Does gender affect land-access, water-access and food security among smallholder farmers? A case of Msinga local municipality, KwaZulu-Natal, South Africa

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Dedication

To my beloved aunt Nonkuliso Mncube and uncle Thandukwazi Mncube. I will forever be grateful for the opportunity you gave me in life, the support, words of encouragement and determination you all instilled in me.

Declaration1

I, **Sithembile Amanda Mthembu,** declare that;

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

2. This thesis has not been submitted for any degree or examination at any other university,

3. This thesis does not contain other people's data, pictures, graphs or other information, unless specifically acknowledged as being sourced from other people,

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As candidate's main supervisor, I, **M. Mudhara,** agree to the submission of this thesis;

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Declaration 2- draft publication manuscripts

Details of contribution to draft publication manuscripts that form part and / or include research presented in this thesis.

Publication Manuscript 1: Chapter 3 of this thesis

Mthembu, S.A. and Mudhara, M. Determinants of land allocation and water access in Msinga local municipality, KwaZulu Natal. (Manuscript submitted to *Development Southern Africa*).

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Author contributions:

Data collection, and analyses, and writing of the above mentioned papers were done by Mthembu, S.A. with advice from Dr Mudhara, M. who contributed valuable comments and editing to the manuscripts.

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Sithembile A. Mthembu November 2014

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Dr Maxwell Mudhara November 2014

Supervisor

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Abstract

While South Africa may be food secure as a country, large numbers of households within the country, particularly female-headed households, are food insecure. Unequal distribution of agricultural production resources between men and women has been identified as one of the main causes of household food insecurity in developing countries. However, information on how the social, economic, cultural and institutional factors affect access to production resources across household head's gender is limited. Therefore, this study set out to understand the disparities in women's access to land and water resources and, how these differences impact the food security status of different households. A random sample of 159 households was selected in Msinga local municipality, KwaZulu-Natal province in South Africa. Data were analysed using both descriptive statistics and econometric analysis (OLS, Tobit, binary and ordered logit models).

The study results indicated that gender of the household head determines access to land, perceived water and land security, and household food security. The results indicated that female-headed households always have smaller sizes of land and their frequency of access to irrigation water is less than that of male-headed households. This implies that there is gender discrimination against women with regards to access to production resources, which leads to their worsened food insecurity. Marital status was also found to be an important determinant of households' access to both land and water, implying that women gain or improve their access to resources through marriage. The Tobit model results indicated that land access was also influenced by factors such as the source of land and livestock head size. Water access was also determined by age of the household head, membership to farmer associations, irrigation type and extension services. Results indicate that level of education, water security and access to irrigation improved household food security. Therefore, there is need for a multifaceted approach, where some interventions will improve access to water security while others will improve land security. Improved water security improves food security via its impact on irrigation. Moreover, women should be empowered through farming education, opening formal job opportunities and access to support services such as extension, credit and farming inputs to close the gender gap.

List of acronyms

AIDS	Acquired Immune Deficiency Syndrome
CS	Community Survey
DAEA	Department of Agriculture and Environmental Affairs
DAFF	Department of Agriculture, Forestry and Fisheries
FAO	Food and Agricultural Organisation
FAOSTAT	Food and Agricultural Organisation Statistics
FGD	Focus Group Discussions
FHH	Female-Headed Households
FIVIMS	Food Insecurity and Vulnerability information and Mapping System
GHS	General Household Survey
GWP	Global Water Partnership
HFS	Household Food Security
HIV	Human Immunodeficiency Virus
HSRC	Human Sciences Research Council
IES	Income and Expenditure Survey
IFPRI	International Food Policy Research Institute
IFSS	Integrated Food Security Strategy for South Africa
ILRI	International Livestock Research Institute
IWMI	International Water management Institute
LEAP	Law Enforcement Against Prohibition
LFS	Labour Force Survey
MDGs	Millennium Development Goals
MHH	Male-Headed Households
NDP	National Development Plan
NFCS	National Food Consumption Survey
OLS	Ordinary Least Squares
SAHRC	South African Human Rights' Commission
SASAS	South African Social Attitudes Survey
SIWI	Stockholm International Water Institute
STATSSA	Statistics South Africa
TLU	Tropical Livestock Units
VIF	Variance Inflation Factor
WUA	Water User Association

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CHAPTER 1: INTRODUCTION

1.1 Background to the problem

Improving food production of smallholder farmers has been identified as a need for ensuring household food security and contributing to the growth of economies of developing countries (Mphalwa, 2008). According to FAO (2011), unless smallholder farming succeeds, agriculture will have limited impact on reducing food insecurity and poverty. Smallholder production feeds one-third of the world's population and has potential to feed more (World Bank, FAO; IFAD, 2012; Aliber and Hart, 2009). In the case of South Africa, Aliber and Hart (2009) and Hendriks (2003) indicate that despite the low-input nature of smallholder production it contributes directly to household food security as a supply of food, as well as enabling households to divert income to meet household's food and other requirements.

However, it has been identified that among other factors, limited access to land and water hinders smallholder farmers from achieving the higher levels of food production (Rao, 2005; De Cock *et al.*, 2013). The smallholder farmers in many developing countries are underperforming, partially because women, who represent a crucial resource in agriculture and the rural economy through their roles as farmers, labourers and entrepreneurs, almost everywhere, face severe constraints in their access to productive resources (Thamaga-Chitja *et al.*, 2010; FAO, 2011; Kassie, 2012; Murugani *et al.*, 2014). FAO (2011) reported that the resource constrained women constitute between 70 and 90 percentage of the agricultural labour force in many Sub-Saharan African countries and play a significant role in achieving food security, better nutrition and higher living standards at both household and country levels (IFAD, 2010). According to Hendriks (2005) rural smallholder agricultural production in South Africa is generally sufficient to meet their own food security needs. However, as reported by IFAD (2012), about 500 million smallholder farmers in the developing world, who feed one-third of the world's population, do not have secure access to land and water resources leading to their potential of ensuring food security hindered. Several studies highlighted some of the factors affecting the distribution of resources among the genders (Alcock and Hornby, 2004; Cousins and Hornby, 2009; Murugani *et al.*, 2014).

Traditional institutions in South Africa have been found to result in unequal distribution of production resources across gender (Alcock and Hornby, 2004). Like many other institutions,

they not only fall short of the gender equity provisions of the Bill of Rights but also are complicit in reproducing gender inequities through their masculine structures and practices, including those dealing with land administration (Alcock and Hornby, 2004). Alcock and Hornby (2004) reviewed resource distribution between males and females in Msinga and argued that most of the social, economic and political institutions in the area benefit and privilege men over women in terms of agricultural production resources such as land and capital. Their findings revealed that only men had right to land tenure and, although women were allowed to use some proportion of land, they were not allowed to own it. Generally, it was stated that a woman would not be allocated a site on her own but would require a male relative to represent her, such as a father, uncle or brother if she is not married.

Access to water cannot be considered independently from secure access to land (IFAD, 2010). Water without guaranteed access to the land will not be sufficient; and vice versa, land without access to water will not be very effective to a farmer (FAO, 2009). In Sub-Saharan African countries smallholder farmers do not have water rights (IFAD, 2010). Water rights for irrigation look at the farmer's right to abstract water from the natural source to feed the irrigation scheme (IFAD, 2010). Development has to take into consideration the interaction between the two important factors of production to improve food security (Bacha *et al.*, 2011). As discussed above, there is still a need for analysing the mechanisms used to allocate these resources to farmers and the activities for which different genders use the resources. It is also crucial to analyse the policies on land and water regarding resource allocation between genders and how the allocation regimes of these resources impact the food security in smallholder farmer's households.

This background information serves to consolidate the overall need to study land and water allocation and security, and specifically to investigate its contribution to smallholder household food security in South Africa.

1.2 Importance of the study

Worldwide, previous policies concerning land in rural and urban areas have been based on the assumption that the household is unitary and that resources are allocated fairly and equally within the household (Kerr, 2005; Agarwal, 2002). Consequently resources were given to male household heads. However, this has led to the disenfranchisement of women (Kerr, 2005; Agarwal, 2002).

The aim of this study is to analyse allocation of land and water across gender. The study also aims at analysing the impact of the resource allocation and perceived security over land and water on the smallholder farmer's household food security. The study will analyse traditional land and water allocation regimes and the knowledge will be helpful for policy developers to understand the way rural communities allocate these resources. The knowledge gained from this study can assist in future development of resource allocation policies with respect to the genders.

1.3 Research objectives

The general objective of the study is to understand the impact of households' socio-economic factors in land and water allocation, and to understand the impact they have on household food security of the smallholder farmers. The following questions will be addressed:

Question 1: What are the determinants of land and water access for male-headed and female-headed smallholder households?

Question 2: What determines security of land tenure and water access for male-headed and female-headed smallholder households?

Question 3: What are the effects of gender differentiated access to resources on smallholder household food security?

1.4 Organisation of the study

The thesis is paper-based and it is organised into six chapters. Chapter 1 has outlined the problem and its setting. Chapter 2 contains a review of relevant literature. The focus of Chapter 3 is to present the determinants of land and water access for rural households. Chapter 4 presents the gendered land and water security determinants, while the effects of gender differentiated access to resources on rural household food security are given in Chapter 5. Finally, Chapter 6 presents the conclusions and recommendations of the study.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Food security has received much attention in recent years, from both academics and non-academics (Altman *et al.*, 2009; Lang and Barling, 2012; Allen, 2013; Sinyolo *et al.*, 2014a). However, in spite of decades of efforts to eradicate hunger and malnutrition, food insecurity is still a significant problem (Candel, 2014). While South Africa may be food secure as a country, large numbers of households within the country are food insecure (Altman *et al.*, 2009). In the 2010/2011 financial year, food security was reprioritised as one of the top priorities for the South African government (State of Nation Address, 2010). This is in line with the MDGs which aim to halve the proportion of people who go hungry over the period 1990 and 2015 and to halve poverty and unemployment by 2014 (Department of Agriculture, 2002). This chapter explores literature on household food insecurity in South Africa and other countries, its possible causes and what has been done to address this issue. For the purpose of this study, 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 (FAO, 1996).

2.2 Measurement of food security

Researchers in South Africa use various methods to assess food security at household's level depending on the objectives and purpose of their study. To mention a few: National Food Consumption Survey (NFCS); Food Insecurity and Vulnerability information and Mapping System (FIVIMS); General Household Survey (GHS); Income and Expenditure Survey (IES); Community Survey (CS); South African Social Attitudes Survey (SASAS); Labour Force Survey (LFS); are some of the national surveys conducted to assess food security status in the country (Labadarios *et al.*, 2009). Due to the complexity of food security, these methods yield different results. The South African government policy formulation process is currently informed by the GHS, IES, LFS and Community Survey which are implemented by Statistics South Africa (Labadarios *et al.*, 2009).

2.3 The food security situation in South Africa

The latest South African statistics from the GHS indicate that 11.5% of households were food insecure in the year 2011 (Statistics South Africa, 2011). This represented an improvement compared to the year 2009, when Statistics South Africa (2009) reported that an estimated 20% of South African households were food insecure. A number of researchers have reported various and changing statistics on food security status in South Africa. For example, the General Household Survey (2007) indicated that in 2007, 10.6% and 12.2% of adults and children respectively were sometimes or always hungry. On the other hand, the National Food Consumption Survey (NFCS) of 2005 found that 52% of households experience hunger (Labadarios *et al.*, 2008). It further reports that another 33% of households were at risk of hunger, implying that they would be pushed into hunger if food prices increase or they lose their income. Several authors point out that this variation in the data is because each survey probes a different dimension of food security such as food expenditure, hunger or household food production, thereby using different indicators or measures (Altman *et al*., 2009; Jacobs, 2009).

The food insecurity situation is not uniform across the all the provinces of South Africa. The General Household Survey (GHS) report indicates further that during 2008 food access problems were higher in Free State, where more than a third of the households had inadequate food access. In provinces such as KwaZulu-Natal, Eastern Cape and Mpumalanga, about a fifth of the households were had inadequate food success. The least affected provinces were Limpopo and Western Cape, where only about 10% of the households had food security problems (StatsSA, 2009). Moreover, research has indicated differences between urban and rural households, with rural households being more food insecure. In 1992, 21 % of the urban population and 63 % of the rural population in South Africa lived below the minimum subsistence level (van Zyl and Kirsten, 1992). In 2008, food insecurity in urban areas was 21% while in rural areas it was 33%.

The figures reported in South Africa are similar to those reported by Vianna *et al.* (2012) on a study in Brazil which indicates that household food insecurity occurrence is higher in rural than in urban areas (55.5% vs. 49.9%) and severe food insecurity is substantially higher in rural areas (14% vs. 9%). Using a different measure of food insecurity, data from Mozambique also indicated that under-nutrition of children 0–60 months olds is much higher in rural than in urban areas. This indicates high poverty and food insecurity levels in rural

area (FAO, 2011). Machete *et al.* (2004) mentioned that food insecurity in South Africa is more prevalent in rural areas where roughly 75% of the people are chronically food insecure. This report is in line with De Klerk *et al.* (2004) who mentioned that 35% of the South African population is vulnerable to food insecurity. According to De Klerk *et al.* (2004), this type of vulnerability is most prevalent among black people who live in rural areas.

According to the FAO (2008), high unemployment rate, inadequate social welfare systems and a high HIV/AIDS infection rate have all contributed to food insecurity in South Africa and mostly in rural areas. Factors used to explain the differences in levels of productivity and food insecurity between households include income, household land holdings, employment status, household productive asset endowments and household composition (FAO, 2008). Rukuni (1994) revealed that to ensure levels and sustainable food security among the poor, especially in low rainfall areas, on-farm productivity and income growth is essential. From the study in Limpopo, Ziervogel *et al.* (2005) concluded that household food security is determined by access to household income, income diversification, area of land cultivated, soil quality and household labour per hectare. Mlambo (2000) finds that rural households with bigger land sizes are better off and less likely to be food insecure than those with small land or without land.

2.4 Government programmes to reduce food insecurity in South Africa

The Department of Agriculture, Forestry and Fisheries (DAFF) has initiated a number of programmes that are meant to contribute positively to food security in the country. The department's major role is, among others, to ensure that opportunities are created to encourage South African citizens to participate in agriculture and produce to reduce food insecurity in the country (Du Toit *et al.*, 2011). In 2002, the Department of Agriculture released a policy document, the Integrated Food Security Strategy for South Africa (IFSS) (Department of Agriculture, 2002). This strategy, however, had little success and the department later admitted that the IFSS had very little impact on food insecurity (Du Toit *et al.*, 2011). Among other reasons for its failure, the IFSS document was rather abstract and mainly reviewed the challenges of and implementation plans of food security in general (Du Toit *et al.*, 2011). According to Du Toit *et al.* (2011), missing from this document was any clear direction on how food security and other programmes such land reform relate to one another, leading to failure to coordinate and synergise these programmes.

The South African government recently launched the National Development Plan (NDP) (National Planning Commission, 2012), which provides an innovative framework to begin to inform action required across society to deal with pervasive hunger and food insecurity. This plan calls for government, the private sector, civil society and citizens to establish self-sustainable local food systems that would underpin universal access and utilisation over time. The range of proposed interventions requires engaging the entire food system, as well as linkages with the education and health systems.

The Zero Hunger Strategy is also a recent national food security program that is aimed at combating hunger and its structural causes (Department of Agriculture, Forestry and Fisheries, 2011). The key pillars of the Zero Hunger Strategy include (i) having programs that target the hungry and poor resource farmers with potential to expand and create job opportunities, (ii) having government procurement of food prioritise the emerging agricultural sector as the key supplier to enhance income distribution to the most disadvantaged of the rural, peri-urban and urban society, and (iii) ensuring that the emerging agricultural sector should have access to cheap production finance (Du Toit *et al.*, 2011). Finally, the Zero Hunger Strategy aims also to encourage enterprise diversification among targeted farmers.

A number of studies recommend provision of sufficient production resources for rural agriculture to be food secure (Hussain *et al*., 2002; May and Rohr, 2000; Manzungu, 2003). In particular, several studies have emphasised the importance of availability and accessibility of irrigation water (Hussain and Hanjra, 2004; Bacha *et al*., 2011; Sinyolo *et al.*, 2014b). Sinyolo *et al.* (2014a) argued that for irrigation agriculture to be effective in ensuring household food security, farmers need to be water secure. Moyo (2006) and Murugani *et al.* (2014) emphasized the importance of land access and security on food security and successful smallholder agriculture.

2.5 The role of smallholder irrigation on household food security

The relevance and potential of agriculture, particularly smallholder agriculture, to improve household food security in South Africa has been noted (Altman *et al*., 2009; Aliber and Hart, 2009). There are many pathways through which agriculture contributes to food security, and these are by reducing food prices, creating employment, improving farm income and increasing wages (Aliber and Hart, 2009; Hussain and Hanjra, 2004). Making agriculture

work, therefore, must be central component of policy approaches to household food insecurity reduction and increasing economic growth in South Africa (Kirsten *et al.*, 2003). According to Kirsten *et al.* (2003), improving agricultural production as a strategy to enhance household food security should target areas where the natural resources were conducive to successful crop production.

Agricultural production in Africa is almost entirely rain-fed despite that rainfall is highly variable and insufficient in many cases (You *et al.*, 2010). In South Africa, the water deficiency caused by low, erratic rainfall and high evaporative demand limits rainfed crop production in most of the country. Irrigated agriculture, therefore, presents an attractive strategy under these conditions (Van Averbeke *et al.*, 2011). Since declining precipitation is a source of major concern for household food security (Ziervogel *et al.*, 2005), many countries in Sub-Saharan Africa, South Africa included, have realised the important role of irrigation in food production, and irrigation investments have increased in the region (You et al., 2010).

Irrigation water is applied to ensure that the water available in the soil is sufficient to meet crop water needs and thus reduce water deficit as a limiting factor in plant growth (Van Averbeke *et al.*, 2011). Irrigation farming plays an important role in food production and food security in the world today. About 30% of the world's food production comes from about 18% of the total cultivated land under irrigation (FAOSTAT, 2012). Lipton *et al.* (2003) argued that Africa's poor performance in poverty reduction can be, to a large extent, attributed to its limited reliance on irrigation farming. The fact that Asia has experienced significant poverty reduction, while poverty has increased in Africa (Faurès and Santini, 2008; Bacha *et al.*, 2011) in recent years, is an indication of the key role irrigation plays in poverty reduction (Lipton *et al.*, 2003).

2.6 Gender inequality and food insecurity inter-linkages

Research has shown that gender inequalities affect both the distribution of agricultural resources for smallholder farming and production at the smallholder farming level (Alcock and Hornby, 2004; Rao, 2005; FAO, 2011). Women have access to only about 20% of all land worldwide, with their allotments generally of smaller size and lower quality (FAO, 2010). This inequality is particularly severe in Western, Central and North Africa and throughout the Middle East where on average less than 10% of landholders are women. In Eastern and Southern Africa, up to 30% of individual land titles are held by women. Only in

a few countries is land somewhat equally divided across gender, such as in Latvia and Lithuania where women hold more than 45% of all land titles (FAO, 2010).

Gender inequality in access to resources hinders the potential of smallholder farming to reduce poverty and food insecurity, as women constitute a crucial and very substantial resource in agriculture and the rural economy (FAO, 2011). According FAO (2011) women have a particular potential for improvement of household food security through their roles as farmers, labourers and entrepreneurs. In South Africa, women contribute as much as 60% to 80% of total food production, despite that they generally have inadequate access to land and/or have poor security to land (Mehra and Rojas, 2008). It has been highlighted that the main constraint to women's contribution to food security in South Africa is limited access to land and water, which are fundamental primary resources of production (Rao, 2005; Inocencio *et al.*, 2007).

Several reports have highlighted that gender inequalities and lack of attention to gender in agricultural development contribute to lower productivity, higher levels of food insecurity, as well as under-nutrition (World Bank, 2009; FAO, 2009; IFAD, 2010; FAO 2011). The 2012 World Development report dedicated to Gender Equality and Development warns that the failure to recognize the roles, differences and inequities between men and women poses a serious threat to the effectiveness of agricultural development strategies (World Bank 2012). According to Agarwal (2003), the gender gap in the ownership and control of property is the single most critical contributor to the gender gap in economic well-being, social status, and empowerment. Agarwal noted that 'working on land without rights in it meant a high vulnerability to poverty' (Agarwal, 2003: 187).

In Ghana, Duncan and Brants (2004), after conducting a study on land and gender issues agreed on the importance of gender equality in land access. They remarked that both men and women acknowledged the fact that if women were to obtain greater access to and control over land, this would have a positive impact on the household food supply, household income and family welfare. Another insight was that if women need to increase their agricultural productivity, there is a need for increased access to resources such as credit, agricultural inputs, information and knowledge (Duncan and Brants, 2004).

Another important aspect of the land issue pertains to land rights and tenure security. Not only do women need access to land, but they also need secure rights to the land. Securing

land rights for smallholder farmers has been shown to improve production and household food security (Prosterman, 2013). Land tenure is the relationship among people, as individuals or groups, with respect to land and associated natural resources (water, trees, minerals, wildlife, etc.) (Hornby, 2000). Rules of tenure define how property rights in land are to be allocated within societies. Land tenure systems are important for determination of who can use what resources for how long, and under what conditions (Hornby, 2000).

Securing women's land rights could increase overall production, since production inefficiency is associated with tenure insecurity and women with land rights and control of produce would be motivated to put in greater effort and investment into the land (Agarwal, 2003). When individuals have secure rights to land, they can make long-term investment and production decisions, are more inclined to protect their natural resource base, are more likely to have access to government programs and financial resources, and may engage more fully as citizens (Hanstad *et al.,* 2009). Land is a key social, economic and political asset for rural families. It is a primary vehicle for creating and transferring wealth within the family, for providing sustenance and generating income, for gaining social status and claiming political voice, and for establishing some economic independence (Hanstad *et al.*, 2009).

Furthermore, secure land access is essential for sustainable rural livelihoods, given agriculture's significance among rural livelihood activities (Li *et al*, 2008; Toulmin, 2008; Aliber *et al.*, 2006; Deininger and Castagnini, 2004). Land access improves water access, and farmers with secure access to both are more productive than those without (Namara *et al.*, 2010; Pellizoli, 2010; Quisumbing and Pandolfelli, 2009). Reduced time and money spent on conflict resolution when access to resources is secure results in increased productivity (Toulmin, 2008; Bogale *et al.*, 2006).

Security of tenure is key to having control over major decisions, such as what crop to grow, what techniques to use, what to consume and what to sell (Moyo, 2000). Without this, women will have difficulties in accessing credit and membership of agricultural associations, particularly those responsible for processing and marketing. Moyo argued that even their access to technological inputs is limited; they are not reached by extension services and are rarely members of cooperatives, which often distribute government-subsidized inputs and vital market information to small farmers. In addition, they lack the cash income needed to purchase inputs even when these are subsidized (Moyo, 2000).

2.7 Law and women's access to land

The challenge with regards to land rights in South Africa and many other developing countries is that they are governed by both statutory and customary laws (Toulmin, 2008). These two law regimes are based on different precepts and confer different bundles of rights to an individual (Joireman, 2008). Statutory law confers the legal or formal rights, and relies on legal persecution to validate the property rights (Toumlin, 2008; Hodgson, 2006). Customary law, on the other hand, is not as legalistic but informal and is backed by local authority, religious values and social norms.

Some women were allocated land for gardening by their chief in Buffelspruit, Mpumalanga, but had no Permission to Occupy (PTO) (Rangan and Gilmartin, 2002). They lost the land when some men decided they wanted to use the land for grazing and the chief reallocated the land to them (Rangan and Gilmartin, 2002). The women petitioned the chief, but to no avail. Their case was in the news and the judiciaries were consulted, but the latter ceded to the chief‘s council since the land was under the chief‘s authority (Rangan and Gilmartin, 2002). Although the women used a combination of public petitions and protests, they lost the land because in the customary law arena they did not have access to the institutions the men could invoke (Rangan and Gilmartin, 2002). Since women have a strong presence in the rural areas of South Africa, this paints a grim picture for rural women‘s land use security as they are not accorded equal protection by customary laws (Rural Women‘s Assembly (RWA), 2011). Would a judgement from the statutory authorities have secured the women access to the land in the above-mentioned case? Or would it have led to the women being ostracised and made into outcasts because statutory land law has no legitimacy in rural areas (Deininger and Castagnini, 2006)?

Trefry *et al.* (2014) on a case study from Eastern Cape, South Africa, concluded that amongst other factors culture causes women to be more food insecure compared to men. They used the definition of culture from Verhelst and Tyndale (2002) who defined it as a complex whole of knowledge, wisdom, values, attitudes, customs and multiple resources which a community has inherited, adopted or created in order to flourish in the context of its social and natural environment. According to Bonnekessen (2010), culture creates ideals , rituals, and rules about food that specify quite clearly what is good to eat, by whom, how people may "reasonably" be denied access, and how to reward or punish those who cultivate, prepare and serve food. Molnar (1999) reported cultural factors that are suppressive of women as a lack of

emphasis on education, marriage at young ages, and 'the rule of the father' within families and communities, as patterns that all contribute to food insecurity for women. Molnar (1999:491) further stated that cultural practices and beliefs determine the status of women, in general, and their access to food in particular, including "norms regarding who eats first, who eats most, and who gets what is left".

In some countries the legal system, in particular inheritance and divorce laws, give women fewer rights to land as compared to men (GIZ, 2013; Agarwal, 2003; Deere and Leon, 2003). Deere and Leon (2003) noted that gender inequality in land ownership is related to male preference in inheritance, male privilege in marriage, male bias in community and state programs of land distribution as well as gender bias in the land market, with women less likely than men to be successful land buyers. Moreover, land titles are often only registered in the name of a male head of household, even if the wife has brought the land into the family or has purchased it from her income (GIZ, 2013). Women are often restricted to so-called secondary land rights, i.e. they hold these rights through male family members, and thus risk losing the land in case of divorce, widowhood or their husband's migration (GIZ, 2013, Agarwal, 2003). Women also risk being disadvantaged in land conflicts. For cultural or religious reasons, wives cannot challenge the authority of their husbands. Also, according to customary law, many females are not allowed to lay claims or defend themselves in court, but must instead be represented by a male (GIZ, 2013).

There are several factors that influence women's access to land. According to GESTES (2010) access to land may differ depending on marital status, childbearing, age, rank of wife in a polygamous marriage. A study conducted by Cousins and Hornby (2009) revealed that the Msinga community use marital status for land allocation. The tribal authorities are the ones who have authority over land. In most cases land is only allocated to married people (Cousins and Hornby, 2009). For a married couple, a husband acting as head of the household, allocates his wife or wives a site within the homestead to build their residential structures, as well as fields for cultivation. However, in some cases land would be allocated to a widow in the presence of her husband's brother or relative but an unmarried woman wanting land would have to be accompanied by a relative to confirm that she really needs her own separate piece of land (Cousins and Hornby, 2009).

In addition, if a woman is unmarried and wants land she must have a son so that the land will be titled under his name. Cousins and Hornby (2009) further explained that an unmarried

woman with no son can negotiate land within the household's site and there will be no tribal authority structures involved. Though it may seem like only unmarried women are constrained to land access, revealed that even men do face this challenge. In Msinga the tribal authorities also don't give sites to single men unless those men also live in their brother's yards (Cousins and Hornby, 2009). Cousins and Hornby (2009) concluded that these allocation mechanisms that are being used by rural communities have been working for them but there are concerns raised by field research which indicates that fewer and fewer people are getting married 'properly', according to the old customs and traditions (Cousins and Hornby, 2009). The argument is that it is going to get more complicated to use marital status as an approach for land allocation (Cousins and Hornby, 2009). This is in line with Murugani *et al.* (2014) who indicated that in Limpopo 27% of women get their land through inheritance while only 18% of males access land this way as they mainly accessed it from traditional authorities (65%).

Community rights over land may discourage investment because the community fears negative externalities from investments made (Besley, 1995).The traditional landowning unit in Ghana is the community. De facto, 80 to 90% of Ghanian land is under customary tenure (Pande and Udry, 2006). Ghanian cultivators face insecurity due to competing claims from other members of the landowning community. In the Goldstein and Udry's (1999) study, the main source of insecurity faced by cultivators is the possibility that lineage land they have left fallow will be reallocated within the lineage. This is particularly true for women and those who do not hold inherited offices. Otsuka *et al.* (2003) find that 39% of plots are received as gifts (inter-vivos transfers to wives and children with community consent), while the next most common tenure types are rental (19%), allocated family land (12%), appropriated village land (11%), and inherited land (5%).

In the commercial sector in South Africa, uncertainty over the terms of "leases" may be a source of insecurity (Zikhali, 2008). In the communal areas, property rights are not transferable, and individual rights within the government resettlement schemes are perceived as even less secure (Ako, 2009). Bamire and Fabiyi (2002) note that the rights of secondary users in the southwest (those who obtain land through gift, borrowing, pledging and leasing as opposed to purchase and inheritance) are typically less secure, and that this discourages fertilizer use. The conclusion drawn on this is that that while land rights may often provide adequate security for investment, rights are only secure conditional on use (Fenske, 2011).

Land left fallow may be lost; this shortens the fallow period in some contexts and lengthens the time between fallow periods in others, depending on the farming system (Fenske, 2011).

2.8 Irrigation water

South Africa has approximately 1.3 million hectares of land under irrigation for both commercial and smallholder farming (SAHRC, 2014). Agriculture accounts for 70% of the worldwide human fresh water use (Gerbens-Leenes and Nonhebel, 2004). According to Van Averbeke *et al.* (2011), cited by Maepa *et al.* (2014), about 83% of potentially irrigable land is already developed. However, the smallholder irrigation covers only 47 667 ha, which is a mere 3% of the developed irrigation area (Backeberg and Sanewe, 2010).

South Africa is semi-arid; with an average annual rainfall of about 500 mm. Rainfall is also irregular Perret (2001). While the eastern side of the country is relatively wet, the western side is progressively drier, and large areas of the western part of the country are both arid and hot. Evaporation exceeds rainfall in large areas of the country (Rosegrant *et al.*, 2002). At the same time, South Africa experiences frequent, if unpredictable, droughts and floods, and the changing climate is contributing to this irregular water supply and water scarcity (Perret, 2001). This indicates the importance of irrigation access for smallholder farming to succeed across different parts of the country.

The National Water Act 36 (1998) of South Africa states that farming households have a right to access irrigation water (FAO, 2011). This act however demands that farmers must form WUAs, register it and get a licence to use water (with a charged water fee) Perret (2001). The aim of WUAs is to enable a community of farmers to pool financial and human resources to more effectively carry out water related activities. Even though the Act proposes something that would solve farmers' water issues, Perret (2001) argues that WUAs are likely to impose water management rules and schedules, which are likely to be source of conflicts and dissatisfaction in farmers' communities. The questions that rise are however, will farmers be willing to pay for water that they can use for free and will WUAs guarantee access to water Perret (2001)?

According to Dinar et al. (1997) from the earliest times water resources have been allocated on the basis of social criteria, maintaining the community by ensuring that water for human consumption, for sanitation, and for the production of food is available. Marginal cost pricing, public allocation, water markets and user-based allocation are the mechanisms that

are used for water allocation. Dinar et al. User-Based allocation is the one that is mostly used by smallholder irrigators in South Africa. This allocation is mechanism is mostly used in farmer-managed irrigation systems. A person's access to water is determined by social, cultural and economic factors (Kulkarni, 2011). According to Kulkarni (2011) class, color, gender and ethnicity, among others, are the social aspects that affect water access.

2.9 Water security

Together with land tenure insecurity, water insecurity at household level influences the success of smallholder food production and household food insecurity (Sinyolo *et al.*, 2014b). As this is an emerging concept, there are multiple definitions which are evolving to define water security (GWP, 2000; Grey and Sadoff, 2007; Schultz and Uhlenbrook, 2007; Norman *et al.*, 2010). Amongst other definitions GWP (2000) states that water security means that "every person has access to enough safe water at affordable cost to lead a clean, healthy and productive life, while ensuring that the natural environment is protected and enhanced. Sinyolo (2013) argued that although this definition brings out some components of water security such as the water availability, affordability, and environmental dimensions, its limitation is that it focuses on water availability and affordability for mainly household consumption use.

For the purpose of this study, following Sinyolo *et al.* (2014a) household water security was defined as access by the irrigating household to sufficient and reliable water of suitable quality to meet their agricultural use needs and their ability to assert the water rights against other parties. Sinyolo *et al.* (2014a) pointed out the key aspects of water security in this definition as; access to reliable and adequate water supply, the ability of the household to pay for the water, and their right or entitlement to the water which they are able to assert against other parties. Water security was, therefore, understood as a continuum of these above-mentioned components, where a household scoring high on these components is more water secure than the one scoring less. Water insecurity was, thus, defined as the perceived difficulty farmers face in securing adequate and reliable access to water for agricultural production (Rijsberman, 2006; Komnenic *et al.*, 2009). Cullis and O'Regan (2004) define water insecurity as a lack of capability to obtain water or as lack of entitlement for water. The water security variable is, therefore, aimed to capture whether farmers have or lack these capabilities.

2.10 Summary

This chapter has showed the extent of food security in South Africa and what government has done to improve it. It has been pointed out that gendered unequal distribution of resources have been a stimulating factor towards household food insecurity. It is striking that while gender issues have received considerable focus as regards land tenure rights research and reforms they appear to have received very little consideration as far as water rights are concerned. This too would appear to be an area calling out for more research. Generally speaking, the relationship between water rights, poverty and livelihoods has received less research. Many of the references in the literature regarding poverty and water relate to access to safe drinking water, which is not usually subject to individual water rights but more of a human right to water. Indeed, many uses of water by the very poor will frequently fall within the *de minimis* exceptions to the need to hold a formal water right.

CHAPTER 3: DETERMINANTS OF LAND AND WATER ACCESS

3.1 Abstract

Many studies have discussed how gender inequalities in resource distribution in rural areas of South Africa have resulted in women's limited access to land and irrigation water. However, there is limited information with regards to how the social, economic, cultural and institutional factors affect land allocation and water access between male- and female-headed households. Therefore, this study aimed to investigate the extent to which land allocation and irrigation water access among rural households in South Africa is influenced by gender. Data was collected from a random sample of 159 households in Msinga local municipality. The methodology used a Tobit model for water access and Ordinary Least Squares model for land access. The regression results indicated that although the gender of the household head did not significantly influence water access, it does however affect land access. Female-headed households always have smaller land sizes and their access to irrigation water per week, although not statistically significant, is less than that of male-headed households. The OLS model results indicated that factors such as marital status, source of land and livestock size influence land access. On the other hand, water access was determined by age and marital status of the household head, association membership, irrigation type and the state of the scheme management. The study concludes that there is gender discrimination against women in accessing productive resources, particularly land, in Msinga. The study recommends that women be organised into groups, and these organisations be supported by government to be always there for the farmers. It is also recommended that women be empowered through access to support services such as extension, credit and farming inputs to close the gender gap.

Keywords: land access, irrigation, water access, gender, land security, OLS, Tobit.

3.2 Introduction

The South African economic reform review of 2007 acknowledged a need for improved food production by smallholder farmers, both to ensure their own household food security and to contribute to national economic growth (Mphalwa, 2008). But a further on-going concern in this regard is the question of gender inequalities affecting both the distribution of agricultural production resources for smallholder farming and production at the smallholder farming level (Alcock and Hornby, 2004; Rao, 2005; FAO, 2011).

FAO (2011) noted that women have the potential to improve household food security as they constitute a crucial and very substantial resource in agriculture, and the rural economy through their roles as farmers, labourers and entrepreneurs. In South Africa, as smallholder farmers, women contribute as much as 60% to 80% of total food production (Mehra and Rojas, 2008). The main constraint to their contribution, however, is limited access to land and water, which are fundamental primary resources for production (Rao, 2005, Inocencio *et al.*, 2007). Alcock and Hornby (2004) in Msinga concluded that most social, economic and political institutions benefitted and privileged men over women in terms of land allocation. Cooke and Niasse (2008) noted that in South Africa's rural areas, women's access to land and irrigation water (Perret, 2002) is limited by their gender and social position in the community, and that family law and inheritance provisions discriminates against women in terms of land tenure.

The aim of this paper is, firstly, to determine the extent to which social, economic, institutional and cultural factors impact land and water allocation and secure rights to male- and female-headed households. Secondly, the paper analyses the impact of these factors on household food security. This paper seeks to provide government and other development agencies with a deeper understanding of the gendered impact that various institutions have on land and water allocation and security.

3.3 Research methodology

3.3.1 Study area description

The study was conducted in Msinga local municipality, which falls under Umzinyathi District Municipality in KwaZulu-Natal province. Figure 3.1 shows the location of Msinga area in KwaZulu-Natal.

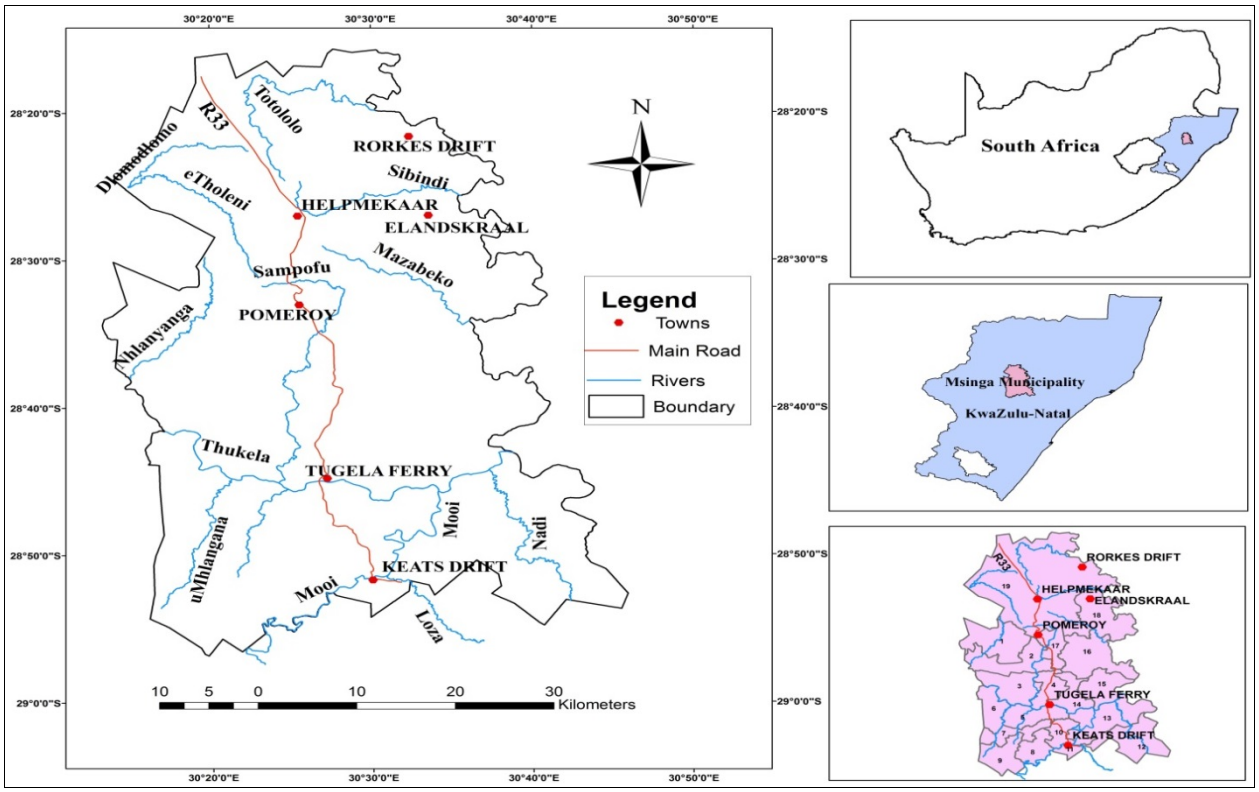

Figure 3-1: Location of Msinga area

Source: Sinyolo *et al.* (2014a)

Msinga local municipality is largely a rural area. Seventy percent of it is administered under Traditional Authority and held in trust by the Ingonyama Trust (Dearlove, 2007). The remaining 30% of land is commercial farm land, all of which is located to the north of the town of Pomeroy. Approximately 99% of the population lives in traditional areas as opposed to the small towns of Tugela Ferry, Keates Drift and Pomeroy. The population of Msinga is estimated to be 177,577 people (City Population, 2012). Females make 58% of the population. In this area, farming plays an important role on the economy as it contributes 18% of the income (Dearlove, 2007). Msinga is located in a dry semi-arid zone with an average annual rainfall of 600 mm, ranging between 350-900 mm. The area is very hot, with

summer temperatures that reach 44^0C. Ran-fed crop production is difficult because of the limited rainfall and high temperatures (Cousins, 2012). Thus dryland farming is better suited to livestock than crop production (LEAP, 2007).

Subsistence agricultural crop production is mostly practiced along the main rivers, the Tugela River and Mooi River (Dearlove, 2007). There are two main smallholder irrigation schemes in the Msinga local municipality, namely the Tugela Ferry irrigation scheme, which draws water from the Tugela River, and Mooi River irrigation scheme which draws water from the Mooi River. The Tugela Ferry irrigation scheme covers 873 ha (Cousins, 2012; Fanadzo, 2012). There are 1,500 irrigators who participate in the irrigation scheme (Sinyolo, 2013). This comprises approximately 15 per cent of all smallholder irrigators in KwaZulu-Natal. The scheme started operating between 1898 and 1902, and Cousins (2012).

According to Sinyolo (2013), Tugela Ferry irrigators were initially allocated two plots of land each of 0.1 ha. However, some of the irrigators have managed to obtain more irrigated land by either leasing or borrowing from neighbours who are not using their land (Sinyolo, 2013). Gomo (2010) highlighted that even the land under irrigation scheme is administered along patriarchal lines where men get user rights directly from the traditional authority whereas women get user rights from the males. Thus, irrigators who are not using the land allocated to them are not approved to sell it but they can only return it to traditional authorities who then re-allocate it to those who need it (Sinyolo, 2013). This irrigation scheme is divided into 7 blocks, which initially, were gravity fed. However, due to water shortages, other blocks now use motorised pumps. For example, Block 4B started using an electric pump which later broke down leading to the use of a diesel pump. The seventh block also uses a well-maintained electric pump renovated in 2013.

Mooi River irrigation scheme is located at kwaNxamala community and has a total of 15 blocks of different sizes for better scheme management and ease of water distribution. Water is abstracted from a weir constructed across the river into a canal that runs for a distance of 20.8 km from the abstraction point to the end of the scheme (DAEA, 2011). Water is distributed from the weir to various plots by means of distributive concreted canals which vary in size depending on the area to be irrigated (Gomo, 2010). The first 11 blocks draw water under gravity while the last four blocks are using a diesel pump (Gomo *et al.*, 2014). Initially, all the blocks obtained water from the canal but due to severe water shortages the last four blocks now use a diesel pump to get water. There are 824 farmers in the scheme of

600 hectares, each using at least one plot of 0.1 hectares, with some farmers having more than one plot (DAEA, 201I).

3.3.2 Data collection and sampling techniques

Data collection was conducted between October and November in 2013 using structured questionnaires, focus group discussions (FGDs), and key informant interviews. Two FGDs were conducted with at least 10 participants per session. They were conducted before the questionnaire survey to inform the questions that could be included in the survey questionnaire. Before the formal survey was conducted, the questionnaire was pre-tested using fifteen household heads from the two irrigations, Tugela Ferry and Mooi River schemes, and the surrounding non-irrigating households in the Machunwini village. Five households each were interviewed in the three areas during the pre-testing stage. Modifications to the questionnaire were made where required after the pre-testing. Pre-testing ensured that the questionnaire collected all the information required, and it helped to improve the translation to the local Zulu language. To get clarifications on issues raised on FGDs and survey questionnaires, three key informant interviews were conducted in the three study areas. Seven Zulu –speaking enumerators conducted the main survey.

A sample of 159 household heads was selected using a multi-stage stratified random sampling method. Households were categorized into two strata: irrigation participants and non-participants. The irrigators were then stratified according to their irrigation system i.e., whether they use gravity or motorised pumps to divert water to their plots. The reason for stratification according to the irrigation system was to capture the differences that exist in the distribution of water in the different systems. From these sub-strata, simple random selection was done to obtain a sample of 53 non-irrigators, 53 gravity-reliant and 53 pump-reliant irrigators. All the non-irrigators were from the surrounding Machunwini village. Eighty one of the irrigators were from Mooi River, and 53 of these were reliant on gravity. Only 25 of the irrigators, all pump-reliant, were from the Tugela Ferry irrigation scheme. An equal number of gravity-reliant and pump-reliant irrigators were interviewed for comparisons reasons.

3.4 Data analysis methods

3.4.1 Simple linear regression model for estimating land access determinants

An ordinary least squares regression was used to estimate the determinants of land size. The model was specified as follows:

$$Y_i = \beta x_i + \varepsilon_i \quad (1)$$

Where: Y_i is the total land owned by a household *i*; x_i is a vector of household characteristics; β is a vector of coefficients to be estimated, and ε_i is the residual term. The variables which were used in the model and their expected signs are described on Table 3.1.

For the purpose of this study, land access was defined as the process of assigning rights to land to a person (individual) within the rules defined by the particular land tenure system (FAO, 2002).

Land access can be through purchase or reversion, inheritance, etc. (FAO, 2002). Gender of the household head is anticipated to have a negative impact on total land a household has. This result is expected because of the reason given by Cousin and Hornby (2009). Education of the household hide is expected to positively affect the land. This is because the higher the education level one is on, the more influential they are expected to be when it comes to negotiating. Access to credit, TLU and off-farm income symbolises wealth, therefore, it is expected that a wealthier household would have more land as they have power to buy or rent from other people. Having access to extension and agricultural training may influence household total land size. This is because, extension officers may assist farmers to getting more land and also training might equip the farmers to source land. Murugani *et al*. (2014) reported that in Limpopo, farmers received the land from traditional leaders and some inherited it. Therefore, it is anticipated in the study that land source will determine total land size.

Sinyolo (2013) reported that irrigators were allocated two plots of 0.1 ha in the schemes. This led to the anticipation that being an irrigator or non-irrigator will determine the total household land size.

Table 3.1: Descriptions of variables used in the land access OLS regression model

Variable code	Variable name	Variable description	Expected sign
Dependent variables			
Totland	Total land	Household total land size in hectares	
Independent			
Gender	Gender	Gender of household head (1=male,0=female)	+
Age	Age	Age of household head, in years	+
Educat_1	Education level	Household head education level (1=no schooling, 0=Otherwise)	-
Educat_2	Education level	Household head education level (1=Secondary/more, Otherwise)	+
Extension	Access to extension	Number of times of engagement with extension support in the past 12 months	+
Credit	Access to credit	Access to credit (1=yes, 0=no)	+
Training	Agricultural training	Received agricultural skills training (1=yes, 0=no)	+
Assoc	Association membership	Farmers' membership to association (1=yes, 0=no)	+
Offfarmincome	Off-farmincome	Off-farm income in Rands (R)	+
Tlu*	Livestock size	Livestock size in Tropical units (TLU)	+
Religion	Religion	Main religion of household head (1=Christianity, 0=Otherwise)	+
Land source	Land source	Source of land (1=allocated, 0=inherited)	+
soilq	Perceived soil quality	Soil quality (1=good, 0=bad)	+
Farmsystem	Farming system	Crop production system (1=irrigation, 0=Rain-fed)	+

Source: Household survey (2013)

*Livestock size was determined using the Tropical Livestock Units (TLU) scales following Sinyolo (2013) (see Appendix C).

3.4.2 Tobit model for estimating water access determinants

The Tobit model was used to estimate the determinants of water access, where water access is the number of days a household has access to irrigation water. This model was used because water access is lower censored at 1 since every household in the scheme has access to irrigation water at least once per week. On the other hand, water access is upper censored at 7, since a household can only have access to water for a maximum access of 7 days in a week.

Table 3.2: Descriptions of variables used in the two regression models

Variable code	Variable name	Variable description	Expected sign
Dependent variable			
Wataccess	Water access	Number of days of household's access to water per week	
Independent			
Gender	Gender	Gender of household head (1=male,0=female)	+
MaritStatus	Marital status	Marital status of household head (1=married, 0=unmarried)	+
Age	Age	Age of household head, in years	+
Educat_1	Education level	Household head education level (1=no schooling, 0=Otherwise)	-
Educat_2	Education level	Household head education level (1=Secondary/more, Otherwise)	+
Hhsize	Household size	Number of members in a household	+
Irrigtype	Irrigation type	Household irrigation type (1=pump,0=Otherwise)	+
Place	Place	Household location (1=Tugela Ferry, 0=Otherwise)	+
Extension	Access to extension	Number of times of engagement with extension support in the past 12 months	+
Credit	Access to credit	Access to credit (1=yes, 0=no)	+
Training	Agricultural training	Received agricultural skills training (1=yes, 0=no)	+
Assoc	Association membership	Farmers' membership to association (1=yes, 0=no)	+
Offfarmincome	Off-farmincome	Off-farm income in Rands (R)	+
Tlu*	Livestock size	Livestock size in Tropical units (TLU)	+
Distance	Distance	Distance of household from the irrigation scheme (km)	-
Soilq	Perceived soil quality	Soil quality (1=good, 0=bad)	+
Duration	Land ownership duration	Number of years that a household has been in possession of the land	+
Wateshortages	Water shortages	Water shortages occurrence in the scheme (1=yes, 0=No)	-
Reg_Water_user	Registered water user	Is household head a registered water user (1=yes, 0=No)	+
Pay_forWater	Paying for water	Does a household head pay for water or its related services (1=yes, 0=No)	-
Watconflict	Water related conflicts	Involvement in any water related conflicts (1=yes, 0=No)	-
Irrigrules	Irrigation rules	Household head satisfied with irrigation scheme rules (1=yes, 0=No)	+

Variable code	Variable name	Variable description	Expected sign
Schmngt	Scheme management	Household head's perception on scheme management (1= good, 0=bad)	+

Source: Household survey (2013)

*Livestock size was determined using the Tropical Livestock Units (TLU) scales following Sinyolo (2013) (see Appendix C).

The model was specified as suggested by Gujarati and Porter (2009) as follows:

$Y_i = \beta x_i + \varepsilon_i$ if RHS>0

$=0$ otherwise

Y_i is the number of days of access to water per week by a household *i*; x_i is a vector of household characteristics; β is a vector of coefficients to be estimated, and ε_i residual term.

The variables which were used in the two models are described on Table 3.2. Gender of the household head is expected to have a negative impact on water access to FHH as a number of studies have reported limited access to production resources such as water to females (Thamaga-Chitja *et al.*, 2010; Department of Agriculture, 2002). Married household heads, especially females, may have less number of days of access to water as they spend most of their time taking care of their husbands and doing home chores than irrigating their land. While age of the household head may negatively affect water access, the household size may positively affect it. It is expected that as a farmer gets older, they are less physically fit to source water and irrigate their land frequently. On the other hand, if a household is bigger, it is expected that there will be more people to work on the land, sourcing water and irrigating. Therefore, even if the household head is less physically active, other family members are there to help.

People with higher levels of education, those who have received agricultural training and those with access to extension are expected to have more water access. This is because those who are educated are expected to have money to pay for water if necessary and including the trained ones and those with extension access, they are expected to have good negotiating skills to get access to water and they can use that water in a conserving manner. Credit access, TLU and off-farm income are wealth indicators which may influence households water access. It is anticipated that wealthier farmers may have more access to water as they have money to pay for water or water related charges where necessary. Scheme management

issues such as irrigation rules breaching, having to pay for water but failing and water conflicts occurrence may all negatively affect household water access. This is expected as reported by Gomo (2010) and Van Averbeke *et al* (2011).

3.5 Results and Discussion

3.5.1 Descriptive statistics

Most of the households were female-headed (86%), with only 14% being male-headed. Tables 3.3 and 3.4 present the chi-square and the t-test results on household demographics according to gender. The t-test results on Table 3.3 indicate that there were no statistical differences between the households' sizes and ages of the male and female heads of households.

Table 3.3: Description of household socio-economic characteristics according to gender

Variable	**Gender**				
	Males (n=22)		**Females (n=137)**		**T-test significance**
	Mean	Std. Dev	Mean	Std. Dev	
Household age	56	14	58	14	n.s
Household size	7.64	7.64	4.75	6.78	n.s
Total land size	0.59	0.80	0.42	0.32	*
Livestock units (TLU)	9.14	10.68	5.29	8.96	*
Off-farmincome (Rands/annually)	30,024	38,071	20,470	19,425	*
Extension access	0.62	1.16	0.50	0.87	n.s

Notes: ***, **, and * means significant at 1%, 5% and 10% levels of significance, respectively. ns=not statistically significant.
Source: Household survey (2013)

The results indicate that the farmers were old. Focus group discussions with farmers indicated that it is very unlikely for the youth to participate in farming as they feel it is not as lucrative as other sources of income. Table 3.3 indicates that there are significant welfare differences between female headed households (FHHs) and male headed households (MHHs). The results indicate that male-headed farmers had bigger land sizes, livestock sizes and had more off-farm income.

The results indicate a statistically significant mean difference between total sizes of land according to the gender of the household head. This implies that a MHH is likely to have a bigger piece of land than a FHH in Msinga. In terms of off-farm income, the results showed

that males had 46.7% more income per year compared to females. The result may be due to the fact that males are more formally employed than females and this may also be due to lower levels of education that females hold compared to males. Lower education levels of females limit their employment opportunities.

The results also indicate that MHHs own more livestock compared to females. Like many other rural areas, in Msinga livestock is associated with wealth and people expect that a man, as the head of a household, should have a big livestock herd to be considered wealthy. Some studies have shown that men do not easily sell their livestock even if they have run out of food whereas women rather sell their livestock to get money to feed their families and to pay for the education of their children (Cross and Hornby, 2000; Hill, 2003; ILRI, 2009).

The chi-square results in Table 3.4 indicate no statistically significant association between marital status or religion of the household head and gender of that household head. However, the chi-square results show a statistically significant association between gender of a household head and their education status. The results suggest that males are more likely to have been to school and reached higher grades compared to females. Only 36% of the males have no schooling compared to 62% females. This may be because of what the farmers highlighted during the FGDs that, historically, school attendance was mostly for boys while girls remained home to perform household chores.

The farmers also highlighted that when they grew up, it was mostly due to their culture that the few girls who attended school had to drop out of school when they reached puberty and get married while boys continued to study.

Culturally it is believed that there is no point in educating a girl who, one day, will leave the household and go to her new home. However, farmers highlighted that this belief is no longer widely held. The survey results indicated that 92% of the children in the sample attended school and at least 65% of them were females.

The majority of the farmers interviewed were unemployed, and the extent of unemployment is higher among FHHs. The chi-square results on Table 3.4 show that there is a significant relationship between gender of a household head and employment. The high rate of unemployment highlights the low employment opportunities in the community, as highlighted by Sinyolo (2013). This relationship between employment status and gender suggests that, if a household head is male they are more likely to be employed and mostly

under formal employment whereas a female is more likely to be unemployed or at least be informally employed. Unemployment especially of women may be aggravated by their low levels of education with very poor skills for the needed standard in the industrial sector.

Table 3.4: Comparison of categorical variables across gender

Variables		**Gender**		
	Categories	**Males (%) (n=22)**	**Females (%) (n=137)**	**Significance of χ^2 value**
Marital status	1=Married	64	48	
	2= Single	32	31	n.s
	3=Widowed	4	21	
Household main religion	1=Christians	59	64	n.s
	2=African Traditional	41	36	
Household head education level	1= No schooling	36	62	**
	2=Primary education	32	25	
	3=Secondary education	22	12	
	4=Tertiary education	9	2	
Access to input	0=no	74	58	n.s
	1=yes	26	42	
Access to credit	0=no	75	74	n.s
	1=yes	25	26	
Training	0=no	82	82	n.s
	1=yes	18	18	
Household head employment status	1=Unemployed	72	91	
	2=Informal/temporal	9	6	***
	3=formal/permanent	18	3	
Land source	1=inherited	59	72	n.s
	2=allocated	41	27	
	3=bought	0	1	
Conflicts	0=No			n.s
	1=Yes	9	24	
	1=Married	91	76	

Notes: *** and ** means significant at 1% and 5% levels of significance, respectively; ns= not statistically significant
Source: Household survey (2013)

The focus group discussions highlighted that females participate in informal employment such as washing clothes for other people or working on other people's crop fields as coping strategies to sustain their household livelihoods. Some females who were interviewed highlighted that they look for jobs as farm labourers in the Tugela Ferry irrigation, where they help with irrigating, planting or weeding activities which normally pay about R20 a day. Even though this is not much, the farmers felt it is better than not working at all. This is an indication of low opportunity cost of female labour.

While there is no gender variation between access to support services such as credit, training, Table 3.4 indicates that the majority of the farmers do not have access to these support services such as credit. This implies that government support to the smallholder farmers is inadequate, as it does not reach many of the farmers.

Only 1.3% of the sample does not own any piece of land and use land that is either borrowed or rented. Amongst the households that own land 69% inherited it, while 29% received it from the traditional authorities. Only 0.6% bought the land they own. The small percentage of households that bought or borrowed land indicates a very poorly developed land market due to the traditional land tenure system that hinders the development of such as market. As explained by the farmers during focus groups discussions, a person is not allowed to sell the land they possess as it legally belongs to the traditional authorities. Therefore, if they wish to relinquish the land, the households report to the traditional authorities to make decisions on re-allocation to other households.

Table 3.5 indicates that there is no association between gender and source of land among the interviewed households. This suggests that there is no particular land source that mostly applies to either males or females. The results also indicate that females are more involved in land related conflict as 19% of them have been in conflicts over land whereas none of the males in the sample have been involved. It was highlighted during the focus group discussions that conflicts over land take place where there is no clear ownership, which is likely to happen within the family when the parents (or husbands) pass away and the household members fight over inheritance of the land. It was mentioned that women are likely to be involved in these conflicts as they would be seeking to take over the land so that they can feed the family while male relatives refuse as they believe they have a legal right to inherit the land. However, the chi-square test shows no statistical significant difference between gender of the household head and their likeliness to be involved in conflicts over land ownership.

Further analysis indicated that there we 41 single women who were land “owners”. Most of these single women (32 out of 41, or 74%) inherited the land from their parents, with very few (8 out of 41) having being allocated the land by the traditional authorities. This demonstrates that women are less likely to be allocated land, and most gain access to land through inheriting.

The results in Table 3.5 indicate a statistically significant mean difference between the total land sizes and the gender of a legal land owner ($p<0.05$). The farmers were asked if the household head is the legal land holder and the farmers who perceived themselves as legal owners of the land had 0.18 ha more land sizes compared to those who felt that they did not have legal ownership of the land. The results implies that as the legal owner of the land shifts from being women to man, it is more likely that the household will own a bigger piece of land. Households in which the head is married have 0.15ha more than those in which the head is not married.

Table 3.5: Land sizes according to marital status and perceived legal entitlement to land

Variable	**Categories**	**Land size (ha)**		**T-test**
		Mean	Std. Dev	
Marital status	Unmarried	0.36	0.31	**
	Married	0.52	0.50	
Legal land owner	female	0.37	0.23	**
	male	0.55	0.58	

Notes: ** means significant at 5% levels of significance
Source: Household survey (2013)

As expected, marital status of the household head has a significant influence on the total land size a household possesses. The results on Table 3.6 indicate that there is a statistically significant mean difference ($p<0.05$) with married household heads holding bigger pieces of land than the unmarried. These results are in line Cousins and Hornby (2009), which also indicated a significant difference in land size according to marital status in Msinga, with the married having more land than the unmarried household heads.

3.5.2 Determinants of land access

A simple linear regression model was estimated to determine the social, economic, cultural and institutional characteristics that influence the total land size that households have. The estimated model presented in Table 3.6 indicates that all the coefficients, collectively, are statistically significant ($p<0.01$). The model results indicate that factors such as marital status of the household head, gender and source of land as well as farming system are significant determinants of total land size a household holds.

The gender variable suggests that MHHS have bigger plots than FHHs. This is to be expected, as the patriarchal nature of the study area is such that land allocation favours males. Land is generally allocated or inherited by men, with women accessing it through inheritance. For females, inheritance is an internal arrangement where unmarried women are allocated land within the family plot. This result is consistent with a number of studies which concluded that there are gender inequalities when it comes to allocation of production resources allocation (Quisumbing, 1996; Fernandez, 2006; Toulmin, 2008).

As expected, the results also show that marital status of the household head is a significant determinant of total land size. This is because in the study area, land is generally allocated to married people. It is common that women to lose their land if they divorce or separate from their husbands. Sometimes, women lose land that belonged to their husbands when the spouses pass away. The increase in land size with marital status may also suggest that married people need more land because of the need to produce, presumably, for larger families. Moreover, it may also indicate the mean the availability of more hands to work on the land. The results also indicate that the source of the land significantly determines household total land size ($p<0.5$). Households that received land from sources such as traditional authorities, land reform programmes or bought the land have 0.15 ha less than those who inherited it.

This indicates that inheritance is the main mode of land transfers through which large pieces of land are obtained. As pointed out in table 3.4, it is also the main mode through which households acquire land. The communal land tenure system in the area is such that, other than inheriting land from parents, there are limited chances of getting larger pieces of land due to population growth. During FGDs farmers mentioned that while traditional leaders allocate land to people, they can only allocate a limited amount of land, of which might not meet the farmer's requirements.

The model results also indicate that household heads who are members of farmers' associations are likely to have more land than non-members. This may be because of the empowerment, information and the voice that farmers benefit as they become association members. According to National Department of Agriculture (2002), farmers are most likely to receive farming resources such as land, mechanisation, fertilizers and seeds when they are a registered group than as individuals.

Table 3.6: OLS model on determinants of household land size

Variables	Coefficients	Std. Err.	Sig
Gender (1=male, 0=female)	0.261	0.093	***
Maritstatus (1=married, 0=unmarried)	0.130	0.064	**
Educat1 (1=no schooling, 0=Otherwise)	-0.125	0.075	*
Educat2 (1=Secondary/more, 0=Otherwise)	-0.163	0.102	ns
Religion (1=Christianity, 0=Otherwise)	-0.004	0.066	ns
Extension	-0.012	0.043	ns
Credit (1=yes; no=0)	-0.033	0.091	ns
Training (1=yes; no=0)	0.033	0.057	ns
Assoc (1=yes; no=0)	0.167	0.070	**
Offfarm income (Rands)	0.000	0.000	ns
Livestock size (TLU)	0.008	0.004	**
Soilq (1=good,0=bad)	0.012	0.067	ns
Farmsystem (1=Irrigation, 0= Rain fed)	-0.041	0.098	ns
Landsource (1=allocated, 0=inherited)	-0.142	0.718	**
_cons	0.313	0.158	**
F-value	3.74		***
Adj R^2	0.22		
n	159		
Mean VIF	1.58		

Notes: ***, **, and * means significant at 1%, 5% and 10% levels of significance, respectively; ns= not statistically significant.
Source: Household survey (2013)

The household livestock size has a statistically significant relationship with the total land a household has. The implication is that households with bigger livestock sizes are likely to have bigger land sizes. TLU is considered a sign of wealth, therefore it gives a household head power to pay for any land related fee if necessary.

3.5.3 Descriptive Statistics on Water access

To determine households' access to irrigation water, farmers were asked to state the number of days in a week that they have it in their plots. The number of days of water access was determined for irrigators only since for non-irrigators the rain is seasonal thus cannot be measured weekly. Irrigating farmers have an average of 3.38 days of access to water (Min=1, Max=7, Standard deviation=1.63).

The survey indicates no gender variations on irrigation water access. This suggests that female-headed households are not discriminated against in terms of accessing water. Also,

the household head's marital status, education level, training and extension access have no significant relationship with the household access to irrigation water.

Table 3.7: Descriptive water access t-test results

Variable	Categories	Freq.	No. of days of water access/week		T-test
			Mean	Std. Dev	
Maritstatus	0= Unmarried	54	2.76	1.41	ns
	1= Married	52	2.98	1.54	
Gender1	0=female	94	3.30	3.03	ns
	1= male	12	4.0	3.59	
Irrigtyp3	0= gravity	53	3.49	1.63	***
	1= pump	53	2.25	0.98	
Educat1	0= Otherwise	46	2.68	1.31	ns
	1= No schooling	60	3.31	1.55	
Educat2	0= Otherwise	86	2.87	1.48	ns
	1=Secondary/more	20	2.84	1.50	
Training	0=No	73	2.86	1.44	ns
	1= Yes	33	2.88	1.61	
Watconflict	0=No	71	2.85	1.43	ns
	1=Yes	34	2.88	1.59	
Credit	0=No	92	2.08	1.49	ns
	1=Yes	14	2.29	0.69	
Pay_forWater	0=No	56	3.66	1.68	***
	1=Yes	50	2.32	0.96	
Reg_Water_user	0=No	77	2.86	1.53	ns
	1=Yes	29	2.90	1.35	
assoc	0=No	47	3.23	1.59	***
	1=Yes	59	2.19	0.78	
Watshortages	0=No	20	5.00	0.92	***
	1=Yes	86	2.37	1.09	

Notes: ***, **, and * means significant at 1%, 5% and 10% levels of significance, respectively.

Source: Household Survey (2013).

Table 3.8 indicate a statistically significant mean difference between water access and irrigation type. This implies that households under gravity-fed scheme have access to water at least two times more than households under pump irrigation. Unexpectedly, the t-test results indicate no statistical significant mean difference between household heads who have been involved in conflicts related to water and access to water per week. The anticipated results were that farmers who have been involved in conflicts may have less water access as it was

highlighted in FGDs that there are perpetual conflicts caused by some farmers using water every day.

The results indicate a statistically mean difference ($p<0.01$) between water access and whether farmers pay any water related costs. This suggests that farmers who do not pay any water costs have more access to water per week than those who pay for costs such as diesel, electricity or pump maintenance. This may be because farmers who depend on diesel pumps for irrigation water can only have access to water when they paid for diesel compared to those who depend on gravity as they do not have to pay to get water flowing to their plots. Farmers from Mooi River at the tail-end blocks which depend on diesel pump mentioned that they can only irrigate their crops when they paid at least an average of R100.00 per 0.1ha plot for fuel. They argued that even this amount they pay is not enough for one plot so they sometimes end up irrigating half of a plot. The problem is worsened by the fact that diesel pump delivers less water than gravity, such that the diesel pump-dependent irrigators need more days of accessing water than the gravity-reliant irrigators.

Another issue they raised was that the pump is now old and it consumes more diesel as it needs more power to divert water from the river to the plots. Only being able to irrigate their crops when paid for diesel has a negative impact on their crops. If a farmer does not have money to pay irrigation over two consecutive weeks, his/her crops will die and the investment in seeds and fertilizers is lost. In Tugela Ferry the farmers from Block 4 had a diesel pump but it is no longer working so they use two small diesel pumps which are owned by some irrigation scheme members. In order for the farmers to use these pumps they have to pay the owner R20 per 0.1ha plot irrigated and in addition they have to buy fuel which costs R50 to irrigate 0.1ha. However, under Block 7 in Tugela Ferry, farmers indicated that they do get access to water at least twice or three times a week even if they did not pay. They are allowed to use water even if they had not paid the monthly R100 but when Eskom shuts down electricity due to unpaid electricity bills they are forced to pay.

Further analysis indicated no significant results between being a registered water user and access to water. This was expected as the survey results indicated that only about 27% irrigators are registered water user while the rest reported that they have no information about water user association and those who have information about it are the ones with active farmers associations. The results also point out a statistically mean difference ($p<0.01$) between water access and being a farmers' associations' member. The results suggest that

farmers who join farmers' associations such as cooperatives have less access to water. Possibly farmers join such associations to seek redress to their limited water access.

Table 3.8 indicates what farmers think may be causes for water shortages in the scheme. Over half of the irrigators perceived breaking of irrigation rules as the major cause for water shortages in the scheme. Such irrigation rules include cleaning of the canal, paying for electricity and irrigating on the day allocated for that particular block.

Table 3.8: Frequency of reasons for water shortages in the scheme

Reason	**% (n=109)**
Canal leakages	12
people breaking irrigation rules	54
Poor supply from dam/river	6
Pump not working	20
Inability to pay for water	8

Source: Household Survey (2013).

3.5.4 Determinants of water access: Tobit results

A Tobit model was estimated to determine socio-economic determinants of household access to irrigation water and the results are presented in Table 3.9. The significant LR value indicates that the model fits data well. The low average variance inflation factor (VIF) of 2.19 indicated that the model had no severe multicollinearity problem.

The model results indicate that the gender of the household head is not a significant determinant of water access. This implies that there is no gender bias with regards to access to water among the interviewed irrigators. Factors such as the age of the household head, household size, off-farm income, irrigation type, association membership, being a registered water user and paying for water are the statistically significant determinants of household's irrigation water access. The model suggests that as the age of the household head increase, their numbers of days of access to water per week are likely to decrease. This may be because as they get older and less physically fit they reduce the frequency of going to their plots to irrigate. In the FGD farmers mentioned that they do often use children to irrigate the plots but only during weekends and school holidays.

The model indicates an unexpected negative impact of household size on water access. One would expect that a bigger household would have higher number of days of access to water per week than a smaller household due to increased labour (Bagamba *et al.*, 2009).

Table 3.9: Tobit results on determinants of irrigation water access

water access	**Coef.**	**Std. Err.**	**Sig**
age	-0.029	0.011	***
gender	-0.580	0.646	ns
educat_1	0.205	0.333	ns
educat_2	0.369	0.372	ns
hhsize	-0.019	0.009	**
tlu	0.031	0.020	ns
totland	0.336	0.366	ns
off_farmincome	0.000	0.000	*
irrigtyp	-4.247	1.386	***
extension	-0.076	0.176	ns
credit	0.266	0.789	ns
training	0.157	0.201	ns
assoc	1.329	0.308	***
soilq	-0.325	0.297	ns
distance	-0.040	0.041	ns
duration	0.007	0.009	ns
watuser	2.186	0.361	***
schmngt_invlve	0.823	0.652	ns
irrigrules	0.004	0.294	ns
conflicts	1.758	1.197	ns
paidfor_water	0.778	0.341	**
_cons	4.214	0.890	***
LR χ^2	105		***
Pseudo R^2	0.28		
n	101		

Notes: ***, **, and * means significant at 1%, 5% and 10% levels of significance, respectively; ns= not statistically significant.
Source: Household Survey (2013).

However, the results imply that as the household size increases, the number of days of water access per week is likely to decrease. This could be due to increased house chores to the household head such that they do not get enough time to go to their gardens to irrigate anytime.

The model also indicates the statistically significant probability of famers on gravity-fed irrigation scheme having a day more of access to water than those from pump-fed scheme. This result may be because pump-fed irrigation is likely to have problems such as lack of money for diesel or electricity, pump breakdown or pump losing power to irrigate all the plots on the same day. The issue of pump break down was highlighted by farmers from Block 4B in Tugela Ferry, where it was mentioned that the pump broke down in January 2013 and

the farmers did not have enough funds to service it thus they resorted to a small diesel pump which can only irrigate four plots per day. Farmers from Tugela Ferry also reported incidents of Eskom disconnecting the electricity due to unpaid bills which also lead to less access to water. Farmers from Mooi River lower also mentioned that due to their pump getting old and requiring service they do not afford, it now takes longer to pump water from the river to the scheme dams while it consumes more diesels then when it was still new.

The results indicate that farmers' association (co-operative) membership is a statistically significant determinant of irrigation water access ($p<0.1$). The model indicates that farmers who join farmers' association tend to have more number of days of access to irrigation water per week. This may be because they join farmers' cooperatives to get their water access problem solved. Farmers from Mooi River lower blocks mentioned that one of the benefits of joining a cooperative was that the chairperson used to negotiate with commercial farmers to release water from their private dams when there was water shortage in the river. This indicated that co-operative members take care of each other when it comes to access to water and this highlights a positive role of farmers' cooperatives as a social capital (Baiyegunhi, 2014).

Even though farmers who reported to be registered water users are the minority of the sample, the model results indicate that those registered on water user association are likely to have more number of days to access irrigation water per week. This may be because water user association oversee that their members have sufficient access to water. The model also indicates that scheme management is a statistical significant determinant of water access. The result imply that scheme members who feel that the scheme management is good are those who have at least 1 day more access to water per week than others. This may indicate that farmers who are under maintained irrigation scheme have more access to water as the pump would be serviced, canal cleaned, bills paid and irrigation schemes rules would be followed correctly.

The model results indicate whether irrigators pay for water or any water related fee is a statistically significant determinant of water. This, as suggested by the chi-square result, implies that irrigators who do not pay any water costs have more access to water per week than those who pay for costs such as diesel, electricity or pump maintenance. This may be because farmers who depend on diesel pumps for irrigation water can only have access to

water when they paid for diesel compared to those who depend on gravity as they do not have to pay to get water to their plots.

3.6 Conclusion

The study's objective was to investigate the extent to which land allocation and water access are influenced by gender among rural households in South Africa. The results indicate that there is an issue of unequal land allocation between males and females in Msinga. The model results and discussions highlighted unequal land sizes held by male and female headed household, with males holding bigger pieces of land compared to females. Even though the model result was not statistically significant, the results also indicated unequal access to irrigation water as male-household heads have more number of days of accessing water than female-household heads.

In contrary to what a number of studies have indicated, the descriptive results show no significant association between whether the land was allocated by the traditional leaders or the household head inherited and their gender. Previous studies have highlighted that in rural areas women mainly own land that was inherited from either husbands or relatives whereas man get preference of being allocated land by traditional authorities, however, this study indicated that there is not one land source for men only or women only in Msinga. With no intentions of interjecting the previous studies, the reason for different results may be because the previous studies in Msinga were not conducted using sample from irrigation scheme but only dry land communal farming. The study also indicated a positive impact of institutions such as water user association, cooperatives and scheme managing committee on water access. As the results indicated that farmers who have less water access join cooperatives and water user association to get their water problems solved, the study recommends that these organisations be supported by government to be always there for the farmers. Also as the good scheme management by scheme committee improves farmers' access to water, it is suggested that the committee members get training and more support so that they can continue their good work. There is little visible impact of government support services in Msinga, thus the study suggests that the concerned development agencies intervene with support services from credit, to agricultural training, inputs supplies and extension access to improve these farmers' utilization of land and water to sustain their livelihoods.

CHAPTER 4: DETERMINANTS OF LAND AND WATER SECURITY

4.1 Abstract

Land and water insecurity have been identified as a stumbling factor to effective household food production. This paper aimed at finding out how land security and water security between male and female-headed households have been affected by the social, economic, cultural and institutional factors. A sample of 159 households was collected in Msinga local municipality, and data was analysed using ordinary least squares and a binary logit model. The models results indicated that male-headed households are more land and water secure compared to female-headed households. While land security is mostly affected by perceived threats to be evicted from the land and farming system, water security is positively impacted by access to extension services, credit and agricultural training that household head received. The study concludes that there is gender discrimination towards women on property rights. To ensure that households who have access to water perceive their water right secure, the study recommends that farmers be trained on water conservation and efficient use. Moreover, women should be encouraged to join farmer's associations that will give them voice in the community to close the gender gap.

Keywords: Water security, Gender, Land security, Logit model

4.2 Introduction

Although food secure at the national level, South Africa is food insecure at the household level (Hendriks, 2012). To ensure household food security, studies have recommended equal access to production resources such as land and irrigation water between males and females (Fenske, 2010; Bolage, 2005). Moreover, Hart (2009b) and Altman *et al.* (2009) have argued that unless the farmers feel land and water secure, the household food security goal will be difficult to achieve.

Land tenure is the relationship, whether legally or customarily defined, among people, as individuals or groups, with respect to land (FAO, 2004). Land tenure includes a right to use land, to exclude unauthorized people from using the land, control how land will be used and a right to protection from illegal expropriation (FAO, 2004). Thus, a person is land secure when all these rights are respected. According to Bogale (2005), providing tenure security is often viewed as a precondition for intensifying agricultural production. It is now being encouraged as it is seen as a prerequisite for better natural resource management and sustainable development. In addition, Brasselle *et al.* (2002) concluded that land tenure security promotes efficiency, growth and investment. Fenske (2011) mentioned that farmers who feel land secure are likely to invest in improving their soil quality by applying fertilizers and other good practices such as crop rotation. The study further argued that these investments play a significant role in household food security as they increase food production. Therefore, it is important for household whose livelihoods are largely land-based to be land secure Fenske (2011).

Water security is an emerging concept, and there is not yet an agreed definition (Sinyolo *et al.*, 2014a). Instead, there are various definitions which often invite debates (GWP, 2000; Cook and Bakker, 2012; Sinyolo *et al.*, 2014a). According to Cook and Bakker (2012), the framings of water security are not consistent and tend to vary with context and disciplinary perspectives on water use. GWP (2000:12) defined water security as a situation where "every person has access to enough safe water at affordable cost to lead a clean, healthy and productive life, while ensuring that the natural environment is protected and enhanced." Reliable access to irrigation water increases farmers' incentives to invest in high yielding crop varieties, or high value crops (Tyler, 2007; Sinyolo *et al.*, 2014a). This leads to increased productivity, overall higher production, and greater returns to farming (Hussain and Hanjra, 2004). In contrast, uncertainties regarding how much water would be available to a

particular farmer results in low incentives to invest in improved inputs and technologies, resulting in farmers investing less in seed and fertilizer than they might otherwise do (Faurès and Santini, 2008).

The aim of this paper is to identify the social, economic, institutional and cultural factors that impact land and water security for male and female-household heads. This paper seeks to provide government and other development agencies with a deeper understanding of the gendered impact that various factors have on land and water security.

4.3 Research methodology

4.3.1 Study area description

The study was conducted in Msinga local municipality, which falls under Umzinyathi District Municipality. Figure 4.1 shows the location of the Msinga local municipality in KwaZulu-Natal, South Africa.

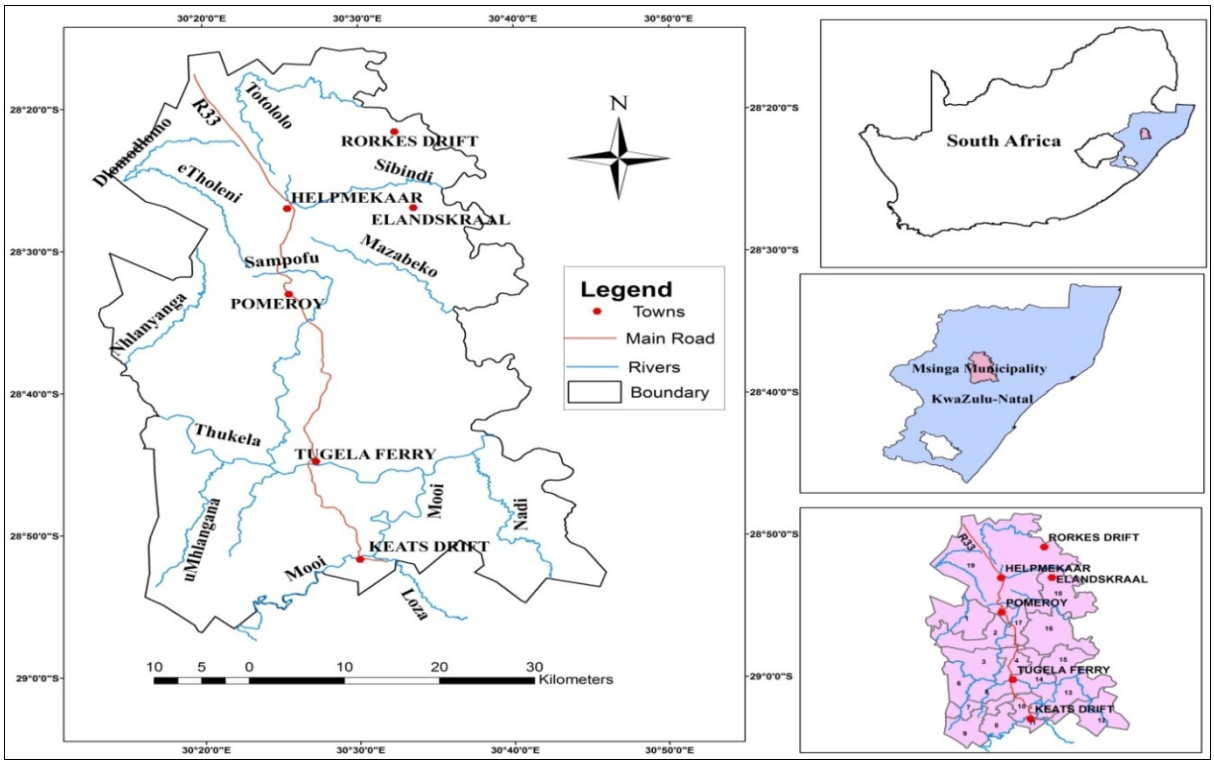

Figure 4-1: Location of Msinga local municipality in KwaZulu-Natal, South Africa

Source: Sinyolo *et al.* (2014a)

Msinga is composed of six Traditional Authority Areas namely, Qamu, Mchunu, Bomvu, Ngome, Mabaso and Mthembu, comprising an area of 2,500 km^2. Msinga is largely a rural area and 70% of it is administered under Traditional Authority and held in trust by the Ingonyama Trust (Dearlove, 2007). The remaining 30% of land is commercial farm land, all of which is located to the north of the town of Pomeroy. Approximately 99% of the population lives in communal areas as opposed to the small towns of Tugela Ferry, Keates Drift and Pomeroy.

The population of Msinga is estimated to be 177,577 people (City population, 2012). Females make 58% of the population. In this area, farming plays an important role on the economy as it contributes 18% of the income of the municipality, with the remainder coming from other sectors such as industry (Dearlove, 2007). The area is in a dry semi-arid zone with an average annual rainfall of 600 mm, with range of 350-900 mm. Summer temperatures reach 44^0C. The low rainfall coupled with high temperatures make it difficult to practice rain-fed crop production (Cousins, 2012). Thus dry land farming is better suited to livestock than crop production (LEAP, 2007).

Subsistence agricultural crop production is practiced in the Tugela River and Mooi River irrigation schemes (Dearlove, 2007). These two schemes were chosen for this study. Several researchers (e.g., Mnkeni *et al*, 2010; Sinyolo *et al*, 2014b; Cousins, 2012) have reported inequities in land and water distribution in the Msinga area where these two schemes are located. Therefore, the schemes were chosen because their relevance to the issues under study. Those practicing crop production in Tugela Ferry utilize water from Tugela River. The irrigation scheme covers 873 ha (Cousins, 2012; Fanadzo, 2012). This scheme started operating between 1898 and 1902. It has about 1,500 beneficiaries, and Cousins (2012) mentioned that this comprises approximately 15 per cent of all smallholder irrigators in KwaZulu-Natal.

According to Sinyolo (2013), Tugela Ferry irrigators have been allocated two plots of land each of 0.1 ha. However, some of the irrigators have managed to obtain more irrigated land by either leasing or borrowing from neighbours who are not using their land (Sinyolo, 2013). Sinyolo (2013) highlighted that even the land under irrigation scheme is administered along patriarchal lines where men get user rights directly from the traditional authority whereas women get user rights from the males. Irrigators who are not using the land allocated to them

are not allowed to sell it but can only return it to traditional authorities who then re-allocate (Sinyolo, 2013).

This irrigation scheme is divided into 7 blocks, which initially, were gravity fed. However, due to water shortages, other blocks now rely on motorised pumps. For example, Block 4B uses using a diesel pump. Block 7 uses a well-maintained electric pump renovated in 2013.

Mooi River irrigation scheme is located at kwaNxamala community and has a total of 15 blocks of different sizes for better scheme management and ease of water distribution. Water is abstracted from a weir constructed across the river into a canal that runs for a distance of 20.8 km from the abstraction point to the end of the scheme (DAEA, 2011).

Water is distributed from the weir to various plots by means of distributive concreted canals which vary in size depending on the area to be irrigated (Gomo , 2010). The first 11 blocks draw water under gravity while the last four blocks are using a diesel pump (Gomo *et al.*, 2014). Initially, all the blocks obtained water from the canal but due to severe water shortages the last four blocks now use a diesel pump to get water. There are 824 farmers in the scheme which is 600 hectares, each occupying at least one plot of 0.1 hectares, but some farmers occupy more than one (DAEA, 201I).

4.3.2 Data collection and sampling techniques

Data collection was conducted between October and November in 2013 using structured household questionnaires, focus group discussions (FGDs), and key informant interviews. Two FGDs were conducted with at least 10 participants per session. They were conducted before the questionnaire survey to clarify the information that could be included in the survey questionnaire. Before the formal survey was conducted, the questionnaire was pre-tested using fifteen randomly selected household heads from Tugela Ferry and Mooi River schemes and Machunwini village. Modifications to the questionnaire were made where required after the pre-testing. Pre-testing was done in order to ensure that the questionnaire collected all the information required. Moreover, pre-testing also helped to improve the translation to the local Zulu language. To get clarifications on issues raised on FGDs and survey questionnaires, three key informant interviews were conducted. Seven Zulu–speaking enumerators conducted the main survey. The enumerators were trained for a week by the researcher to familiarise them with the questionnaire.

A sample of 159 household heads was selected using a multi-stage stratified random sampling method. Households were categorized into two strata: irrigation participants and non-participants. The irrigators were then stratified according to their irrigation system i.e., whether they use gravity or motorised pumps to divert water to their plots. The reason for stratification according to the irrigation system was to capture the differences that exist in the distribution of water in the different systems. From these sub-strata, simple random selection was done to obtain a sample of 53 non-irrigators, 53 gravity-reliant and 53 pump-reliant irrigators. All the non-irrigators were from the surrounding Machunwini village. Eighty one of the irrigators were from Mooi River, and 53 of these were reliant on gravity. Only 25 of the irrigators, all pump-reliant, were from the Tugela Ferry irrigation scheme. An equal number of gravity-reliant and pump-reliant irrigators were interviewed for comparisons reasons.

4.4 Data analysis methods

4.4.1 Binary logit model for estimating the determinants of land security

The factors influencing perceived land security were estimated using a binary logit model. The dependent variable was a categorical variable, which took a value of 1 if land security is perceived, and 0 otherwise. The model was specified as follows:

$$\text{Ln}\,[P_i/(1-P_i)] = \beta_{0j} + \beta_{1j}X_{1i} + \beta_{2j}X_{2i} + ... + \beta_{kj}X_{ki} + u_{ji}\ ; \qquad (1)$$

Where: j = 0, 2; i = 1, 2,……n are the individuals; ln = natural logarithm; P_i = the probability of a farmer being land secure; $(1-P_i)$= the probability of a farmer being land insecure; X_{1i} …….X_{ki} are the k farmer attributes; u_{ji} is the random error term; and β ‘s are the k+1 parameters to be estimated.

The variables used in the model are described in Table 4.1 Even though the households are under the same land tenure system; their perceptions of land security would differ. Farmers make decisions based on their perceptions; hence using perceptions of land security is valid (Besley, 1995; Crewett *et al*, 2008). The variables used to estimate the model are described on Table 4.1. Gender of the household head is expected to negatively affect perceived land security. This is because women are more likely to lose their land when their husbands die (Deere and Leon, 2003; GESTES, 2010). Farming system may determine perceived land security as irrigators may feel land insecure. This is because land under irrigation is in

demand and there are higher chances of households losing land under irrigation than land not irrigated. Receiving threats to be evicted from the land may cause land insecurity to the farmers. This expected negative result may imply that farmers who have received threats are now scared that they are at risk of losing one of the household livelihood and a legacy. Farmers with access to credit and those with higher off-farm income and TLU may feel land secure as they are able to buy off the security.

Table 4.1: Descriptions of variables used in the perceived land security regression model

Variable code	**Variable name**	**Variable description**	**Expected sign**
Dependent			
landsec	Perceived land security	Land security perception (1=secure, 0=insecure)	
Independent			
Gender	Gender	Household head gender (1=male,0=female)	+
MaritStatus	Marital status	Household head marital status (1=married,0=unmarried)	+
Age	Age	Household head age in years	+
Educat_1	Education level	Household head education level categories (1=no schooling, 0=Otherwise)	-
Educat_2	Education level	Household head education level categories (1=Secondary/more, Otherwise)	+
hhsize	Household size	Number of members in a household	+
Irrigtype1	Irrigation type	Household irrigation type (1=pump,0=Otherwise)	+
Place2	Place	Household location (1=Machunwini, 0=Otherwise)	-
Extension	Access to extension	Number of times of engagement with extension support in the past 12 months	+
Credit	Access to credit	Access to credit (1=yes,0=no)	+
Training	Agricultural training	Agricultural skills training received (1=yes,0=no)	+
Assoc	Association membership	Farmers association member	+
Offfarmincome	Off-farm income	Off-farm income in Rands (R)	+
Tlu*	Livestock size	Livestock size in Tropical units (TLU)	+
legalholder	Land “ownership”	The perceived land legal holder(1=yes,0=no)	+
Religion	Religion	Household head main religion (1=Christianity,0=Otherwise)	+
Distance	Distance	Household distance from the irrigation scheme (km)	-
Land source	Land source	Source of land (1=allocated, 0=inherited)	+
Threats	Eviction threats	Received any Threats to be evicted from	-

Variable code	Variable name	Variable description	Expected sign
		the land (1=yes, 0=No)	
soilq	Perceived soil quality	Soil quality (1=good, 0=bad)	+
Duration	Land ownership duration	Number of years that a household has been in possession of the land	+
schmntaine	Scheme maintenance	Household head involved in scheme maintenance (1=yes, 0=No)	+
irrigrules	Irrigation rules	Household head satisfied with irrigation scheme rules (1=yes, 0=No)	+
schmngt	Scheme management	Household head's perception on scheme management (1= good, 0=bad)	+

*Livestock size was determined using the Tropical Livestock Units (TLU) scales following Sinyolo (2013) (see appendix C).

The same model (1) was used to estimate household water security determinants where the dependant variable was perceived water security (water secure=1, water insecure=0) and (1-P_i) was now the probability of a farmer being water insecure.

The variables used in the model are described in Table 4.2. Gender and age of the household head may determine perceived water security. Women are expected to feel water insecure due to discrimination and conflicts that may take place in the irrigation schemes. As the age of the household head increases, they are expected to feel water insecure. This is because the older farmers have gained more experience on addressing water challenges in the scheme. Irrigators who are members of a farmer's associations (cooperatives) are expected to perceive their water right secure. This is because cooperatives were reported to empower farmers and have their voice heard as a group (DAFF, 2011).

4.5 Results and Discussion

4.5.1 Descriptive statistics

The following discussion refers to Tables 3.3 and Table 3.4 in the previous Chapter. The tables were not re-produced here to serve space. The results indicated that the majority of surveyed households were female-headed (86%), with only 14% being male-headed. The results show that these formerly are relatively old with the mean ages of 56 and 58 for males and females, respectively. Focus group discussions with farmers indicated that it is very unlikely for the youth to participate in farming as they feel it is not as lucrative as other

sources of income such wage employment. Male-headed farmers had bigger land sizes, livestock sizes and had more off-farm income.

Table 4.2: Descriptions of variables used in the perceived water security regression model

Variable code	Variable name	Variable description	Expected sign
Dependent			
watersec	Perceived Water security	water security perception (1=secure, 0=Insecure)	
Independent			
Gender	Gender	Household head gender (1=male,0=female)	+
MaritStatus	Marital status	Household head marital status (1=married,0=unmarried)	+
Age	Age	Household head age in years	+
Educat_1	Education level	Household head education level categories (1=no schooling, 0=Otherwise)	-
Educat_2	Education level	Household head education level categories (1=Secondary/more, Otherwise)	+
hhsize	Household size	Number of members in a household	+
Irrigtype1	Irrigation type	Household irrigation type (1=pump,0=gravity)	+
Extension	Access to extension	Number of times of engagement with extension support in the past 12 months	+
Credit	Access to credit	Access to credit (1=yes,0=no)	+
Training	Agricultural training	Agricultural skills training received (1=yes,0=no)	+
Assoc	Association membership	Farmers association member	+
Offfarmincome	Off-farm income	Off-farm income in Rands (R)	+
Tlu*	Livestock size	Livestock size in Tropical units (TLU)	+
Pay_forWater	Paying for water	Does a household head pay for water or its related services (1=yes, 0=No)	-
Watconflict	Water related conflicts	Involvement in any water related conflicts (1=yes, 0=No)	-
schmntaine	Scheme maintenance	Household head involved in scheme maintenance (1=yes, 0=No)	+
irrigrules	Irrigation rules	Household head satisfied with irrigation scheme rules (1=yes, 0=No)	+
schmngt	Scheme management	Household head's perception on scheme management (1= good, 0=bad)	+
totland			

*Livestock size was determined using the Tropical Livestock Units (TLU) scales following Sinyolo (2013) (see appendix C).

Survey results show a statistically significant association between gender of a household head and their education status with males most likely to have been to school and reached higher grades compared to females. The majority of the farmers interviewed were unemployed, and the extent of unemployment is higher among female headed households. The high rate of unemployment highlights the low employment opportunities in the community, as highlighted by Sinyolo (2013). Low levels of education worsen the unemployment issue especially on women.as they lack skills needed in the industrial sector.

While there is no gender variation between access to support services such as extension, credit, training, survey results indicated that the majority of the farmers do not have access to these services. This implies that government support to the smallholder farmers is inadequate, as it is not reached many of the farmers. More detailed households' demographics are presented on chapter 3.5.1 above.

4.5.2 Determinants of land security descriptive statistics

This section presents descriptive statistics to highlight issues with regards to land security. Land security is understood in this study as being determined by whether a land holder can perform any activity on the land without feeling any threat, as suggested by Braselle *et al.* (2002). Land security was explained to farmers, and then they were asked to state whether they are generally satisfied with their land security. The chi-square results, presented in Table 4.3 indicate that farmers who have received threats to be evicted from their land felt land insecure.

The survey results in Table 4.3 indicated a strong association between land security and threats of eviction. However, it must be noted that threats of eviction are very rare in the area, as suggested by the low proportion of those who reported having experienced threats in the past year. This suggests that the communal tenure system and its traditional leadership play a significant role in ensuring that households' right to land is respected. The majority of the 8% of the respondents who experienced threats over land were female, and they reported that these threats were from male relatives. The results in Table 4.3 show a significant relationship between marital status of a household head and perceived land security. In line with expectations, the result suggests that the married feel more land secure than the unmarried. The unmarried, particularly the widowed, may feel land insecure due to the fact that there are possibilities of the late husband's relatives taking away the land from them.

Table 4.3: Association between perceived land security and socio-economic characteristics

Variables		**Perceived land security**		χ^2 **test**
		Land secure (%) (n=109)	**Land insecure (%) (n=50)**	
Threats	Yes	15	85	***
	No	73	27	
Marital status	Married	81	19	***
	Unmarried	56	44	
Farming system	Irrigation	44	56	***
	Rain fed	73	27	
Soil quality	Good	61	39	*
	Bad	74	26	
Gender	Male	70	30	ns
	female	59	41	
Educat1	No schooling	74	26	ns
	primary	65	35	
Educat2	Secondary/more	69	31	ns
	primary	67	33	
credit	yes	79	21	ns
	no	71	29	
training	yes	79	21	ns
	no	66	34	
AssocMember	Yes	54	46	ns
	no	66	34	
Legalland holder	yes	67	33	ns
	no	71	29	
Landsource	Inherited	70	30	ns
	allocated	66	34	
religion	Christian	64	36	ns
	Non-Christian	76	24	

Notes:*** and * means significant at 1% and 10% levels of significance, respectively. ns= not statistically significant.
Source: Household Survey (2013).

There is a significant relationship between land security and whether a farmer is an irrigator or non-irrigator. The results suggest that the non-irrigators feel more land secure than irrigators. During the focus group discussions the irrigating farmers highlighted that it is the scheme rule that if a farmer has not been using a plot, it must be passed on to another community member who is willing to use and this is not necessarily a family member. This creates a threat of a household losing that land permanently and thus decreases their perceived land security.

Farmers' perception in their soil quality status also has an impact on how they perceive their land security. The chi-square results on Table 4.3 indicates a statistically significant relationship between perceived soil quality and land security, suggesting that farmers who have good soil qualities are likely to feel land secure than those have poor soil qualities. The age of the household head is a statistical significant determinant of perceived land security ($p<0.5$) with the older feeling less land secure. The mean differences shown in Table 4.4, imply that as the household heads get older they feel less land secure. This may be because as the household head grow up the use of their land decreases as they are no longer active. This exposes the older farmers to a threat of the land being taken away to be allocated by the traditional authorities. Farmers indicated on the FGDs that when people stop using their plots for a certain period of time without informing the relevant stakeholder, another farmer has a right to go and report a land not used and get permission to take it over.

Table 4.4: T-test results for land security determinants

Variable	**Land insecure**		**Land secure**		**T-test**
	Mean	Std. Dev	Mean	Std. Dev	
Age	62	13	56	14	**
Duration	28	24	21	19	*
Household size	8.4	9.9	7.3	4.1	ns
Off-farm income(R)	21 414	23 039	21 891	22 867	ns
TLU	4.6	10.8	6.4	8.5	ns
Total land(ha)	0.48	0.56	0.42	0.34	ns
Extension	0.59	1.05	0.49	0.86	ns

Notes: ** and * means significant at 5% and 10% levels of significance, respectively. ns= not statistically significant.
Source: Household Survey (2013).

The duration of land holding determines the farmers' perceived land security. The results on table 4.4 indicate a mean significant difference ($p<0.01$) between these two variables. This implies that the longer the years that a household have been on possession of land the more land secure they feel.

4.5.3 Land security: Logit model

To estimate the factors affecting household land security, a binary logit model was estimated and the results are shown on Table 4.5. As indicated on the table, the estimated variables are collectively statistically significant as the LR value has a probability that less than 1%. The

goodness of fit is also good, as indicated by a pseudo R^2 of about 30%. The model also correctly classified about 83% of the cases which confirms that the model fits data well.

The model indicates that the gender of the household head is a significant determinant of a households' land security at 10% significance level. The results shows that male-headed households have a 25% more chance of being land secure compared to female-headed households. This result suggests that, although land allocation does not vary by gender, it is land security that varies according to gender. This is because women are more likely to lose their land when their husbands die. The result is consistent with other studies (Deere and Leon, 2003; GESTES, 2010).

Table 4.5: Land security determinants: Binary logit model results

Variables	**Coefficients**		**Marginal effects**	
	Value	**Std. Err.**	**dy/dx**	**Std.Err**
age	-0.028	0.179	-0.004	0.003
gender1	1.982*	1.041	0.249	0.137
educat_1	-1.982	0.580	-0.130	0.082
educat_2	-0.113	0.778	-0.047	0.106
maritStatus	-0.415	1.244	-0.054	0.162
Hhsize	-0.014	0.029	-0.0009	0.004
farmsystems	-1.672*	0.652	-0.266	0.109
place2	0.782	0.661	-0.0026	0.138
tlu	0.337	0.292	0.0037	0.003
Totland(ha)	0.623	0.587	0.044	0.080
off farm income in Rands/year	0.000	0.000	1.4E-07	1.6E-06
assoc	0.007	0.055	0.004	0.081
Threats	-3.428***	0.975	-0.429	0.114
legalholder	-0.416	0.502	-0.036	0.075
landsource	-0.308	0.523	-0.098	0.080
duration	-0.014	0.013	-0.002	0.002
-cons	4.920	1.411		
LR χ^2(23)	57.89***			
Pseudo R^2	0.30			
Correctly classified	0.83			
n	159			

Notes: ***, **, and * means significant at 1%, 5% and 10% levels of significance
Source: Household Survey (2013).

The results also indicate that irrigators are less likely to feel land secure than non-irrigators. The farmers who practice irrigation farming have a 27% less probability of being land secure. This is because land under irrigation is in demand and there are higher chances of households losing land under irrigation than land not irrigated. Farmers mentioned that if a person stops using their plots another farmer has a right to report that land to the traditional leaders and they might get permission to use it.

Receiving threats to be evicted from the farming land decreases probability of household heads from being land secure. The chances of farmers feeling land secure decrease by about 43% for the household heads who have received threats over their land. This expected negative result implies that farmers who have received threats are now scared that they are at risk of losing one of the household livelihood and a legacy.

4.5.4 Water security descriptives

To determine household heads' water security perception, farmers were asked if the perceived their water right as secure or not after water security was defined to them. Generally the sample is composed of an ageing group of farmers with mean age of 58 with older farmers feeling water insecure. The statistically significant mean difference ($p<0.5$) indicated by Table 4.6 suggest that as farmers grow old they perceive their water right insecure.

Table 4.6: Water security Continuous variables description

Variable	**Total Sample (N=102)**	**Water secure (n=65)**	**Water insecure (n=41)**	**T-test**
	Mean (Std.dev)	Mean (Std.dev)	Mean (Std.dev)	
Age	58 (14)	56 (14)	61 (13)	**
Duration	23 (21)	21 (19)	28 (2)	*
Hhsize	8 (7)	7.3 (4.1)	8.44 (9.9)	ns
Off-farm[a]	16 (21.7)	21.9 (22.9)	21.41 (23.0)	ns
TLU	6 (9)	6.4 (8.5)	4.62 (10.8)	ns
Totalland(ha)	0.4 (0.4)	0.42 (0.3)	0.48 (0.6)	ns
Extension	0.5 (0.9)	0.49 (0.10)	0.59 (1.1)	ns
Lnduse1	0.2 (0.3)	0.17 (0.3)	0.20 (0.2)	ns
Lnduse2	0.1 (0.2)	0.10 (0.3)	0.14 (0.1)	ns

Notes: * means significant at 10% level of significance, ns= not statistically significant. (a= income per annum is in thousands of Rands).
Source: Household Survey (2013).

The sample average number of years that farmers have been in possession of land is 23 and the results indicate that farmers who have been in possession longer feel water insecure compared to those with less years. This unexpected statistically significant result is in line with the ones by Sinyolo (2013) who also found out that as the years of a households' possession of plots increase, their perceived water security decrease. One would have expected that farmers who have been in possession of plots for longer would feel water secure because they would have developed strategies of ensuring water security and better water use in their plots.

Sinyolo (2013) justified the negative impact of land ownership duration as being due to distrust which has developed in farmers who have been members for long, caused by experiences of water problems and conflicts that might have been occurring over years. The new members in the plots might be feeling water secure because lately the water supply has been relatively reliable in the schemes, especially where pumps have been introduced and where pipes and waterways have been renovated.

Marital status of the household head has a statistically significant relationship with household water security perception (table 4.7). The results imply that household heads that are married feel that their water right is secure compared to the single ones. Irrigators that depend on gravity perceived themselves water secure compared to those that depend on pump-fed irrigation. The results on Table 4.7 indicate a statistically significant relationship ($p<0.05$) which may suggest that farmers who depend on pump feel water insecure because of challenges they have been experiencing such as pump break down and inability to pay for electricity or diesel.

The results indicate a statistically significant relationship between households' water security perception and the soil quality of the land they use for crop production. Farmers who perceive their irrigation water right secure are those with good soil qualities. This may indicate that farmers on good soil are motivated tend to invest on improving their soil quality perhaps by buying fertilizers with hopes that by having enough irrigation water the produce will cover the costs and give profits.

Household heads who rated the irrigation scheme management as good are more water secure than those who rated it average or poor. With a statistically significant association at 10% significant level, this result may suggest that where scheme management is good farmers are

having a constant supply of water and scheme issues such as pump break downs, canal leakages and blockages and conflicts in the scheme are addressed timeously thus farmers feel water secure. The results also indicate a statistical significant relationship between perceived water security and farmers' satisfaction with scheme rules.

Table 4.7: Categorical variables descriptions for water security

Variables		**Perceived water security**		χ^2
		Water insecure (%) (n=41)	**Water secure (%) (n=65)**	
Religion	Non-Christian	36	64	*
	Christian	24	76	
Gender	Female	30	70	ns
	Male	41	59	
Soilq	Good	39	61	*
	Bad	26	74	
MaritStatus	Unmarried	19	81	***
	Married	44	56	
Irrigtype	Gravity	25	75	**
	pump	44	56	
Educat1	No schooling	36	64	ns
	primary	26	74	
Educat2	Secondary/more	33	67	ns
	primary	26	74	
credit	yes	21	79	ns
	no	29	71	
training	yes	27	73	ns
	no	32	68	
AssocMember	Yes	46	54	ns
	no	33	67	
Schm_mngt	Bad	44	56	*
	Good	40	60	
Infr_Maint_involvd	Yes	38	62	ns
	No	33	64	
watershortages	Yes	38	62	ns
	No	35	65	
Wat_ShortgSeverence	Slightly	40	60	*
	Average	63	37	
	Strongly	32	68	
IrrigRules_satis	Not satisfied	47	53	*
	Satisfied	28	72	
Reg_Wateruser_assc	Yes	59	41	***
	No	30	70	

Notes: ***, **, and * means significant at 1%, 5% and 10% levels of significance, respectively. Ns= not statistically significant.
Source: Household Survey (2013).

The results imply that household heads who are satisfied with the irrigation scheme are likely to be water secure than those who are not satisfied. Table 4.7 also indicate a statistically significant association ($p<0.01$), between water security and household heads being registered water user association. The results show that farmers who join associations tend to feel water insecure. This could be a reflection of their awareness of the conditions that should prevail regarding access to water.

4.5.5 Water security determinants: Binary logit model results

Table 4.8 below indicate a logit model estimated to determine socio-economic factors affecting household heads' water security perception. The estimated variables are collectively statistically significant as the LR value is statistically significant ($p<0.01$). The results also indicate that the model is fit for data as the pseudo R^2 is about 44% which is considered high for cross sectional data. The model heteroskedasticity was treated by the use of robust standard errors. The model also correctly classified about 84% of the cases which confirms that the model fits data well.

The model indicates that gender of the household head is a statistically significant determinant of perceived water security ($p<0.05$). The results imply that male-household heads are 31% more likely to be water secure than female-household head. This may be because of water conflicts that women in Msinga reported to had been reported on the earlier chapters.

The estimated model indicates that other household characteristics such as the age of the household head, marital status, and their education level are significant determinants of perceived water security. The results imply that water secure perception increases with age of the household head, however, the age-square variable indicate water secure perception increases to a certain point with age and then household head starts to feel water insecure. These results are in line with what is reported by Sinyolo (2013) who further justified that an increase in age means more experience a farmer gains on addressing water challenges and conflicts in the scheme, consequently posing a positive influence on perceived water security. The shifting from water secure to insecure at a certain age as indicated by age-square variable may be because as the household head gets too old they are no longer physically fit to have access to water, no longer capable of practicing efficient water consumption, negotiating skills or conflict management skills they used when they were physically active.

Table 4.8: Logit model results of water security determinants

Variables	**Coefficients**		**Marginal effects**	
	Value	Robust Std. Err.	dy/dx	Std. Err.
age	0.340***	0.126	0.042***	0.015
agesquare	-0.002*	0.001	0.000*	0.000
gender	2.399*	1.302	0.293*	0.153
married	-2.562***	0.781	-0.313***	0.087
educat_1	-0.832	0.709	-0.102	0.088
educat_2	-0.334	0.929	-0.041	0.114
irrigtype1	-2.882*	1.569	-0.353*	0.184
extension	0.900**	0.413	0.110**	0.046
credit	1.459	0.989	0.178	0.124
training	0.941**	0.391	0.115**	0.046
assoc	3.681***	0.941	0.450***	0.074
off_farmincme	0.000***	0.000	0.000***	0.000
tlu	-0.003	0.029	0.000	0.004
schmngt_invlvmnt	-5.975***	1.862	-0.731***	0.193
irrigrules	0.591	0.695	0.072	0.082
schmngt	1.390*	0.809	0.170*	0.088
paidfor_water	1.652	1.514	0.202	0.182
totland	-1.252**	0.508	-0.153**	0.058
waterconflcts	-2.072**	0.927	-0.253**	0.103
_cons	-5.280	3.531		
Wald Chi^2(21)	43.57***			
Pseudo R^2	0.43			
Correctly classified	0.84			
n	102			

Notes: ***, **, and * means significant at 1%, 5% and 10% levels of significance, respectively.
Source: Household Survey (2013).

The model indicates that, contrary to expectation, marital status has a negative influence on perceived water security. The results imply that farmers who are single are more likely to feel water secure than the married ones. One would have expected married household heads to feel water secure as, specifically in a case where the farmer is the woman, since husbands would intervene where women are facing water challenges or scheme conflicts. The negative influence of marital status may be indicating that the unmarried household heads feel water secure because they are not bound to take care of their spouses at home thus can use water any time and can also attend to scheme meetings and get water issues sorted (Sinyolo *et al*., 2014b).

Access to extension services statistically determines household heads' perceived water security. The results imply that farmers who have had access to extension services in the past 12 months are 10% more likely to be water secure than those who have had no extension within this period. This may indicate that farmers who have accessed extension officers have more information on how to access water or solve water challenges and conflicts or even get subsidised support to maintain their scheme and keep water accessible.

Agricultural training is a statistically significant determinant of water security. The results indicate that household heads who have received agricultural training in the past five years felt water secure than those who have not. Farmers who received training have skills on how to use water in a more conserving way even if they have access to the same water quantities with those who did not receive training. Thus the untrained would feel water insecure while the trained feel secure at the same water quantities. The untrained may also feel water insecure because their production capacity may be low hence cannot always afford to pay for water or scheme maintenance.

The estimated model also indicates that household heads who are members of farmers' association felt water secure than those who are non-members. Farmers' association members are expected to feel water secure as being in a cooperative empowers farmers and their voice becomes heard as a group. Farmers' associations are capable of solving water issues better than an individual would do.

Unexpectedly, the model indicates that households' off-farm income is a negative but statistically significant determinant of perceived water security. This imply that farmers who have less off-farm income are the ones who feel water secure, but, one would have expected farmers with higher off-farm income to perceive their water rights secure since having money could be a solution to many water problems. However, these results may simply suggest that farmers with high off-farm income concentrate more on off-farm activities as their source of income thus are not too concerned about using their money to solve water problems and that is why they are still water insecure.

The results also indicate that farmers who feel water insecure are those who are more involved in scheme maintenance such as cleaning or repairing the canal, burying the pipes after the rains etc. This may be because they are worried that not taking care of the scheme might worsen the problem of not accessing water and increase their insecurity. Table 4.8 also

indicate that the perceived status of scheme management is a statistically significant determinant of household heads' perceived water security ($p<0.5$). Farmers who feel that the way the scheme is managed well perceived their water right secure compared to those who feel that scheme is managed badly. This may indicate that managing the irrigation scheme in a bad way cause farmers to feel water insecure. This may be in situations where the farmers or the committee are not taking care of infrastructure or where irrigation rules are being broken by members.

The total hectares of land a household head has are a statistically significant determinant of perceived water security. The negative relationship indicated by Table 4.8 imply that a household with a bigger piece of land are 20% more likely to feel water insecure than a household with smaller piece of land. This may be due to an increase need for water in a bigger piece of land.

Irrigating farmers who use pumps felt water insecure compared to non-irrigators (rain-fed farming). The statistically significant results ($p<0.05$) may indicate that since irrigators depending on a pump pay for water they feel less confident that they can continue paying for water while it is the only best way they can have secure access to it. Moreover, farmers who pay for diesel or electricity may feel water insecure as the pumps are not reliable since they sometimes break down and farmers may not afford to revive them due to their less off-farm and on-farm incomes.

Experiencing water related conflicts is also a statistically significant determinant of water security. The model results imply that household heads who have experienced water related conflicts felt water insecure compared to those who have not been involved in any water conflicts. On the focus group discussions farmers reported that these kinds of conflicts mostly occur when people do not to stick to irrigation schedule. These conflicts do occur between blocks where farmers from a certain block divert water to their block while it is not their day of irrigation or within blocks where a certain block member divert water to their plots before the other farmer finish irrigating theirs.

4.6 Conclusion

The study's objective was to investigate the extent to which land security and water security are influenced by gender among rural households in South Africa. The results indicate that women's access to land and water is not secure. The model results indicated that females felt

less land secure and less water secure compared to males. This has a negative influence on household incomes as a number of studies have mentioned negative impact of insecure property rights. The study recommends that women's rights to productive assets such as land and water be reviewed. To ensure that households who have access to water perceive their water right secure, farmers need to get training on water conservation and efficient water use. Moreover, access to extension officers should be improved as the results indicated a positive relationship between water security and extension.

CHAPTER 5: EFFECTS OF ACCESS TO RESOURCES ON HOUSEHOLD FOOD SECURITY

5.1 Abstract

While South Africa may be food secure as a country, large numbers of households within the country are food insecure and a number of factors play a part in determining households' food security. This paper investigated the socio-economic determinants of food security in rural areas of South Africa with a focus of the effect of gender differentiated access to resources. The study was motivated by a need to understand both the disparities in women's access to land and water resources, and how these differences impact on the food security of female-headed households. The study was conducted in three communities in Msinga, KwaZulu-Natal, with a randomly selected sample size of 159 households. Data was analysed using both descriptive statistics and an ordered logit model. Results indicate that water security has a positive impact on household food security. The model results also indicate that size of land per se did not determine food security status. Instead, use of irrigation (as opposed to dry-land) has a positive impact on food security. However, the results show that irrigation farming is more influential on household food security if the irrigation scheme management is good. Household heads' education is also a determinant of food security. Access to irrigated land and level of education are policy variables that government and other development agencies may intervene to ensure household food security. The study recommends introduction of irrigation schemes to farming households using rain-fed agriculture, including ensuring secure water access and good irrigation scheme management to ensure household food security.

Keywords: household food security, ordered logit model, smallholder irrigation, South Africa.

5.2 Introduction

Food security has become an important indicator of progress in agricultural development (Vink, 2009). Even though South Africa is food secure at the national level, high levels of food insecurity exist at the household level (Sinyolo *et al.*, 2014b). According to D'haese *et al.* (2013) food insecurity is remarkably high in the poorest areas of KwaZulu-Natal province of South Africa. Many rural households struggle to have sufficient access to the food they need or prefer. Food security is a broad concept that includes the nature, quality, access and security of the food supply (Iram and Butt 2004). The 1996 World Food Summit in Rome defined food security as existing when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO, 1996). There has been an on-going argument that female-headed households are more food insecure than male headed households in South Africa (Hart, 2010; Murugani *et al.*, 2014).

The food insecurity noted in female-headed households resulted from gender-based inequity in the distribution of production resources (Rocheleau and Edmunds, 1997; World Bank, 2005). Studies have shown that even though women are more active in food production in rural areas, an increasing number of female-headed households face challenges in accessing production resources such as land, water and credit (Murugani *et al.*, 2014; Thamaga-Chitja *et al.*, 2010). Unequal access to education, training and information has also been pointed as causes of food insecurity in female-headed households (Kassie, 2012). Various, authors, ie, Agarwal (2003) Enarson and Meyreless (2004) and Sachs (2007) pointed out that gender has to be mainstreamed and that women's' groups and networks can improve women's access to knowledge, information and technology.

Various ways of measuring household food security are available. For example Pinstrup-Andersen (2009) proposes the use of total household income and food prices to estimate the household food security. The study further points out that, consumption estimates indicate access to food, household food acquisition and allocation behaviour. An assessment of food consumption does not provide a full understanding of household food security because of its failure to account for the vulnerability and sustainability of the elements contributing to food security. As most previous studies concentrate on objective food security measures at the household level, Mallick and Rafi (2010) argue that consumption has large seasonal

volatility, such that in most of these studies, which use cross sectional data, consumption data may systematically under or over report the true food security status.

There are studies that have assessed the determinants of household food security. Feleke *et al*. (2005) and Kidane *et al.* (2005) investigated determinants of household food security in rural households of Ethiopia. The studies identified a link between food security and improved agricultural technology adoption and concluded that technology adoption increases household food security. Kassie (2012) analysed the relationship between food security and factors such as farm size, livestock ownership, education of head of household, household size and per-capita production of the household. With the exception of household size (a proxy for high food demand) all the other factors were seen to increase food security (Kassie, 2012; Rose & Charlton, 2002). Other studies have highlighted that wealth, assets ownership (e.g., land, livestock) and income are good predictors of food security (e.g., Iram and Butt 2004; Feleke *et al.*, 2005; Kidane *et al.*, 2005; Babatunde *et al.*, 2007).

Different interventions have been shown to improve the food security situation of rural households. For instance, Lemba (2009) showed that irrigation had significant impacts on household food security. Interventions such as training, extension services, credit and input supply have also been identified as having a positive effect on household food security (Sinyolo *et al.*, 2014). HSRC (2007) argues that, rather than being a separate strategy, food security should form part of the government's integrated anti-poverty strategy which should include employment creation, social grants, health, education, and agriculture. This paper aims to identify household food security determinants, with a focus on the role that gender-differentiated access to production resources plays.

5.3 Research methodology

5.3.1Description of study area

The study was conducted in Msinga local municipality, which falls under Umzinyathi District Municipality (see figure 5.1). Msinga local municipalitybis composed of six Traditional Authority Areas namely, Qamu, Mchunu, Bomvu, Ngome, Mabaso and Mthembu, comprising an area of 2,500 km^2. The areas of focus were Tugela Ferry irrigation scheme, Mooi River irrigation scheme and Machunwini which is a rainfed-reliant farming community.

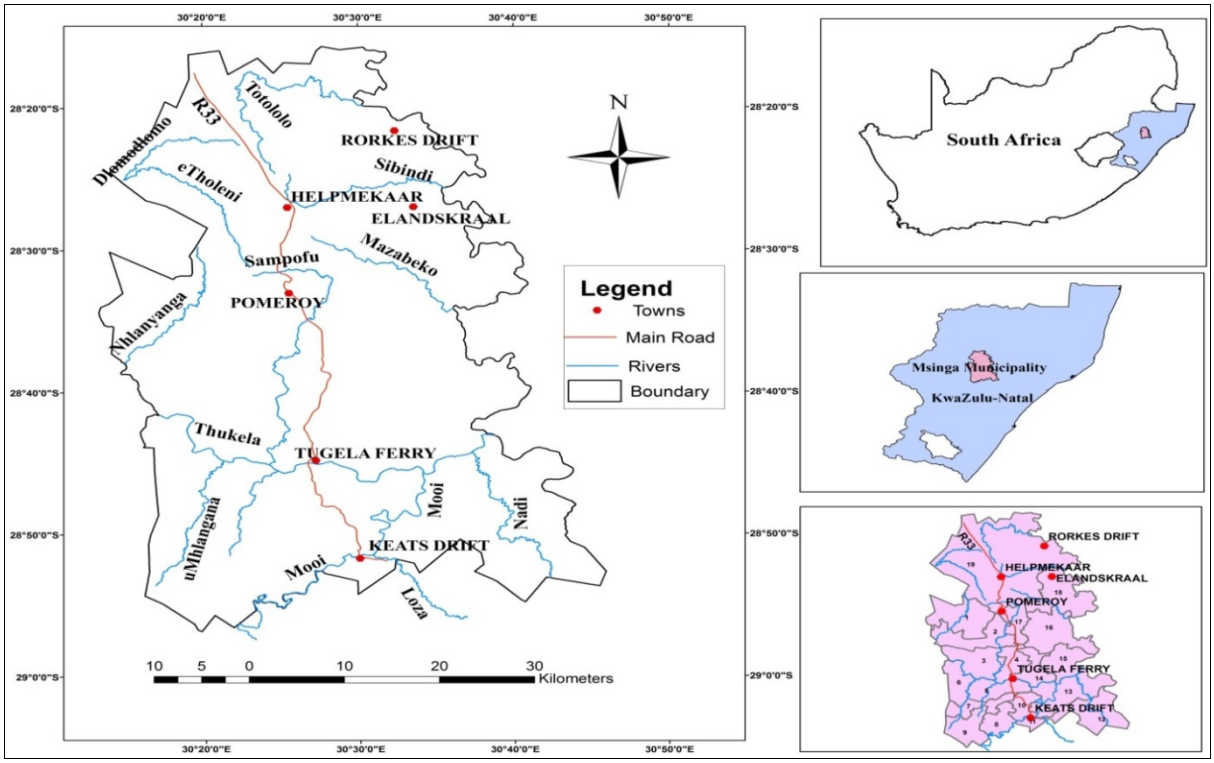

Figure 5-1: Location of Msinga local area in KwaZulu-Natal

Source: Sinyolo *et al.* (2014a).

Msinga local municipality is largely a rural area and 70% of it is administered under Traditional Authority and held in trust by the Ingonyama Trust (Dearlove, 2007). The remaining 30% of land is commercial farm land, all of which is located to the north. Approximately 99% of the population lives in communal areas as opposed to the small towns of Tugela Ferry, Keates Drift and Pomeroy.

Msinga local municipality has an estimated population of 177,577 people and the majority of the population are females which make about fifty eight percent (City Population, 2012). In this area, farming plays an important role on the economy as it contributes 18% of the income while other sectors such as industry contribute the remainder (Dearlove, 2007). With an average annual rainfall of 600mm and summer temperatures reaching 44^0C, practicing rain-fed crop production is difficult in this area. (Cousins, 2012). As a result, dry land farming is better suited to livestock than crop production (LEAP, 2007).

Subsistence agricultural crop production is mainly practiced in the Tugela River and Mooi River irrigation schemes, with a small percentage of farmers marketing some of their produce, due to the low rainfall experienced in many areas (Dearlove, 2007). Several

researchers (e.g., Mnkeni *et al*, 2010; Sinyolo *et al*, 2014b; Cousins, 2012) have reported inequities in land and water distribution in the Msinga area where these two schemes are located. Therefore, the schemes were chosen because their relevance to the issues under study. The Tugela Ferry irrigation scheme started operating between 1898 and 1902 diverting water from Tugela River Cousins (2012). The irrigation scheme covers 873 ha and with 1,500 beneficiaries which makes approximately 15 per cent of all small-holder irrigators in KwaZulu-Natal (Cousins, 2012; Fanadzo, 2012). The irrigation scheme is divided into 7 blocks, which initially, were gravity fed. However, due to water shortages, other blocks now rely on motorised pumps. For example, Block 4B uses a diesel pump. Block 7 uses a well-maintained electric pump renovated in 2013.

According to Sinyolo (2013), Tugela Ferry irrigators have been allocated two plots of land each of 0.1 ha. Even so, some of the irrigators have managed to obtain more irrigated land by either leasing or borrowing, from other scheme members (Sinyolo, 2013). Irrigators who no longer want to use the land allocated to them are not allowed to sell it but they can only return it to traditional authorities who then re-allocate it to those who need it (Sinyolo, 2013).

Mooi River irrigation scheme is located at kwaNxamala community, in Msinga. This scheme is 600 hectares and has 824 beneficiaries each occupying at least one plot of 0.1 hectares, but some farmers occupy more than one (DAEA, 201I). The scheme was divided into 15 blocks of different sizes to allow ease of better scheme management and water distribution. Water is abstracted from a weir constructed across the Mooi River into a canal that runs for a distance of 20.8 km from the abstraction point to the end of the scheme (DAEA, 2011). From the main canal to various plots, water is diverted by means of distributive concrete canals, which vary in size, depending on the area to be irrigated (Gomo , 2010). The first 11 blocks draw water under gravity while the last four blocks use a diesel pump. Initially, all the blocks obtained water from the canal but due to severe water shortages the last four blocks (blocks 12-15) resorted to use of a diesel pump to draw water directly from the river.

5.3.2Data collection and sampling techniques

Data collection was conducted between October and November in 2013 using structured household questionnaires, focus group discussions (FGDs), and key informant interviews. Two FGDs were conducted with 10 participants per session. They were conducted before the questionnaire survey to contribute to information that could be included in the survey

questionnaire. Before the formal survey was conducted, the questionnaire was pre-tested using five randomly selected household heads from Tugela Ferry, Mooi River schemes and Machunwini. The questionnaire was modified following pre-testing to improve its quality. Pre-testing also helped to improve the translation to the local language, which is Zulu. To clarify issues raised in FGDs and survey questionnaires, three key informant interviews were conducted. Seven trained Zulu –speaking enumerators administered the questionnaire on the sample. A sample of 159 farmers who are household heads was randomly selected; 53 farmers were non-irrigators from Machunwini, 53 were farmers depending on gravity-fed irrigation from Mooi River and another 53 irrigators depending on electric or diesel pump.

5.4Data analysis

5.4.1Estimating determinants of household food security

The subjective food security status of the household was captured for the preceding twelve months and used in an ordered logit regression model.

An Ordered logit model that was used to meet the objective is shown as follows:

$y_i^* = \beta' \chi_i + \varepsilon_{i,} \qquad \varepsilon_i \sim N[0,1] \qquad (1)$

$y_{i=0 \text{ if }} y_i^* \leq \mu_0$

$y_{i=1 \text{ if }} y_i^* \leq \mu_1$

$y_{i=2 \text{ if }} y_i^* \leq \mu_2$

.....

$y_{i=J \text{ if }} y_i^* \leq \mu_{J-1}$

where y_i is the observed counterpart of $y_{i,}^*$ β is the vector of coefficients to be estimated, χ_i is the matrix of independent variables, μ_J is the distance variable and ε_i is the error term. The variance of error term is assumed to be 1.00 (Greene, 2000).

Following Mallick and Rafi (2010) and Kassie *et al.* (2014), four ordered categories, which depict of food security situation that households experienced, were used. The categories are (1) food shortages throughout the year (Chronic food insecurity), (2) occasional food shortages (transitory food insecurity), (3) Break-even (no food shortages and no surplus), and

(4) food surplus. An ordered logit model was estimated following Kassie *et al.* (2014) where the above four categories constituted the dependant variable. Description of variables

Table 5.1: Descriptions of variables used in the model

Variable code	Variable name	Variable description	Expected sign
Dependent variables			
Foodsec	0= Chronic or severe food shortage	Shortages for most of the months	
	1= Transitory or moderate food shortage	Shortages for some of the months	
	2= Break-even or no shortage, no surplus	No food shortages for the past 12 months, but no food surplus	
	3= Food Surplus	No food shortages for the past 12 months, there was food surplus	
Independent			
Totland	Total land	Household total land size in hectares (ha)	+
Gender	Gender	Gender of household head (1=female, 0=male)	+
MaritStatus	Marital status	Marital status of household head (1=married, 0=unmarried)	+
Age	Age	Age of household head, in years	+
Educat_1	Education level1	Household head education level categories (1=no schooling, 0=Otherwise)	-
Educat_2	Education level2	Household head education level categories (1=Secondary/more, Otherwise)	+
hhsize	Household size	Number of members in a household	-
hhsizesquare	Household size square	Household size square	-
Irrigtype1	Irrigation type1	Household irrigation type (1=pump,0=Otherwise)	+
Extension	Access to extension	Number of times of engagement with extension support in the past 12 months	+
Credit	Access to credit	Access to credit (1=yes, 0=no)	+
Training	Agricultural training	Received agricultural skills training (1=yes, 0=no)	+
Assoc	Association membership	Farmers' membership to association (1=yes, 0=no)	+

Variable code	Variable name	Variable description	Expected sign
Offfarmincome	Off-farm income	Off-farm income in Rands (R)	+
Tlu*	Livestock size	Livestock size in Tropical units (TLU)	+
Farmsystem	Farming system	Crop production system (1=irrigation, 0=Rain-fed)	+
watersec	Perceived Water security	Are you generally water secure (1=secure, 0=insecure)	+
landsec	Perceived Land security	Land security perception (1=secure, 0=insecure)	+
schmngt	Scheme management	Household head's perception on scheme management (1= good, 0=bad)	+

*Livestock size was determined using the Tropical Livestock Units (TLU) scales following Sinyolo (2013) (see appendix C).

The variables which are used are described on Table 5.1. Following the results from Kassie *et al*. (2012), gender of the household head is expected to negatively affect household food security, with FHHs being food insecure than MHHs. Education level of the household head is also expected to determine household's food security following Najafi (2003) and Amaza *et al.* (2006). Irrigation has been reported to determine food security of a household (Sinyolo *et al.,* 2014a). This is expected because irrigators are able to maximise food production, thus may feel land secure than non-irrigators. Food security expected to be directly or indirectly linked to access to cash to purchase food (Chopra *et al*., 2009). Therefore, Access to credit, off-farm income and TLU are anticipated to determine household food security.

5.4 Results and Discussion

5.5.1Households' demographics

The sample of 159 household was composed of a majority of female household heads (86%) than males (14%). The survey indicated that farming is dominated by an older generation with mean averages of 56 and 58 years for males and females. FGDs with farmers indicated that it is very unlikely for the youth to participate in farming as they feel it is not as lucrative as other sources of income. Survey results also indicate that there are significant welfare

differences between female and male-headed households with male-headed farmers having bigger land sizes, livestock sizes and had more off-farm income.

FHHs have low employment opportunities in Msinga, and low education levels indicated by the survey results may be playing a significant role to these farmers' employment status. There is no gender variation between access to support services such as extension, credit, training, and survey results indicate that the majority of the farmers do not have access to these services. This implies that extension to the smallholder farmers is inadequate, as it is not reached many of the farmers. The detailed households' demographics are presented on chapter 3.5.1.

5.5.2Household food security descriptive statistics

The majority of surveyed households are food insecure, with only 35% food secure. Thirty seven percent of households experienced severe food shortages, 28% experienced moderate food shortages, 24% have not experienced any food shortages but there has been no food surplus and only 11% have had food surplus with no food shortages. The results of this study indicate that food insecurity is very high in Msinga as 65% of the households were classified as food insecure. This result is in line with other studies in South Africa even though they used different measures. For example, Sinyolo *et al.* (2014b) reported that 55% of households being food insecure. Rose and Charlton (2002) reported similar results showing that 43% of households faced food poverty and D'Haese *et al.* (2013) found that 55.4% of South African households were severely food insecure. Also, De Cock *et al.*, 2013 on the study analysing food security situation in rural Limpopo reported 53% of the sampled households being severely food insecure.

They argued that determinants of food insecurity in Limpopo were mainly human capital (education, household size and dependency ratio), household income and district in which the households were situated. Even though the results indicate no statistically significant relationship between gender of the household head and household food availability, Table 5.2 indicate a slight difference between a number of male and female household heads who have experienced food shortages or those who have had food surplus.

The chi-square results indicate a statistically significant relationship between household food security and the scheme management status for those households who are under irrigation farming ($p<0.01$). Table 5.2 indicate that a majority of farmers who perceived the scheme

management as poor fall under severe food shortage (chronic food insecurity) whereas a bigger proportion of those who perceived the scheme management (schmngt) was good fall under a category of no food shortages but no food surplus.

Table 5.2: Association between HFS and socio-economic characteristics

Variable description	**Categorical**	**Food insecure (65%)**		**Food secure (35%)**		χ^2
		Severe food shortage (n=59)	Moderate food shortage (n=44)	No shortage, no surplus (n=39)	Surplus food (n=17)	
Marital status	Married	32	34	28	6	*
	Unmarried	42	21	22	15	
Access to credit	No	33	28	28	11	ns
	Yes	33	42	17	8	
Training	No	39	25	26	10	ns
	Yes	27	42	19	12	
Land source	inherited	35	29	23	13	ns
	Allocated	42	24	28	6	
Threats	No	36	30	23	11	**
	Yes	54	0	46	0	
Farmsystem	Dry-land	43	28	19	10	***
	Irrigators	4	28	56	12	
Land-satis	Yes	33	27	27	13	*
	No	57	29	14	0	
Reg_Water_user	Yes	21	10	48	21	**
	No	36	34	20	10	
Pay_forWater	Yes	14	32	36	18	**
	No	48	23	20	10	
gender	Female	37	26	26	11	ns
	Male	36	37	18	9	
watsecure	Yes	37	31	25	7	ns
	No	38	20	24	18	
Irrigtyp3	Gravity	51	25	17	7	***
	Pump	13	30	38	19	
schmngt	Bad	54	22	10	14	***
	Good	6	32	49	13	
legalholder	Yes	30	27	29	14	*
	No	47	27	20	6	
Educat_1	Yes	41	26	23	10	ns
	No	17	38	33	12	
Educat_2	Yes	41	23	24	12	ns
	No	34	31	25	10	
association	No	44	28	20	8	**
	Yes	16	27	38	19	

Notes: ***, **, and * means significant at 1%, 5% and 10% levels of significance, respectively. ns= not statistically significant.
Source: Household Survey (2013).

The majority of registered water users were food secure while the majority of those who are not registered as water users fall under severe food shortage and moderate food shortage (transitory food insecurity). The statistically significant association may indicate that being a registered water user member ensures consistent irrigation water supply which improves households' food production thus increases chances of a household having enough food for household consumption.

The results indicate that pump irrigation dependant farmers fall under moderate to no food shortages while gravity-fed irrigating farmers mainly fall under severe food shortages. The statistically significant association between food shortage and irrigation type ($p<0.01$) suggests that unreliable water access in gravity-fed plots hinders food production causing food shortages in the household. The results indicate a statistically significant association between household food security and household farming type (Farmsystem), whereby irrigators are more food secure compared non-irrigators. The majority of irrigating households face no food shortage/food surplus category while majority of non-irrigators have severe food shortages. This result is consistent with Sinyolo *et al.* (2014a) who concluded that irrigation improved households' welfare and their food security status in Msinga.

The majority of farmers who are not satisfied with the size of land they have experienced more severe food shortages compared to those who felt satisfied with the size of their land. The statistically significant relationship ($p<0.1$) between size of land ownership and food availability may indicate that households with satisfactory land pieces are able to produce enough food to avoid household food shortages. The results also indicate that the majority of households who have received threats to be evicted from their land have experienced severe food shortage. Given that experiencing threatened access to land is a determinant of land security, the result may suggest that there is a statistically significant association between land security and food security. The implication may be that land insecure farmers do have less incentive to produce food compared to their land secure counterparts.

Table 5.2 indicate that a bigger fraction of farmers who are members of farmers' association (co-operative) have not experienced food shortages nor food surplus (break-even) while majority of non-cooperative members have experienced severe food shortages. This may be

because cooperatives enables farmers to have access to water, credit, land, information and other support services which are key to household food production thus prevents food shortages experience. This result is consistent with Baiyegunhi (2014) who concluded that households that were members of social groups (social capital) were less likely to be poor or food insecure.

Table 5.3: An association between food security and household heads' employment status

Variables		**Food security**		χ^2 **test**
		Food secure (%) (n=56)	**Food insecure (%) (n=106)**	
Employment	unemployed	65	35	*
	informal	78	22	
	Formal	20	80	

Notes: * means significant at 10% levels of significance.
Source: Household Survey (2013).

Table 5.3 presents the chi-square results of association between food security and household heads' employment status. The results indicate a statistically significant association between household food security and household heads' employment status. The results indicate that a majority of unemployed and informally employed household heads are food insecure compared to those who are formally employed. This may imply that household heads with formal employment have higher income which improves their capability to buy food thus become food secure.

Table 5.4 presents t-test results for household food security determinants with 'food security' variable collapsed into binary following Kassie *et al.* (2014) and the results indicate a statistically significant mean difference between household food security and access to irrigation water. The mean differences imply that households with higher number of days of water access are food secure. This result may imply that as farmers have more access to irrigation water they can produce more food since their crops can hardly die from drought. With high access to irrigation water farmers have an advantage of producing surplus food which can be sold thus generate income to improve their food security status.

Table 5.4 also indicate that food secure households are those with bigger pieces of land, however, this result is not statistically significant. The results would have indicated that the bigger the land size the bigger the produce which then a household can consume or sell to improve their food security. The results also indicate that food secure households are those

with bigger TLU and higher off-farm income which are considered as wealth indicators, however, the result is not statistically significant. The results would have implied that having higher off-farm income allows households to outsource food when they do not have enough or they can sell or consume livestock when they run out of food thus improving their food security status.

Table 5.4: T-test results for household food security determinants

Variable	**Food secure**		**Food insecure**		**T-test**
	Mean	Std. Dev	Mean	Std. Dev	
watAccess	3.22	1.64	2.35	0.91	***
Duration	22	20	24	21	ns
Household size	8.16	7.56	6.70	0.71	ns
Off-farm income(R)	23 051	23 640	19 352	21 332	ns
TLU	6.6	10.01	4.3	7.31	ns
Total land(ha)	0.48	0.56	0.42	0.34	ns
Extension	0.59	1.05	0.49	0.86	*
Landuse1	0.18	0.21	0.19	0.17	ns
Landuse2	0.11	0.27	0.13	0.13	ns
Distance	3.0	3.3	2.7	3.4	ns

Notes: *** and * means significant at 1% and 10% levels of significance, respectively. ns= not statistically significant.
Source: Household Survey (2013).

The results indicate a statistically significant mean difference between household food security and farmers who have had access to extension services. The result imply that farmers who have had access to extension officers are likely to be food secure. This could be because farmers who have access to extension have gained some required skills on food production; they might have received some farming inputs and market sourcing support which enables them to produce or sell enough food to ensure adequate food supply for household consumption thus improve household food security. The t-test results also indicate that bigger households are the food secure ones. Even though the result is not statistically significant, this could have been because a bigger household has more labour to work in the gardens to produce enough food for the household. The results could have also been due to the bigger number of members who contribute to household income.

5.5.3Ordered logit model results for household food security

The model was run to estimate the determinants of household food security and the results are presented on Table 5.5. The Brant test was run and an insignificant test statistics provides

evidence that the parallel regression assumption has not been violated. The model results on table 5.5 indicate that household characteristics such as household income, age and marital status of the household head are not statistically significant determinants of household food security.

The Model indicates a statistically significant relationship ($p<0.05$) between household food security and gender of the household head. For this model gender variable was modelled as 1=female and 0=male. The negative coefficient value indicate that FHHs are more likely to be food insecure compared to MHHs. The results are in line with a number of studies (Kassie *et al.*, 2012; Kassie *et al.*, 2014; Kerr, 2005; *Li et al.*, 2008; Mallick and Rafi, 2010). According to Mallick and Rafi (2010), FHHs being food insecure is a function of unequal distribution of resources. This implies that the gender discrimination against women in terms of access to productive resources results in them being more food insecure.

Table 5.5: Ordered logit model for household food security determinants

Variable	**Coef.**	**Std. Err.**	**Chronic**	**Transitory**	**Break-even**	**Surplus**
landsec	-0.03	0.48	0.01	0.00	-0.01	-0.00
watersec	0.93***	0.21	-0.19***	-0.01	0.14***	0.05***
age	0.03	0.02	-0.01	0.00	0.00	0.00
gender	-1.50**	0.69	0.33	-0.01**	-0.23**	-0.01**
married	0.70	0.48	-0.14	-0.01	0.11	0.04
educat_1	0.12	0.58	-0.02	-0.00	0.02	0.01
educat_2	1.21*	0.73	-0.20**	-0.08	0.18*	0.01
hhsize	0.08	0.10	-0.02	-0.00	0.01	0.00
hhsizesquare	-0.00	0.00	0.00	0.00	0.00	0.00
irrigtype1	1.16**	0.59	-0.23**	-0.01	0.17**	0.07*
extension	-0.16	0.27	0.03	0.00	-0.02	-0.01
credit	-0.33	0.66	0.07	-0.00	-0.05	-0.02
road	-0.13	0.54	0.03	0.00	-0.02	-0.01
training	0.03	0.31	-0.01	0.00	0.00	0.00
assoc	0.42	0.43	-0.09	-0.00	0.07	0.02
off_farmincme	0.00	0.00	0.00	0.00	0.00	0.00
tlu	-0.05	0.04	0.01	0.00	-0.01	-0.00
schmngt_invlvmnt	0.13	1.15	-0.03	0.00	0.02	0.01
schmngt	1.71***	0.53	-0.32***	-0.04	0.25***	0.11**
totland	-0.32	0.57	0.06	0.00	-0.05	-0.02
/cut1	4.74	1.92				
/cut2	6.52	1.95				
/cut3	8.43	2.01				
n	**103**					

LR χ^2	**64.62*** **
Pseudo R^2	**0.24**
Brant test parallel regression assumption: χ^2 = 15.95; p=0.97	

Notes: ***, **, and * means significant at 1%, 5% and 10% levels of significance, respectively.
Source: Household Survey (2013).

Survey results also indicated that FHHs are land insecure compared to MHHs and Murugani *et al.* (2014) argues that in Limpopo land use insecurity is a cause of household food insecurity. FHHs being more food insecure compared to MHHs may also be due to water insecurity that survey result indicates on chapter 4. Household where the heads are water secure are likely to be food secure. The water secure households have 14% chance of falling under break-even and 5% of falling into food surplus category. The results are consistent with what Hope *et al.* (2008), Hussain and Hanjra (2004), Sinyolo *et al.* (2014a) and Tyler (2007) concluded as they all mentioned that water security has a positive influence on household food security. This, suggests that water security has a substantial influence on the motivation of smallholder farmers to invest in improved inputs and technologies to maximise agricultural production and/or productivity (Bruns *et al.*, 2005; Faurès and Santini, 2008). The implication of this result is that an irrigator's participation in an irrigation scheme is not sufficient to incentivise farmers to invest in improved inputs and technologies resulting in improved productivity.

Table 5.5 indicate that farmers with secondary/tertiary education are likely to be food secure with 18% chances of falling under break-even category while farmers with primary education or less are likely to be food insecure with 20% chances of being under transitory food security category. The implication may be that the higher the education one has, the more are the chances of having formal employment which pays good salary thus it increases household income to buy food for household consumption. The result is in line with the econometric result reported by Kessie (2012). Bashir *et al.* (2012) who also reported the same result suggested that at least intermediate level of education is a necessary condition to assure food security to the selected household category. They found that having this particular education level increases the chances of a household food security by 99%.

Similarly, Bashir *et al.* (2010) found using categorical variables that graduation level of education increases the odds of a household to become food secure by 21 times compared to having no education. Other studies have also pointed out the positive effect of higher

education on decreasing chances of household food insecurity (i.e. improving chances of food security) by 59% in Nigeria (Amaza *et al.*, 2006) and 29% in the USA (Kaiser *et al.*, 2003). Educational status of household head could lead to awareness of the possible advantages of modernizing agriculture by means of technological inputs; enable them to read instructions on fertilizer packs and diversification of household income which, in turn, would enhance household food supply (Najafi, 2003).

The results also indicate that irrigators are more likely to be food secure compared to rain-fed farmers. The statistically significant results ($p<0.05$) that there is 17% chance of irrigators to shift from transitory food insecurity to break-even and 7% to be under surplus food compared to non-irrigators. The model results are in line with a conclusion by Sinyolo *et al.* (2014a) who stated that irrigation improves household food security in Msinga.

Scheme management is a statistically significant determinant of household food security ($p<0.05$). The result indicate that irrigators who perceived the scheme management as good have 25% chances of being shifting from chronic food insecurity to break-even and 11% to be under food surplus. The result is consistent with Waddington *et al.* (2010) identified poor management of irrigation scheme as an important production constraint for six major food crops in 13 farming systems where there are high poverty rates in Sub-Saharan Africa, South Asia and East Asia.

5.6Conclusion

The paper investigated the household food security determinants in South African context. The results indicate that female headed farmers are more likely to be food insecure than male-headed households. This implies that the unequal distribution of productive resources is resulting in the female-headed households being food insecure. The results also indicated positive impact of water security and education on food security. It is recommended that efforts be made to close the gender gap in resources access in the rural areas. The study also recommends that the water shortage issues that affect irrigators, resulting in water insecurity, be addressed in order to improve the food security of the irrigators.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Recap of the research objectives and methodology

The study's general objective was to evaluate gender-differentiated access to land and water on smallholder farmers and its impact on household food security. The study had three specific objectives. Firstly the study sought to evaluate determinants of land allocation and water access for rural households in Msinga. Secondly, land and water security determinants for rural households were evaluated. Thirdly, the study evaluated the effects of gender-differentiated access to resources on rural household food security. Using a total random sample of 159 farmers, data analysis involved both descriptive and econometric techniques. Descriptive analysis made use of the t-tests and χ^2 tests and econometric analysis involved methods such as logit models, ordered logit models, Tobit and OLS models. Data from focus group discussions and key informant interviews were used to contextually interpret the results from the econometric models and descriptive statistics. This chapter presents the main conclusions of this study. Based on the empirical results, the chapter also draws several policy recommendations. Furthermore, the last section of this chapter presents the remaining knowledge gaps and suggests areas of further studies in the future.

6.2 Conclusions

The study concluded that there is gender inequality in the distribution productive resources in Msinga local municipality. The results indicated that men have access to more land than women. Moreover, men were more water and land secure, implying that women's access to productive resources is not only limited, but also insecure. The results showed that women were more involved in conflicts related to land and water compared to men, and they had experienced more threats to be evicted from the land. It emerged that illiteracy that still persists in Msinga, especially among women, plays a significant role in determining insecurity of rights over resources. Increasing women's ownership of productive assets is important, not only to establish real, formal equality between men and women, but also because rural women's ownership of land is closely associated with their well-being and empowerment.

The study concluded that due to tenure insecurity of land and water, female-headed households are more food insecure compared to male-headed households. This highlights a

positive impact of resources tenure security on household welfare. The results indicated that food security was also influenced by factors such as perceived water security, use of pump and education level. Even though pump-fed irrigation has challenges of servicing costs, diesel or electricity costs, it is more reliable and results water security and food security.

The study also highlighted a positive role played by farmers' co-operatives in access and secure tenure of land and water resources. This highlights the importance of local institutions and farmer organisation in securing resource access for women as well as ensuring their well-being.

6.3 Policy recommendations

Based on the empirical results, the study recommends the following:

- Agricultural training should be provided. Government extension officers and other development agencies should train farmers on skills such as water use efficiency and negotiation skills to ensure household land and water access and security.
- Motorised pumps should be introduced in gravity-reliant blocks. Despite being cheaper to maintain, gravity-reliant blocks were found to be food and water insecure. This implies that the additional cost of introducing and maintaining pumps is unavoidable if irrigators are to be helped to be food water secure. Moreover, smallholder irrigators should be assisted to gain access to existing dams used by commercial farmers to improve their water security. In the Mooi River irrigation scheme, as the river which is the source of irrigation water, was reported to be drying out.
- In the light of the findings from the study, it is recommended that efforts to improve access to credit by farmers. Policies that will make micro-credit from government and nongovernmental agencies accessible to rural farmers will go a long way in addressing their resource acquisition constraints and eventually improving household food security in the country.
- Relevant department should make farmers aware and assist them in forming farmers' associations and to become members. Farmer associations were found to have a positive impact on land access, water access and water security.

6.4 Areas of further study

For the study, gender of the household head did not specifically consider whether the head stays at home or away (migrant), thus the same study can be conducted now considering the *de jure* and *de facto* female household head. A number of papers on resources allocation have bigger sample sizes; therefore this study could be improved by increasing the sample size. The papers have not measured water access to non-irrigators, therefore, the study can be conducted and develop water access measure to rain-fed farming. Only a limited number of factors that significantly affect food security have been looked at in this study. There could be more factors that significantly affect household food security and therefore such relevant factors such as technology availability, infrastructural development and many more may be taken into consideration.

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APPENDICES

Appendix A: Survey data collection questionnaire

The Water Research Commission in conjunction with the University of KwaZulu-Natal is conducting a research on, 'Empowerment of women in rural areas through water use security and agricultural skills training for gender equity and poverty reduction in KwaZulu-Natal Province'. They wish to investigate issues on women empowerment, livelihoods diversification strategies and food security among irrigating and non-irrigating women in KwaZulu-Natal.

Please be informed that your participation in this study is strictly voluntary, and if you do not wish to answer any particular question, please feel free to say so. You are also assured that the information obtained from this study will be kept confidential and will only be used for research purposes. Thank you for your participation in this study.

RESPONDENT IDENTIFICATION

Enumerators Name	
Respondent No.	
Date	
Area	
Gender of respondent	

1: RESPONDENT'S SOCIO-ECONOMIC AND DEMOGRAPHIC DETAILS

1.1 Can you please tell me your age/ year of birth *(……..)*

1.2 What is your employment status?

1. Unemployed
2. Informal / non-permanent employment
3. Formal/permanent employment

1.3 If you are employed, what is your monthly income range?

Less than R2000

1. more than R2000 but less R5000
2. More than R5000 but less than R10 000
3. More than R10000

1.4 What is the highest educational level that you attained so far?

1. No formal education

2. Primary education
3. Secondary education
4. College/University

1.5 What is the highest level of education for the most educated member of your household?

1. No formal education
2. Primary education
3. Secondary education
4. College/University

1.6 How many people live in your household (……)

1.7 How many people in your household are……

1. Below 14 (……)
2. Have disabilities or chronic illnesses*?*(……)
3. Above 65 *(*……)

1.8 How many people in your household contribute to the household income (……)

1.9 Are any of your household members receiving a government grant?

0. No
1. Yes

1.10 If yes in 1.9, how many are on the following?

Type of grant	**No of people receiving it**	**Amount per person per month**
Old Age grant		
Child grant		
Disability grant		

1.11 What is your marital status?

1. Married
2. Single
3. Separated/Divorced
4. Widowed/

1.12 What religion does your household follow?

1. Christianity
2. Muslim
3. African Traditions
4. Shembe

2. ISSUES RELATED TO LAND

2.1.1 Do you have land under the following ownership statuses?

2.1.2 How much land under the various ownership statuses does your household have

2.1.3 *Female respondent* ***(ONLY)****,* indicate on a five point scale, the amount of decision-making power on that land. (Where; 0 = no power; 1 = little power; 2 = moderate power; 3 = much power; 4 = full power)./

	Qs 2.1.1	**Qs 2.1.2**	**Qs 2.1.3**
ASSET	**Availability of such land (0= No; 1 = yes)**	**Total household quantity**	**Woman's decision-making power over use**
Land			
Dry-land			
1. Arable dry land (Ha) (Owned)			
2. Arable dry land (Ha) (Rented)			
3. Arable dry land (Ha) (no formal lease agreement)			

4. Arable dry land (Ha) (borrowed)			
5. Arable dry land (Ha) (bought)			
6. Arable dry land (Ha) (Inherited)			
7. Arable dry land (Ha) (leased)			
8. Arable dry land (Ha) (sharecropped) /			
9. Other (specify)/ ……			
Irrigation land			
10. Arable irrigation land (Ha) (Owned)/			
11. Arable irrigation land (Ha) (Rented))			
12. Arable irrigation land (Ha) (no lease formal agreement)			
13. Arable irrigation land (Ha) (borrowed)			
14. Arable irrigation land (Ha) (bought)			
15. Arable irrigation land (Ha) (Inherited)			
16. Arable irrigation land (Ha) (leased))			
17. Arable irrigation land (Ha) (sharecropped)			
18. Other (specify) ……..			

2.1.4 Overall, indicate the quality of land you are using for agricultural production? (Where; 0 = very poor quality; 1 = poor; 2 = average; 3 = good quality; 4 = very good quality).

2.15 Does your household engage in any crop production?

0. No
1. Yes

2.1.6 If yes to 2.1.5, how do you perceive the profitability of your crop production enterprise?

0. Very unprofitable
1. Unprofitable
2. break-even
3. very profitable

2.2 land related institutional questions

2.2.1 If your household owns some land, who is the legal holder of the household irrigation plot?/
0 = the woman
1= the husband
2.2.2 How did the legal holder of this land get hold of the farm land?
0 = Inherited from parents
1 = Received it from the traditional authorities
2 = Bought the land
3 = Land reform
6 = Initial allocation

2.2.3 **A*re you leasing out any land?***
0 = Yes
1 = No
2.2.4 If yes in 2.2.3, what are the main reasons for leasing it out?
0 = Water shortages
1 = Unavailability of household labor
2 = Lack of capital
3 = Problem of crop damage by livestock
4 = Unprofitability of farming
5 = Other (specify)…….)
2.2.5 If leasing out land, what is the rental?

0 = Nothing
1 = Cash tenancy
3 = Sharecropping (share the produce)
4 = Non-cash benefits (specify)(……..)
2.2.6 Are you satisfied with the piece of land you have? Which of the following applies to you?
0 = I am satisfied with the amount of land I have
1 = I would like more land
2 = I like to reduce the land for crop production
2.2.7. If you would like more land, what would you use it for?*(.....).*

2.2.8 Have you ever received any threat to be evicted from your farming land*?*
0 = No
1 = Yes
2.2.9 If yes in 2.2.8, what was the reason for the threat?
0 = For government redistribution
1 = Failure to obey rules
2 = Over unclear land ownership
3 = Other (specify)(……..)
2.2.10 How was this resolved?
0 = through traditional authorities
1 = though the courts
2 = other institutions (specify)(…….)
2.2.11 Generally, are you satisfied with your present security of land?
0 = No
1 = Yes

2.2.12 Is there a farmer's association in your block/area?
0= No
1= Yes

2.2.13 If yes in 2.2.12, are you a member of any farmers' association/group?
0 = No
1 = Yes
If no in 2.2.13, explain why.……..……..

3. WATER-USE SECURITY FOR AGRICULTURAL PURPOSES

3.1 Indicate whether you agree or disagree with the following statement measuring your water-use security levels? (Where; 0 = strongly disagree; 1 = disagree; 2 = neutral; 3 = Agree; 4 = strongly agree).

Indicator	**Responses**				
	0	1	2	3	4
1. I am satisfied with the consistence of water supply					
2. I am satisfied with the maintenance of the canal					
3. I am satisfied with the sufficiency of water supply					
4. I am satisfied with the quality of water supplied					
5. I am confident with my capacity to pay for water					
6. I am satisfied with my plot's position along the canal (lower/upper end)					
7. I would be happy if there were improvements in the current water supply and water related services					

8. My right or claim to water is secure					

3.2 Have you ever had a shortage of water in your block?
0 = No
1 = Yes
3.3 If yes in 3.2, how severe was the problem?
0 = Slightly
1 = Strongly
3 = Very strongly

3.4 If yes to 3.2, what do you think is the major reason for the water shortages?
0 = Canal leakages
1 = People not sticking to their irrigation schedules
2 = Poor supply from the dam/weir
3 = Other (specify)(……)
3.5 What do you do if you don't receive water on your irrigating day?
0 = Nothing
1 = Report to the irrigation committee
3 = Talk to farmers upstream myself
4 = Report to extension officers
5 = Other (specify)(……)
3.6 If you report to the committee or talk to other farmers yourself in 3.5, how often has your problem been heard and resolved?
0 = Never
1 = Sometimes
2 = Always
3.7 How far is your household from the irrigation scheme?.....(km).

3.8 How long have you been a member of the scheme?…… (years).

3. 9 How is water pumped to reach your irrigation plot(s)?
0 = Gravity
1 = Electric pump
2 = Diesel pump
3.10 How many times per week do you have access to water in your plot(s)?……times

3.11 How do you know when your crops need to be irrigated?
0 = Irrigate when it's my turn
1 = When crops are stressed
2 = When the soil is dry
3 = Other (specify)……)
3.12 Generally, do you perceive your water right secure?
0 = No
1 = Yes

3.12 Institutional questions related to water

3.12.1 Are you a registered water user?
0 = No
1 = Yes
3.12.2 To date who has been responsible for maintenance of irrigation infrastructure (e.g., canal, fence, etc.)?
0 = Users/farmers

1 = Government
2 = NGOs
3 = Other (Specify)…….
3.12.3 Are you (yourself) involved in irrigation infrastructural maintenance (e.g., canal & fence)?
0 = No
1 = Yes
3.12.4 If yes in 3.12.3, how often do you perform such activities in your block?
0 = Rarely
1 = Often
2 = Always
3.12.5 If yes in 3.12.4, what do you contribute towards infrastructural maintenance?
0 = Labor
1 = Money
2 = Equipment/machinery
3 = Expertise/knowledge
4 = Other (specify)(……)
3.12.6 Are the rules in the irrigation scheme able to address any challenges farmers can face?
0 = No
1= Yes
3.12.7 If no in 3.12.6, give reasons?/
0 = Rules have become obsolescent/out-dated
1 = Rules are inadequate
2 = Rules are not well-monitored
3 = Other (specify)……..)
3.12.8 Generally are you happy with the rules in place for collectively managing water in the irrigation scheme?
0 = Not happy at all
1 = Happy
2 = Very happy
3.12.9 If you are not happy, which rule(s) do you think need(s) to be changed? And why
a. ……..……..
b. ……..…….. …….

4. SCHEME MANAGEMENT/*UKUNAKEKELWA KWE IRRIGATION SCHEME*

4.1 Which of the following institutions managing the irrigation schemes do you know of?
0 = Water users' association
1 = Block committee
2 = Catchment management
3 = None
4 = Other (specify)……
4.2 Which of the following institutions managing the irrigation schemes are you a member of?
1. = Water users' association
2. = Block committee
3. = Catchment management
4. = None
5. = Other (specify)…….
4.3 How would you rate the overall scheme management?
0= Very poor
1= Poor
2 = Average
3 = Good
4 = Very good

4.4 If not a member in 4.2, which institution would you be interested in joining?

1.= Water users' association
2.= Block committee
3.= Catchment management
4.= None
5.= Other (specify)……

4. 5 Without the scheme, how different would your life be compared to what it is now?

……
……
……
……

4.6 Irrigation costs

4.6.1 Do you pay any fee for water or water related services?

1. = No
2. = Yes

4.6.2 If yes in 4.6.1 what exactly do you pay for with regards to water?

0 = Diesel
1 = Electricity
3 = Infrastructure maintenance fee
5 = Irrigation Service Fee (ISF)
6 = Other (specify)…….

4.6.3 If yes in 4.6.1, how much do you pay monthly per plot? *(R.……)*

4.6.4 Have you always been able to pay this fee?

0 = No
1 = Yes

4.6.5 If yes in 4.6.4, do you think that the way in which the levels of service fees are determined is logical or transparent?

0 = No
1 = Yes

4.6.6 If no in 4.6.4, do you still have access to water*?*

……

5. CONSUMPTION STATUS AND WOMEN'S CONTRIBUTION TO HOUSEHOLD'S EXPENDITURE

5.1 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	Dry land farming				
	Livestock production				
	Hiring out farming equipment				
Arts and craft					
Permanent employment					
Temporary/casual employment					
Hawking/petty trading					

Other (specify)				

5.2 Household food security

1. Taking all means* into consideration, how would you describe your household food consumption in the last 12 months? **Food shortages throughout the year** =0; **Food shortages for most of the months** =1; **Occasional food shortages**=2; **No food shortages, no surplus**=3; **Food surplus=**4	

*All means include: own production + food purchases + help from different sources + food hunted from forest, lakes, etc

2. Answer questions 2.1-2.9 using the answers below 0=Never 1=Rarely= Once or twice in the past four weeks 2=Sometimes= Three to ten times in the past four weeks 3=Often= More than ten times in the past four weeks 4=Always= All the time	
2.1. In the past 4 weeks, did you worry that your household would not have enough food?	
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?	
2.2 In the past 4 weeks, did you or any household member have to eat limited variety of foods due to lack of resources?	
2.3 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?	
2.4 In the past 4 weeks, did you or any household member have to eat less than you felt because there was not enough food?	
2.5 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?	
2.6 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?	
2.7 In the past 4 weeks, did you or any household member go to sleep at night hungry because there was not enough food?	
2.8 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?	

6. SOCIAL PARTICIPATION (NETWORKS)

6.1 Indicate which of the following cultural, leisure and social groups you belong to?

Group	**Y/N**	**Group**	**Y/N**	**Group**	**Y/N**
Farmers association		Trade/labor union		Cultural association	
Farmers' cooperative		Village committee		Burial society	
Other production group		Religious group		Credit/savings group/	
Traders/Business Assoc.		NGOs /civic group		Professional Assoc. (doctors, teachers, veterans)	
Water users' Assoc.		Political/party/movement		*Other*…….	

7. HOUSEHOLD LIVESTOCK OWNERSHIP AND ASSETS

7.1 How much of the following livestock does your household have?

Livestock type	Number currently owned	Money spent on feeds, chemicals, vet services, e.t.c 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
1.Cattle					
2.Goats					
3.Sheep					
4.Pigs					
5.Chickens					
6. Other specify)					

8. INSTITUTIONAL SUPPORT SERVICES

8.1 Are there any organizations in the area that provide agricultural credit?
0 = No
1 = Yes
8.2 Have you received credit or loan facility in the past 12 months?
0 = No
1 = Yes
8.3 If yes in 8.2, can you name the institutions/organizations that have provided you with some credit in the past twelve months and indicate how much they lent to you?
0 = Relative/friend (……....)
1 = Savings club/stokvel (…….)
2 = Money lender (…….)
3 = Input supplier (……)
4 = Financial institution *(*…….…)
5 = Other, specify (….....)
8.4 If yes in 8.2, what was the purpose of the loan/credit?
0 = Family emergency
1 = Agricultural purposes
2 = Other (specify) (…….……)
8.5 If yes in 8.2, were you able to pay back the loan/credit in time?
0 = No
1 = Yes
8.6 Name the organizations/institution that provided you with any of the following marketing related services, in your efforts to get your produce sold in the past year?

a. Transport (……..)
b. Storage facilities ……...)
c. Bargaining for better prices (……...)
d. Finding the buyers (……...)
e. Other specify (…….....)

8.7 Which institutions provid d you with tillage facilities in the past year?
1 = Government department of agriculture
2 = Non-governmental organization
3 = private institutions
8.8 How did you pay for such services?

1 = Paid in full
2 = Paid part of the fee (partly subsidized)
3 = Paid nothing (completely subsidized)

8.9 How many times have you engaged an extension officer(s) in the past 12 months?
……..

8.10 If you engaged an extension officer, did you invite the extension officers?
0 = No
1 = Yes
8.11 If you engaged an extension officer, what was the main reason for engaging them?

1. Consulting on inputs
2. Consulting on crop production issues
3. Consulting on marketing
4. Any other, specify (……..)

8.12 Has any member of your household ever received any form of agricultural training in the past five years?
0 = No
1 = Yes
8.13 If yes in 8.12, who received that training?
0 = Father
1 = Mother
2 = Daughter
3 = Son
4 = Other specify (……)
8.14 If yes in 8.12, who provided such agricultural training services in your area?
0 = Government/parastatal
1 = Non-governmental organization (NGO)
2 = Private company
3 = Other, specify …….
8.15 How would you describe the usefulness of the training in farming?
0 = Not useful at all
1 = somewhat useful
2 = Useful
8.16 Did you receive any free inputs in the past 12 months?
0 = No
1 = Yes
8.17 If yes in 8.16, what was the source of these inputs?
0 = Government/parastatal
1 = Non-governmental organization (NGO)
2 = Private company
3 = Other, specify…….
8.18 If yes in 8.16, please specify the type of inputs received and their quantities.

Institution	**Type of inputs**	**Quantity received**

8.19 What is your main source of farming information?
0 = None
1 = Radio/television
2 = Extension officer
3 = Cell phone/SMS
4 = Internet
5 = Newspaper
6 = Other farmers
7 = other, specify…….
8.20 Have you ever been involved in any agricultural-related conflict?
0 = No
1= Yes

8.21 If yes, what was it over?
0 = Land related issues
1 = Water related issues
2 = Management related issues
3 = Other, specify (……..)
8.22 Are you a member of any agricultural co-operatives?
0 = No
1 = Yes
8.23 If yes in 8.22, name the agricultural co-operatives you belong to?

a. …….
b. …….

8.24 How often do you have meetings as a cooperative?
…….
8.25 Who makes the constitution of your cooperative*?*
0 = All coop members
1 = Coop committee
2 = Extension Officer
3= Other(specify)…….

10. CONCLUDING REMARKS

Final general comments…….

…….

…….

Thank you

Appendix B: FOCUS GROUP DISCUSSIONS

Date: 17 September 2013

General discussion questions

1. What are the challenges concerning land in Mooi River or Tugela Irrigations scheme, with special emphasis on the following?

- Land allocation (i.e., who allocates it? the inclusion and exclusion criterion, women's access to land)
- Ownership of the land (i.e., does it change hands? Do men and women own relatively same sizes of land)?
- Transfer (i.e., can you trade it? can you rent it out, who can you give it to if you no longer need it or after death)

2. What are the challenges concerning water-use in the irrigation scheme, with special emphasis on the following?

- Accessing water for irrigation
- Control or manage it
- The rights to use of water and timing of these rights?

-Are the challenges different between men and women? To what extent do you think the use of pumps alleviate the water shortages problems? Are there differences in the crops being grown by farmers due to the differences in access to water? Do women have a say in the control of water? Are there any water user associations? Are women parts of these associations?

3. Are there any vocational work skills training done by people in the community? What trainings are being done? Who is doing the training and where? Do men and women have equal opportunities to attend these training courses? What are the gaps or areas where you lack skills or training?

4. Besides farming what other activities are being done by men and women as sources of income? What is their relative importance?

Appendix C: Tropical livestock units (TLU)

Animals	Scale
Cattle	1
Sheep	0.10
Goats	0.10
Pigs	0.20
Chickens	0.01

Source: Sinyolo (2013).