent these irrigated gardens contribute to the food gaps of those families in Kavango East Region. Since rain-fed harvests have been falling over the past years in

the Kavango East Region, irrigated gardens along the Kavango River could be used as alternative sources of food for the rural drought-affected communities. According to Mendelsohn and Obeid (2006), Namibia viewed the river as a passing resource to be exploited. Thus, the river is perceived as a source of water for irrigation. A number of lodges and campsites have been developed by private individuals and companies, and some conservancies, but the leadership has paid little attention to encourage rural climate change affected communities to use water in the Kavango River to address food availability.

According to the Government of the Republic of Namibia (2016), harvest prospects for 2015/2016 indicates significantly below average production as drought conditions intensify. The five years' average maize output was 64,300 Metric Tonne, while the year 2016 maize output was 42,700 Metric Tonne, which translates to the percentage reduction in the year 2016 to 34%. While the five years' average pearl millet output was 48,000 Metric Tonne, while the percentage year 2016 maize output was 33,000 Metric Tonne, which translates to the percentage reduction in the year 2016 to 32%. According to the above-stated report, the communal maize harvest is still expected to decrease by 38 percent below the five-year average of 64,300 MT next year 2017. However, Namibia has the capacity to meet its deficit through commercial imports, which makes it difficult for many rural communities to afford. This has influenced rural communities of Kavango East Region to resort to manual irrigated gardens as a strategy to produce food to compliment the inadequate yield from rain-feed (Government of the Republic of Namibia, 2016).

When combining the four pillars of food security, it gives us two which are an ability food production through own production; and accessibility to markets and ability to purchase food items (Bonti-Ankomah, 2001). Self-sufficiency in food production can be improved through gardening. Gardening refers to small scale cultivation of a range of food plants in gardens (van der Veen, 2005). This study focused mainly on food availability which is the first pillar of food security.

These are a number of regular behaviour responses that people apply to manage household food gap. The higher the index, the more food insecure a household is and as it goes lower this is indicative of an improvement in the household food security. There were variances in security.

1.4 Research Objectives

The main objective of this study is to investigate the role of gardens in the attainment of food security in the Kavango East region of Namibia.

The sub-objectives of this study are:

- To investigate factors determining participation in river-bed irrigated gardening

  among the communities of Kavango East Region.

- To determine socio-economic benefits associated with the irrigated gardens among the communities of Kavango East Region.

- To investigate the contributions of irrigated gardens in filling the food availability gaps among the communities of Kavango East Region.

1.5 Significance of the study

The study will contribute to the body of knowledge on the role played by gardens in enhancing food availability among climate change affected rural communities of Kavango East Region. In addition, the study will provide solutions on questions/issues constantly asked by both the academics and policymakers regarding best practices on addressing hunger caused by climate change in the rural areas of Kavango East Region, and can be used as a base to assess basic food availability methods.

1.6 Limitation of the study

Lack of baseline data on statistics of gardens' harvests for the past years in the rural areas of Kavango East Region, at the Regional Level. To overcome this, the researcher, requested data from the Ministry of Agriculture, Water, and Forestry, Head Office. Many community members in the Kavango East Region were unable to express themselves in English, while the questionnaire was structured in English. To overcome this, the researcher used the local vernacular to communicate with the communities.

1.7 Delimitation of the study

Irrigated gardens play a role in the lives of all 14 regions in the Republic of Namibia. It can also influence the socio-economic of the inhabitants of Kavango East Region, which is a prevailing

problem at the moment. The scope of the study, therefore, was that it covers the Kavango East Region. The participants of the study are located along the Kavango River, and they were taken from 20 villages.

1.8 Conclusion

The study looked at the role of manual irrigated gardens in filling the food gaps left by the rain-fed harvest in Kavango East Region of Namibia. The next chapter will unpack the concept of food security situation in the Kavango East Region, the importance of irrigated gardens, understanding food security and food security gauges, the impact of climate change on food availability, determinant factors for participation in river-bed irrigated gardening and it ends by highlighting the challenges faced in operating irrigated gardens in rural areas.

Chapter three focuses on the research methodology that is suitable for this study. This quantitative study made use of the case study design to assess the role of gardens in filling the food gap in the Kavango East Region. The study entailed a detailed and intensive analysis of a single case. The study was a single location (one Region) study. A quantitative method was used to assess the numeric part of the study.

Chapter four will discuss the findings of the study, results are presented and discussed according to the research questions which were as follows:

•What are the factors determining participation in river-bed irrigated gardening among the Communities of Kavango East Region?

• Do irrigated gardens contribute to filling the food availability gaps among the Communities of Kavango East Region?

•Are there socio-economic benefits associated with the irrigated gardens among the communities of the Kavango East Region?

The last chapter concludes on the findings of the study and makes recommendations on the shortcomings that were revealed.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

As stated in chapter 1, this chapter reviewed related literature on the issue concerning the role of irrigated gardens in filling the food gap. The chapter will look at the food security situation in Namibia and Kavango East Region. The chapter uncovers the importance of irrigated gardens, understanding food security and food security gauges, the impact of climate change on food availability, determinant factors for participation in river-bed irrigated gardening and it ends by highlighting the challenges faced in operating irrigated gardens in rural areas.

2.2 Food Security situation in Namibia

Many households in various parts of Namibia were reported to be facing food insecurity associated with the 2015/2016 El Niño effect, which negatively impacted on the livelihoods and quality of lives. The whole agricultural production and water supply are affected by the drought. For the past five years, the total cereal production trend has been declining in the Kavango East Region (Government of the Republic of Namibia, 2016).

2.3 Food Security situation in Kavango East Region

According to the Government of the Republic of Namibia (2016) since the start of the 2015/2016 rainfall season, the country received poor and below normal rainfall performance which was also the case in the previous season. The report further revealed that a significant delay in the onset of the rainfall season, erratic and insufficient rainfall patterns, as well as prolonged dry spells, was observed in the season before the rainfall ended abruptly. The report further said that crop estimates showed a slight improvement on the last season's harvest but were still below the average production. The aggregate coarse grain indicated that the country noted a slight improvement in the harvest of 18% higher than the last season, but 31% below the average production. The slight improvement came as a result of a small increase in the harvest from most of the major crop producing regions, except the Zambezi and Oshana which were the regions most affected by drought during the year. Household food security remained weak in various parts of the country, as the recent agricultural production was too small to provide a significant improvement in the ailing food security.

According to the Government of the Republic of Namibia (2016), in 2010/11, a 5.6 tons harvest was recorded, 2011/12, 4.0 tons, 2012/13, 1.8 tons, 2013/2014, 3.8 tons, 2014/15 was the worse with 1.1 tons while in 2015/16 it was 1.8 tons in Kavango East Region. Although the total planted area trend has not been declining that much for the past 5 years, in 2010/11, 23.1 hectares were planted, 2011/12, 20.6 hectares, 2012/13, 20.6 hectares, 2013/2014, 21.6 hectares, 2014/15 18.4 hectares, while in 2015/16 it was 17.4 hectares. In the Kavango East region, most farmers covered a greater part of their crop fields, but the harvest was still poor since much of the crops wilted because of the drought. This record low of harvests has forced many rural communities to resort to manual irrigated gardens along the Kavango River as an alternative source of food production for their consumption.

2.4 The importance of irrigated gardens

FAO (2010) reported that a well-developed irrigated garden has the potential, when access to land and water is not a major limitation, to supply most of the non-staple foods that a family needs every day of the year, including roots and tubers, vegetables and fruit, legumes, herbs and spices, small animals and fish. Roots and tubers are rich in energy and legumes are important sources of protein, fat, iron and vitamins. Green leafy vegetables and yellow or orange-colored fruit provide essential vitamins and minerals, particularly folate, and vitamins A, E and C. Vegetables and fruit are a vital component of a healthy diet and should be eaten as part of every meal. Meat, chicken, and fish are good sources of protein, fat, and micronutrients, particularly iron and zinc (FAO, 2010).

Hussain and Clay (1999) observed that the maintenance of this form of production, in the long run, is essential for its economic and nutritional merit. Again, the importance of gardens is further affirmed by the fact that in times of emergency, societies have had to return to the use of gardens to improve food security, as, for example, Irish potato gardens during the Great Depression (Hussain & Clay, 1999). Household food availability can be improved by engaging in food gardening like community gardening and irrigated gardening. Food gardening is an age-old tradition that is widely practiced although it is repeatedly undervalued and resisted by generations of public officials. Food gardening can provide a long-term solution to the dietary diversity of less privileged communities (United Nations Development Program [UNDP], 1996). Irrigated gardening is an affordable, sustainable long-term strategy to complement supplementation and

food fortification programmes and nutrition education (Faber *et al*., 2007). Irrigated gardening produces crops for household consumption to improve the quality, diversity and nutrient content of diets (Faber et al., 2007).

The vegetables provide immediately accessible sources of micronutrients as they can be cultivated throughout the year, providing vitamins, trace elements and other bioactive compounds (Chadha & Olouch, 2003). Vegetables are a vital dietary component, not just as a side dish to add flavor to meals, but they release and make available bound micronutrients in some staple crops for effective absorption and utilization (Chadha & Olouch, 2003). Seasonal malnutrition accentuates already existing malnutrition. Gardens can help overcome the seasonal fluctuations in the availability of nutrients by staggering the planting of a mixture of early, average and late-maturing varieties. Garden projects need to be complemented with other interventions such as nutrition education and promotion and other development initiatives and basic hygiene (Sikhakhane, 2007).

Irrigated gardens can create income and improve food availability for the poor, but only if participants are fit enough to farm. The surplus harvest can be sold for income to purchase other foods to supply multiple nutrients (Faber *et al*., 2007). Chadha and Olouch (2003) added that irrigated gardens enable households to direct the savings towards other needs, such as health care, education, and housing. Pain and Pinero (1999) showed that irrigated gardening raises income among those with low income by 50 percent in rural and informal settlements in Southern Philippines. The impact of increased income on household consumption is important in estimating the benefits of increased income on consumption (Hendriks, 2003).

Irrigated gardens empower households to take ultimate responsibility for the nutritional quality of their diets by growing their own nutrient-rich food and making informed consumption choices (Faber *et al*., 2007). Irrigated gardening assists in lifting people out of poverty by improving their health and nutrition (Faber *et al*., 2007). The process of households producing their own food empowers households and makes them self-reliant (Ruel & Levin, 2000). Hartivegsen and A'Bear, (2004), recommend irrigated garden interventions as they are independent of external financial support and, therefore, more sustainable. According to Hartivegsen and A'Bear, (2004), even to the poorest homestead, unutilized marginal land is often the only resource available to the communities. Gardening can turn this land into a productive source of food and even provide economic security. Most irrigated garden systems are organic-based ensuring availability of fresh

pesticides and chemical-free vegetables, mainly because they use a few purchased inputs as they are primarily for household consumption. Therefore, irrigated gardening involves little risk because of the low capital investment in technology and the cultivation of a variety of crops. The variety of crops planted also ensures household access to fresh produce throughout the year and it means that they are able to rely on other crops in the event that one crop fails thereby improving household food security (Hartivegsen and A'Bear, 2004). Harper (2014), emphasises food Production increases in smallholder agriculture as a possible solution to the food insecurity challenges in rural areas. This was based on a study conducted in the rural areas of the Limpopo Province in 2012/13. Hamper, further said that, overall, research has shown that no country can assure food security for its population if rain-fed agriculture is not coupled with significant investments in manual irrigation farming. However, it is worth noting that, advantages of community gardening are usually countered by the constraints such as poor leadership; knowledge and skills; insecure land tenure and poor water supply (Milburn and Vail, 2010).

Access to water for manual irrigation is expected to enable rural households to gain access to more food. In general, access to manual irrigation farming allows poor people to intensify food production. Food production through farming plays an important role in ensuring access to food for poor rural households (Baiphethi & Jacobs, 2009). Benson (2015) stated that irrigation farming increases output per unit area food production, leading to an improvement in food availability and accessibility. In a study in Zimbabwe, Maroyi (2009) found that home gardens produce, supplements staple crops and also serve as a source of income for several families. Home gardens enable year-round production of different products, reducing the risk of product failure.

Marsh (1998) asserted that traditionally, gardeners would feed their families first and then sell, barter or give away surplus garden produce. In certain contexts, however, income generation may become the primary objective of the home garden. In any case, it is counterproductive to impose the nutrition objective to the exclusion of the income generation objective, since in most gardening contexts, they are linked and compatible. Hendriks and Msaki (2006) in a study in KwaZulu-Natal, South Africa found that involvement of smallholders, in agriculture yielded positive effects on food diversity, consumption patterns, and food intakes because an increase in income resulted in an increase in food expenditure. However, they concluded that it cannot be conclusively stated that smallholder commercialization can alleviate hunger or solve malnutrition. Irrigated gardening

serves as a source of fresh, affordable food that helps to improve family nutrition. Furthermore irrigated gardens are a viable tool that links up directly with four of the major cornerstones of community development which are; health, education, training, economic development and job creation (Cothron, 2009).

A number of studies acknowledge the link between irrigated gardens and improved household food security and welfare. Benson (2015) analysed the impact of irrigation gardens on nutritional outcomes for children in Malawian farm households and on the diversity of diets in those households. The analysis involved examining whether irrigation factors were significant determinants of the growth performance of children aged six months to five years (in terms of their height-for-age) and examining the association between irrigated gardens and diversity in the foods consumed. A strong association was found between irrigated gardens and diversity in the foods consumed by farm households. Conclusions were that irrigation is an important component in reducing the effects of seasonality in household dietary diversity although it is only a necessary, but not sufficient, a determinant of improved household nutrition.

Dube and Sigauke (2015) investigated the importance of rural irrigation schemes in addressing community and household food security and ensuring health nutrition uptake by irrigators and surrounding communities for irrigation gardens in Zimbabwe. They computed Body Mass Indices of irrigators and non-irrigators for checking whether food accessibility and availability had a bearing on the nutritional status of individuals. The study concluded that irrigation enables communities to have reliable access to health, safe and nutritious food and also affords farmers additional income through the sale of surplus produce. Irrigators were able to strengthen food security further through asset accumulation.

De Cock *et al*. (2013) investigated the food security status and determinants of food security in the rural areas of the Limpopo Province in South Africa using descriptive statistics and scores. Recommendations were that promotion of rural education could improve food security coupled with the creation of an enabling environment for the rural labor market with sustainable employment opportunities.

Tshuma (2012) reviewed evidence of the role that agriculture plays in addressing poverty and food security issues in South Africa and advocated for increasing agricultural profitability for

smallholder farmers as a way out of poverty. Bacha *et al.* (2011) applied descriptive statistics, the Foster, Greer and Tobeck poverty indices, and Heckman's selectivity model to understand the poverty reduction impact of irrigated gardens development in western Ethiopia in 2006. Results indicated that the incidence, depth, and severity of poverty were significantly lower among farm households with access to irrigation.

Leroy *et al*. (2001) said that quantitatively evaluated the food security position of food crop and cash crop producing rural households. Conclusions were that the development of integrated food access and utilization was important to link farming with non-farming economic activities for improved household food security. The contribution of own food production to the household nutrition of rural and semi-arid settlements was investigated Faber (2007), through estimating the nutrient content of the different foods consumed, with particular emphasis on protein, iron and Vitamins A and C as indicators. The conclusion was that, without irrigated gardens, household food security would be reduced, particularly among the ultra-poor.

Parry *et al*. (2009) indicated that some of the intangible benefits of community gardens include:

- Psychological well-being through positive aesthetic environmental changes; community gardeners gain a sense of pride and accomplishment, which in turn fosters feelings of self-worth and self-confidence.

- Gains from growing food independently are that gardeners are relieved of purchasing vegetables or fruit from commercial sources which creates a sense of self- reliance.

- Opportunities arise for disenfranchised individuals to join community group efforts as an active member and to take on leadership roles to work towards collective goals.

Australian City Farms and Community Gardens Network (ACFCGN) (2002) reported that in East Timor, women from 121 families worked in community gardens and produced mustard, tomato, and eggplant that provided food for household consumption; the excess was sold, consequently increasing purchasing power and effectively addressing household food insecurity. Community gardens in Lesotho established in the 1960s improved the nutrient welfare of the Basotho by providing fresh vegetables to combat chronic malnutrition and diseases like phalera and leprosy

(Mashinini, 2001). Furthermore, these gardens promoted employment, income generation and the empowerment of women and landless households.

A success story behind two community gardens in Western Cape Province, (New Beginning Shelter and Kibbutz El-Shammah), showed that besides providing shelter for the homeless, community gardens produced enough food to sell and surpluses covered running costs for the next vegetable season (Anon, 2006). In the Gambia, women took loans to build new community vegetable gardens to generate incomes; the majority used these incomes to pay for school fees and teaching materials for their children (United Nations [UN], 2006). Community garden participants in Senegal formed Rural Enterprise Promotion (REP) projects, that added value to agricultural products that allowed parents to invest their added income in the education of their children (UN, 2006).

In order for irrigated gardens to contribute positively to household food security and present an opportunity for households to improve their living standards, they should produce to their full potential (Hendriks, 2003). For irrigated gardens to produce to their full potential, they should be managed properly (Crosby *et al*., 2000). Production in an irrigated garden, like all other processes that require management, involves more than just the ability to plant a crop, but also the ability to manage time, work with other people, share ideas and listen to advise and make collective decisions (Giles & Stansfield, 1995). According to Crosby *et al.,* (2000) irrigated gardens provide rural and urban communities with opportunities to improve their standard of living. This opportunity arises only when the irrigated garden members are able to produce more than their family's consumption needs. This means that if the irrigated gardens households are unable to produce surplus vegetables, irrigated gardens would not contribute to improved living standards. However, the contribution would be in the form of healthy eating habits, since fresh vegetables would be available for the families of the community garden members.

Faber *et al.* (2002) found that irrigated gardens have the potential to increase direct access to pro-vitamin A-rich foods for economically deprived households through the growing of yellow and dark green leafy vegetables. A study involving 83 households in Ndunakazi, a rural village of low socio-economic status in KwaZulu-Natal showed that 33% of the respondents indicated that they no longer bought vegetables, 21% associated home gardening programmes with poverty alleviation, while 8% were able to sell some of their home gardens produce for cash (Faber

& Benade, 2002). In Bangladesh, strengthening home garden production systems for planned year-round production increased the availability, consumption, and sale of vegetables and fruit for poor rural households, resulting in improved nutritional status (Khan and Begum, 2006).

Irrigated gardens in San Jose, Costa Rica were found to improve quality of life by beautifying neighbourhoods; stimulating social interaction; producing nutritious fresh vegetables and fruit; encouraging self-reliance; conserving resources; and creating opportunities for recreation and education (Nell *et al*., 2000). In Nepal and Chile, fast-growing vegetables, beans, and other plants are cropped intensively in irrigated gardens with successive planting occurring almost immediately ensuring availability of food for most of the year (FAO, 2004). By consuming vegetables and fruit from irrigated gardens, money spared from non-purchases was available for other uses in the household, like paying for school fees (Nell *et al.,* 2000).

According to the International Food Policy Research Institute (2016), the world is moving toward more comprehensive or systems level thinking as we look at issues of poverty, hunger, and malnutrition and come to a greater understanding of their complexity. The world's food system includes all of the activities and elements: the environment, people, inputs, processes, knowledge, infrastructure, and institutions involved in getting food from farms to consumers' plates. Just as important, it includes the outputs of these activities, such as socioeconomic and environmental outcomes. Due to the fact that the food system reaches into so many areas, it has a large part to play in people's prosperity, food security, and nutrition. Not only does the food system generate the calories and nutrients that people require for good health, but it is also the basis for the livelihoods of millions of the world's poorest people. Creating a world food system that operates for the well-being of people, as well as the planet on which we all depend, is a major challenge. We need a food system that can help us reach a whole range of SDGs by 2030. What would such a food system look like? How close have we come to achieving it? These questions remain unanswered until today.

2.5 Understanding food security and food security gauges

According to Maxwell (1996), food security is understood in terms of the availability and supply of cereals. A more practical definition of food security is: "food security exists when all people, at

all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life" (FAO, 1996).

Kidane et al. (2005) said that food security is defined in different ways by international organizations and researchers. Since the World Food Conference of 1974, definitions of food security have focused on national food security or increase in food supply (FAO, 1996). However, this kind of thinking was narrow and confined to production as the key to meeting food security demands. Sharma (1999)'s point of view stretched more and said that "food secure households are described as having access to income through various sources such as remittances, off-farm employment and other income-generating activities (Sharma, 1999). To ensure access to food security, an adequate amount of food must be within the physical reach of vulnerable households, whether sourced through own production or the market (Carletto & Kocher, 2001).

According to FAO (1996), "Food insecurity exists when people do not have adequate physical, social or economic access to food". Food insecurity is due to the unavailability of food, insufficient purchasing power, inappropriate distribution or inadequate utilization at the household level (Devereux, 2006). Food insecurity is usually categorized as chronic and transitory. "Chronic food insecurity is a long-term or persistent inability to meet minimum food consumption requirements" (World Food Programme, 2009,p. 2). Chronic implies an individual is consistently unable to obtain sufficient quantities of nutrients. As a rule of thumb, food insecurity lasting for at least six months of the year can be considered chronic (World Food Programme [WFP], 2009). “Transitory food insecurity is a short term or temporary inability to meet minimum food consumption requirements, indicating a capacity to recover” (WFP, 2009,p. 2). Transitory is a temporary reduction in insufficient nutrient intake. As a rule of thumb, short periods of food insecurity related to sporadic crises can be considered transitory (WFP, 2009).

It is important to distinguish between chronic and transitory food insecurity as they are likely to require different types of response, in terms of both content and duration (Devereux, 2006). Typically, chronic food insecurity calls for interventions that address underlying and basic causes of food insecurity and that last for several years. Transitory food insecurity may require shorter-term interventions that address immediate and underlying causes, but interventions tackling basic causes of food insecurity may also be important to prevent repeated transitory food insecurity, which may lead to chronic food insecurity (Devereux, 2006).

Measuring food insecurity has been an ongoing challenge to researchers and practitioners (Coates *et al.*, 2007). For years, measures of food security have been incorporated both objective (consumption) and subjective indicators to allow for the evaluation and monitoring of food security and nutrition at national, regional, community, household, and individual levels. The household unit of analysis is crucial as food scarcity is ultimately experienced at the household level. There are three commonly used indicators of household food security – experience in hunger, dietary diversity and coping strategies (Kirkland, 2011). Coping strategies will be discussed in-depth in section 1.2 above. Dietary diversity has traditionally been measured using a simple count of food or food groups consumed over a reference period, typically ranging from 1 to 15 days (Ruel, 2003). Single food counts are referred to as 'food variety score (FVS)', whereas food group count is considered the 'dietary diversity score (DDS)' (Ruel, 2003). Despite the absence of a standardized measurement tool to evaluate dietary diversity across settings, the variety of measures employed have indicated a positive relationship between dietary diversity and nutrient adequacy, both in developed and developing countries (Kirkland, 2011).

Studies have been carried out to investigate the relationship between dietary diversity and household socioeconomic status. Findings indicate that dietary diversity is greater among households with higher socioeconomic status (Hatloy *et al.*, 2000). Experience in hunger is measured using the Household Food Insecurity Access Scale (HFIAS). This tool was an adaptation of the approach used to generate the annual number of food insecure and hungry people in the United States (US). This method is based on the idea that the experience of food insecurity (access) causes predictable reactions and responses that can be captured and quantified through a survey and summarized in a scale (Coates *et al.*, 2007). In studies representing 15 different countries, Coates *et al.* (2007), found that insufficient food quantity, inadequate food quality, and uncertainty and worry about food are universal experiences of food insecurity and that there are recognized similarities in how households across contexts manage food insecurity. Validation studies in Burkina Faso and Bangladesh showed the HFIAS could be applied successfully in different developing country contexts to assess, evaluate, or monitor household food insecurity (Swindale & Bilinsky, 2006).

2.6 The impact of climate change on food availability

Climate change threatens to exacerbate existing threats to food security and livelihoods due to a combination of factors that include the increasing frequency and intensity of climate hazards, diminishing agricultural yields and reduced production in vulnerable regions, rising health and sanitation risks, increasing water scarcity, and intensifying conflicts over scarce resources, which would lead to new humanitarian crises as well as increasing displacement (Intergovernmental Panel on Climate Change [IPCC], 2007). Climate change is expected to affect all of the components that influence food security: availability, access, stability, and utilization.

The overall availability of food is affected by changes in agricultural yields as well as changes in arable land. Changes in food production, together with other factors, could impact food prices, which would affect the ability of poor households to access food markets and could reduce dietary diversity. Extreme weather effects disrupt the stability of food supply as well as people's livelihoods. In extreme weather, such as floods and drought, as a result of climate change, would exacerbate this trend and could have a negative impact on livelihoods that depend on climate-sensitive activities such as rain-fed agriculture and livestock rearing (Schmidhuber & Tubiello, 2007).

2.6.1 The impact of climate change on food availability in Africa and SADC

The challenge of reaching sustainable food security and delivering on it through 2050 is daunting with an awkward starting point, in 2010, a world with unacceptable levels of poverty and deprivation, as is clear from the 2010 report on the Millennium Development Goals (Nelson *et al.*, 2010). Climate change will affect all four dimensions of food security: food availability, food accessibility, food utilisation and food systems stability with direct impact on human health, livelihood assets, food production, and distribution channels, as well as changing purchasing power and market flows (FAO, 2008). Farmers in developing countries are already seeing the effects of climate change daily with erratic weather patterns that directly affect food production (Trobe, 2002). In 1991 and 1992, cereal production in the Southern African Development Community (SADC) region was almost halved as a result of drought, and around 20 million out of 85 million people suffered food shortages (United Nations Environmental Programme [UNEP], 1999) Rural households tend to rely heavily on climate-sensitive resources such as local water

supplies and agricultural land; climate-sensitive activities such as arable farming and livestock husbandry; and natural resources such as fuel-wood and wild herbs. This implies that climate change can reduce the availability of these local natural resources, limiting the options for rural households that depend on natural resources for consumption or trade (Hunter, 2011). Droughts and floods can also directly impact on health, where polluted water may be used for drinking and bathing, and this could spread infectious diseases such as typhoid, cholera, and gastroenteritis (Trobe, 2002).

Presently, there is little awareness about climate change and its impacts, and climate change issues are given a low priority in the face of competing and urgent priorities (Mitchell & Tanner, 2006). Information about the impacts of climate change on important sectors and systems in developing countries such as agriculture, forestry, fisheries, water resources, human health, human settlements, and ecological systems is inadequate for understanding key vulnerabilities and planning appropriate adaptive strategies (Leary & Kulkarni, 2007). Adaptation will include learning about risks, evaluating response options, creating the conditions that enable adaptation, mobilizing resources, implementing adaptations, and revising choices with new learning (Leary *et al.,* 2007). While climate change is seen as a relatively recent phenomenon, individuals and societies are used to adapting to a range of environmental and socio-economic stresses. In many parts of the world, and especially in semi-arid lands, there is an accumulated experience with phenomena such as drought and the flood.

As climate extremes are predicted to increase in frequency and intensity in future, it is important to understand and learn from relevant past adaptations and indigenous knowledge systems (Intergovernmental Panel on Climate Change [IPCC], 2007). However, changes in climate variability and mean values will bring additional complications to many, especially those dependent on food systems that are particularly vulnerable to these additional stresses (Guijit, 2007).

Understanding the specific impacts of climate change on food security is challenging because vulnerabilities are unevenly spread across the world and ultimately depend on the ability of communities and countries to cope with risks. In the context of food security, some regions of the world might experience gains under climate change, but developing countries are likely to be negatively affected. Projections suggest that the number of people at risk of hunger will increase

by 10–20% by 2050 due to climate change, with 65% of this population in Sub-Saharan Africa. The number of malnourished children could increase by up to 21% (24 million children), with the majority being in Africa (Parry *et al.,* 2009).

Meteorological droughts (resulting from insufficient rainfall) are expected to increase in duration, frequency, and intensity (Burke & Kuylenstiema, 2006). Droughts result in agricultural losses and are a major driver of food insecurity. Similarly, drought has been the primary cause of interannual yield variations in some regions of the world (Hlavinka *et al*., 2006). Globally, the areas sown for the major crops (barley, maize, rice, sorghum, soya bean and wheat) have seen an increase in the percentage of area affected by drought since the 1960s, from approximately 5–10% to approximately 12–25% (Li, Ye, Wang & Yan, 2009). This is especially problematic in the context of population growth. For example, in Africa alone, 650 million people are dependent on rain-fed agriculture in the environment that is affected by water scarcity, land degradation, recurrent droughts and floods, and this trend is expected to exacerbate under climate change and population growth (FAO, 2008).

Climate change affects food production in complex ways. Direct impacts include changes in agro-ecological conditions; indirect impacts include changes in economic growth and distribution of incomes, which in turn affect demand for agricultural produce. Empirical evidence suggests that increases in temperature in the period 1980–2008 have already resulted in average global maize and wheat yield reductions of 3.8% and 5.5% respectively, compared to a non-climate scenario (Lobell *et al*., 2011). To date, climate trends have been largely offset by gains derived from technology, carbon dioxide fertilization, and other factors (Lobell *et al.,* 2011). Future changes in climate patterns coupled with population dynamics could result in a higher vulnerability.

2.6.2 Climate change adaptation

The climate change community uses the term adaptation to refer to the process of designing, implementing, monitoring, and evaluating strategies, policies, and measures intended to reduce climate change-related impacts and to take advantage of opportunities (Smit *et al.,* 2007). The IPCC (2001) further adds that adaptation as an adjustment in ecological, social or economic systems in response to observed or expected changes in climatic stimuli and their effects and impacts in order to alleviate adverse impacts of change or take advantage of new opportunities.

This definition acknowledges that adaptation is a continuous sequence of activities, actions, decisions, and attitudes that inform decisions about all aspects of life, and that reflects existing social norms and processes (Chikozho, 2010). Defining adaptation to climate change is complicated because agents adapt to a number of different pressures at the same time, not just to climate change.

Adaptation to climate change risks will need to take place at the individual, family, community, and government levels (Kristie & Semenza, 2008). Adger *et al.,* (2005) argues that individual adaptation actions are not autonomous because they are often constrained by institutional processes such as formal regulatory structures, property rights and social norms associated with rules in use. Elements of effectiveness, efficiency, equity, and legitimacy are important in judging successful adaptation. Research carried out by IFPRI has revealed that one of the most important obstacles to adaptation in Africa is lack of access to credit, information on climate, as well as limited options for adaptation (IFPRI, 2006). Some of the literature on climate change argues that with adaptation, farmers' vulnerability can be significantly reduced (Odekunle *et al.,* 2007). However, the available information on the vulnerability of specific communities to climate change and potential adaptation measures is still insufficient (Chikozho, 2010). Adaptation is widely recognized as a vital component of any policy response to climate change and without adaptation, climate change would be detrimental. However, with adaptation, the vulnerability can be significantly reduced (Gbetibouo, 2008).

People, property, economic activities, and environmental resources have always been at risk from climate and people have continually sought ways of adapting, sometimes successfully and sometimes not. The long history of adapting to variations and extremes of climate with respect to water includes crop diversification, irrigation, construction of water reservoirs and distribution systems, disaster management and insurance (Adger *et al.,* 2007; Abuo-Hadid, 2006). Rural economies, which are based upon and dominated by agricultural, pastoral and forest production, are highly sensitive to climate variations and change including the livelihoods and food security of those who participate directly in these activities, supply inputs to them, or use their outputs to produce other goods and services (Abuo-Hadid, 2006). Due to the effects of climate change, the responses to climate change will depend on the local context, including geographic, demographic, social, economic, infrastructural, and other factors, many adaptation options were more effective

if designed, implemented, and monitored with strong community engagement (Kristie and Semenza, 2008).

Climate change is likely to reduce the length of the growing season as well as force large regions of marginal agriculture out of production and projected reductions in yield in some countries could be as much as 50% by 2020, and crop net revenues could fall by as much as 90% by 2100, with small-scale farmers being the most affected, adversely affecting food security (IFPRI, 2006; Boko *et al.,* 2007). Maddison (2006), argues that when farmers gradually learn about climate change, they will also learn about the best techniques and adaptation options available which may include: (1) learning by doing, (2) learning by copying, and (3) learning from instruction.

Nhemachena and Hassan (2007) concluded that the adaptation strategies farmers perceived as appropriate include crop diversification; using different crop varieties; varying the planting and harvesting dates; increasing the use of irrigation; minimum tillage farming; increasing the use of water and soil conservation techniques, shading and shelter; shortening the length of the growing season; and diversifying from farming to non–farming activities. Farmers may also engage in rainwater harvesting and storage practices to mitigate mid-season dry spells. Maximizing rainfall infiltration and water holding capacities of soils through various systems of soil and water conservation combined with crop residue management, intercropping and cover cropping, may contribute to dry spell mitigation (Chikozho, 2010).

2.7 Determinant factors for participation in river-bed irrigated gardening

If the irrigated gardens are properly managed, the chances of their being sustainable will be good. In order to look at the participation of irrigated gardens, it is important to look at outside influences that affect decision-making within the irrigated gardens. Chikozho (2010) noted that factors affecting the participation of irrigated gardens are the responsible management of land to meet the needs of the irrigated garden households and the landowner, security of tenure for garden households, participation rates and administration of the irrigated garden.

Sustainable irrigated gardens can provide a continuous supply of fresh vegetables, which would form an important part of the diet of the garden members. The diet of people living in rural areas consists predominantly of maize, supplemented with small and irregular quantities of meat and vegetables (Laing, 1996). The main crops planted in irrigated gardens are onions, spinach,

cabbage, and potatoes. Cabbage is the staple vegetable in the diet of most black South Africans, in both the urban and rural populations, mainly because of its high nutritive value and because it keeps without refrigeration (Laing, 1996). For irrigated gardens to be sustainable and able to maintain good production of vegetables, training of members should be provided. According to Heim (1990), training should start with an overview of the activities regarding management and administration.

2.8 Challenges faced by irrigated gardens in rural areas

It is worthy to note that irrigated gardens face many challenges that limit their production and interaction between members. Lack of irrigation equipment undermined the ability of poor households to raise their agricultural incomes and made them even more vulnerable to frequent droughts. Power relations are an impediment to the success of gardens. These relations determine the controls of irrigated gardens (Moyo & Tevera, 2000). There are also illegitimate forms of transferring land or selling of land or expansion of plots which is common in peri-urban gardens.

According to Moyo and Tevera (2000), irrigated gardens in rural areas face management challenges. Most of the participants in irrigated gardens lack gardening skills. Irrigated gardens attracted members who are politically motivated and they tend to influence decision making. According to Moyo and Tevera (2000), there are conflicts between national institutions and local people, for example, national institutions restrict the cultivation of irrigated gardens using national institutions.

Lack of extension service is another challenge. Extension Officers, according to Crosby *et al.* (2000), not only teach people to grow vegetables but help to plan gardens. Successful gardens very often have a committed extension officer who is easily accessible and available, trustworthy and knowledgeable (Crosby *et al.,* 2000). Female Extension Officers advise on matters such as the cooking of vegetables and home economics (Crosby *et al.,* 2000). Extension staff sometimes also provides transport to buy inputs. They act as a link between the garden and the KZNDAEA (Crosby *et al.,* 2000). It has become increasingly evident that extension systems have grown in size and complexity and have ceased to be controlled by the farming community (Scarborough *et al.,* 1997). The personnel of such systems feels more accountable to their employers or professions than to their farmer clientele (Scarborough *et al.,* 1997).

2.9 Summary

Chapter two reviewed related literature on the issue concerning the role of irrigated gardens in filling the food gap. The chapter looked at the food security situation in the Kavango East Region, the importance of irrigated gardens, understanding food security and food security gauges, the impact of climate change on food availability, determinant factors for participation in river-bed irrigated gardening and highlighted the challenges faced by irrigated garden farmers in rural areas. The next chapter presents the research methods applied in the research.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

Chapter 2 looked at the theoretical and conceptual part of this study. Chapter 3 presents the research design and methodology followed during the fieldwork. It maps the research strategy employed to investigate the problem as formulated in Chapter 1 of this study. This chapter briefly outlines the research design based on the case study of life experiences of the grassroots communities in the Kavango East Region in the light of the role of irrigated gardens in filling food availability gap. This means that the research design is informed by empirical exploratory questions addressing real-life problems of the rural communities living along the Kavango River, in the Kavango East Region.

3.2 Research Design

This quantitative study made use of the case study design to assess the role of gardens in filling the food gap in the Kavango East Region. The study entailed a detailed and intensive analysis of a single case. The study was a single location (one Region) study. A quantitative method was used to assess the numeric part of the study. The data were collected in May 2019, which was just a few weeks after the community of Kavango East Region had completed harvesting their rain-fed crops.

3.3 Population

The population of this study consisted of 140 villages in the Kavango East Region.

3.4 Sample

The sample consisted of 20 randomly selected villages out of the 140 villages. Stratified random sampling was done to form two strata, one comprises of households without irrigated gardens while the other one comprises with irrigated gardens. For each village, there were five households of community member without manually irrigated gardens and five households with manually irrigated gardens i.e. 200 households, were selected and from which data were collected.

3.5 Research Instruments

The research made use of the Household Food Insecurity Access Scale (HFIAS) and Diet Diversity Score (DDS) which were developed by Food and Nutrition Technical Assistance (FANTA) (2005), in order to measure the food insecurity prevalence. This allowed the researchers to explore the factors that determine food security in the villages of Kavango East Region. The instrument is a structured questionnaire as a research instrument for data collection.

3.6 Research Procedure

3.6.1 Household interview as a pilot study

Eight households were selected to pilot the study. The researcher conducted household interviews by using a standardized, open-ended and closed-ended questions approach were asked to all participants. Standardized open-ended and closed-ended questions facilitated the discussions, which could be more easily analyzed and compared. Interviews enabled participants to elaborate on their responses they have provided. The purpose of piloting the household interview was to check that each question measures what it is supposed to measure and if the questions on the questionnaires give responses that are consistency. The piloted study participants and respondents were not part of the actual survey of this study.

3.6.2 Household Interviews

The researcher requested approval from Kavango Regional Council, informing Regional Leaders that he was in the region to conduct research. After that, a meeting was held with the village headmen to explain to them about the research and its processes was convened and then make appointments with selected households on different dates and time at the 20 randomly selected villages interviews; participants were asked questions concerning the role of gardens in filling the food gap in the Kavango East Region. The standardized open-ended and closed-ended questions had 16 sub-questions to answer the three research objectives.

3.7 Data analysis

3.7.1 Data analysis from questionnaires

After the households' interviews, the quantitative data were coded, on which the data dictionary was created to explain the meaning of each code. Then the Data was entered, using Statistical Packages for Social Scientist (SPSS). Bivariate and multivariate analysis were used to test associations and relationships. The analysis included both parametric and non-parametric techniques such as correlation, Chi-square Tests, Independent sample T-tests and Kruskal Wallis H-Tests. The parametric techniques such as Chi-square and T-Tests made a number of assumptions about the population from which the sample was drawn, such as normally distributed scores and an interval level scale or continuous data. While, non-parametric techniques like the Kruskal Wallis H-Test, do not have such stringent assumptions, and were more suitable techniques for the categorical data measured at the ordinal (ranked) level (Pallant, 2010).

Multiple regression analyses were conducted to predict relationships. Logistic regression was used for the multiple regression test, as the dependent variable is categorical. Since Logistic regression tests, the predictive power of a set of variables and assesses the relative contribution of each individual variable. The logistic regression model was thus used to determine the variables that determine participation in river-bed irrigated gardening among the communities of Kavango East Region. After this was done then the data were interpreted, in the form of a report.

The ranked food sources were analyzed by running a correlational analysis to determine the significant relationships the choice of rank and the food source, with those having a smaller correlation coefficient ($r < 0.3$), having weaker relationships. While those with higher coefficients ($r > 0.5$) having strong relationships. Moreover, a negative correlation implies that the ranks were at opposite sides. The study then used the frequency mode and median values of the ranks, as well as the percentages of the respondents who ranked them to interpret the results.

3.7.2 Data analysis from HFIAS and DDS

The HFIAS questionnaire used consisted of nine occurrence questions that represent a generally increasing level of severity of food insecurity (access), and nine "frequency-of-occurrence" questions were asked as a follow-up to each occurrence question to determine how often the

condition occurred. The frequency-of-occurrence question was skipped if the respondent reported that the condition described in the corresponding occurrence question was not experienced in the previous four weeks (30 days). Some of the nine occurrence questions inquired about the respondents' perceptions of food vulnerability or stress (e.g., did you worry that your household would not have enough food?) and others ask about the respondents' behavioral responses to insecurity (e.g., did you or any household member have to eat fewer meals in a day because there was not enough food?). The questions addressed the situation of all household members and did not distinguish adults from children or adolescents. All of the occurrence questions asked whether the respondent or other household members either felt a certain way or performed a particular behavior over the previous four weeks.

Percent of households that responded, "yes" to a specific occurrence question in the better or good category. "Percent of households that ran out of food" was the number of households with response = 1 to Q7 divided by total number of households responding to Q7 multiply by 100.

Percent of households that responded "often" to a specific frequency of occurrence question in the middle category. For example: "Percent of households that ran out of food often." was thenumber of households with response = 3 to Q7a divided by total number of households responding to Q7 multiply by 100.

Percent of households that responded "yes" to any of the conditions in a specific domain or worse category. For example: "Percent of households with insufficient food quality" was the number of households with response = 1 to Q2 or 1 to Q3 or 1 to Q4 divided by a total number of households responding to Q2, or Q3 or Q4 multiplied by 100.

Household dietary diversity scores (FDDS) were calculated by summing the number of food groups consumed in the participating household or by the individual respondent over the 24-hour recall period.

The following steps were included in creating either the HDDS:

1. Created new food group variables for those food groups that need to be aggregated. For example, in the HDDS the food group "Starchy staples" is a combination of "Cereals" and "White roots and tubers". A new variable termed "Starchy staples" should be created by combining the

answers to “Cereals” and “White roots and tubers”. This can be done using the following type of logical syntax:

Starchy staples = 1 if q1 (Cereals) =1 or q2 (White roots and tubers) = 1 Starchy staples = 0 if q1 (Cereals) = 0 and q2 (White roots and tubers)=0

As a check, ran a “frequencies” test on all newly created variables and make sure that all values are either 0 or 1. There should be no values > 1 for the newly created variable.

Table 3.1 show the food types/variables and quantity which was consumed by the communities of Kavango East Region during the period of the investigation.

3.7.3 Logistic regression

According to Moran *et al.*, (2012), logistic regression was developed in the early 1950s by David Cox. Many sectors have used the models in trying to predict the probability of occurrence of a certain condition or issue. Logistic regression is the appropriate regression analysis to conduct when the dependent variable is dichotomous (binary) (Moran *et al.*, 2012). The binary logit was used to find the determinants of participating in river-bed irrigated gardens using the number of months a household consumed vegetables it produced as a proxy for food security.

The logistic regression model is specified as follows:

$L_n = \beta_0 + \beta_1 X_1 +$ e

Where Ln = 1 if a household is participating in irrigated garden or 0 if households are not participating in an irrigated garden, e is the error term, $\beta_1 X_1$ are parameter estimates (coefficients) and are independent variables.

Table 3.1 Food types/ variables tested in Kavango East Region

Food Types/Variables	The quantity of food consumed per month	
	HH with Garden	HH without Garden
Millet	50 Kg	50Kg
Potatoes	10Kg	2Kg
Cassava	2 Kg	-
Cabbage	35Kg	15Kg
Onions	5Kg	1Kg
Tomatoes	10 Kg	3Kg
Beef (fresh)	20 Kg	10Kg
Goat (fresh)	10 Kg	4Kg
Chicken	10Kg	2Kg
Eggs	2kg	0.5Kg
Fish (fresh)	10Kg	2Kg
Beans	5Kg	1Kg
Milk	15Kg	1litre
Cooking oil	2 liters	0.75 Litres
Sugar	5 KG	1 Kg

3.8 Research ethics

Permission to conduct the study was sought from the Kavango Regional Council and the Ministry of Agriculture, Water and Forestry. The researcher applied for ethical clearance from the University of KwaZulu-Natal on which it was granted. The researcher ensured that all questionnaires were accompanied by a statement of intent, where the researcher assured the respondents that the information and data collected was to be used solely for the research and the respondents were accorded open access to results once published. Informed consent after the explanation from the respondents was finally sought before the necessary information was collected. During the entire investigation, anonymity and confidentiality was maintained by not

recording any names and not disclosing any information between participants. The data is being stored in a locked cabinet and will be destroyed by shredding and burning after 5 years.

3.9 Summary

This chapter presented the research design and methodology followed during the fieldwork. It mapped the research strategy employed to investigate the problem as formulated in Chapter 1 of this study. The next chapter presents the results of the study and discusses the findings, making comparisons with the literature reviewed.

CHAPTER 4: RESULTS AND DISCUSSIONS

4.1 Introduction

In this chapter, the results are presented and discussed according to the research questions which were as follows:

- What are the factors determining participation in river-bed irrigated gardening among the Communities of Kavango East Region?
- Do irrigated gardens contribute to filling the food availability gaps among the Communities of Kavango East Region?
- Are there socio-economic benefits associated with the irrigated gardens among the communities of the Kavango East Region?

4.2 Household, Socio-economic characteristics

4.2.1 Gender of respondents

The respondents were asked if the head of household was male or female. Gender was assumed vital in making food available to the households in the Kavango East Region. The respondents for households without gardens were mostly female as they were 68 percent compared to 32 percent males, the same also goes for households with gardens where they were mostly females at 72 percent compared to 28 percent males. This is a true reflection of the Government of the Republic of Namibia's Report of 2016; which stated that in all aspects of making food availability, females are the main providers of food in rural areas of the Kavango East Region (Government of the Republic of Namibia, 2016).

The Chi-square test result shows there is no significance of P=0.537. This shows that there is no association between having a garden and gender. This implies that the gender of the heads of households has no influence in a decision to have a garden. In other words, for one to have a garden, one does not have to be of a specific gender; anyone who is willing and able to start a garden is able to do so.

4.2.2 Age categories of respondents

The researcher expected that age would have an impact on decision making regarding food availability. The older generation was the largest numbers because they are the main role players in food availability, with householders above 41 years old for households without garden, were 55%, while households with gardens were 59%, followed by 31-40 years old category, whereby households without a garden contributed 39%, while households with a garden accounted for 33% respectively. The age group of 20-30 recorded the lowest, with households without a garden recording 6% and with a garden recording 8% (See Figure 4.1 below).

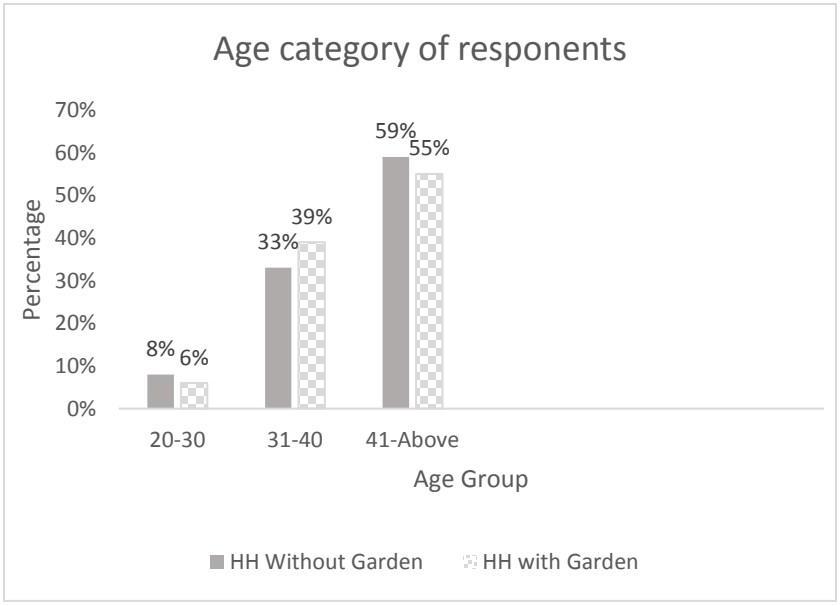

Figure: 4.1 Age category of respondents for households without the garden and with gardens

The Chi-square test result had a significance of P=0.606. This shows that there is no association between having a garden and the age of the household. This means that both young and old participants can have a garden as long as they are willing and are motivated by the need to improve food availability for their household.

4.2.3 Highest qualification attained

The respondents were asked about their highest qualification as this was expected to have an impact on the perception, attitude, views, and decision making on making food available as well as the income status of the households. The assumption was that the higher the level of education,

the more balanced and the objective is their decision making. The study revealed that 42% of the households without gardens had a primary level of education, while households with gardens had 52% with the primary level of education.

There was a high level of people with only primary education meaning that they lacked skills to make them employable in local industries. Secondary education level was low compared to primary education for both households without a garden and those with a garden at 41% and 36% respectively. Tertiary education levels were extremely low contributing 1% of households in all categories. On the other hand, when considering the skill program, this category consisted of people who never attended any formal education but had attended short courses provided by the government. This category (skills program) had 16% for households without a garden and 11% for households with gardens.

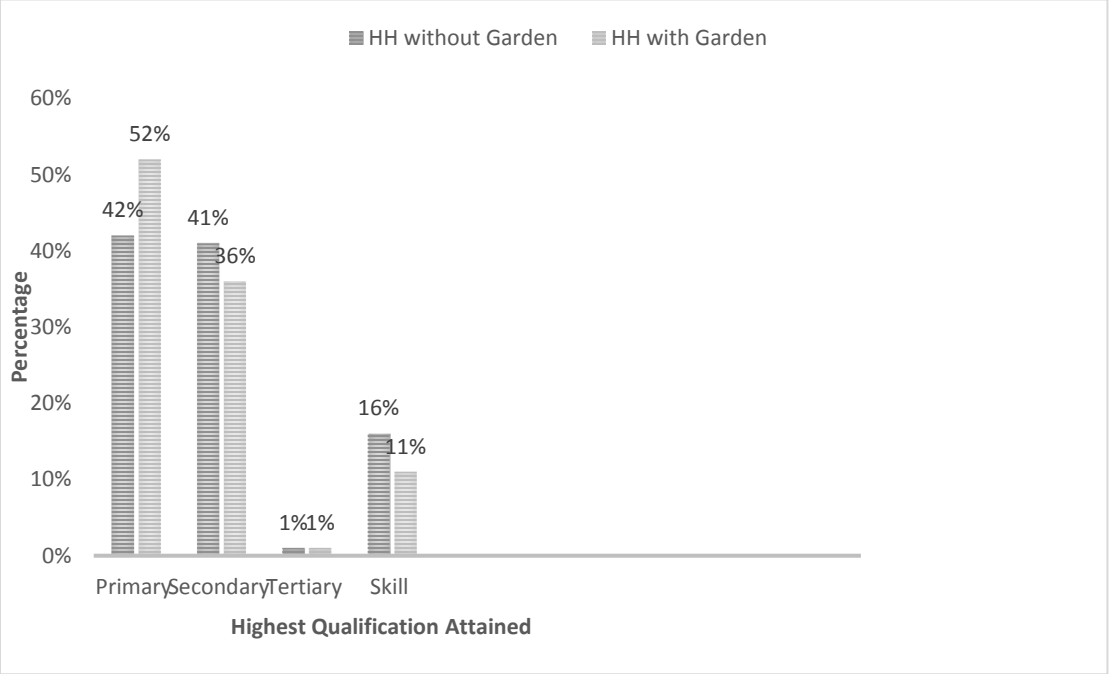

Figure 4.2: Level of academic qualification for heads of households with and without gardens in the Rural Kavango East Region

4.2.4 Composition of Households

The household composition was assumed to be an indicator of how the food is consumed, this was to determine if food availability for the household member was enough or not. The study revealed

that for households without gardens, the category with the highest record was that between eight household members and above, which recorded 66%, followed by the category 7 household members, with 31% and the last category 3, with only 3%. This result shows that the majority of households have a high number of household members in the Kavango East Region and demand more food (refer to Figure 4.2). The study also revealed that, for households with gardens, the highest category between eight household members and above recorded 67%, while the category7 household members contributed 29%, 4% was for the last category which was that for 3. This also confirms that the Kavango East Region's household's composition is dominated by at least eight members and above. This call for more food to be available by the head of the households to their household members (Table 4.1).

Table 4.1: Households size and percentage for households with and without a garden in the Kavango East Region

Households Size / Category	Percentage for households with garden	A percentage for households without a garden
3	4	3
7	29	30
8	67	67
Total	100	100

4.2.5 Employment rate

Respondents were asked to indicate the number of employed people in their households. This question was raised based on the assumption that the number of employed people in a household influence a particular household's ability to make food available, as well as making garden inputs available (FAO, 2003). If a household has a large number of employed people, their ability to purchase food is high, and therefore likely to be more food secure. The study revealed that for households without gardens, under category zero for a number of household members' formal employed had 76%, while 16% of households had only one person employed, and 5% of households had at least two employed members of their households. An additional, 3% had at least

three persons and above employed. For the households with gardens, 65% of households indicated not having a single employed person in their household, 21% of the households had at least one person employed, followed by 10% for households with at least two persons employed, while 4% was for households having at least three and above-employed persons (Table 4.1).

The study also revealed that from all the groups, the level of unemployment in the Kavango East Region was very high especially in the rural areas. This also confirms the recorded symptoms of unemployment which already manifested itself by the manner in which the Kavango East Region is rated with 56% poverty according to the Government of the Republic of Namibia (2013).

Table 4.2 Household Employment level

Number of household members who are formally employed	**Percentage of formally employed household**	
	With garden	Without garden
0	21	76
1	65	16
2	10	5
3 and above	4	3

X^2, P level = 0.032

Findings in Table 4.2 indicated that the Chi-square test result had a significance level of P= 0.032. This shows an association between having a garden and a number of people in formal employment. Households which are not employed may find it difficult to start up a garden due to lack of capital. This is in line with Milburn and Vail, (2010), who stated that it is worth to note that, advantages of community gardening are usually countered by the constraints such as poor leadership; knowledge and skills, start-up capital, insecure land tenure, and poor water supply.

4.2.6 Monthly Income of households in the Kavango East Region

The study used the independent sample t-test to compare the different monthly incomes of the two sample groups, that is, those with gardens and those who do not have gardens. The results are presented in Table 4.3

Table 4.3 Difference in Monthly Income

Income	Group	N$	Mean Difference	P-Value
Monthly Income Formal Employment	Without Gardens [A]	180	1585	0
	With Gardens [B]	1765		
Monthly Income Entrepreneurship	Without Gardens [A]	230	-110	0
	With Gardens [B]	120		
Monthly Income Casual/Part Time Employment	Without Gardens [A]	315	-155	0.271
	With Gardens [B]	160		
Monthly Income Family Remittances	Without Gardens [A]	250	15	0.599
	With Gardens [B]	265		
Monthly Income Social Grant	Without Gardens [A]	675	1155	0.7
	With Gardens [B]	1830		
Monthly Income Irrigated Garden	Without Gardens [A]	100	565	0
	With Gardens [B]	665		
Monthly Income Other -	Without Gardens [A]	100	5	0.045
	With Gardens [B]	105		
Total Average Monthly Income	Without Gardens [A]	1850	2355	0.005
	With Gardens [B]	4910		

Table 4.3 shows that there was a significant statistical difference ($p<0.05$) between the two groups' monthly income for those with formal employment (Mean difference (M.D) of 1.34, $p = 0.001$), in entrepreneurship (M.D = 0.15, $p =0.001$), irrigated garden (M. D=0.56, $p =0.001$) and other income (M. D=0.005, $p = 0.045$). Moreover, the findings show no significant difference ($p>0.05$)

between the two groups' monthly incomes for those in casual/Part time employment (M.D =0.77, p = 0.271), or receiving Family remittances (M.D = 0.31, p =0.599) and those receiving social grants (M.D =0.56, p = 0.700). Overall, the findings in Table 4.3 indicated that there was a significant difference between the monthly incomes of the two groups (M.D = 4.025, p = 0.005) and that these differences emanated from incomes from formal employment, entrepreneurship, having an irrigated garden and other sources. These other sources exclude incomes from casual/Part time employment, family remittances, and social grants. These findings suggest that having an irrigated garden is inferentially comparable to having formal employment or entrepreneurship. Thus, implying that having an irrigated garden can be a source of livelihood at par with formal employment and entrepreneurship. Therefore, irrigated gardens can enhance the food security of the respondents by providing a sustainable monthly income.

4.2.7 Participants' Rankings of their Food Sources

The four main sources of food were ranked by the respondents in the order of 1 to 4, with 1 being the main source and 4 being the least source. The four main sources of food were from purchasing, from irrigation garden, from dry land harvesting and from food aid or donations.

Findings from the respondents in Table 4.4 indicated the respondents' ranks for the individual food source were significantly different with all having significant mean differences at the 95% confidence interval (p-value < 0.05). In addition, the results show that no relationships exist between food from dry land harvest and food purchased (r = 0.131, p = 0.66) or food from irrigated gardens (r = 0.060, p = 0.398). While dryland harvest had a significant negative relationship with Food aid donation (r = =-0.167). The dry land harvest findings indicated the respondents who did not have irrigated gardens and do not purchase food (76%). These respondents would represent subsistence farmers whose primary source of food from dry land harvest and are vulnerable and susceptible to droughts, hence their association with those on food aid or donations (27%).

Table 4.4 Source of Food Ranks

Pair	Source of food	Rank	Count	%	Mean	Std. Dev	Correlation	t-test	Mean Diff.
Pair 1	Purchasing Food aid donation	2 1	124 54	62 27	2.16 0.29	0.64 0.49	-0.289	.000	1.87
Pair 2	Purchasing Irrigated garden	2 2	124 45	62 23	2.16 0.92	0.64 1.06	0.386	.000	1.23
Pair 3	Purchasing Dryland harvest	2 1	12151	62 76	2.16 1.12	0.64 0.62	0.131	.066	1.04
Pair 4	Dryland harvest Food aid donation	1 1	151 54	76 27	1.12 0.29	0.62 0.49	-0.167	.019	0.83
Pair 5	Dryland harvest Irrigated garden	1 2	151 45	76 23	1.12 0.92	0.62 1.06	.060	.398	0.20
Pair 6	Irrigated garden Food aid donation	2 1	45 54	23 27	0.92 0.29	1.06 0.49	-0.516	.000	0.64

Additionally, the findings indicated a strong negative relationship between food from food aid or donation and food from irrigated gardens (r = - 0.516, p =0.001), which implies that for 23% of the respondents' food from irrigated gardens had to substitute the need for Food Aid or donation. While, the positive medium relationship between food from irrigated gardens and food purchased (r = 0.386, p =0.001), would imply that the irrigated gardens provided a sustainable food choice for 23% of the respondent farmers, in the way that was comparable to those whose food source was purchasing (62%). Moreover, those with irrigated gardens can also sell some of the food from their irrigated gardens and purchase other food pieces of stuff.

Lastly, the findings indicated that the more food secure households, whose main source of food is purchased have a negative but weak relationship with Food aid or donations (r = -0.289, p=0.001). Thus, implying that the food secure households (62%) purchased their food, while the food insecure households (27%) relied on Food Aid or donations. As such, having irrigated gardens (23%) is a key food security invention approach to households that primarily depend on dry land harvest food and do not purchase their food (76%).

4.2.8 Dry Land Harvest Consumption patterns

Pallant (2010) notes that non-parametric techniques do not have stringent parametric assumptions, and are thus more suitable techniques for categorical data measured at the ordinal (ranked) level. Therefore, the study used the non-parametric independent samples Mann-Whitney U-test, instead of an independent sample t-test because the continuous or interval scale data for dry land harvest quantity in kilograms was converted to an ordinal scale or categorical data. Therefore, to violating some of the T-test assumptions, the study used a non-parametric test to assess the significant differences in the ordinal dependent variables by a single dichotomous independent variable of the garden grouping. The Mann-Whitney U-test is the appropriate analysis to use for analyzing dryland harvest consumption variables that were on an ordinal scale. Table 4.5 presents the findings.

Table 4.5 Dry Land Harvest Consumption patterns

Variables	p-value	Decision	Mean
The distribution of dry land harvest, what was the harvest (estimated Kg) is the same across categories of with/without gardens	0.625	Retain the null hypothesis	268.25
The distribution of dry land harvest, how long to consume (estimated Month) is the same across categories of with/without gardens.	0.555	Retain the null hypothesis	4.64
The distribution of dry land harvest, how many meals consumed per day (times) is the same across categories of with/without gardens.	0.408	Retain the null hypothesis	1.83

Findings in Table 4.5 indicated that the differences between the two groups of respondents (with gardens and those without) were not statistically significant, in relation to what the dry land harvest was in Kg ($p = 0.632$), how long they consume it in months ($p = 0.555$), or how many meals would be consumed per day ($p = 0.408$). Thus, on average the respondents had a dry land harvest of 268.25 kg that lasts them four and a half months while eating two meals a day. This would imply that the households eat 1 kg of harvested food per meal, which would mean they need 2 – 3 kg per day and between 700 – 1000 kg per year to be food secure eating 2 – 3 meals a day. While the food insecure households would those that do not have enough food to last them a year (less than 700 kg).

4.2.9 Expenditure on food

The study used the non-parametric independent samples Kruskal Wallis H-test, instead of one-way Analysis of variance (ANOVA) in order to avoid violating parametric assumptions. However, the interpretation of the Kruskal Wallis test is used to assess the effect of total income on

expenditure patterns. The Kruskal Wallis was an appropriate technique given that the total monthly income was computed from the respondents' sources of income data. Table 4.6 presents the findings.

The results in Table 4.6 show that four of the six expenditures were the same across categories of the total monthly income when tested at a significant level. The expenses include medical expenses (M= 68.13, p=0.30), transport expenses (M= 88.13, p=0.55), school expenses (M = 117.11, p=0.5) and other expenses (M=0.60, p=0.96). These results suggest that the expenditure patterns for transport, school; medical and other were not influenced by the level of monthly income. While, the expenditure patterns for food (M=582.07, p=0.00) and garden inputs (M=71.65, p=0.00) are affected by the categories of total monthly incomes. The findings suggest that monthly expenditure patterns for food are reliant on how much income is available, as having lower income would make it difficult for the respondents to purchase food. On the other hand, the results also show that having a garden would result in the purchasing of less food since they would be consuming food from the garden. Contrastingly, it also means that they would need to use some of their income for purchasing garden inputs instead of food.

Table 4.6: The Mean of the Effect of Total Income on Respondents' Expenditures between gardeners and non-gardeners

Variables of the effect of total income	Test	Mean	p-value
Amount spent on food for participants across all Monthly Income levels	Kruskal Wallis H- Test	582.07	0.00
The amount of spent on medical for participants across all Total Monthly Income levels	Kruskal Wallis H-Test	68.13	0.30
Amount spent on school is the same across all categories of the Monthly Income.	Kruskal Wallis H-Test	117.11	0.50
Amount spent on transport is the same across all categories of the Monthly Income.	Kruskal Wallis H-Test	88.30	0.55
Amount spent on garden inputs is the same across all categories of the Monthly Income.	Kruskal Wallis H-Test	71.65	0.00
Amount spent on other expenditure is the same across all categories of the Monthly Income.	Kruskal Wallis H-Test	0.60	0.96

4.3 Factors leading to people not to have an irrigated garden

The section describes the factors leading to the respondents not having a garden, as a way to understand the constraints affecting the participation in irrigated gardens. Table 4. 7 presents the findings. The findings indicated different reasons, why the respondents from household without gardens were constrained from participating in the irrigated garden in Kavango East Region. The factors include problem related issues such as limited labour (23.1%), lack of access to land (33.7%), lack of time (5.5%), lack of water (4.5%), poor soil (3.0%), lack of seeds (18.1%), distance garden (5.5%) and other reasons (2.0%), such as it was not their choice of life.

Table 4.7 Reason for not having an irrigated Garden

Reason	Count	Percent
Lack of access to land	67	33.7
Lack of time	11	5.5
Lack of water	9	4.5
Poor Soils	6	3.0
Lack of seeds	36	18.1
Limited Labour	46	23.1
Distant Garden	11	5.5
Other	4	2.0
Total	**190**	**95.4**

4.4 Factors determining participation in river-bed irrigated gardening among the Communities of the Kavango East Region

Pallant (2010) noted that Logistic regression allows one to assess how well a set of predictor variables predicts or explains your categorical dependent variable. The determinants of participating in river-bed irrigated gardens used having an irrigated garden as the binary dependent

variable (DV). The dependent variable was recoded to Yes (1) and No (0) in line with the requirements of logistic regression. The model contained ten independent variables can distinguish between respondents who reported and did not report having a garden. The model as a whole explained between 49.8% (Cox and Snell R square) and 66.8% (Nagelkerke R-squared) of the variance in irrigated garden status, and correctly classified 85.0% of cases. The model had a -2 Log likelihood value of 136.372 indicating how well the model fits the data. With a smaller −2 log likelihood values mean that the model fits the data better, where a perfect model has a −2 log likelihood value of zero. Table 4.8 presents the results.

Table 4.8: Determinants of having a garden

Variable	B	Wald	Sig.	EXP(B)
Household Members	0.050	1.392	0.238	1.051
Food Purchasing	3.690	18.708	***0.000***	40.495
Food from Harvest From Dry Land	2.605	10.309	***0.001***	13.958
Food Aid/Donations	-1.522	7.317	***0.007***	0.221
Time to Consume Dry Land Harvest [Est Months]	-0.010	0.021	0.886	0.990
Formal Employed Household Members	0.388	1.590	0.207	1.474
Monthly Amount Spend N$ Food	0.000	0.024	0.876	1.000
Monthly Amount Spend N$ Other -	0.190	0.000	1.000	1.210
Total Monthly Income	0.042	0.088	0.767	1.042
Dry Land Harvest, Meals Consumed Per Day [Times](1)	-7.139	15.439	***0.000***	0.001
Dry Land Harvest, Meals Consumed Per Day [Times](2)	-6.647	13.263	***0.000***	0.002
Dry Land Harvest, Meals Consumed Per Day [Times](3)	-7.898	15.568	***0.000***	0.000
Constant	-4.148	6.623	0.010	0.014

-2 Log likelihood = 136.372,

Table 4.8 results show the variables in the logit equation and information about the contribution or importance of each of our predictor variables. The logistic regression uses the Wald test statistics for each predictor to determine the variables that had a statistically significant ($p<0.05$) predictive contribution to the model. Table 4.8 shows four significant variables (Food Purchasing, p =000;

Food from Harvest from Dry Land, p = .001; Food Aid/Donations, p =.008). Therefore, the major determinants to whether a person reports having an irrigated garden are sources of food with the Food Purchasing, Food Aid/Donation and Food from Harvest from Dry Land. As well as, the number of meals consumed per day from Dryland harvested food. As more meals would mean that the food stored will finish quicker and less meal may lengthen the time it takes to finish the store of the Dry Land Harvest.

The results show regression beta (B) values. With, the positive or negative B values showing the direction of the relationship or which factors increase the likelihood of a yes answer (having a garden) versus factors which decrease it (do not have a garden). The negative B values indicate that an increase in the independent variable score will result in a decreased probability of the case recording a score of 1 in the dependent variable (indicating those without gardens). Table 4.8 showed a significant variables negative B value included, Food Aid/Donation (–1.508, p = 0.008) and the number of meals consumed per day from Dryland harvested food (-6.49 to -7.686, p = 0.000 to 0.002). The negative B values indicating that the more the farmers rely on food aid/donation or consume more food per day, the less likely, they will report having a garden.

For the two other significant categorical variables (Food Purchasing, Food from Harvest from Dry Land), the B values are positive (3.701, 2.636). This suggests that farmers sourcing their food through purchasing or from the dryland harvest are more likely to answer yes to the question of whether they consider they have a garden. As the surplus garden harvest can be sold for income to purchase other food to supply multiple nutrients. Low-income households in the Kavango East Region, relying on dry land harvested food are more likely to benefit from a garden. This is because gardens will bring both food security and financial security as they may start selling their produce.

Findings in Table 4.8 also shows the results for the exponent of the B values (Exp(B)) and represents the odds ratios (OR) for each of the independent variables. Tabachnick and Fidell (2007), notes that the odds ratio represents ‘the change in odds of being in one of the categories of

the outcome when the value of a predictor increases by one unit' (p. 461). As such, the odds of a farmer answering Yes, they have a garden is 40.495 times higher for those purchasing food for consumption than for a person who does not have a garden, all other factors being equal. Thus, food purchasing is a significant predictor (p=.007), with the odds ratio of 40.495, followed by Food from Harvest from Dry Land (odds ratio=13.985) and Food Aid/Donations (odds ratio = 0.221).

The reason behind this is that household in the Kavango East Region, which are having gardens have food security and diversity, as they are able to sell their vegetables and use the money to buy other food to diversify their dietary intakes resulting in diverse sources of food, from purchasing, dryland harvest and irrigated gardens. Hussain and Clay (1999), agree with this finding, saying that, the maintenance of this form of production, in the long run, is essential for the household's economic and nutritional merit. Again, the importance of gardens is further affirmed by the fact that in times of emergency, societies have had to return to the use of gardens to improve food security, as, for example, Irish potato gardens during the Great Depression. This is also in line with, Faber et al. (2007), who found that irrigated gardens can create income and improve food availability for the poor.

4.5 Household food security status

The results under this section focused on investigating the contributions of irrigated gardens in filling the food availability gaps among the communities of Kavango East Region. Table 4.9 presents the findings.

Table 4.9: Comparison of prevalence of household food insecurity (access) levels in Kavango East Region.

HFIA CATEGORY	HH without Garden (n=100) (%)	HH with Garden (n=100) (%)
Food Secure	1	12
Mildly Food Secure	1	9
Moderately Food Insecure	3	43
Severely food Insecure	95	36
Total	100	100

X^2 , p= 0.001

Table 4.8 revealed that only 1% of households without gardens were Food Secure, while 12% of households with gardens were Food secure, which was quite high compared to 1% of the former. The percentage is attributed to the fact that irrigated gardens really assist the rural community of the Kavango East Region in filling the food availability gaps left by the rain-fed harvest. The one percent for the households without gardens could be attributed to the fact that they sorely depend on rain-fed harvests which have been reducing for the past years due to climate changes resulting in lower levels of rainfall. The study further revealed that only 1% of households without gardens were Mildly Food Secure, while 9% of households with gardens were found to be Mildly Food Secure. For the Moderately Food Insecure category, households without gardens had 3%, while, the households with gardens had 43%. The 43% for households with gardens is attributed to the fact that due to them having gardens, at least they are moderately food insecure if they did not have the gardens this group could also have recorded a low percentage of moderately food insecure.

For the severely food insecure, the study revealed that households without gardens had 95%, while for a household with gardens it was 36%, which is low compared to the rate of the severely food insecure. The rain fed harvest has been falling in recent years, this is in line with a report by the Government of the Republic of Namibia (2016), which states that household food security remained weak in various parts of the country, as the recent agricultural production is too small to

provide significant improvement to the ailing food security. 36% for households with gardens is attributed to the fact that with them having gardens, at least they are less likely to be severely food insecure, if they did not have the gardens, and this group could also have recorded a high percentage. This means that gardens play a very vital role in filling the gap left by the rain fed harvest among the communities of the Kavango East Region. Gardens help villagers fight hunger; it is a solution to fight against the prevalence of hunger in the rural areas.

The Chi square test has an asymptotic significance of P = 0.000 which is less than 0.05 0r 95% confidence interval. The hypothesis is households with gardens are independent of household without gardens. This shows an association between having a garden and food security situations. This association can be attributed to the fact that gardens increase the chances of a diverse diet; they also improve households' income through marketed surplus. This is in line with FAO (2010), which stated that, a well-developed irrigated garden has the potential, when access to land and water is not a major limitation, to supply most of the non-staple foods that a family needs every day of the year, including roots and tubers, vegetables, fruit and legumes. Gardens play a role in filling the food availability gaps left by the rain fed harvest in the Kavango East Region. This is also in line with a research by Milburn and Vail (2010), which showed that no country can assure food security for its population if rain-fed agriculture is not coupled with significant investments in manual irrigation farming.

4.5.1 Consumption frequencies per week

4.5.1.1 Dietary diversity

Household Dietary Diversity Scores were used in this study to show the difference in levels of dietary intake between two different categories of households that is the households with irrigated gardens and households without irrigated gardens. The dietary diversity was high with an average of 8.51 in households with irrigated gardens, while the dietary diversity was low with an average of 3.17 in households without irrigated gardens during the week of the study.

This means that for households to have a better Dietary intake in the rural areas of the Kavango East Region, they need to have irrigated gardens to supplement their Dietary Diversity. This also means that the issue of food insecurity in terms of dietary intake among the communities of the Kavango East Region can be a thing of the past if the communities are motivated and assisted to

have irrigated gardens. This is in line with a study by Faber et al., (2007), which found that, irrigated gardens empower households to take ultimate responsibility for the nutritional quality of their diets by growing their own nutrient-rich food and making informed consumption choices. Rogerson, (2003), also found that, irrigated gardening assists in lifting people out of poverty by improving their health and nutrition.

Table 4.10: Comparison of Food Types consumed in Kavango East Region.

Food Types	**Frequency in percentage**	
	HH with Garden	HH without Garden
Porridge made from millet	100	100
Potatoes and cassava	21	2
Vegetables	97	52
Fruits	99	12
Beef, goat, and chicken,	91	47
Eggs	6	1
Fresh	99	25
Foods made from beans	87	11
milk or other milk products	40	1
Foods made with oil	99	15
Sugar	95	15
Coffee and tea	22	3

Table 4.10 indicates, the food types and the frequency of consumption by the households of Kavango East Region. For households with a garden, had a frequency of less than 50 for coffee and tea, eggs, milk and potatoes, while for households without a garden had porridge made from millet and vegetables with a frequency of more than 50.

Table: 4.11 Monthly Quantity of Food types consumed and Kilocalories' percentage contribution to the to the food needs of Households in Kavango East Region.

Food Types	Quantity of food consumed per month		Kilocalories percentage of food consumed	
	HH with Garden	HH without Garden	HH with Garden	HH without Garden
Millet	50 Kg	50Kg	48.14	48.14
Potatoes	10Kg	2Kg	1.98	0.4
Cassava	2 Kg	-	0.80	-
Cabbage	35Kg	15Kg	4.44	1.90
Onions	5Kg	1Kg	0.63	0.13
Tomatoes	10 Kg	3Kg	0.53	0.15
Beef (fresh)	20 Kg	10Kg	12.43	6.22
Goat (fresh)	10 Kg	4Kg	7.67	1.53
Chicken	10Kg	2Kg	3.67	0.73
Eggs	2kg	0.5Kg	0.83	0.21
Fish (fresh)	10Kg	2Kg	2.51	0.50
Beans	5Kg	1Kg	4.50	0.89
Milk	15Kg	1litre	2.53	0.17
Cooking oil	2 litres	0.75 Litres	4.76	1.78
Sugar	5 KG	1 Kg	5.29	1.05
Total			100.72	63.80

The findings from Table 4.11, reveals that Kilocalories percentage of food consumed in a month by Household without gardens is 63.8%, while the Kilocalories percentage of food consumed in a

month by Households with gardens is 100.7%. This means that the percentage of food availability gap filled by the presence of gardens is 36.9%.

Factors contributing to filling of the above stated food availability gap for the households with gardens is that the consume produce from their garden, the second part is that they sell some of their produce, on which they spend income from their produce sales to access some other food stuffs which they don't normal produce in a required quantities such as beef, goat, chicken, fish, beans, milk, cooking oil and sugar.

4.5.1.2 Disposable income

The results under this section focused on objective 2 of the study, which is to determine socio-economic benefits associated with the irrigated gardens among the communities of the Kavango East Region. Table 4.10 presents the findings.

Table 4.12: Disposable income for households with and without gardens in the Kavango East Region

Variable	with/without gardens	N	Mean	Std. Deviation	t-test
Total monthly income	without gardens [a]	100	1890	2826.87	
	with gardens [b]	100	4602.4	5686.01	0.001
Total monthly income	without gardens [a]	100	3.13	1.79	
	with gardens [b]	100	4.92	2.29	0.005
Disposable Income	without gardens [a]	100	937.03	2789.26	
	with gardens [b]	100	3724.647	5467.79	0.001

Findings from Table 4.10 indicated T-test shows a significance of P=0.001, for total income for HH without garden, which is less than 0.05. The mean of income HH without gardens is 1890.00, while the mean of income for HH with garden is 4602.40. which means that household with garden

has more disposable income as shown on table 4.8, the difference is attributed to the fact the HH with garden derives extra income from the sale of the produce of their irrigated gardens. This indicates that if more households are empowered to have irrigated gardens, their level of income will improve and this will enhance their socio-economic status. This is supported by Prain and Pinierao (1999), whose findings were that irrigated gardening raises income among those with low income by 50 per cent in rural and informal settlements in Southern Philippines.

4.6 Summary

This chapter presented and discussed the results according to the research questions which were as follows: Do irrigated gardens contribute in filling the food availability gaps among the Communities of the Kavango East Region? Are there Socio-economic benefits associated with the irrigated gardens among the communities of Kavango East Region? What are the factors determining participation in river-bed irrigated gardening among the Communities of Kavango East Region? The next chapter presents the conclusions and recommendations and highlights areas for further research.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

As stated in chapter 1, the main purpose of this study was to establish the role of gardens in enhancing food security among climate change affected rural communities of the Kavango East Region. A case study of Kavango East Region yielded empirical data, in particular, the study examined the real situation regarding the role of gardens in the attainment of food security in the Kavango East region of Namibia. Furthermore, the study set off to discover the socio-economic benefits associated with the irrigated gardens among the communities of the Kavango East Region.

In a study conducted by Mendelsohn and Obeid (2006), they found that while the focus of Botswana's use of the Kavango has been on its tourism, Namibia viewed the river as a passing resource to be exploited before it exits at Muhembo. Thus, the river is perceived as a source of water for irrigation and provision of water for domestic and industrial needs in the Central Regions. A number of lodges and campsites have been developed by private individuals and companies. The leadership has paid little attention to the creation of wealth and jobs through the use of water in the Kavango River.

In addition to the Mendelson study, the problem identified by Kawana (2016), is that, the rural communities of the Kavango East Region have resorted to planting gardens along the Kavango River, due to poor harvests experienced from their rain-fed crops for the past few years. Some small villages such as Shighuru have established 101 gardens.

However, up to date, there has been no scientific study conducted to investigate the role of irrigated gardens in filling the food gap left by the shortfalls in the rain-fed harvest. It is not known yet as, to what extend these gardens contribute to the food gaps of those families in the Kavango East Region. Since rain-fed harvests in the Kavango East Region have been falling over the past few years, irrigated gardens along the Kavango river could be used as alternative sources of food for the rural drought-affected communities. In order to examine the role of irrigated gardens in filling the food gap left by the rain-fed harvest in the Kavango East Region as a case study, the research pursued the following objectives:

- To identify the current contribution of irrigated gardens in filling the food availability gaps among the communities of the Kavango East Region. The researcher consulted the grassroots people in the villages of the Kavango East Region for interviews to obtain this information and further information was obtained from government vulnerability assessment reports and the food security status reports.

- To determine socio-economic benefits associated with the irrigated gardens among the communities of the Kavango East Region. The researcher consulted the grassroots people in the villages of the Kavango East Region for interviews to obtain this information, information was obtained from government vulnerability assessment reports and food security status reports.

- To investigate factors determining participation in river-bed irrigated gardening among the communities of the Kavango East Region. The researcher consulted the grassroots people in the villages of the Kavango East Region. Interviews were conducted to obtain this information and further information was obtained from World Archaeology, through literature review.

Many rural households in developing countries are often the victims of poor health due to poor nutrition and hunger. These households often consume staple-based diets, low in nutrients. Such staple-based diets can be rectified through household vegetable production (gardening). Irrigated gardening can directly enhance food availability, accessibility and utilisation of nutritious foods through the provision of a diverse range of fresh food. Irrigated gardening activities can also enhance the socio-economic condition of rural folks by bringing in income for households to buy other types of food which the households do not produce or use the income to create wealth. Irrigated gardening is an age-old tradition that has been passed on from generation to generation and throughout history, gardening has proved to be a reliable source of food for the impoverished.

It could be said that the constructivism approach, which obviously informs some theoretical assumptions for this study, shares an interesting point of commonalities with the conclusions of this study. Therefore, informed by the problem and objectives stated above, and based on the Kavango East Region case study, this study arrived at the conclusions as covered in the next section.

5.2 Conclusions

In contextualising this very important study, introduced in Chapter 1, it was very difficult to identify another study conducted in the Kavango East Region investigating aspects of the role of irrigated gardens in filling the food availability gap left by the rain-fed harvest in the Kavango East Region, as well as the socio-economic benefits associated with the irrigated gardens among the communities of the Kavango East Region.

As indicated in chapter 1, it came to light that there is a problem concerning the role of irrigated gardens in filling the food availability gap left by the rain-fed harvest in Kavango East. There is lack of exploitation of the socio-economic benefits associated with the irrigated gardens, which may contribute to socio-economic development in the Kavango East region. It was found that while the focus of Botswana's use of the Kavango has been on its tourism, Namibia viewed the river as a passing resource to be exploited before it exits at Muhembo. Thus, the river is perceived as a source of water for irrigation and provides water for domestic and industrial needs in the Central Regions. Private individuals and companies have developed a number of lodges and campsites. A single conservancy has also been established in addition to the irrigated gardens whose support for food security is yet to be exploited to the full.

Supported by several reports, the problem identified by Kawana (2016), is that, the rural communities of the Kavango East Region have resorted to planting gardens along the Kavango River, due to poor harvests experienced with the rain-fed crops for the past years. Some small villages such as Shighuru have established 101 gardens. However, up to date, the researcher could find no scientific study conducted to investigate the role of irrigated gardens in filling the food gap left by the rain-fed harvest. It is not known yet as, to what extend these gardens contribute to the food gaps of those families in Kavango East Region.

The results of the study were obtained using Livelihood Analysis, Income and Expenditure Patterns, Household Food Insecurity Access Scale Scores (HFIAS), and Dietary Diversity Scores (DDS). A questionnaire with structured and non-structured questions was used for data collection, which included all the parts stated above. These methods were empowering rather than extractive and they helped the researcher to get a deeper understanding of the participants' perceptions of their household food security situation and the role played by irrigated gardens in filling the food

gaps. A total of 200 household representatives from two groups, namely: Households without gardens and the other group for Households with gardens or at least one homestead gardening project participated in this study.

The questionnaire captured the perceived levels of household food security as per the participants in terms of the Household Food Insecurity Access Scale Score (HFIAS), dietary diversity, proportion of expenditure spent on food, increase in economic opportunities and improvement in resilience to climate change. The data collection process took approximately six hours per village to be completed, with at least 20 households per village; the study took at least 12 days respectively. The researcher's ability to speak the local vernacular made it easy to translate the question from English to the local language.

The results of the study showed that, households with gardens had more ability to fill the food gap left by the rain fed harvest, as compared to the households without gardens. This was due to the fact that irrigated gardens complement the food availability status directly and indirectly, through purchasing other food from the income generated from the sale of the produce from the garden. The results further, showed that households with gardens were experiencing an improvement in their dietary diversity through irrigated gardening, as compared to households without irrigated gardens. This was shown by the quantity of vegetables consumed. Household Dietary Diversity Scores were used in this study to show the difference in levels of Dietary intake between two different categories of Households, that is the Household with irrigated gardens and Households without irrigated gardens. The dietary diversity was high with an average of 8.51 in Households with irrigated gardens while the dietary diversity was low with an average of 3.17 in Households without irrigated gardens during the week of the study. This means that for Households to have a better Dietary intake in the rural areas of the Kavango East Region, they need to have irrigated gardens to supplement their Dietary Diversity. This also means that the issue of food insecurity in terms of dietary intake among the communities of the Kavango East Region can be a thing of the past if the communities are motivated and assisted to have irrigated gardens.

The results also show that while the range of the monthly incomes for formal employment (<N$100 to N$20,000) were the same, those with gardens had a higher mean income (-1.36). Overall, those with gardens (N=100) received higher monthly total income than those without gardens (N=100), as shown from the statistically significant mean differences ($t = 6.24$, $p = 0.00$).

A decrease in the food expenditure was experienced by households with irrigated gardens as compared to households without gardens. This decrease in expenditure was due to an increase in the supply of affordable food through irrigated gardens.

Binary logistic regression was performed using the EFA extracted determinants of participating in river-bed irrigated gardens using the: do you have an irrigated garden variable, as the binary dependent variable (DV). The dependent variable was recoded to Yes (1) and No (0) in line with the requirements of logistic regression (See Appendix for the full results). The model contained nine independent variables from the EFA analysis (see Table 4.1.5). The full model containing all predictors was statistically significant, $\chi 2$, $p = .000$, indicating that the model was able to distinguish between respondents who reported and did not report having a garden. The model as a whole explained between 57.7% (Cox and Snell R square) and 76.9% (Nagelkerke R square) of the variance in irrigated garden status, and correctly classified 86.0% of cases. As shown in Table 4.3, only two of the independent variables made a unique statistically significant contribution to the model (income as the first and second ranking of sources of food under purchasing and dry land harvest).

5.3. Recommendations

Irrigated gardening contributes to filling the food availability gaps left by the rain-fed harvests in the Kavango East Region, in other words it contributes to the food security of the households having gardens. Irrigated gardens compliment the dietary intake of the households, at the same time enhances their income, and reduces expenditure on food, since food is available from the irrigated gardens. However, there is a need for the gardeners operating irrigated gardens to adopt commercial vegetables that they can grow throughout the year and sell for more income. Some traditional pumpkin leaves are good, but, not good enough for commercial purposes, since they are only cultivated seasonally.

The households with irrigated gardens in the Kavango East Region are recommended to decrease their level of reliance on external stakeholders for job opportunities and use their irrigated gardens for self-employment and to enhance socio-economic benefits associated with irrigated gardens. On food security perspectives, leaders of the Kavango East Region, should motivate, and provide leadership and support to the inhabitants of the Kavango East Region to use gardens to fill the food

availability gaps left by the rain-fed harvest, in this way the level of food insecurity in the Kavango East Region would be mitigated.

On a socio-economic part, the leadership of the Kavango East Region should promote irrigated gardening and encourage its community to cultivate irrigated gardens at a larger scale for onward selling of the produce; this would assist them to create wealth. This could be done by the leaders creating markets for the inhabitants to sell their produce at a better price. It is further recommended that the leadership of the Kavango East Region needs to provide basic inputs such as fencing, training, pesticides and fertilizers to mention but a few.

5.4 Recommendations for improvement of study

The methodology could have included a discussion with the Kavango East Leadership as key informants and the Ministry of Agriculture water and forestry. This could have provided more information and an informed opinion on the contribution of irrigated gardens to the households' food availability.

5.5 Recommendations for further study

The study gave a deep understanding of the role irrigated gardens play in filling the food availability gaps among the community of the Kavango East Region. It also looked at the socio-economic contribution of irrigated gardens. Further research could be carried out to look into the role irrigated gardens play in enhancing food market accessibility for households with gardens in the Kavango East Region. There is also a need to conduct a research on the role of leadership in promotion and supporting irrigated gardens to enhance food availability in the Kavango East Region. Finally, a study could be carried out to investigate the role of market availability for irrigated garden produce in enhancing the socio-economic situation of irrigated gardeners in the Kavango East Region.

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APPENDICES

APPENDIX A: Questionnaire

UNIVERSITY OF KWAZULU-NATAL

DISCIPLINE OF FOOD SECURITY

Title: "An Investigation into the Role of irrigated Gardens in Filling the Food Gap in Kavango East Region, Namibia"

Questionnaire no.....

SECTION A: PERSONAL INFORMATION

Please mark (X) the appropriate box

1. DEMOGRAPHIC CHARACTERISTICS

a. Gender of respondents:

Male:……. Female:……

b. Age of household head (years)…….

c. Highest educational attainment of respondents (years of completed schooling).

1: Primary: …… 2: Secondary: …….. 3: Tertiary….. 4: Skills program:……..

d. Number of household members……...

e. Number of formal employed household members.....

2. WHAT ARE THE SOURCES OF YOUR INCOME

Source of income	Monthly income (N$)

1. Formal employment	
2. Entrepreneurship (vending, crafting, sewing etc.)	
3. Casual/Part time employment (skill services)	
4. Family remittances/support	
5. Social grants	
6. Irrigated Gardening	
7. Other (specify)	

3A. CAN YOU RANK THE SOURCES OF YOUR FOOD

Source of food	Rank (1) main-(4) least
1. Purchasing	
2. Harvest from the dry land	
3. irrigated gardening	
4. Food aid/donations	
5. Other (specify)	

3B-1. FOOD GAP ASSESSMENT

For how long do you consume the harvests from the following sources?

	Dry land harvest	Garden produce
What was your harvest? (an estimate Kg)		
How long did you consume it? (estimate in months)		
How many meals did you Consume per day with this harvest?		

3B-2. FOOD GAP ASSESSMENT

Types of food Consumed	Quantity in Kilogram per month	Sources of food

4. **EXPENDITURE PATTERNS**

How much did you spend on the followings during the last month?

Expenditures	Monthly amount (in N$)
Food	
Medical expenses	
School expenses	
Transport expenses	
Garden inputs	
Others (Specify)	

5A. GARDENING AS A SOURCE OF LIVELIHOOD

1. Do you have an irrigated garden?

Yes……..	No……..

If Yes skip to Q 5B.

2. If no, would you have wanted one: Yes/No

If yes, what are the reasons for not having an irrigated garden?

Lack of access to land	
Lack of time	
Lack of water	
Poor soils	
Lack of seeds	

Limited labor	
Distant garden	
Others (Specify)	

5B. ESTABLISHMENT OF IRRIGATED GARDEN AND CHALLENGES FACED

1. How many years have you been engaged in irrigated garden?.....

2. How did acquire the land for your irrigated garden?

Mode of land acquisition	Please tick
Allocated by the traditional authority	
Inherited it	
Leasing it	
Purchased it	

3. What is the size of your irrigated garden? _____

4. What is the distance between your irrigated garden and the river? _____

5. What type of hedge do you have for your irrigated garden?

Type of hedge	Please tick
Modern fencing	

Traditional hedge	
No hedge	

6. What do you produce in your irrigated garden?

a…… d…….

b…….. e……

c…… f……..

7. What is the aim of having this irrigated garden?

1. Consumption	2. Commercial purpose	3. Both

8. Do you sell some of your produce from the irrigated garden?

If yes, where is the main market for your produce?

Locally (Community)	Informal market	Formal market	Other markets (Specify)

9. Did you receive any funding or assistance towards your irrigated garden?

Yes/ No…..

10. If yes, where do you get your funding from?

…….

11. What are some of the challenges facing the irrigated garden?

1: (Lack of inputs)….. 2: (Lack of labour)…. 3: (lack of extension service)…..

4: (Pest and Diseases)….. 5: (Lack of market) 6: (Others)…..

12. What would you do to improve the output and why?

……
……
……
……

13. Will you keep this irrigated garden in the next 5 years? If yes why?

……
……
……

Section B: Household food security Status (HFIAS)

No	Question	Response Question	Code
1	In the past four weeks, did you worry that your household would not have enough food?	0 = No (skip to Q2) 1=Yes	
1 a	How often did this happen?	1 = Rarely (once or twice in the past Four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more	

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

	resources to obtain other types of food?		
4 a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	
5	In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?	0 = No (skip to Q6) 1 = Yes	
5 a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	
6	In the past four weeks, did you or any other household member have to eat fewer meals in a day because there was not enough food?	0 = No (skip to Q7) 1 = Yes	
6 a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times	

		in the past four weeks) 3 = Often (more then ten times in the past four weeks)	
7	In the past four weeks, was there ever no food to eat of any kind in your household because of lack of resources to get food?	0 = No (skip to Q8) 1 = Yes	
7 a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	
8	In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?	0 = No (skip to Q9) 1 = Yes	
8 a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	
9	In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?	0 = No 1 = Yes	

9 a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	

SECTION C: CONSUMPTION FREQUENCIES PER WEEK

QUESTIONS AND FILTERS	CODING CATEGORIES
Now I would like to ask you about the types of foods that you or anyone else in your household ate yesterday during the day and at night. READ THE LIST OF FOODS. PLACE A ONE IN THE BOX IF ANYONE IN THE HOUSEHOLD ATE THE FOOD IN QUESTION; PLACE A ZERO IN THE BOX IF NO ONE IN THE HOUSEHOLD ATE THE FOOD. A. Any [INSERT ANY LOCAL FOODS, E.G. YISIMA], bread, rice noodles, biscuits, or any other foods made from millet, sorghum, maize, rice, wheat, or [INSERT ANY OTHER LOCALLY AVAILABLE GRAIN]?	A ..... |___|

B Any potatoes, yams, manioc, cassava or any other foods made from roots or tubers?	B ..... |___|
C Any vegetables?	C ..... |___|
D Any fruits?	D ..... |___|
E Any beef, pork, lamb, goat, rabbit wild game, chicken, duck, or other birds, liver, kidney, heart, or other organ meats?	E ..... |___|
F Any eggs?	F ..... |___|
G Any fresh or dried fish or shellfish?	G ..... |___|
H Any foods made from beans, peas, lentils, or nuts?	H ..... |___|
I Any cheese, yogurt, milk or other milk products?	I ..... |___|
J Any foods made with oil, fat, or butter?	J ..... |___|
	K ..... |___|

K Any sugar or honey? L Any other foods, such as condiments, coffee, tea?	L ..... |__

Thank you / Matumero / Mpandu unene

APPENDIX B

Dr. Romanus K. KAWANA
P.O. Box 20815
Windhoek

Honorable AMB. Dr. Samuel K. Mbambo
Governor
Kavango East Region
Namibia

RE: PERMISSION TO CONDUCT RESEARCH IN KAVANGO EAST REGION.

The above mentioned subject matter has reference.

Firstly, allow me to thank you, for always being there for the Kavango East Region and Namibia in particular. It is only with leaders of your caliber that, Namibia will also develop to greater levels. I would like to congratulate you Honorable Governor for the Operation Werengendje, indeed it is a brilliant initiative.

Secondly, this note serves to humble request your good office on the above stated matter. I'm currently accomplishing a Master of Agricultural Economics with the University of Kwazulu Natal, in South Africa. However, as you may be aware, that at this level a thesis (Research) is a prerequisite for this program.

Due to my interest in the well-being of the Namibian people and Kavango East in particular, it has necessitated me to carry out a research within the great Kavango East Region once again. Please Honorable Governor take note that this research is designed for academic purpose only and the data to be collected will be used as such. The topic of this research is AN INVESTIGATION INTO THE ROLE OF IRRIGATED GARDENS IN FILLING THE FOOD GAP IN KAVANGO EAST REGION. The research will cover 20 randomly selected villages within the Kavango East Region. At each village two strata's will be interviewed as follows: 5 community members with irrigated gardens and 5 community members without irrigated gardens.

The research is expected to be conducted between 20 August 2017 to 30 October 2017. For any enquiries from the University's side please do not hesitate to contact Dr. Maxwell Mudhara at +2733 260 6275 or Mudhara@ukzn.ac.na.

Your considerations in this matter will be appreciated.

Thanking you in advance.

Dr. R. K. Kawana
Student Number: 216077017
Cell: 081 2353 922

07.08.2017
Date

APPENDIX C

REPUBLIC OF NAMIBIA
OFFICE OF THE REGIONAL GOVERNOR
KAVANGO EAST REGION

Tel 066-267243
Fax 066-255 036
Enq Immy Garosab (Personal Assistant)
immanuelg3@gmail.com

Private Bag 2124
Rundu
Namibia

15 September 2017

TO WHOM IT MAY CONCERN

The Office of the Governor hereby grant permission to Dr. R.K. Kawana, Student Number: 216077017, to carry out a research within Kavango East Region, to accomplish a Master of Agriculture Economics with the University of Kwazulu Natal, in South Africa.

The topic of the said research is" **AN INVESTIGATION INTO THE ROLE OF IRRIGATED GARDENS IN FILLING THE FOOD CAP IN KAVANGO EAST REGION".**

Please, accept the assurances of my Office's highest consideration.

Amb Dr. Samuel Kaveto Mbambo
Governor

KAVANGO EAST REGION
OFFICE OF THE GOVERNOR
15 SEP 2017
P/BAG 2124, RUNDU

APPENDIX D

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

1 November 2017

Dr Romanus Kavindame Kawana 216077017
School of Agricultural, Earth and Environmental Sciences
Pietermaritzburg Campus

Dear Dr Kawana

Protocol reference number: HSS/1513/017M
Project title: An investigation into the role of irrigated Gardens in Filling the Food Gap in Kavango East Region, Namibia

Full Approval – Expedited Application

In response to your application received on 23 August 2017, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and **FULL APPROVAL** for the protocol has been granted.

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 Shamila Naidoo (Deputy Chair)
Humanities & Social Sciences Research Ethics Committee

/pm

cc Supervisor: Dr Maxwell Mudhara & Dr Joyce Chitja
cc. Academic Leader Research: Professor Onisimo Mutanga
cc. School Administrator: Ms Marsha Manjoo

Humanities & Social Sciences Research Ethics Committee
Dr Shenuka Singh (Chair)
Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
Telephone: +27 (0) 31 260 3587/8350/4557 **Facsimile:** +27 (0) 31 260 4609 **Email:** ximbap@ukzn.ac.za / snymanm@ukzn.ac.za / mohunp@ukzn.ac.za
Website: www.ukzn.ac.za

APPENDIXE

Dr.GM

The Rev. Dr. Greenfield Mwakipesile
ThD, MBA, BSS | mwakipg@outlook.com

CONTACT

PO Box 40529,
Ausspannplatz,
Windhoek,
Namibia

LANGUAGE & COPY-EDITING CERTIFICATE

1st June 2018

RE: LANGUAGE, COPYEDITING AND PROOFREADING OF ROMANUS KAVINDAME KAWANA's THESIS FOR THE MASTER OF AGRICULTURE (FOOD SECURITY) OF THE UNIVERSITY OF KWAZULU-NATAL, PIETERMARITZBURG, SOUTH AFRICA

This certificate serves to confirm that I copyedited and proofread **ROMANUS KAVINDAME KAWANA's** Thesis for the degree of **MASTER OF AGRICULTURE (FOOD SECURITY)** entitled: **AN INVESTIGATION INTO THE ROLE OF IRRIGATED GARDENS IN FILLING THE FOOD GAP IN THE KAVANGO EAST REGION, NAMIBIA**

I declare that I professionally copyedited and proofread the thesis and removed mistakes and errors in spelling, grammar, and punctuation. In some cases, I improved sentence construction without changing the content provided by the student. I also removed some typographical errors from the thesis and formatted the thesis so that it complies with the University of KwaZulu-Natal's guidelines.

I am a trained language and copy editor and have edited many Postgraduate Diploma, Masters' Thesis, Dissertations and Doctoral Dissertations for students studying with universities in Namibia, Zimbabwe, Swaziland, South Africa and abroad. I have also copy-edited company documents for companies in the region and abroad.

Please feel free to contact me should the need arise.

Yours Sincerely,

The Rev. Dr. Greenfield Mwakipesile

greenfield.mwakipesile @mwakipg +264813501701 Dr. Greenfield Mwakipesile