

**AN ASSESSMENT OF AGRICULTURAL SKILLS AND THEIR EFFECT  
ON AGRICULTURAL PRODUCTIVITY AND HOUSEHOLD FOOD  
SECURITY: A CASE OF TUGELA FERRY IRRIGATION SCHEME IN  
KWAZULU-NATAL PROVINCE OF SOUTH AFRICA**

**BY**

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## ABSTRACT

Agriculture is a crucial sector of the economy in many developing countries as it significantly contributes to domestic production and hence household food security. Lack of technical and managerial skills have been cited as the main reasons for poor performance among smallholder farmers. This study assessed the contribution of agricultural skills and knowledge to agricultural productivity, on one hand, and household food security, on the other hand. By identifying agricultural skills that are critical to agricultural productivity, the study seeks to find out ways of improving the level of competence in farmers' agricultural skills, hence, food security. Data was collected from a random sample of 250 smallholder farmers (67% women) in the Tugela Ferry irrigation scheme and Machunwini area in Msinga, KwaZulu-Natal Province of South Africa. A structured questionnaire was administered through face-to-face interviews for data collection. Descriptive statistics were used to present the results of the relationship between gender, age, level of education, access to extension services and agricultural skills and knowledge. Descriptive statistics were also used to present the results of the relationship between agricultural skills and knowledge, and agricultural productivity.

The results of the descriptive statistics show that age of household head, gender, level of education and access to extension services had a significant effect on the level of competence in agricultural skills. It was also observed that agricultural skills and knowledge significantly affected agricultural productivity and household food security. The Ordinary Least Squares regression model was used to determine maize productivity and its results showed that competency in determining planting depth, irrigation scheduling and frequency, education level, farming practice and farming experience had a significant effect on maize productivity. Gender, education level, farming practice, competency in determining planting depth and nutrient deficiency in crops, goat ownership and total income had a significant effect on household food security. These findings of the regression models suggest that adjustment of the respective significant variables can influence agricultural productivity and household food security.

In view of the research findings, the study identified weaknesses in the provision of extension services. Farmers experienced few extension visits and the study recommends that extension

services be improved by increasing the number and effectiveness of extension agents in rural areas.

## DECLARATION

I, Mbongeni Maziya declare that:

1. The research reported in this thesis, except where otherwise indicated, is my original research.
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Signed: ..... Date.....

Mbongeni Maziya

As Research Supervisor, I agree to submission of this thesis for examination

Signed:.....Date.....

Dr M Mudhara

As Research Co-Supervisor, I agree to submission of this thesis for examination.

Signed:.....Date.....

Dr JM Chitja

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## TABLE OF CONTENTS

<b>ABSTRACT.....</b>	<b>i</b>
<b>DECLARATION.....</b>	<b>iii</b>
<b>ACKNOWLEDGEMENTS .....</b>	<b>iv</b>
<b>TABLE OF CONTENTS.....</b>	<b>v</b>
<b>LIST OF FIGURES .....</b>	<b>ix</b>
<b>LIST OF TABLES .....</b>	<b>x</b>
<b>LIST OF ABBREVIATIONS .....</b>	<b>xii</b>
<b>CHAPTER 1: INTRODUCTION.....</b>	<b>1</b>
<b>1.1 Background of the study.....</b>	<b>1</b>
<b>1.2 Problem statement.....</b>	<b>3</b>
<b>1.3 General research objective .....</b>	<b>3</b>
<b>1.3.1 Specific objectives .....</b>	<b>3</b>
<b>1.4 Hypotheses .....</b>	<b>4</b>
<b>1.5 Importance of the study.....</b>	<b>4</b>
<b>1.6 Definition of terms.....</b>	<b>4</b>
<b>1.7 Study limits .....</b>	<b>5</b>
<b>1.8 Organisation of the thesis .....</b>	<b>5</b>
<b>CHAPTER 2: REVIEW OF RELEVANT LITERATURE.....</b>	<b>6</b>
<b>2.1 Introduction .....</b>	<b>6</b>
<b>2.2 Sustainable livelihoods.....</b>	<b>6</b>
<b>2.3 Gender and agriculture .....</b>	<b>9</b>
<b>2.4 Women in agriculture .....</b>	<b>10</b>
<b>2.5 The concept of food security.....</b>	<b>10</b>
<b>2.5.1 Food access .....</b>	<b>11</b>

2.5.2 Food availability .....	12
2.5.3 Utilisation of food.....	13
2.5.4 Stability of food supply.....	13
2.5.5 Determining household food security .....	14
2.6 The role of markets to food security.....	15
2.7 Education and training among rural farmers .....	16
2.8 Skills in agricultural production .....	17
2.9 Constraints limiting rural female farmer’s participation in agriculture.....	20
2.9.1 Limited access to credit.....	20
2.9.2 Land and property rights.....	20
2.9.3 Access to improved agricultural technology .....	22
2.10 Approach and methods of data collection.....	22
2.10.1 Questionnaire surveys .....	22
2.10.2 Participatory Rural Appraisal .....	23
2.10.2.1 Semi-structured interviews.....	24
2.10.2.2 Key informant interviews.....	24
2.11 Summary .....	25
<b>CHAPTER 3: RESEARCH METHODOLOGY .....</b>	<b>26</b>
3.1 Introduction .....	26
3.2 An overview of the Tugela Ferry irrigation scheme .....	26
3.3 Data collection .....	27
3.4 Sampling procedure .....	28
3.5 Data analysis .....	28
3.5.1 Descriptive statistics .....	28
3.5.2 Determinants of agricultural productivity .....	28
3.5.3 Household Food Insecurity Access Scale.....	31

3.5.4 Household Food Insecurity Access Prevalence .....	33
3.5.5 Determinants of household food security .....	33
3.6 Summary .....	37
<b>CHAPTER 4: RESULTS AND DISCUSSION .....</b>	<b>38</b>
4.1 Introduction .....	38
4.2 Demographic characteristics of the households .....	38
4.3 Marital status of farmers .....	39
4.4 Land ownership .....	40
4.5 Sources of farming information .....	41
4.6 Determinants of agricultural skills and knowledge .....	42
4.7 Highest education level of farmers .....	46
4.7.1 Relationship between agricultural skills and knowledge, and level of education.	48
4.8 Age of farmers .....	50
4.8.1 The effect of age of household head on agricultural skills and knowledge .....	51
4.9 Extension services and agricultural skills and knowledge .....	52
4.10 Summary .....	54
<b>CHAPTER 5: THE IMPACT OF AGRICULTURAL SKILLS AND KNOWLEDGE ON AGRICULTURAL PRODUCTIVITY .....</b>	<b>55</b>
5.1 Introduction .....	55
5.2 The impact of agricultural skills and knowledge on maize productivity .....	55
5.3 Determinants of maize productivity in Msinga .....	59
5.4 Agricultural skills and knowledge and tomato productivity.....	61
5.5 Summary .....	63
<b>CHAPTER 6: CONTRIBUTION OF AGRICULTURAL SKILLS AND KNOWLEDGE TO HOUSEHOLD FOOD SECURITY .....</b>	<b>64</b>
6.1 Introduction .....	64

<b>6.2 Anxiety and uncertainty about household food supply .....</b>	<b>64</b>
<b>6.3 Insufficient quality of food consumption .....</b>	<b>64</b>
<b>6.4 Insufficient quantities of food consumed .....</b>	<b>66</b>
<b>6.5 Household food insecurity access prevalence in Msinga .....</b>	<b>67</b>
<b>6.6 Determinants of household food security.....</b>	<b>68</b>
<b>6.7 Summary .....</b>	<b>71</b>
<b>CHAPTER 7: CONCLUSIONS AND POLICY RECOMMENDATIONS .....</b>	<b>72</b>
<b>7.1 Introduction .....</b>	<b>72</b>
<b>7.2 Summary of findings.....</b>	<b>73</b>
<b>7.3 Conclusions .....</b>	<b>74</b>
<b>7.4 Policy recommendations.....</b>	<b>75</b>
<b>7.5 Recommendations for further research .....</b>	<b>77</b>
<b>REFERENCES.....</b>	<b>78</b>
<b>APPENDIX 1: SURVEY QUESTIONNAIRE .....</b>	<b>89</b>

**LIST OF FIGURES**

<b>Figure 2.1: The Sustainable Livelihood Framework.....</b>	<b>8</b>
<b>Figure 4.1: Distribution of households by marital status.....</b>	<b>39</b>
<b>Figure 4.2: Land tenure system in Msinga.....</b>	<b>40</b>
<b>Figure 4.3: Main sources of farming information among farmers.....</b>	<b>42</b>
<b>Figure 4.4: Highest educational levels of farmers in Msinga.....</b>	<b>46</b>
<b>Figure 4.5: Distribution of education level between irrigators and non-irrigators.....</b>	<b>47</b>

## LIST OF TABLES

<b>Table 4.1: Distribution of households by gender of household head.....</b>	<b>38</b>
<b>Table 4.2: Gender of household head and amount of land owned by irrigators and non-irrigators.....</b>	<b>41</b>
<b>Table 4.3: Relationship between gender of household head and agricultural skills and knowledge among irrigators in Msinga.....</b>	<b>44</b>
<b>Table 4.4: Relationship between gender of household head and agricultural skills and knowledge among non-irrigators in Msinga.....</b>	<b>45</b>
<b>Table 4.5: Education level of farmers.....</b>	<b>47</b>
<b>Table 4.6: Education level and gender farmers.....</b>	<b>48</b>
<b>Table 4.7: Relationship between agricultural skills and knowledge, and level of education among irrigators in Msinga.....</b>	<b>49</b>
<b>Table 4.8: Relationship between agricultural skills and knowledge, and level of education among non-irrigators in Msinga.....</b>	<b>50</b>
<b>Table 4.9: Age of farmers.....</b>	<b>51</b>
<b>Table 4.10: Age and gender farmers.....</b>	<b>51</b>
<b>Table 4.11: Relationship between age and agricultural skills and knowledge of household head among irrigators.....</b>	<b>52</b>
<b>Table 4.12: Relationship between agricultural skills and knowledge and extension among irrigators in Msinga.....</b>	<b>53</b>
<b>Table 5.1: Relationship between agricultural skills and knowledge, and maize productivity among irrigators in Msinga.....</b>	<b>56</b>
<b>Table 5.2: Relationship between agricultural skills and knowledge, and maize productivity among non-irrigators in Msinga.....</b>	<b>58</b>
<b>Table 5.3: The determinants of maize productivity in Msinga.....</b>	<b>60</b>
<b>Table 5.4: Relationship between agricultural skills and knowledge, and tomato productivity among irrigators in Msinga.....</b>	<b>62</b>
<b>Table 6.1: Anxiety and uncertainty about having enough food among farmers .....</b>	<b>64</b>
<b>Table 6.2: Household responses to poor quality food coping strategies in the past four weeks in Msinga.....</b>	<b>65</b>
<b>Table 6.3: Household responses to inadequate food quantity consumption in Msinga.....</b>	<b>67</b>

<b>Table 6.4: Proportion of households in each food security category in Msinga.....</b>	<b>67</b>
<b>Table 6.5: Ordinary Least Squares results for the determinants of household food security in Msinga.....</b>	<b>70</b>

**LIST OF ABBREVIATIONS**

ANOVA	Analysis of Variance
AOFF	African Organic Farming Foundation
DFID	Department for International Development
FAO	Food and Agriculture Organization
HFIAS	Household Food Insecurity Access Scale
IFAD	International Fund for Agricultural Development
MDG	Millennium Development Goal
NDA	National Department of Agriculture
OLS	Ordinary Least Squares
PRA	Participatory Rural Appraisal
SLA	Sustainable Livelihoods Approach
SPSS	Statistical Package for Social Sciences
SSI	Semi-structured Interviews
UN	United Nations

## CHAPTER 1: INTRODUCTION

### 1.1 Background of the study

Agriculture is a vital sector of the economy of many developing countries as it significantly contributes to domestic production and employment (FAO, 2006). The sector is crucial because of its significant contribution to ensuring food security, which remains a major challenge in many developing countries. It contributes to development as an economic activity, as a provider of environmental services and this makes it critical for development (World Bank, 2008).

The agricultural sector is the main source of livelihood for 86% of rural households in developing countries and 75% of poor people still live in rural areas and derive the major part of their income from the agricultural sector and related activities (Dethier & Effenberger, 2012). The World Bank (2007) also noted that agricultural production is important for food security as it is a source of food for the majority of the rural poor, especially due to the variable nature of domestic production, which includes the limited tradability of food staples and foreign exchange constraints in terms of the ability to purchase food imports.

FAO (2011) describes the critical role of women in agricultural production in developing countries. It also noted that rural women manage households and pursue multiple livelihood strategies while at the same time working in agriculture on their own farms and as unpaid workers on family plots. Women produce food (staples) and cash crops and manage mixed agricultural operations involving crops, livestock and fish farming (FAO, 2011). However, women's role in agriculture remains unrecognized in policy formulation and resource allocation (IFAD, 2010). Women also carry a workload burden of food provision and household chores, which is a double burden.

Agricultural productivity is low in many developing countries for a myriad of reasons; such as lack of appropriate technologies, lack of inputs, credit and access to markets and rural infrastructure; and gaps in agricultural skills and knowledge prevent rural producers from adopting technologies and using them effectively (Meinzen-Dick *et al.*, 2011). Quismbig (1996) argues that woman's lower levels of human and physical capital result in lower agricultural productivity. In poor areas where men have been forced to migrate in search of work, women

often have the sole responsibility for farming and raising children (IFAD, 2011). Women as smallholder farmers are marginalized and face significant challenges to engaging productively in agricultural activities. Rural women are vulnerable to both economic and social shocks and stresses such as indebtedness due to economic, food insecurity, health problems, lack of access to inputs and gender discrimination in the ownership of productive assets (Holmes & Jones, 2009). Nkala *et al.* (2011) also argue that women experience problems of inadequate farming knowledge and skills.

Close to half of South Africa's population (45%) resides in rural areas (Statistics SA, 2009). In KwaZulu-Natal, 56.7% of the total population and 54% of women reside in rural areas (National Land Committee, 2000 cited in Bob, 2002). In South Africa, an estimated four million people engage in smallholder agriculture and the majority of these people are in rural areas (Baiphethi & Jacobs, 2009). Many of those who engage in subsistence agricultural activities are women and their main reason being the provision of extra food for their poor families (Stats SA, 2012). It is also widely accepted that more than half of the rural households in South Africa are headed by women who, together with children, make up the poorest of the poor (Thabethe & Mathe, 2010).

Feynes & Meyer (2003) and Ortmann & Machete (2003) noted that the South African agriculture is dualistic or dichotomous in nature and describe the sector as consisting of a well-developed, large scale, market-oriented part and a developing small part. According to the 2007 commercial agricultural census (Statistics SA, 2009), there are 39 982 commercial farm units in South Africa, producing about 95% of the agricultural output and the majority of these farms are situated on 87% of the total agricultural land. In contrast, despite the land reform initiatives since the inception of democracy in 1994, smallholder farmers are predominantly settled in the former homeland rural reserves, and only have access to the remaining 13% of the agricultural land. According to Feynes & Meyer (2003), the majority of rural farmers in the former homelands comprise of the aged, women and children who reside on land more for social security purposes than for agricultural production.

The segregation and discrimination policies of the apartheid system left a legacy of inequality and poverty among rural communities in South Africa (Woollard, 2002 cited in Shisanya &

Hendriks, 2011). Kirsten & Moldenhauer (2006) reported that low agricultural productivity in rural areas is a major cause of household food insecurity in South Africa. Machete (2004) observes that since most people in developing countries reside in rural areas and engaged, directly or indirectly, in agricultural activities, agriculture could be the most effective way to reduce rural poverty and food insecurity.

Rural households in the smallholder farming sector of South Africa engage in diverse activities for a living. On average, monetary income from farming typically contributes less than 10% to total household income (Van Averbek & Khosa, 2007). Households that have farming as their main source of income are rare (Monde, 2003), meaning households supplement their farming income by engaging in off-farm activities.

## **1.2 Problem statement**

Smallholder farmers in rural areas of South Africa have little or no formal education. They are generally unable to make informed decisions regarding farming. According to the African Organic Farming Foundation (AOFF) (2003), rural farmers in South Africa have little business experience and lack information on technologies, markets and prices of products when there is surplus. Skills and knowledge are central to improve livelihood opportunities. Skills and knowledge increase the ability to innovate and adapt new technologies in agriculture and enhance farmer's performance. The lack of agricultural skills and knowledge in these rural farmers results in poor performance and negatively affects their livelihoods and that of their households (Machete, 1990 cited in Chibanda *et al.*, 2009). Mwaniki (2005) emphasized the crucial role that capacity building can play in improving agricultural performance among rural farmers.

## **1.3 General research objective**

The general objective is to assess agricultural skills and knowledge, and their effect on agricultural productivity and household food security in a selected irrigation scheme in Msinga Local Municipality.

### 1.3.1 Specific objectives

The specific objectives are stated as follows:

- To determine the agricultural skills and knowledge of women (also compared to that of men) in Msinga.
- To determine the linkage between agricultural skills and knowledge on one hand, and agricultural productivity on the other.
- To determine the linkage between agricultural skills and knowledge on one hand, and household food security on the other.

### 1.4 Hypotheses

- Women and men in Msinga possess agricultural skills essential for ensuring household food security.
- Agricultural skills and knowledge have a significant effect on agricultural productivity.
- Agricultural skills and knowledge have a significant effect on household food security.

### 1.5 Importance of the study

The study will provide baseline information on agricultural skills possessed by rural women and men. The study will then identify agricultural skills that have a positive bearing on household agricultural productivity and household food security. The study will also identify skills gap in rural men and women and this will help in making key recommendations for further training in rural women and men in order to improve their livelihoods.

### 1.6 Definition of terms

**Agricultural productivity:** At the production level, agricultural productivity measures the value of output for a given value of inputs (FARA, 2006). Gains in overall agricultural productivity can come from changes in the physical productivity level through change in level of skill of the labour employed.

**Food security:** According to the Food and Agriculture Organization (FAO) (1996), food security exist 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.

### **1.7 Study limits**

Results obtained from the study will only be specific for Msinga Local Municipality and cannot be used for places outside the jurisdiction of Msinga. This is so because agricultural skills and productivity will vary across district municipalities, reflecting differences in level of training.

### **1.8 Organisation of the thesis**

The study comprises of seven chapters. The second chapter discusses the literature review on smallholder farmers, their livelihoods, agricultural skills and knowledge and the constraints limiting them from participating effectively on agriculture. In the third chapter, the methodology is presented. The chapter explains the data collection procedure and analysis. Chapter four, five and six presents the research results, where chapter four gives descriptive results and the determinants of agricultural skills and knowledge. Chapter five discusses the contribution of agricultural skills and knowledge to agricultural productivity. Chapter six discusses the contribution of agricultural skills and knowledge to household food security. Finally, chapter seven presents the conclusion and recommendations.

## CHAPTER 2: REVIEW OF RELEVANT LITERATURE

### 2.1 Introduction

This chapter looks at sustainable livelihoods and gender dynamics involved in agriculture and how these dynamics have limited female farmers from engaging effectively in agriculture. It also discusses the concept of food security in relation to gender. The constraints faced by women farmers are highlighted, among these, is the lack of access to credit. The chapter concludes by discussing data collection methods.

### 2.2 Sustainable livelihoods

Sustainable livelihoods is a way of thinking about the objectives, scope and priorities for development in order to enhance progress in poverty elimination (Ashley & Carney, 1999). A livelihood in its simplest sense is a means of gaining a living; it comprises the capabilities, assets and activities required for a means of living. A livelihood is sustainable if it can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihoods opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels in the short and long term (Chambers & Conway, 1991).

Amartya Sen is generally credited with shifting the food security debate away from an exclusive focus on the availability of food towards a focus on the ability of households to access food (Maxwell & Slater, 2003). His work highlighted the effect of personal entitlements (resources used for production) in ensuring household food security. Adato & Meinzen-Dick (2002) argue that the concept of “livelihoods” has become increasingly popular in development thinking as a method of conceptualizing the economic activities poor people undertake in pursuing their livelihoods. Households and communities must have access to and exploit livelihood assets in order to be food secure.

The Sustainable Livelihood Approach (SLA) (Figure 2.1) allows the analysis of the relationship between people’s access to resources, their diverse livelihoods activities, different factors at micro, intermediate, and macro levels. It is also a framework for assessing and prioritizing interventions (Adato & Meinzen-Dick, 2002). The SLA draws attention to the activities that take

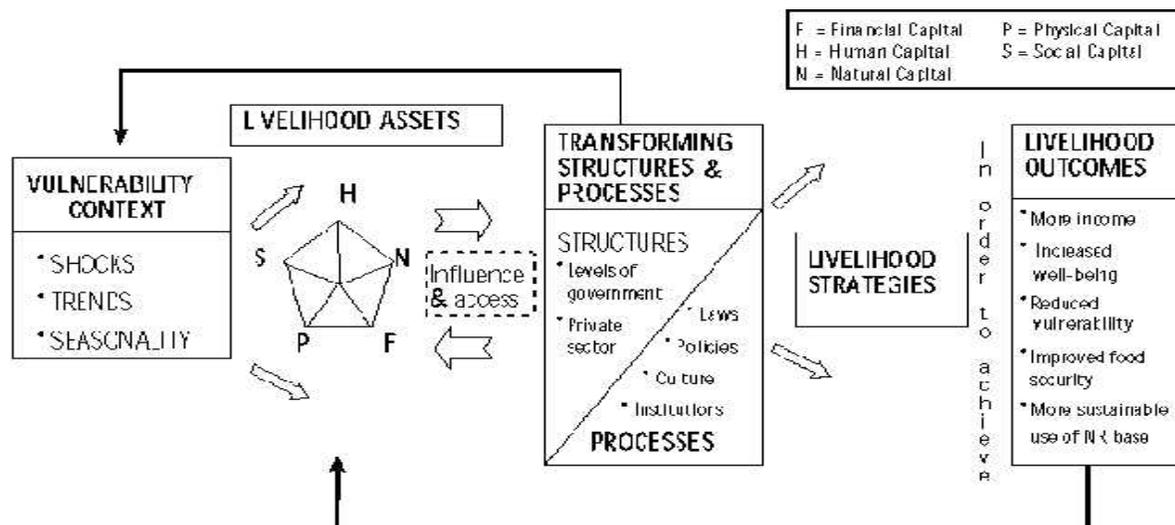
place within the broader policy and institutional context at different times and how they support or undermine livelihood strategies (DFID, 2000 cited in Hart 2009).

The SLA recognizes that households require assets to achieve their livelihood strategies. The inclusion of assets as one of the core components of livelihoods has its roots in the work of Swift (1985), which deals with the problem of coping with vulnerability to famine (Van Averbek, 2008). These assets are human, social, political, natural and financial assets. Out of these assets people construct and contrive a living, using physical labour skills, knowledge and creativity. Households adjust to their social, physical, economic and political environments by using their assets for livelihood strategies designed to strengthen their well-being (Timmer, 2003; Bryceson, 2005 cited in Matshe, 2009). Households are viewed as sustainable if they can adjust to threats without compromising their future ability to survive shocks to their livelihoods. This approach suggests that adequate ownership of livelihood assets is essential for pursuing a range of livelihood opportunities, and is a key determinant of livelihood performance and the ability to accumulate assets for optimal production and for consumption smoothing in the face of seasonal climatic and market risks (Matshe, 2009).

Transforming structures and processes, such as government and private sector, play a second-tier role in shaping livelihood strategies that can be pursued to attain higher livelihood outcomes (Dorward & Kydd, 2004). The SLA is ideal for this study because the predicament of rural people is largely determined by the lack or erosion of their livelihood assets, in one form or the other. The framework is holistic as it interrogates the notion of empowerment for rural people and acts as a tool for understanding the implication of rural people's access to assets. Human capital, which encompasses knowledge and skills, especially in agriculture, is key as it influences effective use of other livelihood assets and hence agricultural productivity and household welfare.

Livelihood capabilities refer to the ability of individuals to realize their potential as human beings, both in the sense of being, such as being adequately nourished and free of illness, and of doing, such as exercising choices, acquiring skills and knowledge and experiences, and participating socially. Livelihood capabilities can be seen as the ability to cope with stresses and

shocks, and being able to find and make the best use of livelihood opportunities (Chambers & Conway, 1991).



**Figure 2.1: The Sustainable Livelihood Framework**

Source: Farrington *et al.* (1999)

In recent years, several countries in Southern Africa, including South Africa, have emphasized the importance of employment in rural areas as a way of reducing rural poverty and food insecurity (Matshe, 2009). This has taken the form of establishing schemes to identify strategic priorities and channel financial resources towards rural development. In most poverty stricken African states, the primary motive of policies enacted by governments was to solve the immediate problem of hunger through smallholder production of food and the generation of sufficient income to enable rural households to purchase adequate food.

Rosegrant & Hazell (2001) suggest that because most of the poor live in rural areas and derive part of their livelihoods from agriculture, growth that stems from agricultural productivity and that raises the incomes of smallholder farmers and landless labourer's is important in reducing rural poverty. Across Southern Africa, efforts have been made by governments toward resourcing rural areas, where most smallholder farmers were the main beneficiaries. The aim was to increase production and employment through subsidized inputs and developing production related infrastructure. Unfortunately, these efforts have resulted in little real progress in agricultural production and food security among rural households. In these interventions,

governments were more concerned about eradicating the immediate problem of food production deficits, rather than focusing on long term development approaches (Misselhorn, 2009).

Most rural people work in agriculture (as farmers or farm workers) or get non-farm or off-farm job opportunities only seasonally and often part time. Individuals also create a living from various sources including production (farming, craftwork, small scale industries), trading, transfers (grants and remittances). Transfers usually form the backbone of rural people's livelihood in South Africa, especially through child support grants and old age pensions (Anseeuw *et al.*, 2001). In a study on livelihoods conducted in the Limpopo Province, South Africa, Perret *et al.* (2005) found that although significant, earnings from agriculture were not the primary source of income. Cousins (2012) also stressed that the key distinguishing features of rural livelihoods in South Africa is the diminishing contribution of small scale farming to total income, declining proportions of income from wages and remittances, and the increasingly large contribution of state transfers in the form of social grants.

### **2.3 Gender and agriculture**

Challenges faced by women are gender specific and they hinder them from engaging effectively in agricultural production. Women across the developing world are disadvantaged relative to men (Rahman, 2008). In all societies, men and women are assigned tasks, activities and responsibilities according to their sex. In almost all patriarchal societies, gender and power relations are skewed in favor of men; different values are ascribed to male and female tasks. These gender differences exacerbate the social, economic and cultural inequalities that define the status of women in society (Matshe, 2008).

Gender roles and relations have significance in generating household livelihood security. In most societies, including South Africa, women find themselves in positions of subordination as they are culturally, socially and economically dependent on men. As a result of centuries of discrimination, black women in rural areas are the poorest with lower access to markets, credit, land, education and health (Sewpaul, 2008). As a result, rates of poverty, illiteracy, and malnutrition are significantly higher among women and girls than they are among men and boys

(Horenstein, 1989 cited in Rahman, 2008). These challenges may require policy interventions to redress the situation.

Women play a critical role in agricultural and rural economies in all developing countries. Thamaga-Chitja (2012) and Ihali (2000) both argue that, globally, women experience a heavy load on their time as they are responsible for other activities both in and outside their households. FAO (2011) also stresses that rural women manage households and pursue multiple livelihood strategies. Their activities typically include producing agricultural crops, tending animals, preparing food, working for wages in agricultural or other rural enterprises, collecting fuel wood and water, engaging in trade and marketing, caring for family members and maintain homes. Ihali (2000) suggest that surveys on time-use conducted across many countries estimate that women provide between 80 and 90% of the time spent on household food preparation and that they are usually responsible for childcare and other household chores.

#### **2.4 Women in agriculture**

In sub-Saharan Africa, agriculture is becoming a predominately female dominated sector as a consequence of faster male migration to urban areas in search of work (FAO, 2002). Women constitute the majority of smallholder farmers, providing most of the farm labour and manage large parts of the farming activities. It is argued that women contribute 60 to 80% of the food produced in most developing countries. In sub-Saharan Africa, women produce up to 80% of the staple crops (Yekinni, 2010; FAO, 2011). Rural women are responsible for storage and handling of agricultural produce in developing countries. Traditionally, the roles of men and women in farming differ in Africa. Men clear the land and women undertake most of the remaining farming activities, particularly planting, weeding and processing (FAO, 2011).

#### **2.5 The concept of food security**

The heads of state and government representatives gathered at the World Food Summit in November 1996 in Rome, Italy, to reaffirm the right of all people to have access to safe and nutritious food, consistent with the right to adequate food and the fundamental right of everyone to be free from hunger (FAO, 1996). The delegates committed to achieving food security for all and an ongoing effort to eradicate hunger in all countries, with an immediate view to reducing

the number of undernourished people to half the present level by no later than 2015 (FAO, 1996).

Food security exists, at the individual, household, national, regional and global levels when all people at all times, have physical, social, and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for a healthy and active life (FAO, 2002). This definition has three distinct but inter-related pillars: food availability, food access or effective demand and reliability of food. Barrett (2010) sums this up by arguing that food security consists of three hierarchical pillars: food availability is necessary but not sufficient to ensure food access, which in turn is necessary but not sufficient for the effective utilisation of food. If the concept of stability is added as a fourth pillar, then food security exists when all four pillars are realised simultaneously. The South African constitution affirms the right to food security for its citizens and the government has set itself an overarching target of halving poverty between 2004 and 2014 (Jacobs, 2009). This is in line with the first Millennium Development Goal (MDG) of the United Nations (UN) which seeks to eradicate extreme poverty and hunger. Despite all these efforts, large numbers of households in South Africa remain food insecure. Food insecurity is said to exist when households lack access to amounts of food of the right quality to satisfy their dietary needs of all its members throughout the year (Rose & Charlton, 2002). The four pillars of food security are further discussed below.

### **2.5.1 Food access**

When food prices declined in the 1980s and the 1990s, the focus shifted away from food supply issues to food consumption issues, largely because poverty and hunger were still widespread despite the availability of cheaper food (Vink, 2012). The Nobel Economics Laureate in 1998, Amartya Sen, demonstrated that, unless people have the means to obtain access to food (i.e. income to purchase food or the entitlement such as grant from the state), they would go hungry. This was the basis of the concept of capabilities which allow people to function consequently leading them to achieve their objectives.

Food access is ensured when households and all individuals within them have adequate resources to obtain appropriate foods for a nutritious diet (Riely *et al.*, 1999). Access to food depends on

income available to the household, on the distribution of income within the household, and on the price of food. Food access is also a function of the physical environment, social environment and policy environment which determine how effectively households are able to utilize their resources to meet their food security objectives (Riely *et al.*, 1999). Drastic changes in these conditions, such as during period of drought or social conflict, may seriously disrupt production strategies and threaten the food access of affected households.

Access to food has improved for most people on the African continent as a result of more than a decade of rapid economic growth (Vink, 2012). However, the purchasing power of consumers is not the same, and access to food can be a problem, especially in rural areas where most of the poor live. South Africa is a case in point. At the national level, South Africa is considered to be food secure, yet large numbers of households remain food insecure. For example, the 1995 Income and Expenditure Survey indicated that around 43% of households were subjected to food insecurity (Rose & Charlton, 2002), and the General Household Survey of 2007 estimated that 10.6% and 12.2% of children and adults respectively were sometimes or always hungry (Altman *et al.*, 2009). Rose & Charlton (2002) suggest that the incidence of household food poverty in South Africa increases with decreasing income, increasing household size, female-headed households and being located in rural areas.

### **2.5.2 Food availability**

Food availability refers to the supply of food at local, national or international level (FAO, 1996). Food availability may also refer to a continuous supply of food at both national and household level and it is affected by input and output market conditions, as well as production capabilities of the agricultural sector (NDA, 2002). Riely *et al.* (1999) argues that the use of the term “availability of food” is confusing since it can refer to food supplies available at both the household level and at a more aggregate (regional or national) level. In this study, unless used in defining food security, the term refers to the availability of food at household level.

Earlier definitions of food security have tended to focus on the supply of food. In this regard, the general image of African agriculture remains negative (Vink, 2012). While African agriculture lags behind the rest of the world in some important respects (i.e. calorie supply per person, the

absolute staple yield), per person production of agricultural products have been increasing in the past decades (World Bank, 2009). However, the increased in agricultural production which further increases the availability of food does not guarantee access to food but access to food is dependent on consumer's purchasing power.

### **2.5.3 Utilisation of food**

Utilization is regarded as the way the body makes the best use of various nutrients in the food. Sufficient energy and nutrient intake by individuals is a consequence of hygienic feeding practices, food preparation and diet diversity. Under this definition of utilization, even if households have sufficient food, food security may still not be assured (Pinstrup-Anderson, 2009). In addition, household preferences, for example, may be for less nutritious food such as fast foods and non-food items such as alcohol. Pinstrup-Anderson (2009) argues that while utilization is a vital pillar of food security, good nutrition depends on other non-food factors such as clean water and access to primary healthcare.

### **2.5.4 Stability of food supply**

Stability of food supplies refers to the ability of households to procure, through income, production or transfers, adequate food supplies on a continuous basis, even when the household is faced with situations of unpredictable stress, shocks or crisis (FAO, 1997). The concept of stability also denotes an ability to stabilize food supplies through seasonal fluctuations of production or income. The critical test for stability is the ability to bounce back or to regain quickly an adequate food supply. For this to be a reality, safety net-mechanisms such as commodity grain stores or labour intensive public works are needed to enhance the buying power of the poor and to absorb the effect of short term production or income losses that adversely affect the food supply of the affected households.

Seasonal constraints for households in agricultural communities often occur just before the harvest when stocks from the previous year's harvest are nearly exhausted, and cash is running out. Shortages of food give rise to high market prices which eventually decline following the harvest. Agricultural communities that have lived under difficult climatic conditions often develop management strategies to lessen the impact of environmental and climatic stresses on

household food security (FAO, 1997). These mechanisms include selecting and planting crops and varieties that provide the best risk spread.

### **2.5.5 Determining household food security**

The most prevalent ways of measuring food security is by using proxy variables or by using variants of people's opinion on their food security status (Vink, 2012). The measurement of food security at the household level aims to measure the access component of food security and is based on the idea that the experience of food insecurity causes predictable reactions and responses that can be captured and quantified through a survey and summarized on a scale (Knueppel *et al.*, 2010).

Current attempts to measure food insecurity include indicators such as the Household Food Insecurity Access Scale (HFIAS), the Household Dietary Diversity Score and the Hunger Index. In this study, focus is given on the HFIAS as it has been used. The HFIAS is based on a methodology developed by the US Agency for International Development (USAID) that categorizes households into different food security types. The classification is based on the answers to nine questions related to different dimensions of food access. The nine questions are designed to capture experiences associated with varying levels of insecurity severity and to reflect three domains perceived as central to the experience of food insecurity: anxiety about food supply; insufficient quality, which includes not edibility but also variety, preferences and social acceptability; and insufficient food supply and intake and the physical consequences (Knueppel *et al.*, 2010). In a recent study in South Africa, using the HFIAS in Maphetheni, KwaZulu-Natal, Shisanya & Hendriks (2010) found that 89% of the households were severely food insecure.

Several studies have also attempted to document the factors that affect household food security. Osei *et al.* (2013) argues that these factors or determinants of household food security are most often than not location-specific (i.e. different study areas have been found to have variant attributes as food security determinants with some attributes recurring). The study conducted by Amaza *et al.* (2006) in Nigeria using logit regression model found out that sex of household head, age, education level, farm size and access to extension services have a positive influence

on household food security. Sikwela (2008) in South Africa, using logistic regression model, showed that per aggregate production, fertilizer application, cattle ownership and access to irrigation have positive effect on household food security whereas household size have a negative effect on household food security.

## **2.6 The role of markets to food security**

Access to output markets, ranging from small village-level markets to sophisticated export processors, is the key for smallholder farmers to earn more from the sale of their produce (Senyolo *et al.*, 2009). With very few options for employment in rural areas, as farmers in the second economy (informal sector), rural women seek to expand production and sell their produce for income (Garcia, 2006 cited in Thamaga-Chitja, 2012). Poor farmers in remote areas appear to have limited access to markets. According to Heinemann (2002), rural people in Africa, especially the poor, often say that one reason they cannot improve their lives is because of poor access to markets where they can obtain agricultural inputs and sell their produce. Even those who produce surplus cite inaccessibility to markets as a major constraint.

Factors such as poor infrastructure, lack of market transport, dearth of market information, insufficient expertise on, and the use of grades and standards, packaging and inability to conclude market contractual agreements are major constraints among smallholder farmers. In a study conducted by Mkhabela (2005) at Tugela Ferry, he argued that middlemen in the form of mobile traders take advantage of poor access to markets. They buy farmers product at a lower price and sell them to final consumers in the urban areas at a higher price. Rural farmers could also tap into the supermarket market as this form of market has become a dominant market for smallholder farmers in South Africa (Jayne *et al.*, 1997 cited in Mkhabela, 2005). Although this form of market can provide smallholders with viable income, it is also worth noting that quality standards at these supermarkets are high and emerging farmers cannot always keep up with the required standards.

A study conducted by Mathye *et al.* (2000) among banana and mango farmers in the Limpopo province of South Africa, indicated that knowledge about markets is also a contributing factor in the choice of marketing channels among smallholder farmers. Improving market access for the

disadvantaged involves, not only the provision of physical infrastructure; it requires a range of interventions by the state. Such interventions include capacitating farmers with value adding skills of their products. Value adding can be in the form of grading, sorting, cutting and packaging in standard weights (Mather, 2005).

## **2.7 Education and training among rural farmers**

The low level of education among smallholder farmers, especially women who form the bulk of the agricultural labour force has remained a major constraint to the adoption of modern farming techniques and the ability to access other inputs necessary for increased productivity in the agricultural sector.

Agwu (2004) reported that farmers with a higher level of education had a higher probability of adopting improved technology. The importance of capacity building or investing in education was also underscored by Mwaniki (2005) and Von Braun *et al.* (2003). Both authors recommend that Africa should focus on education, research and development and access to capital. Education would enable the acquisition of new information through sources such as newspapers, radio and extension programmes which positively facilitates adoption of new technologies. In an example drawn from Malawi, educational investments helped smallholders enter into tobacco production. Better access to information, together with improved ability to use it may be especially valuable in improving agricultural productivity. With sound educational background, farmers are better equipped to improve managerial ability as well as acquiring better information to improve marketing ability (Machingura, 2007).

According to Wye (2003), relevant agricultural training, socioeconomic conditions and extension services are determinants of smallholder farmer's market access. In most instances, these factors have a direct positive or negative impact on the level of farm income. Low levels of education and lack of farmer support have a negative impact on the emerging farmers in this dispensation of free market system. Education plays a key role in the agricultural industry where competition is high between the previously disadvantaged and previously advantaged farmers in the commercial markets. High level of education amongst rural farmers may assist them to understand and interpret market information better. Education can also assist them to have better

farm management principles and marketing skills and develop financial intelligence. Several studies have found a direct relationship between the level of education and successful performance in farming (Montshwe *et al.*, 2005 cited in Moloji, 2008; Bizimana *et al.*, 2004; and Mohammed & Ortmann, 2005). According to Montshwe *et al.*, (2005) cited in Moloji (2008), the training received by small scale farmers was found to have improved the possibility of the farmers to sell livestock which in turn improved their income.

## **2.8 Skills in agricultural production**

There is a general consensus that improving agriculture by enhancing productivity will remain a key strategy for rural poverty alleviation (Hussain & Hanjra, 2004). Increasing agricultural productivity increases farm supply so that farming households can increase the amount of food they retain for home consumption and market an increased volume of produce. This in turn can raise household income, which can then be used to improve general household livelihoods.

Low yields realized by smallholder farmers have been concrete evidence of poor farmer performance on smallholder irrigated fields in South Africa (Crosby *et al.*, 2000). Machete *et al.* (2004) linked low crop yields to limited knowledge and lack of agricultural skills in crop production among farmers. Machete *et al.* (2004) and Mnkeni *et al.* (2010) identified basic management practices, such as weed, water, fertilizer and plant population management, late planting, and choice of cultivars, all of which are within the farmers' abilities, as the main agronomic factors limiting productivity among rural farmers.

At Zanyokwe in the Eastern Cape, yield gap analysis of grain maize and butternut indicated that large gaps existed between yields achieved by farmers and those achieved with good management in researcher-managed, on-farm trials (Fanadzo *et al.*, 2010). The average yield of 2.4 tons of maize grain per hectare and 6 tons of butternut per hectare was less than 25% of the maximum economic yield achieved at Zanyokwe in on-farm experiments managed by researchers (Fanadzo *et al.*, 2010). Even though experimental plots are easier to manage than field-scale plantings (large plots managed by local farmers), these findings suggested that inadequate farm management rather than infrastructural constraints was the principal factor that limited crop productivity at Zanyokwe. As a result of these findings, Mnkeni *et al.* (2010)

concluded that investment in capacity building and competence among farmers could improve the scheme performance and agricultural productivity.

Irrigation scheduling and frequency is an important agronomic practice in irrigation schemes. Koegeleng *et al.* (2003) cited in Mnkeni *et al.* (2010) states that the main purpose of irrigation scheduling is to determine the amount of water required by a crop per cycle during peak demand periods and how often it should be applied. However, Stevens *et al.* (2005) observed that despite the importance of irrigation scheduling and the large amount of research devoted to it, the adoption of proper irrigation scheduling methods have been below expectation and this limits agricultural production and productivity.

Mnkeni *et al.* (2010) conducted a study at Tugela Ferry irrigation scheme to assess infield water management by farmers. Results obtained showed that water was applied inefficiently to crops, particularly with regard to distribution uniformity. This could affect crop yields as crops may in some cases be over-irrigated and in some cases be under-irrigated. Water allocation among farmers was also found to be a problem as some farmers used larger volumes compared to others, making the water less available to others. Fanadzo *et al.* (2010) alluded that farmers in irrigation schemes do not exercise objective scheduling methods; farmers observe the condition of the soil and the crops as the basis for irrigation decisions. Machete *et al.* (2004) noted that farmers tended to apply the same amount of water regardless of the plant growth stage and this could result in over-irrigation in early crop growth stages and under-irrigation during advanced growth stages such as flowering as the plant water requirements increases. This could adversely affect crop production.

Nutrient management among smallholder farmers in irrigation schemes is lacking. A study conducted by Monde *et al.* (2005) showed that farmers applied fertilizer once in two to three years because they lack cash. Machete *et al.* (2004) noted that in the Limpopo province farmers tended to apply unspecified amounts of inorganic fertilizers and these were usually marginal, especially for the field crops. Fertilizer application rates were usually not based on soil fertility analysis and recommendations. Farmers cited lack of information on soil fertility

recommendations and funds as the main reason to resorting to low blanket applications (Machete *et al.*, 2004).

Crop protection is a crucial crop management skill if farmers want to realize substantial crop yields. Weeds, insects, pests and diseases are the main biological constraints faced by smallholder farmers (Fanadzo *et al.*, 2010). Van Averbeké *et al.* (1998) established that insects and fungal diseases were the major pests responsible for reduction in crop yield but the type of pests were not specified and yield reductions were not quantified. Bembridge (2000) also cited inadequate pests and disease control as a contributing factor to crop failure in several irrigation schemes in South Africa. Smallholder farmers are aware of the detrimental effects of pest and diseases and also weeds but do not have the means to control them especially where tractor mechanization has resulted in vast land being planted (Steyn, 1988 cited in Fanadzo *et al.*, 2010). However, even though farmers have the necessary means to control pests and disease, they still need the necessary skills to operate equipment such as sprayers which are used to spraying weeds and eliminating diseases.

Agricultural skills go beyond agronomic practices; they also encompass smallholder farmer's abilities to negotiate better markets output prices. Farmers in developing countries also need improved business and marketing skills to make smallholder farming a viable source of descent income (Collett & Gale, 2009). While food production for the household is essential, the rural poor also sell cash crops on local, regional and national markets, so they need business skills to better represent their interests. Business skills will be effective in enhancing farmers to decide on what to grow based on predictions of market prices.

Several studies have attempted to document the socio-economic factors affecting agricultural productivity among smallholder farmers. In a study conducted in Imo State, Nigeria, Obasi *et al.* (2013) used the Ordinary Least Squares (OLS) multiple regression model to assess the determinants of agricultural productivity. Their study found that farming experience, extension contact, education level and labor all have a positive and significant relationship with agricultural productivity. They concluded that total factor productivity will increase significantly if these factors are increased above their present level of use. In a study conducted among cocoyam

farmers in Enugu State, Nigeria, using the OLS criterion, Okoye *et al.* (2008) also found that access to extension services, education level, farming experience and capital inputs all had a positive and significant relationship with agricultural productivity. Using the OLS criterion, Anyaegbunam *et al.* (2012) reported an inverse relationship between farm size and agricultural productivity. Okoye *et al.* (2008) also found that there exists an inverse relationship between farm size and agricultural productivity.

## **2.9 Constraints limiting rural female farmer's participation in agriculture**

This section discusses the constraints that limit farmer's participation in agriculture. These include limited access to credit, land and property rights and access to improved technology.

### **2.9.1 Limited access to credit**

Access to credit is a central requirement for the expansion of small and medium entrepreneurial activities in rural areas (Fletscher & Kenney, 2011). Credit is still unobtainable for women (Kongolo, 2012). Legal regulations and customary rules restrict women's access to and control over assets that can be accepted as collateral such as land and livestock (FAO, 2011). Women's access to financial services is largely conditioned by their legal, social and economic position within the community and household. Ensuring women adequate access to financial resources is a key tenet of successful rural development and ensuring food security. Without adequate access to loans, producers who face negative shocks such as floods, price volatility and droughts, can lose some of the assets (crops/livestock) they have (Diagne & Zeller, 2001). Conversely, producers who have adequate access to credit, can avail themselves of capital to purchase inputs, hire additional labour and purchase equipment they need to generate income; can afford to invest in riskier but more profitable enterprises and can reach markets more effectively (Zeller *et al.*, 1997 cited in Fletschner & Kenney, 2011).

### **2.9.2 Land and property rights**

Land ownership and agricultural growth are vital for poverty reduction. Land ownership has been identified as one of the factors that could explain the poor agricultural performance in developing countries (Dormer, 1964; Feder & Onchon, 1987 cited in Matchaya, 2009).

Clearly defined rights to resource use are crucial for sustainable exploitation and efficient allocation of agricultural resources. This is particularly important in resources such as land, water and forests (Binswanger-Mkhize *et al.*, 2009). Established land rights provide an incentive for self-induced efficiency in resource use and voluntary investments in conservation and technological efficiency. According to Kongolo (2012) women's land rights and access to land are at the core of their ability to drive livelihoods in rural areas. Women's land rights are crucial, as secure access to land and other natural resources is a basis for sustainable livelihoods and a key factor in assuring household food security (Pallas, 2011). Kagoda (2008) emphasizes that the direct advantage of land rights are that a women can use it to grow food crops, fodder for animals, keeping livestock, growing trees and vegetable gardening. Land rights also facilitate access to credit as most financial institutions require collateral prior to granting a mortgage loan. The ability to access land and to claim, use and defend land and other productive resources, of individuals and groups, is in line with the processes of empowerment.

Governments have long recognized the importance of secured land tenure in promoting equitable, sustainable agricultural development. Contrary to these efforts, women have not always benefited from general land distribution and titling efforts. In some cases, women have seen their customary rights eroded as formal rights have been extended to their male counterparts. A combination of legal and cultural practices has often frustrated governments efforts which have attempted to strengthen women tenure rights within marriage (FAO, 2011).

Land is the single most important asset for farming poor households in Southern Africa. Land underpins cultural identity, political power and participation in decision making, provides a secure place to live and engage in economic activities and constitute collateral for credit. Women's access to land is constrained in the customary system. In the customary system, land ownership by women is indirect through their male kin (Kongolo, 2011). The widespread exclusion of African women from owning or controlling land means that they are often barred from effectively engaging in economic activities contributing to a secure and sustainable livelihood.

### **2.9.3 Access to improved agricultural technology**

Rapidly increasing population pressures has necessitated the need for improved crop production practices which are geared towards achieving sustained and efficient food production and as well as increased income which enable farmers to meet household demands (Matthews-Njoko *et al.*, 2008). Advancements in technology have positively impacted farmers in developing countries by providing means to improve soil fertility and increase land productivity and overall crop yields. Such technologies include inorganic fertilizers, insecticides, improved seed varieties and mechanical power. Female farmers who are more likely to be asset poor and subsistence oriented than their wealthier male counterparts, have benefited from such technology (World Bank, 2009). Gilbert *et al.* (2002) analyzed a cropping system trial survey in Malawi and found a significant gender difference in fertilizer use among 1,385 farmers selected to participate in the study. Following the treatment period in which all participants were supplied with inorganic fertilizer, they found that there was no significant gender difference in maize yield.

Gender gaps still exists for a wide range of technologies despite the fact that there is no difference between the agricultural productivity of men and women. However, the adoption of technology among women farmers cannot be treated as a separate issue. The use of purchased inputs depends on the availability of complementary assets such as land, credit, education/extension services, all of which tend to be more constrained for female farmers (FAO, 2011).

## **2.10 Approach and methods of data collection**

This section discusses the approach and methods used for data collection. The study used a mixed-method approach. According to Creswell (2003) mixed method designs are those that include at least one quantitative (designed to collect numbers) method and one qualitative method (narrative). The mixed method approach is crucial in this study as it provides strengths that offset the weaknesses of both quantitative and qualitative research.

### **2.10.1 Questionnaire surveys**

Questionnaires are administered to a sample of a population in order to learn about the distribution of characteristics, attitudes, or beliefs (Czaja & Blair, 2005). When using

questionnaires in a survey, researchers rely on honesty and accuracy of the participants' responses. Questionnaires typically entail several questions that have structured response categories; some open-ended questions may also be included (Mertens, 2005). The questions are examined for bias, sequence, clarity, and face-validity (Mertens, 2005). Questionnaires are usually tested on small groups to determine their usefulness and, perhaps, reliability. Questionnaires can be used to collect both quantitative and qualitative data. In a questionnaire survey, data are collected in a standardized format, usually from a probability sample of the population (Cox, 1996). A survey is a preferred method if the researcher is targeting a small amount of data from a population. The strengths of questionnaire surveys include their accuracy, generalizability, and convenience (Cox, 1996). Accuracy in measurement is enhanced by quantification and replicability (Czaja & Blair, 2005). Results can be generalized to a larger population within known limits of error. Surveys are amenable to rapid statistical analysis and are comparatively easy to administer and manage.

### **2.10.2 Participatory Rural Appraisal**

Participatory Rural Appraisal (PRA) is a term used to describe a growing family of approaches and methods to enable local people to share, enhance and analyze their knowledge of life and conditions, to plan and to act (Chambers, 1994). Participatory approaches received attention in the quest to involve smallholder farmers in research and development (Chambers *et al.*, 1989). PRA evolved in the 1980's and aims to facilitate information sharing among stakeholders. It offers a method which involves groups rather than individuals, and visual representation rather than solely verbal communication. PRA was introduced in response to the perceived problems of outsiders (researchers) missing or miscommunicating with local people in the context of development work (Abdullah *et al.*, 2012).

In PRA, information is more elicited and extracted by outsiders as part of a process of data gathering (Chambers, 1994). This in turn provides a thorough and comprehensive idea regarding problems, potentials, resources and solutions to existing problems within that specific time. PRA approaches and methods encourage the local people to voice out their opinions and ideas with researchers acting as facilitators. Therefore, PRA is an approach for the local community to analyze their own conditions and engage with outsiders. PRA helps the local people to better

assess their resources and overall situation regarding areas such as agriculture, health, and education (Abdullar *et al.*, 2012).

#### **2.10.2.1 Semi-structured interviews**

Interviewing is one of the main techniques used in developmental studies. Participatory methods have contributed to adjusting the interview to be more conversational, while still controlled and structured. Semi-structured interviews (SSI) are regarded as the “core” of good PRA (Chambers, 2005). In a semi-structured interview, some of the topics to be discussed are pre-determined whilst the majority of the questions are formulated during the interview. Questions are asked according to a flexible checklist and not from a formal questionnaire. SSIs are normally conducted alongside other explanatory and participatory techniques (i.e. focus groups) and are used to complement the survey methods with in-depth information.

#### **2.10.2.2 Key informant interviews**

A key informant is an expert source of information (Marshall, 1998). Key informant interviews involve interviewing a selected group of individuals who are likely to provide needed information, ideas, and insights on a particular subject (Kumar, 1989). Key informants, as a result of their personal skills, or social status, are able to provide more information and a deeper insight into what is going on around them (Marshall, 1998). Tremblay (1989) cited in Marshall (1998) highlights the characteristics of an ideal key informant. He argues that the key informant’s role within the community should expose him/her to the kind of information sought by the researcher. In addition to having the desired information, the informant should have absorbed the information meaningfully. Also, the key informant should be willing to communicate their knowledge to the interviewer and to cooperate as fully as possible, and should be objective and unbiased. The principle advantage of key informants relates to the quality of information that can be obtained within a short space of time. Gathering the same amount of information and insight from in-depth interviews with other community members can be time consuming. The potential weakness of key informant approach is that informants are unlikely to represent, or even understand, the majority-view of those individuals in their community.

### **2.11 Summary**

The chapter reviewed literature on sustainable livelihoods and how these livelihoods are vital for rural people. The concept of food security was critically discussed. The role of agricultural skills and knowledge to agricultural production and productivity has been highlighted. The discussion on agricultural skills and knowledge has led to the conclusion that smallholder farmers lack basic technical/agronomic skills which results in poor performance in irrigation schemes. In addition to poor technical/agronomic skills, farmers lack business and marketing skills. This is further compounded by the low levels of education among smallholder farmers as high levels of education can assist farmers to have better farm management principles and marketing skills and develop financial intelligence. The chapter has also highlighted the important role played by women in agriculture and the challenges they face. These constraints include limited access to credit, land and improved agricultural technology.

## **CHAPTER 3: RESEARCH METHODOLOGY**

### **3.1 Introduction**

This chapter describes the research methodology of data collection and analysis for the study. A description of the background information of the Tugela Ferry irrigation scheme includes issues regarding to history, agricultural potential and economic activities. Data collection techniques included focus group discussions, interviews with key informants and questionnaire administration. Lastly, the analysis techniques to be used are discussed.

### **3.2 An overview of the Tugela Ferry irrigation scheme**

The Tugela Ferry irrigation scheme is situated in the Midlands region of KwaZulu-Natal, falls within Msinga local municipality, and is close to the small town of Tugela Ferry (Cousins, 2012). Msinga is a semi-arid area with an average rainfall of 600 mm per annum (varying between 400 and 900 mm) (Mkhabela, 2005). On average, the area experiences two days of frost in winter and soils have a pH of 5.7 to 6.2 (CAP, 2003 cited in Mkhabela, 2005). Farming in Msinga is divided into two, namely, dryland and irrigated crop farming. Rainfed farming in the area is considered as a “supplement” for irrigated farming hence is not that crucial to farmer’s livelihoods. Land under dryland farming in the area ranges between 0.4 to 1.3 hectares and these fields are attached to the family surname, therefore, land belong to the family permanently.

Irrigated farming in the area is more central to the livelihoods as a source of income to those who are involved in irrigated farming. Livelihoods of farmers practicing irrigated farming are adversely affected by crop failure as most people at Tugela Ferry depend on agriculture to a larger extent than any other area in the province of KwaZulu-Natal (Mkhabela, 2005). Common causes of crop failure in the irrigation scheme are hail storm and inadequate water supply. Farmers in the scheme practice furrow irrigation where water is diverted through secondary canals into individual plots using small furrows. The planted area is then flooded with water with the small furrows. Individual plots in the irrigation scheme are popularly known as „beds“ and each plot is approximately 0.1 hectares (Mkhabela, 2005). While other farmers have only one plot, others have multiple plots (beds). The possession of beds seems to depend on historical allocation to families. Farmers whose families were not allocated plots are able to get beds through lease agreements. Vegetable crops grown in the irrigation scheme during winter and

summer includes tomatoes, spinach, green peppers, sweet potatoes, potatoes, onions and butternuts. Maize is the main crop grown in summer (Mkhabela, 2005).

### **3.3 Data collection**

Primary data was obtained from field surveys that were conducted in the Tugela Ferry irrigation scheme and in the Machunwini area. These included focus group discussions with farmers, interviews with key informants (extension officers and committee members) and the use of a structured questionnaire administered to 250 farmers (irrigators and non-irrigators). They were two focus group discussions conducted in the irrigation scheme. The purpose of the focus group discussions was to gather in-depth information about the constraints limiting farmers in engaging effectively in agriculture. In each focus group, they were 10 farmers. The 10 farmers on each focus group discussion were randomly selected from the plots on which they were working. Key informant interviews involved a discussion with one extension officer and two committee members in the irrigation scheme.

Quantitative data were collected through a structured questionnaire (Appendix 1). The questionnaire was designed to capture data on demographics (age, gender, level of education attained, family size and income), crop production, livestock ownership, support services and farmer training, land ownership, agricultural skills and knowledge, and food security.

The questionnaire was pre-tested on five non-sampled households in the Tugela Ferry irrigation scheme. The five non-sampled households were randomly selected from the irrigation scheme and the questionnaire was administered to them to see whether it flows. After pre-testing the questionnaire was modified and the final modified questionnaire was used to interview the sampled households. Enumerators were trained before data collection to familiarize them with the questionnaire. The enumerators in this study interviewed and filled the questionnaires on behalf of the farmers. Interviews with farmers in this case ensured direct communication and this was necessary to ensure that there was clarity with the questions in the questionnaire.

### **3.4 Sampling procedure**

The study employed a stratified random sampling procedure and farmers were sampled according to their irrigation method. The reason for stratification using irrigation method was to capture differences that exist in the distribution of water across the different irrigation methods. A list of the irrigating farmers was obtained from extension officers and farmers were stratified according to their irrigation method, i.e., whether they use electric/diesel pump or gravity to divert water to their plots. Irrigation methods in the irrigation scheme included gravity, diesel powered irrigation and electric powered irrigation. A proportional sampling of 10% was employed in each irrigation method and 184 farmers were interviewed in the irrigation scheme. Out of 800 farmers using electric powered irrigation, 96 farmers were randomly selected and out of 500 farmers using gravity, 59 farmers were randomly selected. However, out of 68 farmers using diesel pump, 29 farmers were sampled because the 10% proportion was seven. This was done in order to increase their representation so that they do not miss out in proper analysis. In order to compare irrigators and non-irrigators, 66 dryland farmers were randomly sampled from the Machunwini area, an outskirts of the Tugela Ferry irrigation scheme.

### **3.5 Data analysis**

#### **3.5.1 Descriptive statistics**

This section discusses how the data obtained from the sampled households was analyzed. In this study, Stata (version 11) and the Statistical Package for Social Sciences (SPSS version 21) were used to analyse the data collected from farmers. Data presentation tools in the form of tables, bar graphs and pie charts were used to identify broad categories of constraints faced by farmers. These constraints include land ownership, access to farming information and level of education. Descriptive statistics and Chi-square tests have been employed to present results. The Chi-square test was employed to determine whether there was a gender difference in skills level among men and women in Msinga. A one-way ANOVA was employed to determine whether agricultural skills and knowledge had a significant effect on agricultural productivity.

#### **3.5.2 Determinants of agricultural productivity**

The study assessed the determinants of maize productivity in Msinga. Mohammed and Ortmann (2005) suggested that several methods can be used to explain the relationship between dependent

and independent variables. Such methods include linear regression models, probit analysis, log linear regression and discriminant analysis. A linear regression model (also known as the Ordinary Least Squares regression (OLS)) has been used in this study. Montshwe (2006) suggested that linear regression is the most widely used modeling method for data analysis and has been successfully applied in most studies. Gujarati (1992) also pointed out that the method is useful for analyzing data with a (continuous numerical) dependent variable. The regression model used in this study is specified explicitly as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_i X_{ik} + E_t \dots \dots \dots \mathbf{3.1}$$

Where Y= Maize productivity (t/ha) for household i

$\beta_0$  = the constant term in the model

$\beta_i$  = a vector of the variable coefficient for  $i = 1 \dots k$ , where k is the number of independent variables

$X_i$  = the vector of variables, for  $i = 1 \dots k$

$E_t$  = Error term

By fitting the variables in the model, the model is presented as:

$$Y = \beta_0 + \beta_1 \text{TOT-LAND} + \beta_2 \text{SE\_DEPTH} + \beta_3 \text{IRRIG\_SCHED} + \beta_4 \text{AGE} + \beta_5 \text{GENDER} + \beta_6 \text{EDU\_LEVEL} + \beta_7 \text{FARM\_PRAC} + \beta_8 \text{DSTA\_FARM} + \beta_9 \text{EXP} + \beta_{10} \text{EXT} + E_t \dots \dots \mathbf{3.2}$$

The variable for total land (TOT-LAND) owned is a continuous variable and it refers to the total farm size cultivated to food and cash crop by a household, measured in hectares. Okoye *et al.* (2007) and Ojo (2000) reported an inverse relationship between agricultural productivity and farm size. It is therefore hypothesized that this variable will have a negative effect on agricultural productivity.

The variable for seed depth (SE\_DEPTH) measures the competency level in farmers' ability to determine the correct planting depth. The following scores were assigned to different responses based on the following likert scale. It is treated as level of competence: not competent = 0, competent = 1, very competent = 2. Farmers who are competent or very competent in determining their crop planting depth can achieve better plant densities hence improved productivity. This variable is hypothesized to have a positive effect on maize productivity.

The variable for irrigation scheduling (IRRIG\_SCHED) also measures the level of competence in farmer's ability to schedule and determine the frequency of irrigation. The following scores were assigned to different responses based on the following likert scale. It is treated as level of competence: not competent= 0, competent= 1, very competent = 2. Farmers who are competent or very competent in the practice of irrigation scheduling and determining frequency can avoid under-irrigation or over-irrigation which can lead to improved agricultural productivity. This variable is expected to have a positive effect on maize productivity.

Age (AGE) refers to the chronological age of household head at the time of the survey. It was measured in number of years. As the age of the household head increases, it is expected that farmers acquire more farming experience and their productivity increases. Therefore, it is hypothesized that age will have a positive effect on maize productivity.

Gender (GENDER) of household head is a dummy variable which takes the value of 1 if the respondent is male and 0 otherwise. The effect of this variable on maize productivity can either be positive or negative.

The variable for household head level of education (EDU\_LEVEL) is a continuous variable. Operationally, it refers to the number of years of schooling attained by the household head. Educated individuals have the capacity to process and apply the information (farming) passed on to them (Okoye *et al.*, 2008). Therefore, it is expected that education will have a positive effect on maize productivity.

In the model, the variable for farming practice (FARM\_PRAC) refers to the method of farming, which can either be irrigation or dryland. FARM\_PRAC is a dummy variable which takes the value of 1 if the respondent is practicing irrigated farming and 0 otherwise. Todkari (2012) reported a strong positive correlation between irrigation intensity and agricultural productivity. This variable is expected to have a positive effect on maize productivity.

In the model the variable for distance from the farm (DSTA\_FARM) is a continuous variable that estimates the distance between the farmers' residential area and the farm. Farmers who walk

for long distances to reach their farms are expected to be less productive than those who stay near their farms. This variable is expected to have either a positive or negative effect on maize productivity.

The variable for farming experience (EXP) is a continuous variable measured in number of years. Experienced farmers are expected to obtain a higher yield as they are more efficient in decision making and are willing to take risk associated with the adoption of innovations (Okoye *et al.*, 2008). Therefore, farming experience is expected to have a positive effect on maize productivity.

The variable for access to extension services (EXT) is a dummy, which takes the value of 1 if the respondent had access to extension services in the past 12 months and 0 otherwise. Extension helps in the dissemination of agricultural information which can result in improved agricultural productivity. Hence, this variable is expected to have a positive effect on maize productivity.

### **3.5.3 Household Food Insecurity Access Scale**

The Household Food Insecurity Access Scale (HFIAS) was used to analyse food access among farming households in Msinga. Food security levels were determined by creating HFIAS score indicator (Coates *et al.*, 2007). The HFIAS score is a continuous measure of the degree of food insecurity (access) in the past four weeks. HFIAS score was calculated from each household by summing the coded frequency for each question (Coates *et al.*, 2007). The instructions for the nine individual questions as adopted from Coates *et al.* (2007) are as follows:

#### **Q1: Worry about food**

This question asks the respondent to indicate their personal experience with uncertainty and anxiety about acquiring food during the previous month.

#### **Q2: Unable to eat preferred foods**

This question asks whether any household member was not able to eat according to their preference due to lack of resources. Preference can refer to the form of a particular food (i.e., whole rice vs broken rice), type of staple (i.e., millet or corn) or a high quality food (i.e., meat or fish).

**Q3: Eat just a few kinds of foods**

This question asks about dietary choices related to variety – i.e., whether the household had to eat an undesired monotonous diet (little diversity in the different types of foods consumed).

**Q4: Eat foods they really do not want to eat**

This question, which also captures the dimension of limited choices, asks whether any household member had to eat food that they found socially or personally undesirable due to the lack of resources. Generally, these are foods that are consumed only under hardship.

**Q5: Eat a smaller meal**

This question asks whether the respondent felt that the amount of food (not just the staple food but any kind of food) that any household member consumed in any meal during the past four weeks was smaller than they felt they needed due to lack of resources.

**Q6: Eat fewer meals in a day**

This question asks whether any household member, due to lack of food, had to eat fewer meals than the number typically eaten in food secure households in their area.

**Q7: No food of any kind in the household**

This question asks about a situation in which the household has no food to eat of any kind in the home. This describes a situation where food was not available to household members through the household's usual means (i.e., through purchases, from storage or own production).

**Q8: Go to sleep hungry**

This question asks whether the respondent felt hungry at bed time because of lack of food or whether the respondent was aware of other household members who were hungry at bedtime because of lack of food.

**Q9: Go a whole day and night without eating**

This question asks whether any household member did not eat from the time they woke in the morning to the time they awoke the next morning due to lack of food.

Each question has a maximum score of three. When summing up the scores from the nine questions, the minimum score is 0 and the maximum score is 27. The higher the score, the more food insecurity a household experienced and the lower the score, the less food insecurity a

household experienced. A household score was given by the sum of the frequencies or experience (equation 3.1).

HFIAS Score (0-27) = Sum frequency code (Q1 + Q2 + Q3 + Q4 + Q5 + Q6 + Q7+ Q8 + Q9).....**3.3**

Responses to Q1 were analysed and the percentages of men and women who responded affirmatively to this question were calculated to give the percentage of households who experienced anxiety and uncertainty at any level of severity. The degree of severity of the households in all the questions was calculated in consideration to the number of farmers who responded “rarely” or “sometimes” or “often” or “always” to Q1. Responses to Q2, Q3 and Q4 of the HFIAS were analysed and expressed as percentage of households experiencing insufficient food quality, including variety and preferences of food types (Coates *et al.*, 2007). Responses to Q5, Q6, Q7, Q8 and Q9 of the HFIAS were also analysed and expressed as a percentage of farmers experiencing inadequate food intake. The responses of the nine HFIAS score questions were entered into SPSS as an additional variable.

#### **3.5.4 Household Food Insecurity Access Prevalence**

The Household Food Insecurity Access Prevalence (HFIAP) status was used to report household food insecurity (access) prevalence. Households were categorized into four levels of household food insecurity (access): food secure, and mild, moderately and severely food insecure. Households are categorized as increasingly food insecure as they respond affirmatively to more severe conditions and/or when they experience those conditions more frequently (Coates *et al.*, 2007). A food secure household experiences none of the food insecurity (access) conditions, or just experiences worry, but rarely. A mildly food insecure household worries about not having enough food sometimes or often and is unable to eat preferred foods or eat a more monotonous diet than desired or some foods considered undesirable, but only rarely. A moderately food insecure household sacrifices quality more frequently, by eating a monotonous diet or undesirable sometimes or often, and he/she started to cut back on quantity by reducing the size or number of meals, rarely of sometimes but does not experience any of the three main severe conditions. A severely food insecure household has graduated to cutting down on meal size or on number of meals often, and or experiences any of the three most severe conditions (running out of food, going to bed hungry, or going the whole day and night without eating).

### 3.5.5 Determinants of household food security

The study also determined the determinants of household food security in Msinga. The regression model used in this study is specified explicitly as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_i X_{ik} + E_t \dots \dots \dots 3.4$$

Where Y= HFIAS score (measure of household food security/access) for household i

$\beta_0$  = the constant term in the model

$\beta_i$  = a vector of the variable coefficient for  $i= 1 \dots k$ , where k is the number of independent variables

$X_i$  = the vector of variables, for  $i=1 \dots k$

$E_t$  = Error term

By fitting the variables in the model, the model is presented as:

$$\begin{aligned} Y = & \beta_0 + \beta_1 AGE + \beta_2 GENDER + \beta_3 EDU\_LEVEL + \beta_4 FARM\_PRAC + \beta_5 SE\_DEPTH \\ & + \beta_6 NUTDEFICNT + \beta_7 PUMPMANT + \beta_8 TOTALLAND + \beta_9 GOATWND \\ & + \beta_{10} CATTLOWND + \beta_{11} CREDITUSE + \beta_{12} TOT\_INC + \beta_{13} AGRIC\_INC \\ & + E_t \dots \dots \dots 3.5 \end{aligned}$$

The model that has been developed above explains the relationship between household food security and the factors affecting it. In the model, household food security is represented by HFIAS score which is the dependent variable. The independent variables with their expected signs are defined as follows:

The variable for age (AGE) of household head is expected to impact on his or her labour supply for food production. Young household heads are expected to cultivate larger plots as compared to older household heads. Age of household head also determines the ability to seek and obtain off-farm employment which younger household heads can do better. Bashir *et al.* (2012) found that an increase of one year in the age of household head decreases the chances of a household to become food secure by 3%. This variable is expected to have a positive effect on household food security.

The variable for gender (GENDER) of household head is a dummy variable which takes the value of 1 if the respondent is male and 0 otherwise. Female household heads have higher

dependency which hinders household capacity to allocate labour to off-farm or other income generating activities. Also, female headed households tend to be older and have fewer years of education than male heads of households (FAO, 2012). The expected effect of this variable on household food security can either be negative or positive.

Level for education (EDU\_LEVEL) of household head is a social asset which is expected to have a positive effect on household food security. Shaikh (2007) argued that educated individuals have capacity to process and apply information (farming) passed on to them. Low levels of education impede access to better job opportunities in the labour market (FAO, 2012). In a study conducted in Nigeria, Benjamin & Umeh (2012) found that level of education has a positive and significant effect on household food security.

The variable for farming practice (FARM\_PRAC) refers to the method of farming, which can either be irrigation or dryland. FARM\_PRAC is a dummy variable which takes the value of 1 if the respondent is practicing irrigated farming and 0 otherwise. Farmers who irrigate their crops will possibly attain higher yields which can lead to improved food access. This variable is expected to have a positive effect on household food security.

The variable for seed depth (SE\_DEPTH) measures the competency level in farmers' ability to determine the correct planting depth. The following scores were assigned to different responses based on the following likert scale. It is treated as level of competence: not competent= 0, competent= 1, very competent = 2. Farmers who are competent or very competent in determining their crop planting depth can achieve better plant densities hence improved productivity which can lead to improved food security. This variable is hypothesized to have a positive influence on household food security.

The variable for the practice of determining nutrient deficiency (NUTDEFICNT) in crops measures the competency level in farmers' ability to determine nutrient deficiency. The following scores were assigned to different responses based on the following likert scale. It is treated as level of competency: not competent= 0, competent= 1, very competent = 2. Farmers who are competent or very competent in determining nutrient deficient in crops are expected to

achieve a higher yield as they can timely apply fertilizers. This variable is expected to have a positive effect on household food security.

The variable for pump maintenance (PUMPMANT) measures the competency level of farmers in ensuring their irrigation pump is in good working condition. The likert scale was used to give scores for the different competency levels: where not competent= 0, competent= 1, very competent= 2. This variable is expected to have a positive effect on household food security.

Total land owned (TOTALLAND), in this study, refers to the total area of land cultivated to food and cash crop by households, measured in hectares. Deininger (2003) cited in Kuwornu *et al.* (2013) found a positive relationship between total land owned and improvement in household income and food security. The larger the farm size, the higher the expected level of food production and food security. It is therefore expected that households with a larger area to be more food secure than households with a small area, all things being equal. The expected effect of this variable on food security is positive.

In this study, goats (GOATWND) and cattle (CATTLOWND) ownership are continuous variables. In times of need, households can sell their goats or cattle and get cash to buy food thereby becoming food secure. In a study conducted by Haile *et al.* (2005) in Ethiopia, they found that an increase of one livestock (ox) increased the probability of a household to become food secure by 5%. Most recently, Bashir *et al.* (2012) found that an increase in small livestock (goats) increase the chances of a household to be food secure by 31% in rural Punjab, Pakistan. In this study, it is hypothesized that goat and cattle ownership will have a positive effect on household food security.

Access to credit (CREDITUSE) is the ability of households to obtain credit both in cash and kind for either consumption or to support agricultural production (Kuwornu *et al.*, 2013). Credit obtained for consumption purposes increases the consumption basket of households (Babantude *et al.*, 2007). On the other hand, production credit, when obtained on time, increases the chances of farming households to acquire productive resources (pesticides, seeds, fertilizers and machinery hire) which will boost production and improve the food security of a household.

Access to credit is a dummy variable and is determined as 1 (yes) for households that obtained credit in the past 12 months and 0 (no) otherwise. The expected effect of access to credit on household food security is positive.

Total income (TOT\_INC) in this study refers to the sum of earnings of household from both off-farm and on-farm sources whereas agricultural income (AGRIC\_INC) refers to income gained from on-farm activities. According to Arene & Anyaeli (2010), the more households engage in gainful employment, the higher he/she earns income and the greater the chances of being food secure. The expected effect for both total income and agricultural income on household food security is, therefore, positive.

### **3.6 Summary**

This chapter has given an overview of the Tugela Ferry irrigation scheme. The methods used to analyse data were reviewed. Data was collected from 250 smallholder farmers in the Tugela Ferry irrigation scheme and Machunwini area in Msinga. A stratified random sampling procedure was used to select the sample of farming households. To collect data, a structured questionnaire was administered to the respondents through face-face interviews. The results of the research are presented in the next three chapters.

## CHAPTER 4: RESULTS AND DISCUSSION

### 4.1 Introduction

This chapter presents the results of the analysis of the survey data. The chapter begins with the presentation of an analysis of the demographic data of the sampled farmers. Results of descriptive analysis are presented. To describe the farmers in Tugela Ferry and identify the broad categories of constraints, the study utilized data on characteristics of household heads, household demographic backgrounds, sources of farming information, agricultural skills and knowledge.

### 4.2 Demographic characteristics of the households

In this section, household head's aspects such as gender, age, marital status, highest educational levels, land ownership and sources of farming information are discussed. Table 4.1 represents the results in relation to gender of the *de-facto* household head.

**Table 4.1: Distribution of households by gender of household head**

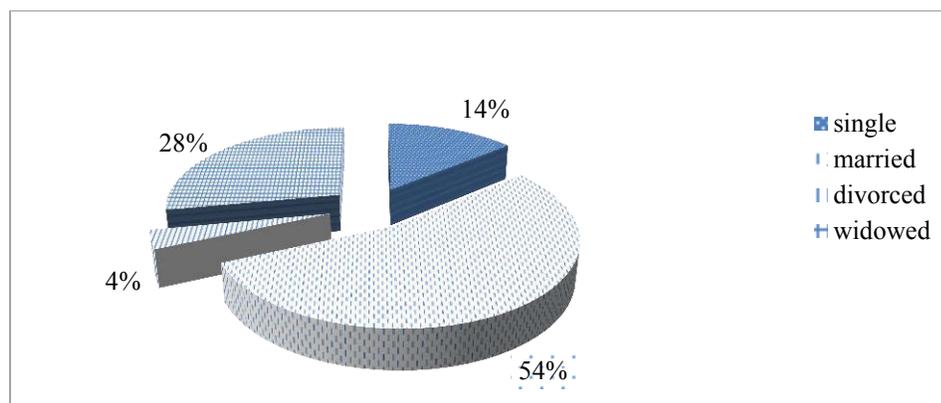
Gender	Frequency	Percentage (%)
<b>Irrigators</b>		
Female	124	67.4
Male	60	32.6
Total	184	100
<b>Non-irrigators</b>		
Female	43	65.2
Male	23	34.8
Total	66	100

The results show that more female-headed households (67.4% irrigators and 65.2% non-irrigators) are involved in crop farming than male-headed households. These figures are comparable to that obtained from the Income and Expenditure Survey (IES) of 2005/6 where nationally, more female-headed households (61%) are engaged in smallholder agriculture (Aliber, 2009). This is so because men usually migrate to urban areas in search of employment leaving the women and children to farm. This could also be a reflection of the patriarchal role of

men in African families and gendered nature of food production in rural areas. Men as the heads of households are expected to provide for their families hence they migrate and seek jobs which will pay them monthly. However, men who are unemployed or have lost their jobs join the women in farming. These results may also be an indication that households do not expect to meet all their requirements from rural activities, including farming, be it irrigated or dryland farming.

### 4.3 Marital status of farmers

The sampled farmers were also assessed in terms of their marital status. This was divided into four categories namely; married, single, divorced and widowed (Figure 4.1). In this scenario, people who stay with their spouse may be better off as compared to people who do not. Often in an African rural set up, the husband and wife play complementary roles with regard to their livelihoods. While the female may be engaged to agricultural activities, the male may be more involved in income generating activities in urban areas. In the absence of a spouse, one may encounter a problem where he/she has to perform duties of the other and this might be a burden to women who are not formally employed. The implication of this scenario is that households where both spouses are alive may be more food secure as compared to those where the household head is single. In an African set up, marital status can also affect access to productive resources such as land. Women who are single are not allowed to own land, women own land through their spouses.

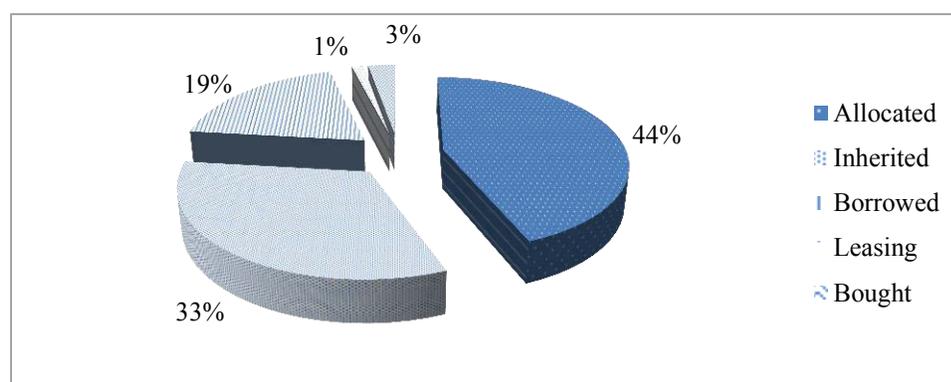


**Figure 4.1: Distribution of households by marital status**

Figure 4.1 above suggests that 54% of the sampled farmers are married and the rest are either single, divorced or widowed. Single, divorced or widowed household heads who are not formally employed have high chances of becoming food insecure as they are no complementary roles played by the other partner in ensuring household food security.

#### 4.4 Land ownership

The study examined the patterns of land ownership in the Tugela Ferry irrigation scheme as land is the most important asset needed for agricultural production. The study also examined whether farmers were satisfied with the present security of land ownership. In this study, land ownership is equated to land access. Land tenure systems are vital to this study as they determine who can use land, for how long, and under what conditions (FAO, 2002). Figure 4.2 shows the results concerning land ownership in Msinga. Some 44% of surveyed farmers were allocated land by the chief, 33% of the farmers inherited land from their relatives and the rest of the farmers had borrowed, bought or leased land from other farmers. Farmers with secured land rights are more likely to make necessary improvements and take measures to conserve soils and maintain the fertility of the land, which will have a positive effect on agricultural production and productivity (Amani, 2004). According to Amani (2004), the implication of the scenario prevailing in the area is tenure insecurity which gives rise to lack of desire to improve land.



**Figure 4.2: Land tenure system in Msinga**

The study examined if there was a gender difference on land ownership. The results show that there was a significant ( $p < 0.1$ ) difference in the amount of land that female-headed and male-headed households owned under irrigation. On average, female-headed households owned 0.19

ha while male-headed households owned 0.22 ha. However, there was no significant mean difference between gender and total land owned by dryland farmers.

**Table 4.2: Gender of household head and amount of land owned by irrigators and non-irrigators**

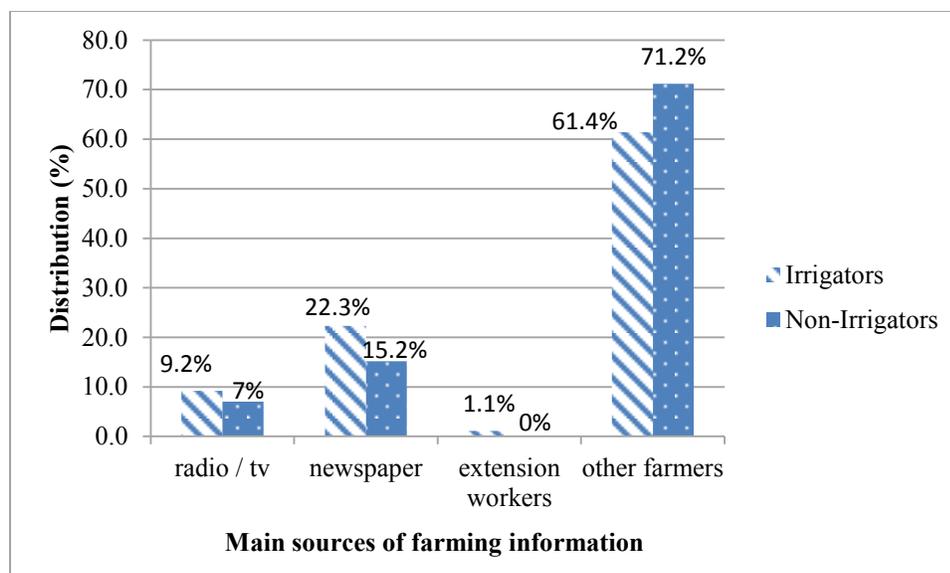
Variable	Male	Female	Significant level (T-test)
Irrigators (n=184)	0.22 ha	0.19 ha	*
Non-irrigators (n=66)	1.22 ha	0.65 ha	ns

\*=Significant at the 0.1 level, ns= not significant

#### 4.5 Sources of farming information

Weak support services are recurrent in most assessments of smallholder irrigation scheme in South Africa (Bembridge, 2000; Machete *et al.*, 2004; iSeneke Developments, 2004; Tlou *et al.*, 2006 cited in van Averbake, 2008). Acquiring farming information is one of the determinants of agricultural productivity. Smallholder farmers need information on what and when to plant and also the market prices of the different commodities they produce. The sources of farming information include newspapers, radio/television, other farmers and extension officers. These sources of information were not regarded as means of communication. Figure 4.3 presents the main sources of information for farmers.

Most farmers (61.4% of irrigators and 72.2% non-irrigators) obtain farming information from other farmers. A few farmers (1.1% irrigators) indicated their extension officers as the main source of information. These findings contradict Machete (2004) who found that extension services play a pivotal role in empowering farmers with farming techniques, skills and knowledge. This could indicate area specific levels of availability of extension services. The implication of this scenario is that agricultural information is poorly disseminated to farmers by extension officers. According to Ango *et al.* (2013), dissemination of agricultural information is crucial for increased agricultural productivity of rural women. The information allows the farmers to learn about production technologies and other aspects which they were not aware of, which can lead to improved production.



**Figure 4.3: Main sources of farming information among farmers**

#### 4.6 Determinants of agricultural skills and knowledge

Limited agricultural skills and knowledge have been identified as the main causes of poor crop production among rural farmers (Machete *et al.*, 2004). This study assessed the competence of farmers in a range of agricultural skills: production, marketing and business skills. Production skills such as irrigation scheduling and frequency, determining intra and inter row spacing, application of herbicides and fungicides and fertilizer application are critical as inappropriate application of these skills could negatively affect yield and hence the livelihood of farmers. After harvesting period smallholders need to market their produce so that they get a return in their investment, hence marketing skills such as price determination, knowledge of market for produce and packaging are crucial. Appropriate application of business skills such as financial management enables farmers to be managers of their own finances.

Farmers were asked to rate themselves across various skills into three classes, i.e., not competent, competent and very competent. However, this method of measuring agricultural skills and knowledge has potential limitations in that farmers may not be aware that they do not know their level of skills competence. The study also set out to determine the factors that could be contributing to the competence i.e., gender of household head, level of education, age and

access to extension services. Table 4.3 shows the Chi-square test results of the relationship between gender and levels of skills competence among irrigators.

There was a significant difference across gender in the level of competence in the production skill of herbicide and fungicide application. Men were significantly ( $p < 0.1$ ) more competent than women in application of herbicides and fungicides. This might be because men had attained more education than women and, therefore are better at reading and understanding instructions on fungicide and herbicides labels. Culture and socialization of girl children in rural areas may also play a role in encouraging and fostering technical activities for girls and boys thus resulting in girls to have a lower affinity to technical activities even when the same formal education has been acquired. The insignificance in differences in other production skills might be attributed to the fact that most of the farmers in the irrigation scheme are old hence have all accumulated the same knowledge on how to farm over the long time.

Mnkeni *et al.* (2010) cited poor marketing skills as a constraint in smallholder farming. There were significant ( $p < 0.1$ ) gender differences in farmers' knowledge of market for their produce. The results show that more female (47.6%) farmers do not know where to sell their produce as compared to 35% male farmers. As further evidence of the better knowledge of males on marketing, most female farmers sell their produce to men who come to buy directly from the field.

**Table 4.3: Relationship between gender of household head and agricultural skills and knowledge among irrigators in Msinga**

Agricultural skills and knowledge	Not Competent (%)		Competent (%)		Very Competent (%)		Significant level ( $\chi^2$ )
	Male	Female	Male	Female	Male	Female	
<b>Production skills</b>							
Selecting appropriate planting methods for various crops (n=184)	5	4.8	53.3	62.9	41.7	32.3	ns
Determining inter and intra row spacing (n=184)	8.3	2.4	43.3	53.2	48.3	44.4	ns
Irrigation scheduling and frequency (n=184)	13.3	15.3	41.7	54.8	45	29.8	ns
Application of herbicide and fungicide (n=184)	30	45.2	31.7	29.8	38.3	25	*
Planning and carrying out harvesting appropriately for various crops (n=184)	10	11.3	51.7	54	38.3	34.7	ns
Determining the amount of fertilizer to apply for various crops (n=184)	31.7	25.8	46.7	46.8	31.7	27.4	ns
Soil and water conservation for specific farm lands (n=184)	31.7	34.7	40	42.7	28.3	22.6	ns
Determining seed depth (n=184)	13.3	19.4	43.3	49.2	43.3	31.5	ns
Determining nutrients deficiency symptoms in crops (n=184)	11.7	16.9	45	41.9	43.3	41.1	ns
Calibration and use of sprayer (n=184)	28.3	37.9	33.3	33.9	38.3	28.2	ns
Maintenance of water pump (n=184)	50	59.7	30	24.2	20	16.1	ns
Storage of produce (n=184)	18.3	22.6	53.3	58.1	28.3	19.4	ns
<b>Marketing skills</b>							
Packaging of produce (n=184)	23.3	21.8	50	56.5	26.7	21.8	ns
Knowledge of marketing contracts (n=184)	53.3	50.8	28.3	39.5	18.3	9.7	ns
Price determination for your produce (n=184)	20	13.7	46.7	60.5	33.3	25.8	ns
Knowledge of the market for your produce (n=184)	35	47.6	38.3	38.7	26.7	13.7	*
<b>Business skills</b>							
Financial management (n=184)	56.7	42.7	30	44.4	13.3	12.9	ns
Farm record keeping (n=184)	78.3	69.4	13.3	22.6	8.3	8.1	ns

\* =Significant at the 0.1 level, ns= not significant

The study also set out to assess whether there was a significant gender difference in the level of skills competence among non-irrigators. Table 4.4 shows the results of the Chi-square test. The results show that there was no significant gender difference in the level of competence in production skills among non-irrigators. There was a significant ( $p < 0.05$ ) gender difference in the level of competence in packaging of produce. Women are more competent in the packaging

of produce. This might be an indication that packing is regarded as a woman's work in rural areas.

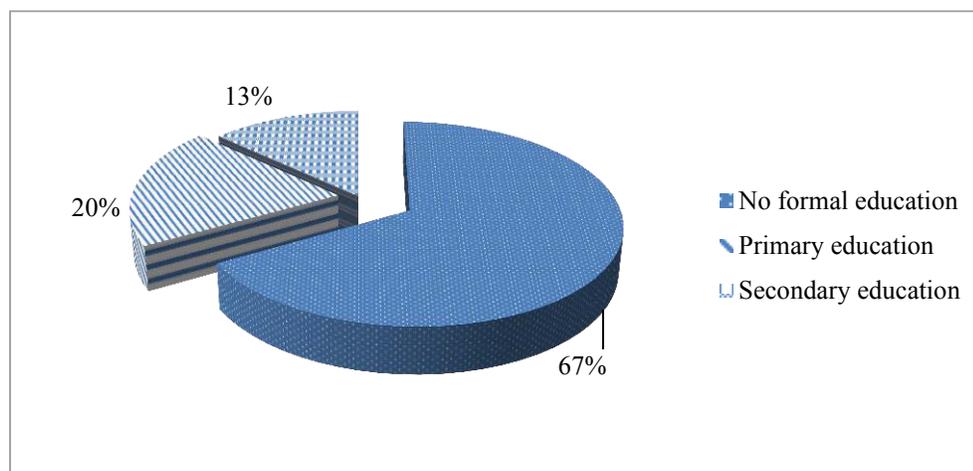
**Table 4.4: Relationship between gender of household head and agricultural skills and knowledge among non-irrigators in Msinga**

Agricultural skills and knowledge	Not Competent (%)		Competent (%)		Very Competent (%)		Significant level ( $\chi^2$ )
	Male	Female	Male	Female	Male	Female	
<b>Production skills</b>							
Selecting appropriate planting methods for various crops (n=66)	47.8	39.5	39.1	23.3	13	37.2	ns
Determining inter and intra row spacing (n=66)	30.4	39.5	39.1	30.2	30.4	30.2	ns
Irrigation scheduling and frequency (n=66)	87	79.1	8.7	16.3	4.3	4.7	ns
Application of herbicide and fungicide (n=66)	91.3	69.3	4.3	11.6	4.3	18.6	ns
Planning and carrying out harvesting appropriately for various crops (n=66)	21.7	18.6	47.8	39.5	30.4	41.9	ns
Determining the amount of fertilizer to apply for various crops (n=66)	65.2	79.1	13	11.6	21.7	9.3	ns
Soil and water conservation for specific farm lands (n=66)	82.6	83.7	17.4	14	0	2.3	ns
Determining seed depth (n=66)	34.8	37.2	47.8	30.2	17.4	32.6	ns
Determining nutrients deficiency symptoms in crops (n=66)	43.5	46.5	39.1	60.9	17.4	20.9	ns
Calibration and use of sprayer (n=66)	82.6	74.4	8.7	20.9	8.7	4.7	ns
Maintenance of water pump (n=66)	95.7	93	0	2.3	4.3	4.7	ns
Storage of produce (n=66)	4.3	20.9	60.9	41.9	34.8	37.2	ns
<b>Marketing skills</b>							
Packaging of produce (n=66)	65.2	44.2	30.4	18.6	4.3	37.2	**
Knowledge of marketing contracts(n=66)	100	100	0	0	0	0	ns
Price determination for your produce(n=66)	95.7	93	0	7	4.3	0	ns
Knowledge of the market for your produce (n=66)	100	97.7	0	2.3	0	0	ns
<b>Business skills</b>							
Financial management (n=66)	91.3	97.7	4.3	0	4.3	2.3	ns
Farm record keeping (n=66)	95.7	90.7	4.3	9.3	0	0	ns

\*\*= significant at the 0.05 level, ns= not significant

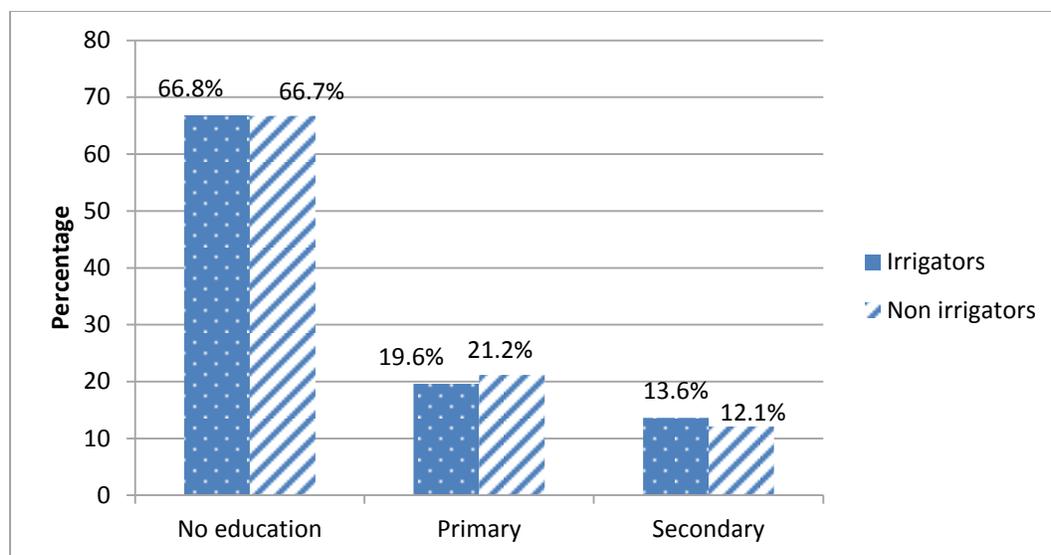
#### 4.7 Highest education level of farmers

In this study, level of education is regarded as important for enhancing farmer's agricultural (technical) and marketing skills. The education level of smallholder farmers in Msinga was generally low. Figure 4.4 show that 67% of the sampled farmers have not attended school. For those who attended school, 20% have gone up to primary level and 13% have attained secondary education. However, there is no farmer who has achieved tertiary education. Education level of farmers is considered to be vital for this study as education level could directly affect agricultural productivity, skills and hence the food security status of the farmers. Farmers with low levels of education are less likely to adopt new technologies geared to improving agricultural productivity. The lower educational levels among the sampled farmers imply that written agricultural information is of minimal benefit to the farmers in the area.



**Figure 4.4: Highest educational levels of farmers in Msinga**

An investigation on the highest educational levels between irrigators and non-irrigators was made and the results are presented in figure 4.5. The results show that 19.6% of irrigators and 21.2% of non-irrigators attained primary education. Some 13.6% of irrigators and 12.1% of non-irrigators attained secondary education.



**Figure 4.5: Distribution of education level between irrigators and non-irrigators**

A further investigation was carried out to determine whether the differences in levels of education attained by irrigators and non-irrigators were statistically significant. However, there was no statistical significant difference in the mean years of schooling attained by irrigators and non-irrigators (Table 4.5).

**Table 4.5: Education level of farmers**

Variable	Minimum	Maximum	Mean	Significant level (T-test)
<b>Education</b>				
Irrigators (n= 184)	0	12	2.32	ns
Non-irrigators (n=66)	0	12	2.44	

ns= not significant

An investigation was also carried out to determine whether there was a significant gender difference in the level of education attained by female and male farmers. The results (Table 4.6) show that men had higher levels of education than women and the difference was significant ( $p < 0.01$ ).

**Table 4.6: Education level and gender farmers**

Variable	Mean	Std. Deviation	Significant level (T-test)
<b>Gender</b>			
Female (167)	1.81	3.25	
			***
Male (83)	3.43	4.18	

\*\*\* = significant at the 0.01 level

#### 4.7.1 Relationship between agricultural skills and knowledge, and level of education

Citing Sewpaul (2008), Trevor Manuel, the then Minister of Finance in South Africa, noted that 15% of rural women have school leaving certificate (matriculation) compared to 50% for urban women. Level of education among rural farmers affects the competence of farmers in agricultural skills. Cronje *et al.* (2003) cited low levels of education as a cause for the failure of some smallholders to perform basic farm managerial tasks.

This study set out to determine whether there is a relationship between agricultural skills and knowledge, and level of education. Level of education in this case was measured by the number of schooling years attained by farmers. Table 4.7 shows the results of the comparison of agricultural skills and knowledge across different education levels of irrigators. There was a significant mean difference between levels of competence in calibration and use of sprayer and determining seed depth and mean level of education attained by farmers in the irrigation scheme. The significance ( $p < 0.05$ ) in the competency levels of sprayer use and calibration implies that such equipment require some level of education. The results showed that there was a significant ( $p < 0.1$ ) mean difference in the level of farmers' competence in determining seed depth. Farmers who are more educated are able to plant their seeds at the desired planting depth. One can infer that more educated farmers get better germination and possibly achieve better yields. The insignificance of most production skills to education level signifies the important role played by indigenous knowledge rather than formal education among rural farmers.

The effect of education on marketing skills was also assessed. Collett & Gale (2009) argue that smallholder farmers need marketing and business skills to better represent their smallholder businesses in markets. There was a significant ( $p < 0.1$ ) difference in the level of competence in

the practice of financial management. This implies that as level of education increases, farmers become more competent in managing their farming income.

**Table 4.7: Relationship between agricultural skills and knowledge, and level of education among irrigators in Msinga**

Agricultural skills and knowledge	Not Competent	Competent	Very Competent	Significant level (ANOVA)
<b>Production skills</b>	<b>Level of education (number of schooling years)</b>			
Selecting appropriate planting methods for various crops (n=184)	3	2	3	ns
Determining inter and intra row spacing (n=184)	3	2	3	ns
Irrigation scheduling and frequency (n=184)	2	2	3	ns
Application of herbicide and fungicide (n=184)	2	2	3	ns
Planning and carrying out harvesting appropriately for various crops (n=184)	2	2	3	ns
Determining the amount of fertilizer to apply for various crops (n=184)	2	2	3	ns
Soil and water conservation for specific farm lands (n=184)	3	2	2	ns
Determining seed depth (n=184)	3	2	3	*
Determining nutrient deficiency symptoms in crops (n=184)	1	3	3	ns
Calibration and use of sprayer (n=184)	1	3	3	**
Maintenance of water pump (n=184)	2	3	2	ns
Storage of produce (n=184)	3	2	3	ns
<b>Marketing skills</b>				
Packaging of produce (n=184)	2	2	3	ns
Knowledge of marketing contracts (n=184)	2	2	2	ns
Price determination for your produce (n=184)	3	2	3	ns
Knowledge of the market for your produce (n=184)	2	2	3	ns
<b>Business skills</b>				
Financial management (n=184)	1	2	3	*
Farm record keeping (n=184)	2	2	3	ns

\*\* = significant at the 0.05 level, \* = Significant at the 0.1 level, ns= not significant

The agricultural skills were compared across levels of education among non-irrigators. There was a significant ( $p < 0.1$ ) difference in the level of competence in determining the correct amount of fertilizer to apply and this implies that farmers who are more educated are able to apply the correct amounts of fertilizer in their crops and possibly achieve better yields. Farmers' ability to determine seed depth was significant ( $p < 0.1$ ). This implies that farmers with more schooling years are likely to get a better yield as they plant in the correct seed depth and can

achieve better germination rates. There was a significant ( $p < 0.1$ ) difference in the level of farmers' competence in determining the price of their produce. Level of competence in financial management was also significant ( $p < 0.1$ ). This implies that farmers who had more schooling years can manage their finances better.

**Table 4.8: Relationship between agricultural skills and knowledge, and level of education among non-irrigators in Msinga**

Agricultural skills and knowledge	Not Competent	Competent	Very Competent	Significant level (ANOVA)
<b>Production skills</b>	<b>Level of education (number of schooling years)</b>			
Selecting appropriate planting methods for various crops (n=66)	2	2	3	ns
Determining inter and intra row spacing (n=66)	2	2	4	ns
Irrigation scheduling and frequency (n=66)	2	3	4	ns
Application of herbicide and fungicide (n=66)	3	2	1	ns
Planning and carrying out harvesting appropriately for various crops (n=66)	1	3	2	ns
Determining the amount of fertilizer to apply for various crops (n=66)	1	3	5	*
Soil and water conservation for specific farm lands (n=66)	3	2	0	ns
Determining seed depth (n=66)	1	3	3	*
Determining nutrients deficiency symptoms in crops (n=66)	3	1	4	ns
Calibration and use of sprayer (n=66)	2	4	1	ns
Maintenance of water pump (n=66)	3	0	2	ns
Storage of produce (n=66)	2	3	2	ns
<b>Marketing skills</b>				
Packaging of produce (n=66)	2	3	2	ns
Knowledge of marketing contracts(n=66)	-	-	-	ns
Price determination for your produce(n=66)	2	0	10	*
Knowledge of the market for your produce (n=66)	2	-	0	ns
<b>Business skills</b>				
Financial management (n=66)	2	7	8	*
Farm record keeping (n=66)	2	2	-	ns

\*=significant at the 0.1 level, ns=not significant

#### 4.8 Age of farmers

Age of the sampled farmers was also assessed. Table 4.9 presents the results. The results show that the average age of irrigators was 57 years while the average age for non-irrigators was 59 years, with the youngest farmer being 25 years old (irrigator) and the oldest farmer being 90 years old for non-irrigators and 89 years for irrigators. However, there is no statistical significant difference in age between irrigators and non-irrigators.

**Table 4.9: Age of farmers**

Variable	Minimum	Maximum	Mean	Significant level (T-test)
<b>Age</b>				
Irrigators (n=184)	25	89	56.88	
				ns
Non-irrigators (n=66)	26	90	58.50	

ns: not significant

A further investigation was carried out to determine if there was a statistical difference in the age of female and male farmers. The results (Table 4.10) show that there was no significant age difference among female and male farmers.

**Table 4.10: Age and gender farmers**

Variable	Mean	Std. Deviation	Significant level (T-test)
<b>Gender</b>			
Female (167)	57.3	14.57	
			ns
Male (83)	57.4	12.51	

ns: not significant

#### 4.8.1 The effect of age of household head on agricultural skills and knowledge

Elderly people constitute the majority of smallholder farmers. It is therefore necessary to determine whether age has a significant effect on the level of competence in agricultural skills and knowledge. Table 4.11 shows the results of a Chi-square test between agricultural skills and knowledge, and age of household head among farmers in the Tugela Ferry irrigation scheme. Only agricultural skills that were significant are shown.

The results show that age of household head had a significant effect on farmers' level of competence in irrigation scheduling and frequency and determining nutrient deficiency symptoms in crops. The significant ( $p < 0.1$ ) effect of age on the level of farmer's competence in carrying out irrigation scheduling and frequency implies that, with age, farmers in the irrigation scheme become more experienced in determining the correct amount of water to be applied to crops. The significant ( $p < 0.05$ ) effect of age on farmers' level of competence in determining nutrient deficiency in various crops implies that, with age, farmers gain hands on experience and are able to avoid crop losses which may be a result of deficiencies in plant nutrition.

**Table 4.11: Relationship between age and agricultural skills and knowledge of household head among irrigators**

Agricultural skills and knowledge	Level of skill's competence	Age category				Significant level (ANOVA)
		25-40	41-55	56-70	>71	
<b>Production skills</b>						
Irrigation scheduling and frequency (n=184)	<b>Not Competent</b>	4	3	17	3	**
	<b>Competent</b>	14	35	37	7	
	<b>Very Competent</b>	8	15	28	13	
Determining nutrient deficiency symptoms in crops (n=184)	<b>Not Competent</b>	1	8	12	7	*
	<b>Competent</b>	17	20	34	8	
	<b>Very Competent</b>	8	25	36	8	

\*\* = significant at the 0.05 level, \* = Significant at the 0.1 level, ns= not significant

#### 4.9 Extension services and agricultural skills and knowledge

Extension services are crucial in disseminating agricultural information. In the survey, farmers were asked whether they had contact with an extension officer in the past 12 months. A Chi-square test was employed to determine whether farmers' access to extension services has an effect on the level of competence in agricultural skills and knowledge in the Tugela Ferry irrigation scheme. Table 4.12 shows that access to extension services has a significant effect on production skills.

Access to extension services had a significant ( $p < 0.01$ ) effect on farmers' level of competence in irrigation scheduling and frequency. This implies that access to extension services has the potential to improve crop production in the irrigation scheme since farmers are able to apply the right amount of water through the guidance of their extension agents. There was also a significant ( $p < 0.01$ ) effect of access to extension services on level of competence in herbicide and fungicide application. This implies that farmers who have access to extension can get more yield as they are less likely to experience crop losses as a result of pest and diseases since extension officers help them to follow and interpret herbicide and fungicide manuals. Access to extension services has a significant ( $p < 0.01$ ) effect on farmers level of competence in determining the correct amount of fertilizer to apply. This implies that farmers with access to

extension services are more competent on fertilizer application, and this can have a positive bearing in overall crop yield in the irrigation scheme.

**Table 4.12: Relationship between agricultural skills and knowledge and extension among irrigators in Msinga**

Agricultural skills and knowledge	Not Competent		Competent		Very Competent		Significant level ( $\chi^2$ )
	Yes	No	Yes	No	Yes	No	
<b>Production skills</b>							
Selecting appropriate planting methods for various crops (n=184)	5	4	79	31	57	8	**
Determining inter and intra row spacing (n=184)	6	2	64	28	71	13	*
Irrigation scheduling and frequency (n=184)	15	12	69	24	57	7	***
Application of herbicide and fungicide (n=184)	46	28	47	9	48	6	***
Planning and carrying out harvesting appropriately for various crops (n=184)	13	7	72	25	56	11	ns
Determining the amount of fertilizer to apply for various crops (n=184)	24	21	67	18	50	4	***
Soil and water conservation for specific farm lands (n=184)	44	18	57	20	40	5	*
Determining seed depth (n=184)	23	10	62	24	56	9	*
Determining nutrient deficiency symptoms in crops (n=184)	14	14	60	19	67	10	***
Calibration and use of sprayer (n=184)	36	27	53	10	52	6	***
Maintenance of water pump (n=184)	76	28	38	10	27	5	ns
Storage of produce (n=184)	26	13	78	26	37	4	**
<b>Marketing skills</b>							
Packaging of produce (n=184)	29	13	75	24	37	6	ns
Knowledge of marketing contracts (n=184)	73	22	50	16	18	5	ns
Price determination for your produce (n=184)	21	9	76	26	44	8	ns
Knowledge of the market for your produce (n=184)	64	16	52	19	25	8	ns
<b>Business skills</b>							
Financial management (n=184)	65	22	56	18	20	3	ns
Farm record keeping (n=184)	102	31	26	10	13	2	ns

\*\*\* = Significant at the 0.01 level, \*\* = Significant at the 0.05 level, \* = Significant at the 0.1 level, ns = not significant

#### **4.10 Summary**

This chapter presented the descriptive results on demographic characteristics of smallholder farmers in Msinga. The gender distribution results of the sampled farmers show that females outnumber males. Most (54%) household heads in the study area are married. The education level of farmers was generally low as 66.8% of irrigators and 66.7% of non-irrigators, respectively, did not attain primary education. Most farmers in Msinga cited other farmers as the main source of farming information.

The determinants of agricultural skills and knowledge were discussed. There was a significant gender difference in the level of competency in agricultural skills. Age, level of education, access to extension services all had a significant effect on the level of competency in agricultural skills.

## **CHAPTER 5: THE IMPACT OF AGRICULTURAL SKILLS AND KNOWLEDGE ON AGRICULTURAL PRODUCTIVITY**

### **5.1 Introduction**

This chapter presents the results of the relationship between agricultural skills and knowledge, on one hand, and agricultural productivity, on the other. These relationships specifically relate to maize and tomato productivity. Maize has been selected as it is a staple crop and tomatoes are the main crop grown for income. In this study, agricultural productivity is measured as the ratio of agricultural output (yield) to agricultural inputs (land). The production data discussed in this chapter was self-reported by farmers. It is also worth noting that smallholder farmers seldom keep crop records hence self-reported production data may not be reliable. This chapter also discusses the empirical results of the Ordinary Least Squares (OLS) regression model on the determinants of maize productivity. An in-depth explanation is provided for the significant variables and the summary concludes this chapter.

### **5.2 The impact of agricultural skills and knowledge on maize productivity**

Smallholder farmers grow maize as a high value crop and as a food crop (Van Averbake, 2008). Low maize productivity that emanates from low levels of agricultural skills and knowledge can render rural households vulnerable to food insecurity. Table 5.1 shows the one-way ANOVA results of the effect of agricultural skills and knowledge on maize productivity among irrigators.

The competency level in the practice of irrigation scheduling and determining frequency of irrigation have a significant ( $p < 0.01$ ) effect on maize productivity among irrigators. Competency in irrigation scheduling and frequency is critical as it affect the ability to determine the amount of water used for irrigation. Farmers who are very competent in the practice of irrigation scheduling and frequency obtained a higher maize yield (5.1 t/ha) whereas those who are competent and not competent obtained 4.7 t/ha and 3.3 t/ha respectively. The better maize yield attained by very competent and competent farmers might be an indication that competent farmers are neither over-irrigating nor under-irrigating their maize. Competency level in herbicide and fungicide application have a significant ( $p < 0.05$ ) effect on maize productivity. Farmers who were very competent obtained a higher maize yield (5.3 t/ha) than farmers who were competent (4.3 t/ha) and not competent (4.1 t/ha). The implication of this scenario is that

farmers who have a high level of competence in the application of farm chemicals obtain a better yield as crop losses emanating from pest and diseases are minimized. There is a need to train women farmers on herbicide and fungicide application since men were more competent in the execution of this production skill yet they form a small proportion of smallholders. Controlling pest and diseases require that farmers use a sprayer and the competency level in the practice of sprayer use and calibration have a significant ( $p < 0.05$ ) effect on maize productivity. Farmers who are more skills competent in this practice obtained a higher yield (5.1 t/ha) than farmers who were competent (4 t/ha) and not competent (3.7 t/ha).

**Table 5.1: Relationship between agricultural skills and knowledge, and maize productivity among irrigators in Msinga**

Agricultural skills and knowledge	Not Competent	Competent	Very Competent	Significant level (ANOVA)
<b>Production skills</b>	<b>Maize productivity (t/ha)</b>			
Determining inter and intra row spacing (n=184)	4	4.3	4.4	ns
Irrigation scheduling and frequency (n=184)	3.3	4.7	5.1	***
Application of herbicide and fungicide (n=184)	4.1	4.3	5.3	**
Planning and carrying out harvesting appropriately for various crops (n=184)	3.2	4	4.7	**
Determining the amount of fertilizer to apply for various crops (n=184)	3.9	4.8	4.1	ns
Soil and water conservation for specific farm lands (n=184)	4.5	4.1	3.9	ns
Determining seed depth (n=184)	4.2	4.5	4.1	ns
Determining nutrient deficiency symptoms in crops (n=184)	4.2	4.5	4.1	ns
Calibration and use of sprayer (n=184)	3.7	4	5.1	**
Maintenance of water pump (n=184)	4.4	4.3	3.6	ns
Storage of produce (n=184)	4.4	4.6	3.4	*
<b>Marketing skills</b>				
Packaging of produce (n=184)	4	4.7	3.7	*
Knowledge of marketing contracts (n=184)	4.3	4.3	4.5	ns
Price determination for your produce (n=184)	3.7	4.4	5.1	**
Knowledge of the market for your produce (n=184)	4.2	4.5	4.3	ns
<b>Business skills</b>				
Financial management (n=184)	3.9	5.1	4	**
Farm record keeping (n=184)	4.3	4.6	4.1	ns

\*\*\* = Significant at the 0.01, \*\* = Significant at the 0.05 level, \* = Significant at the 0.1 level, ns = not significant

Competency level in planning and carrying out harvesting have a significant ( $p < 0.05$ ) effect on maize productivity. Farmers who are very competent obtained a higher maize yield (4.7 t/ha) than those who are competent (4 t/ha) and not competent (3.2 t/ha). This implies that farmers who are more competent in harvesting avoid crop losses which may result from poor crop handling. Competency level in price determination have a significant ( $p < 0.05$ ) effect on maize productivity. Farmers who are very competent in determining the price of their maize crop attained a higher yield (5.1 t/ha) than farmers who were competent (4.4 t/ha) and not competent (3.7 t/ha). This implies that farmers who obtain a higher maize yield per hectare are able to set the price for their produce and this is crucial as the profit attained by farmers is determined by the price at which they sell their produce.

Continuity in farming among irrigators is determined by the availability of funds from the profits of the previous harvest. The results (Table 5.1) show that competency level in the practice of financial management have a significant ( $p < 0.05$ ) effect on maize productivity. Farmers who were very competent attained a better yield (5.1 t/ha) compared to less competent farmers (3.9 t/ha).

The study also determined whether there was a relationship between maize productivity and level of competence in agricultural skills and knowledge among dryland farmers. The results (Table 5.2) show that competency levels in production skills were not statistically significant to maize productivity among dryland farmers except farmers' level of competence in determining amount of fertilizer to be applied. Farmers who are very competent in determining the amount of fertilizer to apply obtained a higher maize yield (4.7 t/ha) compared to farmers who were competent (2.2 t/ha) and not competent (1.6 t/ha). This implies that farmers who are very competent in fertilizer application can achieve better yields.

The competency level in farmers' ability to determine planting depth have a significant ( $p < 0.01$ ) effect on maize productivity. Farmers who were very competent attained a higher maize yield (8.5 t/ha) compared to farmers who were competent (1.5 t/ha) and not competent (0.04 t/ha). This implies that farmers who are very competent in determining the depth of planting achieve a better yield and this could be attributed to their achievement of better plant densities.

Competency levels in production skills such as water pump maintenance and irrigation scheduling and frequency were insignificant to maize productivity and this is attributed to the fact that most dryland farmers do not irrigate their fields. However, competency levels in production skills such as determining nutrient deficiency, storage of produce and carrying out harvesting were not significant and these skills are critical for maize productivity. Competency levels in marketing and business skills had no bearing on maize productivity among dryland farmers. This is so because dryland farmers grow their maize for subsistence consumption.

**Table 5.2: Relationship between agricultural skills and knowledge, and maize productivity among non-irrigators in Msinga**

Agricultural skills and knowledge	Not Competent	Competent	Very Competent	Significant level (ANOVA)
<b>Production skills</b>	<b>Maize productivity (t/ha)</b>			
Selecting appropriate planting methods for various crops (n=66)	1.7	3.1	1.9	ns
Determining inter and intra row spacing (n=66)	1.5	2.7	2.5	ns
Irrigation scheduling and frequency (n=66)	2.1	1.3	7	ns
Application of herbicide and fungicide (n=66)	2.4	1.5	0.6	ns
Planning and carrying out harvesting appropriately for various crops (n=66)	1.3	2.2	2.7	ns
Determining the amount of fertilizer to apply for various crops (n=66)	1.6	2.2	4.7	*
Soil and water conservation for specific farm lands (n=66)	2.4	0.9	-	***
Determining seed depth (n=66)	0.04	1.5	8.5	ns
Determining nutrient deficiency symptoms in crops (n=66)	2.4	2.2	1.6	ns
Calibration and use of sprayer (n=66)	1.6	2.7	2.5	ns
Maintenance of water pump (n=66)	2.2	5	1.2	ns
Storage of produce (n=66)	1.4	1.9	2.7	ns
<b>Marketing skills</b>				
Packaging of produce (n=66)	2.1	3.3	1.2	ns
Knowledge of marketing contracts (n=66)	-	-	-	-
Price determination for your produce (n=66)	2.2	0.5	5	ns
Knowledge of the market for your produce (n=66)	2.2	0.9	-	ns
<b>Business skills</b>				
Financial management (n=66)	2.1	4.7	-	ns
Farm record keeping (n=66)	5.5	6.5	-	ns

\*\*\* = Significant at the 0.01, \* = Significant at the 0.1 level, ns= not significant

### 5.3 Determinants of maize productivity in Msinga

This section presents the empirical results of the Ordinary Least Squares (OLS) regression model and discusses the results of the significant variables that determine maize productivity in Msinga. The variables that were discussed in the methodology section were considered for the model and tested for their significance to maize productivity. The overall model is statistically significant because the computed F value was statistically significant. Table 5.3 shows the estimated coefficients ( $\beta$  values), standard error, t values and significant values of the independent variables. The goodness-of-fit test for a logistic regression model measures the suitability of the model to a given data set. An adequate fit corresponds to a finding of non-significance for the tests (Hill *et al.*, 2001). The results for the goodness-of-fit test shown in table 5.3 indicate that the model fits the data well.

According to Gujarati (1992), the coefficient values measure the expected change in the dependent variable for a unit change in each independent variable, all other independent variables being held constant. The sign of the coefficient shows the direction of influence of the independent variable on the dependent variable. It follows that a positive value indicates an increase in the dependent variable. On the other hand, a negative value shows a decrease in the dependent variable. Therefore, in this study, a positive coefficient implies an increase in maize productivity and a negative coefficient implies a decrease in maize productivity.

Total land owned has a negative and significant ( $p = 0.06$ ) effect on maize productivity. All other variables held constant, an additional hectare of land owned will decrease maize productivity by 4.98 tons. This implies that productivity decreases with increase in farm size. This result is not uncommon with previous studies by Okoye *et al.* (2007) and Ojo (2000) who reported that farm size has an inverse relationship with agricultural productivity.

Determining seed depth is an important attribute that affects plant density and agricultural production. There was a positive and significant relationship ( $p = 0.08$ ) between level of competence in determining planting depth and maize productivity. This implies that farmers who are competent on the depth of planting their maize achieve better yield than those who are less

competent. The better yield could be attributed to their achievement of better plant densities which leads to improved productivity.

**Table 5.3: The determinants of maize productivity in Msinga**

Maize productivity	Coefficient	Std. Err.	t	P>t	95% Conf.	Interval
Total land owned	-4.98	2.64	-1.89	0.06	-10.18	0.23
Seed depth	1.89	1.07	1.75	0.08	-0.23	4.01
Irrigation scheduling	1.12	0.53	2.12	0.03	0.08	2.17
Age	0.03	0.02	1.24	0.21	-0.02	0.07
Gender	-0.52	0.70	-0.74	0.46	-1.91	0.87
Education level	0.30	0.11	2.83	0.01	0.09	0.51
Farming practice	6.60	2.20	3.00	0.00	2.23	10.95
Distance to farm	0.08	0.08	0.95	0.34	-0.09	0.25
Experience	0.05	0.02	2.21	0.03	0.01	0.09
Extension	0.68	1.03	0.66	0.51	-1.35	2.72
Constant	3.77	1.39	2.70	0.00	1.02	6.52

#### Model's Goodness-of-Fit

Source	SS	df MS	Number of observations	= 194
		F( 10, 183)	= 37.83	
Model	7224.07	10 722.42	Prob > F	= 0.0000
Residual	3494.91	183 19.09	R-squared	= 0.67
		Adj R-squared	= 0.67	
Total	10718.99	193 55.54	Root MSE	= 4.37

The variable for the competency level in the practice of irrigation scheduling and determining the frequency of irrigation have a positive and significant ( $p = 0.04$ ) effect on maize productivity. This implies that farmers who are competent in the practice of irrigation scheduling and frequency achieve a better maize yield as they are neither under-irrigating nor over-irrigating their maize. As discussed earlier, competency in irrigation scheduling and frequency is critical as it affect the ability to determine the amount of water used for irrigation.

The coefficient of education level has a positive and significant ( $p = 0.01$ ) effect on maize productivity. All other variables held constant, an additional year of schooling will increase maize productivity by 0.30 tons. This result is similar to that of Okoye *et al.* (2008) who found a positive relationship between education level and agricultural productivity. The implication of this scenario is that better educated farmers may have improved access to knowledge and tools that enhance maize productivity.

Farmers who irrigate their crops can hedge against unfavorable climatic conditions such as drought. The coefficient for farming practice have a positive and significant ( $p= 0.003$ ) effect on maize productivity. All other variables held constant, irrigation increases maize yield by 6.60 tons. This implies that farmers who grow their maize under irrigation have a better chance of getting a better maize yield than dryland farmers.

The variable for farming experience have a positive and significant ( $p = 0.03$ ) effect on maize productivity. All other variables held constant, an additional year of farming increases maize yield by 0.05 tons. The more experienced a farmer is, the more efficient his decision making processes and the more he will be willing to take risks associated with the adoption of innovations. This result coincides with that of Okoye *et al.* (2008) who found a positive relationship between agricultural productivity and farming experience.

It was expected that access to extension services will have a positive and significant effect on maize productivity. However, the *a priori* expectation does not hold true. A few farmers (1.1% irrigators) indicated their extension officers as the main source of information. These findings contradict Machete (2004) who found that extension services play a pivotal role in empowering farmers with farming techniques, skills and knowledge.

#### **5.4 Agricultural skills and knowledge and tomato productivity**

Tomatoes are grown as a cash crop in the Tugela Ferry irrigation scheme and the appropriate application of agricultural skills and knowledge can enhance tomato productivity which can result in improved agricultural income. The results (Table 5.4) show that farmers' competency levels in determining inter and intra row spacing has a significant effect on tomato productivity. Farmers who were very competent obtained a higher tomato yield (7.5 t/ha) compared to farmers who were not competent (1.1 t/ha). The lower tomato yield achieved by less competent farmers might be attributed to more plant populations per hectare which can consequently lead to plant competition and lower yield.

The competency level in the practice of herbicide and fungicide application has a significant ( $p < 0.05$ ) effect on tomato productivity and there was a yield difference across levels of competence. Farmers who are very competent obtained a higher tomato yield (12.9 t/ha) while those who

rated themselves as competent and incompetent, obtained 1.7 t/ha and 1.4 t/ha respectively. This implies that farmers who are more competent in applying fungicides and herbicides avoids yield losses from weeds and diseases thereby increasing tomato yield per hectare.

**Table 5.4: Relationship between agricultural skills and knowledge, and tomato productivity among irrigators in Msinga**

Agricultural skills and knowledge	Not Competent	Competent	Very Competent	Significant level (ANOVA)
<b>Production skills</b>	<b>Maize productivity (t/ha)</b>			
Selecting appropriate planting methods for various crops (n=45)	1.5	6.6	1.5	ns
Determining inter and intra row spacing (n=45)	1.1	75	4.1	***
Irrigation scheduling and frequency (n=45)	12	4.3	1.3	ns
Application of herbicide and fungicide (n=45)	1.7	1.4	12.9	**
Planning and carrying out harvesting appropriately for various crops (n=45)	1.4	4.3	25.3	**
Determining the amount of fertilizer to apply for various crops (n=45)	1.5	7.8	4.7	ns
Soil and water conservation for specific farm lands (n=45)	1.4	1.9	9.9	ns
Determining seed depth (n=45)	1.4	8.2	1.5	ns
Determining nutrient deficiency symptoms in crops (n=45)	1.1	7.3	1.5	ns
Calibration and use of sprayer (n=45)	1.9	4.6	11.5	ns
Maintenance of water pump (n=45)	40.6	2.1	6.7	ns
Storage of produce (n=45)	1.2	4.7	9.2	ns
<b>Marketing skills</b>				
Packaging of produce (n=45)	1.7	4.2	10.6	ns
Knowledge of marketing contracts (n=45)	1.6	1.6	8.3	ns
Price determination for your produce (n=45)	1.3	4.6	13.6	ns
Knowledge of the market for your produce (n=45)	1.7	1.7	9.3	ns
<b>Business skills</b>				
Financial management (n=45)	1.4	1.6	18	ns
Farm record keeping (n=45)	0.18	5.6	1.7	ns

\*\*\* = Significant at the 0.01, \*\* = Significant at the 0.05 level, ns= not significant

Tomatoes are a delicate fruit and poor handling can result in decay thereby contributing to yield losses (Van Dam *et al.*, 2005). Competency level in carrying out appropriate tomato harvesting have a significant ( $p < 0.05$ ) effect on tomato productivity. More competent farmers in tomato

harvesting obtained 25.3 t/ha while those who were competent and incompetent, obtained 4.3 t/ha and 1.4 t/ha respectively. The implication of this scenario is that farmers who are very competent in carrying out appropriate harvesting can minimize yield losses which can emanate from poor crop handling.

Competency levels in carrying out irrigation scheduling and frequency have no bearing on tomato productivity while this production skill is essential in ensuring that farmers irrigate the required amount of water to improve tomato productivity. However, it was expected that competency levels in the practice of irrigation scheduling and determining frequency will have a significant effect on tomato productivity as tomatoes in the Tugela Ferry are grown under irrigation. It was also expected that competency level in the practice of fertilizer application will have a significant effect on tomato productivity as fertilizer is a production input.

## **5.5 Summary**

This chapter provided empirical evidence on agricultural skills that can enhance maize and tomato productivity in Msinga. It also provided empirical evidence on the factors determining maize productivity in Msinga. The determinants of maize productivity were tested using an Ordinary Least Squares (OLS) regression model. The statistically significant variables were total land owned, competency in determining planting depth, competency in determining irrigation scheduling and determining frequency of irrigation, education level, farming practice and farming experience. Based on the regression results, several suggestions can be made on how smallholder farmers can improve their maize productivity. Generally, the findings of the regression model suggest that an adjustment in each one of the significant variables can significantly influence maize productivity. Technological growth and institutional developments aimed at enhancing farmers with regard to such variables can help farmers improve agricultural productivity. The relevant policy recommendations on these institutional developments are discussed in the last chapter.

## CHAPTER 6: CONTRIBUTION OF AGRICULTURAL SKILLS AND KNOWLEDGE TO HOUSEHOLD FOOD SECURITY

### 6.1 Introduction

The study assesses the impact of agricultural skills and knowledge on household food security. The study assessed the responses of household heads in Msinga to the nine generic questions of the HFIAS tool. Food security levels were obtained by creating Household Food Insecurity Access Scale indicators. Determinants of household food security are also discussed.

### 6.2 Anxiety and uncertainty about household food supply

Despite the challenges and complexity of the smallholder agricultural sector, Hendriks (2003) suggest that subsistence production renders two distinct benefits, first, the food produced on the farm can be consumed, secondly, it saves income that can then be spent on more nutritious foods that the household might not be in a position to produce. In contradiction, most of the farming households, 92.2% and 86.4% of irrigators and non-irrigators respectively, indicated that they were anxious and uncertain about accessing enough food in the past 30 days, but to varying degrees (Table 6.1). These results seem to affirm earlier findings by Altman *et al.* (2009) that households who engage in own food production are not necessarily more food secure than households who do not.

**Table 6.1: Percentage of households who experienced anxiety and uncertainty about having enough food among farmers in Msinga**

	Frequency of anxiety and uncertainty in the past 30 days				Total
	Never	Once or twice	Three to ten times	More than ten times	
Irrigators (n=184)	7.6	44	40.2	8.2	100
Non-irrigators (n=66)	13.6	39.4	27.9	19.1	100

### 6.3 Insufficient quality of food consumption

Coates *et al.* (2007) suggested the use of three questions of the HFIAS to address insufficient quality of food consumption. Question 2 in the HFIAS, “not able to eat food they preferred” asks whether any household member was not able to eat food they preferred because of lack of resources. Question 3, “eat limited variety of foods” asks whether any household member was

not able to eat a diet of his/her choice. Question 4, “eating foods you did not like” asks whether household members had to eat food they viewed as undesirable due to lack of resources.

Among the sampled farmers in the Tugela Ferry irrigation scheme, 89.8% responded to the affirmative that they are not able to eat the kinds of foods they prefer, 84.2% consumed a limited variety of foods and 86.4% reported to have consumed foods they did not prefer to eat because of lack of resources (Table 6.2). On the other hand, 84.9% of non-irrigators were also not able to eat the kinds of foods they preferred, 80.3% consumed limited variety of foods and 80.4% of non-irrigators reported to have consumed foods they did not prefer because of lack of resources.

Coates *et al.* (2007) suggested that these categories, respectively, represent a least severe, intermediate and most severe household coping strategies. Consuming poor quality food could have a negative effect on household food security. Poor quality food may affect young children as they can show poor cognitive development and poor school performance. This can further result in drop outs who cannot find well-paying jobs, consequently becoming a food insecurity burden for the household.

**Table 6.2: Household responses to poor quality food coping strategies in the past four weeks in Msinga**

	Percentage of households that used poor quality food coping strategies in the past four weeks			
<b>Irrigators</b>				
Poor quality food coping strategies	Never	Once or twice	Three to ten times	More than ten times
Not able to eat preferred kinds of foods (n=184)	10.3	28.8	33.2	27.7
Eating a limited variety of foods (n=184)	15.8	29.3	32.6	22.3
Eating foods that are not preferred (n=184)	13.6	25.5	33.2	27.7
<b>Non-irrigators</b>				
Not able to eat preferred kinds of foods (n=66)	15.2	16.7	39.4	28.8
Eating a limited variety of foods (n=66)	19.7	22.7	39.4	18.2
Eating foods that are not preferred (n=66)	19.7	16.7	36.4	27.3

#### **6.4 Insufficient quantities of food consumed**

Five key household coping strategies were used to ask farmers about their lack of sufficient quantities of food. The household coping strategies regarding quality of food consumed and pursued in varying degree of severity were: eating smaller meals; eating fewer meals per day; experiencing total lack of food due to lack of resources; going to sleep at night hungry due to lack of food and going the whole day and night without food because of lack of food. The proportion of households (irrigators) who used these coping strategies were 79.3%, 67.9%, 69.6%, 32.1% and 17.9%, respectively (Table 6.3).

Dryland farmers were also assessed to determine whether they did consume insufficient quantities of food. The results (Table 6.3) show that 75.8% of dryland farmers consumed smaller meals as compared to 79.3% of irrigators who also responded to the affirmative on the same coping strategy. However, more dryland farmers (22.7%) as compared to 17.9% of irrigators responded to the affirmative to have spent a day without eating anything in the past four weeks, which is the most severe of the household coping strategy.

Both irrigators and non-irrigators used the first three household's coping strategies. This implies that households in Msinga generally consume insufficient quantities of food. However, irrigators were expected to consume enough quantities of food. This might be an indication that income derived from farming activities is not enough to support farming households. Although farmers may have the necessary agricultural skills and knowledge, consumption of insufficient quantities of food may lead to weak household members which can consequently affect their agricultural productivity. Household members who are weak may be prone to diseases. In turn, sick household members may further reduce the workforce required in the fields thereby reducing agricultural output per person which affects crop yield.

**Table 6.3: Household responses to inadequate food quantity consumption in Msinga**

	Percentage of households who used inadequate food quantity consumption coping strategies in the past four weeks			
<b>Irrigators</b>				
Inadequate quantity of food coping strategies	Never	Once or twice	Three to ten times	More than ten times
Eating a smaller meal (n=184)	20.7	31.5	28.3	19.6
Eating fewer meals in a day (n=184)	32.1	28.3	26.6	13
Experiencing total lack of food due to lack of resources (n=184)	30.4	25	23.9	20.7
Going to sleep at night hungry due to lack of resources (n=184)	67.9	15.2	10.9	6
Spending whole day and night without eating anything due to lack of food (n=184)	82.1	7.1	6	4.9
<b>Non-irrigators</b>				
Eating a smaller meal (n=66)	24.2	24.2	36.4	15.2
Eating fewer meals in a day (n=66)	34.8	25.8	22.7	16.7
Experiencing total lack of food due to lack of resources (n=66)	50	18.2	18.2	13.6
Going to sleep at night hungry due to lack of resources (n=66)	74.2	13.6	6.1	6.1
Spending whole day and night without eating anything due to lack of food (n=66)	77.3	12.1	4.5	6.1

### 6.5 Household food insecurity access prevalence in Msinga

Surveyed households were grouped into categories based on their food security status based on their responses to the questions about anxiety and uncertainty of food supply and frequency of using the different household coping strategies (Table 6.4). A high proportion (45% irrigators and 36.4% non-irrigators) of households in Msinga were moderately food insecure. Respectively, 7.6% and 9.1% of irrigators and non-irrigators were food secure. Non-irrigators had a high proportion (27.3%) of households who were severely food insecure as compared to 22.8% of irrigators. As discussed earlier, most households were anxious about not having enough food. The implications of households being anxious about food supply, consuming poor quality and insufficient can be disastrous to households as this could affect their agricultural production and productivity.

**Table 6.4: Percentage of households in each food security category in Msinga**

	Food secure	Mildly food insecure	Moderately food insecure	Severely food insecure
Irrigators (n=184)	7.6	23.9	45.7	22.8
Non-Irrigators (n=66)	9.1	27.3	36.4	27.3

### 6.6 Determinants of household food security

This section presents the empirical results of the Ordinary Least Squares (OLS) regression model and discusses the results of the significant variables that determine household food security in Msinga. The variables that were discussed in the methodology section were considered for the model and tested for their significance to household food security. The overall model is statistically significant because the computed F value was statistically significant. Table 6.5 shows the estimated coefficients ( $\beta$  values), standard error, t values and significant values of the independent variables.

According to Gujarati (1992), the coefficient values measure the expected change in the dependent variable for a unit change in each independent variable, all other independent variables being held constant. The sign of the coefficient shows the direction of influence of the independent variable on the dependent variable. It follows that a positive value indicates an increase in the HFIAS score. On the other hand, a negative value shows a decrease in the HFIAS score. Therefore, in this study, a positive coefficient implies an increase in the likelihood that a household would be food insecure and a negative coefficient implies a likelihood that a household would be food secure.

A positive and significant relationship ( $p = 0.02$ ) was observed between gender and household food security. Households headed by men are more prone to food insecurity. This is so because men migrate to urban areas in search for work and their presence in rural areas imply that they are unemployed or constitute the elderly. On the other hand, married *de-facto* female-headed households are more likely to have their male counterpart away in urban areas earning income and can use remittances to purchase food. A negative and significant relationship ( $p = 0.08$ ) was observed between level of education and household food security. All other variables held constant, an additional year of schooling decreases the HFIAS score by 0.22. This implies that

household whose heads have high level of education are more likely to be food secure as they are more skilled in technical agricultural skills and this improves their agricultural production and productivity and total income. This result coincides with findings by Benjamin & Umeh (2012) that more years of formal education increases the food security status of households.

The results show that there was a significant relationship ( $p = 0.04$ ) between farming practice and household food security. However, the coefficient of farming practice is positive, implying that irrigation farming will increase the HFIAS score by 2.46. The implication of this scenario is that irrigation does not guarantee improved food security in Msinga.

Determining planting depth is an important agricultural skill that affects plant density and agricultural production. There was a negative and significant relationship ( $p = 0.07$ ) between competency level in determining planting depth and household food security. This implies that farmers who are competent on the depth of planting their crops are more food secure than those who are less competent. This could be attributed to their achievement of better plant densities and improved productivity.

Goat ownership has a negative and significant relationship ( $p = 0.01$ ) to household food security. All other variables held constant, an additional goat owned by a household will decrease the HFIAS score by 0.09. This implies that livestock ownership has the potential to provide income and bartering power and that contributes to their owner's ability to access food of all kind. This result coincides with that of Bashir *et al.* (2012) who found that an increase in goat ownership increases the chances of a household to be food secure.

Credit use has a positive and significant relationship ( $p = 0.02$ ) to the HFIAS score. A unit increase in money borrowed, all other variables held constant, increases the HFIAS score by 2.16. This implies that households who use credit are more likely to be food insecure as they are unable to pay their debt and this increases the HFIAS score (food insecurity). However, it was expected that credit use will decrease the HFIAS score as households who receive credit can hire farm equipment and buy agricultural inputs such as fertilizers thus increasing their agricultural production.

**Table 6.5: Ordinary Least Squares results for the determinants of household food security in Msinga**

Variable	Coefficient	Std. error	t	P>t	95% Confident	Interval
Age	0.02	0.03	0.69	0.49	-0.04	0.09
Gender	2.21	0.96	2.38	0.02	0.38	4.02
Education	-0.22	0.12	-1.78	0.08	-0.46	0.02
Farming practice	2.46	1.16	2.12	0.04	0.18	4.75
Seed depth	-1.10	0.60	-1.83	0.07	-2.29	0.09
Nutrient deficiency	0.27	0.61	0.44	0.66	-0.93	1.47
Pump maintenance	-0.64	0.62	-1.04	0.30	-1.85	0.57
Total land owned	0.51	0.38	1.34	0.18	-0.24	1.27
Goat owned	-0.09	0.04	-2.46	0.01	-0.17	-0.02
Cattle owned	-0.01	0.05	-0.20	0.84	-0.11	0.09
Credit use	2.16	0.93	2.32	0.02	0.33	3.98
Total income	-0.03	0.01	-2.25	0.03	-0.05	-0.00
Agricultural income	-0.08	0.08	-1.03	0.30	-0.23	0.07
Constant	10.57	2.27	4.64	0.00	6.08	15.05

**Model's Goodness-of-Fit**

F (13, 236)	3.15
Prob> F	0.00
R <sup>2</sup>	0.15
Adjusted R <sup>2</sup>	0.10
Root MSE	6.40

The coefficient of total income has a negative and significant relationship ( $p = 0.02$ ) to the HFIAS score. A Rand increase in total income decreases the HFIAS (food insecurity) score by 0.03. This implies that an increase in income will have an effect on food security because the change in income will lead to a constant change in expenditure. Thus, an additional Rand gained increases the stable income so that the capacity of households to consume more will increase thereby increasing household food security. This result is plausible because households that have other sources of income in addition to farming alone tend to be more resilient in times of food crisis than those engaged in farming alone. This result is consistent with that of Arene & Anyaeli (2010) who found that an increase in household income decreases the chances of a household to be food insecure.

Age of household head was expected to have a positive influence on food security. As people get older, are expected to acquire more farming experience and to improve their agricultural

production and household food security. The unexpected results are an indication that when people get older, their agricultural productivity and ability to create income opportunities decreases, thus having a negative bearing on household food security.

### **6.7 Summary**

The HFIAS tool was used to group households into food security categories and results of descriptive statistics were presented. Based on evidence presented in this chapter, it can be concluded that smallholder farmers in Msinga face challenges in ensuring household food security. Most household, 92.2% and 86.4% of irrigators and non-irrigators respectively, reported that they were anxious and uncertain that there will have enough food in the past 30 days.

The results of the OLS regression model were also discussed. Level of competence in the practice of determining planting depth, gender, level of education, total income, goat ownership, credit use and farming practice were found to have a significant effect on the HFIAS score. The significance of these variables suggests that an adjustment in each variable can significantly affect household food security. As mentioned in the previous chapter, any institutional developments in the enhancement of farmers regarding such variables can help improve household food security. The next chapter discusses the appropriate policy recommendations to help farmers improve their household food security.

## CHAPTER 7: CONCLUSIONS AND POLICY RECOMMENDATIONS

### 7.1 Introduction

The smallholder agricultural sector in South Africa makes a modest contribution to household food security and comprises of an estimated four million people and the majority of whom are in rural areas. Many of those who engage in subsistence agricultural activities are women and their main reason being the provision of extra food for their poor families. The full potential of the smallholder sector remains untapped since its farmers lack the necessary agricultural skills and knowledge to enhance agricultural productivity. Agricultural skills and knowledge are a crucial aspect of human capital which can contribute to the enhancement of agricultural productivity and hence household food security. The lack of technical and managerial skills is further exacerbated by weak support institutions such as extension services.

The main objective of the study was to assess women's level of agricultural skills and knowledge, and, their effect on production decisions and household food security at the Tugela Ferry irrigation scheme and the adjacent Machunwini dryland area in Msinga. The specific objectives of this study were to:

- To determine the agricultural skills and knowledge of women (also compared to men).
- To determine if there was a linkage between agricultural skills and knowledge on one hand, and agricultural productivity, on the other.
- To determine if there was a linkage between agricultural skills and knowledge on one hand, and household food security, on the other.

Data was collected from a random sample of 250 smallholder farmers in the Tugela Ferry irrigation scheme and Machunwini area in Msinga. A structured questionnaire was administered through face-to-face interviews. To analyse data, descriptive statistics were used together with the Ordinary Least Squares (OLS) regression model. The main descriptive statistics were analysed using Chi-square, t-test and one-way ANOVA. The OLS regression model was used to test the determinants of maize productivity and household food security.

## 7.2 Summary of findings

Descriptive statistics provided information related to demographic, socio-economic characteristics and the determinants of agricultural skills and knowledge. The descriptive statistics showed that more female-headed households are involved in farming than male-headed households. The results also show that the average age of irrigators was 57 years while the average age of non-irrigators was 59 years.

The study investigated the determinants of agricultural skills and knowledge. There was a significant difference across gender in the level of competence in agricultural skills and knowledge. Men were more competent than women in the application of herbicides and fungicides. Access to extension services significantly affected the level of competence in agricultural skills and knowledge, yet 1.1% of the sampled smallholder farmers have limited access to extension services. Most farmers in the irrigation scheme cited other farmers as their most important source of farming information. This suggests that farmers cannot easily access extension services. Age and level of education of household head significantly affected the level of competence in agricultural skills and knowledge. Generally, older household heads were more competent in executing agricultural skills. The education level of farmers was generally low as 66.8% and 66.7% of irrigators and non-irrigators, respectively, did not attain primary education. Household heads who attained higher levels of education were more competent in agricultural skills.

The study examined the impact of agricultural skills and knowledge on agricultural productivity with special reference to maize and tomato productivity. Significant relationships were observed between competence levels in agricultural skills and knowledge, and maize and tomato productivity, respectively. Generally, farmers who were very competent in agricultural skills obtained higher yields than those who were not competent. An improvement in the competency level in farmers' agricultural skills and knowledge is likely to improve agricultural productivity in Msinga.

The study examined the determinants of maize productivity. The parameters were estimated using the OLS regression model. The statistically significant variables were total land owned,

competency level in the practice of determining planting depth and irrigation scheduling, education level, farming practice and farming experience. However, total land owned had a negative effect on maize productivity. Farmers with smaller farm size were more productive. An increase in the significant variables, other than total land owned, can enhance maize productivity, hence an improvement in the farmers' livelihoods.

The study also discussed the food security status of smallholder farmers. It was observed that irrigators were more anxious and uncertain about having enough food. This implies that households who engage in food production are not necessarily more food secure than households who do not. It was also observed that non-irrigators had a high proportion of households who were severely food insecure. This implies that such households consumed insufficient food.

The study examined the determinants of household food security in Msinga. The parameters were estimated using the OLS regression model. Competency level in the practice of determining planting depth had a significant effect on household food security. Gender, farming practice, education level, goat ownership, and total income had a significant effect on household food security. The significance of these variables suggests that an adjustment in each variable can significantly affect household food security. Access to credit had a significant and negative effect on household food security. This implies that farmers do not use credit for farming but consumption purposes.

### **7.3 Conclusions**

The study demonstrated that smallholder farming in Msinga is female dominated. Women constitute the majority of smallholder farmers and findings of this study apply to women. Where there was a gender analysis, women were found to be at a disadvantage compared to men. Therefore, efforts to improve the level of competence in agricultural skills and knowledge among smallholder farmers should target women as female headed households are mostly involved in farming. Education is critical in farming as farmers who attained higher levels of education were very competent in agricultural skills. Women had lower levels of education and this implies that most women in Msinga can hardly execute agricultural skills.

Lack of access to appropriate farmer support services is one of the major constraints limiting agricultural productivity among smallholder farmers. Access to extension services has a potential of improving the competency level in agricultural skills and knowledge. Little can be achieved in terms of improving agricultural productivity and food security unless the problem of farmers' access to information and support services is addressed.

Improving crop productivity among smallholder farmers should form an important part of efforts to improve household food security. Agricultural productivity, expressed in yield per hectare, in the study area was largely determined by level of competence in agricultural skills and knowledge. Competency level in the practice of irrigation scheduling and frequency, fungicide and herbicide application, calibration and use of sprayer and maize storage had a positive bearing on maize productivity. Knowledge of financial management was also crucial for maize farmers. Competency levels in determining inter and intra row spacing, herbicide and fungicide application and harvesting were essential for tomato productivity. An improvement of farmers' level of competence in these agricultural skills and knowledge can enhance crop productivity and hence household food security. On the other hand, the study demonstrated the important role played by irrigation in improving agricultural productivity.

While agriculture plays a dominant role in poverty alleviation and food security in Msinga, farming alone is not a sufficient source of household income for all farmers regardless of farm (plot) size. The results of the determinants of household food security suggest that total income rather than farming income, contributes to household food security. Furthermore, this suggests that the farmers derive additional income from other non-agricultural sources of income.

#### **7.4 Policy recommendations**

This section gives options that can be considered by the relevant institutions in an effort to help smallholder farmers reach their full potential.

The study highlighted that access to farming information is limited among smallholder farmers. As such, farming information should consistently be supplied to farmers through various agencies e.g. private and governmental organizations. Access to useful farming information will

ensure that crop planning is informed by market information. In an effort to make information available, it is important to know the types of information that farmers need, such as pricing, markets for their produce and suitable crops for that season in a specific area. Of equal importance, is devising ways of disseminating the information in order to reach all the smallholder farmers. When devising these ways, it is important to consider the heterogeneity of smallholder farmers, in terms of education, location and the availability of communication assets. Radio programmes conducted in the local language and farmer workshops can be considered for information dissemination.

The study found that access to extension services had a significant effect on the level of competence in agricultural skills, yet few farmers (1.1%) cited extension services as useful to them. Some farmers in interviews complained that their extension agents hardly visit them. There is therefore, a need to increase the number and effectiveness of extension agents in rural areas. This should require that farmers be served by well-trained and knowledgeable extension agents using participatory approach. Smallholder farmers are able to identify and prioritize their problems, and possess some knowledge that is relevant to finding solutions. Therefore, inputs from smallholder farmers should be taken into account when planning and executing extension services aimed at addressing their problems and needs.

The results of this study have shown that irrigation has the potential to improve agricultural productivity. Government can support rural farmers through technical innovation in order to enhance smallholder farmers' agricultural productivity. Technical innovation may be in the form of investment in irrigation infrastructure. The provision of such infrastructure can help in ensuring that water is consistently supplied to the irrigation scheme throughout the year and this can further lead to improved crop productivity. Farmers also have a role to play in ensuring that such infrastructure is maintained.

The agricultural sector does not only provide direct access to food but also an employment opportunity particularly for rural women. Lack of technical skills in agriculture has been cited as the cause of poor agricultural productivity among smallholder farmers. Programmes designed to help rural farmers should not focus on hardware issues only but rather on developing human

capital. Government institutions can play a pivotal role in capacitating farmers with technical and managerial skills. These may include training in crop husbandry, irrigation management, and financial management and leadership skills. Such training can take the form of farmers' day. Empowering smallholder farmers with the appropriate non-farming skills will help them to be good managers of their farming operations.

Smallholder farmers in rural South Africa face unfair market competition from commercial farmers. There is a need for government to implement support programmes in the rural areas. For example, farmers do not apply enough fertilizers and most farmers complain that they do not have resources to purchase inorganic fertilizers. Support, in the form of input government subsidies, can stimulate growth among smallholder farmers.

#### **7.5 Recommendations for further research**

The study has provided baseline information on agricultural skills that can improve agricultural productivity and household food security in Msinga. It has been identified that capacity building with regard to agricultural skills can help improve agricultural productivity and hence food security. Future research is needed to investigate the impact of capacity building on agricultural productivity and household food security in a number of Districts in KwaZulu-Natal to see the extent of agricultural skills.

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## 1.2 Land use, cropping patterns and marketing system

What is the total area of land your household owns/operates (If irrigator, include both dry land and irrigated land)	Dry land	ha
	Irrigated land	ha

1.2.1 Indicate the number of plots you have, their sizes and the means of ownership by completing the table below (Include both irrigated and dry land plots if irrigator).

Plot ID	Size of plot (ha)	Means of ownership	Farming practice	Rate the quality of land for crop production	Land fees per year
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

### Key

<u>Means of ownership</u> 1=Allocated 2=Inherited 3= Borrowed 4=Leasing 5=Bought 6= Other (Specify)	<u>Farming practice</u> 0=Dry land 1=Irrigation	<u>Quality of land</u> 0=Poor 1=Good 2=Very Good
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1.2.2 Generally, are you satisfied with the present security of ownership of your land? Yes=1 No =0	(a) Dry land
	(b) Irrigated land
1.2.3 How often do you fail to sell your farm produce due to lack of market? Never =0 Sometimes =1 Always =2	
1.2.3 How far away is your household to the Tugela Ferry irrigation scheme	
1.2.4 Are you a member of the Tugela Ferry irrigation scheme Yes =1 No=0	
1.2.5 If yes in 1.2.4, how long have you been a member of the Tugela Ferry irrigation scheme	
1.2.6 How do you know when your crops need to be irrigated? 0=Irrigate when it's my turn 1=When the soil is dry 2=When crop are stressed	
1.2.7 Is there a farmer association in your block? Yes=1 No=0	
1.2.8 If yes in 5.1, are you a member of the farmer association Yes=1 No=0	

### 1.3 Income sources

1.3.1 What were the sources of your household income in the last 12 months? (Indicate approximately how much each source contributed and how often)

Source of household income	Amount per given time	How often? (e.g. monthly)	Number of times in the past 12 months	Total amount
Remittances				
Agricultural activities	Irrigation farming			
	Dry land farming			
	Livestock production			
	Hiring out farming equipment			
Arts and craft				
Permanent employment				
Temporary/casual employment				
Hawking/petty trading				
Welfare grants				
Other (specify)				

### 1.4 Livestock and asset ownership

1.4.1 Do you own the following livestock (Indicate number owned in the appropriate box, zero if not owned? Complete table below)

Livestock type	Number currently owned	Money spent on feeds, chemicals, vet services, etc. in the past 12 months	Number sold in the past 12 months	Price per unit	Number slaughtered for family purpose in the past 12 months
Cattle					
Goats					
Sheep					
Pigs					
Chickens					
Other (specify)					

## 1.5 Agricultural production & productivity

1.5.1 Please indicate the main crops you planted in the past summer (rainy) season in a particular plot (Plot number as mentioned in 1.2.1 above) and the output you produced (Complete the table below)

Plot ID	Crop	Area planted (ha)	Farming practice 0=dry land 1=irrigation	Quantity harvested (specify units e.g., kg)	Quantity sold (specify units e.g., kg)	Price per unit	Output market
1							
2							
3							
4							
5							
6							

Key

<u>Crops</u> 1=Maize 2=Tomatoes 3=Potatoes 4=Sugarcane 5=Spinach 6=Cabbage 7=Beans 8=Onions 9=Butternut	<u>Market outlet</u> 1=Local shop in town 2=Neighbors 3=Contractor 4=Hawkers 5=Shops 6=Other(specify)
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1.5.2 Please indicate the main crops you planted in the past winter (dry) season in a particular plot (plot number as mentioned in 1.2.1 above) and the output you produced (Complete the table below)

Plot ID	Crop	Area planted (ha)	Farming practice 0=dry land 1=irrigation	Quantity harvested (specify units e.g., kg)	Quantity sold (specify units e.g., kg)	Price per unit	Output market
1							
2							
3							
4							
5							
6							

Key

<u>Crops</u>	<u>Market outlet</u>
1=Maize 2=Tomatoes	1=Local shop in town
3=Potatoes	2=Neighbors
4=Sugarcane	3=Contractor
5=Spinach	4=Hawkers
6=Cabbage	5=Shops
7=Beans	6=Other(specify)
8=Onions	
9=Butternut	
10=Other (specify)	

## 1.6 Support services

1.6.1 Did you use any credit or loan facility in the past 12 months? Yes =1 No =0			
1.6.2 If yes in 1.6.1, what was the main source of credit/loan? Relative or friend =1 Money lender =2 Savings club (stokvel) =3 Input supplier =4 Financial institution =5 (Specify name of financial institution ..... ) Output buyer =6 Other=7(Specify).....)			
1.6.3 What was the purpose of the loan/credit? Family emergency =1 Agricultural purposes =2 Other (specify).....)=3			
1.6.4 Were you able to pay back the loan/credit in time? Yes =1 No =0			
1.6.5 Did you receive funding or any other sources of credit support from government in the past 12 months? Yes =1 No =0			
1.6.6 If yes in 1.6.5, how often? Sometimes =1 Always =2			
1.6.7 Did you have any contact with an extension officer(s) in the past 12 months? Yes =1 No =0			
1.6.8 If yes in 1.6.7, how often did you contact extension officers? Once a week =1 Twice a week =2 Once a fortnight =3 Once a month =4 Once in 6 months=5			
1.6.9 If yes on 1.6.7, did you invite the extension officers? Yes =1 No=0			
1.6.10 Are the extension officers from: 1=Government/parastatal? 2=Non-governmental organisation (NGO)? 3=Private company?			
1.6.11 Did you receive any free inputs in the past 12 months? Yes =1 No =0			
1.6.12 If yes in 1.6.11, what was the source? 1=Government 2=Non-governmental organisation (NGO) 3=Private company			
1.6.13 If yes in 1.6.11, please specify the type of inputs received and their quantities ..... ..... .....			
1.6.14 Indicate your sources of agricultural/farming information ( <i>Complete table below</i> )			
Source of information	Use	Information received Commodity prices =1 Weather =2 Ploughing =3 Government programmes =4 What to produce =5	Usefulness of source of information Low =1 Moderate =2 High =3
Radio/television			
Newspaper			
Cell phones/SMS			
Internet			
Extension workers			
Other farmers			
Other (specify).....			

1.6.15 What is your main source of farming information 1=Radio/television 2=Extension officer 3=Cell phone/SMS 4=Internet 5=Newspaper 6=Other farmers 7=Other (specify .....)	
1.6.16 Do you understand the information disseminated by the main information source in 1.6.15? Not at all =0 Somewhat =1 Absolutely =2	

## 1.7 Food Security

### Interpretation of responses

**Rarely**= Once or twice in the past four weeks

**Sometimes**= Three to ten times in the past four weeks

**Often**= More than ten times in the past four weeks

Answer questions 1.7.1-1.7.9 using the answers below 0=Never 1=Rarely 2=Sometimes 3=Often	
1.7.1 In the past 4 weeks, did you worry that your household would not have enough food?	
1.7.2 In the past 4 weeks, were you or any household member not able to eat the kinds of foods you preferred because of lack of resources?	
1.7.3 In the past 4 weeks, did you or any household member have to eat limited variety of foods due to lack of resources?	
1.7.4 In the past 4 weeks, did you or any household member have to eat some foods that you really did not want to eat because of lack of resources?	
1.7.5 In the past 4 weeks, did you or any household member have to eat less than you felt because there was not enough food?	
1.7.6 In the past 4 weeks, did you or any household member have to eat fewer meals in a day because there was not enough food?	
1.7.7 In the past 4 weeks, was there ever no food to eat of any kind in your household because of lack of resources to get food	
1.7.8 In the past 4 weeks, did you or any household member go to sleep at night hungry because there was not enough food?	
1.7.9 In the past 4 weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?	

## 1.8 Farmer training and skills

1.8.1 Do you take individual decisions on what to produce? Yes =1 No =0	
1.8.2 If yes, how confident are you in deciding what to produce? Not confident =1 Moderate confidence =2 Very confident =3	
1.8.3 Did you or a member of your household receive any training from government or any other organization? Yes =1 No =0	
1.8.4 If yes in 8.3, what was the gender of the person who received training? Male =1 Female=2	
1.8.5 If yes in 8.3, please specify the training provided .....	
1.8.6 How would you describe the usefulness of the training in farming? Not useful at all =1 somewhat useful =2 Useful =3 Very useful =4	
1.8.7 Which type of fertilizer do you use in your field? Manure =1 Inorganic fertilizer/ =2 Both =3	
1.8.8 If you use inorganic fertilizer, how do you determine the type of fertilizer to apply?.....	
1.8.9 Do you use mulching? Yes =1 No =0	

1.9 Please indicate your level of competence in the following farming activities/skills (Use responses given below)

0=Not competent	
1=Competent	
2=Very competent	
Determining seed depth	
Selecting appropriate planting methods for various crops	
Determining inter and intra row spacing	
Irrigation scheduling and frequency	
Application of herbicide and fungicide	
Planning and carrying out harvesting appropriately for various crops	
Determining the amount of fertilizer to apply for various crops	
Soil and water conservation measures for specific farm lands	
Farm record keeping	
Packaging of produce	
Determine nutrient deficiency symptoms in crops	
Calibration and use of sprayer	
Maintenance of a water pump	
Storage of produce	
Financial management	
Knowledge of marketing contracts	
Price determination for your produce	
Knowledge of the market for your produce	

Final general comments.....
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