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**IMPACT OF IN-FIELD RAINWATER HARVESTING TECHNOLOGY ON
HOUSEHOLD FOOD SECURITY: A CASE OF GUQUKA AND KHAYALETHU
VILLAGES IN CENTRAL EASTERN CAPE PROVINCE**

BY

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Declaration

I, Yoliswa Happiness Hlanganise hereby declare that the work contained in this study is my own original work, and has not previously in its entirety or in part been submitted at any University for a degree.

.....
Y.H. HLANGANISE

Date: 12 – 04 - 2010

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I would also like to extend my sincere gratitude to my parents, siblings, my husband and my children for their understanding, moral support and endless prayers.

I believe that every endeavour taken for the success of this study fell according to the plan of the Almighty God, my Lord and my Saviour. Whom I strongly believe nursed my relationship with my supervisor, protected my entire family from uncertainties, took care of my finances and most of all shielded me from falling sick and gave me the courage to endure till this day and time. He is indeed worthy to be praised.

Dedication

I specially dedicate this paper to my parents Thandeka and Mongezi Hlanganise. I thank them for their moral support and their vote of confidence on me.

Abstract

The aim of this investigation was to assess the impact of the In-Field Rainwater Harvesting technology on household food security in the study area. The study was conducted in Nkonkobe Local Municipality of the Amathole District Municipality in central Eastern Cape Province. The areas under investigation are Guquka and Khayaletu villages of the Thyume Valley, which is located about 30 kilometres north of Alice. The method used to assess the impact of the IRWH on household food security was a pair wise comparison method. During September 2009, there were 60 (34 in Guquka and 26 in Khayaletu) households who adopted the technology in home gardens. In order to get a clear picture of the impact of the technology on food security, a decision was taken to assess both the project members and non-project members, hence the pairwise comparison method. The non-project members (also 60 households) were selected randomly from those who were interviewed during the situation analysis in 2004.

Five indicators were used to assess household food security. These were household income, expenditure on food, diet diversity, energy-protein intakes, and micro-nutrient intakes (Vitamin A, C and Iron). The income and expenditure data were collected from the 120 households. However, the detailed food data were collected from selected cases from both groups at different times (seasons) of the year. A case study approach was employed in data collection. A total of 12 cases (six households per village) were selected for this investigation. These were selected mainly according to the degree of poverty. The total of six households from each village comprised three project members and three non-members i.e. one from each poverty class (non-poor, poor and ultra-poor) in both categories. The data on the kinds of food products consumed by households was gathered using the food account method (FAM). The food consumed was then analysed for nutrient adequacy.

The main findings of this investigation show the IRWH technology to have a positive impact on food security and nutrition of the project members. The technology made significant contributions to the amount of energy and vitamins A and C consumed by households especially during wet seasons. Substantial contributions of garden produce were noted among the project members. However, these contributions were not enough to ensure household food security. The results indicate that there are nutritional problems in the study area. Firstly, there is protein-

energy malnutrition mainly affecting the poor and the ultra-poor households. Secondly, there is hidden hunger affecting all poverty categories, even the non-poor households. This is mainly demonstrated by poor diet quality i.e. diet that lacks essential nutrients identified.

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List of acronyms

IRWH	- IN-FIELD RAINWATER HARVESTING
UFH	- University of Fort Hare
FAM	- Food Account Method
UN	- United Nations
NDA	- National Department of Agriculture
FAO	- Food and Agriculture Organisation
ARC	- Agricultural Research Council
WRC	- Water Research Commission
SPII	- Studies in Poverty and Inequality Institute
RDP	- Reconstruction and Development Programme
DoA	- Department of Agriculture
NFSMS	- National Food Security Management System
FIVIMS	- Food Security and Vulnerability Information Mapping System
IFSNP	- Integrated Food Security and Nutrition Programme
ANC	- African National Congress
WHO	- World Health Organisation
RWHC	- Rainwater Harvesting and Conservation
RDA	- Recommended Daily Allowance
PL	- Poverty Line
CPI	- Consumer Price Index

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CHAPTER 1: INTRODUCTION

1.1. Background

Food security is a universal concern. According to Obi (2004), the burden of food insecurity falls on those already at the margin. For developing countries current high food prices mean that the poorest people have to spend a larger proportion of their income on food (Annan, 2008). This may mean they will buy less food, or food that is less nutritious, or they may have to rely on outside help to fulfill their nutritional needs. Since 1948, the United Nations (UN, 2005) has identified access to adequate food as both an individual right and a collective responsibility. Supporting this, Dickson (1999), wrote that, everyone on the planet has the right to food. He also confirms that, this right is the most fundamental and enabling human right of all. According to the South African Constitution Section 27 of (1996), it is stated that every South African citizen amongst other rights, has a right to sufficient and nutritious food and safe water (NDA, 2009). It is through the accessibility of food that human beings and all living organisms live function and thrive. The right to food therefore, can be seen as a birth right for everyone living around the globe.

Multitudes of people are suffering from malnutrition, hunger and starvation throughout the world (Monde, *et al*, 2005). Poverty and food insecurity is mostly evident in the African countries. South Africa is no exception to that. The challenge is accentuated by the fact that, the population is growing and the resources, especially land and water are declining (De Klerk, *et al* 2004). Faced with global warming, agriculture which is the sole provider of food security is challenged and the vulnerability of the nation to food insecurity is increased. According to Uzma and Muhammad (2004), the world has been facing a paradox of widespread food insecurity and malnutrition amid net food surpluses. Increased food supplies do not automatically enhance access to food by the poorer groups of society, which means that adequate food availability at the national level do not automatically translate into food security at the individual and household levels (Uzma and Muhammad, 2004). It is therefore of fundamental importance to note that, food security should be met at household level first, then at national and global levels.

Food security has been defined by a number of scholars throughout the years. Household food security has been defined as ‘access by all people at all times to enough food for an active, healthy and productive life’ (World Bank, 1986; Maxwell and Smith, 1992 and Hoddinott, 1999). FAO (1996) adds that, “Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life”. FAO’s (1996) contribution to the World Bank’s definition is that, food security does not only include the readily availability of enough food, but also nutritionally adequate and safe foods, and an assured ability to acquire acceptable foods in socially acceptable ways. According to Kapungwe (2005), access to food in socially acceptable ways, means to obtain it from own production, purchase, gifts or exchanges. Smith *et al* (2006), therefore comes to this conclusion: “ food security at household level is achieved when all people at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life”.

Sen (1981) described poverty as a situation whereby people lack resources, or even the buying power to purchase their basic necessities which mostly include food for household consumption. He further developed an entitlement approach, which suggests that food security, flows from possessions which in turn come from endowment. Borton and Shoham (1991) agree and note that quite a number of studies have shown that food insecurity occurred in situations where food was available but inaccessible due to the erosion of their entitlement to food. In clarifying this, van Zyl and Kirsten (1992) confirmed that food insecurity and poverty are closely related. Van Zyl and Kirsten (1992) go on and argue that food insecurity in fact is the result of poverty.

It can then be concluded that food insecurity is the exact opposite of food security. In simple terms food insecurity is limited or uncertain availability of nutritionally adequate and safe food or limited or uncertain ability to acquire food in socially acceptable ways. It leads to hunger, which is defined as an uneasy or painful sensation caused by a lack of food or is a recurrent and involuntary lack of access to food (FAO, 1996; NDA, 2005).

1.2 Problem statement

South Africa is classified as an upper middle-income country with high levels of poverty and unemployment (May, 1998). Its income distribution is one of the most skewed when compared to the income distribution of other countries (Naledi, 2006). It has a population of 46 million people, of which 48.5% of the population were living in poverty in 2002 according to the national poverty line of R354 per month per adult equivalent (1995 value) (Naledi, 2006). Twenty five percent of the population can be categorised as ultra-poor. South Africa is self sufficient in food production, but 14 million people are said to be vulnerable to food insecurity and 43 percent of households suffer from food insecurity and poverty (National Treasury, 2003). De Klerk *et al*, (2004) estimated about 35% of the South African population who might be vulnerable to household food insecurity. Faber and Wenhold (2007) noted that substantial numbers of children in South Africa suffered from malnutrition due to inadequate dietary intake (Faber and Wenhold, 2007). A food insecure household is unable to supply all the daily nutrients required by their children. According to NDA (2007), food insecurity and malnutrition in South Africa are the highest in provinces with large rural populations. The Eastern Cape Province where this study was conducted is one of those Provinces.

According to Monde *et al*, (1997), about 80% of the households in the study area earned incomes that were below the poverty line. Fraser *et al* (2003) reported high degree of poverty and food insecurity in the study area. Buying food from the urban markets was an important food security strategy for these people. Own production of food was not important in terms of securing household food needs, especially during drier seasons (Fraser *et al*, 2003). People rely on state grants for a means of living, which contribute more than 90% to household income (van Averbek, *et al*, 1998).

Nevertheless, a number of attempts are being made to mitigate the food insecurity and poverty in South Africa. One of the continuing aims of the South African government is to ensure that all South Africans have enough to eat (NDA, 2007). The South African government attempts to create employment opportunities through food security programmes and interventions. Another effort is being made to reach a wider population through social grants. The majority of

households in Eastern Cape Province rely on these grants for survival (Monde, 2003). Another attempt is to improve access to water, a resource that has been identified as the most important to achieve food security at household level.

One of the main reasons for the insignificant contributions of farming to the lives of rural people is limited access to irrigation water (Lipton and Ellis, 1996). Improving people's access to water is seen by many as the potential solution. However, people have difficulty in practicing farming due to lack of irrigation water. South Africa is a drought prone and water poor region (Niewoudt *et al* (2004). It is predominantly an arid region with an average annual rainfall of 497mm, which is far below the world's average of 860mm (Gakpo *et al*, 2005). Niewoudt *et al*, (2004) further state that this rain is unevenly distributed across the country. In the light of this limitation, a number of water harvesting technologies have been developed and introduced in rural areas. The main aim is to encourage rural households to harvest rain water during rainy season. The Agricultural Research Council (ARC) developed a rainwater harvesting technology that could be used by resource-poor farmers in an attempt to improve agricultural production and food security (Botha *et al*, 2003). This technique, which is called the In-field Rain Water Harvesting (IRWH) technology, was introduced in 2004 in the villages of Guquka and Khayaletu of the Nkonkobe Local Municipality in Eastern Cape Province.

The water harvesting project is a collaborative effort between the ARC and the University of Fort Hare (UFH). The project received funding from the Water Research Commission (WRC). The IRWH technology introduced in the study area is practiced in home gardens. The basic structure of the *IRWH* system comprises a 2-metre runoff strip along the slope of the field (catchment area) and 1-metre basin (storage) area across the slope of field and at the end of the runoff strip. In this way, runoff is directed and stored into the basin area. The basic structure of the *IRWH* system can be altered by the use of different mulches in the basin and runoff area to give six different *IRWH* technique variants. The mulch can be organic (crop residue or grass) or inorganic (stones) and is applied either in the basins or the runoff surface. Households are also encouraged to harvest water from the roofs to rainwater tanks. While this water is mainly used for domestic purposes (drinking, cooking and washing), some of it is also used to irrigate the gardens during times of water scarcity.

The main objective of the Infield Rain Water Harvesting (IRWH) project was to address the challenges of poverty and food insecurity in the study area. The objective of this research therefore was to demonstrate the level at which this objective has been met by the project. It reveals the impact (positive and negative) the project has had on food security at household level in the study area.

1.3 Purpose and objectives of the Study

The main objective of this study was to determine the impact of the water harvesting project on household food security in the study area (Guquka and Khayaletu households).

1.4 Specific objectives

The specific objectives were to:

- Investigate income and expenditure patterns of project and non-project members
- Investigate the kinds and amounts of products consumed by both project members and non-members as well as the sources where these products were obtained
- Determine the impact of IRWH on food and nutrition security of households

1.5 Research questions:

The research questions of the study were as follows:

- What are the income and expenditure patterns of the sampled households?
- Which products are consumed by households in the study area and what are their sources?
- What is the impact of IRWH on household food security?

1.6 Hypothesis/ Thesis statement

This study's premise is that, the Infield Rain Water Harvesting has a positive impact on food security and nutritional status of households in the study area.

1.7 Justification

Food security measurement, serves as a guiding principle for designing government interventions in rural areas (NDA, 2007). It helps identify the food insecure, assess the severity of their situation and to characterise the nature of their insecurity (Hoddinott, 1999). The purpose of this study therefore, is to contribute to the understanding of food security realities at household level in the rural areas of the Eastern Cape Province. This might contribute to the formulation of policy aimed at improving food security in the rural areas of the Eastern Cape Province. Food security is an essential, universal dimension of household and personal well-being. According to NDA (2005), monitoring food security can help to identify and understand the basic aspect of well-being of the population and to identify population subgroups or regions with unusually severe conditions. This can help policy makers, service providers and the public at large to evaluate the general populations' changing needs for assistance.

1.8 Report orientation

This report is organised as follows: Chapter two is a literature review, which explains the concept of household food security and nutrition in terms of definitions and its measurements and how household food security relates to poverty. Chapter three is a review of water harvesting techniques. The in-field rainwater harvesting technology is also explained in detail in this chapter. Chapter four provides an overview of the sites and the methods used to collect data. In describing the sites, the biophysical characteristics as well as the economic activities of the study area are briefly explained. Chapter five summarises findings from the household survey that was conducted in the two villages, emphasising the impact of the technology on household food security. The summary, conclusions and policy recommendations are presented in Chapter six.

CHAPTER TWO: POVERTY, HOUSEHOLD FOOD SECURITY AND HUMAN NUTRITION

2.1 Introduction

This chapter deals with the concepts of poverty, food security and human nutrition. It provides theoretical definitions of these concepts as well as their measurements. It also sets out some of the alternative ways in which poverty can be conceptualised and how it can be related to food insecurity and malnutrition. The discussion about food security begins with a section on theoretical definitions of household food security, which is followed by the categorization of households into food security status. The main aim of this section is to explain the degrees of food security at household level. A brief explanation of the methods used to assess food security at household level is also entailed in this chapter. The South African government interventions to alleviate poverty and food insecurity are also discussed. The relationship between food security and human nutrition is also discussed in this chapter.

2.2 Poverty

2.2.1 The experts' point of view

In South Africa poverty is one of the major causes of food insecurity (van Zyl and Kirsten, 1992; Monde, 2003). Sen (1981) defines poverty as a situation whereby the poor live below the poverty line. According to Magasela (2005) poverty in South Africa dates back in the 1940's, where a poverty datum line was developed. It had both the primary and the secondary sides of it. The primary poverty datum line measured an extremely limited basket of goods, which included the cost of food, clothing, cleansing material and fuel. The secondary poverty datum line on the other hand, made provision for accommodation, tax and transport. These have both been seen as the narrow notions of defining poverty (SPII, 2007). According to World Bank (1986) cited by Monde (2003), most of the studies used single measures, which are either land holding or per capita annual income. World Bank (2000) measured poverty using its one dollar/person/day

poverty line, since its development in 1990 to measure poverty in developing countries. This definition has been accepted for the Millennium Development Goals (2007). However, it has been challenged by a number of scholars, who argue that this definition is narrow and it suggests that the needs of the poor countries are less than those of the rich countries (Townsend, 1990; Townsend and Gordon, 2002 and Townsend 2006). Meth (2006) stated that, poverty should also be viewed in a political perspective. He argues that, this is because poverty reflects the impact of past and present policy choices.

2.2.2 The poor's perspective view of poverty

Poverty definition should be the mirror image of the society's principles (SPII, 2007). This is because its characteristics differ between and within countries and regions and as well as between different social groups. There are often differences between members of the same household. Hence it's often linked with inequality. This then brings about the question of, who should define poverty. It has been said in a number of studies that it's mostly about the level of income obtained by households or individuals, as stated prior. Others argue that the poor's point of view of poverty should be taken into consideration when defining poverty. This term has different meanings which can be portrayed well when the poor define poverty on their own. Often contrary to the picture brought about by the conventional absolute poverty line approach, which equates poverty to the lack of material resources, a different picture is brought about. According to Kilpatrick (1973); Rainwater (1974); Goedhart *et al*, (1977), the poor can provide a subjective poverty expression by giving their perceptions and assessment of their well being. Questions like the following can be a guide:

- How much would a household with a certain number of members need to make ends meet?
- Do they perceive themselves as poor?
- Do they feel poorer than before or not?
- What amount of earning per individual would they assign to the label poor?

Conclusively SPII (2007) and Swedish Development Cooperation (1997) see poverty, to mean a number of different things which include the following:

- Lack of material, especially the resources needed for survival, these may include food, or a lack of access to food, safe drinking water, quality health, sanitation, education, information. This is conceptualized as absolute poverty (Rowntree 1901, cited by World Bank, 2000).
- Lack of security – this includes lack of security to the basic needs, natural disasters, unemployment, prejudice, economic and political crises, security in old age.
- Lack of dignity, people who are able to survive may still be considered poor if survival requires them to give up their self-respect, or if they are not able to fulfill their minimal social obligations in society (SPII, 2007). This is referred to as relative poverty (Galbraith, 1958 as cited by SPII 2007).

2.2.3 Causes of poverty

There are a number of different approaches to understanding the causes of poverty SPII (2007). These can impact on the types of policies that are used to reduce the levels of poverty. According to SPII (2007), the causes of poverty can be broadly divided into three kinds namely: structural, residual and pathological.

- **Structural explanation of causes of poverty**

According to Alcock (2006) cited by SPII (2007), structural explanations point out that growth and development can in themselves produce poverty and inequality. Therefore in order to address the resultant poverty, necessary changes to the structure of the nature of the social and economic forces should be done. SPII (2007) argues that an example of this in South Africa is understanding that poverty for many people is caused by unemployment, which is itself influenced by changes in both global and national production strategies and hence also because of the historical political economy.

- **Residual explanation of causes of poverty**

Residualists see poverty as the result of being left out of the growth and development process. Residualist approaches tend to assume that what is required is simply getting more people linked to markets or participating in employment. Residualist assumptions that economic growth and participation is good for poverty reduction as such are often linked to explanations of the persistence of poverty (SPII, 2007).

- **Pathological explanation of causes of poverty**

Pathological explanations emphasise the responsibility of individuals for their own poverty. Simply put, those who advocate for such an analysis of the causes of poverty would argue that each individual should be responsible for moving themselves out of poverty. A pathological line of reasoning would argue that a person's poverty can be attributed to their failure to get a job or start an enterprise. This approach would attribute the failure to find a job to a person's lack of initiative or 'preference for leisure' above an understanding that finding a job for many people is not possible due to a labour surplus, or that the total costs of finding and maintaining a low paid job (including transport costs, child care costs and the need for additional nutrition etc) might exceed the total cost benefit that employment might be able to provide (SPII).

- **Special reference to South Africa**

Poverty is not a new term in the whole world and South Africa is no exception to this. In South Africa poverty and food insecurity recognized as the legacy of the apartheid socio-economic and political order (NDA, 2009). This is not a natural occurrence, it has everything to do with history and it can never be overlooked because it gives a view point. According to NDA (2009), poverty and food insecurity in South Africa is the result of several centuries' worth of colonial and apartheid policies, designed specifically to create general conditions unfavourable to the well being of black people in all its aspects, especially in the former homelands. According to Soga (1931) cited by Monde (2003), before colonisation the needs of the Xhosa were

unsophisticated. Their diet was milk, meat, eggs, corn, wild fruit and vegetables. This was so until colonisation era when they were dispossessed of all their belongings and left to starve and live in abject poverty. Many of South Africa's challenges with regard to unequal development high levels of poverty and unemployment especially in rural areas are due to systematic and inefficient policies of the past (Isaacs and Hersoung, 2002).

According to Isaacs and Hersoung (2002), The Natives Land Act of 1913 is one of such. It promoted an unequal distribution of land resources by racial groupings. It led to a scheduling of land in the form of reserves for occupation by native populations. These reserves formed only eight percent of the country's total land area. This was occupied by more than 80% of the country's total population. However, the Restitution of Land Rights Act of 1994, which is aimed to provide for the restitution of rights in land to persons or communities dispossessed of such rights after June 1913 as a result of past racially discriminatory laws or practices (NDA, 2001).

Again Vink and Kirsten, 2002 also blames the Marketing Act of 1937. They argue that it became law due to the lobbying of government powerful commercial farmers. The act resulted in strong government interventions in almost each and every crop market and institution. These have been seen to have long term negative economic effects especially for emerging farmers (Vink and Kirsten, 2002). This act has also been redressed by the ANC led government, through the Marketing of Agricultural Products Act of 1996.

2.2.4 Measurements of Poverty

SPII (2007), notes that measuring poverty is essential as part of the design of policy and government interventions. These interventions can contribute to effective poverty eradication in the following ways (SPII, 2007):

- By being able to measure poverty governments can also begin to map geographically where poverty is more severe and so direct resources accordingly.
- By understanding the various dimensions of deprivations experienced by people living in poverty governments can focus its resources on specific programmes, such as housing, basic services etc.

- By having a poverty measure governments are able at appropriate intervals to evaluate whether the poverty programmes are being effective and moving people out of poverty and improving their well-being, both in the short term and over an extended period of time.
- By placing information about the levels of poverty and the resultant inequality in the public domain governments can build a national commitment to eradicate poverty.

According to Sen (1981) cited by Monde (2003), there are two alternative methods in measuring poverty, and these are the direct and the income method.

- **The direct method**

According to Sen (1981), the direct method involves the identification of people whose actual consumption baskets leave some basic needs unsatisfied, and does not involve the use of any notion of income. Its advantage over the income method is that, it is not based on certain assumptions of consumption behaviour that may or may not be true (Monde, 2003).

- **The income method**

Sen (1981) stated that, the income method involves the calculation of the minimum income required to satisfy all specified minimum needs, and then identify people whose income falls below the poverty line. It seeks to identify people who do not have the ability to meet their basic needs. It provides a measurement of numerical distances from the poverty line, in terms of income shortfalls (Monde, 2003). Poverty is measured through the poverty line (Sen, 1981), which is defined by Ravallion (1998) as the monetary cost to a given person at a given place and time as a reference level of welfare. According to Sen (1981), poverty line is the minimum income required to satisfy all specified minimum needs. In addition SPII (2007) defines poverty line as a statistical representation of the value of all the goods and services considered necessary for either an individual or a household. Rio (2006) notes that this measure can only give a brief overview the distribution of resources within a country, however, it does not on its own describe the depth of poverty. In South Africa to date the poverty line is estimated at R354 per month per

adult equivalent (Naledi, 2006). This then means that anyone at working age in South Africa, who earns below R354 per month, is living in poverty.

This method has its complications in measuring poverty, because households differ in size, and therefore a way of standardising the estimates is therefore recommended (Monde, 2003). To address the challenge of differences of needs between children and adults within the same household, Sen (1981) proposed that families should be expressed in terms of adult equivalence scale.

However (SPII, 2007) emphasized that adopting more than one poverty measure would assist in deepening an understanding about both the level and nature of poverty in the case of South Africa. SPII (2007) mentioned that in order to achieve this, it would be useful to consider a range of tools that measure the following:

- Calorie based food poverty
- Expenditure based basket of extended basic needs
- Asset/capability measure
- Perception based measure
- Poverty adjusted inequality measure (given the very unequal nature of South African society)
- Deprivation indicator based on a consensual selection of domains

2.3. Household food security

2.3.1 Definitions of Household Food Security

Food security is a broad concept, encompassing issues related to the nature, quantity, quality, and security of the food supply as well as issues of food access (Uzma Iram and Muhammad, 2004). Accordance to Maxwell and Frankenberger (1992), there are about 200 definitions and about 450 indicators of household food security. “Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life” (FAO, 1996). The World Bank (1986) also

defines household food security as ‘access by all people at all times to enough food for an active, healthy life’. Food security includes ready availability of nutritionally adequate and safe foods, and an assured ability to acquire acceptable foods in socially acceptable ways. Aker (2003) defines food security as, food that is available at all times, to which all people have means of access that is nutritionally adequate in terms of quality, quantity and variety and acceptable within a given culture.

According to Sen (1981), food insecurity should not solely be seen as a problem of inadequate food but also as a problem of inadequate purchasing power. In other words people become food insecure because they lack entitlements. This entitlement appraisal approach of Sen (1981) has had a strong influence on the way food security is understood. Sen (1981) stated that food security stems from endowments. He then emphasised the point that food insecurity and poverty are closely related. People are said to be living in poverty when they lack resources or buying power needed to acquire their basic needs. According to van Zyl and Kirsten (1992), in South Africa poverty is one of the main causes of food insecurity. Borton and Shoham, (1991) stated that through research it has been realised that food insecurity occurred in situations where food was available but not accessible because of erosion to people's entitlement to food.

All this supports Sen's (1981), entitlement approach, which states that households derive food security from their own entitlements which they derive from their own production, income, gathering of wild foods, community support (claims), assets, migration, etc. Thus a number of socio-economic variables have an influence on a household's access to food. Aker (2003) argues that there are six elements of food security, and these include, availability, accessibility, acceptability, affordability, adequacy and utilisation. These should therefore be all met at all times for a household to be considered food secured.

It can then be concluded that food insecurity is the exact opposite of food security. In simple terms food insecurity is limited or uncertain availability of nutritionally adequate and safe food or limited or uncertain ability to acquire acceptable food in socially acceptable ways. It leads to

hunger, which is defined as an uneasy or painful sensation caused by a lack of food or is a recurrent and involuntary lack of access to food (FAO, 1996, NDA 2005).

In addition to the definitions discussed above other scholars came out with the following (Maxwell and Frankenberger, 1992):

“Availability of food at all times of adequate supplies of basic food – stuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices” UN (1975).

“Everyone has enough to eat at anytime – enough for life, health and growth of young and for productive effort” Kracht (1981).

“Ensuring that all people at all times have both physical and economic access to basic food they need to eat” (Maxwell 1988).

“Adequate access to enough food to supply the energy needed for a all family members to live healthy, active and productive lives” Sahn (1989).

“The absence of hunger and malnutrition” Kennes (1990).

“The assurance of food to meet needs throughout every season of the year “UNICEF (1990).

“A situation in which all individuals in a population possesses the resources to assure access to enough food for an active healthy life” Webber and Jayne (1991).

“Access to food adequate in quantity and quality, to fulfil all nutritional requirements for all household members throughout the year,” Jonsson and Toole (1991).

“A basket of food that is nutritionally adequate, culturally acceptable, procured in keeping with human dignity and enduring overtime,” Oshaug (1985).

According to NDA (2009), food security definition has four distinct but inter-related components. These are:

Food availability is defined as effective or continuous supply of food at both national and household level. It is affected by input and output market condition, as well as production capabilities of the agricultural sector.

Food access or effective demand is described as the ability of a nation and its households to acquire sufficient food on sustainable basis. It addresses issues of purchasing power and consumption behaviour.

Reliability of food is understood as the utilisation and consumption of safe and nutritious food.

Food distribution is defined as the equitable provision of food to points of demand at the right time and place. This spatial/time aspect of food security relates to the fact that a country might be food secure at the national level, but still have regional pockets of food insecurity, at various periods of the agricultural cycle.

2.3.2 Categorisation of households according to food security status

Bickel *et al* (2000) noted the following four categories which are being used to categorize household food security status:

- ***Food secure households*** : Those that show no or minimal evidence of food insecurity.
- ***Food insecure without hunger***: Food insecurity is not evident amongst household members as the number of meals is not reduced, however, the quality of food consumed is poor and there is an increase in unusual coping patterns.
- ***Food insecure with hunger (moderate)***: Food intake for adults in the household is reduced to an extent that implies that adults have repeatedly experienced the physical sensation of hunger. In most (but not all) food-insecure households with children, such reductions are not observed at this stage for children.
- ***Food insecure with hunger (severe)***: All households with children have reduced the children's food intake to the extent that signs of malnutrition are visible, indicating that the children have experienced hunger. For some other households with children, this already has

occurred at an earlier stage of severity. Adults in households with and without children have repeatedly experienced more extensive reductions in food intake.

2.3.3 Measurements of Food Security

Bickel *et al* (2000) stated that the full range of food insecurity and hunger cannot be captured by any single indicator. Instead, a household's level of food insecurity or hunger can be determined by obtaining information on a variety of specific conditions, experiences, and behaviors that serve as indicators of the varying degrees of severity of the condition.

Reliable and adequately detailed information about the food security of a nation's population is important for the development of policies and programmes to increase food security and reduce food insecurity and hunger. According to Hoddinott (1999), there are four ways of measuring food security. These include individual intake, household caloric acquisition, dietary diversity, and indices of household coping strategies. Each method of measuring food security outcomes entails different methods of collecting and analyzing the data (Hoddinott, 1999). Hoddinott (1999) further explains these methods as follows:

- **Individual intake**

Individual intake is a measure of the amount of calories, or nutrients, consumed by an individual in a given time period, usually 24 hours. There are two basic approaches used to collect these data, one is observational and the other one is recall method.

- *Observational* - An enumerator resides in the household throughout the entire day, measuring the amount of food served to each person, and the amount of food prepared but not consumed is also measured. In addition, the enumerator notes the type and quantity of food eaten as snacks between meals as well as food consumed outside the household.
- *Recall* - The enumerator interviews each household member regarding the food they consumed in the previous 24-hour period. This covers the type of food consumed, the

amount consumed, food eaten as snacks and meals outside the household. Data collected on quantities of food are expressed in terms of their caloric content.

This method has two principal advantages, namely, it produces the most accurate measures of individual caloric intake (and other nutrients) and therefore the most accurate measure of food security status of an individual. Secondly, because the data are collected on an individual basis, it is possible to determine whether food security status differs within the household.

- **Caloric acquisition**

This is the number of calories, or nutrients, available for consumption by household members over a defined period of time. The principal person responsible for preparing meals is asked how much food she prepared over a period of time. After accounting for processing, this is turned into a measure of the calories available for consumption by the household. This measure produces a crude estimate of the number of calories available for consumption in the household. Questions are retrospective, the possibility that individuals will change their behavior as a consequence of being observed is lessened.

- **Dietary Diversity**

This is the sum of the number of different foods consumed by an individual over a specified time period. It may be a simple arithmetic sum, the sum of the number of different food groups consumed, sums of the number of different foods within a food group, or a weighted sum where additional weight is given to the frequency by which different foods are consumed. One or more persons within the household are asked about different items that they have consumed in a specified period. These questions can be asked to different household members where it is suspected that there may be differences in food consumption among household members.

- **Food Account Method (FAM)**

According to Nelson and Bingham (1992) the FAM requires the respondents in the household to keep detailed records of the quantities of food entering the household. These include purchases,

food from own gardens, gifts, payments in kind and other resources. Food consumption is quantified by estimating portion size. Food consumed external to the household supply is estimated by means of a diary kept by each household member. The nutrient content of the diet is estimated by using appropriate nutrient conversion tables.

The advantages of this method are as follows:

- It is cheap due to the fact that only periodic visits are made by field workers for supervision.
- It's accurate, because the respondent records food consumption at the time of eating, it does not require memory.
- It gives detailed information on food intake, like the sources from where the food is acquired.

Against the afore-mentioned advantages, this method has the following disadvantages (Nelson and Bingham, 1992):

- It provides information on households not individuals.
- It assumes that nutrients are equally distributed among individual members of the household.
- Wasted food due to spoilage or that which is given to animals is not accounted for.
- The method requires a lot of time to obtain data

- **Indices of Household Coping Strategies**

This is an index based on how households adapt to the presence or threat of food shortages. The person within the household who has primary responsibility for preparing and serving meals is asked a series of questions regarding how households are responding to food shortages.

2.3.4 South African government food security intervention programmes

In South Africa the rate of unemployment is increasing and the average household incomes are decreasing against increasing food expenditures (Ankomah, 2001). This therefore calls for government transfers or social welfare system to cater for the disadvantaged in society. The following are some of the South African government interventions to alleviate poverty and food insecurity amongst South African citizens.

The strategic framework for action to achieve food security was first outlined in the Reconstruction and Development Programme (RDP) (Monde, 2003). According to NDA (2007), the RDP food security framework was then refined in subsequent policy papers, such as the Agriculture White Paper (1995), BATAT, and the Agricultural Policy Discussion Document (1999). According to NDA (2007), the improvement of rural household's food security is central to the DoA's policy. The policy's aim is to increase the ability of all South Africans, to meet their minimum daily, safe and nutritious food requirements (NDA 2009).

2.3.4.1. National Food Security Management System

The Department of Agriculture developed a National Food Security Management System (NFSMS) (NDA, 2009). The system's primary goal is to monitor Food Security programmes and facilitate agricultural (rural/urban) development (NDA, 2009). This system gives information to government and the other role players to guide their plans of action against food insecurity and malnutrition (NDA, 2007). Their programmes include:

- Production and trade
- Food safety and nutrition
- Social safety net and food emergency

According to (NDA, 2009) its functions are to:

- Conduct a Vulnerability Assessment for targeted rural and urban Food Security programmes.

- Strengthen local and provincial information network capacities on Food Security.
- Mobilize and coordinate support for the implementation of viable local Food Security information programmes
- Support the establishment and maintenance of the comprehensive Food Security and Vulnerability Information Mapping System(FIVIMS)
- Compile and distribute Food Security Status Reports.

2.3.4.2. Integrated Food Security and Nutrition Programme (IFSNP)

IFSNP's aim is to reduce the number of food insecure households by half by 2015. Their strategy is to increase domestic food production by providing support services to farmers. According to NDA (2007), to this effect the DoA want to do away with food parcels, and start giving their 244 000 food parcel beneficiaries "starter packs" for food production for their own benefit. It also aims to support individual and community gardens to supply school nutrition and health care projects (NDA, 2009).

2.3.4.3 The Social Security System

South Africa has basic social security system comprising social assistance grants and social insurance payments (Ankomah, 2001). Social assistance grants are available to all resident citizens subject to a means test. According to (Ankomah, 2001) old age and disability grants are the most common. The main social security grants currently in operation in South Africa are (Ankomah, 2001):

- *Old Age Pension* - Old Age Pension, as in many countries, provides income security for older people in South Africa and it is one of the three main categories of social grants in the country. People who qualify for old age pension include any South African citizen, 60 yrs old (for females) or 65 yrs old (for males).
- *Disability grant* - is paid to any South African who owing to his or her disability is unable to obtain employment or does not have any other resources to support him or herself.

- *Child support Grant* – This was introduced in 1998 by the African National Congress (ANC) led government. It's meant to cater directly for the basic needs of children. Children who are 14 years and younger qualify for this grant.
- *Care dependency grant* - Care dependency grant is also a grant payable to the parents or foster parents of a care-dependent child between the ages of 1 and 18 years, who due to severe mental and/or physical disability, needs full time care.
- *Foster Care grant* - This is also another grant that benefits children. It is payable to a foster parent or parents in respect of a foster child who has been placed in their custody in terms of the *Child Care Act*.

2.4. Human Nutrition

Household food security is a necessary but not sufficient condition for nutritional security (World Bank, 1989). It is one factor amongst others, these include, disease, poor sanitation, adequate health environment, and adequate maternal and childcare. According to the Constitution of South Africa of 1996, nutrition is considered as a basic human right. According to World Bank, (1989), there are two main processes that have a bearing on nutritional security. The first involves the household's access to resources for food. This is the path from production or income to food. The second process involves translating the food obtained into satisfactory nutritional levels. Lee and Nieman (1996) pointed out that measurement of nutrient intake is probably the most commonly used indirect indicator of nutritional status. They further stated that this is done to improve human health. Like poverty and food security measuring diets can be done in different ways, and each technique has its own strengths and weaknesses (Monde, 2003).

There is a positive relationship between food security and nutrition. Food insecure households will never be able to cater the nutritional needs. This leads to malnutrition. Young (2001) defines malnutrition as a state in which the physical functioning of an individual is impaired to the point where he/she can no longer maintain adequate performance in such processes as growth, pregnancy, lactation, physical work, resting and recovering from disease. Young (2001) stated that the most common form of malnutrition is protein energy malnutrition. He further mentions

that, this form of malnutrition covers a range of clinical disorders that are the result of inadequate intake of protein and energy, as well as other nutrients.

Young (2001) pointed out that under nutrition is taken as an indicator of food insecurity, and it usually refers to an insufficient consumption or intake of energy, protein or micro nutrients. According to World Health Organisation (WHO) (1985), a body's daily caloric requirements depend on the following:

- Age
- sex
- Weight
- body composition
- disease state
- Genetic traits
- Pregnancy and lactating status
- Activity level

Table 2.1 shows the recommended daily allowances of energy required by different groups of people.

Table 2.1: Recommended daily caloric intakes of energy

Age group	Kilocalories per day		
Young children			
<1	820		
1-2	1150		
2-3	1350		
3-5	1550		
Older children	Boys	Girls	
5-7	1850	1750	
7-10	2100	1800	
10-12	2200	1950	

12-14	2400	2100	
14-16	2650	2150	
16-18	2850	2150	
Men	light activity	Moderate activity	Heavy activity
18-30	2600	3000	3550
30-60	2500	2900	3400
>60	2100	2450	2850
Women	light activity	Moderate activity	Heavy activity
18-30	2000	2100	2350
30-60	2050	2150	2400
>60	1850	1950	2150

Source: FAO/WHO/UNU (1985), as cited by Smith *et al*, 2006

2.5 CONCLUSION

The concept of poverty has been defined in two approaches in this study. The first one being the way the experts view it to be and the second one being the way the poor themselves view poverty to be. According to Monde (2003), van Zyl and Kirsten 1992 and the World Bank (1986), poverty is measured through the poverty datum line. Magasela (2005) further indicates that there is the primary and secondary datum line. The primary datum line measures the cost of food, clothing, cleansing material and fuel. The secondary datum line made provision for accommodation, tax and transport (Magasela, 2005). SPII (2007) challenges these and states that they are the narrow notions of defining poverty. Poverty definition should be the mirror image of the society's principles. Because its characteristics differ between and within countries, regions and social groups logic then suggests it be defined by such societies. Through these definitions of different groups, it can then be noted that poverty actually has different meanings for different people. These go beyond the conventional absolute poverty approach. The poor give their perceptions and assessment of their well being. They often range from lack of material needed for survival, lack of security and lack of dignity.

SPII (2007) argues that poverty is caused by three aspects, the structural, the residual and the pathological explanations. The structural explanation suggests that poverty is caused by growth and development, the residual explanation on the other hand suggests that poverty is the result of being left out of growth and development processes. The pathological explanation mostly puts the blame on the poor themselves, when it states that a person's poverty can be attributed to their failure to find a job or start an enterprise.

In South Africa poverty and food insecurity are recognised as the legacy of the apartheid socio-economic and political order (NDA, 2009). This history therefore cannot be ignored because it gives a view point that poverty and food insecurity in South Africa results from colonial and apartheid policies (NDA, 2009). These were designed to create unfavourable conditions to the well being of black people. These include the Natives Land Act of 1913, which led to scheduling of land in the form of reserves for occupation by native populations (Isaacs and Hersoung, 2002). About 80% of the country's population occupied these reserves, which solely constituted 8% of the country's land area. Redressing this situation therefore became of fundamental importance in the process of alleviating if not rather eradicating poverty in the country. The South African government committed in a number of interventions designed to mitigate food insecurity and poverty. Such interventions include social grants, Siyazondla, Siyakhula, Massive food production, to mention but a few.

Food security comprises of the nature, quality, quantity, security as well as the accessibility of food at all given times. It has been defined by a number of scholars who all accord that food security includes ready availability of nutritionally adequate and safe food and assured ability to acquire it in socially acceptable ways. Sen (1981) stated that food insecurity should also be seen as a problem of inadequate purchasing power. He therefore developed an entitlement appraisal approach. This approach had a strong influence on the way food security is understood. Borton and Shohan accord with Sen (1981) when they note that research has shown that food insecurity has occurred in situations where food was available but not accessible due to people's entitlement erosion to food.

Hoddinott (1999) notes that there are three methods used to measure food insecurity, these include Individual intake, which has two approaches the observational and the recall approach. The second method is caloric acquisition and the third one is dietary diversity. Nelson and Bingham (1992) also discussed the Food Account method as yet another method used in food security measurement.

CHAPTER THREE: RAIN WATER HARVESTING TECHNOLOGIES

3.1. Introduction.

This chapter is an attempt to describe the different types of rainwater harvesting technologies. The chapter begins with the definitions of rainwater harvesting. Thereafter the water harvesting technologies are identified and explained. For the purpose of this paper, the Infield Rain Water Harvesting (IRWH) will be discussed in detail immediately thereafter. The chapter ends by explaining the importance of rainwater harvesting on household food security.

3.2. Definitions of Rain Water Harvesting

Sekar and Randhir (2007) defined Water harvesting as a technique which can be used to minimize water loss and to augment water supplies in watershed systems. Water harvesting is also defined as the redirection and productive use of rainfall (Frasier, 1983). Hatibu *et al.*, 2006, stated that water harvesting for agricultural production, can be practiced mostly at the local scale using deep percolation ditches to on-farm catchments. In its simplest form, NDA (2009) points out that rain water harvesting can be done by any household with a roof and street access. It can also be accomplished through in situ harvesting, soil conservation methods, and increasing infiltration for recharge of groundwater (Sekar and Randhir' 2007).

Water harvesting has multiple benefits which include, increasing cropping intensity and increase groundwater levels. Many people in the world have returned to it in order to relieve pressure on overburdened underground tables or municipal water systems. Water harvesting techniques have been employed for thousands of years to get more water to the fields in order to improve crop production. It can be traced back through human history almost as far as the origins of agriculture. These ancient practices sustained ancient people when conditions would have otherwise totally prevented agriculture (FAO, 1990). Unlike conventional irrigation, however, rainwater harvesting does not depend on a constant flow of water; it is totally dependent on rain.

3.3.Types of rain water harvesting technologies

Harvesting rain water can be done in a number of ways. Alem, (1996) identified the following water harvesting techniques:

- ***RUN OFF AND FLOOD FARMING:*** Every bit of rainfall runoff from the farm and its surroundings is harvested and directed back to the farm to provide supplementary irrigation. The technique involves diversion of runoff from the farm, run off from roadsides, foot trails and farm boundary grass waterways
- ***PONDS:*** These are used to harvest rainwater for both human and livestock watering, particularly in the arid and semi arid rural areas. They are major sources of water in the Rift Valley where ground water is deep and other sources of water are not feasible.
- ***DUG WELLS:*** Dug wells (3 to 15 meters) are major sources of water both for domestic water supply and agricultural uses and they are widely used in wetland areas, sand river beds and valley bottom lands.
- ***SOIL MOISTURE CONSERVATION:*** In -situ water harvesting using open and tied ridges in moisture stress areas improved land and crop productivity by 100% and farmers are increasingly using them in drought prone areas.
- ***ROOF WATER HARVESTING:*** People collect water from their individual house roofs, churches, schools, etc. They use tanks, drums and other huge containers to collect water.

3.4. In Field Rain Water Harvesting

IRWH is a specific technique of water harvesting. The basic structure of the *IRWH* system comprises a 2-metre runoff strip along the slope of the field (catchment area) and 1-metre basin (storage) area across the slope of field and at the end of the runoff strip. In this way, runoff is directed and stored into the basin area, as shown in plate1 below

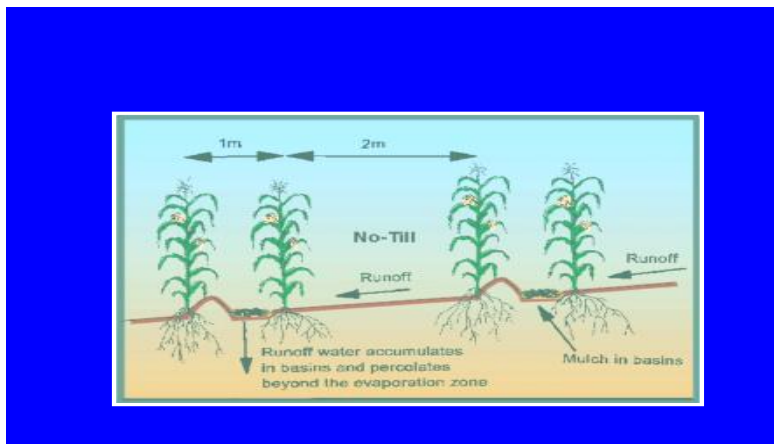


Plate 1: - IRWH

Source: (Baiphethi *et al*, 2006)

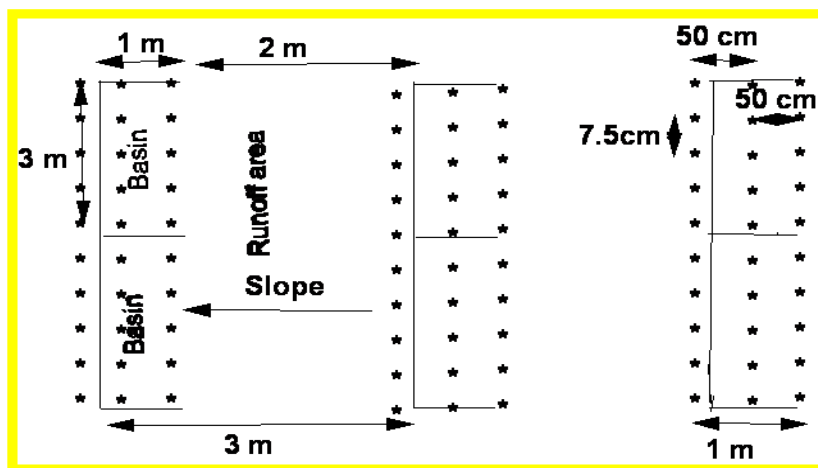


Plate 2: In-field rainwater harvesting in practice

Source: (Baiphethi *et al*, 2006)

The basic structure of the IRWH system can be altered by the use of different mulches in the basin and runoff area. The mulch can be organic (crop residue or grass) or inorganic (stones) and is applied either in the basins or the runoff surface (see Plate 1 above).



Plate 3: Mulching on IRWH

Sources: Own, 2008

3.5 Benefits of IRWH

The following have been noted as the advantages of this technique (Botha *et al*, 2001):

- It reduces runoff – the technique reduces total run off from the field to zero. Through the run off strip of two meters, the crust is formed on the top layer of the soil. This makes it easy for water to run through that hard surface straight to the catchment basin where its stored for later use.
- It reduces evaporation – evaporation is reduced through the mulches
- It improves soil structure – this is true in the case of organic mulch
- It retains moisture in the root zone for crop production
- It is capital extensive – it utilises the resources that the small scale farmers can access.
- It reduces production risk

- It increases the farmer's yield – proven in the Free State as reported by Botha *et al* (2003), that it has shown that the yields of crops such as maize and sunflower can be increased by 50 percent.

3.6 Importance of Infield Rain Water Harvesting on household Food Security.

Water is one of the essential resources in food production, making it a critical factor in food security. According to Juana *et al*, (2008), the majority of the models used to predict climate change suggests that, there will be a reduction in fresh water availability by 2050. Contrary to this, the population growth is projected at 3 percent per annum (Juana *et al*, 2008). Achieving food security of growing numbers of people with the same amount of water thus is an important societal concern (Wenhold, 2007). Growing population and escalation in per capita consumption of water have implications for water supplies (Sekar and Randhir 2007). Rosegrant *et al*, (2002) noted that, this shortfall in water supplies has consequences for the production of food in the country. Food security is the outcome of many interrelated factors, one of which being water, an essential resource for food production. Food production is the most water-intensive activity in society and water is the number one food-limiting factor in many parts of Africa. Agriculture accounts for 70% of the worldwide human fresh water use (Hoddinot, 1999) and this figure can be higher in developing countries.

People's access to water in rural areas, and the price of water, affects their food security for the following reasons (Hatibu *et al*, 2006):

High cost of rural water

It is a common belief that rural areas have a number of natural resources, which can be seen as the birth rights of the community members. These include the land, water (rivers, dams and lakes), etc. However, this is not the case in most of the rural areas especially in South Africa. According to Khosa (2003), rural water costs tend to be high and unstable. This can be seen either in monetary terms, for example one can pay R0.50 for 20l of water for human consumption in some rural areas (Khosa, 2003) or it can also be seen in the time and effort

required by households to fetch water for purposes other than human consumption, thus influencing their real incomes.

Lack of clean and safe water

King *et al.*, (2006), stated that, nearly 50% of South African children do not have access to clean safe water and large numbers of children are hospitalized annually for complications as a result of diarrheal disease in South Africa.

3.7 CONCLUSION

As mentioned prior, food production is the most water-intensive activity in society. Therefore it is of paramount significance for the people to have access to enough water so as to meet their food consumption needs. This is one of the ways poverty and food insecurity can be reduced in rural areas. This has resulted in water being called the dividing line between poverty and prosperity, as it is a cross-cutting tool for the achievement of the millennium development goals and one of which is to halve the proportion of people who are poor and food insecure by 2015 (UN, 2005). To meet this access to sufficient quantities of water is needed.

The demand on this scarce resource makes the efficient use of it a necessity (NDA, 2007). The NDA (2007) stresses that now is that time where the poor especially, should recognise the need for productive uses of water. According to the NDA (2007), grey water use is also encouraged for irrigation in backyard gardens. This is the water used within the household; it includes bath water, water from the kitchen, and water from washing machine. This is water that would normally be wasted, but it can be re- used in production and income generation. This in turn would be a way of saving fresh water. In South Africa, backyard gardens of rural homesteads amounts to 200 000ha, an amount which doubles the area under irrigation (NDA, 2007). This then means that, their potential impact on household food security is very significant.

According to Baiphethi *et al* (2006), about 72% of South Africa's poor live in former homelands. This percentage constitutes the country's majority of the population. These areas are mostly semi arid to arid, and that makes them marginal for crop production, except for a small proportion under irrigation (Baiphethi *et al*, 2006). Bembridge (2000) discovered that over the past ten years

since he wrote, the irrigation schemes in these areas have collapsed. Backeberg (2004) argued that the potential contribution of irrigated agriculture to rural livelihoods is probably less than rain fed agriculture. He states that, the majority share of irrigation water use and the biggest contribution to agricultural production is by commercial farming. This confirms the schools of thought of FAO (1990) and Parr *et al* (1990) that, rain-fed agriculture will continue to be an important source of food in these areas. This then calls for a need for efficient use of water and land if poverty reduction is to be achieved (Weibe, 2001).

Inadequate and extreme fluctuations in the amount of water available is a major constraint to productivity and profitability of agriculture, making most poor farmers remain at subsistence level and in perpetual poverty (Hatibu *et al.*, 2006). Given that water productivity in agriculture continues to be low, it is obvious that huge amounts of water will be required to produce enough food for the future population of the world.

According to Botha *et al* (2001), the ARC has developed a new production technique that incorporates water conservation, as a potential solution to the problem of water shortage and increased land utilization for agricultural production in semi arid rural areas of South Africa. Botha *et al* (2003) followed the pioneer work of Hensley *et al* (1997, 2000) of Rainwater Harvesting and Conservation (RWHC). They developed an Infield Rain Water Harvesting (IRWH) technique.

CHAPTER 4: METHODOLOGY

4.1. Site description

The area under investigation is the Tyhume Valley, which is located about 30 kilometres north of Alice in Nkonkobe Local Municipality, Central Eastern Cape Province. The valley, which is traversed by the Tyhume River, is the home of the AmaKhuze Tribal Authority under Chief Mqalo. Within Tyhume Valley, there are five villages, namely, Guquka, Khayaletu, Gilton, Sompondo and Mpundu. The first two villages were selected for the water harvesting project. Guquka and Khayaletu lie just below the escarpment of the Amatola Mountains with the upper Tyhume River flowing past them. The Tyhume River acts as a border between the two villages. The two villages are home to 190 and 213 households respectively (Monde and Aliber, 2007). Plate 1 shows the homesteads and landscape of the study area (Khayaletu in front and Guquka on the upper slope).



Plate 4: The study area: Villages of Khayaletu and Guquka

Source: Monde and Aliber 2007

Climatically, the area in which these villages lie can be described as sub-humid. The mean annual rainfall ranges between 700 and 800 mm, making rain-fed crop production possible. The villages lie in a veld type known as the Dohne Sourveld of the Eastern Cape. Sourveld is not well

suited to livestock production, as it is nutritionally deficient during the winter months and does not generally tolerate high grazing pressures. Although the mean annual rainfall is relatively high, the winter period is generally dry, with June and July as the driest months. One can expect only 7% of the total annual rainfall in those months, compared to roughly 70% in the months of October through March (Bennett, 2003).

4.2. Methods used

- **Pairwise comparison method**

The method used to assess the impact of the IRWH on household food security was a pair wise comparison method. During September 2008, there were 60 (34 in Guquka and 26 in Khayaletu) households who adopted the technology in home gardens. In order to get a clear picture of the impact of the technology on food security, a decision was taken to assess both the project members and non-project members, hence the pairwise comparison method. The non-project members (also 60 households) were selected randomly from those who were interviewed during the situation analysis in 2004. A survey was used to collect socio-economic data using a semi-structured questionnaire as a data collection tool. Five indicators were used to assess household food security. These were household income, expenditure on food, diet diversity, energy-protein intakes, and micro-nutrient intakes (Vitamin A, C and Iron). The income and expenditure data were collected from the 120 households.

- **Case study approach**

The detailed food data were collected from selected cases from both groups at different times (seasons) of the year. These cases were selected mainly according to the degree of poverty. A total of 12 cases (six from each village) were selected and assessed. Two households were selected from each poverty class (non-poor, poor and ultra-poor), i.e. one project member and one non-member hence six households per village. The main aim of selecting households this way was to evaluate the impact of IRWH technology by comparing and contrasting food data of project members and non-members from each poverty class.

- **Food account method**

The data on the kinds of food products consumed by households was gathered using the food account method (FAM) reviewed in chapter two. Each household was supplied with a notebook to record the amounts and sources of all food products consumed on a daily basis during the month of investigation. These notebooks contained sheets of papers that were dated guiding the respondents during the recording of the information. The food data were collected at different times of the year during summer (September 2008), December 2008 (Summer) autumn (March 2009) and winter (June 2009). The kinds of data collected were the types and quantities of products consumed as well as the sources where food was obtained. The nutrient composition of the food consumed was then determined using the South African food composition tables. This information was then compared to the recommended daily allowances (RDAs) of these nutrients as published by the MRC (2005) in order to evaluate the nutritional status of these households.

Indicators of diet quality used were household diet diversity and the percentage of households with low diet diversity. Diet quality refers to the variation of food consumed by households (Smith *et al*, 2006). Based on the quantity data collected from households, diet diversity was calculated by counting the number of food groups, out of seven, from which food was acquired over the survey reference period. The percentage of households with low diet diversity was measured by determining whether a household failed to acquire at least one food from four of the seven groups over the reference period. The seven food groups that were considered were:

- Cereals, roots and tubers
- Pulses and legumes
- Dairy products
- Meats, fish and sea foods, and eggs
- Oils and fats
- Fruits
- vegetables

4.3. Data analysis and interpretation

The unit of analysis was a household. However, for comparison purposes, the unit of analysis was the adult equivalent (AE). AE unit was used to analyse income and expenditure as well as the nutrition data. This was done so as to overcome the problems of household size and composition.

The RDAs of nutrients are usually given per gender and age group. The RDAs therefore for each household are likely to differ since households vary greatly in size and composition. One way to address this is to express households in terms of adult equivalents, where adult equivalence is determined by recommended daily allowances (Rose *et al*, 2002). All individuals in each household were expressed in equivalent terms to the adult female, with reference to their energy, protein, vitamins A and C as well as iron. This was done by dividing their RDAs by that of the adult female. The total nutrient intakes therefore for each household were divided by the number of adult equivalents in that particular household in order to get average figures. This enabled for the calculation of the average RDAs in each poverty class for the entire study (Guquka and Khayaletu households combined)

CHAPTER 5: EMPIRICAL ANALYSIS OF THE RESULTS

5.1 Demographic Characteristics of households

5.1.1. Size and composition of households at Guquka and Khayaletu

The size of households and the age of members of households surveyed in 2008 are presented in Tables 1 (project members) and 2 (non-project members). The mean household size at Khayaletu amongst project members (6.4) and non-project members (6.5) was slightly larger than that of Guquka (5.7 and 5.9 respectively), but the difference was not statistically significant. The most important difference between the two settlements was that in Guquka the majority of households (76 %) were headed by males, whereas in Khayaletu the majority (64 %) was headed by females.

Table 1: Size of households and age distribution of household members at Guquka and Khayaletu amongst project members (September 2008; n = 60)

Variable	Guquka (n =34)		Khayaletu (n = 26)	
	Mean	Range	Mean	Range
Household size	5.7	1 - 12	6.4	1 - 13
Number of household members aged 65 or older	0.5	0 - 1	0.6	0 - 2
Number of household members aged 15 to 64	4.2	1 - 9	4.6	1 - 11
Number of household members aged less than 15	1.0	0 - 6	1.4	0 - 7

Table 2: Size of households and age distribution of household members at Guquka and Khayaletu amongst non-project members (September 2008; n = 60)

Variable	Guquka (n =34)		Khayaletu (n = 26)	
	Mean	Range	Mean	Range
Household size	5.9	1 - 12	6.5	1 - 13
Number of household members aged 65 or older	0.6	0 - 1	0.7	0 - 2
Number of household members aged 15 to 64	4.1	1 - 8	4.4	1 - 10
Number of household members aged less than 15	1.1	0 - 7	1.5	0 - 8

5.1.2. Employment status of household heads at Guquka and Khayaletu

Tables 3 and 4 show the employment status of the heads of households in the two villages amongst the project members and non-members respectively. Again, there were no significant differences among the two categories of households. In both settlements five to six out of every 10 households were headed by a retired person, and one to two out of 10 by an unemployed person. The proportion of household heads unemployed was much higher in both household categories at Guquka (20.6 and 17.6 respectively) than that of Khayaletu (15.4 and 11.5). Households headed by a person in formal employment were higher amongst the non-project members in both villages.

Table 3: Employment status of heads of households in Guquka and Khayaletu amongst the project members (September 2008; n = 60)

Employment status	Guquka		Khayaletu		All	
	No of households	Proportion of total (%)	No of households	Proportion of total (%)	No of households	Proportion of total (%)
Full-time formally employed	4	11.8	3	11.5	7	11.7
Part-time formally employed	2	5.9	2	7.7	4	6.7
Unemployed	7	20.6	4	15.4	11	18.3
House wife	3	8.8	2	7.7	5	8.3
Retired	17	50.0	15	57.7	32	53.3
Scholar	1	2.9	0	0.0	1	1.7
Total	34	100.0	26	100.0	60	100.0

Table 4: Employment status of heads of households in Guquka and Khayaalethu amongst non-project members (September 2008; n = 60)

Employment status	Guquka		Khayaalethu		All	
	No of households	Proportion of total (%)	No of households	Proportion of total (%)	No of households	Proportion of total (%)
Full-time formally employed	5	14.7	4	15.4	9	15.0
Part-time formally employed	1	2.9	1	3.8	2	3.3
Unemployed	6	17.6	3	11.5	9	15.0
House wife	3	8.8	2	7.7	5	8.3
Retired	18	52.9	16	61.5	34	56.7
Scholar	1	2.9	0	0.0	1	1.7
Total	34	100.0	26	100.0	60	100.0

5.2 Impact of IRWH on economic status of households

The sources of income and their contributions household income are presented in Table 5. The mean monthly household income among the project members was R424.15 ranging from R47.77 to R1800.00 per person. Table 5 shows the incomes of the non-project members to be slightly lower than those of the project members. The mean household income among the non-members was R333.45 ranging from R63.42 to R883.71. Grants followed by salaries and wages were the most important sources of income in both categories. These findings are consistent with those of studies conducted in the same area (Fraser *et al*, 2003 and Monde *et al*, 2005) as well as other rural areas in South Africa (Van Averbek and Khosa, 2007). While the contribution of agriculture to household income is still less than 15% in the area (13.3% for project members and 8.1% non-project members), an improvement in the contribution of this income source was noticed in both household categories. This improvement is a result of better utilization of home gardens (land use intensity). In 2004, before the adoption of the IRWH technology, agriculture contributed 7.2% to household income (Monde *et al*, 2005). As demonstrated in Table 1, even the non-project members managed to get more (8.1%) from agriculture. Amongst agricultural activities, home gardening was the main activity and it made significant contributions to

agricultural income as revealed in Table 5. The ‘other’ category included the consumption and sale of chickens and pigs. Only one out of 120 households was involved in field cropping.

Table 5: Sources of income and their contributions to household income among the project members and non-project members at Guquka and Khayaletu (n= 120; 2008)

Source	Project members (n = 60)		Non-project members (n = 60)	
	(R month)	(%)	(R month)	(%)
Remittances	1298.79	5.1	1518.97	8.0
Wages	8887.78	34.9	4955.65	26.1
Grants	11459.88	45.0	10689.77	56.3
Trade	432.93	1.7	284.81	1.5
Agriculture - gardening	2062.78	8.1	949.36	5.0
Agriculture - other	1324.25	5.2	588.60	3.1
Total	25466.41	100.0	18987.16	100.0

As demonstrated in Table 5, no significant changes were noted in the contribution of various income sources to household incomes. The external economic activities are still the main sources of income in these villages. Local economic activities, including agriculture still make modest contributions. Nonetheless, about 75% of respondents mentioned that they earn money from selling vegetables, however small. Before the project, none of the garden produce was sold as the produce was not even enough for home consumption.

Using a poverty line (PL) of R593.12, which was proposed for rural South Africa in 2006 (Woolard and Leibrandt, 2006), the degree of poverty in the area was analysed. This figure was adjusted using the relevant consumer price indices (CPIs). Thus, the new PL used in this study, was R605.73. Only 17% of households in the project member group were categorized as non-poor as they earned incomes that were above PL. The rest (83%) of households were poor. Forty five percent (45%) of these poor households earned incomes that were below R302.06, which is half of poverty line, and therefore were categorized as ultra-poor households. The other 38% earned incomes that were between these two limits (PL and half of PL), and were categorized as

poor households. For the non-project member group, the non-poor households amounted to 7%, ultra-poor 57% and the poor households 36%.

When asked about whether there has been any improvement in household incomes since the introduction of the IRWH, the majority (90%) of non-project members in both villages (92% in Guquka and 88% in Khayaletu) said no. The responses from project members were different. At Khayaletu, a 'no' response was obtained amongst 60% while 75% of respondents at Guquka gave a positive response. When probed, the 40% at Khayaletu and 75% at Guquka who gave positive responses mentioned improvement in agricultural income due to improvement in home garden production. Improvements in production were due to improvement in accessing water. Apparently having access to portable water changed the situation for better especially during the dry periods.

The respondents were then further asked to rate their economic well-being. Economic well-being in this context refers to the state of households being healthy, happy, or prosperous. All these states depend on a number of various factors such as family characteristics, the resources of these farm households, production and employment levels, and the ability of income to meet consumption, savings, and other household needs. The responses as obtained from the two categories of households are shown in Figures 1 and 2

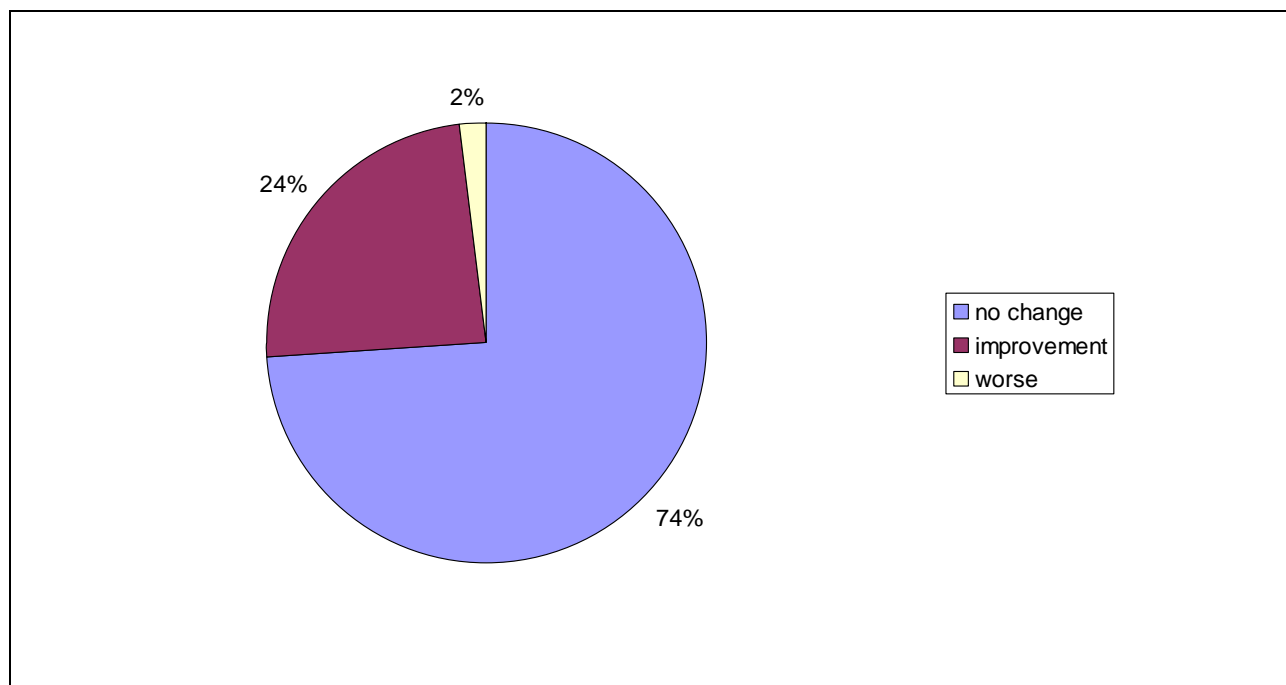


Figure 1: Changes in economic well-being amongst the non-project members at Guquka and khayaletu during March 2008

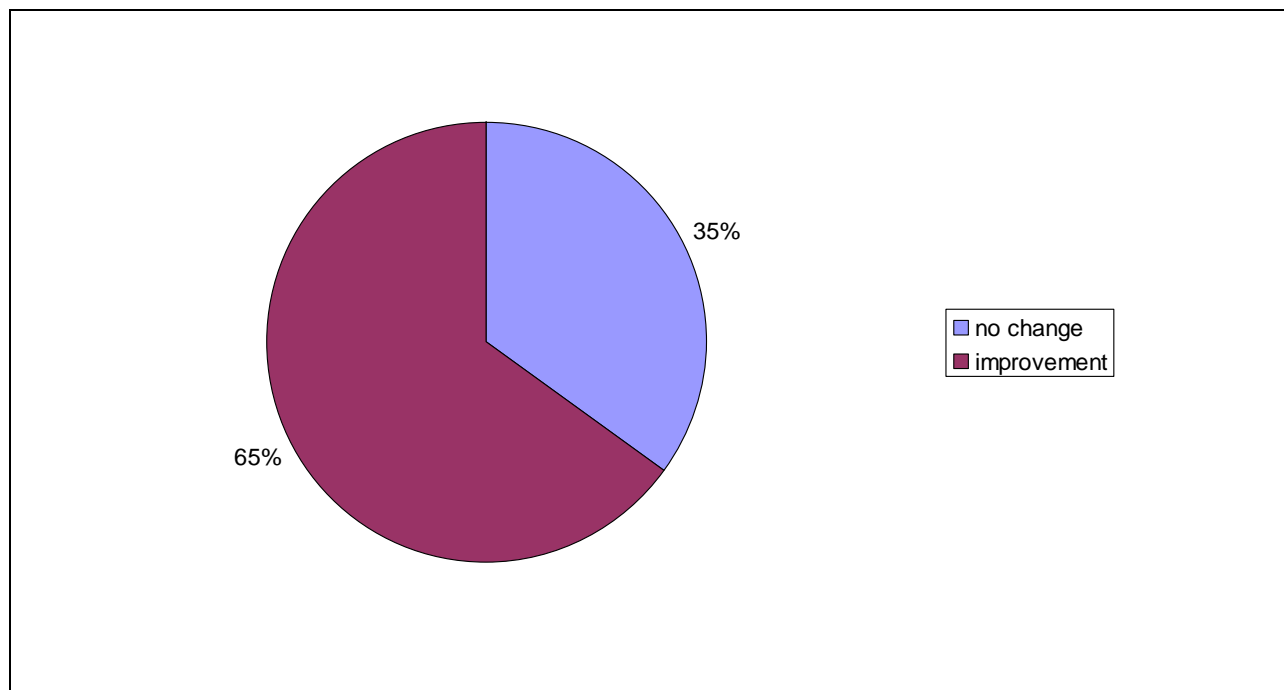


Figure 2: Changes in economic well-being amongst the -project members at Guquka and Khayaletu during March 2008

Again, the majority (74%) of non-members felt that there was no change in their economic wellbeing while 24% felt that there was an improvement. The other 2% felt that things have gone from bad to worse. The majority (65%) of respondents amongst the project members in both villages however indicated that economic status had improved. They mentioned a decrease in food expenditures due to increase in own production, especially vegetables; the frequent consumption of vegetables during wet seasons; as well as general improvement in health.

5.3. Impact of IRWH on food and input expenditure

Figures 3 and 4 show the relationship between the household income and the proportion of total expenditure spent on food by the project members (Figure 3) and non-project members (Figure 4). The figures show a strong relationship between the two variables. The proportion of income spent on food was smaller for households with incomes that were higher than the PL (R605). The opposite was true for poor and ultra-poor households. The correlation co-efficient was even

higher ($R^2 = 0.9$) for the non-project member group. The R^2 was 0.8 for the project members, and at R600 the proportion was less than 30% compared to more than 50% among the non-members. Whether project members or not, these findings show that food is still the main expenditure category among the rural households and that household food security is attained mainly through purchased food. Monde (2003) and Van Averbek and Khosa (2007) found similar results. Own-production of food is still not important in terms of attaining household food security in rural areas.

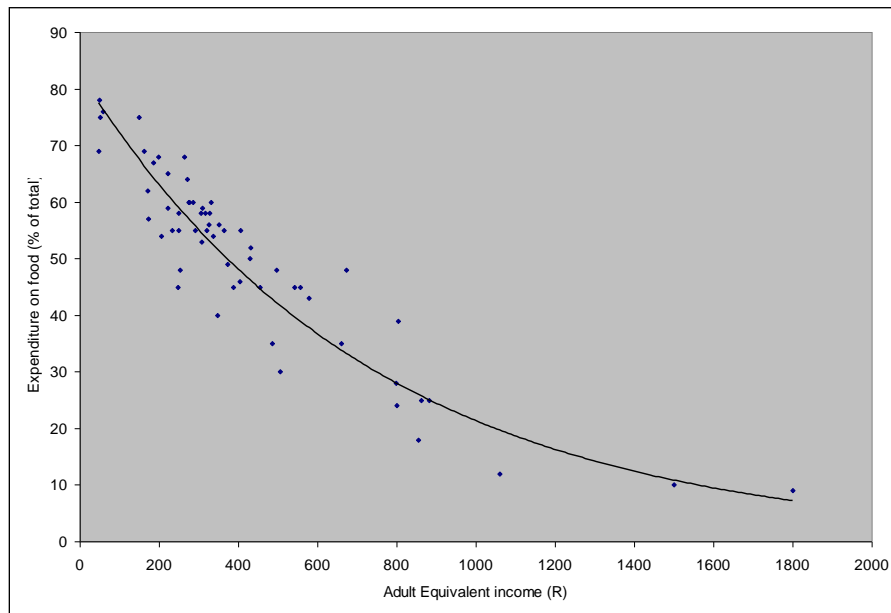


Figure 3: Relationship between household income expressed in adult equivalent and the proportion of total expenditure spent on food among project members in 2008 (n = 60)

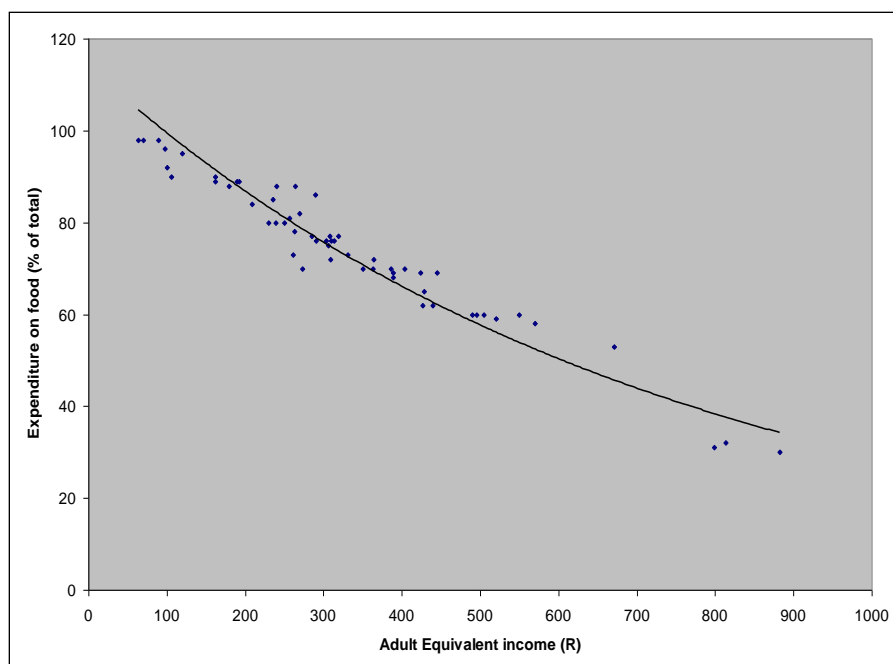


Figure 4: Relationship between household income expressed in adult equivalent and the proportion of total expenditure spent on food among non-project members in 2008 (n = 60)

About 84% of respondents from the project member group indicated that the costs on agricultural inputs had decreased since the introduction of the project. There are reasons for this change. Firstly, the decrease in input expenditure has been brought by the fact that the project beneficiaries no longer use the plough and other tractor-drawn implements in home gardens. The application of the IRWH technology encourages minimum tillage. So, instead of using the plough, the respondents make use of garden tools and implements such as hoes and spades. Secondly, the beneficiaries do not pay a full price for the inputs such as seeds, fertilizers and pesticides as they are subsidized. Thirdly, the majority make use of family labour to carry out most garden activities. Another commonly used type of labour is exchange labour, which involves informal labour contracts between households to accomplish certain garden activities. The farmer usually invites friends and neighbours to assist, and in return he or she does the same for others. Hired labour is used by few during soil preparation. Soil preparation is usually done by hand, which is rather too difficult for the older members.

5.4. Impact of IRWH on household food security in Guquka and Khayaletu

5.4.1. Socio-economic characteristics of cases

The social and economic characteristics of Guquka and Khayaletu households selected to evaluate the impact of the IRWH technique on household food security are shown in Tables 6 and 7 the information presented in these tables show the prevalence of female heads in both villages; four in Guquka and five in Khayaletu. Household heads at Khayaletu appeared to be older than those of Guquka households. All younger household heads belonged to either the poor or ultra-poor in Guquka while households with older heads were the poorest at Khayaletu. The sizes of households at Guquka were more or less equal across the poverty classes. At Khayaletu, the household sizes varied amongst the poverty classes ranging from two to seven members per household.

Table 6: Socio-economic characteristics of Guquka cases during September 2008

Poverty class	Gender head	Age head	Adult equivalent	Household size	AE income
NPM ^a	Female	63	2.7	4	918.94
NPN ^b	Female	69	3.5	5	618.86
PM ^c	Male	54	3.5	5	482.45
PN ^d	Female	48	4.3	6	289.66
UPM ^e	Male	55	4.3	6	185.58
UPN ^f	Female	42	3.1	5	161.91

Notes: a = non-poor project member; b = non-poor non-member; c = poor project member; d = poor non-member; e = ultra-poor project member; f = ultra-poor non-member

Table 7: Socio-economic characteristics of Khayaletu case during September 2008

Poverty class	Gender head	Age head	Adult equivalent	Household size	AE income
NPM	Female	68	3.9	5	947.93
NPN	Female	67	1.9	2	1260.41

PM	Female	77	4.6	7	380.12
PN	Male	39	2.3	3	675.11
UPM	Female	70	4.6	7	203.32
UPN	Female	77	3.1	4	278.50

5.4.2. Impact of IRWH technique on food diversity

The introduction of the WH project has made a positive impact on household food security. About (96%) of the project members felt that they were better off since the introduction of the IRWH technology in 2004. When asked about whether their household members ever went hungry, the majority said never. About 80% of respondents could afford three meals a day whilst the remaining 20% ate two meals everyday. None survived on one meal as was the case in the past (Monde, 2003). The respondents also indicated that even the quality of diet improved since the introduction of the WH project. They began to produce more vegetables in home gardens. These include cabbage, carrot, tomatoes, beetroot and spinach as well as new vegetables such as cauliflower, broccoli, turnips and green pepper. About 38% of the project members consumed vegetables on a daily basis.

The food security situation was a little bit different for the non-project members. Unlike, the project members, they did not produce a variety of vegetables. The main vegetable produced in home gardens was still cabbages. Although the non-project members did not grow many vegetables in their gardens, they also managed to consume a variety of vegetables obtained from friends and relatives who are project members. The main source of vegetables for the non-project members was local producers during summer while own production was the main source for project members during summer and autumn seasons. This is a big change for these communities as these sources were never the main sources of vegetables before 2004.

To assess food consumption and diversity, seven food groups were considered. These were: Cereals, roots and tubers; pulses and legumes; dairy products; meats and meat products; oils and fats; fruits; and vegetables. Indicators of diet quality used were household diet diversity and the percentage of households with low diet diversity. Diet quality refers to the variation of food

consumed by households (Smith *et al*, 2006). Based on the food data collected from households, diet diversity was calculated by counting the number of food groups out of seven, from which food was acquired over the survey reference period. The percentage of households with low diet diversity was measured by determining whether a household failed to acquire at least one food from four of the seven groups over the reference period. The seasonal food calendars of different categories of households showing the amounts of food consumed by one person from each food group are presented in Figures 5 to 10. The food calendars are for the non-poor, poor and ultra-poor project members and non-project members.

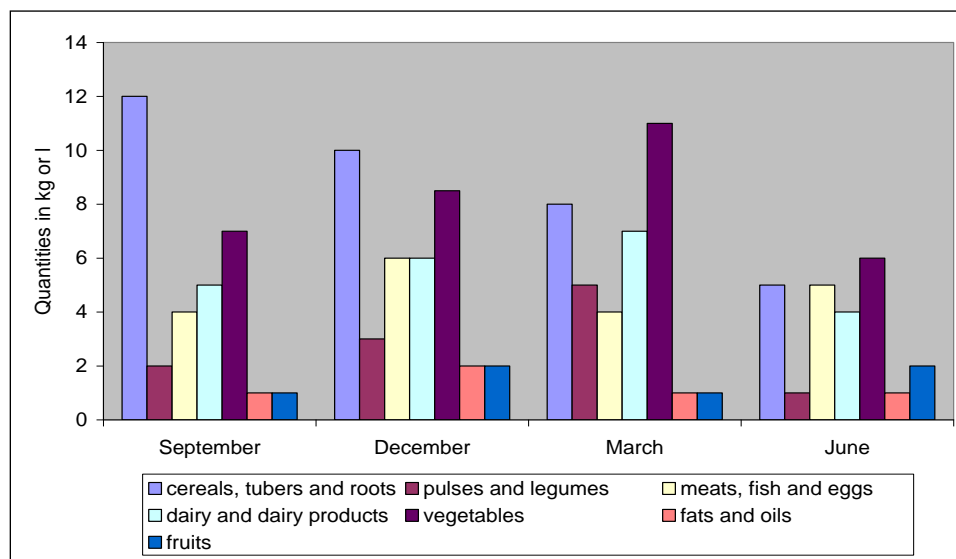


Figure 5: Seasonal food calendar of the non-poor households showing the amounts and kinds of food consumed by one adult equivalent among the project member category (September 2008 to June 2009)

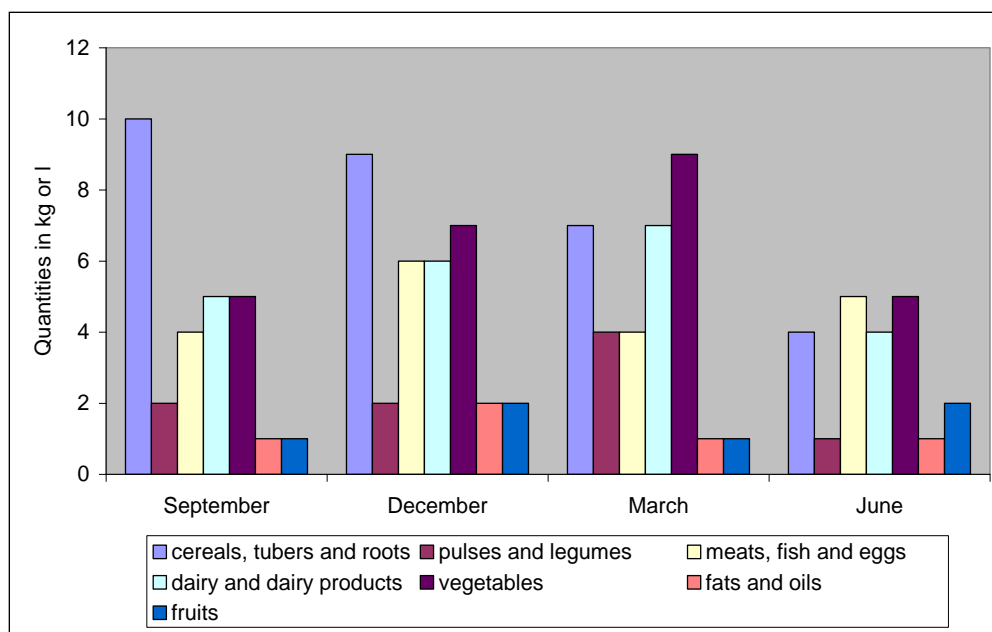


Figure 6: Seasonal food calendar of the non-poor households showing the amounts and kinds of food consumed by one adult equivalent among the non-member project category (September 2008 to June 2009)

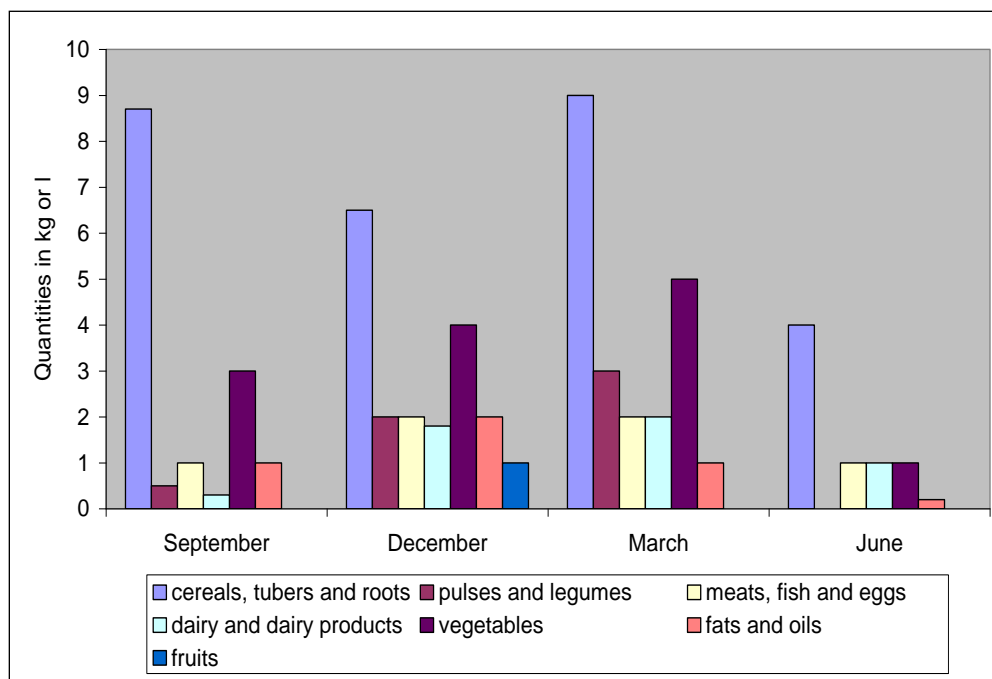


Figure 7: Seasonal food calendar of the poor households showing the amounts and kinds of food consumed by one adult equivalent among the project member category (September 2008 to June 2009)

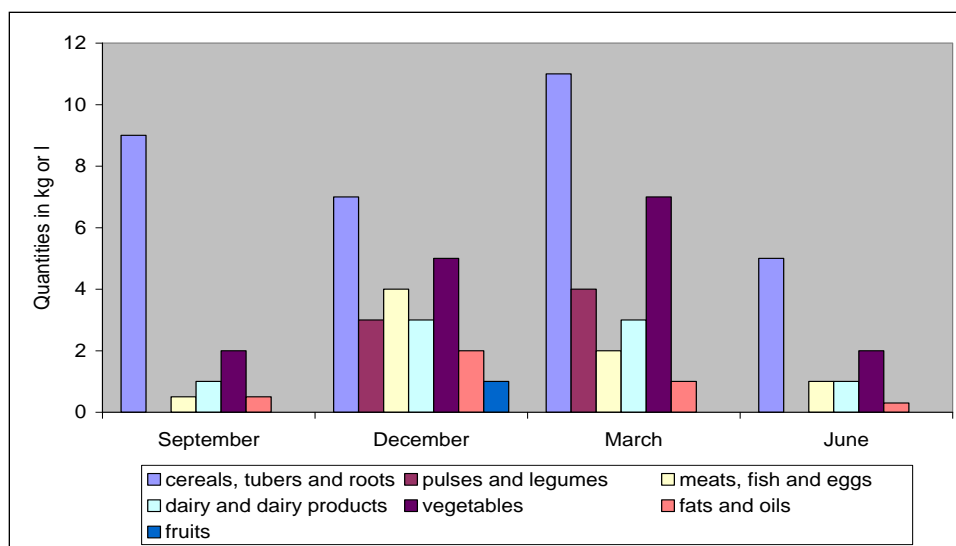


Figure 8: Seasonal food calendar of the poor households showing the amounts and kinds of food consumed by one adult equivalent among the non-member project category (September 2008 to June 2009)

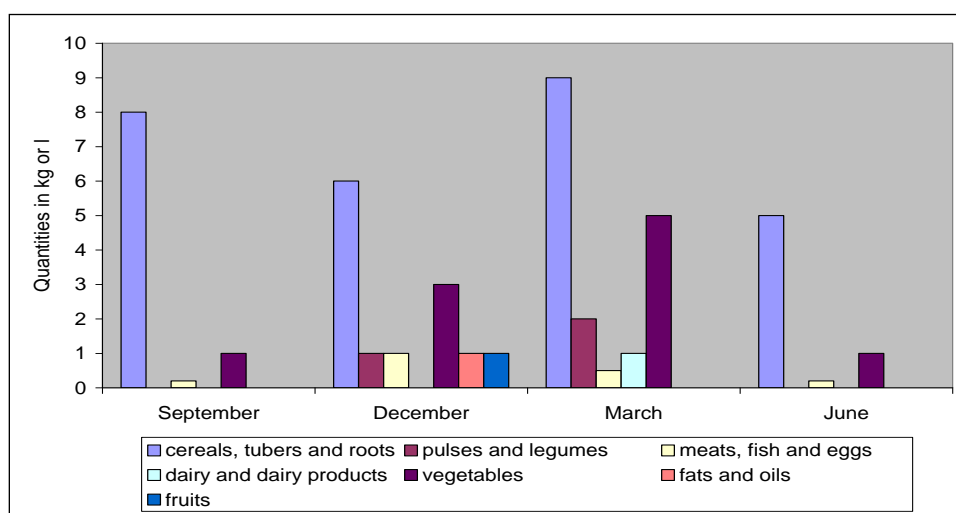


Figure 9: Seasonal food calendar of the ultra-poor households showing the amounts and kinds of food consumed by one adult equivalent among the project member category (September 2008 to June 2009)

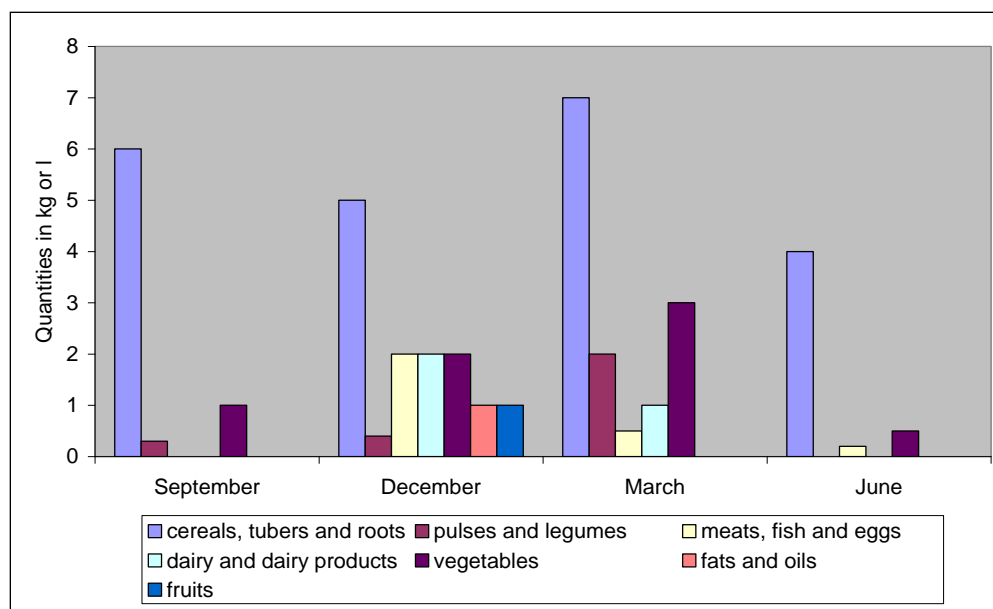


Figure 10: Seasonal food calendar of the ultra-poor households showing the amounts and kinds of food consumed by one adult equivalent among the non-member project category (September 2008 to June 2009)

All non-poor households both project members and non-members consumed foods from all seven food groups at all seasons. However the consumption of cereals, legumes and vegetables was higher among project members than was the case in non-members. The poor households also managed to consume foods from more than four food groups at all seasons even though the portions consumed by one adult equivalent were small. Fruits and legumes were omitted in the diet of these households during September and June. The diet of the ultra-poor also showed variation during the summer (December) and autumn (March) seasons. However, their diet during the spring (September) and winter (June) was of poor quality. These households had low food diversity during these times as their diet was limited to three food groups only (cereals, vegetables and meats). The diet of these households during these critical times consisted mainly of cereals.

Of the seven food groups presented in these figures, all households at both villages consumed larger quantities of cereals, tubers and roots. Also, all households showed more consumption of cereals during the spring season (September). This appears to be the consumption pattern in this area. These results confirm findings by Monde (2003) in the same area. Most cereal products

consumed are the maize products namely, maize meal and samp. Maize is harvested in June in the study area and hence more consumption of cereals during spring. The consumption pattern of non-project members followed a similar pattern but two important differences were noticed. Firstly, the portions of cereals, vegetables and legumes consumed by all poverty classes among the non-members were smaller. This difference was noted between households in the same village and between the two villages. The difference between villages was brought about by the differences in garden sizes. The Guquka households had slightly larger (300m²) home gardens than Khayaletu (211m²). Secondly, the ultra-poor households from the project member group consumed bigger portions of vegetables during the seasons of scarcity (winter and spring) while their counter partners in the non-member category group consumed less quantities.

5.4.3. Impact on energy and protein intakes

The energy and protein intakes of households investigated in both villages are shown in tables 8 and 9. The information presented in these tables show average figures in respect to recommended daily allowances of energy and protein as well as intakes of these nutrients at different times of the year by one adult equivalent in all households. It also shows the contribution of home garden produce throughout the year. As already mentioned, these are average figures recommended for and consumed by household members in each poverty class. With regard to the consumption of energy, table 8 shows highest consumption of energy in summer followed by autumn season. All non-poor households met their energy requirements at all seasons. With the exception of ultra-poor households who were non-project members, all households met their energy in summer. In autumn, none of the ultra-poor households whether project members or not had enough levels of energy. During winter and spring the food insecurity also affected the poor households as well. The poor non-project members could not achieve the required energy levels in winter and the project members in the same poverty class were also did not have enough energy.

The month of December is usually a period of plenty whereby households consume a variety of foods obtained from different sources. The popular food sources at this time are ceremonies and social functions. Even the poor households were able to consume enough levels of energy at this

time as revealed in Table 8. The intake of energy by the ultra-poor households in summer also improved even though they still showed some energy deficiencies.

The contribution of home garden produce to energy intakes, however, was highest during the spring (September) due to high intakes of cereals at that time. The main cereals consumed by all households at this time are maize meal and samp. These are processed products derived from the maize obtained from the gardens. Hence home gardens contribute more to energy intakes at this time of the year. Its contribution was also higher among the project members in all poverty categories.

Table 8: Energy consumption (kcal) among the project members and non-members by poverty class and the contribution of home gardens at different seasons in Guquka and Khayaletu during 2008/9

	RDA^a	Sept	HG^b	Dec	HG	March	HG	June	HG
	(kcal)	(kcal)	%	(kcal)	%	(kcal)	%	(kcal)	%
NPM ^c	1923	2360	40.5	2450	28.5	2375	30.1	2290	35.3
NPN ^d	2336	2370	35.3	2495	25.3	2415	27.4	2355	33.6
PM ^e	2198	2315	38.1	2400	27.2	2385	28.5	2283	34.8
PN ^f	2760	2530	32.7	2775	23.4	2690	25.1	2512	30.2
UPM ^g	2655	2130	36.7	2345	25.8	2300	28.5	2105	30.5
UPN ^g	2241	1950	30.6	2100	22.1	2092	23.4	1937	28.7

Notes: a = recommended daily allowance; b = home garden; c = non-poor member; d = non-poor non-member; e = poor member; f = poor non-member; g = ultra-poor member; h = ultra-poor non-member

Table 9 shows protein intakes amongst the poverty classes as well as the contribution of home garden produce at different times of the year. The figures presented in this Table show protein deficiencies amongst most households in the study area. Only the non-poor households were able to consume enough protein at all seasons. The poor and the ultra-poor households (irrespective of whether they were project members or not), did not have enough protein. However, the project members in all poverty classes managed to consume higher protein levels when compared to

their counterparts (non-members). The protein consumption was again highest in summer followed by autumn across all poverty classes.

As shown in Table 9, garden produce did not contribute much to protein intakes. The contributions ranged from 0.1 to 4.6 depending on the season. Highest contributions of garden produce to protein intakes were recorded during autumn season. Most of the protein consumed by households was animal protein. The protein composition of crops and vegetables produced in home gardens was very low to make substantial contributions to protein intakes. Protein consumption was again higher amongst the project members.

Table 9: Protein consumption (g) among the project members and non-members by poverty class and the contribution of home gardens at different seasons at different seasons in Guquka and Khayaletu during 2008/9

	RDA*	Sept	OP	Dec	OP	March	OP	June	OP
	(g)	(g)	%	(g)	%	(g)	%	(g)	%
NPM	62	64	0.5	67	1.8	65	4.6	63	0.4
NPN	57	59	0.3	65	0.7	61	2.4	59	0.2
PM	61	56	0.4	59	1.2	57	3.3	54	0.3
PN	62	53	0.2	59	0.5	55	2.1	51	0.1
UPM	63	46	0.3	58	1.0	56	1.8	44	0.2
UPN	57	43	0.1	53	0.3	51	1.2	41	0.1

5.4.4. Impact of IRWH technique on Vitamins A and C intakes

Tables 10 and 11 show the intakes of vitamins A and C by different categories of households as well as contribution of home garden produce to the intake of these essential minerals at all seasons. None of the households investigated met their requirements of Vitamins A and C, even the non-poor households. However, the contribution of garden produce to the consumption of Vitamins A and C was significant especially during the wet seasons (summer and autumn). Similar findings were noted by Van Averbek and Khosa (2007). The contribution of garden

produce to the consumption of essential vitamins amongst the project members in all poverty categories was higher than that of non-members.

Table 10: Vitamin A consumption (µg RE) among the project members and non-members by poverty class and the contribution of home gardens at different seasons at different seasons in Guquka and Khayaletu during 2008/9

	RDA*	Sept	HG	Dec	HG	March	HG	June	HG
			%		%		%		%
NPM	1181	1060	29.2	1155	45.1	1190	57.3	1053	27.5
NPN	1197	1045	16.9	1142	30.8	1183	38.4	1036	15.1
PM	1276	1005	27.3	1180	42.2	1198	51.5	1001	25.5
PN	1160	990	15.1	1050	29.5	1075	35.6	996	14.3
UPM	1248	1060	22.7	1148	38.6	1163	45.3	1045	20.4
UPN	1323	998	14.8	1056	26.5	1089	32.7	987	13.9

Table 11: Vitamin C consumption (mg) among the project members and non-members by poverty class and the contribution of home gardens to nutrient intake at different seasons at different seasons in Guquka and Khayaletu during 2008/9

	RDA*	Sept	HG	Dec	HG	March	HG	June	HG
			%		%		%		%
NPM	74	68	22.8	70	43.2	75	54.2	65	20.1
NPN	70	63	17.8	65	30.9	68	37.3	61	16.5
PM	76	65	24.6	68	41.6	72	48.7	63	22.4
PN	73	62	14.2	63	28.5	70	30.7	60	13.8
UPM	74	66	20.1	69	38.9	71	45.3	63	19.5
UPN	78	65	12.8	68	24.5	72	28.7	61	11.4

Vitamin A, which is a fat-soluble vitamin, plays essential roles in vision, growth, and development. It is also called is also called retinol. Measurement of the amount of vitamin A is

taken in retinol activity equivalents (RAE). A good source of vitamin A contains substantial amounts of vitamin A and/or carotene in relation to its calorie content and contributes at least 10% of the RDA for vitamin A in a serving. Vitamin A can be lost from foods during preparation, cooking, or storage. To prevent loss of vitamin A, it is recommended to consume raw fruits and vegetables whenever possible (Browne, 1993).

The food sources of Vitamin A include sweet potatoes, carrots, pumpkins, peppers, spinach, etc. the amount of Vitamin A contained in these vegetables tend to differ. Some vegetables contain more Vitamin A than others. In fact, sweet potatoes contain the highest amounts of Vitamin A than carrots. For example, one baked medium sweet potato contains 1096mg of Vitamin A compared to only 671mg of half cup of cooked carrots. Also, the way people prepare or consume their vegetables is important. For example three quarter cup of carrot juice seem to contain more (1692mg) of Vitamin A than cooked carrot or sweet potatoes for that matter. None of the households investigated produced sweet potatoes. The production of carrots was common though, however, none of the households consumed carrot juice. So, it's not just what they produce and consume that has an effect on their nutritional status, it's their knowledge of nutritional education as well.

Dietary deficiency occurs only in people who have an exceptionally poor diet; it is most common in some developing countries. The effects of vitamin A deficiency include poor night vision; dry inflamed eyes; dry, rough skin; loss of appetite; diarrhea; and lowered resistance to infection. Severe deficiency may cause weak bones and teeth, corneal ulcers, and in extreme cases, keratomalacia. This is an eye disorder in which there is severe corneal damage that can lead to blindness if untreated.

Vitamin C is water soluble and antioxidant vitamin, which is used for proper functioning of human body. Unlike Vitamin A, it cannot be stored in the body. It is excreted from the body regularly, meaning that one has to supply it regularly to the body. It is also known as ascorbic acid. Ascorbic acid is an antioxidant which helps in protecting the body against pollutants. Ascorbic acid helps in promoting healthy cell development, normal tissue growth and repair such as healing injuries and burns, and helps in absorption of calcium. The main function of vitamin C

is that it helps in the synthesis of collagen. Collagen is an important component of ligaments, blood vessels, bone and tendons. It is found throughout the body, present in cartilage and connective tissues and is used to separate skeletal and smooth muscle cells.

Vitamin C is obtained from vegetables and fruits. The foods which are rich in it are oranges, water melon, cabbage, cauliflower, papaya, grapes, strawberries, kiwi, broccoli, mango, tomatoes, Brussels sprouts, and citrus juices. Vitamin C can be easily lost from foods during preparation, storage or cooking. To preserve vitamin C, one has to follow some precautions. It is again recommended to take fruits and vegetables in raw form. When vegetables are to be cooked, boil, steaming, or simmering foods in minimum water for shorter time is recommended. Prepared fruit juices should not be stored or refrigerated for more than two days. After cutting, raw fruits and vegetables should be stored in airtight container and should be refrigerated. Fruits or vegetables should not be stored in water as vitamin C will be dissolved in water.

Scurvy is the main disease that is caused by vitamin C deficiency. It is characterized by loose teeth, anemia, poor healing, easy bruising and fragility of blood vessels. The other deficiencies include dry and splitting hair, bleeding gums, nose bleeds, swollen and painful joints, rough and dry skin. The symptoms of vitamin C deficiency include weight loss, irritability, fatigue, depression and weakness. Low levels of it cause gall bladder disease, atherosclerosis, hypertension, stroke and cancer. The occurrence of the diseases in the study was not investigated though

5.4.5. Impact of IRWH technique on Iron intakes

Table 12 shows the intake of iron by households as well as the contribution of garden produce to the intake of this mineral at different times of the year. The information presented in this table show all categories of households to consume insufficient amounts of iron. As was the case with protein intakes, home gardens were not important in terms of supplying the household members with iron. But still the intake of iron amongst the project members was better than that of the non-members, especially during summer and autumn seasons.

Table 12: Iron consumption (mg) among the project members and non-members by poverty class and the contribution of home gardens at different seasons in Guquka and Khayaletu during 2008/9

	RDA*	Sept	HG	Dec	HG	March	HG	June	HG
			%		%		%		%
NPM	15	9	2.2	11	2.7	10	2.9	9	1.8
NPN	12	9	1.0	10	2.2	10	2.4	9	1.1
PM	16	8	1.8	11	2.5	13	2.8	8	1.5
PN	14	7	1.2	10	2.1	12	2.3	7	0.9
UPM	17	9	1.5	12	2.4	11	2.6	9	1.1
UPN	15	8	0.8	10	1.8	11	1.2	7	0.6

Iron (Fe) is a component of red blood cells and the muscles that assist in the transportation of oxygen throughout the body. It is essential for the formation of hemoglobin and certain enzymes that maintain good health. It also transports oxygen in the blood to all parts of the body. It is also responsible for many metabolic reactions and the regulation of cell growth and differentiation, immune activity, as well as proper functioning of the liver. Iron deficiency can lead to anaemia, a condition when the iron stores in the body become depleted and hemoglobin synthesis is inhibited. Symptoms and signs of anaemia include feeling tired and weak, difficulty in maintaining body temperature, decreased immune function, which increases susceptibility to infection, headaches, insomnia, and loss of appetite.

Dietary iron exists in two different forms, namely, haem and non-haem. Haem iron only exists in animal tissues, whilst in plant foods iron is present as non-haem iron. Non-haem iron is less easily absorbed by the body than is haem iron. The amount of iron absorbed from various foods ranges from around 1 to 10% from plant foods and 10 to 20% from animal foods. Good sources of iron in plant foods include wholegrain cereals and flours, leafy green vegetables, some dried fruits and pulses, such as, lentils and kidney beans (Sullivan, 2002).

5.5. Overall nutritional problem in the study area

The results presented in this chapter show the IRWH technology to have a positive impact on food security and nutrition of households. The technology made significant contributions to the amount of energy and vitamins A and C consumed by households especially during wet seasons. Substantial contributions of garden produce were noted among the project members. However, these contributions were not enough to ensure household food security. The results indicate that there are nutritional problems in the study area. Firstly, there is protein-energy malnutrition mainly affecting the poor and the ultra-poor households. Secondly, there is hidden hunger affecting all poverty categories, even the non-poor households. This is mainly demonstrated by poor diet quality i.e. diet that lacks essential nutrient mentioned above.

When people omit certain foods from their diet or consume relatively small quantities of these foods, they are likely to show problems of food insecurity and poor nutrition. The cereals, roots and tubers that are consumed in larger quantities by these households are the main source of dietary energy. In order to get sufficient requirements of other nutrients, people need to consume enough quantities of meat and dairy products as well as fruits and vegetables on a daily basis (Smith *et al*, 2006). The United Nations' (2007) report also revealed that while the poverty rate has declined by nearly six percent (6%) since 2000 in Sub-Saharan Africa, the region is not on track to reach the goal of reducing poverty and hunger by half by 2015. These results support such findings.

5.6. Categorisation of households according to food security status

Bickel *et al* (2000) noted the following four categories which are being used to categorize households in United States of America:

Food secured households i.e. those that show no evidence of food insecurity.

Food insecure without hunger: Food insecurity is not evident amongst household members as the number of meals is not reduced, however, the quality of food consumed is poor and there is an increase in unusual coping patterns,

Food insecure with moderate hunger: Food intake for adults in the household is reduced to an extent that implies that adults have repeatedly experienced the physical sensation of hunger. In most (but not all) food-insecure households with children, such reductions are not observed at this stage for children.

Food insecure with severe hunger: All households with children have reduced the children's food intake to the extent that signs of malnutrition are visible, indicating that the children have experienced hunger. For some other households with children, this already has occurred at an earlier stage of severity. Adults in households with and without children have repeatedly experienced more extensive reductions in food intake.

Applying the same categorization of households in the study area, the following conclusions can be made: From the data presented in this report, category one, which is food secure households, does not exist in the study area. Households investigated belong to categories two, three and four. Category two (food insecure without hunger) affect the non-poor households, whether project members or not. However, the diet of the project members tend to be slightly better than that of non-members as demonstrated in Section 5.3. It is also concluded that the poor households belong to category three (food insecure with moderate hunger) while the ultra-poor household belong to category four (food insecurity with severe hunger). However, no distinction was made as to whether hunger affected more or less adults or children in this study.

CHAPTER 6: SUMMARY OF FINDINGS , CONCLUSIONS AND POLICY RECOMMENDATIONS

6.1 Summary of the findings

In Guquka the majority of households (76 %) were headed by males, whereas in Khayaletu the majority (64 %) was headed by females. In both settlements fifty to sixty percent of households were headed by a retired person. The proportion of household heads unemployed was much higher in both household categories at Guquka than that of Khayaletu. Households headed by a person in formal employment were higher amongst the non-project members in both villages.

The findings show that food is still the main expenditure category among the rural households and that household food security is attained mainly through purchased food. Own-production of food is still not important in terms of attaining household food security in rural areas. This makes the income to be a key determinant of food security, having a larger influence over both diet quantity and diet quality. The proportion of income spent on food was smaller for households with incomes that were higher than the PL (R605). The opposite was true for poor and ultra-poor households. The correlation co-efficient was even higher ($R^2 = 0.9$) for the non-project member group. The R^2 was 0.8 for the project members, and at R600 the proportion was less than 30% compared to more than 50% among the non-members.

Although no significant changes were noted in the contribution of various income sources to household incomes, the external economic activities are still the main sources of income in these villages. Local economic activities, including agriculture still make modest contributions. Grants followed by salaries and wages were the most important sources of income in both categories. While the contribution of agriculture to household income is still less than 15% in the area (13.3% for project members and 8.1% non-project members), an improvement in the contribution of this income source was noticed in both household categories. This improvement is a result of better utilization of home gardens (land use intensity). Hence, 75% of respondents mentioned that they earn money from selling vegetables, however small. Amongst agricultural

activities, home gardening was the main activity and it made significant contributions to agricultural income.

Only 17% of households in the project member group were categorized as non-poor as they earned incomes that were above Poverty Line. The rest (83%) of households were poor. Forty five percent (45%) of these poor households earned incomes that were below R302.06, which is half of poverty line, and therefore were categorized as ultra-poor households. The other 38% earned incomes that were between these two limits (PL and half of PL), and were categorized as poor households. For the non-project member group, the non-poor households amounted to 7%, ultra-poor 57% and the poor households 36%.

About 84% of respondents from the project member group indicated that the costs on agricultural inputs had decreased since the introduction of the project. Reasons for this change being: Firstly, the decrease in input expenditure has been brought by the fact that the project beneficiaries no longer use the tractor-drawn implements in home gardens. The application of the IRWH technology encourages minimum tillage. So, instead of using the plough, the respondents make use of garden tools and implements such as hoes and spades. Secondly, the beneficiaries do not pay a full price for the inputs such as seeds, fertilizers and pesticides as they are subsidized. Thirdly, the majority make use of family labour to carry out most garden activities.

6.2 Conclusions

From the findings of this investigation, it can be concluded that the IRWH technology introduced at Guquka and Khayaletu has a positive impact on household food security. The results also indicate that this technology has a potential to address nutritional problems in rural areas. The intake of essential nutrients by beneficiaries (project members) of the water harvesting project was much better compared to that of the non-project members. The intake of vitamin A and C improves considerably during wet seasons. Even the poor and ultra-poor households consumed higher quantities of these nutrients. Home garden produce (own production) made significant contributions to household nutrition during wet seasons.

The introduction of the WH project has made a positive impact on household food security. About (96%) of the project members felt that they were better off since the introduction of the IRWH technology in 2004. About 80% of respondents could afford three meals a day whilst the remaining 20% ate two meals everyday. None survived on one meal as was the case in the past. The respondents also indicated that even the quality of diet improved since the introduction of the WH project. They began to produce more vegetables in home gardens. These include cabbage, carrot, tomatoes, beetroot and spinach as well as new vegetables such as cauliflower, broccoli, turnips and green pepper. About 38% of the project members consumed vegetables on a daily basis. The food security situation was a little bit different for the non-project members. Unlike, the project members, they did not produce a variety of vegetables. The main vegetable produced in home gardens was still cabbages. Although the non-project members did not grow many vegetables in their gardens, they also managed to consume a variety of vegetables obtained from friends and relatives who are project members. The main source of vegetables for the non-project members was local producers during summer while own production was the main source for project members during summer and autumn seasons. This is a big change for these communities as these sources were never the main sources of vegetables before 2004.

These results show that these households have two nutritional problems, protein-energy malnutrition affecting poor and ultra-poor households, and hidden hunger affecting all households. None of the households investigated were food secure, even the so called “non-poor” households. The majority (poor and ultra-poor) of households are categorized as food insecure with moderate and severe hunger. This is probably the common scenario in most rural areas.

6.3 Policy recommendations

The purpose of this study was to contribute to the understanding of food security realities at house hold level in the rural areas of the Eastern Cape Province. It also serves to contribute to the information of policy formulation aimed at improving food security in the rural areas of the Eastern Cape. It is therefore recommended that:

- IRWH be implemented in all parts of the province. Though still at a small scale but IRWH seems to be promising in fighting food security although it still has its challenges.
- More water saving technologies should be introduced if food production and household food security is to be improved in rural areas.
- Access to infrastructure and production equipment should be improved in rural areas. Some of the households who were not project members mentioned lack of access to infrastructure and or equipment such as fencing and storage tanks as the main reasons for not adopting the IRWH technique.

6.4 Suggestions for further research

However, in spite of these positive impacts these households were still food insecure. There are two main reasons for this.

- One, the IRWH does not seem to have an impact during dry seasons. With regard to this, important questions arise as to whether this technology is suitable for summer rainfall areas, and whether an alternative technology should be implemented in conjunction with IRWH, especially during dry seasons.
- Two, lack of access to nutrition education amongst these households is another factor that contributes to food insecurity. The question of nutrition education is relevant but also complicated in the sense that it is not easy to change long standing diet habits. However, if this is not addressed, all food security interventions are likely to have similar impacts.

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APPENDIX 1

UNIVERSITY OF FORT HARE
FACULTY OF SCIENCE AND AGRICULTURE
Department of Agricultural economics and extension

IMPACT OF IN-FIELD RAINWATER HARVESTING TECHNOLOGY ON HOUSEHOLD FOOD SECURITY: A CASE OF GUQUKA AND KHAYALETHU VILLAGES IN CENTRAL EASTERN CAPE PROVINCE

COMPILED BY Y.H. HLANGANISE - Mobile No. 072 6130 785

Interviewer's name	1. :
Interviewee's name	2. :
Date	
Village	
Household status	
Questionnaire number	

A. DEMOGRAPHIC INFORMATION

A 1. Household characteristics

	Relation to househol d head	Age	Gender (m/f)	Marital status	Highe st educ. Qual.	Employment status	Occupation	Field of employment	Time at home
	a	b	c	d	e	f	g	h	i
A1.1									
A1.2									
A1.3									
A1.4									
A1.5									
A1.6									
A1.7									
A1.8									
A1.9									
A1.10									

B. LAND AND AGRICULTURE

RESIDENTIAL SITE

B1 Does this household own a residential site?

Yes = 1 No = 2

B2. If yes

B2.1 What form of ownership does your household have over this residential site?

Certificate of occupation	
Private ownership (title deed)	
Don't know	
Other (specify)	
.....	
.....	

B2.2 Is your household in possession of a written document proving ownership of your residential site? (Yes =1 / No=2 / Don't know =3)

B3 If no

How did your household get access to the homestead where you stay?

.....

B4 What is the size of your residential site?

.....m x.....m

B5 Do you have a garden on your residential site?

(Yes = 1 / No =2)

B6 What is its size?

.....m x.....m

B7 Do you grow crops or vegetables in your garden?

(Yes = 1 / No =2)

B8 How many fruit trees do you have on your residential site?

B9 How many trees other than fruit trees grow on your residential site?

B10 Which of the following micro – livestock do you keep and indicate numbers owned?

	Type	Number owned
B10.1	Broilers	
B10.2	Layers	
B10.3	Dual – purpose chickens	
B10.4	Pigeons	
B10.5	Geese	
B10.6	Ducks	
B10.7	Turkeys	
B10.8	Rabbits	
B10.9	Pigs	

B10.10	Dogs	
B10.11	Cats	
B10.12	Other (specify)	

ARABLE LAND

B11 Do you have access to one or more arable fields? Yes = 1 No =2

B12 If yes

How many fields to you have access to? (Indicate number)

B13 What is the size of each of the fields?

		Area (indicate units)
B 13.1		
B 13.2		
B 13.3		

B 14 How did you obtain access to each of the fields? (Tick where applicable)

		B 14.1	B 14.2	B 14.3
		Field 1	Field 2	Field 3
a	Bought from a private person (Title deed)			
b	Rented from another household			
c	Inherited from parents (Title deed)			
d	Inherited from parents (Tribal land)			
e	Given by government through tribal authority			
f	Given by government through the residential committee			
g	Other (specify)			

B 15 Did you grow any crops on your arable land during any of the past three seasons?

(Yes = 1; No =2)

B 16 If no, Why not?

--

.....

RANGE LAND

B 17 Do you have access to range land (yes = 1; no = 2)

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B 18 How did you obtain access to range land? (Tick where applicable)

By virtue of being a resident in this community	
Through an application to the Tribal Authority	
Through an application to the residents committee	
Other (specify)	

☐

B 19 What does your household use access to range land for? (Tick where applicable)

	Uses	Yes = 1 No =2
B 19.1	Grazing of animals	
B 19.2	Collect fire wood	
B 19.3	Collect wood for building	
B 19.4	Collect wood for fencing	
B 19.5	Collect bush for kraals and other enclosures	
B 19.6	Collect grass for feeding animals	
B 19.7	Collect plants for medicinal purposes	
B 19.8	Collect grass for thatching	
B 19.9	Other (specify)	

B 20 Which of the following livestock do you keep and indicate numbers owned?

	Type	Number owned
B 20.1	Cattle	
B 20.2	Sheep	
B 20.3	Goats	
B 20.4	Horses	
B 20.5	Donkeys	
	Other (specify)	

C INCOME

C 1 What are the sources of income available to your household and what amounts are received per month or per year?

EXTERNAL SOURCES

	Source	C	EXP/C (R)	Tot.inc/C (R)	No. C/a	Net inc/a (R)
C 1.1	Remittances (Cash)					
C 1.2	Remittances (Kind)					
C 1.3	Child support from parent outside household					
C 1.4	Salaries and Wages					
C 1.5	Overtime					
C 1.6	Bonuses					
C 1.7	Pensions					
C 1.8	Disability grant					
C 1.9	Child support grant					
C 1.10	Other government grants					

LOCAL SOURCES : TRADE

C 2.1	Hawking (food)					
C 2.2	Hawking (other)					
C 2.3	Spaza shop					
C 2.4	Shop					
C 2.5	Selling liquor/shebeen					
C 2.6	Lending money					
C 2.7	Other trade					

LOCAL SOURCES:

AGRICULTURE

C 3.1	Source	C	Exp/C	GI/C	C/a
-------	--------	---	-------	------	-----

C 3.2	Agriculture (Kind) : crops				
C 3.3	Agriculture (Kind) : animals				
C 3.4	Agriculture (Cash) : crops				
C 3.5	Agriculture (cash) : animals				

LOCAL SOURCES: HOUSING INDUSTRY

C 4.1	Building of houses / thatching				
C 4.2	Carpentry				
C 4.3	Electrical installations				
C 4.4	Plumbing				
C 4.5	Making toilets				
C 4.6	Sewing and selling clothing				
C 4.7	Brick making				
C 4.8	Brooms, baskets and other				
C 4.9	Making and selling food/ meals				
C 4.10	Preparing and selling traditional medicines				
C 4.11	Arts and craft				
C 4.12	Chopping and selling wood				

LOCAL SOURCES: TRANSPORT

C 5.1	Transport of goods and people				
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LOCAL SOURCES: MAINTANANCE

C 6.1	Repairs (electric)				
C 6.2	Repairs (mechanical)				
C 6.3	Repairs (other)				

LOCAL SOURCES: AGRICULTURAL SERVICES

C 7.1	Land preparation for farmers				
C 7.2	Fencing and kraal making				

LOCAL SOURCES: OTHER

C 8.1	Provide casual labour to other community members (All tasks)				
C 8.2	Other self employment activities				

D EXPENDITURE

D 1 How much money does your household spend on the following items per month or per year?

	Item	C	EXP/C (R)	C/a	EXP/a R)
D 1.1	Groceries				
D 1.2					
D 1.3					
D 1.4	Fuel				
D 1.5	Clothing				
D 1.6	Furniture				
D 1.7	Medical expenses				
D 1.8	Educational expenses				
D 1.9	Transport (work)				
D 1.10	Transport (other)				
D 1.11	Housing rates and				

	rentals				
D 1.12	Maintenance / Building of residence				
D 1.13	Maintenance (other)				
D 1.14	Hiring of labour				
D 1.15	Telephone and postage				
D 1.16	Subscription and membership fees				
D 1.17	Church contributions				
D 1.18	Entertainment, tobacco and liquor				
D 1.19	Interests on loan				
D 1.20	Other (specify)				

D 2 Do you save any money in any of the following? (Tick where applicable)

		Total amount a	Amount per month (R) b	Total amount per annum (R) c
D2.1	Formal institutions (banks, building societies, trusts)			
D2.2	Saving policy/insurance			
D2.3	Burial clubs			
D2.4	Mgalelo			
D2.5	Other (specify)			

D3 Do you have any credit still outstanding?
Yes = 1; No=2

D4 If yes provide the following information

	Institution or person a	Amount (R) b	Interest rate c	Guarantee d	Duration e
D4.1					
D4.2					
D4.3					
D4.4					
D4.5					

E DIETARY INFORMATION

E1. Has your household have enough food to eat?

Yes = 1; No=2

E2 If No

E2.1 Give reasons why

.....
.....
.....

E3 Are there times that your household go hungry? Indicate how often

E3.1	Very often (several days every month)	
E3.2	Often (at least a few days in most months)	
E3.3	Rarely (not more than ten days per year)	
E3.4	Very rarely (one or two days per year)	
E3.5	Never	

E4 Are there particular times of the year during which food is in short supply?

Yes = 1; No=2

E5 If yes indicate period or season

E6 Are there particular times of the year during which food is abundant?

Yes = 1; No=2

E7 If yes indicate period or season

.....

E8 Please indicate which meals does your household usually have a day. (Tick where applicable)

Week days	Breakfast	Mid-morning snack	Lunch	Mid- afternoon snack	Dinner
Week days					
Saturday					
Sunday					

E9 Please provide the following information about your household's meals during week days

Meal time	Meal content	Main ingredients

E10 Please provide the following information about your household's meals during weekends.

Meal time	Meal content	Main ingredients

E11 Please provide the following information about the source of meal ingredients used by your household.

	Ingredient	Source	C	Amount/C	C/a	Amount /a
E11a	Maize meal					
E11b	Samp / maize grain					
E11c	Dry beans					
E11d	Dry peas					
E11e	Rice					
E11f	Flour					
E11g	Sunflower oil					
E11h	Solid vegetable fat					
E11i	Sugar					

Coding 1 = grown in own vegetable garden/ field
 2 = bought fro a vegetable producing friend/neighbour
 3 = bought from local shop
 4 = bought outside community
 5 = other (specify)

E12 How often does your household eat vegetables obtained from the following sources (indicate cycle and season)

	Source	Cycle	No/C	C/a	Season
E12.1	collected in fields or range lands				
E12.2	Grown in own vegetable garden				
E12.3	bought from a vegetable producing neighbour/ friend				
E12.4	bought from local shop				
E12.5	bought from local hawkers				
E12.6	bought outside community (

	e.g. town)				
E12.7	donated by friends or relatives				
E12.8	others (specify)				

E13 How often does your household eat fruit obtained from the following sources? (Indicate cycle and season)

	Source	Cycle	No/C	C/a	Season
E13.1	collected in fields or range lands				
E13.2	Grown in own orchard				
E13.3	bought from a fruit producing neighbour/ friend				
E13.4	bought from local shop				
E13.5	bought from local hawkers				
E13.6	bought outside community (e.g. town)				
E13.7	donated by friends or relatives				
E13.8	others (specify)				

E14 How often does your household eat meat obtained from the following sources? (Indicate cycle and season)

	Source	Cycle	No/C	C/a	Season
E13.1	at festivities and funerals				
E13.2	slaughtering of own animals				
E13.3	Consumption of animals that have died of natural causes				
E13.4	bought from a animal producing neighbour/ friend				
E13.5	bought from local shop				
E13.6	bought from local hawkers				
E13.7	bought outside community (e.g. town)				
E13.8	donated by friends or relatives				
E13.9	others (specify)				

E15 How often does your household consume milk products (fresh milk, masi, cheese) obtained from the following sources? (Indicate cycle and season)

	Source	Cycle	No/C	C/a	Season
E15.1	from own animals				
E15.2.	bought from milk product producing neighbour/ friend				
E15.3	bought from local shop				
E15 .4	bought from local hawkers				
E15 .5	bought outside community (e.g. town)				
E15 .6	donated by friends or relatives				
E15 .7	others (specify)				

E16 E15 How often does your household eat eggs obtained from the following sources? (Indicate cycle and season)

	Source	Cycle	No/C	C/a	Season
E16.1	from own chicken				
E16.2.	bought from egg producing neighbour/ friend				
E16.3	bought from local shop				
E16 .4	bought from local hawkers				
E16 .5	bought outside community (e.g. town or farmers)				
E16 .6	donated by friends or relatives				
E16 .7	others (specify)				

F. GENERAL

F1 State 3 major community needs

F1.1.....
F1.2.....
F1.3.....

F2 State your 3 major household needs

F2.1.....
F2.2.....
F2.3.....

F3 State your 3 major agricultural needs

F3.1.....
F3.2.....
F3.3.....

F4 Compared to five years ago (1992) has the quality of life of your household:
Improved (=1); remained the same (=2); or deteriorated (=3)

F5 Compared to five years ago (1992) has your agricultural production
Improved=1; remained the same=2; or deteriorated=3