Analysing food security status among farmworkers in the Tshiombo Irrigation Scheme, Vhembe District, Limpopo Province

by

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DEDICATION

To my grandmothers Vho-Tshinakaho Johana Kwinda and Vho- Nkhukhuna Nora Mutakusi, thank you so much for encouraging me to continue going to school, I love you to the moon and back.

DECLARATION

I, **Mudzielwana Rudzani Vhuyelwani Angel** declare that:

1. The research reported in this dissertation, except where otherwise indicated, is my original research.
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Professor Maxwell Mudhara

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ABSTRACT

Historically, South African rural households produced most of their food. Recently, rural households depend on market purchases, and possibly from neighbours. Currently, unemployment and lack of access to irrigable land, to own or lease, has affected livelihoods patterns of the rural poor, such as farm workers. The lack of financial resources leads to poverty and hinders the ability to purchase food at the household level. This study assessed food security status among farmworkers and land lessees' households in the Tshiombo Irrigation Scheme, Vhembe District, in Limpopo Province, with 51%.8 food secure, 7.3% mildly food secure, 19.9% moderately food insecure and 20.9% severely food insecure. The study aims to contribute to a better understanding of the relationship between rural livelihoods and food security status among farmworker households. A simple random sampling technique was used to select 191 farmworker households. A structured questionnaire was administered, and a focus group discussion and key informant interviews were conducted for data collection. The Binary Probit regression model was used to analyze livelihood diversification strategies among farmworkers' households. The results showed that the gender of a farmworker ($p<0.05$), number of farmworker's dependents ($p<0.01$), and access to the market ($p<0.05$) were statistically significant factors that positively influenced farmworker household's livelihood diversification. However, employment type ($p<0.01$), years of farming experience ($p<0.01$) and leasing land ($p<0.05$) were found to negatively influence irrigation farmworker's livelihood diversification. The Multinomial Logistic regression model was used to determine factors that influence the choice of livelihood strategy among farmworker households. Regression results showed that age of the farmworker ($p<0.01$), marital status of the farmworker ($p<0.01$) and ($p<0.5$), dependents of the farmworker ($p<0.05$), leasing land from employer ($p<0.05$) and ($p<0.05$), years of farming experience ($p<0.1$) and ($p<0.01$), agricultural training ($p<0.05$) and access to the market, significantly influence the choice of livelihood strategy.The Ordered Probit regression model was used for assessing the determinants of household food insecurity. The results showed that land size ($p<0.05$) and total household expenditure ($p<0.05$) positively influence farmworkers household food insecurity. Food stored ($p<0.1$) and leasing land from employer ($p<0.01$) had a negative influence on farmworkers food insecurity status. This study concluded that land leasing has the potential to improve food security status and enhance the standard of living among irrigation farmworkers. Therefore, the

government, in collaboration with local authorities, should develop and implement effective policies to support farm owners to rent out irrigation plots to their employees as a way of addressing food security.

Key words: Binary Probit regression model, farm workers, land lease, livelihood diversification, food insecurity, Multinomial Logistic regression model, Ordered Probit regression model.

LIST OF ACRONYMS

CSI	Coping Strategies Index
DAFF	Department of Agriculture, Forestry and Fisheries
DDS	Dietary Diversity Score
FANTA	Food and Nutritional Technical Assistance
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
HFIAS	Household Food Insecurity Assess Scale
MDGs	Millennium Development Goals
SDGs	Sustainable Development Goals
WHO	World Health Organization

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CHAPTER 1: INTRODUCTION

Farmworkers in South Africa are categorized as a powerless group with poor livelihoods (Atkinson, 2007). Farm-working households are identified by poverty, food insecurity, low education levels, lack of access to infrastructure and governmental services (Kruger *et al.,* 2006). The challenges that farmworkers encounter is a result of apartheid laws, for instance, the Native Land Act of 1913 banned black farm-working households from accessing land outside designated areas called homelands, which covered 13% of rural areas (Atkinson, 2007). Therefore, black farm-working households who had share cropping agreements with white landowners lost such rights (Atkinson, 2007). The loss of land hampered agriculture among the black people. In addition, most farmworkers were left unemployed due to the use of capital-intensive equipment by white farmers (Bernstein, 2007).

In the advent of democracy in 1994, South Africa implemented a land reform programme to review the Apartheid land distribution. The programme included land redistribution, land compensation and land residency to its rightful owners (Makombe, 2018). The land reform programme was to expand land access to poor family units and to decrease disparity of destitution. However, the programme has been criticized for the slow pace of land transfers relative to the goal of transferring approximately 30% of agricultural land to the previously disadvantaged (Mendola and Simtowe, 2015).

Most of the farmworkers rely on farm owners for access to food and other goods, services and accommodation (Kruger *et al.,* 2006). Moreover, farmworkers lack social and economic information and social support (Lemke and Jansen van Rensburg, 2014). This is regardless of laws and arrangements implemented since 1994 to ensure reasonable work practices and security of residency for farm labourers (South Africa Department of Land Affairs, 1997). Since then, the state has failed to implement, monitor, and enforce these laws (Visser and Ferrer, 2015).

In rural areas, owning land can provide the food security to poor households if the resource is utilized productively. Land productivity can reduce unemployment, improve food security and increase economic growth (Lahiff and Cousins, 2005). Land in South Africa, especially in rural areas, has always belonged to the community, with the chief being the custodian. Community members rely on the chief to provide them with land that they can occupy for production purposes (Thamaga-Chitja and Morojele, 2014). However, there are gender issues when acquiring land in

irrigation schemes as women's land rights are often violated. Women are often restricted from having tenure, access, and control of the land. This exclusion is violent as it denies women the autonomy for full participation in society as they are only seen as effective at working on farms and taking care of children (Makhetha and Hart, 2018).

The South African government has been directing its focus on smallholder irrigation schemes to eradicate unemployment, lessen poverty and boost pro-poor sustainable agricultural and economic growth (van Koppen *et al.,* 2017). In South Africa, the total size of irrigation schemes can range from 5 to more than 1 000 hectares, and a farmer can acquire about 1.5 hectares of land in the scheme (Van Averbeke *et al.,* 2011). Limpopo Province have 180 public irrigation schemes on 20 788 ha of land supported by the government (van Koppen *et al.,* 2017).

Worldwide, irrigation labour is mostly supplied by poor and marginalized farm-working groups as well as migrants who lack full protection of the law. Farmworkers in South Africa are mostly vulnerable and accept any agricultural job they are offered. South African agriculture sector contributes about 11% of formal employment and about 27% of informal employment (Cousins, 2013). The government introduced minimum wages for farmworkers in 2003 to improve the economic situation of the country. This led to farmers reducing benefits such as housing subsidies and food portions, leaving farmworkers worse-off, with some getting unemployed (Rogan and Skinner, 2017).

Food security is defined as a state in which "all people at all times have both physical and economic access to sufficient food to meet their dietary needs for a productive and healthy life" (Coates *et al*., 2007). Although South Africa produces enough staple food to feed its citizens, the country experiences high rates of household food insecurity due to rising food prices, particularly of maize and wheat, which are the staple diet of the poor who are net food buyers (Abdu-Raheem and Worth, 2011). In 2015, the Millennium Development Goals (MDGs) came to an end with many developing countries still battling with fulfilling the goals (WHO, 2015). A post-2015 agenda comprising of 17 Sustainable Development Goals (SDGs) was then introduced (WHO, 2015). In relation to the focus of the study of analysing food security status among farmworkers who are land lessees and non-lessees, the SDG agenda goal number 2 aims to end hunger, achieve food security and improve nutrition and promote sustainable agriculture by 2030 (Lee *et al.,* 2016). This goal is to be implemented through investing in agricultural productivity, rural infrastructure,

agricultural research and extension services (Lee *et al.,* 2016). Additionally, to limit the extreme food price increases, food commodity markets and market information will adopt measures to ensure proper functioning (Lee *et al.,* 2016). Ensuring the food security dimensions (food availability, food accessibility, food utilization and food stability) to all, while always a major policy focus for Sub-Saharan African countries, including South African, is a barrier in achieving SDG goal number 2 (Sachs, 2012).

1.1 Problem statement

Diversification of rural households' income is vital to survival (Omotesho *et al.,* 2020). Rural households adjust their activities either to exploit new opportunities created by market liberations or to cope with livelihood risks (Idris-Adeniyi *et al.,* 2020). However, it is also argued that rural people establish their livelihoods via three main strategies: agricultural intensification; livelihood diversification; and migration (Tyenjana and Taruvinga, 2019). A comprehensive body of research revealed that rural households, especially in African countries, are resource-poor, which leads to vulnerable livelihoods (Tyenjana and Taruvinga, 2019). Regasa (2016) pointed out that either lack of or limited access to crucial assets such as environmentally friendly technologies or credit, and lack of arable land and finance is what forces rural households to engage in low-return strategies. Due to such a tight resource access, argued that the entry to more worthwhile farm and non-farm livelihood activities is severe. Regasa (2016) states that people negatively affected by such constraints in rural areas are those who rely on farming as a major livelihood activity, and yet have insufficient assets to produce a surplus from their agricultural activities.

Sithole (2005) concluded that numerous households within South Africa are food insecure, with farmworkers being an extremely vulnerable group. Farmworkers are employed to produce food for the country but ironically find themselves with severe risk of hunger, diet-related chronic diseases, unsafe living settlements and working conditions and inadequate access to health care (Wadsworth *et al.,* 2016). There are barriers for farmworkers to access healthy food in rural communities, such as limited access to land, limited access affordable and nutritious food, and living in poverty. According to Food and Agriculture Organization (FAO, 2014), living in poverty is one of the major barriers to accessing healthy food among farmworkers. They workers then must make difficult choices between meeting other basic needs such as medical care and food.

Wadsworth *et al.* (2016) noted that much attention had been paid to a single pillar of food security status, i.e., access to food. However, food may not be accessible to specific households despite being available in markets. Therefore, this study will identify the factors that influence the choice of livelihoods strategies among farmworkers and measure the welfare status among land-leasing and non-leasing farmworkers in Tshiombo Irrigation Scheme, Limpopo Province, South Africa.

1.2 Research objectives

General research objectives

The main objective of this study is to the identify food security status among farmworkers in Tshiombo Irrigation Scheme.

1.3 Specific objectives

- To analyze livelihood diversification strategies among Tshiombo Irrigation Scheme farmworker households.
- To determine factors that influence the choice of livelihood strategies among farmworker households in Tshiombo Irrigation Scheme.
- To analyze the determinants of food security status among irrigation farmworkers' households in Tshiombo Irrigation Scheme.

1.4 Hypotheses

- Livelihood diversification strategic sources among farmworkers in Tshiombo Irrigation Scheme are not a significant factor to the determination of food security.
- There are not factors that determine the choice of livelihood strategies among farmworkers.
- Farmworkers who rent land from landlords are more food secured than non-land renting farmworkers.

1.5 Importance of the study

Food insecurity is an ongoing challenge to human beings globally. To address food security challenges, there is a need for a broader understanding on the nature and occurrence of food security and a proper identification of the groups of people that are affected (Wadsworth *et al.,* 2016). Food security is a multidimensional problem. It has been a challenge to understand it

because it is mainly focused on one dimension. Several attempts to create an indicator made up of several elements have not been successful (Ike, 2015). Furthermore, not much is known about the livelihood impact of farmworkers who obtain land through leasing land in irrigation schemes from farm owners in South Africa and food security status. In trying to address the problem of multidimensionality of food security, scholars and food security agencies have proposed the use of more than one binding modelled indicator or measurements that can complement each other in food security status (Ike, 2015). This study aims to increase the volume of information in livelihood diversification and food security, thus, allowing for more effective policies and programmes to be designed to have positive impact on farmworkers.

1.6 Organization of the dissertation

The dissertation is paper-based and is organized into six chapters. Chapter 1 has outlined the problem and its setting. Chapter 2 contains a review of the relevant literature to the study. Chapter 3 presents an analysis of livelihoods diversification strategies among farmworkers of Tshiombo Irrigation Scheme. Chapter 4 determines factors that influence the choice of livelihood diversification strategies among farmworker households of Tshiombo Irrigation Scheme. Chapter 5 determines the determinants of farmworker households' food security status of Tshiombo Irrigation Scheme. Finally, Chapter 6 presents the conclusions and recommendations of the study. The next chapter two (2) presents literature review.

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CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter reviews the characteristics of smallholder farmers residing in rural areas, as well as factors constraining agricultural production among farming households. In addition, this chapter further gives an overview of food security in South Africa, factors affecting farm workers' food security status, key indicators that measure food security, land rental participation, and the impact of irrigation schemes on farming households.

2.2 The smallholder farming sector

Globally, it is estimated that smallholder farms are a source of livelihoods and homes for two billion people living in rural households (Gradl *et al.,* 2012). This is highlighted by research which cites the importance of the agricultural sector and its potential to improve the livelihoods of the low income and the vulnerable in an agro-based economy (Som *et al.,* 2018). Wiggins and Keats (2013), state that improved agricultural production in the smallholder sector improves incomes and consumption for participating households. According to South Africa's Department of Agriculture, Forestry and Fisheries (DAFF, 2013) the smallholder farming sector incorporates several types of farmers who are either subsistence or commercial producers, operating at different levels. The DAFF (2013) distinguishes the subsistence from the smallholder farmers, by indicating that the former produce only for consumption while the latter produce for the market.

The smallholder and subsistence farmers produce about 13% of agricultural land in South Africa (Aliber and Hart, 2009). These smallholder farmers have different production objectives, they face different environments and are involved in varying farm enterprises (Wiggins and Keats, 2013). These differences make targeting institutional support difficult, yet DAFF (2013) stresses that such support is vital in improving the farmers' agricultural productivity. Improved agricultural productivity enables the smallholder farmers to produce for the market and may also be an alternative way to improve rural household welfare (Wiggins and Keats, 2013). Darroch and Mushayanyama (2006) showed that smallholder farmers involved in selling and marketing agricultural produce stand a chance of improving their livelihoods. Barlow and van Dijk (2013) showed that smallholder farmers can market and sell their produce to fresh produce markets, informal markets and supermarket chains produce. Generally, agriculture is viewed as important

in creating employment, providing labour, providing food supplies and inputs to other economic sectors and generating foreign exchange (Aliber and Hart, 2009; Alemu, 2012). The significance of smallholder farming with respect to income, poverty alleviation and employment creation is further discussed in the following subsections.

2.2.1 Employment creation and providing rural incomes

Several studies concur that in Africa the agricultural sector has the potential to create employment in the form of agricultural labour, thereby making it possible for the rural communities to earn an income (Aliber and Hart, 2009; Alemu, 2012; Boomsma *et al.,* 2014). In addition, the agricultural sector is recognized by DAFF (2013) as being important in addressing rural poverty issues. Smallholder agricultural production in South Africa is generally labour intensive and DAFF (2013) reasons that, if this sector is well capacitated, it can address rural unemployment in a meaningful way. Altman *et al.* (2009) posit that creating rural employment helps reduce poverty and thereby increases household incomes.

2.2.2 Contribution towards food security and food availability

The smallholder sector is receiving attention around the world because they produce 80% of the food consumed in Asia and sub-Saharan Africa (Gradl *et al.,* 2012). In South Africa, many households are not food secure, even though the nation is food secure (Altman *et al.,* 2009). Smallholder agricultural production has been identified to alleviate food insecurity and reduce vulnerability at the household level (Altman *et al.,* 2009; Aliber and Hart, 2009; Baiphethi and Jacobs, 2009). Baiphethi and Jacobs (2009) point out that households taking up subsistence farming as an extra source of food are increasing, a practice which may be considered as a coping strategy to household food insecurity. With appropriate support to the smallholder sector, smallholder farming could make a meaningful contribution to food production, household food security and livelihoods (Aliber and Hart, 2009; DAFF, 2013).

According to Wiggins and Keats (2013), enhancing smallholder sector agriculture production and allowing the farmers to participate in produce markets can improve food security through improved earnings. Van Averbeke and Khosa (2007), state that household income is one of the most important determinants of food security. Subsistence farming is the primary source of food for most rural households and its contribution to rural household food requirements has been on the decline (Aliber and Hart, 2009; Baiphethi and Jacobs, 2009). As a result, rural households have

developed a dependence on market purchases and money transfers for food provision (Baiphethi and Jacobs, 2009). In addition, poor households are net food buyers and spend a considerably high proportion of their earnings on food (Altman *et al.,* 2009; Wiggins and Keats, 2013). A study by Altman *et al.* (2009) identified maize and wheat as the staple food items in the food provisions in South Africa. This reliance by rural households on these food products exposes them to volatile food prices. Increased agricultural production is seen to stabilize food availability for these households (Wiggins and Keats, 2013). Household food production in many rural communities is inadequate in meeting the quantity and variety in nutritional needs of people in those households (Altman *et al.,* 2009). Baiphethi and Jacobs (2009) suggest that increased food production by smallholder farmers may reduce household food expenditure.

2.3 Factors constraining agricultural production among rural households

There are numerous challenges for smallholder farmers in accessing input and product markets, although some have the potential to grow high-value crops such as vegetables, fruits and cut flowers (Ortmann and King, 2007; Aliber and Hart, 2009). This section examines factors which constrain agricultural production among rural households. These include limited land, household composition, infrastructure, financial resources, extension services and farmer support. The factors are discussed below.

2.3.1 Limited land

Agricultural land is crucial in overcoming poverty in rural areas in Africa (Yobe *et al.,* 2019). There is a problem with land which is available for farming; the land is either limited in size or, is unsuitable for agricultural production and farmers have insecure property rights (Ortmann and King, 2007). Limitation of suitable land for agricultural production has been an area of interest in income diversification and livelihood choices studies such as those of Puttergill *et al.,* 2011; Yobe *et al.,* 2019 and Tjale *et al.,* 2017. The redistributive land reform programme by the South African government seeks to address the land distribution inequalities which were a result of the apartheid era (Jayne *et al.,* 2010).

2.3.2 Household composition

Household composition among rural households is an important determinant of livelihood strategy choices and its income diversification strategies. The production system of subsistence farming is labour intensive (DAFF, 2013) and the main source of labour is predominantly family labour

(Gradl *et al.,* 2012). Altman *et al.* (2009), state that the bulk of those dwelling in the former homelands are the aged women and children. In some cases, even though such household members are available, they are not able to fully engage in agricultural activities. For example, the elderly may be beyond their prime, physically and economically and, therefore, cannot contribute to subsistence agricultural production. According to Dlova *et al.* (2004) cited by Yobe (2019), the age of the household head has a strong influence on the choices a household's livelihood activities. Older household heads may make decisions based on maturity and experience, which younger household heads would otherwise not make. This study embraces the view that the age of the head affects the households' responsiveness to certain livelihood strategies and income diversification patterns. Dlova *et al.* (2004) cited by Yobe (2019), stated that female-headed households and marital roles such as child rearing and household chores may constrain their labour availability and decision-making process within the household.

2.3.3 Infrastructure

Within rural communities, smallholder agricultural production is constrained by the lack of good roads, access to electricity, sanitation, health care services, water, and productive assets (Sikwela and Mushunje, 2013). The presence of infrastructural developments and technology may improve livelihood and agricultural production by enabling all-year-round agricultural production, the production of high-value crops, broadening the range of cultivated products and making smallholders less dependent on rain-fed agriculture (Gradl *et al.,* 2012). Efficient use of, and access to water resources, is required for improvements in smallholder productivity. Irrigation infrastructure is crucial to achieving this (Boomsma *et al.,* 2014). The intensity of production may be achieved by utilizing machinery which, for instance, can allow the cultivation in larger pieces of land. In addition to performing other activities such as transportation and harvesting can be done with heavy machinery (Gradl *et al.,* 2012).

2.3.4 Financial resources

Smallholder farmers lack financial resources to boost their productivity (Sikwela and Mushunje (2013). The level of intensification and management of resources required to achieve a good return from production can be achieved when adequate financial resources are available (Hofs *et al.,*

2006). According to Boomsma *et al.* (2014) and Gradl *et al.* (2012), inputs such as fertilizers and improved seeds or improved animal breeds are often inaccessible to the smallholder farmer in sub-Saharan Africa. The proper use of fertilizers has been shown to improve agricultural output and productivity, especially when combined with improved seeds and soil management techniques (Gradl *et al.,* 2012). These agricultural inputs are often not prioritized and make up a small part of smallholder expenditure due to constraints in access to credit and other financial resources (Aliber and Hart, 2009). Access to credit for crop and livestock production is vital for smallholder farmers to produce a marketable surplus (Babatunde, 2009). Access to credit is limited for most smallholder farmers due to the lack of documentation reflecting legal ownership of the land they have access to, which is a usual requirement to access agricultural loans from financial institutions (Gradl *et al.,* 2012). Access to savings and credit can improve the resource poor base of farmers within the rural communities (Gradl *et al.,* 2012). Babatunde (2009) examined the importance of financial resources, such as access to credit, in determining livelihood choices and identify credit as an important factor in this regard.

2.4 Risk and diversification of the rural households

Farming is vulnerable to uncertain and adverse weather, pests and diseases, factors which undermine its reliability as a livelihood source (Gradl *et al.,* 2012). Rural households mitigate the risk associated with agricultural production by diversifying their livelihood activities and sources of income. This diversification differs from one region to another across countries and within countries (Boomsma *et al.,* 2014). These are discussed in the following subsections.

2.4.1 Livelihood choices

The diversification livelihood choices of each household are determined by several factors such as resource endowment, its assets (mainly availability or lack of land and livestock) and the household members' levels of education. In addition, the composition of the household, household risk perception and the opportunities accessible form part of the determinants of livelihood choices at the household level (Boomsma *et al.,* 2014). The farmers' ability to take part in the agricultural production and participate in markets is largely determined by assets and resource endowment (Baiphethi and Jacobs, 2009). Thus, rural households in the smallholder sector, with varying asset and resource endowment, respond differently to risks. Their diversification depends on socioeconomic factors and the livelihood options that are available to them. Rural households

reliant on one type of livelihood activity for instance subsistence farmers are more likely to be in deep poverty compared to those relying on a variety of sources (Altman *et al.,* 2009; Boomsma *et al.,* 2014). Diverse livelihood opportunities are more common in non-farming communities. As previously mentioned, farming communities lack several resources that would afford them the same opportunities with those in non-farming communities (Baiphethi and Jacobs, 2009). Compared to non-farming income sources, farming income provides less income than remittances, social grants and off-farm employment (Aliber and Hart, 2009). The low agricultural productivity and meagre farming incomes are the reasons why rural households are shifting their dependence away from agricultural production towards activities that provide a more stable income (Baiphethi and Jacobs, 2009). This has led rural households to participate less in agricultural production; they do it as a form of a supplementary livelihood strategy, or even for recreation (Altman *et al.,* 2009).

2.4.2 Income diversification

Development economics literature has established that farming households do not depend on a single source of income for their livelihoods (Perret *et al.,* 2005). Reasons for income diversification include increasing earnings to sustain livelihoods when the main activity fails to sufficiently provide household needs and reducing income variation (Babatunde, 2009). According to Arthur *et al.* (2020), income diversification patterns vary across regions. In the rural parts of South Africa, individuals can acquire payment from different sources (Alemu, 2012). These incorporate payments from wages, salaries, rates and commissions; pay from possess organizations; salary from deals of farm produce and administrations, pay from rents and intrigue; lastly pay from remittances, pensions and grants (Alemu, 2012). The income sources in this study were identified in the following manner: on-farm alone, on-farm plus off-farm, on-farm plus non-farm and a combination of on-farm plus off-farm and non-farm.

2.5 Sustainable rural livelihoods

Rural livelihood determines the well-being of the people residing in rural communities while taking into account the activities that are required for people to implement to have sustainable living (Samuel and Sylvia, 2019). In African countries, such as South Africa, rural livelihood is strongly connected to agriculture and the use of natural resources (Samuel and Sylvia, 2019). Smith (2004) asserts that livelihoods are covered by assets and activities, while also determining the living gained by the household or individuals. The sustainable livelihoods framework is

designed to help understand and analyse poor people's livelihoods (Ellis, 2000). A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future while not condemning the natural resource base (Ellis, 2000). Sustainable rural livelihood is achieved through livelihood diversification, whereby rural families conduct a portfolio of activities and social support for survival in order to improve their standard of living (Smith, 2004). For instance, rural people can move between rural areas, towns or cities to look for work, market their produce, and buy manufactured goods to sell as hawkers (Smith, 2004). Through agricultural livelihood diversification, small scale irrigation schemes are an option to many rural families (Chazovachii, 2012). Irrigation farming is a key driver to enhancing rural livelihoods more especially when interested stakeholders in rural development render necessary support (Chazovachii, 2012). Irrigation farming has become a source of income for disadvantaged people in rural areas, thus extending its support to vulnerable individuals such as orphans and widows (Chazovachii, 2012). Accessing information among irrigation farmworkers and farmers is limited and tends to affect competitiveness. Therefore, it is important for farmworkers in rural areas to work hand in hand with farmers to enhance productivity and competitiveness while eradicating food insecurity and poverty of vulnerable groups (Chazovachii, 2012).

2.6 Food security in South Africa

There are various definitions of food security. The most recognized is that by FAO (2017), which denotes that food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meet their dietary needs and food preferences for an active and healthy life (Jones *et al.,* 2013). The four pillars of food security are food availability, food access, food utilization, and food stability (Sinyolo and Mudhara, 2018). Food availability refers to effective or continuous supply of food at both national and household levels. Food availability is affected by production capabilities of the agricultural sector, and input and output market conditions (FAO, 2017). Food access refers to the ability of households to acquire enough nutritious food (Hwalla *et al.,* 2016). This pillar reflects the demand side of food security and highlights uneven inter and intra-household food distribution and socio-cultural limits on food choices (Headey and Ecker, 2012). Food access is determined by two factors: economic and physical access. Economic access is determined by disposable income, food prices and

accessibility of social support, while physical access depends on the physical infrastructure that supports access such as paved roads, railways, electricity, and irrigation facilities (Headey and Ecker, 2012). Food utilization refers to a process through which the body utilizes various nutrients in the food. It also requires proper food preparation and hygiene practices, wide-ranging eating habits, a diverse diet which necessitates availability of all essential nutrients and proper intra-household distribution of food (Hwalla *et al.,* 2016). Food stability strives to secure the dimensions of food availability, food access and food utilization over time, therefore, access to food should remain unaffected even during sudden shocks such as economic crises (Hwalla *et al.,* 2016). FAO (2017) points out that the variables in this pillar measure dependence on food imports, domestic price variability, and variation in land equipped with irrigation. To achieve food security, all four dimensions must be fulfilled simultaneously (Hwalla *et al.,* 2016). Food insecurity is considered to occur when one or more of these factors are affected (Magombeyi *et al.,* 2016). Temple et al. (2011) agrees that South Africans, particularly those with a low income, may select a relatively less healthy diet that is associated with malnutrition.

McLaren *et al.* (2015) state that regardless of the right to food being highlighted in the international human rights documents and in section 27(1)(b) of the Constitution of the Republic of South Africa which states that everyone has the right to have access to sufficient food and water, this is often violated. One of the challenges for the South African government is aligning policies and programmes to reach and maintain food security status for all (Altman *et al.,* 2009). South Africa still lacks specific and accepted methods to measure food security and has no regulated way of monitoring the food security status of its population (De Cock *et al.,* 2013). Muzah (2015) has shown that measuring food security is a complex challenge hence the full range of food insecurity and hunger cannot be captured by any single indicator. Poverty is more prevalent in rural areas of South Africa. About 65% of the poor are in former homeland areas (Pienaar and Von Fintel, 2014). A few of the South African rural residents are linked either directly or indirectly to agricultural activities. The agricultural sector has always been projected to provide income, extra source of food, leisure activity and employment for people residing in rural areas (Aliber and Hart, 2009). Reducing poverty is a core strategy in reducing the food insecurity levels in the country. Unemployment remains critically high due to structural attributes of the national economy and weak education levels (Chakona and Shackleton, 2019). The South African government has invested in public spending focusing on improving the food security conditions of disadvantaged

people (Hendriks, 2014). It introduced social grants; child grant, feeding in disadvantaged schools and agricultural programs to ease the burden of poverty in poor households. This has contributed towards the eradication of poverty and food insecurity for many poor households (Hendriks, 2014). Findings from Chakona and Shackleton (2019), show that social grants improved household food security and reduced poverty in South Africa, as the social grants provided most of the poor households with improved means to purchase food. The money obtained from social grants is not adequate to cater for food of all household members including other household needs. Social grants on their own cannot eradicate food insecurity in the country (Chakona and Shackleton, 2019).

2.7 Major indicators utilized to measure food security dimensions

The following indicators have been identified, their robustness and validity proven to be cost effective, time sensitive and effective in identifying those that lack access to adequate food, and have been used across different geographical locations and cultures (Coates *et al.,* 2007). Each of these measures has been confirmed to be valid by the following authors: The Household Food Insecurity Access Scale by Coates *et al.* (2007); Coping Strategies Index (CSI)by Maxwell *et al.* (2003) and Household Dietary Diversity Score (HDDS) by (Maxwell *et al.,* 2013).

2.7.1 Household Dietary Diversity

The Household Dietary Diversity Score (HDDS) was released in 2006 as part of the Food and Nutritional Technical Assistance (FANTA) II project as a population level indicator of household food access (Swindale and Bilinsky, 2006). Household dietary diversity can be described as the number of food groups consumed by a household over a given period, and is an important indicator of food security dimensions. A more diversified household diet is correlated with caloric and protein adequacy, percentage of protein from animal sources, and household income (Christensen, 2014). The HDDS indicator provides an indication of a household's ability to access food as well as its socio-economic status based on the previous 24 hours (Kennedy *et al.,* 2011). The dietary diversity questionnaire is based on a set of food group questions and can be used to find a household's dietary diversity score by categorizing different types of food based on nutrients they comprise (Christensen, 2014).

Few households in South Africa are making use of wild foods as part of their nutrient diet (Chakona and Shackleton, 2019). Wild foods are important for food security, poverty alleviation

and they are often cost efficient and time efficient to collect saving households time and money (King *et al.,* 2013). Wild foods are especially important for the more disadvantaged members in the communities, those that are at most risk of food insecurity rely on these products for food while others consume these because of cultural and taste preferences (King *et al.,* 2013). According to Bvenura and Afolayan (2015), the consumption of wild vegetables is on the decline. Their economic importance is not fully realized by most South Africa citizens, unlike in other Sub-Saharan countries such as Zimbabwe, Zambia, Kenya, Botswana, Nigeria and Swaziland, whose citizens continue to cultivate wild vegetables in abundance. Some of the vegetables grown are C. olitorius, C. gynandra and some Amaranthus species which are also sold to supplement household income. The species mentioned above are also still cultivated on a small scale in some parts of Limpopo and KwaZulu Natal Provinces (Bvenura and Afolayan, 2015). Rural households also supplement their dietary needs with a variety of insects and wild meat, and also collect wild fruits for consumption and for sale.

2.7.2 Coping Strategies Index

The coping strategy index (CSI) is a group of questions that are asked in a household to find out how they manage to cope with the shortage of consuming enough food. The coping strategy index is estimated by measuring behaviour, such as the alternative actions individual household use when they cannot acquire sufficient food (Drysdale *et al.,* 2019). The coping strategies are often identified by the person who is responsible for preparing or consuming the food. The coping strategies observed are usually linked to food practices in the short-term (Ndobo, 2013). Chagomoka *et al.* (2016) observed that gathering of wild food and selling of firewood was widely practiced in the rural parts of Limpopo Province and identified five coping strategies along the rural areas as the most severe in times of food insecurity, namely skipping a whole day without food, borrowing, buying food on credit, consuming seed stock and restricting adult intake in favour of children. A study conducted by Oldewage-Theron *et al.* (2006) in Gauteng (Vaal triangle) revealed that most female-headed households experienced incidences of money shortfall as their money was used for food the month preceding the study. The coping strategies employed by these households were cooking of a limited variety of foods during the previous month and limiting portion sizes (Oldewage-Theron *et al.,* 2006).

2.7.3 The Household Food Insecurity Access Scale

The HFIAS is a continuous measure for investigating the incidents of household food insecurity in the previous month (Coates *et al.,* 2007). The scale is based on the principle that the occurrence of food insecurity can be established, quantified and examined by classifying individual household's using the food insecurity level (Christensen, 2014). According to Carletto *et al.* (2013), the HFIAS highlights three broad aspects of household food insecurity access which include; worrying about the likelihood of food insecurity, inadequate quality of food and inadequate food supplies. The HFIAS is an advanced tool for measuring household food insecurity and it consists of a set of nine generic questions (Coates *et al.,* 2007). Question 1 addresses anxiety and uncertainty of household food supply, Q2–Q4 address food quality variety and preference and Q5–Q9 address insufficient food intake and its physical consequences. Q2–Q4 and Q5–Q9 are organised in order of increasing severity of the food insecurity condition (Coates *et al.,* 2007). Based on the response to the nine questions and frequency of occurrence over the past 30 days, households are assigned a score that ranges from 0 to 27 (Musemwa *et al.,* 2015). A study by Nasrabadi *et al.* (2014) indicated that the HFIAS method produces accurate results because of its internal consistency, criterion validity and reliability for analyzing household food insecurity.

2.8 Factors affecting farmworkers' food security status

Low pay and poverty are common among those who are formally and informally employed on South African farms (Lemke, 2005). Farmworkers are the most vulnerable members of the South African workforce, earning lower than R18.68 wage per hour, with women earning even less than men (Claasen and Lemke, 2019). Farmworks are described by persistent poverty, high levels of food insecurity, low education levels, lack of access to infrastructure and governmental services, and social discrimination (Claasen and Lemke, 2019).

Agricultural production contributes substantially into the economic sector by providing about 11% formal employment and about 27% of informal employment in South Africa (Rogan and Skinner, 2017). Although the government introduced minimum wages for farmworkers in 2003 to improve their economic situation, this was circumvented by farmer owners who subsequently cut previous benefits such as housing subsidies and food portions (Naidoo *et al.,* 2007). The introduction of minimum wages in some cases also led to higher unemployment and leaving farmworkers with fewer benefits than before (Naidoo *et al.,* 2007). Farmworkers have also been exposed to health

hazards from risks of injury to chronic illnesses in agricultural work (Fielding-Miller *et al.,* 2015). Much research and interventional work has focused on human immunodeficiency virus/ acquired immunodeficiency syndrome (HIV/AIDS) and its effects towards the improvement of food security (Ladzani, 2009). One in five South African adults aged between 15 and 49 are currently living with HIV (Fielding-Miller *et al.,* 2015). Food insecurity has a negative impact on the overall nutritional and health status of those infected and affected by HIV/AIDS as it is often expressed that nutritious food is the greatest need for individuals who are HIV positive and their families (Fielding-Miller *et al.,* 2015).

HIV infection affects the general health of a person and her or his ability to perform daily activities, including the ability to generate income, and ultimately the overall quality of life (Fielding-Miller *et al.,* 2015). One of the great concerns is the nature, extent, and magnitude of the impact of HIV and AIDS on agriculture and food security systems. The disease also impacts economic development as traditional food production methods demand heavy manual labour, which is reduced when employees are infected with HIV and AIDS (Ladzani, 2009). As farmworkers are also infected, it would be anticipated that the general population will be affected as a result of the declining workforce and consequent low agricultural production (Ladzani, 2009). It had been said that to end AIDS as a global epidemic by the year of 2030, the Joint United Nations Programme on HIV and AIDS (UNAIDS) set the world determined targets of 90-90-90. The programme aimed to have 90% of all people living with HIV be tested and know their status by 2020, of those that tested positive, 90% be on antiretroviral treatment and lastly, 90% of those on antiretroviral treatment will have achieved viral suppression (Nyirenda *et al.,* 2018).

2.9 Participation in rural land rental markets in Sub-Saharan Africa

Although land rental market has been previously focused mainly on Asia, land is the most productive asset for rural residents in developing countries (Chang and Takahashi, 2018). African countries such as Malawi, Zambia, Kenya and Ethiopia are involved in land rental markets (Chamberlin and Ricker-Gilbert, 2016). The land market contract arrangements vary considerably from country to country. Majority of the land farmed by African smallholder farmers is under customary system making the sale of land prohibited. Land rental markets are a significant way of re-adjusting land-labour ratios among farming households (Ricker-Gilbert and Chamberlin, 2018). Leasing land is often used to generate quick cash in response to emergency needs. Poor households

cannot afford to rent land, having an unstable income makes it difficult to have financial security needed to rent land (Jin and Jayne, 2011). The proportion of households renting land increased by about 20% in 2007 with common forms of land rental contracts arrangements made through informal fixed rental rates paid in cash. Kenya's national land policy of 2007 encouraged the development of land rental markets while protecting the rights of smallholder farmers by providing an efficient transaction making poor potential female landlord households more willing to rent out their land. It has, therefore, also become easier for potential tenants to access land to rent and is an important mechanism through which young farmers access land (Ricker-Gilbert and Chamberlin, 2018).

In Ethiopia, leasing of land is common (Ricker-Gilbert and Chamberlin, 2018; Gottlieb and Grobovšek, 2019). The Government of Ethiopia allows land leasing and informal transfers of irrigable land except for land sales to avoid the issues of land redistribution. However, there are restrictions that have been imposed on lease arrangements in some regions of the county; land tenure contracts have been decreasing time of the agricultural land tenure in the land lease markets and causing conflicts among farmers such as sharing of tenancy (Gottlieb and Grobovšek, 2019). Sharing of tenancy causes inefficient resource allocation where the share tenant only receives marginal revenue only for a fraction of the value of the marginal product of labour while reducing the tenant's incentive to supply other inputs (Ricker-Gilbert and Chamberlin, 2018). Landless households acquire cropland through other means from other households. Farm owners in Ethiopia are therefore reluctant to rent out their land to farmworkers or tenants as they can easily set a claim of ownership. Such a threat is particularly likely for landlords who migrate, landowners then guard labour to prevent expropriation so that the land does not become reallocated by local authorities (Gottlieb and Grobovšek, 2019).

2.10 The influence of irrigation on rural livelihoods

Despite the minimum rainfall in many areas in Sub-Saharan African countries, their agricultural production is almost entirely dependent on rain-fed irrigation system (Burney *et al.,* 2013). Irrigation is defined as the artificial application of water to land for the purpose of enhancing plant production. It reduces or removes water deficit as a limiting factor in plant growth and makes it possible to grow crops where the climate is too dry for this purpose and to increase crop yields where plant-available soil water is a yield-limiting factor during parts or all of the growing season

(Van Averbeke *et al.,* 2011). Irrigation farming plays an important role in food production and enhances food security in the world. About 30% of the world's food production comes from about 18% of the total cultivated land under irrigation (Alexandratos and Bruinsma, 2012). Fanadzo and Ncube (2018) stated 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 developed countries have experienced significant poverty reduction through irrigation, while poverty has increased in Africa in recent years, is an indication of the key role irrigation plays in enhancing food security and eradicating effects of poverty on rural livelihood (Fanadzo and Ncube, 2018).

In South Africa, there are currently about 302 smallholder irrigation schemes across eight provinces that use different irrigation systems. The most used irrigation systems in these provinces are; gravity-fed surface, pumped surface, overhead and or sprinkler (Van Averbeke *et al.*, 2011). Most of these schemes are concentrated in Limpopo , Eastern Cape and KwaZulu-Natal Provinces. A proportion of 69.6% of the 302 schemes are functional, 30.4% non-functional and the status of 2% of the irrigation schemes is not known. Amongst the 296 functional schemes some may not be fully operational (Fanadzo and Ncube, 2018). In South Africa, shortage of water is caused by low, erratic rainfall and high evaporative demand, thus negatively affects crop production in the country. Irrigated agriculture, therefore, presents an alternative source of water during unfavourable weather conditions (Van Averbeke *et al.,* 2011). Irrigation boosts crop output, higher cropping intensities, larger cropped areas and enhanced use of complementary inputs such as high-yielding seeds and agrochemicals, thus improving total factor productivity (Hanjra *et al.,* 2009).

van Rooyen *et al.* (2017) noted that irrigation schemes generate higher and more stable labour demand due to additional labour requirements for initial construction and on-going maintenance of irrigation infrastructure. Higher production and higher incomes make food available and affordable for the poor, due to a steady supply of food, lower prices, and increased purchasing power (Burney *et al.,* 2013). Rural poor and landless labourers benefit from lower food prices and higher wage incomes. Irrigation enables farmers to switch from subsistence to market-oriented production and thus supports crop diversification and specialization, which generates demand for rain-fed crops, leading to poverty reduction within and outside areas of irrigation schemes (Burney *et al.,* 2013). However, adoption of irrigation may be difficult for poorer farmers because it requires capital, familiarization and is cash intensive to operate (Smith, 2004). Irrigation farming

like any other business requires financial capital. It also needs chemicals, seeds, fertilizers and in certain instances irrigation pipes and sprinklers. It is unfortunate that smallholder farmers do not have finance to purchase agricultural implements. As a result, they have to forego certain important inputs which in turn negatively affect the quality of their crop (Smith, 2004).

Irrigation may worsen absolute poverty for some if it reinforces processes of land consolidation in which poor households lose rights to land (Chazovachii, 2012). Badly designed or managed irrigation schemes can negatively impact public health and human capital through the spread of water-borne diseases, usually with a greater incidence for the poor (Chazovachii, 2012). The consumption linkages that are major drivers of poverty reduction are likely to be less effective when income and land distribution are highly skewed, at the end these problems make irrigation farming a failure in uplifting rural people's livelihoods (Chazovachii, 2012).

2.11 Conclusion

This chapter has reviewed the literature on the characteristics of smallholder farming in rural areas. Factors which constrain agricultural production among the rural households were examined. Benefits of smallholder farming include food security at household level and income from the sale of surplus agricultural produce. Despite this potential within smallholder farming systems, agriculture falls short in meeting household requirements and has been mainly practised for subsistence purposes. Rural households, therefore, depend on diverse livelihood choices and income sources since smallholder agriculture is not adequate in meeting their livelihood needs. Diversification is viewed as an important strategy for managing risks associated with depending on one source of income. Furthermore, there is little evidence from South Africa of addressing the motive behind farmworkers in rural communities renting agricultural land and the consequences of participating in land rental markets especially those who are constrained with limited off-farm employment opportunities. HIV/AIDS continues to threaten social and economic development and nutrition security of the projected future agricultural labour force not only in South Africa but also in other parts of Sub-Saharan African countries. Social grants and irrigation schemes have played a significant role in reducing poverty and ensuring that the well-being of rural communities is achieved by means of improving income to purchase food. However, more needs to be done to ensure that households access food that meet their required daily nutritional diet. Food security

measurements have been implemented to capture the food security dimensions. However, due to the complexity of food security they yield different results making it difficult to draw out effective policies. Therefore, there must be a central component of policy approaches to household food insecurity reduction and uplifting livelihoods of marginalized irrigation farm working groups in South Africa. The next chapter presents chapter three (3), an analysis of livelihoods diversification strategies among farmworkers of Tshiombo Irrigation Scheme.

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CHAPTER 3: ANALYSIS OF LIVELIHOOD DIVERSIFICATION STRATEGIES AMONG FARMWORKER HOUSEHOLDS: A CASE OF TSHIOMBO IRRIGATION SCHEME, VHEMBE DISTRICT, SOUTH AFRICA

3.1 Abstract

Diversifying household livelihood activities is essential to farmworker households' food security status, as it brings different sources of food, income and opportunities. In South Africa, farming in irrigation schemes represents an economic livelihood activity essential to farmworker households. Agricultural production and livelihoods of farm labourer face a burden characterized by poor land availability due to limited land access, partly due to landowners not leasing land, lack of markets access, and inadequate support by local extension officers. These factors put pressure on smallholder irrigation farmworkers to diversify their livelihood income, as they cannot solely rely on the irrigation scheme for their sustenance. The purpose of the study is to determine if the farmworker households in the study area diversify livelihoods, identify the choice of livelihood diversification strategies and their determinants. A structured questionnaire was administered to 191 randomly selected smallholder irrigation farmworkers from Tshiombo Irrigation Scheme, Vhembe District in Limpopo Province of South Africa. Data was captured, coded and analysed using Statistical Package for Social Sciences (SPSS) version 26 and STATA software. Descriptive statistics and Binary Probit model were used for analysis. The results showed that the probability of farmworker households diversifying their livelihood from farm work was 55.5%, while the probability of farmworkers not diversifying their livelihood from farm work activities accounted was 44.5%. Furthermore, the regression model results indicate that the gender of farmworker ($p<0.05$), number of farmworkers' dependents ($p<0.01$), employment type ($p<0.1$), years of farming experience ($p<0.01$), land leasing ($p<0.05$) and access to market ($p<0.05$), were statistically significant factors that influence farmworker households' livelihood diversification in the study area. These findings suggest that policy makers should design policies that are sensitive to the farmworkers household-level characteristics in promoting livelihood income diversification.

Key words: Binary Probit model, Food security, Irrigation scheme farmworker households, Thulamela Municipality.

3.2 Introduction

Rural livelihoods explain the well-being of the rural communities as they capture the activities rural people required to sustain a living. In developing countries, especially in Africa, rural livelihood is connected to agriculture and natural resource use (Samuel and Sylvia, 2019). Ellis (2000) defines livelihood diversification as a process by which rural households generate a variety of activities and social support capabilities in their struggle for survival and improvement of living standards. Dedehouanou and McPeak (2019) showed that rural livelihood diversification has become an important policy issue, and this is reflected in the increasing attention it has gained in reports and scholarly articles. Most of the farming households in rural sub-Saharan Africa are involved in a combination of some form of non-farm activity, smallholder farming such as crop farming and other common rural livelihood strategies for survival, reflecting strategies designed to diversify income sources (Dzanku, 2015; Dedehouanou and McPeak, 2019).

Agriculture is the largest sector that hires a relatively high percentage of manual labour and contributes to a significant part of household income (Zezza *et al.,* 2009). In Africa, approximately 70% of the income in the rural households is from farming activities. In Southern Africa, rural households are characterized as poor and with many reporting food shortages for several months per year (Zezza *et al.,* 2009). These livelihoods are largely dependent on farming and natural resources (Kanu *et al.,* 2014). Kanu et al. *(*2014) and United Nations Economic Commission for Africa Sub regional Office for Southern Africa (UNECA-SA) (2010) found that more than half of the people in the Southern African sub-region are still living in rural areas, mostly in villages. South Africa is no exception because most of the households in the rural areas are involved in farm-based activities. Agriculture is deeply embedded in South Africa's culture and it is the mainstay for many households in rural areas as households make their livelihood from some form of farming activities, directly or indirectly (Silva, 2009). Nkoana (2014) posited that agricultural production (crop cultivation and livestock) is the principal source of livelihood for poor households in KwaZulu-Natal Province of South Africa.

Irrigation farmworker households' livelihoods in Tshiombo Irrigation Scheme face pressure characterized as; severe low leasing of land by landowners, lack of access to markets, inadequate involvement of local extension officers that inhibit diversification of their livelihood income. However, Samuel and Sylvia (2019) found that rural households obtain a livelihood from various

other sources such as craftwork, hiring out manual labour, trading and transfers (grants and remittances), and these collectively create a livelihood for rural people.

Apart from understanding rural households' preferred livelihood strategies, underlying variables responsible for livelihood diversification strategies among farmworker households are equally important. Livelihood diversification can clarify the strategic choices made by irrigation farmworker households. Such clarification may allow for suitable policy interventions that can address the challenges farmworker households face through analysing livelihood diversification strategies among Tshiombo Irrigation Scheme farmworker households.

3.3 Conceptual framework

A livelihood strategy can be defined as an activity or a set of activities that a household engages in to make a living that can be in agriculture, non-agriculture or crosscutting (Adi, 2007). Samuel and Sylvia (2019) echoes the same evidence obtained by UNECA-SA (2010), which state that regardless of gradual increases in urbanization and migration, the majority of South African citizens are still residing in villages with many deeply involved in farm-based activities while increasingly diversifying their rural livelihood strategies. The livelihoods framework provides a comprehensive and complex, approach to understand how people make a living. It can be used as a loose guide to a range of issues which are important for livelihoods or it can be thoroughly investigated in all its aspects (Kanji *et al*., 2005). The livelihood framework emphasizes on the understanding of the context within which people live, livelihood strategies they follow in the face of existing policies and institutions, and livelihood outcomes they intend to achieve (Batterbury, 2016).

The choice of a livelihood strategy depends on the vulnerability context for instance shocks and livelihood assets (human, natural, physical, financial and social capital). The livelihood assets are human capital like age, education, gender, health status, household size, dependency ratio and leadership potential. Physical capital comprises the basic infrastructure and producer goods needed to support livelihoods; Social capital which refers to networks and connectedness. Financial capital like savings, credit, and remittances from family members working outside the home and natural capital which is the natural resource stock (Farrington *et al*., 2002). Livelihood outcomes are the achievements of livelihood strategies, such as more income, increased well-being, and reduced

vulnerability improved food security and more sustainable use of natural resources (Eneyew and Bekele, 2012). Figure 3.1 shows a sustainable livelihood framework.

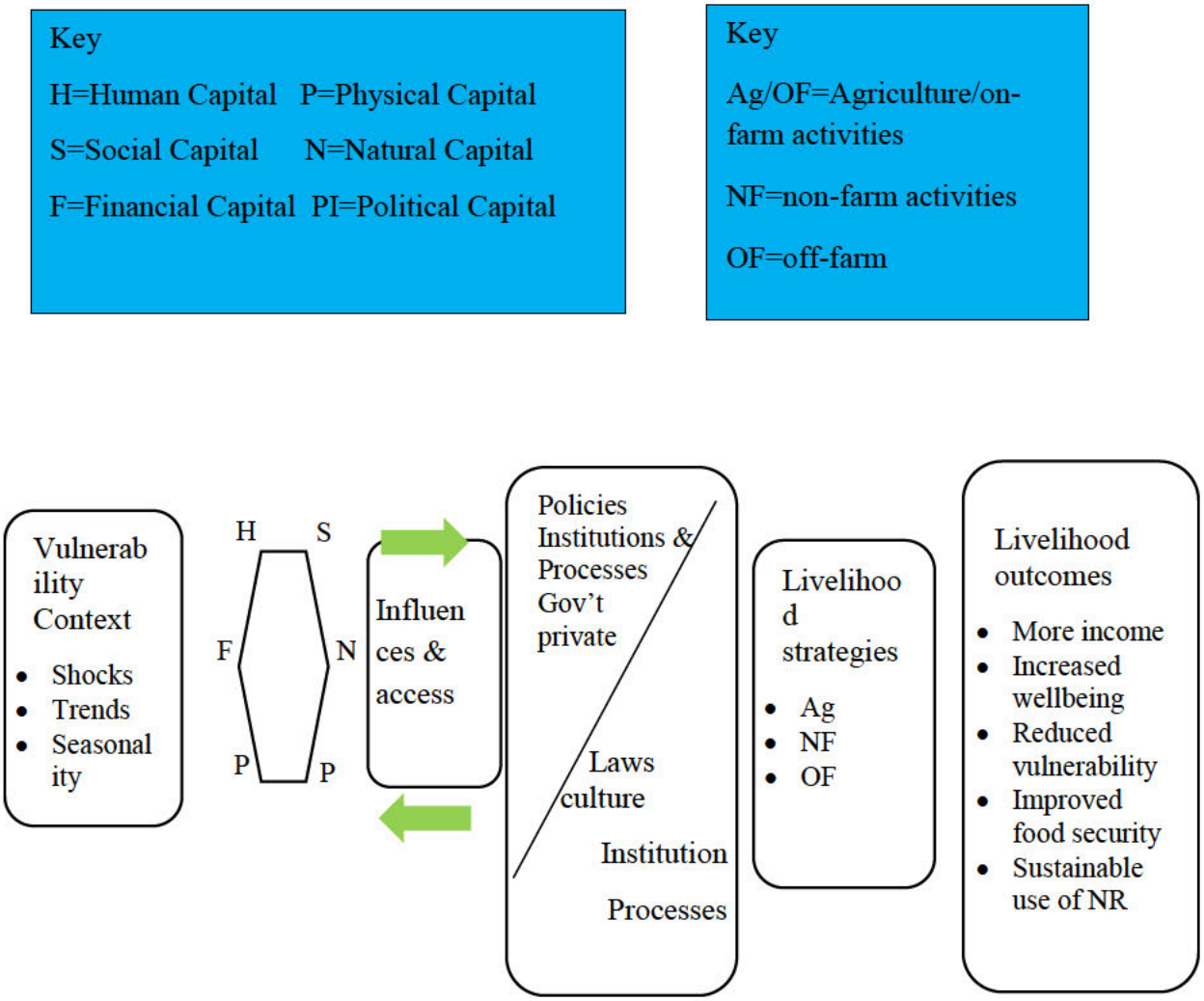


Figure 3. 1 Sustainable livelihoods framework adapted from DFID (1999)

3.4 Research methodology

3.4.1 Description of the study area (geographical location and demographic information of the study area).

Tshiombo Irrigation Scheme is located 40 km north of Thohoyandou Service Centre in Limpopo Province of South Africa. The scheme is 1 195 hectares with 9 30 plots and each farmer owning an average of 1 286 hectares. Seven villages benefit from the Tshiombo Irrigation Scheme (Van Averbeke *et al.,* 2011; Lahiff, 1997). The Department of Agriculture initiated the scheme in 1958. Tshivhase Tribal Authority was consulted for the approval of the scheme. The scheme was handed over to the community on completion in 1963 (Lahiff, 1997). Farmers can lease lands and pay an annual fee to the Department of Agriculture. Tractors were purchased by the Department of Agriculture to support farmers for cultivation at subsidized price. Block committees were developed to govern the irrigation scheme (Van Averbeke *et al.,* 2011; Lahiff, 1997).

The average rainfall is ±5 00 mm/annual with most of it falling during summer (October to March), whilst the other three seasons are generally dry (Cai *et al.,* 2017). The distribution of rains is uneven and erratic. The average summer temperature is around 27°C, though maximum temperatures can be as high as between 45º and 50°C. These climatic conditions give rise to frequent droughts (Cai *et al.,* 2017). The irrigation scheme offers the local community an opportunity to increase income and participate in the local economy. Irrigation development benefits the rural poor in various ways including (a) reduced food prices resulting from increased production and (b) increased on-farm and off-farm employment leading to income generation for the poor (Machethe *et al.,* 2004). Thus, irrigation contributes to food security. Most of the farmers on the scheme, more than 50%, are commercially orientated and sell more than 50% of their crops. Most of the farmers sell produce in the informal market. About 50% of the farmers also sell crops in the formal markets with maize, cabbages, potatoes, tomatoes, onions, beans, spinach, and butternut being the most commonly produced in the irrigation scheme (Louw and Flandorp, 2017).

3.4.2 Data collection

Data collection was conducted in August 2019, using structured household questionnaires, focus group discussion (FGD) and key informant interviews. An ethical clearance was presented to the respondents before gathering data. The study incorporated a mixed method approach of data collection whereby both qualitative and quantitative data was collected. The data used in the study

was obtained from both primary and secondary sources. Primary data was obtained from field surveys through structured questionnaires and focus group discussions. The secondary data was collected through journals, internet, and the Department of Agriculture. A probability sampling method involving a simple random technique was used to select 191 farmworkers. As part of the fieldwork preparation, the questionnaire was pretested. The main aim was to assess whether the questionnaire was relevant and that respondents would understand the questions, in terms of the concepts, the way the questions were phrased and improving translation of the questionnaire to the local language and any impediments to the instrument's ability to collect the required data. Possible responses that were not captured in the close ended questions were added to reduce the number of responses getting to 'other'. Based on the findings of this process, the questionnaire was restructured, and some items were modified to make them clearer. After pretesting and modification of the questionnaire, a date for the inception of data collection was set. Field research assistants were trained about the study before the scheduled interviews with the farmers. The enumerators were trained on the contents of the questionnaire, its interpretation, data recording, general behaviour, and personal security during the survey.

3.4.3 Sampling technique and sample size

The sampling technique focused on locations with specific characteristics to assist with the collection of relevant data and each unit of the population had an equal probability of inclusion in the sample. This method was used to capture a true reflection of farmworkers' circumstances. The Raosoft (http://www.raosoft.com/samplesize.html) sample size calculator suggested that when the margin of error is at 5% with a confidence level of 95%, a desired sample size of land-leasing land farmworkers would be 114 from a population of 160 and 77 non-lessee's farmworkers from a population of 95 in Tshiombo Irrigation Scheme.

3.5 Analytical techniques and methods

3.5.1 Descriptive statistics

The study used descriptive statistics to analyse all the variables of interest, as it is important to describe the features of the data collected (Howe *et al.,* 2008). Descriptive analysis involved looking at means, frequencies, standard deviation of the variables, t-tests and chi-square tests. Samuel and Sylvia (2019) advise that descriptive statistics should be used to determine whether respondents diversify their livelihood. They can also be used to analyse the choice of livelihood

strategies among the respondents and other socio-economic variables. Qualitative data from the focus group discussion was analysed by explaining the themes, content and concepts acquired from the topics and questions discussed as supporting information of the survey. The descriptive statistics was analysed using Statistical Package for Social Scientists (SPSS version 26 of 2019) and the STATA version 23 of 2019 was used to run the regression and marginal effects of the Binary Probit model.

3.6 Results and discussion

3.6.1 Household demographics and socio-economic characteristics

Table 3.1 and 3.2 show the descriptive statistics of the data gathered in the study.

Table 3. 1 Characteristics of farmworker households' in Tshiombo Irrigation Scheme (continuous variables)

Variable description	Mean (*n* = 191)	Std. Deviation
Age (years)	46.30	13.23
Number of dependents per household	5.15	2.27
Years of working in farms	16.79	11.05

Source: Author's Computation (2019)

Age

Respondents have an average age of 46 years. The age group is in line with the findings of Tekana and Oladele (2011) who found that the active participants in irrigation farmwork were between the ages of 40 and 50 years. This finding shows that the youth in the study area are not actively involved with farmwork activities in Tshiombo Irrigation Scheme. The findings by Oduniyi (2018) support and confirm that the youth are diverting their livelihood from agricultural activities to areas such as information technology, tendering and mining.

Number of dependents

A mean number of five dependents per household was recorded. The recorded household size was in line with Tekana and Oladele (2011), ranging from one to 10 people in a household. According

to Nhemachena (2009), a household size consisting of household members between four and six adults is considered as a large household size.

Gender and Marital status

Table 3.2 indicates that most of the respondents (62.8%) were female. The results contradicted with the findings by Oduniyi (2018) whose research was done in the North West Province of South Africa, who highlighted that farming is dominated by males. Table 3.2 also shows that 52.4% of the respondents were single and 47.6% were married.

Table 3.2 Farmworker households' demographics

Variable description	Categories	Frequency	%
Gender	Female	120	62.8
	Male	71	37.2
Marital status	Single	100	52.4
	Married	91	47.6
Level of education	No formal education	85	44.5
	Formal education	106	55.5
Type of farmworker	Seasonal farmworker	128	67.0
	Permanent farmworker	63	33.0
Agricultural training	No	121	63.4
	Yes	70	36.6
Leasing land	No	77	40.3
	Yes	114	59.7
Market access	No	153	80.1
	Yes	38	19.9

n = 191 Source: Author's Computation (2019)

Level of education

A total of 55% respondents had achieved high levels of formal education (primary / secondary school education) (Table 3.2), while 44.5% had no formal education (foundation phase school education). The results are in line with StatsSA (2017) revealing provincial educational attendance

was high in Limpopo Province with 93.1%, with much lower school attendance in Gauteng Province and Western Cape Province with 77.5% and 84.9%, respectively. However, due to high unemployment rate in South Africa, educated residents can be without formal employment.

Land lease and type of farmworker

Table 3.2 indicates that 59.7% lease land from their employers and 40.3% of the farmworkers were not. Occupation was grouped into two categories. The survey shows that 67% were seasonal irrigation farmworkers and only 33% had permanent employment in the irrigation scheme.

Irrigation training course or farmworker's workshops

A total of 36.6% of irrigation farmworkers had taken a livelihood development skill training course provided by government extension officers. However, most of the irrigation farmworkers (63.4%) had never attended workshops provided by extension officers. The focus group discussion with participants asserted that there was an inadequate involvement of local extension officer with irrigation farmworker heads of households.

Market access

Table 3.2 shows that 19.9% of the farmworker households had access to a market with an average distance of 35 kilometres, while 80.1% reported having no access to the market. According to Khatun and Roy (2012) the geographical closeness to market or town influences livelihood diversification and increases the prospects of non-farm employment for rural households.

3.6.2 Gender disaggregated characteristics among farmworker households

A t-test was carried out to determine whether the observed differences were statistically significant. The mean, standard deviation and t-statistic significance level of the variable are presented in Table 3.3.

The age of the irrigation farmworker households was statistically significant between males and females ($p<0.01$). The number of dependents and years of working experience was statistically significant between males and females ($p<0.05$). This may be due to that majority of female-headed irrigation farmworkers households in the study area reported to be single parents and had to find other alternatives to feed their family members.

Table 3. 3 Farmworker household gender disaggregated characteristics

Variable	Female		Male		t-test sig.
	Mean	Std	Mean	Std	
Age	48.26	(12.02)	42.99	(14.54)	***
Number of dependents	5.43	(2.24)	4.67	(2.27)	**
Years of farm work	18.13	(10.83)	14.53	(11.14)	**

n = 191

In brackets are Std. Deviations

Note: *** and ** means the coefficient is statistically significant at 1% and 5%, respectively.

Source: Author's Computation (2019)

Table 3.4 indicates that more females than males had formal education at 50.9% and 49.1%, respectively. The findings from Tshiombo Irrigation Scheme show a chi-square statistically significant relationship of $p<0.05$ between gender and level of education of the irrigation farmworker households.

Table 3. 4 Gender and Level of education

Gender	Level of education		X^2 significance level
	Non-formal education	Formal Education	
Female	77.6%	50.9%	***
Male	22.4%	49.1%	

Note: *** means statistically significant at 1% confidence level.

Source: Author's Computation (2019)

Table 3.5 indicates the relationship between gender of the irrigation farmworker and the type of irrigation employment. More female heads of households were permanently employed than male heads at 49.2% and 42.4%, respectively. On the other hand, the majority of male household –heads preferred seasonal employment than females at 57.1% and 50.8%, respectively. The chi-square test illustrates a statistically significant relationship ($p<0.01$). During group discussion, seasonal

farmworkers noted that a part-time contract gave them an opportunity to look for more income generating work to survive since full time contracts were not paying enough to meet their standard of living.

Table 3.5 Gender and Type of farmworker

Gender	Type of farmworker		X^2 significance level
	Seasonal farmworker	Permanent farmworker	
Female	50.8%	49.2%	
Male	57.1%	42.4%	***

Note: ***: Statistically significant at 1% confidence level.
Source: Author's Computation (2019)

Table 3.6 indicates the relationship between gender of the irrigation farmworker and leasing of land from their employers. The chi-square test shows a statistically significant relationship ($p<0.05$). Majority of the female irrigation farmworker households have access to land from their landlord than male irrigation farmworker households with a total of 46.7% and 29.6%, respectively. The higher proportion of women participating in agriculture could be a result of recent rural development efforts, where women are empowered to take up economic activities.

Table 3. 6 Gender and leasing land from employer

Gender	Leasing land from employer		X^2 significance level
	No	Yes	
Female	53.3%	46.7%	
Male	70.4%	29.6%	**

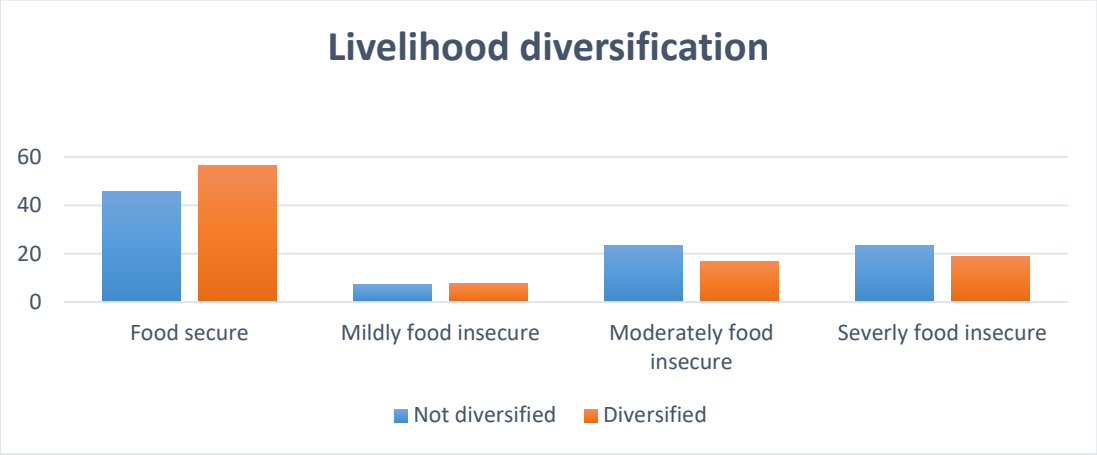
Note: ** means Statistically significant at 5% confidence level.

Source: Author's Computation (2019)

Figure 1 shows an association between livelihood diversification and food security status of irrigation farmworker households. Livelihood diversification can be described as a good indicator

for measuring irrigation farmworker household's food security status. The food security status was classified in four categories, i.e., (i) food secure (ii) moderately food secure (iii) mildly food insecure and (iv) severely food insecure. The four categories comprise of the following as detailed in the HFIAS Indicator Guide v3 (Coates *et al*., 2007).

Figure 3. 2 Association between livelihood diversification and food security



Source: Author's Computation (2019)

Figure 3.2 indicates that irrigation farmworkers households who did not diversify their livelihood from farm work, 45.9% food secure, 7.1% mildly food insecure, 23.5%moderately food insecure and 23.3% were severely food insecure. Irrigation farmworkers who diversified their livelihood from farm work were 56.6% food secure, 7.5% mildly food insecure, 17% moderately food insecure and 18.9% severely food insecure.

3.7 Method of data analysis

3.7.1 Binary Probit Regression (BPR)

Binary Probit model was employed to determine whether the individual respondent diversify their livelihood from farming activities or not. A Binary Probit model is used to model a binary response variable. The assumptions under this model are: (1) Should have enough data of more than 30 observations, (2) the data is assumed to follow a standard normal, and the error follows the standard normality and lastly (3) the categorical predictors are assumed to have a linear effect on the response variable (Moore, 2013). The model perfectly fits the objective well, as it takes account where the dependent variable is of two categorical outcomes, diversified or not diversified which

is coded as 1 and 0 respectively. A respondent who diversified from farm work was coded as 1 and not diversified as 0.

The model could be econometrically stated as:

$P_i=F(Z_i) = \frac{1}{1+ e-(\alpha+\sum\beta iX_i)}$ …… (1)

Were P_i is the probability that a respondent diversified

X_i represents the i^{th} explanatory variables

α and $\beta_i$are regression parameters to be estimated.

e is the base of the natural logarithm

For ease of interpretation of the coefficients, a probit model could be written in terms of the odds and log of odd. The odds ratio is the ratio of the probability that a respondent diversify livelihood income (P_i) to the probability that a respondent did not diversify livelihood income (1-P_i).

That is, $\left(\frac{P}{1-P}\right) = e^{Z_i}$ …… (2)

And taking the natural logarithm of equation (2) yields:

$In\left(\frac{P}{1-P}\right) = e^{Z_i} = Z_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots + \beta_m X_m$ …… (3)

If the disturbance term Ui is considered, the probit model becomes:

$Z_i = \alpha + \sum_{i=1}^{m} \beta i\, X_i + Ui$ …… (4)

Where X_i represents the i^{th} predictor variables. The parameters of the model, α and β can be estimated using the maximum likelihood method. The explanatory variables used in the analysis include the socioeconomic variable of the respondent and information pertaining to livelihood diversification in the Binary Probit model is provided in Table 3.1

Table 3.7 Description of independent variables used in the model

Variables	Measure	Expected sign
Age	Years	+
Gender	Male = 1; Female = 0	+/-
Marital status	Married =1; Single = 0	+
Level of education	1 = Formal education; 0 = Non- formal education	+
Number of dependents	Number of dependents in a household	+
Employment type	1= Permanent farmworker; 0= Seasonal farmworker	+/-
Years of working in farms	Years	+
Agriculture training	Yes = 1; No = 0	+
Savings	Rand (R)	+
Market access	Yes = 1; No = 0	-
Leasing land from employer	Yes = 1; No = 0	+

Source: Author's Computation (2019)

3.7.2 Variables and working hypothesis

The determinants of farmworker household livelihood diversification were obtained through a review of literature. Table 3.7 presents the expectations of the potential explanatory variables. The independent variable age is a continuous variable measured in years of the household head. Age is expected to have a positive influence on household income diversification. The more experienced the household head is, the better chances for it to enhance the standard of living and becoming food secure (Babatunde and Qaim, 2009).

Gender of the household head is a dummy variable which takes the value of 1 if the respondent is male and 0 if the respondent is female. Male-headed households have more productive labour and asset ownership than their female counterparts and positively influence income diversification (Ragasa *et al*., 2013).

Marital status of the household head is a dummy variable which takes the value 1 if the household head is married and 0 otherwise. Irrigation farmworker households with married spouses can have

more livelihood strategies, as they help each other on household necessities (Olale and Henson, 2012).

The level of education takes the value 1 if the household head has acquired formal education and 0 if otherwise. Educated irrigation farmworker households are likely to diversify from farm work to enhance their standard of living. A positive effect is expected to influence household income diversification (Olale and Henson, 2012).

Number of dependents is a continuous variable. A farmworker household that has more household members can participate in several economic activities compared to smaller households. Larger households are therefore more likely to have a greater measure of livelihood diversification than smaller households. Therefore, a positive effect is expected to influence household income diversification (Olale and Henson, 2012).

Employment type of the household head is a dummy variable which takes 1if the household head is a permanent farmworker and 0 seasonal farmworker. It is expected that an irrigation farmworker household being a seasonal worker compared to a permanent worker is associated with lower levels of food security, given that employment and earnings are less secure. A negative or positive effect is expected to influence household income diversification in the study (Devereux and Tavener-Smith, 2019)

Years of working on farms is a continuous variable. Irrigation farmworker households with managerial skill gained due to the number of years working on farms are more motivated to make better informed choice to keep their livelihood sustained. A positive effect is expected to influence household income diversification (Adekunle *et al*., 2015).

Agricultural training is a dummy variable which takes 1 if a household head has received any formal training on livelihood skill development and 0 otherwise. Irrigation farmworker households who have received on livelihood development skill, have better choices of livelihood diversification strategies to sustain a standard of living (Khatun and Roy, 2012). Most of the non-farm activities being skill-based, training increases the possibility of getting nonfarm jobs, therefore, a positive effect is expected to influence household livelihood diversification.

Market access and the immediacy to market or town have a significant influence on livelihood diversification and increases the prospects of non-farm employment for the irrigation farmworker households. The distance to market was hypothesized to negatively affect the influence farm labourer livelihood diversification. Leasing land from employer is a dummy variable which takes 1 if an irrigation farmworker household is renting land from their employer and 0 otherwise. Irrigation farmworker households who diversify their livelihood through leasing land from their employer, have better chances of enhancing their standard of living and becoming food secure. A positive effect is expected to influence household livelihood diversification (Khatun and Roy, 2012).

The diversification of farming activities in the study area. A total of 55.5% irrigation farmworkers managed to diversify from working in the irrigation scheme. A total of 44.5% irrigation farmworkers from the sample could not diversify from working outside the irrigation scheme. This is supported by a study conducted by (Manjur *et al.,* 2014), who reported that majority (83.1%) of the irrigation farmworker household heads were able to diversify their livelihoods.

Table 3. 8 Farm worker participation in livelihood strategies

Variable	**% (n=191)**
Remittance	45.5
Irrigated sale-crops by lessee	36.1
Trading and hawking by lessee	33.0
Receiving social grants from the government	30.4
Livestock activities;	29.8
Part time labour	17.8
Artisan activities	3.7

Source: Author's computation (2019)

Furthermore, a combination of various livelihood strategies in which a respondent could adopt more than one choice of livelihood strategies at a time was noted. The participation by the respondents in the study area was captured by either agreeing or disagreeing "yes or no" in respect

of whether any of the irrigation farmworker household was involved in any of the livelihood strategic activities. From the study, the results revealed that rural irrigation farmworker households participating in part time labour, or in irrigated sale-crops, or in trading and hawking, or in trading and hawking or who participated in selling livestock at 45.5, 36.1, 33.0, 33.04 and 29.8% respectively, had an additional important means of livelihood. Table 3.8 also shows that, of the respondents in the study area, only 17.8% received remittance and with only a few respondents accounting for 3.7% received income from artisans' activities.

Multicollinearity test of variables

A multicollinearity test for the variables was carried out, showing variance inflation factor (VIF) for each variable (see Table 3.9). High level of tolerance occurred among the variables, which indicated that there was no serious multicollinearity among the variables used in the analysis. The Cox and Snell square and Nagelkerke R square were not statistically significant. This indicated that the data fit the model well.

Table 3. 9 Multicollinearity test of variables

Variables	**Collinearity statistics**	
	Tolerance	**VIF**
Age	0.570	1.755
Gender	0.840	1.190
Marital status	0.870	1.150
Level of education	0.629	1.591
Number of dependents	0.909	1.100
Employment type	0.851	1.175
Years of farming experience	0.745	1.343
Have taken irrigation training	0.906	1.104
Savings	0.909	1.058
Market access	0.945	1.058
Leasing land from employer	0.826	1.210

Source: Author's computation (2019)

3.8 Determinants of livelihood diversification strategies among irrigation farmworkers

A Binary Probit model was used to estimate parameters responsible for livelihood diversification among the irrigation farmworker households (Table 3.10). The coefficients of the Binary Probit model do not represent the magnitude of the effects of the explanatory variables, hence the marginal effects are discussed. The results indicate that gender, household dependents, employment type, working years, land leasing and market access statistically significantly influence the probability of a farmworker households in the study to diversify their livelihood.

Table 3. 10 Parameter estimates of the Binary Probit regression analysis on livelihood diversification

Independent variables	**Coefficients**	**Robust Std. Error**	**Marginal Effects**
Age	0.005	0.009	0.002
Gender	0.554	0.221	0.218**
Marital status	-0.237	0.208	-0.093
Level of education	0329	0.249	-0.129
Number of dependents	0.134	0.046	0.052**
Employment type	-0.381	0.221	-0.150*
Years of farming experience	-0.033	0.010	-0.013***
Irrigation training	0.093	0.210	0.036
Land leasing	-0.423	0.215	-0.166**
Market access	0.486	0.249	0.191**
Savings	0.158	0.106	0.062
Constant	-0.069	0.547	
n=191 LR X^2 = 113.36 *** Pseudo R^2= 0.14			

Source: Author's computation (2019)

Note: ***, ** and * means the coefficient is statistically significant at 1, 5 and 10% levels, respectively.

Gender statistically significantly influenced ($p<0.05$) livelihood diversification, with a positive coefficient. This implies that the male gender of the respondents leads to increased probability of livelihood diversification from farming activities. The marginal effect displays that males have a 21.8% higher probability of becoming diversified, compared to female-headed households. The result is supported by Kramer and Lambrecht (2019) who affirmed that although rural development programmes were targeted to improve women economic empowerment in agriculture, women preferred to diversify their livelihood from farming activities through investing in non-farm activities due to rural agricultural income variation. The focus group discussion with irrigation farmworker households revealed that due to mutual agreement between household counterparts, most men had migrated to urban areas for formal employment to sustain their household's livelihood by sending remittances. Most female counterparts preferred to remain in the rural area taking care of the rest of the family. Women in the study area play a key role in irrigation activities, and due to women empowerment programmes, females were likely to be offered a plot by their landlords.

In Table 3.10, the number of dependents was found to be statistically significant ($p<0.05$) with a positive coefficient. The implication is that the larger the number of dependents, the more likely a household diversifies its livelihood income from farming activities. The marginal effect displays that one-unit change in number of dependents causes a 5.2% change in chance of irrigation farmworker households becoming diversified. The average number of households' dependents is five members. Oduniyi (2018) reported similarly that family size significantly and positively influences a rural household head to diversify livelihood income. Additionally, research on livelihood diversification by Adepoju and Obayelu (2013) enunciated that in large sized households, limited resources are spread thinly to maintain many people to meet their basic and other needs. Household size increases is also synonymous with more dependents who do not contribute to household income. For household heads to meet their families' basic needs, they will engage in a combination off-farm and non-farm strategies relative to the livelihood choice of the farm strategy only.

Type of farmworker was statistically significant ($p<0.1$) with a negative coefficient. The implication is that the variable type of farmworker negatively influences the choice of livelihood diversification. The marginal effect displays that type of irrigation farmworker household causes

a -15% change, in the chance of irrigation farmworker households becoming diversified. The focus group discussion with participants revealed that the contractual agreement between an irrigation farmworker household and the farm owner, limited the probability of farmworkers from diversifying their livelihood from non-farming activities. There were more seasonal farmworkers than permanent farmworkers in Tshiombo Irrigation Scheme, accounting for 67 and 33%, respectively.

Years of farming experience was statistically significant ($p<0.01$) with a negative coefficient. The implication is that the number of years of farming experience decreases the probability of livelihood diversification. The more experience in farming, the lower the diversification of livelihood as the household head would have better experience dealing with the unpredictability of farming. The marginal effect displays that a year change in farming experience causes a -1.3% of irrigation farmworker households becoming diversified. Oduniyi (2018) reported similar results. Manjur *et al.* (2014) also explained that younger farmworker households tend to engage on off-farm activities than older ones.

Land leasing (Table 3.10) was found to be statistically significant ($p<0.05$) with a negative coefficient. The marginal effect indicates that leasing land causes a -16.6% of irrigation farmworker households becoming diversified. The implication is that household head renting irrigable plots from the employer, lower the chances of a respondent of attaining other income strategies.

Access the market was statistically significant ($p<0.05$) with a positive coefficient, meaning that access to the market increases the probability of the respondent to diversify their livelihood from farming activities. The marginal effect displays that access to the market or town leads to a 19.1% higher chance of irrigation farmworker households becoming diversified.

3.8 Conclusion

The paper examined the livelihood diversification strategies employed by farmworkers of Tshiombo Irrigation Scheme of Vhembe District, South Africa. The representative sample of 191 among the rural irrigation farmworker household heads combined several livelihood strategies to diversify from farming activities. They combined livelihood activities, such as remittance, welfare-grant, selling livestock, selling irrigated crops, part-time paid labour, trading and hawking, and artisan activities to obtain their livelihood strategies and increased food security. Among the

factors influencing diversification status at a household level; gender, number of dependents, and market access play a positive significant role in enhancing the household likelihood. However, type of farmworker, years of farming, and land leasing significantly reduced the likelihood of diversifying livelihood activities. These findings suggest that policy makers should design policies that are closely related to the irrigation farmworkers household-level characteristic. Policymakers should also design policies that encourage tribal leaders in the study area to give farm owners formal and non-formal employers to lend irrigation scheme plots to their employees as an addition to the adaptation to livelihood diversification strategies. The next chapter presents chapter four (4), determining factors that influence the choice of livelihood diversification strategies among farmworker households of Tshiombo Irrigation Scheme.

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CHAPTER 4: FACTORS INFLUENCING CHOICE OF LIVELIHOOD DIVERSIFICATION STRATEGIES AMONG SMALLHOLDER IRRIGATION SCHEME FARMWORKER HOUSEHOLDS': A CASE OF TSHIOMBO, VHEMBE DISTRICT, SOUTH AFRICA

4.1 Abstract

Farmworkers engage and pursue diverse off-farm livelihood activities to cope with challenges such as poverty and food insecurity. Income obtained from farm work alone cannot sustain the farmworker households. Without adopting diversified livelihood strategies, attaining household food security and improvement of livelihood security could not be achieved. The objective of the study was to analyse factors that influence the choice of livelihood diversification strategies among Tshiombo Irrigation Scheme farmworker households. A Multinomial Logistic regression model was used to analyse the factors that influence choice of livelihood strategies among the 191 respondents. Data analysis revealed that a combination of on-farm and non-farm activities are the leading livelihood strategy among irrigation farmworker households (43.5%), followed by on-farm alone (24.1%), on-farm off-farm and non-farm combined (19.4%) and on-farm and off-farm (13.1%). Regression results showed that age of the farmworker ($p<0.01$), marital status of the farmworker ($p<0.01$) and ($p<0.5$), dependents of the farmworker ($p<0.05$), leasing land from employer ($p<0.05$) and ($p<0.05$), years of farming experience ($p<0.1$) and ($p<0.01$), agricultural training ($p<0.05$) and access to the market were the statistically significant factors that influence the choice of livelihood strategies among Tshiombo Irrigation Scheme farmworker households. The findings suggest that policymakers need to reflect on the most suitable ways of supporting livelihood choices among irrigation farmworker households. Due to few farm owners leasing or renting out land to farmworkers in the study area, rural development programmes should promote non-farm and off-farm activities in rural areas as they may positively impact the income-generating capacity of farmworkers.

Keywords: Farmworkers, Multinomial logistic model, Non-farm, Income-generating activity, On-farm, Off-farm.

4.2 Introduction

The livelihood choices households make have recently attracted the attention of researchers. In the last decade research has focused on livelihood strategies and choices. However, such studies have not been the case in South Africa. One of the contributions of the sustainable livelihoods approach is to deepen the understanding of poverty in rural Africa through empirical studies (Gebru *et al.,* 2018). Research into the nature of rural poverty utilizing the livelihoods approach uncovers aspects of rural poverty that have not been well understood or have been neglected in mainstream policy discourses (Ellis and Allison, 2004). According to this approach, diversification can protect vulnerable households from environmental and economic shocks, trends, and seasonality. Livelihoods diversification strategies are complex and include enterprise development, non-income and off-farm income activities (Ellis and Allison, 2004; Eneyew and Bekele, 2012). Livelihood strategies are the combination of activities that people choose to undertake to achieve their livelihood goals. Rural people are involved in several strategies, including farming intensification activities or non-farming activities to create employment opportunities to attain their livelihoods goal (Gebru *et al.,* 2018).

Agriculture represents the main economic livelihood activity for many rural households in sub-Saharan Africa (Dzanku, 2015). Agriculture hires the largest percentage of the workforce and contributes to the prime quota of household income (Zezza *et al.,* 2009; Davis *et al.,* 2010). Rural settlers in South Africa use natural resources to provide their families with food (Palmioli *et al.,* 2020). Farming activities in rural South Africa remain important for household livelihood diversification and income stability (Samuel and Sylvia, 2019). In general, rural households access food through smallholder farming, informal markets and from neighbouring households (Baiphethi and Jacobs, 2009). In South Africa, rural household heads commonly participate in informal markets, which are common across the agro-food value chain (Baloyi, 2010). Baiphethi and Jacobs (2009) showed that Tshakhuma and Khumbe informal markets in Vhembe District comprises of hawkers who reported that income from the informal market trading rather than subsistence agriculture is a only source of stabilizing their household livelihood.

The contribution made by livelihood diversification to rural livelihoods has often been ignored by policymakers who have chosen to focus their support on agriculture. Understanding the local context of irrigation farmworker household livelihoods is not only necessary to ensure appropriate

development strategies but can also be the basis for monitoring and evaluation, and a means of assessing the potential for replication in other contexts. The aim of the study was to analyse determinants of the choice of livelihood strategies among irrigation farmworker households in the study area.

4.3 Conceptual framework

The central concept of this study is sustainable livelihoods. Chambers and Conway (1992) defined livelihoods as comprising people, their capabilities and their means of living, including food, income and assets. The concept of sustainable livelihoods has been applied in many studies done in developing countries, including African countries (Yobe *et al.,* 2019). The livelihoods framework provides a comprehensive and complex approach to understanding how people make a living. It can be used as a loose guide to a range of issues which are important for livelihoods or it can be thoroughly investigated in all its aspects (Kanji *et al.,* 2005). The livelihood framework emphasizes the understanding of the context within which people live, the assets available to them, livelihood strategies they follow in the face of existing policies and institutions, and livelihood outcomes they intend to achieve (Batterbury, 2016).

The choice of a livelihood strategy depends on the vulnerability context, for instance shocks and livelihood assets (human, natural, physical, financial and social capital). The livelihood assets are human capital such as age, education, gender, health status, household size, dependency ratio and leadership potential. Physical capital comprises the basic infrastructure and producer goods needed to support livelihoods. Social capital, which refers to networks and connectedness. Financial capital like savings, credit, and remittances from family members working outside the home and natural capital which is the natural resource stock (Farrington *et al.,* 2002). Livelihood outcomes are the achievements of livelihood strategies, such as more income, increased well-being, reduced vulnerability, improved food security and more sustainable use of natural resources (Eneyew and Bekele, 2012).

4.4 Research methodology

The data collection, population and sampling procedures of this study are presented in Chapter 3 (3.4.2) and (3.4.3).

4.5 Method of data analysis

4.5.1 Multinomial logistic model

A Multinomial Logit model (MLN) was employed in analysing the factors influencing the choice of livelihood strategies among Tshiombo Irrigation Scheme farmworkers. Statistical Package for Social Scientists (SPSS version 26 of 2019) software package was used for data manipulation. The model is selected because the responses of households for livelihood strategies were expected to be polytomous. Logistic regression can be extended to handle responses that are polytomous, for instance, responses greater than two categories (Anshiso and Shiferaw, 2016; Tizazu *et al*., 2019).

One of the underlying motivations for the household's alternative livelihood strategies is to maximize utility from expected earnings of strategy (Tizazu *et al*., 2019). The model determining the probability that the household chooses an alternative livelihood strategy set "$\boldsymbol{a}$" is the MNL, if the sets are not ordered (Yamane, 1967). The model exhibits a superior ability to predict livelihood diversification and picking up the differences between the livelihood's strategies of rural households (Hussain *et al*., 2017; Tizazu *et al*., 2019). However, for one to use MNL, the households have to be clustered into different categories and the basic assumption is that households in a given category participate in some given livelihood strategies, and hence, cannot participate in strategies that are chosen by households in another category (Chan, 2005).

The probability associated with choice of a livelihood strategy of a rural household is denoted by p_{ij} (j = 1–4), where *i* represents the household; j(1) = represents the ~~g~~ household choosing on-farm alone; j(2) = represents the household choosing on-farm + off-farm; j(3) = represents the household choosing on-farm + non-farm; and j(4) = represents the labouring household choosing on-farm + off-farm + non-farm income-generating activities. The multinomial logistic model is specified as follows, if the unobserved portion of the utility (εn) is identically and independently distributed (iid) across alternatives according to Train (2003), cited by Yobe (2016).

The probability, that a household with characteristics x choose livelihood strategy j , p_{ij} is modeled as:

$$p_{ij} = \frac{\exp(xi\beta j)}{\sum_{j=0}^{j}\exp(xi\beta j)} j = 0 \quad \text{..... (2)}$$

With the requirement of $\sum_{j=0}^{j} p_{ij=1}$ for any i

Where:

p_{ij}= probability representing the i^{th}respondent's chance of falling into category j

x= Predictors of response probabilities

β_j= Covariate effects specific to j^{th} response category with the category as the reference

Then through normalization of the model, it is assumed that β_1=0 (this arises because probabilities sum to 1, so only J parameter vectors are needed to determine the J + 1 probabilities), (Anshiso and Shiferaw, 2016; Tizazu *et* al., 2019) so that exp ($xi\beta j$) =1, implying that the generalized equation (1) above is equivalent to:

$p_{ij} = \frac{e^{(Xi\beta j)}}{1+\sum_{=1}^{4} e^{(x\prime i\beta j)}}$, for ($j = 1,2,3,4$) and $p_{i1} = \frac{1}{1+\sum_{j=1}^{4} e^{(x\prime i\beta j)}}$ ..... (3)

Similar to binary logit model it implies that we can compute *J* log-odds ratios which are specified as;

$ln\frac{p_{ij}}{p_{ij}} = x'(\beta_j - \beta_i) = x'\beta_j$, if $j = 0$..... (4)

Definition of model variables

Table 4. 1 Description of dependent variables used in the MLR model

Choices (*j*)	**Livelihood diversification strategies**
j_1, ON	On-farm alone
j_2, ON+OFF	On-farm + off-farm
j_3, ON+NF	On-farm + non-farm
J_4, ON + OFF+ NF	On-farm + off-farm + non-farm

Source: Author's computation (2019)

Table 4. 2 Explanatory variables used in the (MLR) model

Variables	Unit of measurement	Expected Sign
Age	Years	+
Gender	Male = 1; Female = 0	+
Marital status	Married =1; Single = 0	-
Level of education	1 = Formal education; 0 = Non-formal education	+
Number of dependents	Number of dependents in a household	+
Employment type	1= Permanent farmworker; 0= Seasonal farmworker	+/-
Years of working in farms	Years	+
Leasing land from employer	Yes = 1; No = 0	+
Savings	Rands (R)	+
Agricultural training	Yes = 1; No = 0	+
Market access	Yes = 1; No = 0	+

Source: Author's computation (2019)

4.7 Results and discussion

4.7.1 Livelihood diversification and household parameters

This section presents descriptive statistics to highlight factors that influence the choice of livelihood diversification strategies. The chi-square results indicate whether there has been an association between the irrigation farmworker household's livelihood diversification with different socio-economic parameters. The chi-square results in Table 4.3 show an association between marital status and livelihood diversification at $p<0.01$. This suggests that a household-head with a counterpart could diversify their livelihood income generating activities and combine their remuneration to sustain their household. The level of education showed statistical significance with livelihood diversification at ($p<0.05$). A study conducted by Khatun and Roy (2012) noted that investing in education has the potential to assist the rural households in getting alternative income. An improvement in educational level therefore increases the probability of engagement in livelihood diversification strategies to sustain households. Leasing land by

irrigation farmworker has proven to statistically influence livelihood diversification at p<0.01. This suggests that an opportunity of farmworker households accessing irrigatable plots from their employers has a direct influence of respondents producing their own cash-crops to generate more income and buy other household necessities.

Table 4. 3 Association between livelihood diversification and socio-economic parameters

Variable	Measure	Livelihood diversification strategies				*n*	X^2
		On- farm alone (n=46) %	On-farm + non-farm (n= 83) %	On-farm + off-farm (n= 25) %	On-farm + off-farm + non-farm (n= 37) %		
Gender	Female	21.7	46.7	12.5	19.2	120	ns
	Male	28.2	38.0	14.1	19.7	71	
Marital status	Single	16.0	54.0	12.0	18.0	100	***
	Married	33.0	31.9	14.3	20.9	91	
Level of education	No formal education	22.4	48.2	18.8	10.6	85	**
	Formal education	25.5	39.6	8.5	26.4	106	
Type of farmworker	Seasonal farmworker	24.2	42.2	12.5	21.1	128	ns
	Permanent farmworker	23.8	46.0	14.3	15.9	63	
Leasing land from employer	No	18.2	53.2	19.5	9.1	77	***
	Yes	28.1	36.8	8.8	26.3	114	
Agricultural training	No	25.7	50.0	7.1	17.1	70	ns
	Yes	23.1	39.7	16.5	20.7	121	
Market access	No	24.2	41.8	12.4	21.6	153	ns
	Yes	23.7	50.0	15.8	10.5	38	

Source: Author's computation (2019)

Note: *** and ** means the coefficient is statistically significant at 1 and 5% and level respectively, ns= not significant, *n*=sample size, X^2= chi-square.

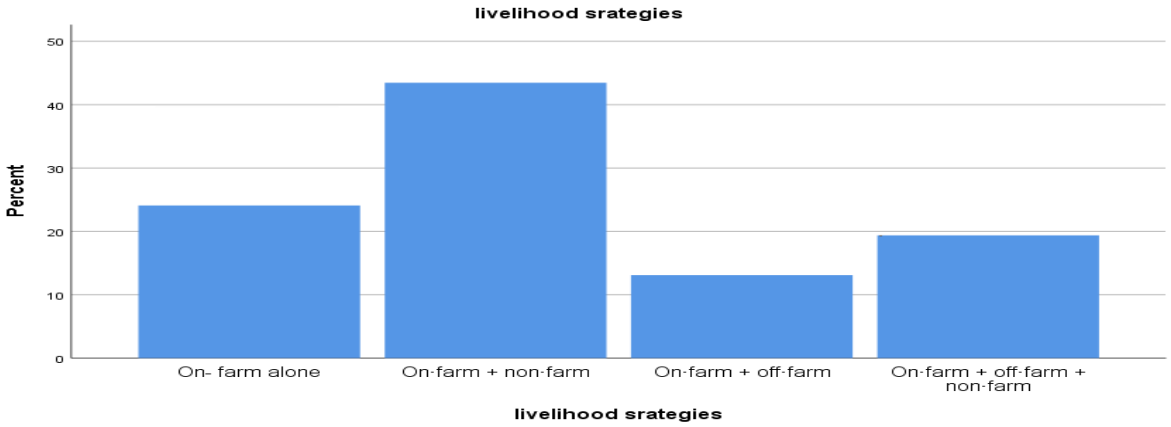
One-way ANOVA results confirm that the variation in mean age of the irrigation farmworker households is significantly different among the livelihood diversification strategies ($p<0.01$). The mean age for on-farm alone, on-farm combined with non-farm, on-farm combined with off-farm and on-farm with a combination of off-farm and non-farm is 48.41, 47.06, 49.28 and 39.95 years respectively (Table 4.4). Similar results were found in Southern Ethiopia (Eneyew, 2012).

Table 4. 4 One-way Anova test results for labourer' livelihood diversification determinants

Variables	On- farm alone	On-farm + non-farm	On-farm + off-farm	On-farm + off-farm + non-farm	F Sig. level
Mean Age	48.41	47.06	49.28	39.95	***
Mean Number of dependents	5.08	5.48	4.68	4.81	ns
Mean Years of farming experience	17.30	14.73	18.76	19.45	ns

Source: Author's computation (2019)
Note: *** means the coefficient is statistically significant at 1% and level, ns= not significant.

Figure 4. 1 Farmworker participation in livelihood strategies



Source: Author's computation (2019)

Results showed that 43.5, 24.1, 19.4 and 13.1% of the farmworkers' households diversified into on-farm & non-farm, on-farm & on-farm alone, on-farm & off-farm & non-farm and on-farm & off-farm income-generating livelihood strategies, respectively (Figure 4.1). The results revealed

that most of the farmworkers households diversified their livelihoods into more than one income-generating activity. Gebru *et al.* (2018) also emphasised that due to the unstable and meagre agricultural context of sub-Saharan Africa, farm income alone cannot feed the ever-increasing population.

Before running the MNL model, the explanatory variables were checked for multicollinearity using Variation Inflation Factor (VIF) and contingency coefficient (Table 3.9). The variables had high level of tolerance occurred among them, which indicated that there was no serious multicollinearity among the variables used in the analysis. The Cox and Snell square and Nagelkerke R square were not statistically significant. This indicated that the data fit the model well.

4.7.2 Factors that influence the choice of livelihood diversification strategies

The MLM regression results (Table 4.4) revealed seven independent variables to influence irrigation farmworker households' choices of livelihood diversification strategies are statistically significantly. The identified variables were; age of the respondent, number of dependents of the respondent, leasing land from an employer by the respondent, marital status, years of farming experience by the respondent, respondents taking irrigation courses and respondents having access to tarred roads to the market at different probability levels. Marginal effects were determined after MNL estimation. Therefore, the interpretation of significant variables was based on marginal effects.

The model outcome shows that the age of irrigation farmworker households significantly and negatively ($p<0.01$) influenced the participation of the respondents in a combination of on-farm plus off-farm and non-farm income diversified livelihood strategies (Table 4.6). This means that an increase in the number of household members below 15 and above 64 years, who are unable to engage in some activities, affects livelihood diversification negatively. This result is inconsonance with the findings of a study conducted by Asmah (2011) in Ghana, that age decreases the ability of the household to engage in a combination of livelihood diversification strategy thus negatively affecting rural household welfare and food security status.

Table 4. 5 Result of Multinomial Logistic regression model

Livelihood diversification strategies adopted by the irrigation farmworker households

Independent Variables	On-farm only			On-farm & off-farm			On-farm & off-farm & non-farm		
	Coef.	**Std. Err.**	**ME**	**Coef.**	**Std. Err.**	**ME**	**Coef.**	**Std. Err.**	**ME**
Age	-0.002	0.020	0.003	-0.024	0.025	0.007	-0.081	0.025	-0.001***
Gender	0.128	0.442	0.016	0.564	0.536	-0.031	-0.254	0.517	0.060
Marital status	1.358	0.430	0.209***	0.409	0.536	-0.259	1.039	0.517	-0.017**
Level of education	0.297	0.502	0.065	-0.860	0.624	-0.021	0.518	0.579	-0.109
Number of dependents	-0.113	0.093	-0.009	-0.226	0.115	0.037**	-0.157	0.111	-0.016
Employment type	0.461	0.464	0.073	-0.005	0.542	-0.090	0.454	0.563	-0.022
Leasing land from employer	-0.958	0.449	-0.147**	0.582	0.531	0.164	-1.354	0.573	0.114**
Farming experience	0.030	0.021	0.001	0.047	0.026	-0.012	0.089	0.027	0.002***
Agricultural training	-0.105	0.424	-0.061	1.307	0.619	0.058**	0.128	0.495	0.119
Savings	0.213	0.212	0.016	0.338	0.259	-0.071	0.382	0.256	0.021
Market access	-0.571	0.513	-0.074	0.233	0.626	0.131	1.416	0.670	0.064**
Constant	-0.951	1.09		-1.163	1.464		1.564	1.221	
Number of observations =191 LR X^2 = -207.89*** Pseudo R^2 = 0.16									

Source: Author's computation (2019)

The reference category is on-farm & non-farm

Note: ***, ** and * means the coefficient is statistically significant at 1, 5 and 10% levels, respectively.

Marital status significantly and positively ($p<0.01$) and ($p<0.5$) influenced the decision of the irrigation farmworker households to participate in on-farm only and a combination of on-farm & off-farm &non-farm income-generating activities, respectively. The results of the odds-ratio depict that by keeping other influential factors constant, the odds-ratio in favour of the likelihood of the irrigation farmworker households to choose on-farm only and the combination of on-farm, off-farm and non-farm livelihood diversification strategy will increase by 20.9 and 1.7% respectively. The possible explanation is that irrigation farmworker households with counterparts who work in the same field have a chance to combine their income to improve their welfare and sustain their livelihood. However, the result was not inconsonance with the report of Adeniyi *et al.* (2016) who pointed that marital status was negatively significant and implied that married respondents have lesser probability of having better livelihood because married women are often limited to taking part in other livelihood activities due to household and marital roles. In addition, Gradl *et al.* (2012) stated that the main source of labour in rural communities is family labour. Therefore, in married households, one of the partners is most likely to attend to household subsistence production. Thus, married households are less likely to diversify their income.

The number of dependents in a household was found to have significantly and negatively ($p<0.05$) influenced the irrigation farmworker household's livelihood diversification into a combination of on-farm and off-farm income-generating activities. The interpretation of the odds-ratio implies that if other influencing factors are held constant, the odds-ratio in favour of the probability of an irrigation farmworker household engaging in on-farm plus off-farm income-generating livelihood strategy decreases by 3.7%. This is inconsonance with the findings of Khatun and Roy (2012), who asserted that dependent family size and involvement in agriculture plus off-farm plus non-farm activities negatively affected rural household livelihood diversification. The rationale behind this might be that an increase in dependency on the household, leads to shortage of working hands to earn from diversified activities to fulfil the household needs and affect livelihood diversification negatively.

The model outcome shows that irrigation farmworker households leasing land from their employers in the irrigation scheme adds significantly to the share of total income received by participating in various farm income diversification strategies. However, contrary to prior expectation, Table 4.6, revealed that irrigation farmworker households leasing land from their

employers significantly and negatively ($p<0.05$) and ($p<0.05$) influenced the participation of irrigation farmworker households in on-farm only and a combination of on-farm plus off-farm and non-farm income diversified livelihood strategies. The interpretation of the odds-ratio depicted that, if other factors are held constant, the odds-ratio in favour of the probability of the irrigation farmworker households to diversify into on-farm only and a combination of on-farm plus off-farm and non-farm income diversified livelihood strategies, decreases by 14.7 and 11.4% respectively. Although one would anticipate rural poor and landless irrigation farmworker households around the study area to benefit from lower food prices and wages from working in the irrigation scheme, during the focus group discussion, some participants revealed renting irrigation land plots is challenging. This is because acquisition of land from their employers, due to several regulations and water competition between the farmworker and the landlord, act as a barrier to generating more income.

As expected, years of farming experience by farmworkers (Table 4.2) positively and significantly ($p<0.1$) and ($p<0.01$) influenced the participation of the respondents in combination of on-farm plus off-farm and the combination of on-farm plus off-farm plus non-farm income diversified livelihood strategies. The interpretation of the odds-ratio in favour of the probability of the respondents to diversify into a combination of on-farm plus off-farm and a combination of on-farm plus off-farm and non-farm income diversified livelihood strategies, increase by 1.2 and 0.2% respectively. A possible explanation is that, irrigation farmworker households who have been working in the agricultural field for a long period, know how to adjusted when faced by economic challenges such as retrenchment or when the farm owner has passed on, off-season unemployment and general increases in the price of basic needs, food in particular, such as maize meal and meat.

As expected, the model outcome shows that farmworkers who have access to attend an irrigation training positively and significantly ($p<0.05$) influenced the participation of the respondents in combination of on-farm plus off-farm income diversified livelihood strategies. The interpretation of the odds-ratio implies that if other influencing factors are held constant, the odds-ratio in favour of the probability of a farmworker household-head choosing combination of on-farm plus off-farm income diversified livelihood strategies, increases by 5.8%. A possible explanation is that the skills acquired from the course assists irrigation farmworker households to obtain more income since the participation in irrigation helps them in strengthening their economic capacity to

participate in different livelihood diversification activities. A study conducted by Gebru *et al.* (2018) assert that household heads who have access to potential small-scale irrigation and use it properly make surplus production and better income out of it. This therefore helps them to cope with failure of rain dependent crop production compared to nonusers of irrigation due to risks associated with drought and other climate change induced factors.

The model outcome shows that market access was found to be one of the most important determinants of livelihood diversification in the study area. As expected in Table 4.5, the variable, access to the market was found to have a positive relationship and statistically significant ($p<0.05$) with irrigation farmworker households diversifying their livelihoods into a combination of on-farm plus off-farm and non-farm generating activities. The result of the odds-ratio depicts that, by keeping the influence of other factors constant, the odds-ratio in favour of the likelihood of the irrigation farmworker households to choose a combination of on-farm plus off-farm and non-farm income-generating livelihood diversification strategies will increase by 6.4%. This is in line with the study by Abdissa (2011) and Olalekan and Eyitayo (2015) that households who have been living around and have access to market centres have higher involvement in livelihood diversification and are able to diversify their sources of income than those households living far from market centres.

4.8 Conclusion

Irrigation farmworker households of Tshiombo Irrigation Scheme diversify livelihood with other income sources to achieve their prioritized livelihood objectives. The results of this study revealed that majority of the respondents in the study area diversified their livelihood strategies from on-farm activities based on various choices of livelihood strategies which were categorized into on-farm combined with non-farm, on-farm combined with off-farm and a combination of on-farm combined with off-farm and non-farm income activities. Results of the Multinomial Logistic regression model attested that households' choice and adoption of livelihood diversification strategies were determined by the age of the respondent, marital status of the respondents, access to the market, leasing land from employer, years of farming experience and access to agricultural training, and significantly affected households' choice and adoption of livelihood diversification strategies. Based on this study, it can be concluded that the rural irrigation farmworkers households in the study region are likely to have a diversified livelihood

when they have more experience which comes with age, better livelihood skills developed from training, and more working hands in a household. The findings of this study suggest that policymakers need to reflect on the most suitable ways of supporting livelihood skills development among rural farmworker households. Due to the slow adoption of farm owners leasing or renting land to irrigation farmworker households in the study area, rural development policies should emphasise promoting non-farm and off-farm activities in rural areas as it may have positive effects on income-generating capacity. The next chapter presents chapter five (5), determining the determinants of farmworker households' food security status of Tshiombo Irrigation Scheme.

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CHAPTER 5: AN ANALYSIS OF THE DETERMINANTS OF IRRIGATION FARMWORKER HOUSEHOLDS' FOOD SECURITY STATUS: A CASE OF TSHIOMBO IRRIGATION SCHEME, SOUTH AFRICA

5.1 Abstract

Food security has become one of the most important concerns for the world, as more people are living in poverty and hunger. Food security and nutritional status of irrigation schemes farmworkers in South Africa is not extensively documented. Although the national productivity of subsistence or smallholder agriculture ensures long-term food security, farmworkers are the most vulnerable group regarding their health and nutrition status than any categories of workers. Furthermore, farmworkers in South Africa earn the lowest wages and live in poverty. It is important to have a clear understanding of food security status to guide policymakers and planners to devise effective policies that enhance food security among irrigation farmworkers' households. The study was carried out to assess the determinants of food security among irrigation employees who either rent or do not rent irrigation plots from their employers in Tshiombo Irrigation Scheme, Limpopo Province. Data were collected from 191 randomly selected farmworkers. The Household Food Insecurity Access Scale was utilized to determine the extent of food security among farmworkers. Analytical techniques employed included descriptive statistics to characterize the farmworkers' households and Ordered Probit model to examine the determinants of food security among the farmworkers' households. Among the variables considered in the model, land size ($p<0.05$), land leasing ($p<0.01$), total household expenditure ($p<0.05$) and food stored by farmworker ($p<0.1$) were found to significantly influence irrigation farmworker household food security status. These findings suggest that policymakers should design policies that encourage strategies that enhance irrigation farmworkers household income through the engagement in informal land lease contracts to encourage land rental market participation by both farm employers and farmworkers in rural areas of Tshiombo Village.

Keywords: Farm workers, food security status**,** Limpopo Province, Ordered Probit model.

5.2 Introduction

Globally, food security has been an outstanding and considered issue on the agricultural policy agenda since 1970 (Bashir and Schilizzi, 2013). Smallholder and commercial farming are the pillars of South Africa's primary agricultural production (DAFF, 2015). While the country has an impressive statistic of self-sufficiency and is one of the world's six net food exporter nations (Chikazunga and Paradza, 2013), large numbers of households within the country are food insecure and live below the food poverty line (Altman *et al.,* 2009). One in four South Africans experience hunger due to poverty, low paid work and high food prices (Teka Tsegay *et al.*, 2014). Statistics South Africa (2019) released a report that looked at poverty and inequality trends in South Africa between 2006 and 2015. The report indicated that 25.2% of the population lived below the poverty line of R4 41 per person per month in 2015, compared to almost a third (28.4%) in 2006 (StatsSA, 2019). Irrigation farmworkers earn the lowest wage among all legally employed individuals in the agricultural sector in South Africa (Devereux and Tavener-Smith, 2019). The Government is promoting and supporting smallholder irrigation in former homelands to create jobs, reduce poverty and enhance economic growth (Chikazunga and Paradza, 2013). Unfortunately, there is not much research computed concerning food security and nutrition status of irrigation scheme farmworkers in South Africa (Devereux and Tavener-Smith, 2019).

Food insecurity among farmworkers in South Africa is rising. In Western Cape, the majority of farmworkers lost their jobs after the farmworkers' strike of 2013 with many describing how their food supplies were exhausted by mid-week, forcing them to skip meals due to low wages and during though periods ending up eating porridge twice a day (Wilderman, 2015). Countrywide, the agricultural labour force has been shifting away from workers living on farms with permanent contracts, towards seasonal or casual workers living on farms with short-term contracts or no contracts at all (Devereux and Tavener-Smith, 2019). Seasonal and casual farmworkers are more vulnerable than permanent farmworkers to food insecurity as they are employed only during the agricultural season and often at below the legislated minimum wage rate (Devereux and Tavener-Smith, 2019). The purpose of this study was to investigate the determinants of food security and generate evidence for policy decisions where interventions are required to alleviate food insecurity among both land-leasing and non-leasing farmworkers of Tshiombo Irrigation Scheme in Limpopo Province.

5.3 Research methodology

The data collection, population and sampling procedure of this study are presented in Chapter 3 (3.4.2) and (3.4.3).

5.4 Data analytical method

5.4.1 Food security measurement - Household Food Insecurity Access Scale (HFIAS)

To determine food insecurity among irrigation farmworker households, a Household Food Insecurity Access Scale (HFIAS) questionnaire composed of nine questions was used as detailed in the HFIAS Indicator Guide v3 (Coates *et al*., 2007). The nine questions represented a generally increasing level of severity of food insecurity and nine frequency of occurrence questions which were asked as a follow-up to each occurrence question to determine how often the condition occurred (Coates *et al*., 2007). An irrigation farmworker household-head was asked to describe how often a condition had occurred in the past 30 days, if the response to the condition described in the corresponding occurrence question was yes. The four categories of food security status comprise of the following as detailed in the HFIAS Indicator Guide v3 (Coates *et al*., 2007):

- A food secure household experiences none of the food insecurity (access) conditions, or just experiences worry, but rarely. HFIA category = 1 if [(Q1a = 0 or Q1a = 1) and Q2 = 0 and Q3 = 0 and Q4 = 0 and Q5 = 0 and Q6 = 0 and Q7 = 0 and Q8 = 0 and Q9 = 0].

- A mildly food insecure household sometimes or often worries about not having enough food and is unable to eat preferred foods, or eat a more monotonous diet than desired, or, however rarely, eat some foods considered undesirable. HFIA category = 2 if [(Q1a = 2 or Q1a = 3 or Q2a = 1 or Q2a = 2 or Q2a = 3 or Q3a = 1 or Q4a = 1) and Q5 = 0 and Q6 = 0 and Q7 = 0 and Q8 = 0 and Q9 = 0].

- A moderately food insecure household sacrifice quality more frequently, by eating a monotonous diet, or, sometimes or often, undesirable foods. They sometimes, however rarely, start cutting back on quantity by reducing the size or number of meals, although they do not experience any of the three main severe conditions. HFIA category = 3 if [(Q3a = 2 or Q3a = 3 or Q4a = 2 or Q4a = 3 or Q5a = 1 or Q5a = 2 or Q6a = 1 or Q6a = 2) and Q7 = 0 and Q8 = 0 and Q9 = 0].

- A severely food insecure household goes further to cutting down on meal size or on the number of meals, and/or experiences any of the three most severe conditions (running out of food, going to bed hungry, or going the whole day and night without eating). HFIA category = 4 if [Q5a = 3 or Q6a = 3 or Q7a = 1 or Q7a = 2 or Q7a = 3 or Q8a = 1 or Q8a = 2 or Q8a = 3 or Q9a = 1 or Q9a = 2 or Q9a = 3] (Coates *et al*., 2007).

5.4.2 Estimating determinants of household food security: Ordered Probit Model

The Ordered Probit is suitable for modelling with an ordered categorical dependent variable and determines factors that will influence farm worker's food security status. The dependent variable in this study is household food security, grouped into four ordered categories. The four categories were formulated, in that during a survey a household can fall into any one of the four categories depending on the household's socio-economic condition. The categories are Q_1 (food secure), Q_2 (mildly food insecure), Q_3 (moderately food insecure) and Q_4 (severely food insecure).

The respective category for food security is unobserved and is denoted by the latent variable Q_i*. The latent equation below models how Q_i* varies with personal characteristics.

$Q_i^* = fX_i$ …… (1)

Where:

Q_i*measures the difference in the value derived by individual *i* from either food secure or mildly food secure or moderately food insecure or severely food insecure.

i = 1, 2, 3……. n) n represents the number of respondents. Each individual *i* belongs to one of the four groups.

X is a vector of exogenous variables.

Taking the value of 4 if the household was severely food insecure and 1 if household was food secure, the implied probabilities are obtained as:

Pr $\{Q_i = 1| X_i\} = \Phi (-X_i\beta)$,

Pr $\{ Q_i= 2| X_i\} = \Phi (\mu_2 -X_i\beta) - \Phi (\mu -X_i\beta)$,

Pr $\{Q_i = 3| X_i\} = \Phi (\mu_3 –X_i\beta) - \Phi (\mu_2 – X_i\beta)$,

Pr $\{Q_i = 4| X_i\} = 1 - \Phi (\mu_3 - X_i\beta)$. …… (2) Following Greene (2003)

Where μ_i is the unknown parameter that is estimated jointly with β. Estimation is based upon the maximum likelihood where the above probabilities enter the likelihood function. The interpretation of the β coefficients is in terms of the underlying latent variable model in equation.

The probability of households being found between Q_1 and Q_4 can be written as:

$$Pr\ (Q_i = 1) = \Phi\ (X_i\beta_1) \quad \ldots\ldots (3)$$

Where $\Phi\ (\cdot)$ is the cumulative distribution function (cdf) of the standard normal

5.5 Variables and working hypothesis

The Ordered Probit model was used to determine farmworkers characteristics that predict their food security status. The farmworker household food security determinants were obtained through a review of literature. A description of the explanatory variables used in the Ordered Probit model and the expected signs of the potential explanatory variables are provided in Table 5.1.

The coefficients of the Ordered Probit model do not represent the magnitude of the effects of the explanatory variables. A positive value indicates an increase in the food insecurity prevalence, which implies an increase in the likelihood that a household would be food insecure, while a negative coefficient implies a likelihood that a household would be less food insecure.

Table 5. 1 Description of independent variables used in the model

Variables	Measures	Expected sign
Age	Years	-
Gender	Male = 1; Female = 0	-
Marital status	Married =1; Single = 0	+
Level of education	1 = Formal education; 0 = Non- formal education	-
Number of dependents	Number of dependents	-
Leasing land from employer	Yes = 1; No = 0	-
Land size	Hectares	-
Food storage	Yes = 1; No = 0	-
Total monthly income	Rand (R)	-
Total household expenditure	Rand (R)	+

Source: Author's computation (2019)

Age of the household head is a continuous variable measured in years. A negative effect is expected to influence household food security. The more experienced the household head is, as expressed in the age of the head of household, the less chances for a household to be food insecure (Agidew and Singh, 2018).

Gender of the household head is a dummy variable which takes the value of 1 if the respondent is male and 0 if the respondent is female. Females have a high dependency and are likely to have less chances of taking part in other income-generating activities. In addition, female household heads have few years of education and resources than male household heads. A negative effect on food insecurity is expected (Maziya *et al.,* 2017*)*.

Marital status of the household head is a dummy variable which takes the value 1 if the household head is married and 0 if otherwise. Married household heads may have a larger household size thus prompting the liability of feeding more mouths in the household. A positive effect is expected in the study (Asefach and Nigatu, 2007).

The level of education is a dummy variable which takes the value 1 if the household head has acquired formal education and 0 if otherwise. A negative effect is expected between the level of education and household food security. Food insecurity decreases with higher levels of education achieved by a household head. Education positively influences the household head's production and nutritional decisions (Ibok *et al.*, 2014).

Number of dependents is a continuous variable. A positive effect is expected since a household head with a small household is likely to be food secure and feeding fewer mouths compared to a large household (Van der Veen and Gebrehiwot, 2011).

Land leasing is a dummy variable which takes value of 1 if the household head leases land from an employer and 0 if otherwise. Irrigation farmworkers households who have access to leasing irrigation scheme plots from their employers are food secured than those who do not lease. Therefore, a negative effect is expected in the study.

Food storage is a dummy variable which takes 1 if the household head stores food for emergencies to alleviate any future malnutrition shocks, drought or high food prices. A negative effect is expected between food storage and household head food security. Land size is a continuous variable. In this study farm size is expected to negatively affect household head food insecurity.

5.6 Results and discussion

5.6.1 Irrigation farmworker household's demographics

The sample of 191 irrigation farmworker households was dominated by female respondents (62.8%). Middle-age irrigation farmworkers dominated in Tshiombo Irrigation Scheme with an average of 46 years for both males and females. Most of the respondents surveyed resided in households with more than five members, often a spouse or cohabiting partner and dependents. About 55.5% of the respondents had acquired formal education and 44.5% had no formal schooling. Even though most of the survey irrigation farmworker households were food secure at 51.8%, 7.3% were mildly food insecure, 19.9% were moderately food insecure, while 20.9% had severely food insecure.

5.6.2 Determinants of irrigation farmworker household food insecurity descriptive statistics

This section presents descriptive statistics to highlight factors which determine irrigation farmworker household's food insecurity. The chi-square results indicate whether there has been an association between irrigation farmworker household's food securities and different socio-economic parameters.

Table 5.2 indicates the presence of a strong association between irrigation farmworker household's food security status and owning a home garden ($p<0.01$). The results respectively indicate that 58% and 45.1% irrigation farmworker households who owned a home garden and those who did not own a home garden were food secure, while 10 and 33% irrigation farmworker households who owned a home garden and those who did not own a home garden were severely food insecure. These findings imply that irrigation farmworker households who owned a home garden are more food secure compared with irrigation farmworker households who do not own a home garden.

A statistically significant relationship exists between irrigation farmworker household's food security status and leasing of land from employer ($p<0.01$). Some 64.9 and 32.5% irrigation farmworker households leasing land from their employers and non-leasing irrigation scheme farmworkers were food secured, while 5.3 and 44.2% irrigation farmworker households leasing land from their employers and non-leasing irrigation scheme farmworkers were severely food insecure, respectively. This suggests that irrigation farmworker households' who have acquired

irrigation plots from their employers are more likely to be more food secure than those who do not have access to irrigation scheme plots.

Table 5. 2 Association between food security and socio-economic parameters

Variable	Measure	Food secure (n= 99) (%)	Mildly food insecure (n= 14) (%)	Moderately food insecure (n= 38) (%)	Severely food insecure (n=40) (%)	*n*	X^2
Gender	Female	46.7	6.7	23.3	23.3	120	ns
	Male	60.6	6.8	14.1	16.9	71	
Marital status	Single	45.0	8.0	20.0	27.0	100	ns
	Married	59.3	6.6	19.8	14.3	91	
Level of education	No-formal education	50.6	8.2	14.1	27.1	185	ns
	Formal education	52.8	6.6	24.5	16.0	106	
Employment type	Seasonal farmworker	53.9	5.5	21.1	19.5	128	ns
	Permanent farmworker	47.6	11.1	17.5	23.8	63	
Leasing land from employer	No	32.5	7.0	22.8	44.2	77	***
	Yes	64.9	15.6	7.8	5.3	114	
Own a home garden	No	45.1	8.8	13.2	33.0	91	***
	Yes	58.0	6.0	26.0	10.0	100	
Food stored	No	4.7	7.1	42.4	45.9	66	***
	Yes	89.6	7.5	1.9	0.9	125	

Source: Author's computation (2019)

Note: *** means the coefficient is statistically significant at 1%. ns= not significant, *n*=sample size, X^2= chi-square.

A statistically significant relationship was found between irrigation farmworker household's food security status and food storage ($p<0.01$). The results respectively indicate that 89.6 and 4.7% of irrigation farmworker households storing food and those who did not store food were food secure, while 0.9 and 45.9% and irrigation farmworker households storing food and those who did not

store food were severely food insecure, respectively. This result indicates that farmworkers who secure food for a long time as a form of back-up are more food secure than those who do not store food at all. During the focus group discussion, participants emphasized that food storage secures them with enough food in off-season times when irrigation labour is in low demand.

Table 5.3 presents the one-way Analysis of Variance (ANOVA) test results for irrigation farmworker household's food security and its determinants. The results indicate a statistically significant difference in land size across farmworkers household of different food security status ($p<0.01$). Land ownership is critical for achieving food security, rather that the absolute size of the land. It probably indicates the limit to which farm workers can use the land availed to them. This is probably because of resource constrains for investing in their own land. According to Ibrahim *et al.* (2020) land size reflects own-food production ability and incomes of the households. Therefore, the availability and increase in land size will result in increased food production which ultimately, increases likelihood of household food security.

Table 5.3 One-way ANOVA results for household food security determinants

Variables (Mean)	Food secure	Mildly food insecure	Moderately food secure	Severely food insecure	F Significance
Age (Years)	44.98	51.50	46.42	47.63	ns
Number of dependents	4.96	5.57	5.02	5.57	ns
Land size (ha)	1.94	2.00	1.34	4.00	***
Total household monthly expenditure (ZAR)	2222.82	1894.28	2306.32	2613.75	*
Total household monthly income (ZAR)	2026.36	1557.14	1744.47	1817.30	ns

Source: Author's computation (2019)

Note: ***, * means the coefficient is statistically significant at 1 and 10% level. ns = not statistically significant, ns= not significant.

Table 5.3 indicate a statistically significant difference in total household monthly expenditure farmworkers household food security status ($p<0.1$). The mean monthly expenditure difference

implies that irrigation farmworker household food security status decreases with level of income received.

Multicollinearity test of variables

A multicollinearity test for the independent variables was carried out, showing the level of tolerance and variance inflation factor (VIF) for each independent variable (Table 5.4). The results show that multi-collinearity was not a problem as all VIF values were below 10.

Table 5. 4 Multicollinearity test of variables

Variables	Collinearity statistics	
	Tolerance	**VIF**
Age	0. 670	1.493
Gender	0. 845	1.183
Marital status	0. 861	1.161
Level of education	0. 638	1.566
Number of household dependents	0. 906	1.104
Total household monthly expenditure	0. 767	1.303
Total household monthly income	0. 754	1.326
Food storage	0. 857	1.167
Land size	0. 604	1.656
Leasing land from employer	0. 568	1.759

Source: Author's computation (2019)

5.6.3 Factors influencing irrigation farmworker household food insecurity

The Ordered Probit model was used to determine household characteristics that determine irrigation farmworker households' food security status (Table 5.5). The results indicate that, collectively, all estimated coefficients are statistically significant since LR statistic is statistically significant ($p<0.01$). The coefficients of the Ordered Probit model do not represent the magnitude of the effects of the explanatory variables, the marginal effects are discussed. It follows that a positive value indicates an increase in the HFIAS score, which implies an increase in the likelihood

that a household would be food insecure, while a negative coefficient implies a likelihood that a household would be food secure.The results indicate that irrigation farmworker household's characteristics such as land leasing, food storage, land size and total household expenditure are statistically significant determinants of the respondent's food security status.

The coefficient for leasing land is statistically significant ($p<0.01$), and as expected, has a negative influence on household food insecurity status. This implies that when an irrigation farmworker household has access to leasing land from their employer, the lower the chances of becoming food insecure. The results indicate that if a household head leases land from employer, the household will have a 26.6% of becoming food secure and about 1.8% of becoming mildly food secure. In the same household, if an irrigation farmworker has no access to leasing land, the household has a 19.9% of moving into moderately food insecure and 4.8% chances of dropping into severely food insecure category. Rayner and Kijima (2019) noted that land rental markets play an important role in enhancing income efficiency in the short-run and attempts to eradicate poverty and food insecurity in rural households. In addition, Garedow and Edriss (2014) distinguished that rural households lease farm plots as a safety net from food insecurity shocks.

Contrary to expectation, the results in the model show that land size is statistically significant ($p<0.05$) has a positive influence on household food insecurity. This suggests that when land size increases, so does food insecurity increase among farmworkers. The results indicate that the household with access to land will have a 0.2% chance of becoming food secure and about 0.6% of becoming mildly food secure. In the same household, if a household head does not have access to utilize available land, the household head will move into moderately food insecure 4.2% and 0.8% chances of falling under the severely food insecure category. A possible explanation is that household heads might have a resource constrain for investing in their own land.

As expected, the result also show that total monthly household expenditure is statistically significant ($p<0.05$) and is positively related to household food insecurity. This implies that a one Rand increase in monthly expenditure of household basic needs has a 0.9% chance of remaining food secure. The same households have a 0.68% chance of moving into moderately food insecure and 0.13% probability of falling into severely food insecure categories if there is a Rand shortfall in their monthly total expenditure.

Table 5. 5 Ordered Probit results of determinants of household food security

Independent variables				Marginal Effects			
	Coefficients	Robust St. Error	P>z	Food secure	Mildly food insecure	Moderately food insecure	Severely food insecure
Age	0.009	0.009	0.349	-0.003	0.0003	0.003	0.001
Gender	-0.051	0.233	0.826	0.020	-0.002	-0.015	-0.003
Marital status	-0.206	0.219	0.345	0.081	-0.009	-0.060	-0.012
Level of education	0.240	0.261	0.359	-0.095	0.011	0.070	0.013
Number of dependents	0.013	0.049	0.789	-0.005	0.001	0.003	0.001
Leasing land from employer	-0.691	0.259	0.008	0.266 *	-0.018*	-0.199*	-0.048*
Total monthly income	-0.0001	0.0001	0.159	0.0068	-7.45e-06	-0.0051	-0.0001
Food storage	-3.028	0.273	0.000	0.854*	-0.005*	-0.460*	-0.388*
Land size	0.144	0.057	0.012	0.002 **	0.006**	0.042**	0.008**
Total household expenditure	0.0002	0.0001	0.035	-0.0091 **	9.99e-06**	0.0068**	0.0013**
Number of observations =191 LR X^2 =*** Pseudo R^2= 0.48; Log likelihood = -116.57							

Source: Author's computation (2019)

Note: *and ** means the coefficient is statistically significant at 10% and 1% levels, respectively.

As expected, Table 5.5 indicates that the coefficient of food stored by irrigation farmworker household is statistically significant ($p<0.1$) and has a negative relationship to food insecurity. This suggests that the probability of a household being food secure increases as the household head stores food for long run purposes in this case future shocks such low employment demand of farmworkers during off-seasons. The results indicate that if a household head stored food, the household will have 85.4% chance of becoming food secure and about 0.5% of becoming mildly food secure. In the same household, if a household head does not store food for future shocks, the household has a 46% chance of moving into moderately food insecure and 38.8% of falling under the severely food insecure category. Thamaga-Chitja *et al*. (2004) pointed out that despite the abundant food supply in South Africa, food storage is needed as it plays a significant role in ensuring food availability at a household level.

5.7 Conclusion

The paper sought to assess the determinants of food insecurity among irrigation farmworkers household's in Tshiombo Irrigation Scheme. The descriptive statistics and the model estimates showed that leasing land from employer, food storage, land size and total household monthly expenditure play a significant role and are considered as primary determinants of irrigation farmworkers household's food security. Ordered Probit model results indicated an association between food security among farmworkers and the selected variables. Total household monthly expenditure and land size lowers the probability of a household being food secure. Leasing land and food storage increases the probability of a household being food secure. Therefore, improving household income and promoting irrigation farmworker household heads to rent land from their employers will reduce household food insecurity. These findings suggest that policymakers should design policies that enhance irrigation farmworkers household income through engagement in informal land lease contracts to encourage land rental market participation by both farm employers and farmworkers in rural areas of Tshiombo Village. The last chapter six (6) presents the conclusions and recommendations of the study.

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CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary of the research objectives and methodology

Food insecurity is a cause for concern in rural areas among irrigation farmworker households and needs to be addressed through concrete and clearly defined policies and should emerge with effective implementation strategies. There is a need to rethink current rural development policies and programming. The study general objective was to examine food security status among irrigation farmworker households who lease irrigation plots from their employers and those who do not lease irrigation plots in Tshiombo Irrigation Scheme. The study had three specific objectives. Firstly, the study sought to analyze the livelihood diversification strategies among farmworkers in Tshiombo Irrigation Scheme. Secondly, the study identified factors that influenced the choice of livelihood diversification strategies among Tshiombo Irrigation Scheme farmworkers. Lastly, the study evaluated the determinants of food security status among Tshiombo Irrigation Scheme farmworkers. The study used a mixed method approach of data collection whereby both qualitative and quantitative data were collected. The data used in the study was obtained from both primary and secondary sources. Primary data was obtained from field surveys through structured questionnaires and a focus group discussion. Using a randomly selected sample of 191 farmworkers, data analysis involved both descriptive and econometric techniques. Descriptive statistics provided information related to demographic and socio-economic characteristics of the irrigation farmworkers households. Qualitative and quantitative data was captured and analysed using Statistical Package for Social Scientists (SPSS version 26 of 2019) and STATA 13.0. Descriptive analysis made use of the t-tests, chi-square tests and ANOVA and econometric analysis using Binary Probit model, Multinomial Logit model and Ordered Probit model. Data from a focus group discussion and key informant interviews were used to contextually interpret the results. This chapter presents the main conclusions of the study. Based on the results, the chapter draws policy recommendations and the remaining knowledge gaps and suggests areas of further studies in the future.

6.2 Summary of key results

There were more female-headed irrigation farmworker households (62.8%) than males-headed irrigation farmworker households (37.8%) employed in the irrigation scheme. The probability of irrigation farmworkers households diversifying their livelihood from farm work was 55.5%. Binary Probit regression showed that gender of farmworker, number of household dependents, market access were statistically significant factors that positively influence irrigation farmworkers household livelihood diversification. However, employment type of farmworker, working years and land leasing from employer were statistically significant factors that negatively influence irrigation farm workers household's livelihood diversification in the study area. Multinomial Logistic regression showed that age of the farmworker, marital status of the farmworker, years of farming experience, number of household dependents, leasing land from employer by farmworker, agricultural training and farmworker having access to the market were statistically significant factors that influenced the choice of livelihood diversification strategies among Tshiombo Irrigation Scheme farmworker households. Ordered Probit regression showed that land size and total household expenditure positively influence farmworkers household food security. Food stored and leasing land from employer was found to negatively influence farmworkers household food security status. Food insecurity affected majority farmworkers who could not afford to lease land from their employer's in the irrigation scheme.

Based on the results, more attention must be paid to livelihood diversification of vulnerable and food insecure farmworker households. Livelihood diversification can be a viable strategy to achieve sustainable rural livelihood if farmworkers are capacitated with agricultural training services provided from extension officers. Farm owners should be encouraged to lease irrigation plots and increasing land use so that farmworkers can have more option for diversifying their livelihood strategies among their existing options.

6.3 Policy recommendations

The following recommendations are made based on the study:

- Policy makers should design policies that are sensitive to the irrigation farmworker household characteristics in promoting livelihood diversification.
- The Government should provide an extensive formal training based on livelihood skills development for farmworkers.

- Policymakers need to reflect on the most suitable ways of supporting livelihood diversity among irrigation farmworker households. Rural development strategies should promote non-farm and off-farm activities in rural areas as they could positively affected the income-generating capacity of farmworkers.
- Policies should be designed to encourage the engagement in informal land lease contracts to encourage land rental market participation by both farm employers and employees in smallholder irrigation schemes such as Tshiombo Irrigation Scheme.
- Infrastructure such as roads should be improved to create an effective market and thus encourage more irrigation farmworker households to lease or rent irrigation plots to participate in the agricultural sector.

6.4 Areas for further study

It is vital to note that ongoing research on the issue of food security status among farmworkers in irrigation schemes is needed. To fully understand the complex dynamics of this issue and to acquire more information on the diverse conditions regarding food and nutrition insecurity among farmworkers labouring in smallholder farms, this would include:

- Income inequality was not examined in this study. An examination of income inequality among farmworkers could provide further insight into the welfare of rural farmworker households.
- A comparative investigation of livelihood diversification between irrigation smallholder farmers and employees was not conducted. An examination of income diversification between a farm owner and irrigation scheme farmworkers need to be investigated to see how their results would differ from the present study. This investigation will also provide more insight of the welfare impacts of such activities of both employer and employees.

- A seasonal hunger analysis among farmworkers in rural households needs to be investigated through monthly to yearly monitoring indicators which measure different aspects of food insecurity determine to what extent food security fluctuates.

APPENDICES

Appendix A: Research questionnaire

INFORMED CONSENT LETTER FOR FARM WORKERS ALONG TSHIOMBO IRRIGATION SCHEME

Dear Sir/Madam

My name is Rudzani Vhuyelwani Angel Mudzielwana, a master's student in the department of Food Security under the College of Agriculture, Engineering and Science (University of KwaZulu Natal), under the supervision of Professor P. L. Mafongoya and Professor M Mudhara.

I am conducting a study that seeks to identify food security dimensions among farm workers both (leasing and non-leasing land) in Tshiombo irrigation scheme, Limpopo Province of South Africa. I would like you to participate in this study, your response will be highly appreciated. This study uses the following research tools to obtain the required information:

- Questionnaires
- Focus group discussions

It is essential to know that:

- Participation in this study is voluntary, you can stop participating at any time during the study,
- There will be no payment for participating in the study,
- All information will be kept confidential and will only be used for the purpose of this study,
- Overtime, the information provided will be destroyed when deemed necessary.

For further information about the study please contact the researcher or the study supervisors:

CONTACT DETAILS:

1. Rudzani V.A Mudzielwana: Email:vhuyelwani@gmail.com: phone: 082 555 9870
2. Professor P. L. Mafangoya: Email: mafongoya@ukzn.co.za: Phone: 033 260 5464
3. Professor M Mudhara: Email: mudhara@ukzn.ac.za: Phone: 033 260 5518

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or the UKZN Humanities & Social Sciences Research Ethics Committee, contact details as follows:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION

Research Office, Westville Campus
Govan Mbeki Building
Private Bag X 54001
Durban
4000
KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557- Fax: 27 31 2604609

Email: HSSREC@ukzn.ac.za

CONSENT

I……. have been informed about the study entitled "Analysing food security dimensions among farm workers in the irrigation scheme of Tshiombo Village, Vhembe District, Limpopo Province" area by Rudzani V.A Mudzielwana.

- I understand the purpose and procedures of the study. I have been given an opportunity to answer questions about the study and will answer to my satisfaction.
- I declare that my participation in this study is entirely voluntary and that I may withdraw at any time.
- If I have any further questions/concerns or queries related to the study I understand that I may contact the researcher at 082 555 9870 or vhuyelwani@gmail.com

If I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researchers then I may contact:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION

Research Office, Westville Campus
Govan Mbeki Building
Private Bag X 54001
Durban
4000
KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557 - Fax: 27 31 2604609

Email: HSSREC@ukzn.ac.za

…….. ……

Signature of Participant Date

LIMPOPO
PROVINCIAL GOVERNMENT

DEPARTMENT OF
AGRICULTURE AND RURAL DEVELOPMENT

Ref: S.6/4/1

Enquiries: Nethamba MC

Date: 29 April 2019

To: Vhuyelwani Angel Mudzielwana

From: Thulamela Municipality

Subject: **Request to collect data from Thulamela Municipality (Tshiombo irrigation scheme)**

1. The above matter has reference
2. Our municipality has received your application requesting for collecting data for Master in agriculture in food security at Tshiombo irrigation scheme. A permission is granted for you to come and conduct a study.
3. We are ready to support you during the time that you will be collecting data.
4. We are requesting you to do the following for the municipality and the farmers :
   - After you finish with your study we wish you to come and share your findings with the farmers and the extension advisors and other stake holders
   - Provide the Municipality with a copy of your final research document for future reference
5. Hoping that our response would be taken into consideration

Regards

[redacted]

Deputy Director Thulamela Municipality

African Centre for Food Security
Questionnaire

The information captured in this questionnaire is strictly confidential and will be used for research purposes by staff and students at the KwaZulu-Natal ONLY. Respondents can choose not to answer questions – answers are voluntary.

Date of survey:	**Village name:**
Irrigation scheme:	**Name of enumerator:**

Section A: farm worker's demographics

1. Age of respondent

(0) ≤25<	(1) ≥25 - 35	(2) ≥35 - 45	(3) ≥45 - 55	(4)≥ 55 - 65	(5) ≥66 >

2. Gender of respondent

Female (0)	Male (1)

3.Marital status of respondent

Single (0)	Married (1)

4. What is the educational level of the respondent ?

No formal schooling (0)	Primary school (1)	Secondary school (2)	Tertiary (3)

5. How many dependents reside with you? _____

6. Are you a seasonal farm worker (0) ___ or a permanent farm worker (1) _____

7. Do you have another (secondary) occupation? No (0) or Yes (1)

7.1 If yes, what is the occupation _____

8. Have you ever taken training/education related to irrigation listed below?

Skills	**No (0) Yes (1)**	**If yes, who offered the training?**

a. General crop/vegetable production		
b. Land preparation		
c. Fertilizer application		
d. Herbicide application		
e. General irrigation practices		
f. Irrigation schedule		
g. Irrigation water management		
h. Agricultural commodity marketing		
i. Packaging of fresh produce		
j. Processing of farm produce		
k. Pricing of products		
l. If other (please specify)		

9. Complete the table below and indicate the extent to which you agree with the following statements

Statement	**Indicate the extent to which you agree with the statement**
a. I attend all training sessions that are held in the department of agriculture	
b. I fully understand the information provided in the training sessions	
c. I put into practice all the advice I receive from the training	

Rank Codes: Strongly disagree (0) Disagree (1) Neutral (2) Agree (3) Strongly Agree (4)

Section B: Income and financial status

1. Are you leasing land from your employer?

No (0)	Yes (1)

2. If no **to above 1,** what are your reasons of not leasing land?

_____

_____

If yes **to above 1**, how many plots have you leased? _____

3. What is your primary source of your food?

Own production, gathering, hunting, fishing (0)	Purchased (1)	Food aid (2)

4. Which crops do you grow and why? Both boxes for sale and food can be ticked if applicable.

Crop	For sale	Consumption
a. Maize		
b. Potatoes		
c. Beans		
d. Okra		
e. Cabbage		
F. other		

5. Complete table below on sources of household income

Sources of income	No (0) yes (1)	Rank of income source (see codes below)	Estimate income
a. Permanent employment			
b. Temporary employment			
c. Welfare grant			
d. Remittances			
e. Crop sales-irrigated			
f. Crop sales-rain fed			
g. Livestock-sales			
h. Forestry			
i. Fishing			
j. Other (please specify)			
Total Monthly Income			

Rank codes: Not at all (0) Rarely (1) Sometimes (2) Often (3) Always (4)

6. What type of monthly expenses do you pay for?

Type of expenses	Yes (1) No (0)	Estimated amount (R)
a. food items		
Food		
Domestic Water		
		TOTAL
b. non-food items		
Electricity		
Education		
Clothing		

3

Health		
Transport		
Household items		
Other items		
		TOTAL

7. Are your family expenses covered well from your income sources?

No (0)	Yes (1)

8. Do you have any form of savings?

No (0)	Yes (1)

9. If yes to **8 above,** which type of saving? Formal i.e., bank (0) Informal i.e., Stokvel (1) both (2)

10 . How much do you save in the last 12 months? R _____

≤R1000 < (0)	R2000 – R 3000 (1)	R 4000 – R5000 (2)	≥R6000> (3)

11. Have you ever taken credit or used any loan facility in the past 12 months?

No (0)	Yes (1)

12. If Yes to **above 11**, what was the main source of credit or loan? Relative or friend (0) Money lender (1) Savings club*Stokvel (2) Input supplier(3) Output buyer (4) Financial institution (5)

13. If No, to **11 above,** please specify the reason(s) (0) The interest rate is high (1) I could not secure the collateral (2) I have my own enough money (3) It is not easily accessible (4) other, please specify

_____

14. If you took a loan or credit, what was the purpose for it? (0) Family emergency (1) Agricultural purposes (2) Other, please specify _____

15. Did you receive funding or any sources of grant support from the government in the past 12 months?

No (0)	Yes (1)

16. Do you own a home garden?

No (0)	Yes (1)

17. If yes to **above 16**, do you produce to (0) sell or for (1) own consumption?

Section C: Resources

1. What is the source of your drinkable water?

River (0)	Communal tap (1)	Private tap (2)	Other (3)

2. Sanitation: Source of toilet facility

Pit toilet (0)	Improved ventilated pit toilet (1)	Flush toilet (2)	Bush (3)

3. If you are not connected to the electricity supply, what source of energy do you use for cooking?

Wood (0)	Paraffin oil (1)	Other (2)

4. Do you have access to free medical care?

No (0)	Yes (1)

4.1 If yes, is the distance less than 1km

No (0)	Yes (1)

5. Do you have access to social and economic information through TV, radio or agricultural extension agents?

No (0)	Yes (1)

6. Do you have access to paved roads to the markets?

No (0)	Yes (1)

Section D: Physical Household Assets Owned

a. Farm implement	**Number of assets**	**Total value of assets**
Plough		

Irrigation pipes		
Wheelbarrow		
Spades/hoes		
Other		
		TOTAL
b. Household assets		
Mud house		
Brick house		
Furniture (please specify)		
Car		
other		
		TOTAL
c. domesticated livestock		
Chickens		
Pigs		
goats		
Cattle		
other		
		TOTAL

Section E: Household Food Insecurity Access scale

In the past four weeks …	**No (0) Yes (1)**	**Indicate the extent to which you agree with the statement. SEE CODES BELOW**
a. Did you worry that your household would not have enough food?		
b. Were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?		
c. Did you or any household member have to eat a limited variety of foods due to a lack of resources?		
d. Did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food?		
e. Did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?		

f. Did you or any household member have to eat fewer meals in a day because there was not enough food?		
g. Was there ever no food to eat of any kind in your household because of lack of resources to get food?		
h. Did you or any household member go to sleep at night hungry because there was not enough food?		
i. Did you or any household member go a whole day and night without eating anything because there was not enough food?		

Rank codes: (0) Rarely (once or twice in the past four weeks), (1) Sometimes (three to ten times in the past four weeks), (2) Often (more than ten times in the past four weeks).

2. Number of meals a day on a normal circumstance?

Breakfast, lunch and super only (0)	Breakfast and super only (1)	Lunch and supper only (2)	One meal a day (3)

3. What is the main source of maize meal?

(0) Own production	(1) Supermarkets	(2) Tuck-shops (spaza)	(3) Food aid	(4) Other

4. What is the main source of vegetables?

(0) Own production	(1) Supermarkets	(2) Tuck-shops (spaza)	(3) Food aid	(4) Other

5. What is the main source of meat and fish?

(0) Own production	(1) Supermarkets	(2) Tuck-shops (spaza)	(3) Food aid	(4) Other

6. What do you personally suggest can be done to help households that are experiencing hunger or a lack of food?

_____

_____

_____

_____

_____

Thank you for your time
Aah!

Ethical clearance

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

16 July 2019

Ms Rudzani Vhuyelwani Angel Mudzielwana (218087064)
School of Agriculture, Earth & Environmental Sciences
Pietermaritzburg Campus

Dear Ms Mudzielwana,

Protocol reference number: HSS/0415/019M
Project title: Analysis of food security dimensions among farm workers in Tshiombo Irrigation Scheme of Tshiombo Village Vhembe District Limpopo Province

Approval Notification – Expedited Application

In response to your application received on 21 May 2019, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL**.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 1 year from the date of issue. Thereafter Recertification must be applied for on an annual basis.

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

Yours faithfully

[redacted]
.....
Dr Rosemary Sibanda (Chair)

/ms

Cc Supervisor: Professor PL Mafongoya and Professor M Mudhara
cc Academic Leader Research: Professor Trevor Hill
cc School Administrator: Ms Marsha Manjoo

Humanities & Social Sciences Research Ethics Committee
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Website: www.ukzn.ac.za

Appendix B: The Binary Probit regression results of livelihood diversification strategies among farm workers' households.

```
Probit regression                               Number of obs   =        191
                                                LR chi2(11)     =      35.74
                                                Prob > chi2     =     0.0002
Log likelihood = -113.36426                     Pseudo R2       =     0.1362
```

LIVELI_DIVERSIFICATION	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
AGE	.0052694	.0098875	0.53	0.594	-.0141098	.0246486
GENDER	.5542652	.2215674	2.50	0.012	.120001	.9885294
MARITAL_STATUS	-.2371787	.2086128	-1.14	0.256	-.6460522	.1716949
LEVEL_EDU	-.3297564	.2492408	-1.32	0.186	-.8182595	.1587466
HOUSEHOLD_DEPENDTS	.1342973	.0465711	2.88	0.004	.0430197	.225575
EMPLOYMENT_TYPE	-.3813969	.2212441	-1.72	0.085	-.8150274	.0522336
WORKING_YEARS	-.0332598	.0102047	-3.26	0.001	-.0532607	-.0132589
AGRIC_TRAIN	.0938536	.2107873	0.45	0.656	-.3192819	.5069891
LAND_LEASING	-.4239403	.2153686	-1.97	0.049	-.8460551	-.0018255
ROAD_MARKET_ACCESS	.4865922	.2492398	1.95	0.051	-.0019088	.9750932
SAVINGS	.1586166	.1068757	1.48	0.138	-.050856	.3680892
_cons	-.0697224	.5475888	-0.13	0.899	-1.142977	1.003532

Marginal effect

```
Conditional marginal effects                    Number of obs   =        191
Model VCE    : OIM

Expression   : Pr(LIVELI_DIVERSIFICATION), predict()
dy/dx w.r.t. : AGE GENDER MARITAL_STATUS LEVEL_EDU HOUSEHOLD_DEPENDTS EMPLOYMENT_TYPE WORKING_YEARS AGRIC_TRAIN LAND_LEASING ROAD_MARKET_ACCESS SAVINGS
at           : AGE             =    46.29843 (mean)
               GENDER          =    .3717277 (mean)
               MARITAL_ST~S    =    .4764398 (mean)
               LEVEL_EDU       =    .5549738 (mean)
               HOUSEHOLD_~S    =    5.151832 (mean)
               EMPLOYMENT~E    =    .3298429 (mean)
               WORKING_YE~S    =    16.79581 (mean)
               AGRIC_TRAIN     =    .6335079 (mean)
               LAND_LEASING    =    .4031414 (mean)
               ROAD_MARKE~S    =    .1989529 (mean)
               SAVINGS         =     .565445 (mean)
```

	Delta-method dy/dx	Std. Err.	z	P>|z|	[95% Conf.	Interval]
AGE	.0020731	.0038898	0.53	0.594	-.0055506	.0096969
GENDER	.2180663	.087013	2.51	0.012	.0475239	.3886086
MARITAL_STATUS	-.0933139	.0821064	-1.14	0.256	-.2542396	.0676117
LEVEL_EDU	-.1297371	.0980243	-1.32	0.186	-.3218612	.062387
HOUSEHOLD_DEPENDTS	.052837	.0182824	2.89	0.004	.0170042	.0886698
EMPLOYMENT_TYPE	-.1500542	.0870606	-1.72	0.085	-.3206897	.0205814
WORKING_YEARS	-.0130855	.0040135	-3.26	0.001	-.0209519	-.0052191
AGRIC_TRAIN	.0369251	.0829411	0.45	0.656	-.1256364	.1994866
LAND_LEASING	-.1667921	.0846384	-1.97	0.049	-.3326803	-.000904
ROAD_MARKET_ACCESS	.1914415	.0981277	1.95	0.051	-.0008852	.3837681
SAVINGS	.062405	.0420319	1.48	0.138	-.0199761	.1447861

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Appendix C: The Multinomial Logistic regression results of factors that influence the choice of livelihood diversification strategies among farm workers' households.

Multinomial logistic regression — Number of obs = 191
LR chi2(33) = 76.67
Prob > chi2 = 0.0000
Log likelihood = -207.89235 — Pseudo R2 = 0.1557

Livelihood_strategies	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
On__farm_alone						
AGE	-.0026587	.0204287	-0.13	0.896	-.0426982	.0373808
GENDER	.1286688	.4420533	0.29	0.771	-.7377396	.9950773
MARITAL_STATUS	1.358512	.4302696	3.16	0.002	.5151991	2.201825
LEVEL_EDU	.2976849	.5026313	0.59	0.554	-.6874543	1.282824
HOUSEHOLD_DEPENDTS	-.1133422	.0931984	-1.22	0.224	-.2960077	.0693234
EMPLOYMENT_TYPE	.461189	.4643227	0.99	0.321	-.4488667	1.371245
WORKING_YEARS	.0301166	.0216007	1.39	0.163	-.01222	.0724533
AGRIC_TRAIN	-.1052663	.424475	-0.25	0.804	-.9372221	.7266895
LAND_LEASING	-.9580566	.4491445	-2.13	0.033	-1.838364	-.0777496
SAVINGS	.21391	.2126598	1.01	0.314	-.2028956	.6307156
ROAD_MARKET_ACCESS	-.5716444	.5135772	-1.11	0.266	-1.578237	.4349484
_cons	-.9517825	1.099534	-0.87	0.387	-3.106829	1.203264
On_farm___non_farm	(base outcome)					
On_farm___off_farm						
AGE	-.0242665	.025721	-0.94	0.345	-.0746786	.0261457
GENDER	.5643475	.5364419	1.05	0.293	-.4870594	1.615754
MARITAL_STATUS	.4091702	.5363819	0.76	0.446	-.6421191	1.460459
LEVEL_EDU	-.8608664	.6243277	-1.38	0.168	-2.084526	.3627934
HOUSEHOLD_DEPENDTS	-.2263003	.1152267	-1.96	0.050	-.4521405	-.0004601
EMPLOYMENT_TYPE	-.0055156	.5421772	-0.01	0.992	-1.068163	1.057132
WORKING_YEARS	.0472269	.0261626	1.81	0.071	-.0040509	.0985048
AGRIC_TRAIN	1.307856	.6196181	2.11	0.035	.0934272	2.522285
LAND_LEASING	.5822521	.5316816	1.10	0.273	-.4598246	1.624329
SAVINGS	.3386977	.2594522	1.31	0.192	-.1698193	.8472148
ROAD_MARKET_ACCESS	.2333215	.6262092	0.37	0.709	-.994026	1.460669
_cons	-1.163349	1.464863	-0.79	0.427	-4.034428	1.707731
On_farm___off_farm___non_farm						
AGE	-.0810727	.0251339	-3.23	0.001	-.1303343	-.0318112
GENDER	-.2547512	.5172797	-0.49	0.622	-1.268601	.7590983
MARITAL_STATUS	1.039327	.5101271	2.04	0.042	.0394958	2.039157
LEVEL_EDU	.5184212	.5793327	0.89	0.371	-.6170499	1.653892
HOUSEHOLD_DEPENDTS	-.1579688	.1114907	-1.42	0.157	-.3764866	.060549
EMPLOYMENT_TYPE	.4546871	.5636889	0.81	0.420	-.6501229	1.559497
WORKING_YEARS	.0894783	.0270312	3.31	0.001	.0364981	.1424584
AGRIC_TRAIN	.1286775	.4955152	0.26	0.795	-.8425145	1.09987
LAND_LEASING	-1.35429	.573097	-2.36	0.018	-2.47754	-.2310404
SAVINGS	.3824358	.2565668	1.49	0.136	-.120426	.8852975
ROAD_MARKET_ACCESS	-1.416376	.6705628	-2.11	0.035	-2.730655	-.1020975
_cons	1.564808	1.221695	1.28	0.200	-.8296693	3.959286

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Marginal effect

Marginal effects after mlogit
y = Pr(Livelihood_strategies==On__farm_alone) (predict, outcome (1))
= .2651179

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
AGE	.0033242	.00364	0.91	0.361	-.003811	.010459	46.2984
GENDER*	.0161713	.07832	0.21	0.836	-.137327	.169669	.371728
MARITA~S*	.209714	.07395	2.84	0.005	.064765	.354663	.47644
LEVEL_~U*	.0650131	.08609	0.76	0.450	-.103712	.233739	.554974
HOUSEH~S	-.0092013	.01653	-0.56	0.578	-.041606	.023203	5.15183
EMPLOY~E*	.0732446	.0869	0.84	0.399	-.097084	.243573	.329843
WORKIN~S	.001011	.0038	0.27	0.790	-.006441	.008463	16.7958
AGRIC_~N*	-.0614572	.07784	-0.79	0.430	-.214016	.091102	.633508
LAND_L~G*	-.1476313	.07167	-2.06	0.039	-.288101	-.007161	.403141
SAVINGS	.0167947	.03687	0.46	0.649	-.05546	.089049	.565445
ROAD_M~S*	-.0740015	.08064	-0.92	0.359	-.232059	.084056	.198953

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Marginal effects after mlogit
y = Pr(Livelihood_strategies==On_farm___non_farm) (predict, outcome (2))
= .47648042

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
AGE	.0072411	.00415	1.74	0.081	-.000894	.015376	46.2984
GENDER*	-.0318662	.09049	-0.35	0.725	-.209227	.145495	.371728
MARITA~S*	-.2590955	.08171	-3.17	0.002	-.419245	-.098946	.47644
LEVEL_~U*	-.021188	.10202	-0.21	0.835	-.221135	.178758	.554974
HOUSEH~S	.0374683	.01921	1.95	0.051	-.000189	.075126	5.15183
EMPLOY~E*	-.0901168	.09347	-0.96	0.335	-.273311	.093078	.329843
WORKIN~S	-.0125329	.00451	-2.78	0.005	-.021376	-.00369	16.7958
AGRIC_~N*	-.0587035	.08763	-0.67	0.503	-.230448	.113041	.633508
LAND_L~G*	.1645671	.08728	1.89	0.059	-.006502	.335636	.403141
SAVINGS	-.0717397	.04512	-1.59	0.112	-.160172	.016692	.565445
ROAD_M~S*	.1319282	.10454	1.26	0.207	-.07296	.336816	.198953

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Marginal effects after mlogit
y = Pr(Livelihood_strategies==On_farm___off_farm) (predict, outcome (3))
= .1136684

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
AGE	-.0010309	.00246	-0.42	0.675	-.005851	.00379	46.2984
GENDER*	.0604372	.05691	1.06	0.288	-.05111	.171985	.371728
MARITA~S*	-.0172434	.04875	-0.35	0.724	-.112788	.078301	.47644
LEVEL_~U*	-.1099785	.065	-1.69	0.091	-.237384	.017426	.554974
HOUSEH~S	-.0167848	.01082	-1.55	0.121	-.037997	.004428	5.15183
EMPLOY~E*	-.0220833	.04859	-0.45	0.649	-.117308	.073142	.329843
WORKIN~S	.0023784	.00247	0.96	0.336	-.002464	.007221	16.7958
AGRIC_~N*	.119425	.0463	2.58	0.010	.028688	.210162	.633508
LAND_L~G*	.1144437	.0567	2.02	0.044	.00332	.225567	.403141
SAVINGS	.0213851	.02373	0.90	0.368	-.025134	.067904	.565445
ROAD_M~S*	.0644942	.07463	0.86	0.387	-.081769	.210757	.198953

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Marginal effects after mlogit
y = Pr(Livelihood_strategies==On_farm___off_farm___non_farm) (predict, outcome (4))
= .14473329

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
AGE	-.0095344	.00276	-3.45	0.001	-.014947	-.004122	46.2984
GENDER*	-.0447423	.05464	-0.82	0.413	-.151831	.062346	.371728
MARITA~S*	.0666249	.05727	1.16	0.245	-.045621	.178871	.47644
LEVEL_~U*	.0661534	.06232	1.06	0.288	-.05599	.188297	.554974
HOUSEH~S	-.0114822	.01271	-0.90	0.366	-.036389	.013424	5.15183
EMPLOY~E*	.0389554	.06935	0.56	0.574	-.096971	.174882	.329843
WORKIN~S	.0091435	.00309	2.96	0.003	.003081	.015206	16.7958
AGRIC_~N*	.0007357	.05568	0.01	0.989	-.108397	.109868	.633508
LAND_L~G*	-.1313795	.05617	-2.34	0.019	-.241467	-.021292	.403141
SAVINGS	.0335599	.02854	1.18	0.240	-.022384	.089503	.565445
ROAD_M~S*	-.122421	.04671	-2.62	0.009	-.21397	-.030872	.198953

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Appendix D: The Ordered Probit regression model was used for assessing determinants of household food security.

```
Ordered probit regression                       Number of obs   =        191
                                                LR chi2(10)     =     217.91
                                                Prob > chi2     =     0.0000
Log likelihood =  -116.5798                     Pseudo R2       =     0.4831
```

Food_security_status	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
AGE	.0090285	.0096346	0.94	0.349	-.0098549	.027912
GENDER	-.0512081	.2334459	-0.22	0.826	-.5087536	.4063375
MARITAL_STATUS	-.2069189	.21911	-0.94	0.345	-.6363667	.2225288
LEVEL_EDU	.2402145	.2618436	0.92	0.359	-.2729895	.7534186
HOUSEHOLD_DEPENDTS	.0133289	.0499209	0.27	0.789	-.0845143	.1111721
LAND_LEASING	-.6912098	.2590037	-2.67	0.008	-1.198848	-.1835719
TOTAL_EXPENDITURE	.0002306	.0001092	2.11	0.035	.0000166	.0004446
TOTAL_INCOME	-.0001718	.0001219	-1.41	0.159	-.0004107	.000067
LAND_SIZE	.1441023	.0573698	2.51	0.012	.0316595	.2565451
FOOD_STORED	-3.028207	.2736005	-11.07	0.000	-3.564454	-2.491959
/cut1	-1.176867	.6708962			-2.491799	.1380655
/cut2	-.5659089	.6662313			-1.871698	.7398804
/cut3	.9004084	.6606345			-.3944114	2.195228

Marginal effect

```
Marginal effects after oprobit
      y  = Pr(Food_security_status==1) (predict, outcome(1))
         =  .45386005
```

variable	dy/dx	Std. Err.	z	P>|z|	[	95% C.I.	]	X
AGE	-.0035778	.00382	-0.94	0.349	-.011065		.00391	46.2984
GENDER*	.0203051	.09262	0.22	0.826	-.161218		.201828	.371728
MARITA~S*	.081897	.08649	0.95	0.344	-.087624		.251418	.47644
LEVEL_~U*	-.0951013	.10332	-0.92	0.357	-.297604		.107402	.554974
HOUSEH~S	-.0052819	.01978	-0.27	0.789	-.044054		.03349	5.15183
LAND_L~G*	.2660518	.09475	2.81	0.005	.080338		.451766	.596859
TOTAL~RE	-.0000914	.00004	-2.11	0.034	-.000176		-6.7e-06	2297.23
TOTAL~ME	.0000681	.00005	1.41	0.158	-.000026		.000163	1892.1
LAND_S~E	-.0571036	.02276	-2.51	0.012	-.101714		-.012494	2.25654
FOOD_S~D*	.8547642	.03613	23.66	0.000	.78396		.925568	.554974

(*) dy/dx is for discrete change of dummy variable from 0 to 1

```
Marginal effects after oprobit
      y  = Pr(Food_security_status==2) (predict, outcome(2))
         =  .23585516
```

variable	dy/dx	Std. Err.	z	P>|z|	[	95% C.I.	]	X
AGE	.0003913	.00052	0.75	0.451	-.000625		.001408	46.2984
GENDER*	-.0022925	.01097	-0.21	0.834	-.023795		.01921	.371728
MARITA~S*	-.0091425	.0116	-0.79	0.431	-.031886		.013601	.47644
LEVEL_~U*	.011031	.01489	0.74	0.459	-.018153		.040215	.554974
HOUSEH~S	.0005776	.0022	0.26	0.793	-.003735		.00489	5.15183
LAND_L~G*	-.0184773	.01963	-0.94	0.347	-.056951		.019996	.596859
TOTAL~RE	9.99e-06	.00001	1.20	0.230	-6.3e-06		.000026	2297.23
TOTAL~ME	-7.45e-06	.00001	-1.01	0.313	-.000022		7.0e-06	1892.1
LAND_S~E	.0062449	.005	1.25	0.211	-.003548		.016038	2.25654
FOOD_S~D*	-.005356	.02925	-0.18	0.855	-.062684		.051972	.554974

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Marginal effects after oprobit

y = Pr(Food_security_status==3) (predict, outcome(3))

= .2853663

variable	dy/dx	Std. Err.	z	P>|z|	[	95% C.I.	]	X
AGE	.0026603	.00284	0.94	0.350	-.002915		.008236	46.2984
GENDER*	-.0150652	.06859	-0.22	0.826	-.149503		.119372	.371728
MARITA~S*	-.0607481	.06439	-0.94	0.345	-.186956		.06546	.47644
LEVEL_~U*	.0703335	.07655	0.92	0.358	-.079706		.220373	.554974
HOUSEH~S	.0039274	.01471	0.27	0.790	-.024912		.032767	5.15183
LAND_L~G*	-.1994053	.07602	-2.62	0.009	-.348402		-.050408	.596859
TOTAL~RE	.000068	.00003	2.02	0.043	2.1e-06		.000134	2297.23
TOTAL~ME	-.0000506	.00004	-1.39	0.166	-.000122		.000021	1892.1
LAND_S~E	.0424596	.01762	2.41	0.016	.007923		.076996	2.25654
FOOD_S~D*	-.4604387	.06175	-7.46	0.000	-.581471		-.339407	.554974

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Marginal effects after oprobit

y = Pr(Food_security_status==4) (predict, outcome(4))

= .02491849

variable	dy/dx	Std. Err.	z	P>|z|	[	95% C.I.	]	X
AGE	.0005262	.00058	0.91	0.365	-.000613		.001666	46.2984
GENDER*	-.0029473	.01323	-0.22	0.824	-.028871		.022977	.371728
MARITA~S*	-.0120064	.0134	-0.90	0.370	-.038262		.014249	.47644
LEVEL_~U*	.0137368	.015	0.92	0.360	-.015659		.043133	.554974
HOUSEH~S	.0007769	.00293	0.27	0.791	-.004956		.00651	5.15183
LAND_L~G*	-.0481692	.02519	-1.91	0.056	-.097537		.001198	.596859
TOTAL~RE	.0000134	.00001	1.75	0.080	-1.6e-06		.000028	2297.23
TOTAL~ME	-.00001	.00001	-1.28	0.201	-.000025		5.3e-06	1892.1
LAND_S~E	.008399	.00452	1.86	0.063	-.000468		.017266	2.25654
FOOD_S~D*	-.3889694	.05973	-6.51	0.000	-.506042		-.271897	.554974

(*) dy/dx is for discrete change of dummy variable from 0 to 1