IMPACT OF COMMERCIALIZATION OF INDIGENOUS CROPS ON HOUSEHOLD FOOD SECURITY OF SMALLHOLDER FARMERS IN LIMPOPO AND MPUMALANGA PROVINCES, SOUTH AFRICA

by

NONKULULEKO THANDEKA BRIGHTNESS ZONDI

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School of Agricultural, Earth and Environmental Sciences,

College of Agriculture, Engineering, and Science

University of KwaZulu-Natal,

Pietermaritzburg

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UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

ABSTRACT

Indigenous crops have been the main source of food for many rural communities. However, colonial economies and post-independence development systems placed greater emphasis on the production and consumption of cash crops, introduced foods that led to the displacement of indigenous food crops and caused subsequent changes in the diet of African people. Due to increasing consumer awareness of the dietary importance of indigenous crops, their demand is increasing with some consumers indicating a greater willingness to pay premium prices. This study estimated the impact of commercialization of indigenous crops on household food security of smallholder indigenous crops farmers in the Limpopo and Mpumalanga provinces.

The study was conducted in Limpopo and Mpumalanga provinces. A sample of 209 indigenous crop producers was drawn out of 1520 analysable sample sizes of the total number of smallholder farmers. In analysing factors influencing the decisions and extent of indigenous crops farmers to participate in the market, a household commercialization index (HCI) was used to estimate the commercialization level of the indigenous crops farmers and subsequently, a double-hurdle with fractional response model was employed to estimate the factors influencing the decision of indigenous crops' farmers to participate in the market (first stage) while fractional response model (FRM) with quasi-maximum likelihood was employed to assess the extent of market participation in the second stage. The results showed that off-farm income, gender, a family with an HIV infected person as well as market information access influenced the farmer's decision to participate in the market. Market access and household size on the other hand influenced the extent of commercialization. It was then recommended that much support and attention should be provided to women's involvement in the market participation. Also, the government together with other stakeholders need to channel their support towards these smallholder farmers through organising cooperatives within them.

Furthermore, the study evaluated the impact of the commercialization of indigenous crops on the household food security of smallholder farmers. The descriptive analysis, Household Food Insecurity Access Scale (HFIAS) and Poisson regression model (with endogenous treatment model) were used to analyse the findings of the study. It was revealed that extension services, marital status, household size and a member living with HIV positively influenced the household food security of smallholder farmers and were significant. It was concluded that there is still an improvement and a lot of work to be done to diminish the escalating number of food insecure smallholder farmers. Furthermore, it was recommended that the government should intervene through the provision of trained extension officers so that they can assist

smallholder farmers to overcome their challenges. Policymakers should develop policies that primarily represent the interests of smallholder household food security of smallholder farmers since the current policies make little mention of the impact that indigenous crops' commercialization has on their food security status.

The participation of smallholder farmers in the marketing of produce can play a critical role in meeting their goals such as food and nutrition security, poverty alleviation and sustainable agriculture. This study found that the market participation and sales ratio of smallholder indigenous crop farmers are constrained by numerous factors, such as socioeconomic, market and institutional factors. The commercialization of the indigenous crop for smallholder farmers in the market was affected by gender, educational level, off-farm income, agricultural information, and a member being infected by HIV. The household size and market access were found to highly influence the extent of commercialization among the smallholder indigenous vegetable farmers.

To fully realize the optimum contribution of indigenous crops to household food and nutrition security, support from the stakeholders must be geared towards the smallholder indigenous farmers through the provision of farm training for an effective and efficient grasp of agricultural and marketing information. To improve smallholder farmers' access to markets, the government also needs to ensure that their support for the production of indigenous crops is timely and well-targeted to upscale its production for consumption and commercialization. Where possible, the government and other stakeholders need to channel their support through organized cooperatives that exist within the smallholder farmers. Much attention and support need to be given to women's involvement in market participation, and they also need to be empowered by the government and other interested stakeholders to participate fully in the decision making relating to the price of their produce and where to sell it. More workshops especially for young people and women need to be conducted in rural areas to raise awareness on the nutritional importance of indigenous crops and the need to include these indigenous crops into South Africa's dietary guidelines.

Keywords: Indigenous crops; commercialization index; household food security; HCI; Double-Hurdle, Fractional Response model.

DECLARATION 1

I, Nonkululeko Thandeka Brightness Zondi, declare that:

i. The research reported in this dissertation, except where otherwise indicated, is my own original research.

ii. This dissertation has not been submitted for any degree or examination at any other university.

iii. This dissertation does not contain other person's data, pictures, graphs or other information unless specifically acknowledged as being sourced from those people.

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As the candidate's main supervisor, I, Dr Mjabuliseni Ngidi, agree to submission of this dissertation for examination.

Supervisor'signature:..... Date: 21 December 2021

Dr. Mjabuliseni SC Ngidi

DECLARATION 2: PUBLICATION

Author's contribution to publications that form part of the dissertation.

Publication 1 – Chapter 4.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

APAP Agricultural Policy Action Plan

DAFF Department of Agriculture, Forestry and Fisheries

DALRRD Department of Agriculture, Land Reform and Rural Development

DHM Double-Hurdle Model

FANTA Food and Nutrition Technical Assistance

FAO Food and Agriculture Organization

GDP Gross Domestic Product

HCI Household Commercialization Index

HDDS Household Dietary Diversity Score

HFIAS Household Food Insecurity Access Score

HFPS Household Food Production Strategy

HHS Household Hunger Scale

HIV Human Immunodeficiency Virus

IFAD International Fund for Agricultural Development

IMR Inverse Mills Ratio

KZN KwaZulu-Natal

MDGs Millennium Development Goals

NFNSP National Food and Nutrition Security Plans

NPFNS National Policy on Food and Nutrition Security

SA South Africa

SAVAC South African Vulnerability Assessment Committee

SPSS Statistical Packages for Social Science

VIF Variance Inflation Factor

CHAPTER 1

THE PROBLEM AND ITS SETTING

1.1 Introduction and background of the study

Indigenous crops form an essential constituent of the vast majority of the South African households' diets. These crops are mostly produced and consumed by rural households and form part of their staple food (Akinola et al., 2020). Indigenous crops are not only well known for their significance in providing nutritious foods but also consists of medicinal-value properties (Mahlangu, 2014). Indigenous crops are said to be the plant species that grow naturally in a particular region or have been introduced long enough to have evolved either through farmer selection or natural processes (Mahlangu, 2014). Agricultural Research Council (2014) defined these crops as crops that are popular for their ability to tolerate and grow vigorously under a variety of harsh weather and environmental conditions. Unlike exotic crops, indigenous crops are obtained in various ways, they may be found readily available and harvested from their habitat where they appear as weed or volunteer crops or cultivated by rural households (Ngugi et al., 2007). Therefore, they are considered traditional crops. The literature revealed that indigenous crops are rich sources of fundamental micronutrients that are required by the body, such as vitamins (A, B and C) and minerals namely; copper, zinc, potassium, iron, selenium and calcium (Faber et al., 2010; Amao, 2018; Shayanowako et al., 2021). Examples of these underutilized indigenous crops are amaranth (Amaranthus spp.), African eggplant (Solanummacrocarpon, S. aethiopicus and S. anguivi), Bambara groundnut (Vigna subterranean), vegetable cowpea (Vignaenguiculata), Ethiopian mustard (Brassica carinata), jute mallow (Corchorusolitorius), amadumbe (Colocasia esculenta), okra (Abelmoschusesculentus), Sorghum (Sorghum bicolor), Millet (Panicum miliaceum), cassava (Manihot esculenta), leafy vegetables and pumpkin (Cucurbitamoschata) (Mabhaudhi et al., 2018). Although they were neglected and viewed as a poor man's crop, indigenous crops play a fundamental role in improving nutrition and increasing the dietary diversity of the households (Akinola et al., 2020).

Senyolo et al., (2014) pointed out that the consumption of indigenous crops among South African rural households drastically increased. This means that the country is moving towards achieving the no hunger Sustainable Development Goal (SDG). According to Agricultural Research Council (2014), indigenous crops offer unique opportunities that help diversify farming systems, safeguard food security and mitigate poverty, while improving income and

enhancing human health. Therefore, by raising awareness about all the benefits that these crops provide, a large number of poverty-stricken rural households can overcome hunger. Although unrecognised, smallholder farmers are partly responsible for promoting the cultivation, production and consumption of indigenous in South Africa. Mahlangu et al. (2020) stated that indigenous crops offer such great potential and trade for smallholder farmers in rural areas. Therefore, through the agricultural potential that they possess to contribute to food security poverty could be history, especially in developing countries.

Although smallholder farmers have the potential to contribute towards making indigenous crops available for consumption, they are reported to be the farmers that are characterised by small plots of land, limited resource endowments compared to other farmers, which is insufficient to provide an acceptable livelihood (Mehta et al., 2014). In most cases, these farmers are popular for prioritising their consumption first and then selling the surplus to the market when their consumption needs have been satisfied. Furthermore, most of the smallholder farmers in the agricultural sector are involved in the production of the indigenous crops simply because they require limited cultivation equipment, including water, and can thrive under adverse conditions. So, through commercializing indigenous crops, smallholder farmers play an essential role towards sustainable food and nutrition security of the country by producing the local nutritious foods. According to Dioula et al. (2013), smallholder farmers, directly and indirectly, contribute to households' food and nutrition security, since they are the main domestic food and nutrient producers. Therefore, increased agricultural production by smallholder farmers means more food in the marketplace, resulting in lower food prices followed by better diets. Moreover, food policymakers and the government cannot underestimate the potential of smallholder farmers to combat poverty and ensure food security through the production of indigenous crops. Therefore, improvement and efficiency of indigenous crops productivity hold notable potential in addressing South African food and nutrition insecurity.

Food (in)security issue remains a critical concern in many parts of the world including South Africa, especially since it is food secure at the national level and not the same can be said about the household level. The rapid increase in food demand resulting from a growing global population is causing pressure, placed on the limited land and water resources of the planet, which further leads to the concerns around global food security and its sensitivity to become apparent (Suweis et.al, 2015). Food security is defined as "the situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious

food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2012). This definition includes pillars such as food availability, social and economic food access, the ability of an individual to consume a good healthy diet (utilization) and maintaining the stability of all the above-mentioned pillars during the time (Roy et al., 2019). The lack of one or all of the above pillars results in hidden hunger, poverty and diseases such as malnutrition. As one of the sustainable development goals for 2030, the United Nations Organization has determined and specified the end of hunger through sustainable agriculture promotion and nutrition betterment (Gold, 2016).

Therefore, if the efficiency of agricultural production is increased then the income and household food security of smallholder farmers is automatically improved which then leads to poverty reduction (Bogale, 2012; Ogundari, 2014). This means that the main key to providing practical, long-term and sustainable solutions with the ability to address the growing issue of food insecurity lies in the improved productivity of smallholder farmers. According to Masekoameng and Molotja (2019), a household is deemed food secure when all the four pillars of food security are achieved. Amongst other factors, food availability highly depends on the land that has been allocated for production. The larger available portion of land allows smallholder farmers to grow a massive number of crops and diversify their production. The diversification of crops can be used to create a resilient agricultural system. From the study that was conducted by Masekoameng and Molotja (2019), it was discovered that the farmers with a larger portion of land produced more crops than the ones with small portions of land. Therefore, the larger the land available for agricultural production the higher the number of various food crops to be available and sold in the market.

After producing a variety of indigenous crops, smallholder farmers require some assistance from the extension services to gain formal market access. This makes it easier for them to sell their produce and for households to purchase the food. So, through selling their crops they gain income and profit, which enables them to provide for their families and enhance food security. The consumption of indigenous crops is referred to as utilization (Akinola et al., 2020). When the indigenous crops become accessible to the households they can buy and consume them. Since the indigenous crops are outstanding sources of micronutrients, the consumption of various crops improves households' utilization patterns together with their food security status. Khattak (2011) stated that indigenous crops not only provide the body with all the requirements to stimulate human health but also help prevent diseases. Krause et al. (2019) added that indigenous crops are a solution to the pressing issue of micronutrient deficiencies or hidden

hunger. This means that through the utilization of different kinds of food crops they can obtain various nutrients that will enable them to overcome diseases. So, it is clear that food availability is about smallholder farmers producing quantities of indigenous crops. On the other hand, food utilization is about the quality of food consumed by the households, thus leading to food security. Therefore, the stability of the household's food security status is a result of all the three pillars being met (food availability, accessibility and utilization).

However, smallholder farmers face numerous challenges that impede their progress and success in the agricultural sector. Since most smallholder farmers stay in rural areas with poorly maintained roads, storage facilities, inadequate transport, lack of good market infrastructure, skills and information, they end up suffering from high transaction costs of market participation (Jari and Fraser, 2012) and (Sebatta, 2014). Quisumbing, and Pandolfelli (2010) added that these farmers also get affected by the human immunodeficiency virus (HIV) status of household members, size of the household, education and age, marital status and source of income. All the above-mentioned factors result in the decline of the agricultural production of the smallholder farmers, which in turn has a negative impact on their livelihoods.

In conclusion, there seems to be a huge gap in the literature about how indigenous crops, smallholder farming and food security can be combined to combat poverty, overcome diseases and achieve food security at the household level. Therefore, the action to promote the linkage between the indigenous crops, smallholder farmers and food security need to be taken into consideration. If the smallholder farmers can receive appropriate and enough support and improve their level of productivity while diversifying their produce then the food security status level can increase. The motive of this study is to find and provide relevant information on the impact of the commercialization of indigenous crops on the household food security of smallholder farmers. The extension services should play their respective role, provide assistance, expertise and the necessary equipment to ensure that the smallholder farmers are consistently supported in any way possible.

1.2 Research problem

Despite indigenous crops' nutritional benefits and resilience to climatic conditions, there is little information available on the impact that the commercialization of indigenous crops has on households' food security. While there are reported nutritional benefits and access to the indigenous crops, in South Africa these crops are not commercialised and studies on commercialising them are limited (Hlatshwayo et al., 2021). While the indigenous crops grow

easily, resist pests and diseases and generally have an acceptable taste, they are considered as the crops consumed by the poor people. . This negative perception about the indigenous crops limits their demand in the market. The insufficient context-specific information about the commercialization of these crops has resulted in farmers not only being oblivious of their potential contribution to the stability of income and food availability but also how it could contribute to their nutritional statuses. This has led most smallholder farmers to perceive the trade of indigenous crops as only a temporary activity.

Furthermore, there are various constraints faced by smallholder farmers that impede their potential to produce and make the indigenous crops available in the market (Von loeper et al., 2016). Insufficient land availability, lack of food storage, market access and information, poor physical infrastructure and lack of extension services are some of the most common challenges among smallholder farmers that hinder their possibilities of producing and selling their produce in the market (Dioula et al., 2013; Mpandeli and Maponya, 2014; Khapayi and Celliers, 2016). So, as a result of lack of market access, smallholder farmers end up selling their produce in the informal markets or practising barter with their neighbours in the rural areas. This does not necessarily provide them with any profit for that matter, rather they experience a deficit.

1.3 Importance of the study

While some studies have been conducted in Africa on a number of agricultural experiments concerning indigenous crops and their economic potential, South Africa does not have much information/ literature on the potential income that could be created through the commercialisation of indigenous crops and the impact that it would have on reducing food insecurity in the country. Mahlangu (2014) reported that there is a market for indigenous crops and therefore it is important to understand the impact of market participation on household food security of the smallholder farmers in South Africa. Therefore, if smallholder farmers could be encouraged and supported in providing their produce to the market more households could easily access the produce leading to the increment of food-secure households.

Lack of knowledge on the benefits of indigenous crops could be a reason why they are not readily found on supermarket shelves. The provision of information on the benefits of commercialising these vegies will be useful to smallholder farmers and may influence them to grow for commercial purposes. The information will be useful in the implementation and relevant strategies formulation to commercialize indigenous crops. Understanding the contribution of indigenous crops towards rural households/ smallholder farmers' food security

can raise awareness with regards to effective participation. They can adopt strategies to grow these and sell them on the market. The availability of these crops in the market may lead to the introduction of more communities into consuming them and thus gain the nutritional benefits that households members need.

1.4 Objectives

The main purpose of the study was to investigate the impact of the commercialization of indigenous crops on the household food security of smallholder farmers. The specific objectives were to:

- Estimate factors influencing commercialization and extent of commercialization among indigenous crops farmers; and
- Analyse the impact of commercialization of indigenous crops on household food security of smallholder farmers.

1.5 Sub-problems

- What are the factors influencing the commercialisation and the extent of commercialisation among the indigenous crop farmers?
- What is the impact of commercialisation of indigenous crops on the household food security status of the sampled farmers?

1.6 Definition of terms

Commercialization- refers to a process whereby products or services are brought to the market with the aim of financial gain.

Demand- is an economic principle referring to how much a consumer desires (quantity) and is willing to pay for a good or service (price).

Food insecurity- limited or uncertain ability to access food of sufficient quality and quantity, or the inability to access these foods in socially acceptable ways (Dowler and O'Connor, 2012).

Food security- when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for active and healthy life (FAO, 2012).

Household- refers to a group of people, particularly a family who live under the same house and where living space and meals are shared.

Indigenous crops- Crops that naturally grow in a specific region, cultivated or collected from the wild and are harvested and used as food sources.

Socio-demographic- is whereby a population is being studied based on characteristics such as age, gender, occupation, education level, income, etc.

Smallholder farmers- these are farmers that are in ownership of small-based plots of land from which they normally practice subsistence farming and highly rely on family labour.

1.7 Outline of the thesis

This study has got six chapters, including this introductory study. The previous chapter (Chapter 1) provided the background, the problem statement and the importance of the study. Chapter 2 provided reviewed literature information, with some key concepts and terminologies defined. Chapter 3 briefly provided some information on the methods and materials that were used during the collection of data. It also highlights the tools that were used to capture and analyse data. Chapters 4 and 5 answered the objectives of the study in relation to the commercialization of indigenous crops and their impact on household food security of smallholder farmers. Chapter 6 was the last chapter, which presented the conclusion and policy recommendations of the research findings for further research.

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CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In South Africa and around the globe, smallholder farmers are involved in the agricultural sector to grow and consume their produce as well as generate income. However, their economic growth is constrained by challenges of institutional weakness, lack of lucrative market access and production issues (Thamaga-Chitja and Morojele, 2014). This chapter presents a reviewed literature from previous researchers pertaining to the commercialization of indigenous crops and household food insecurity of smallholder farmers in South Africa. The chapter provides an insight into the role that various actors such as extension officers, government, policy makers and smallholder farmers perform to support agricultural development.

2.2 Characteristics of smallholder farmers

There is no standard universal definition, but various terms have been used to define smallholder farmers; in which the definition not only depends on the context but also ecological zone and a country. The different roles that smallholder farmers play in their societies (locally, nationally, and internationally) are what leads to the diversity of definitions (Mvelase, 2017). Across the board, the definition of smallholder farmers arises through assessing the common characteristics that they possess such as access to land and capital, market orientation, input technologies and exposure to risk (Chamberlin, 2008). Rurinda et al. (2014) defined smallholder farmers as those that consist of limited resource endowments compared to other farmers. However, according to Pienaar and Traub (2015) smallholder farmers are characterised by small plots of land where subsistence crops are grown with one or more cash crops that entirely depends on household labour. In general terms, smallholder farmers are characterized by limited resource allocation relative to other farmers that are involved in the agricultural industry.

A variety of descriptive words such as subsistence farmers, land reform beneficiaries, peasant farmers, emerging farmers and small-scale farmers have been used to refer to smallholder farmers (Chamberlin, 2007; Afolabi, 2010; Birabi and Dienye, 2012; Khapayi and Celliers, 2016). Smallholder farmers are popular for their small resource base that is not enough to provide an acceptable livelihood. Cousin (2013) contends that a majority of smallholder farmers produce mostly to satisfy their own consumption and consistently sell the surplus there after. This means that smallholder farmers mainly cultivate for meeting their own consumption

needs first. As a result of insufficient resources, especially land, it becomes strenuous for them to be able to produce for consumption as well as generate a level of income and attain a sustainable livelihood (Mahieux et al., 2011). Thus, smallholder farmers attempt to enhance their livelihoods through being involved in both agricultural and non-agricultural activities where they rely solely on family labour.

Family labour is yet another indicator that is used to characterise/describe smallholder farmers, especially in rural areas. Smallholders normally rely on family labour during the production cycle, especially during the cultivation and harvesting periods (Swaminathan et al., 2012). The condition of hiring labourers are normally impossible because the employers are prone to poverty themselves (Longley, 2011). Since family labour is very important to the smallholder farming sector, therefore

Since smallholders rely on family labour, therefore the quality of life in terms of health and access to basic domestic services is of primary importance and this is also true for education and training to improve family skills (FAO, 2012).

2.2.1 The importance of smallholder agriculture

Agriculture plays an important role in South Africa as it ensures food security, enhances living conditions and serves as a tool to generate income for numerous households (Aliber et al., 2009; Bahta et al., 2014; FAO, 2017). Agriculture contributes significantly to the South African economy and has the potential to create close to an estimated one million new jobs by 2030 (Meyer, 2014). It is also important to note that agriculture contributed 33.6% to the Gross Domestic Product (GDP) growth of 2.5% in the second quarter (Stats SA, 2014). In South Africa, approximately 20.7% of all households engage in agriculture, which is equivalent to approximately three million households (Tibesigwa and Visser, 2016). Therefore, smallholder farmers are expected to play a significant role in both poverty alleviation and rural development in South Africa. Improved market access is essential in enhancing smallholder participation in the markets and their participation level (Fan and Brzeska 2016).

2.3 Smallholder agricultural constraints

The market participation of smallholder farmers is the source and an outcome of economic expansion. It’s an important way for rural households of ensuring better income and improve their food security. Nonetheless, smallholder farmers continue to be challenged by various

factors that impede their growth, potential and ability to successfully contribute to food and nutrition security compared to commercial farmers.

First and foremost, the smallholder farmers are located in remote areas with limited availability of basic facilities. The common constraints that they face are poor land access, lack of extension services, transport and proper infrastructure, storage facilities, market information and access, mechanism and farming equipment (Mabuza et al., 2013, Musah, 2013, OXFAM, 2011). According to Baloyi (2010) constraints affecting farmers may be divided into internal or external constraints. Internal constraints include lack of knowledge, limited skills, lack of education, cultural issues, liquidity problems and labour problems that impede their success of having control over endowments like water and land. The external constraints, on the other hand, are complex and difficult to deal with and therefore demand extended support because they transpire from an extensive agricultural perspective. These constraints include infrastructure, natural disasters that affect farm activities, mechanisation and limited access to credit facilities. Furthermore, poor legislation and policies, high transaction costs as well as limited access to market information also form great barriers to smallholder farmers' agricultural success.

Gender inequality and land rights regarding poor resource allocation also negatively affect the agricultural productivity of smallholder farmers. A majority of rural households are led by women due to the increasing number of men migrating to the cities to seek better employment opportunities (FAO, 2011). This has shifted the role of women in rural households and led them into smallholder farming to be dominant (Thamaga-Chitja, 2012). They have stepped up and embraced the role of being the heads of the households and they continue to be active in the agricultural sector as never before. However, as a result of gender inequality in the agricultural sector, they have suffered heavy losses of limited access to productive resources such as capital, land, and credit facilities compared to their male counterparts (FAO, 2011; Kapungu, 2013). This then hinders their potential, ability and success in the agricultural sector. Kapungu (2013) added that women face several cultural customs and legal issues that impede them from accessing financial services like acquiring loans, productive resources, land and owning bank accounts. Therefore, it is through the marriage ties that most women smallholder farmers obtain land rights so that they can produce crops (Chitja and Mabaya, 2014). This is a result of unequal distribution of productive resources that always favours men. Furthermore, they are also deprived of market access and information, which hinder their agricultural progress and negatively affect their livelihoods.

2.4 Smallholder farmers' role in the agricultural sector towards achieving food security

For the longest time, the smallholder agriculture industry has been ignored and insufficiently supported, even the economic trends and policies' orientation were not inevitably as concerned with smallholder agriculture (Swaminathan et al., 2013). All the hopes about the future were slanted towards the commercial farmers other than the smallholder farmers. On the national level, things changed where food security became one of the top priorities that got reprioritized in 2010. This was concerning the millennium goal that aimed at reducing the poverty and unemployment rates by halving during 1990-2015 (Ark et al., 2016).

Smallholder farming has been distinguished as the driving force that could assist Sub-Saharan Africa to attain rural development goals such as poverty reduction, even though their potential is mostly not considered (Pienaar and Traub 2015; Khapayi and Celliers 2016). The agricultural industry's indigenous crop production can contribute to mitigating poverty and enhancing the food and nutrition status level of smallholder farmers in third world countries.

According to the Department of Agriculture, Forestry, and Fisheries (DAFF) (2012), declining farm yields are the leading cause of growing poverty among African smallholders. Their recovery offers the most significant opportunity for disadvantaged groups to escape poverty. Food insecurity among vulnerable agricultural workers leads to a risk-minimizing conservative strategy for farming systems. In this sense, smallholder farming's potential role allows it to be ignored or treated as another adaptation sector for the small market economy.

Smallholder farmers among play a vital role in creating livelihoods of the households among the rural poor. Even though the production of smallholder farmers is very important for household food security, productivity is very small (Von Loeper et al., 2016).

Smallholder farmers among rural poor play a significant role in creating livelihoods. Despite the importance of smallholder production for household food security, this sector's productivity is relatively small (Von Loeper et al. 2016). Low returns can be one reason why urban and rural families either give up on agricultural production or are not interested in it. Therefore, to guarantee long-term food security, it is necessary to considerably boost smallholder farmers' productivity (Von Loeper et al. 2016). Promoting smallholder farmers through enhanced outputs to achieve sustainable production intensification will increase the productivity of smallholder farmers.

2.5 The production and marketing of indigenous crops

According to Maseko et al. (2018), indigenous crops can either be collected from cultivated fields where they grow as volunteer crops (weed), grown or collected from the wild. Maseko et al. (2019) indicated that these crops are tolerant to adverse weather conditions. Therefore, they can be grown and cultivated in any season. Mvelase (2017) added that indigenous crops can withstand diseases and pests. Furthermore, indigenous crops are most common in rural areas and are popular for their high nutritional benefits to the body. Maseko et al. (2018) postulated that these crops offer an affordable and healthy nutrient-dense alternative that can help contribute towards addressing nutritional gaps. Smallholder farmers play a vital role in the production, promotion and consumption of indigenous crops. They also play a huge role in ensuring their availability in the market.

However, they are faced with numerous challenges such as poor infrastructure, inadequate technological access, poor market access and information, inappropriate policies as well as a lack of extension services that hinder their potential of progressing in the agricultural sector (Christian et al., 2019). This then leads the smallholder farmers to prioritize their own consumption and sell the surplus to the market. Hlatshwayo et al. (2021) South Africa consists of two types of marketing, namely; formal and informal marketing. Formal marketing includes the formal movement of indigenous crops through various chains of factors, whereas informal involves the exchange or selling of crops to neighbours, other farmers or local communities (Hlatshwayo et al., 2021).

A majority of South African smallholder farmers that are involved in the production of indigenous crops are highly dependent on informal markets to sell their produce, as a result of insufficient linkages with formal markets (Soukand et al., 2020). This stresses the need to revise all the policies, institutions and programmes that support the agricultural participation of smallholder farmers in the formal market. This is because smallholder agriculture can render a path out of poverty not only if it’s productive, orientated commercially, but also associated with formal markets. The literature indicated that market participation consists of the significant potential for identifying the appropriate opportunity sets that smallholder farmers need to acquire higher incomes and long-term livelihoods (Fischer and Qaim, 2012; Gwiriri et al., 2019; Meemken, 2020). Therefore, facilitating the development of smallholder farmers' market involvement can be beneficial in assisting households in alleviating food poverty and insecurity.

2.6 The state of food security in South Africa

Food security is observed at global, national, household and individual levels. Food security at a global or national level may not usually address the household level food security problem. The relationship between national food security and household food security is less prominent in developing countries than in developed ones (FAO, 2009). At the national or regional level, food security is measured by indicators such as food production, trade balance, and per capita income and it does not guarantee food security in the household (FAO, 2001). At the household level, food security refers to the availability of food in one's home which one has access to and a household that does not live in hunger or fear of starvation is regarded as food secure (Labadarios et al., 2009).

Globally, the food produced is enough for the entire population, but the challenge is its distribution which then results in some households consuming less than daily required meals leaving them in the vulnerability of being food insecure (Masipa, 2017). Wunderlich and Martinez (2018) stated that food distribution includes the packaging, processing, storage, transporting as well as marketing of food. According to Godfray et al. (2010), lack of proper transport infrastructure could have a negative effect on the price of agricultural inputs together with the distribution of food to the regional market. South Africa is deemed food secure at the national level while at the household level people are still prone to hunger, poverty, malnutrition and suffer from food insecurity.

After 27 years of democracy, a huge number of South African people still suffer from lacking enough income to purchase all their household needs (Stats SA, 2013). South Africa still experience the food access issue even though the country continuously maintains its capacity of meeting the food requirements at the national level (DAFF, 2012). The ability of the country to boost the national food adequacy is through the combination of food imports and own production. However, the prevailing high levels of hunger, malnutrition and poverty at the household level are a result of insufficient food access and not food shortages.

Moreover, issues such as climate change, globalisation, poor storage and food distribution as well as international trade regimes highly threaten South African household food security (DAFF, 2014). The country's food-insecure households are faced with a number of challenges like diseases, high unemployment rate, increasing interest rates, poverty, population growth, rising prices, unstable household production of food, urbanisation and loss of employment (Abdu-Raheem and Worth, 2011; Labodorios et al., 2011). These unfavourable conditions have

put drastic pressure on people that are already struggling with meeting their basic household needs.

According to a report that was conducted by FAO (2006) smallholder farmers are the ones who are mostly experiencing and affected by food insecurity in South Africa. Regardless of the fact that they grow food for a living, they still lack resources that will help them meet their needs either by purchase or production. The continuous increase of poverty among the smallholder farmers in Africa is highly influenced by their declining agricultural performance (DAFF, 2012).

Therefore, it was due to the ever-rising number of vulnerable households that the South African government developed policies and programmes intending to improve food security and nutritional levels. They were specifically developed to guarantee availability, accessibility as well as affordability of healthy, nutritious and safe food for all the households in South Africa. Some of these policies and programmes involve; Household Food Production Strategy (HFPS) (2011), National Policy on Food and Nutrition Security (NPFNS) (2013) and Agricultural Policy Action Plan (APAP) (2015). The main intention of designing and implementing the National Policy on Food and Nutrition Security was to eradicate hunger, poverty and malnutrition, especially at the household level through increasing agricultural investments (DAFF, 2013).

2.6.1 Food security concepts

The food security term is complex, hence providing a variety of definitions by numerous organisations worldwide. Woller (2011) defined food security as the ability of households to acquire and have access to enough quality and quantity of food on a daily basis for consumption. According to Food and Agriculture Organisation (FAO) (2006), food security is the ability of all people to access food that is required for a healthy life at all times. World Bank (2010) stated that food security means to ensure quality consistent food access along with sufficient quantity for all the members of the household. Securing household food security is deemed as extremely important in improving the standards of living of the rural poor.

On the contrary, food insecurity refers to a situation whereby the households are unable to meet their daily nutritious food requirements (Turyahabwe et al., 2013). Woller (2011) stated that food insecurity is not only a principal manifestation but also a primary result of poverty. Poverty is a condition in which people lack the essentials to afford a minimum living standard

such as shelter, clean water, food, clothing, health care and education (DAFF, 2011). Households living in poverty face numerous challenges which then limit their ability to search for employment. This then contributes to a long-term unemployment trap.

Food security consists of four pillars namely; food availability, access, utilization and stability. Food availability is said to be the physical existence of food in desired quantities for consumption, regardless of the location (Woller, 2011). In addition, food can be available from international, domestic markets or households' backyard farms. Food availability in the definition insinuates that a state must have adequate quantities of food available at the national and household levels consistently. The resources or means that households have to obtain an appropriate quantity of foods to meet their daily dietary requirements are referred to as food access. According to DAFF (2011) employment rate, per capita food consumption, price of food, meal frequency and wage rate are food access indicators that affect the consumption patterns of the households. The International Fund for Agricultural Development (IFAD) and FAO (2013) indicated that asset endowments like income, labour and land determine a household's ability to access food. This means that households with enough income can be able to purchase appropriate food, or sufficient land to cultivate their food can overcome food shortages and sustain their food access. Food utilisation refers to the ability of an individual to obtain adequate nutritional intake for a given period of time. A diversified diet leads to food security when an individual is consistent. The food stability term refers to the consistency of the other three terms.

2.7 Factors influencing the extent of the commercialization of indigenous crops among smallholder farmers

Indigenous crops are an important food source for most rural households in developing countries. These crops not only consist of multiple uses within society but also play a vital role in the attempt of diversifying the food to improve food and nutrition security. The definition of indigenous food crops not only varies between authors, but also is elusive as a result of the encompassing variety of foods, roots and leafy vegetables, herbaceous plants, fruits, and leaves of trees that it includes (Van der Merwe et al., 2016). So, there are numerous names by which indigenous crops can be categorized by different scholars which include traditional leafy vegetables, wild vegetables, indigenous and traditional food crops or African leafy vegetables (Nesamvuni et al., 2001; Odhav et al., 2007; Turner and Turner, 2007; Vorster et al., 2008; Van Jaarsveld et al., 2014). Mahlangu (2014) defined them as plant species that are genuinely

native to a particular region, or which were introduced to that region for long enough to have evolved through natural processes or farmer selection. Omotayo et al. (2020) added that, after these crops have been introduced into that particular region, they become recognized as traditional or naturalized crops. Indigenous crops are often referred to as and interchangeably with wild foods and "orphan crops" or "neglected" and "underutilized species" (NUS) and are viewed as secondary crops (Mabhaudhi et al., 2016). Indigenous crops are commonly produced and utilized by smallholder farmers in rural areas. Examples of indigenous crops include amaranth (Amaranthus spp.), African eggplant (Solanummacrocarpon, S. aethiopicus and S. anguivi), Bambara groundnut (Vigna subterranean), vegetable cowpea (Vignaenguiculata), Ethiopian mustard (Brassica carinata), jute mallow (Corchorusolitorius), amadumbe (Colocasia esculenta), okra (Abelmoschusesculentus), Sorghum (Sorghum bicolor), Millet (Panicum miliaceum), cassava (Manihot esculenta), leafy vegetables and pumpkin (Cucurbitamoschata).

Most people in developing countries rely highly on indigenous crops for survival since they are easily accessible and rich in the nutritional requirements of the body (FAO, 2017). Bazzano et al. (2005) added that the consumption of these crops minimizes the chances of being stricken by malnutrition and also helps protect against diseases such as heart disease, diabetes and stroke. Maroyi (2011) conducted a study on indigenous crops which found that a majority of Zimbabweans depend solely on indigenous crops, as they play a very strong and integral part in their day-to-day livelihoods. Furthermore, not only have these crops played a huge role in the contribution of food availability and income safety net for quite a number of households (especially smallholder farmers) in rural areas, but they have also been very useful for poverty alleviation and food insecurity. Indigenous crops are the primary source of food and nutrition security in many rural households. Moreover, they play a significant role in contributing to sustainable food systems under climate change. In addition, Bvenura and Afolayan (2015) postulated that there is a developing acknowledgement that the utilization of locally accessible resources, for example, indigenous crops, can contribute to adjusting environmental inconstancy and change. The majority of indigenous crops are heat stress and drought-tolerant; need few growth inputs; and also adapt to arid and semi-arid conditions (Dioula et al., 2013 Abraham and Pingali, 2020).

However, reports on indigenous crops are mainly unreliable with insufficient research to support their cultivation. This is primarily a result of inadequate funding, the lack of a clear research purview in agricultural sciences, and journal apathy toward publishing work on

indigenous crops (Akinola et al., 2020). Promoting and marketing indigenous crops can help improve the attainability of and access to nutritious foods by households, especially in rural areas, and generate opportunities for their economic improvement through the development of new value chains (Abraham and Pingali, 2020).

Smallholder farmers that grow these crops are faced with a number of challenges that hinder their participation in the indigenous crop market. These challenges mainly affect smallholder farmers in developing countries like Southern African countries. Smallholder farmers are characterized by a small piece of land with limited resources, which is not enough to provide an acceptable livelihood (Mvelase, 2017). Smallholder farmers are known for mainly prioritizing their consumption, and marketing the surplus (Cousins, 2013). South African smallholder agriculture is mostly practised in the rural areas, where unemployment is very high and households are stricken with poverty. So, indigenous crops have become a staple food source for many smallholder farmers and have the potential to alleviate poverty and nutrition insecurity. However, the potential of these crops remains underrated. In addition, they also encounter other biophysical and socio-economic constraints including poor infrastructure, soil quality, access to improved varieties of seeds, low availability of water, and limited credit and information access.

Mutemim and Sakwa (2017) indicated that due to limited information access to the markets, the majority of Kenyan smallholder farmers producing legumes end up selling their surplus to their neighbours. Mazur (2012) pointed out that language also could be a barrier to the market participation of these farmers. So, to increase market participation, the information should reach the farmers preferably in their local language. Mahlangu (2014) found that distance to the market negatively affected both the quality and the quantity of the product sold. Smallholder farmers lack appropriate storage facilities, and therefore their crops after harvest cannot last long. Especially some easily perishable crops like vegetables. This can result in loss of income and food and health issues.

Women are often an essential resource in agriculture and the rural economy in developing countries. However, Addison et al. (2014) found that the number of Ghanaian females contributing to the rice market participation was lower than that of men. The study further explained that this was because of women-owned less land than men. Land possession and ownership play a huge role in ensuring the participation of households in the market (Achandi and Mujawamariya, 2016). Bachewe et al. (2019) found that women did not participate in the

market because they did not have access to extension services compared to men. This implies that there is a "gender effect" in the commercialization industry. On the contrary, Mutemim and Sakwa (2017) found that both women and men in Kenya did not have access to extension services which hindered their opportunity to participate in the legume agribusiness. Farmers ended up selling to their local communities which resulted in the loss of a lot of income.

In the same vein, this study builds upon this literature by investigating whether there is an association between participation in the commercialization of indigenous crops and the location of residence. As posited by Nkosi et al. (2020) indigenous crops, which naturally grow within a specific geographic location are often characterized by limited development relative to their potential (Mabhaudhi et al., 2017). Chhetri et al. (2012) found that location plays an important part in agricultural production. Lawin et al. (2016) found there is a regional gap in terms of output commercialization. Farmers in the Southern region where the cropping system is dominated by cash crops are more market-oriented.

The lack of access to market information and extension services limits smallholder farmers' access to improved knowledge on crop management (Mazur, 2012). In addition, lack of good quality infrastructure, low levels of education, insufficient marketing skills, poor production, and limited resource endowments fail in interpreting the market information required in production planning and marketing. Khapayi and Celliers (2016) found that most South African smallholder farmers end up consuming their produce and not selling them because they lack farming equipment and because the skills that they apply do not produce that much. Lack of basic infrastructure makes it difficult for many smallholder farmers to access market information. Maliwichi et al. (2014) on the other hand, said that the level of education plays a vital role in farm decision making. The ability to read and write plays an important role in the extension services as farming instructions can be distributed as educational pamphlets and books.

Therefore, to alleviate food insecurity, the efficiency of marketing the produce of smallholder farmers should be prioritized. This can increase their productivity significantly while ensuring long-term food security. It can be achieved through the encouragement of the farmers to consider and pursue the sustainable intensification of production by using improved inputs. When the farmers grow crops of improved varieties they help increase their income (agricultural income) and escape poverty, while improving local food security. However, bringing these indigenous crops to the market could not only make them widely recognized by

the consumers but could also increase the curiosity of researchers on how else could they could be valuable. This could present an opportunity for further research about their benefits to the livelihoods of households other than the potential of increasing economic growth. Therefore, smallholder farmers play a huge role in ensuring the availability of these crops in the markets.

2.8 Impact of commercialization of indigenous crops on household food security of smallholder farmers

Agriculture is a solid contender for empowering economic growth, poverty reduction and advancing the food security situation in South Africa. It plays a significant role in helping ensure good nutrition, in which good nutrition assembles human capital, which contributes as input in agricultural production, making a circular pathway between nutrition and agriculture (Dioula et al., 2013). Smallholder farmers play a vital role in ensuring that the food is available in the markets. Hawkes (2012) postulated that food production by smallholder farmers is viewed as holding the potential to influence their households' members' nutrition, either via direct consumption or indirectly through generating some income which permits them to purchase local food. Dorward and Dangour (2012) further added that food consumption of smallholder farmers together with their nutritional statuses is normally influenced by what they grow, therefore own production impacts their diets.

The food security of smallholder farmers is extremely dependent on the income or sales that they obtain from their production. Since the majority of rural smallholder farmers' production includes indigenous crops, participating in the commercialization of these crops will help them a lot because they will gain some income and improve their standard of living. Smallholder farmers are farmers that are located in rural areas and are normally characterized by poor resources such as capital, farming equipment, labour, and land while they assume a significant part in poverty alleviation, especially in poor rural areas (Sikwela, 2013). Their production usually includes indigenous crops, simply because they are easy to grow, survive under harsh weather conditions, do not necessarily require many fertilizers. It is evident from the past literature that the smallholder farmers highly benefit from growing indigenous crops in two ways. Firstly, they economically benefit from a rising market, and secondly, through the consumption of these crops they benefit with regards to their food security level/ status because of the nutritional value indigenous crops contain (Krause et al., 2019). So, this makes their livelihoods to be highly dependent on farming.

A considerable amount of literature has been published on how the commercialization of indigenous crops enhance the income of smallholder farmers (Muhanji et al., 2011; Nzabakenga et al., 2013; Nwibo et al., 2017; Mohammed and Shallo, 2020; Simon et al., 2020). Muhanji et al. (2011) conducted a study on African indigenous vegetable enterprises and market access for small-scale farmers in East Africa. The results showed that smallholder farmers that produced and sold indigenous crops earned a lot of income compared to the ones that produced exotic vegetables. The study also revealed that as a result of increased consumer demand even smallholder farmers that only specialized in exotic vegetables shifted their focus and diversified their produce by targeting the indigenous crops as their new source of income. All this was due to the income that they all obtained from producing and selling these crops. These findings were supported by Simon et al. (2020) who argued that the Horticultural Innovation Nutrition Research Program project that was undertaken in Zambia and Kenya played a huge role in assisting smallholder farmers to earn high income from commercializing indigenous crops. This was due to the increased demand for the crops following the training programs (on the production, selling and preparation methods of indigenous crops) that the project provided together with the awareness about the nutritional value of these crops. Nonetheless, Nzabakenga et al. (2013) found something different from their study. Their results revealed that the smallholder farmers with large pieces of land earned more income due to high productivity levels compared to those with smaller pieces of land. However, even though Ademe et al. (2017) discovered that smallholder farmers with larger pieces of land in the highlands of Eastern Ethiopia produced more crops but the market distance hampered their opportunities of obtaining high income. This is because they could not reach the market due to lack of transport, extension services and poor infrastructure.

According to Nzabakenga et al. (2013), family labour that consists of more women stands a good chance of expanding their agricultural productivity leading to more income for the households. This is in line with the goal of the Horticultural Innovation Nutrition Research Program project that was undertaken in Zambia and Kenya. Their goal was not only to help provide the smallholder farmers with training and skills on the productivity of indigenous crops but also to ensure that more women participated in the project so that the income will rise (Muhanji et al., 2011). This is due to the fact that women have proved to be extremely more productive and hands-on compared to men in the agricultural industry. Moreover, with more vulnerable women being economically empowered the higher the number of households with a balanced diet because women are well known for prioritizing healthy eating over junk food

stuffs. Moreover, a comparative study by Nzabekanga et al (2013) concluded that households with few members tend to generate less income from agriculture as a result of family labour than those with higher members. This leaves the higher income earners be privileged to diversify their diets.

In addition, a detailed examination of production diversity, dietary diversity and consumption seasonality: panel data evidence from Nigeria by Ayenew et al. (2018) revealed that an increase in the crop yield together with the high productivity of indigenous crops sold to the markets can lead to high income of smallholder farmers resulting in the diversity of their diets. Nzabakenga et al. (2013) further stated that the purchasing power of many rural households, including smallholder farmers, is extremely determined by the agricultural income since agriculture is the backbone of their livelihoods. Therefore, the increase in the production of indigenous crops together with the income can lead to the smallholder farmers being food secure. However, Ochieng et al. (2020) postulated that there is a massive number of smallholder farmers with high productions of indigenous that still suffer heavy losses of limited income. This is normally due to the lack of market access, storage capacity, market information and lack of infrastructure (Khapayi and Celliers, 2016). Furthermore, Mayekiso (2016) added that the underutilization of these crops can also be a lack of awareness and nutritional value.

There are other studies that have been conducted on the impact of income on indigenous crops farmers' productivity (Rapsomanikis, 2015; Nwibo et al., 2017; Ezeanya-Esiobu et al., 2018; Nyaruwata, 2019; Ogutu et al., 2020). From the study that was conducted by Nyaruwata (2019), it was concluded the level of income influenced smallholder farmers' production quantity. The higher the income they received the higher the quantity they produced on their next production. On other hand, Ogutu et al. (2020) discovered that possession of super-market contracts directly proportionally affected the income of smallholder farmers. It was revealed that the smallholder farmers that produced more produce and earned more income were those in possession of super-market contracts, which in turn helped improved their livelihoods. However, Rapsomanikis (2015) found that the income received by smallholder farmers was highly influenced by the land size. This is due to smallholder farmers with larger pieces of land producing higher quantities than those with smaller land. However, there has been relatively little literature published on the impact of the commercialization of indigenous crops on household food security of smallholder farmers, especially in South Africa (Mayekiso, 2016; Ngema et al., 2018) most of the literature is from other African countries (Opiyo et al., 2015; Aneyew et al., 2018; Simon et al., 2020). Opiyo et al. (2015) concluded that the marking of

indigenous crops plays a vital role in enhancing the nutritional status of households, especially in rural areas. This view was supported by Mayekiso (2016) who also added that lack of knowledge about their nutritional value is the reason why they have been neglected and underutilized.

Therefore, from the existing literature, there is limited research about the impact of indigenous crops and households' food security status. This study will not only add more information and knowledge on that but also combine the two aspects. Because it is very important that the two are combined since the combination has a high effect on smallholder farmers, especially their food security status level. It will also help bring awareness to the policy makers so that they can intervene by making suitable policies specifically for smallholder farmers experiencing such challenges. All that will lead to the increment of their productivity together with their income, but also can enhance their food security status levels.

2.9 Review of analytical techniques of the study

Double-Hurdle Model

The literature proposes that the Heckman sample selection model, Double-Hurdle Model (DHM), and Tobit model are the most employed analytical techniques when analysing the crop market participation (Donkor et al., 2018; Chen et al., 2020; Tafesse et al., 2020). Cameron (2005) suggested that the Heckman approach is more suitable for incidental truncation where the unobserved values are represented by the zeros. On the other hand, the Tobit model is said to be more restrictive and assumes simultaneous variables Ricker-Gilbert et al. (2011). The DHM, originally proposed by Cragg (1971), has been extensively applied in several studies (e.g., Reyes et al., 2012; Senyolo et al., 2018; Andani, 2019; Mwema and Crewett, 2019; Ojo et al., 2021). According to Reyes et al. (2012), the DHM is a more flexible alternative compared to the Tobit model because it allows for the possibility thar factors influencing the decision to sell a crop be different than the factors affecting the decision of how much to sell. Therefore, this study opted for the DHM, since it is flexible, efficient, consistent with parameters and unbiased.

In a study conducted in Southwestern Nigeria, Ojo et al. (2021) employed the DHM to estimate the commercialization level and factors influencing the level of commercialization among the *moringa* farmers. The results revealed that half of the *moringa* farmers are still operating at the

subsistence level with a large number of them at the low-medium level while the rest are high-level market participants. The participation in the commercialization of *moringa* was influenced by age and square of household head age, marital status, level of education, farming experience in moringa farming, and access to market information. In the same vein, age and age square of household head, level of education, access to credit and extension services were factors influencing the level of commercialization. Andani (2019) used the DHM to identify factors influencing households' adoption and extent of indigenous food crop production decisions among farm households in northern Ghana. The results indicated that significant factors influencing farm households' decisions on adoption are crop income use by women, farm size, awareness of the nutritional importance of indigenous crops, participation in food security projects, access to credit and distance to a market. Moreover, the factors that affect indigenous crop production diversity positively included income use by women, farm size, number of land parcels, household size and bicycle ownership.

In estimating the effects of market information networks on commercialisation decisions of smallholders of African indigenous vegetables in Kenya, Mwema and Crewett (2019) employed a two-stage Cragg's DHM. Findings showed that market information networks to have positive effects on the second stage decision of volumes sold. Other determinants of commercialisation were farm size and household size which reported positive marginal effects while age, livestock units and off-farm income reported negative marginal effects. Senyolo et al. (2018) used the DHM to examine the factors influencing households' participation decision in the production of African leafy vegetables in the Limpopo Province, South Africa. The empirical results suggested that factors explaining participation decision and the level of participation are dissimilar. Thus, it is imperative that policies that are aimed at incentivising participation and level of participation and their impacts on food security and nutrition target different groups.

In their analysis to estimate the factors influencing market decisions among potato growers in the central highlands of Angola, Reyes et al., (2012) employed the DHM. They discovered that the households that were involved in the growing and selling of potatoes, especially male headed were rich compared to their female counterparts. The results suggested that female headed households produced less quantity of potatoes due to lack of public and productive assets such as having access to the market, extension services, etc (Reyes et al. 2012).

Probit Regression Model

To date, several studies have used a variety of methods to determine factors influencing the commercialization of crops among smallholders (Ater et al., 2021). To determine the main factors influencing the decisions of smallholder African indigenous vegetables farmers to access pillars of competitiveness in high-value market chains in Kenya, Ngenoh et al. (2019) used Probit regression model. The results indicated that about two thirds of small-scale farmers had access to at least one pillar of competitiveness in high-value market chains. The model results show the presence of interdependency of household level decisions to access multiple pillars of competitiveness in high-value market chains. Furthermore, the results also reveal that coping with shocks, coupled with access to information on market prices and warnings of unexpected events, contract farming, certification and modern irrigation technologies are the main conditioning factors to the access of the pillars of competitiveness by smallholder farmers.

Mustapha et al. (2016) employed Probit regression model to examine the determinants of food insecurity and the degree to which the factors influence the level of food insecurity of households in Northern Ghana. The results indicated that locality (i.e., residing in rural areas), household size, age, land size and access to credit significantly increase households' level of food insecurity. Contrary, marital status and maize crop output significantly reduce households' level of food insecurity. Senyolo et al. (2014) applied Probit regression model to determine consumer's willingness-to-pay for African leafy vegetables and to explore the socio-economic and perception factors influencing willingness to pay for African leafy vegetables in Limpopo Province, South Africa. The study found that willingness-to-pay was mainly a function of socio-economic factors, namely gender, urbanization, age, distance to the market, tastes/preferences and availability of African leafy vegetables throughout the year. Demand and preference for African leafy vegetables were found to be high as they have been historically important food security crops to rural households.

Household Food Insecurity Access Score (HFIAS)

In 2006 the United States Agency for International Development (USAID) funded the Academy for Educational Development the Food and Nutrition Technical Assistance (FANTA) Project to publish a tool that can be useful and suitable in measuring household food insecurity (Maziya et al., 2017). The motive behind the development of the tool was to have a simple, easy to use and applicable instrument to help measure the level of food insecurity of the households. HFIAS is said to be an approved legitimate method that has been employed by

various scholars in the respective studies (Mohammadi et al., 2012; Mango et al., 2014; Makate et al., 2016; Awodele and Olajide, 2020).

Many studies in the past have used Household Food Insecurity Access Score (HFIAS) to analyze and measure the food insecurity status level of the rural households (e.g., Mohammadi et al., 2012; Mango et al., 2014; Makate et al., 2016; Moroda et al., 2018; Gewa et al., 2021). Gewa et al. (2021) examined the agricultural production, traditional foods and household food insecurity in rural Kenya using the HFIAS tool. It was mainly about the prevalence and determinants of household food insecurity among households with mothers and young children in Seme sub-County, Kenya. The results indicated lower scores during the season of harvest. This means that food-insecure household numbers increased in the harvest season whereas the number of food insecure decreased. Through these results, they were able to spot the main cause of food insecurity.

To examine factors influencing household food security among smallholder farmers in Mudzi district of Zimbabwe, Mango et al. (2014) applied HFIAS. The study found that household dietary diversity is influenced by the age and education of the household head, household labour and size, livestock ownership, access to market information and remittances. Linear regression on another indicator, the household food insecurity access score, shows that labour, education of the household head, household size, remittances, livestock ownership and access to market information all affect household food security. Moroda et al. (2018) also used HFIAS to examine the food insecurity status of the rural households in Boset district of Ethiopia. The results revealed that about 21% of respondents were highly food insecure through HFIAS. Moreover, results from the inferential statistics showed that educational status, farmland size, total annual income, distance from health facilities, and the availability of supporting organizations were positively associated with the household food security situation, while access to irrigable land, frequent drought, distance to input/output markets, and distance to road transport were negatively associated.

Endogenous Poisson Model

The endogenous Poisson Model has been rarely applied to investigate the impact of commercialization of indigenous crops on household food security exception would be Wabwile (2016). To investigate the potential contribution of improved sweet potato varieties on food security in Kenya, Wabwile (2016) applied the Endogenous Switching Poisson Model.

The findings indicated that adoption of improved sweet potato varieties was largely influenced by extension contact and also education level but negatively influenced by farming experience.

2.10 Conceptual Framework

This dissertation employed various kinds of research methodologies in investigating the specific objectives listed in this study (Barrientos, 2012). The main goal of producing and commercializing indigenous crops by smallholder farmers is to earn income, improve their livelihoods (financially, physically), fight off poverty, hunger and malnutrition as well as achieve food security. For all this to be accomplished, there's a need for them to have market access, extension service assistance, and governmental support. If farmers had their crops into the market their food security status would be better. This is because being involved in the market participation could help open them business adventures and earn profit from their produce. This could help them improve their food security status level.

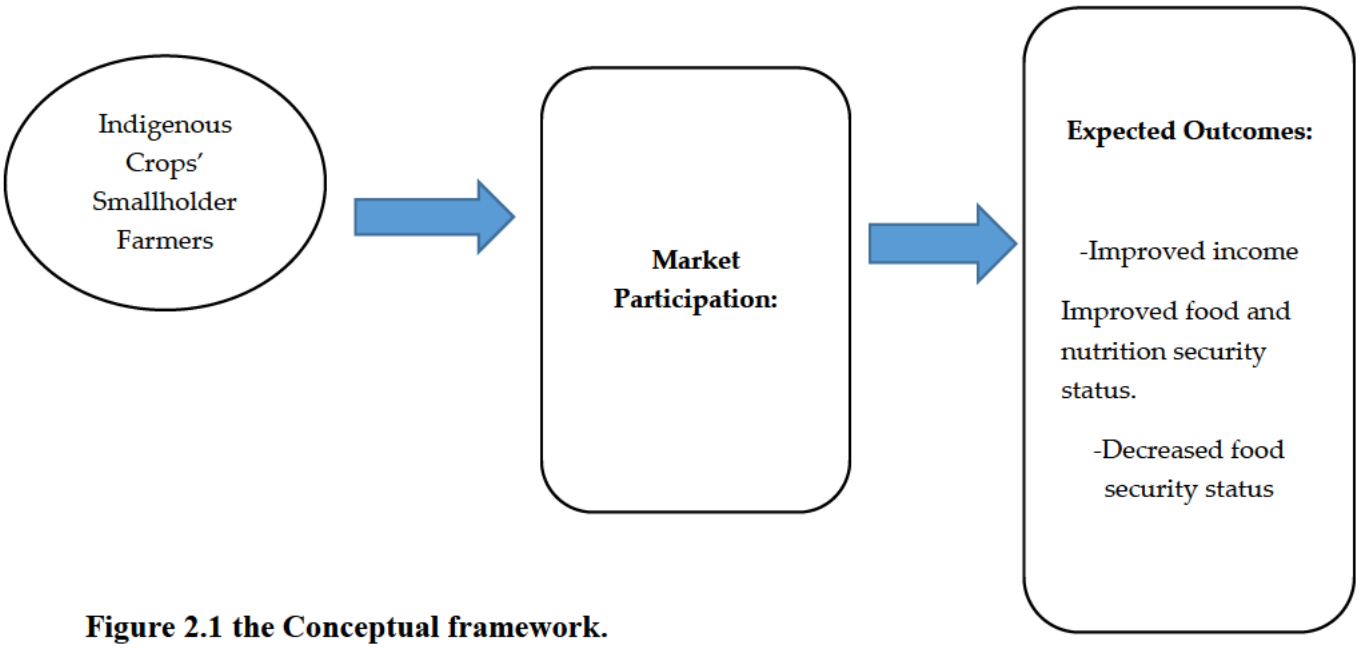

Figure 2.1 the Conceptual framework.

2.11 Summary

This chapter provided reviewed literature on the smallholder farmers, their importance and the role they play in achieving food security, the production and marketing of indigenous crops. The chapter has also stressed the constraints that smallholder farmers come across in the agricultural sector. The food security concept was briefly discussed as well. The challenges that restrict smallholder farmers from effectively contributing to household food security were also mentioned.

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CHAPTER 3

METHODOLOGY

3.1 Introduction

The focus of this chapter is on the study area, data collection and analysis methods used in this study. The chapter begins with the study areas descriptions where it provides brief background information about the areas where the study was performed and data collected. It also includes the quantitative instrument employed in the study.

3.2 The study areas descriptions

This study was conducted in the Northern and North-East Regions of South Africa covering about two of the nine provinces in South Africa. For this study, both Limpopo and Mpumalanga provinces were used based on the predominance of smallholder farmers involved in indigenous crop production. Limpopo and Mpumalanga provinces are populated by smallholder communal farmers that mainly depend on agricultural and livestock farming for their livelihoods. Limpopo is situated in the Northern part of South Africa, covering about 125 754km² of the area, which is only 10.2% of the total area of the country. Its population is about 5,8 million with five districts of Mopani, Vhembe, Capricorn, Waterberg and Sekhukhune (Christopher, 2017). The people in this province are highly involved and dependent on agriculture for survival, as 89% of the peoples' occupation is agriculture. Stats SA (2021) discovered that Limpopo is the most food-secure province in the country (93.6%). The study was conducted in the districts mentioned above.

The adverse consequences of climate change and fluctuations can be extremely severe in this province, where about 57% of the population is involved in crop production with the remaining 25% of farmers irrigating (Afful and Ayisi, 2020). Annually, Limpopo has an average temperature of about 24.6 °C, with a maximum average of 28.2 °C in January, while the minimum average of 18.9 °C is in June (Makondo et al., 2020). July ends up being the driest month with 2mm annual rainfall, whereas about 420 mm is received in January, the wettest month (Makondo et al., 2020). The average annual relative humidity recorded in this study area is about 77.4%.

The second study area is Mpumalanga province, which is located in the North-Eastern part of South Africa. It covers about 6.5% of the country's land area. It consists of about 4,04 million

people with 72% being involved in agriculture (Christopher, 2017). The overall rainfall received in this province per year is about 1, 000 mm, with its warm and temperate weather conditions as it lies 665m above sea level. This province contributes to the agricultural economy through farms produce such as corn (maize), sugar, cotton, groundnuts, potatoes, wheat, and indigenous crops such as Amaranth, Vegetable Cow-pea, African eggplant, Okra and pumpkin (Lehohla, 2016). A variety of fruit is also produced in this province including mangoes and oranges in the subtropical low-veld, whereas peaches are produced at higher elevations.

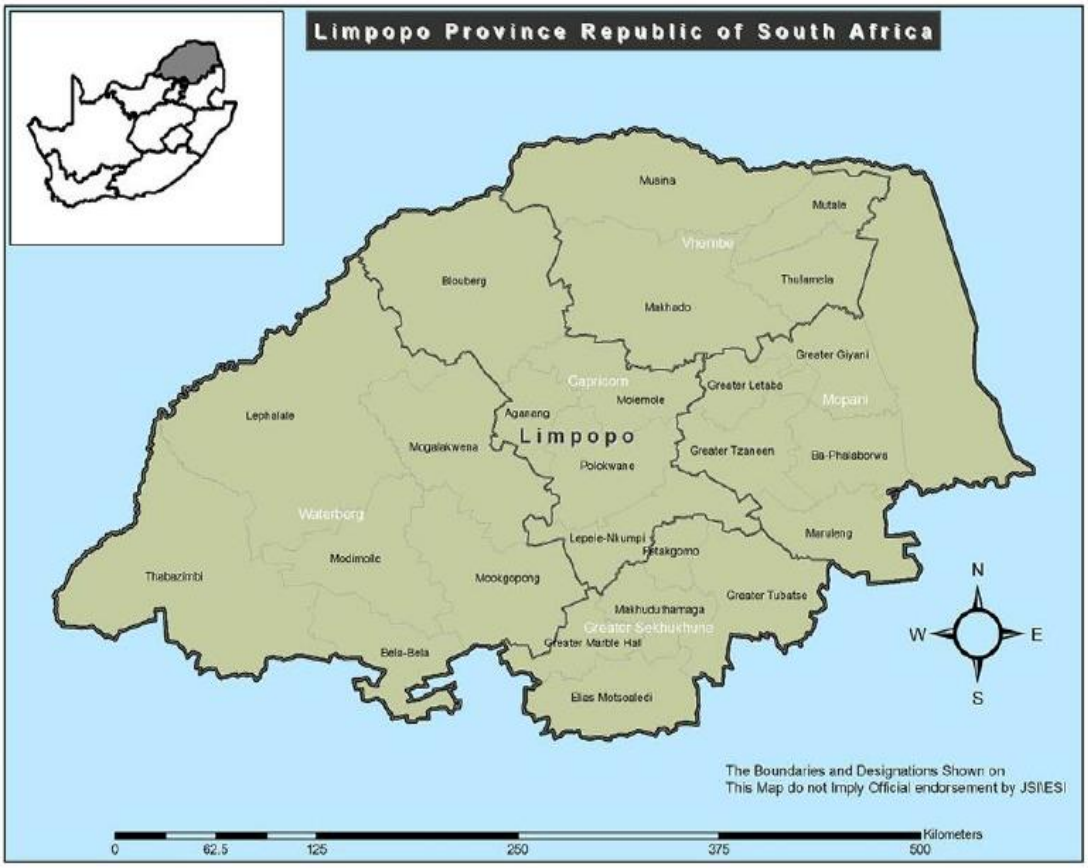

Figure 3.1: Limpopo Province

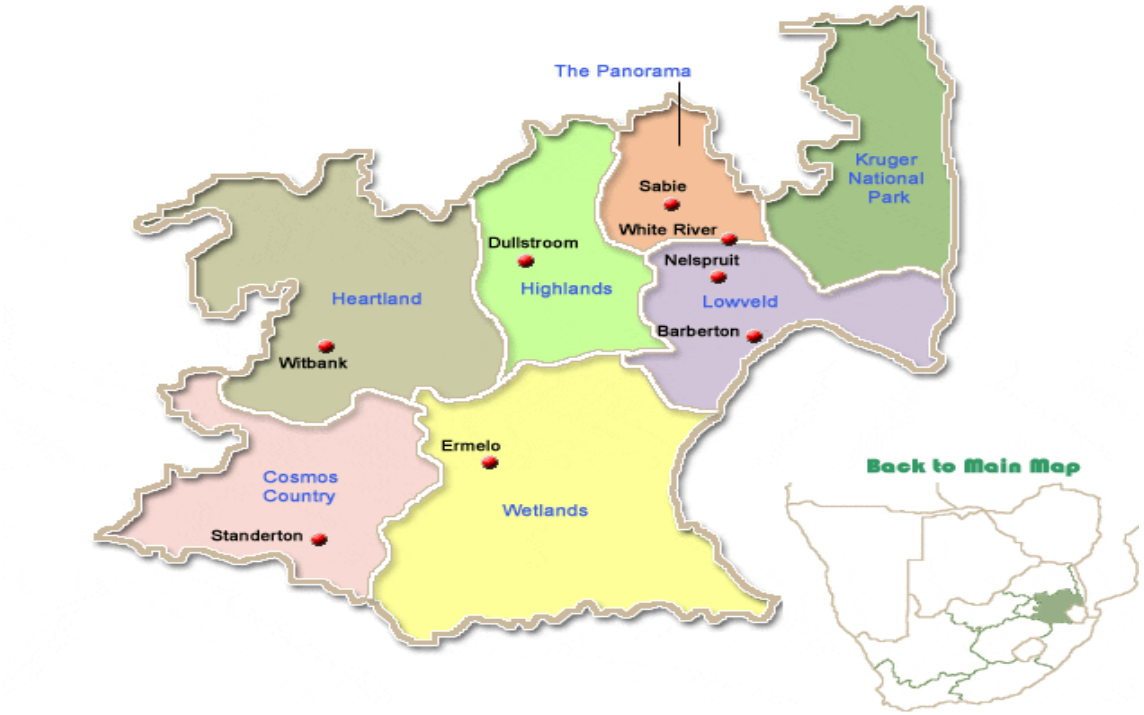

Figure 3.2: Mpumalanga Province

3.3 Data types, Sources and Methods of Data Collection

While the data analysed in this study focuses on two provinces, the research was part of a bigger baseline assessment study that was conducted in four provinces in South Africa. Therefore, this study used secondary data collected through questionnaires (Appendix A). The data used in this study has been extracted from an assessment study that was conducted in various provinces of South Africa by the South African Vulnerability Assessment Committee (SAVAC), led by the Secretariat hosted in the Department of Agriculture, Land Reform and Rural Development (DALRRD) in 2016. Permission to use this data was granted by SAVAC (Appendix B). Data collected included the demographics of the participants, crops (indigenous and cash crops) produced and consumed by rural households, food security and nutrition information. However, the purpose of this particular study is to assess the factors influencing the extent of indigenous crops' smallholder farmers' market participation. Smallholder farmers were asked to list the different types of crops they produce, consume and sell. From the list of crops identified by the smallholder farmers, indigenous crops were selected (Table 3.1). Although the study uses secondary data from 2016, the government has a keen interest in the findings of this study and has permitted the researchers to use the data. The findings of this

study are, therefore, important not only for the research community but even more important for the government and policymakers, as findings help inform better programming.

Table 3.1: Indigenous crops grown by Limpopo and Mpumalanga Smallholder farmers.

Indigenous Crops	Scientific Names
Amadumbe	*Colocasia esculenta*
Bambara Groundnut	*Vigna subterranea*
Cassava	*Manihot esculenta*
Cowpea	*Vigna unguiculata*
Eggplant	*Solanum melongena*
Leafy Vegetables	
Millet	*Panicum miliaceum*
Okra	*Abelmoschus esculentus*
Pumpkin	*Cucurbita*
Sorghum	*Sorghum bicolor*

Source: authors' own analysis.

The study used a quantitative research method to collect data. The multi-stage stratified random sampling technique was used to select households' representatives' samples. A multi-stage stratified random sampling is a process that is normally applicable in huge inquiries of geographical data. In this process, each individual has an equal chance of being chosen as a part of the sample. This technique was perfect for the study, not only because it provides detailed and more reliable information about the sample, but also because it saves time and money. This technique also has the least performance prediction errors. Characteristics such as institutional factors, sales, socio-economic characteristics, household sizes, and outputs were used to divide the farmers into groups in each site. The DAFF surveys covered random samples of about 4 286 rural smallholder farmers in four provinces of the country. However, this study has only focused on two of the provinces, namely Mpumalanga and Limpopo, with a total of 1 520 respondents selected. Of these 1520 smallholder farmers, 209 were found to be involved in indigenous crops farming. The focus was not only on their participation in the cultivation of indigenous crops but also on the commercialization of their produce since their livelihoods

depended solely on agriculture for survival. The main intention of this research was to estimate the factors that influence commercialization and the extent of commercialization among indigenous crops smallholder farmers.

In this study, statistical analysis of data was performed using Statistical Packages for Social Science (SPSS) (Abu-Bader, 2021). Both descriptive statistics and econometric models were used in the analyses of data. Descriptive analysis quantitatively describes and summarizes samples and observations in a meaningful way. Descriptive statistics are distinguished from inferential statistics, in that descriptive statistics aims to summarize a sample, rather than use the data to learn about the population that the sample of data is thought to represent. According to Jaggi (2003: 1) "descriptive analysis gives numerical and graphic procedures to summarize a collection of data clearly and understandably". Furthermore, he stated that "descriptive statistics helps us to simplify large amounts of data sensibly".

3.4 Methods of data analysis

The methods of data analysis used by this study were divided into descriptive statistics and econometric analysis methods. Descriptive statistics such as mean and standard deviation were used to analyze the socio-demographic factors of the respondents (Kumar, 2018). The study employed various types of econometric analytical tools for the objectives to be answered. Both Double-Hurdle Model (DHM) and Probit Regression Model were significant in the estimation of factors that influence commercialization and the extent of commercialization among indigenous crops' farmers. The DHM was perfect for the study because it estimates unbiased, efficient and consistent parameters. On the other hand, Probit Model was employed as a result of its widespread application from other studies with the same motive (Mustapha et al. 2016; Mwambi et al. 2020). The detailed information about the analytical tools used in this study is available in Chapter 4.

Following the past literature (Mohammadi et al., 2012; Mango et al., 2014; Makate et al., 2016; Awodele and Olajide, 2020) from other developing countries, Household Food Insecurity Access Score (HFIAS) was employed in this study to analyze and measure the food insecurity status level of the rural households in the Limpopo and Mpumalanga provinces. The endogenous Poisson Model was also used in this section of the study to measure the effect of the commercialization of indigenous crops on the household food security of smallholder farmers. The use of the Endogenous Poisson Model is advantageous in offering a solution that amends for problems of bias selectivity in some simultaneous equation models. Furthermore,

it should, however, be noted, that it is not automatic that there is endogeneity between market access and production. The main motive of this study's section was to analyze the impact that the commercialization of indigenous crops has on the household food security of smallholder farmers. The full detailed information is in Chapter 5.

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CHAPTER 4

Factors Influencing the Extent of the Commercialization of Indigenous Crops among Smallholder Farmers in the Limpopo and Mpumalanga Provinces of South Africa.

4.1 Abstract

Smallholder farmers encounter countless challenges that not only restrict them from maximizing market opportunities but also limit their access to the markets. This paper aims to achieve a thorough understanding of the factors that influence the market participation of indigenous crops by smallholder farmers while also analysing the extent of market participation in South Africa. An analyzable sample size of 1520 was used for the study. Of these 1520 farmers, 209 were indigenous crops smallholder farmers. Household commercialization index (HCI), T-test, description analysis, and a double hurdle model with quasi-maximum likelihood fractional response model were employed to analyze the commercialization and extent of commercialization among indigenous crops by smallholder farmers in South Africa. The study demonstrated that a farmer's decision to participate in the market is highly dependent on gender, off-farm income, access to market information, and a family member being infected by HIV. Factors such as household size and access to the market had statistical significance in the extent of market participation by smallholder farmers. While we recommend the need for the government to ensure support for the production of indigenous crops by smallholder farmers, it is also important that women are not side aligned regarding their involvement in the market participation. Also, the government and other stakeholders can provide support through the implementation of cooperatives within the smallholder farmers.

Keywords: smallholder farmers; indigenous crops; household commercialization index; double-hurdle fractional response model; South Africa.

4.2 Introduction

The agricultural sector is the backbone of many South African households (Pawlak and Kołodziejczak, 2020). The majority of households residing in rural areas not only depend on agriculture for their livelihoods and well-being but also are highly involved in subsistence agriculture which is characterized by a combination of crop and animal production (Shackletonet al., 2001; Gautam and Andersen, 2016). They are well known for producing and marketing biodiverse, ecologically resilient indigenous crops that can withstand a changing climate and other challenges (Akinola et al., 2020). "Indigenous crops are defined as plant species that are either genuinely native to a particular region, or which were introduced to that region for long enough to have evolved through natural processes or farmer selection"

(Mahlangu, 2014). These crops are not only a source of income for several smallholder farmers but also the primary source of food and nutrition security for many rural households. Furthermore, they can contribute to sustainable food systems under climate change, and thus its commercialization can make it available and accessible all year round. Gitz et al. (2017) reported that about 70% of the very poor residing in rural areas, completely or partially depend on indigenous crops for their livelihoods. However, smallholder farmers especially in developing countries are faced with numerous constraints that hinder their participation in indigenous crop markets and benefit from agricultural market chains (Meemken and Bellemare, 2020).

Smallholder farmers are faced with a lack of marketing and production knowledge, information, and skills that could enable them to compete in the markets internationally (Minot and Sawyer, 2016). They also suffer heavy losses from financial capital restrictions for investments which result in their inability of benefiting from opportunities in both domestic and international market chains. Moreover, the majority of smallholder farmers reside in remote areas and are faced with poor quality infrastructure, inadequate storage facilities and transport, and are associated with a lack of information and skills which leads to high transaction costs of participating in the market and hence, over-reliance on traditional social networks and mechanisms for marketing their produce (Ali et al., 2021). Some smallholder farmers still use bartering or gifts to exchange or obtain seeds and crops.

The literature also revealed that other factors that affect the commercialization of indigenous crops are socio-demographic factors such as education level, market information access, HIV status, source of income, and age (Key et al., 2000; Adenegan and Adewusi, 2007; Lubungu and Chapoto, 2012; Dlamini-Mazibuko et al., 2019). Smallholder farmers operate on small pieces of land which leaves them with no choice but to consume all the produce with a lack of surplus to sell (Rapsomanikis, 2015). Lack of land possession limits farmers from engaging in long-term investment and makes it difficult for them to access credit. Also, the government and policymakers do not recognize them and hence the benefits of indigenous crops remain unknown (Von Loeper et al., 2016). So, they end up prioritizing consumption rather than both consumption and selling.

Furthermore, due to low education levels, the smallholder farmers fail to interpret the market information that is required to help assist them in the production planning and marketing of indigenous crops (Mpandeli and Maponya, 2014). Also, the lack of storage facilities makes it

difficult for the farmers to keep their produce much longer. This leads to the vegetables perishing easily. Therefore, it is of high importance that the specific factors that restrict the development of smallholder farmers are better understood so that policies, models, programs, and development strategies aimed at supporting and improving their transition are prepared.

While some studies have been conducted in Africa on several agricultural experiments with regards to indigenous crops and their economic potential, South Africa does not have much information on the factors that affect the participation of smallholder farmers in the commercialization of indigenous crops. Mahlangu (2014) reported that there is a market for indigenous crops and, therefore, it is important to understand the impact of market participation on the livelihoods of smallholder farmers in South Africa. Lack of knowledge on the impact of marketing the indigenous crops could be the reason why some smallholder farmers are not participating in the market in the first place. The provision of information on the benefits of commercializing these crops together with the strategies to address the factors that affect their market participation will be useful to smallholder farmers and may not only influence them but also open up opportunities for them to grow for commercial purposes. Understanding the contribution of indigenous crops towards rural households or smallholder farmers' livelihoods and food security can raise awareness with regard to effective participation. They can adopt strategies to grow these and sell them to the market. The information will be useful in the implementation and formulation of relevant strategies to commercialize indigenous crops effectively.

The main purpose of this study was to identify the factors that influence the commercialization and the extent of the commercialization of indigenous crops among smallholder farmers since very little is known about the issue. It was clear from the literature that some farmers had been suffering from a lack of market information, farming equipment, and support from extension services. This should be addressed as it results in farmers making poor decisions about which channels of the market to participate in. Lastly, in line with its objective, this study has provided recommendations that will help the government with information about the importance of allowing smallholders to participate in the market, and policymakers to recognize the role of smallholder farmers in market participation.

4.3 Theoretical/ Analytical Framework

The data were analyzed using descriptive statistics and econometric analysis. The descriptive statistics that were employed in the analysis of data include standard deviation and mean. The

most used econometric analytical techniques in the analysis of crop market participation include Tobit models, Double-Hurdle Models, and Heckman sample selection models (Donkor et al., 2018; Chen et al., 2020; Tafesse et al., 2020). The Heckman approach is more suitable for incidental truncation where the unobserved values are represented by the zeros; for instance, in situations of wage rate models where the unemployed people are included in the sample (Heckman, 1976; Cameron, 2005). On the other hand, the Tobit model is more restrictive and assumes simultaneous variables Ricker-Gilbert et al. (2011), which makes it unsuitable for this study. Therefore, this study used the DHM, which has been used by many previous studies to analyze the determinants of market participation, including Market participation and sale of potatoes by smallholder farmers in the central highlands of Angola: A Double Hurdle approach Reyes et al. (2012) Market participation by smallholder rice farmers in Tanzania: a double hurdle analysis (Achandi and Mujawamariya, 2016); and Towards commercial agriculture in Rwanda: Understanding the determinants of market participation among smallholder bean farmers (Ingabire et al., 2017).

The DHM is a two-step decision model: (1) the household decides whether or not to participate in the indigenous crop market and (2) the household decides on the volume of indigenous crops to be marketed. As closely related to the Tobit model, the DHM is known to be a corner solution outcome in dealing with issues of agricultural commercialization of smallholder farmers. This model allows for two types of zero: always zeros, and corner solutions (so that participants have to overcome two hurdles instead of one to sell a positive quantity). However, unlike the Tobit model, this model is more flexible and it also represents the generalization of the Tobit model. Therefore, the DHM was perfect for this study because it estimates unbiased, efficient and consistent parameters following numerous studies that have applied it (Komarek, 2010; Mather et al., 2013; Achandi and Mujawamariya, 2016). Also, it does not require the participation decision and the participation intensity to be determined in the same process. In addition, the DHM becomes an appropriate solution in considering both low agricultural surplus and transaction costs in explaining the potential of smallholder farmers in the agricultural commercialization sector. Therefore, it is through this model that a useful framework to survey variables' effects on the probability of participation in the crop's market and the intensity of sale is provided. The model involves a two-step estimation procedure. The DHM was implemented first by estimating a probit model (maximum likelihood estimator/ MLE) of indigenous crops' market participation. It was used in the first stage to identify the factors that affect the decisions of the smallholder farmers to commercialize indigenous crops.

The probit model takes values of 1 and 0 that are assigned to represent the choice of the smallholder farmer's decision on whether to commercialize the produce or not. Then in the second stage, the factors that determine the extent of commercialization of indigenous crops sold to the market were analyzed using a fractional response model with quasi-maximum likelihood.

A smallholder farmer's decision to participate in indigenous crops marketing can be represented by:

$$Market\_Part_i^* = x_i\beta + e_i \tag{0.1}$$

Where $Market\_Part_i^*$ is the latent variable that indicates whether or not the farmer participates in the market (sells the crops), x is a vector of observed independent covariates explaining the decision of market participation, β is an unobserved parameter that is to be estimated and e_i is an unobserved error term capturing all other factors, and e_i $N(0,1)$.

$$MARKET\_PART_i = \begin{cases} 1 if\ Y_i^* > 0 \\ 0 if\ Y_i^* < 0 \end{cases} \tag{0.2}$$

$MARKET\_PART_i$ is positive $MARKET\_PART_i = 1$ if a farmer effectively participates in the selling of crop (as a seller), i.e. $Market\_Part_i^* > 0$, and $MARKET\_PART_i = 0$ or negative if a farmer i chooses not to or does not sell in the market. Y_i^* is the quantity of crops sold by smallholder farmer i Conditional to market participation decision.

In accurate terms, the probit model in stage one of assessment is expressed as:

$$\Pr(MARKET\_PART_i) = X_0 + X_1\beta_1 + X_3\beta_3 \ldots X_n\beta_n + e \tag{0.3}$$

Where $\Pr(MARKET\_PART_i)$ is a smallholder farmer's probability of settling to participate in the market in the form of selling their produce or not, X_0 is a constant parameter, whereas $X_1 \ldots X_n$ are parameters are to be estimated, $\beta_{1\ldots}\beta_n$ are identified in Table1 respectively as the vector of explanatory variables, e represents an error term.

From the probit model of the first hurdle, the Inverse Mills Ratio (IMR) is predicted and included as a regressor in the second stage (second hurdle). This is done purposefully to control

the selection bias to obtain unbiased, consistent as well as efficient estimators using ordinary least squares. The IMR equation is expressed as follows:

$$\frac{\phi\left[\nu\left(\frac{P_i}{\alpha}\right)\right]}{\phi\left(P_i\alpha\right)} \tag{0.4}$$

Where ϕ denotes the normal probability density function. Following is the second-stage equation:

$$E = Y / Z = f\left(x_i\beta_i\right) + e\frac{\phi\left[\nu\left(\frac{P_i}{\alpha}\right)\right]}{\phi\left(P_i\alpha\right)} \tag{0.5}$$

Where E denotes the assumption operator, Y representing the (continuous) extent of the vegetables sold in the market, x influences the volume of the vegetables sold and is known as the vector of independent variables, and β is said to be the vector of the comparing coefficients to be assessed.

In the second hurdle, the study employs the method recommended by Papke and Wooldridge (1996). A fractional response model was employed to estimate the level of commercialization while taking into account the type of dependent variable. The generated sample selection term IMR from the probit model (first hurdle) was fitted as an exogenous variable to account for potential selectivity bias in the fractional response model regarding the level of commercialization (Wooldridge, 2012). The second stage (level of commercialization) equation is expressed as:

$$E(HCI_i / MARKET\_PART_i = 1) = f(P_i, \beta) + \omega\lambda \tag{0.6}$$

$$E(HCI / X_i HCI > 0) = \alpha(X_i\Psi) + \omega\lambda \tag{0.7}$$

where HCI is the observed response on the level of commercialization (HCI)[1], E is the expectation operator; P_i is a vector of the household characteristics; β is a vector of parameters

[1]*The outcome variable for the second hurdle, level of commercialization, is the HCI index from the indigenous farmers in the study area.*

to be estimated; λ is the IMR which accounts for sample selection bias in the probit model, and ω is the associated parameter to be estimated.

Following Cardoso et al. (2010), assumptions of independence and dominance of the DHM entered multiplicatively into the log-likelihood function. This allows the two parts of the DHM to be estimated separately: the participation process by a probit regression model while the second hurdle was estimated with the aid of fractional logit QML estimation approach on the sub-sample of positive observations of HCI with the Inverse Mills Ratio used as a regressor in the estimation for correcting selection bias.

The Household Commercialization Index (HCI) was useful in the analysis of the level of indigenous crop output marketed by the smallholder farmers. This is a tool that is used to determine the specific level of commercialization that each household contributes to the market. The most frequently used method of measuring agricultural commercialization in the literature is the proportion of the value of crop sold concerning the value of crop harvested (Chukwukere et al., 2012; Ochieng et al., 2020; Nwafor et al., 2020). The index can be expressed as follows:

$$HCI_i = \frac{Gross\ value\ of\ crop\ sales\ hhi\ year\ j}{Gross\ value\ of\ all\ crop\ production\ hhi\ year\ j} \times 100 \quad (0.8)$$

The index measures the ratio of the gross value of indigenous crop sales by household i in year j to the gross value of all indigenous crops produced by the same household i in the same year j expressed as a percentage. The index measures the extent to which household indigenous crop production is oriented toward the market. Thus, a value of zero would be an indication of a subsistence-oriented smallholder farmer whereas the closer the index is to 100, the higher the degree that the smallholder farmer is market-orientated (Hailua et al., 2015). The advantage of this approach is that commercialization is treated as a continuum thereby avoiding a crude distinction between "commercialized" and "non-commercialized" households.

Table 4.1: Estimated factors that affect the decision for market participation.

Variable name	Variable definition	Variable type and measurement	Estimated effect of market determinants	Results received by Alpizar

			on food security	**et al. (2020)**
Age	Age of the household head	In years (continuous)	±	-
Gender	Gender of the household head	Dummy (1= male, 0=female)	+	-
Marital status	Marital status of the household head	Marital status (1=married, 0 = single)		+
Household size	Number of members of the household	Size of household (continuous)	–	-
Educational attainment	Education level of the household head	Education level (continuous)	+	-
Livestock	Ownership of livestock	Dummy (1= yes, 0=no)	±	-
Distance	Distance to the market	In kilometers (continuous)	–	-
Credit access	Access to credit	Dummy (1= yes, 0=no)	+	+
Extension services	Access to extension service	Dummy (1= yes, 0=no)	+	-

Notes: ± indicates whether the hypothesized effect will be positive or negative, + indicate a positive estimated effect, and – indicate the negative estimated effect.

Source: authors' own analysis

4.4 Area of the study, methods of data collection and sampling methods.

The above information is all found in chapter 3.

4.5 Results and discussion

4.5.1 Descriptive statistics

4.5.1.1 Demographic and socioeconomic characteristics of the household involved in the production and marketing of indigenous crops

This sub-section of this study presents the demographic and socioeconomic features of the respondents, from a sample of 1520 rural households. The study found these features to be of great assistance in the matter of distinctly portraying the respondents' diverse backgrounds and the impact diversity has had on the descriptive, statistical, and econometric results. The results revealed that out of 1520 smallholder farmers that participated in the study, about 209 were involved in the production of the indigenous crops. Out of 209 smallholder indigenous farmers, about 41 were involved in the commercialization of the identified indigenous crops (Table 3.1). As presented in Table 4.2, the most produced indigenous crop was pumpkin (36%), followed by leafy vegetables (30%). The least (0.5%) produced indigenous crop was sorghum. This could be as a result of sorghum not being popularly consumed as food but mainly used as an ingredient in the production of traditional beer.

Table 4.2: Distribution of indigenous smallholder crop farmers.

	Indigenous crop farmers in the Mpumalanga and Limpopo Provinces	
Indigenous crops	**Frequency**	**Percentage**
Sorghum	1	0.5
Pumpkin	75	36
Okra	4	1.9
Millet	3	1.4
Leafy vegetables	63	30
Eggplant	4	1.9
Cowpea	4	1.9
Cassava	4	1.9
Bambara groundnut	15	7

Amadumbe	36	17

Source: authors' own analysis.

Table 4.3 showed the different indigenous crops sold by smallholder farmers. As represented in Table 4.3, the results showed that leafy vegetables were the most sold indigenous crops compared to the other crops. It was also revealed that indigenous crops such as millet, eggplant and cowpea were not commercialized. A possible explanation for this could be the fact that the crops were not enough for both consumption and selling. While pumpkin was found to be the most grown indigenous crop, the extent of its commercialization was limited, suggesting the need to encourage smallholder indigenous crop farmers to participate in the market.

Table 4.3: Distribution of smallholder indigenous crop farmers participating in the market.

	Smallholder indigenous farmers participating in the market	
Indigenous crops	**Frequency**	**Percentage**
Sorghum	1	2.4
Pumpkin	8	20
Okra	2	5
Millet	0	0
Leafy vegetables	15	37
Eggplant	0	0
Cowpea	0	0
Cassava	2	5
Bambara groundnut	3	7
Amadumbe	10	24

Source: authors' own analysis

The result of the t-test as shown in Table 4.4, revealed that the smallholder indigenous crop farmers' mean age and education were not significantly different among the market participants and non-participants. As represented, the mean age for smallholder farmers that participated in the market was 47.33 years, whereas the ones that did not participate in the market had a mean

age of 44.23 years. Furthermore, the mean number of years of education for market participants was 9.16 as compared to the non-participants with an average of 5.44 years of formal education. This implies that the literate farmers could at least read, write and hold conversations about commercial farming. Also, they had greater opportunities in terms of taking their farming ventures into other levels of success, including having more international market access than the illiterate ones. The mean output of indigenous crops together with market participation had a significant difference ($P < 0.05$). From the results, at least 800.69 kg was the average yield that was harvested specifically for market participation, whereas only 200.17 kg represented those that did not participate in the market. The higher market yield for participant farmers meant that they had the privilege of consuming and selling at the same time. Amongst all the other tables of this study with demographic characteristics of smallholder farmers in Limpopo and Mpumalanga, South Africa, Tables 4.4 and 4.5 present various means and standard deviations.

Table 4.4: Demographic characteristics of smallholder indigenous crop farmers in Limpopo and Mpumalanga provinces, South Africa.

Characteristics	Market participation	Mean	F-value	Degrees of Freedom	P-value
Age of the household head	Yes	47.33	1.009	129	0.314
	No	44.23		21.52	
Education of the household head	Yes	9.16	0.000	102	0.989
	No	5.44		17.14	
Total output of indigenous crops (KG)	Yes	800.69	26.623	318	0.000***
	No	200.17		132.00	

Note: ***, **, * Indicate significance at 1%, 5%, and 10% level, respectively. Source: authors' own analysis.

Table 4.5: Demographic characteristics of smallholder farmers in Limpopo and Mpumalanga provinces, South Africa.

	Market Participants	Non-Market participants	pooled

Variables	Mean	Standard deviation (SD)	Mean	Standard deviation (SD)	Mean	Standard deviation (SD)
Gender of the household head	0.564	0.112	0.533	0.100	1.27	0.45
Household age (Years)	47.333	13.342	44.443	12.666	49.12	11.89
Marital status	0.465	0.356	0.443	0.344	4.21	2.44
Household size (Numbers)	4.786	1.223	3.889	1.012	4.93	2.71
Educational level of household (Years)	6.678	3.048	5.423	2.345	33.58	40.30
Ownership of livestock	0.587	0.357	0.700	0.327	1.77	0.42
Distance to the market (Km)	0.487	0.356	0.475	0.245	1.86	1.82
Access to market information	0.573	0.785	0.455	0.676	1.94	0.24
Access to agricultural assistance	0.486	0.345	0.428	0.367	1.92	0.27
Family member with HIV	0.444	0.432	0.378	0.421	0.47	0.79
Family member worked on farm	0.655	0.557	0.544	0.447	0.98	0.76
Social grant	0.468	0.367	0.490	0.455	1.99	0.73
Irrigation type	0.586	0.234	0.354	0.345	1.52	0.50
Total output of indigenous crops(kg)	800.69	671.8	200.17.2	6.74	1000.22	768.067

Source: Authors' own analysis.

4.5.2. The distributions of commercialization level of indigenous crops

According to Strasberg et al. (1999), the household commercialization index (HCI) measures the extent to which indigenous vegetable production gravitates towards the market. The index

indicates variations in the level of indigenous crops commercialization across the study area. Households were divided into three categories of equal size according to their HCI. As shown in Figure 4.1, different levels of indigenous crops commercialization among the farmers in the study area are revealed. The results of Figure 4.1 show that half of the farmers (51%) are still operating almost at the subsistence level. In the same vein, a large number (31%) of the farmers are still at low-medium levels while the rest (18%) are high-level market participants. Following the studies of Rubhara and Mudhara (2019); Ogutu and Qaim (2019), a value of zero would signify a totally subsistence-oriented farmer while the closer the index is to 1, the higher the degree of market orientation would be. The advantage of this approach as employed by Ogutu and Qaim (2019) is that commercialization is treated as a continuum thereby avoiding crude distinction between commercialized and non-commercialized households.

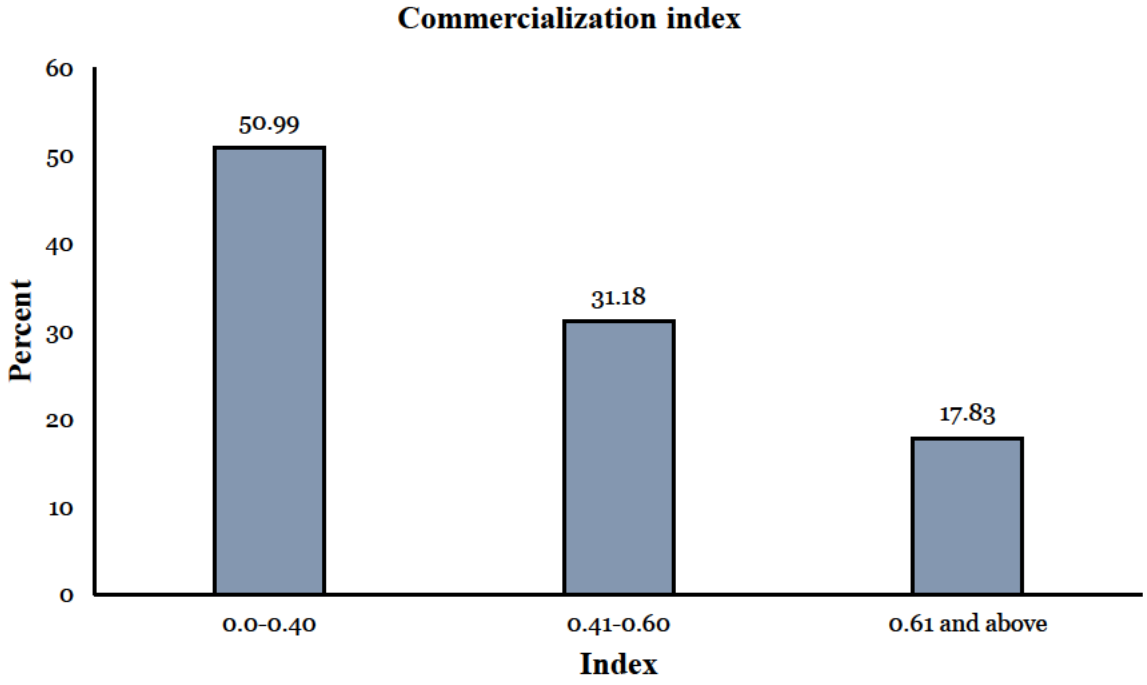

Figure 4.1: Distribution of the commercialization index of indigenous crops.

Determinants of commercialization of indigenous crops: (First hurdle)

While estimating the double-hurdle with the Quasi-maximum likelihood fractional response model, the covariates included in the models were tested for multi-collinearity using the variance inflation factor (VIF). An average VIF of 2.17 shows that the multi-collinearity problem is not an issue among the covariates used for the study. The Probit model (first hurdle) was used to estimate factors influencing the commercialization of indigenous crops among the

respondents in the study area. The results are shown in Table 4.6 below, where the first-hurdle model of the double-model revealed that only the salary of the household and agricultural information was significant at the 1% level. Surprisingly, education had not only had no significant impact on the smallholder farmers commercializing their produce, but also it had an unexpected negative coefficient.

Table 4.6: Probit results for determinants of commercialization of indigenous crops.

Commercialization	**Coef.**	**St.Err.**	**p-value**	**dy/dx**	**Std.Err.**	**P-value**
Household size	0.016	0.049	0.740	0.000	0.001	0.740
Gender of the household head	0.849	0.358	0.018**	0.012	0.005	0.018**
Residents of household	-0.092	0.704	0.896	-0.001	0.010	0.896
Educational level	-0.236	0.721	0.744	-0.003	0.011	0.744
Marital status	0.188	1.272	0.882	0.003	0.019	0.883
Agricultural information	2.057	0.564	0.000***	0.030	0.008	0.000***
Involved in livestock prod	-0.511	0.613	0.405	-0.007	0.009	0.404
Off-farm income	1.037	0.418	0.013**	0.015	0.006	0.013**
WEALTHINDEX[2]	1.139	0.260	0.000***	0.017	0.004	0.000***
Access to extension	-0.274	0.334	0.412	-0.004	0.005	0.410

[2]WEALTHINDEX was generated using principal component analysis (PCA) from the list of wealth indicators owned by the indigenous vegetable farmers. The lists are: wall materials of the house, bank account, owning vehicles, owning a TV, owning radio, type of ceiling, the main fuel used for cooking, etc.

Access to the disability grant	-0.427	1.293	0.741	-0.006	0.019	0.741
Household member with HIV	-1.000	0.542	0.0658*	-0.015	0.008	0.062*
Constant	0.152	0.996	0.878			
Mean dependent var	0.646					
Pseudo r-squared	0.957					
Chi-square	1824.810					
Akaike crit. (AIC)	107.636					
SD dependent var	0.516					
Number of obs	1454.000					
Prob> chi2	0.000					
Bayesian crit. (BIC)	176.303					
VIF	2.17					

Note: ***, **, * Indicate significance at 1%, 5%, and 10% level, respectively. Source: Authors' own analysis

From the Probit results, the gender of the household head had a positive effect, at a 5% level of significance, on the determinants of the commercialization of indigenous crops. The results showed that off-farm income had a positive impact, and statistically significant at the level of 5%. Furthermore, the results revealed that if a household member was HIV positive that had a negative effect on the market participation of the farmer with a 10% level of significance. The results show that a household with a member infected with HIV is likely not to participate in the market.

4.5.3. The determinants of the commercialization level of indigenous vegetable production: A Quasi-maximum likelihood estimates fractional logit model

The results on factors influencing the level of commercialization among indigenous vegetable farmers are as presented in Table 4.7. The variable household size, gender, marital status, access to information, access to extension, and disability grant were statistically significant and discussed. To correct for selectivity bias, an inverse mill ratio (IMR) was used as a covariate in the model (second hurdle). The IMR was not statistically significant which shows that bias due to selection was not a problem. Hence, using a double hurdle model for estimating determinants and level of commercialization is justified. From the second-hurdle equation, it was revealed that the household size, gender of the household head, marital status, access to extension as well as disability grant were all statistically significant.

Table 4.7: Determinants of level of commercialization of indigenous crops (Quasi-maximum likelihood estimates fractional logit model).

Commercialization index.	Coef.	Std. Err.	P-value
Household size	0.014	0.008	0.091*
Gender of household head	-0.192	0.108	0.077*
If the household head resident	-0.224	0.215	0.298
Education of household head	0.124	0.226	0.584
Marital Status	1.034	0.459	0.024**
Access to information	-0.200	0.094	0.033**
If_HH_involved_in_livestock_prod	-0.107	0.261	0.681
If_member_worked_for_a_wage_salary	-0.206	0.182	0.257
WEATHINDEX	0.168	0.105	0.111
HH_received_advice_from_government	-0.043	0.098	0.659
Access to extension	0.085	0.048	0.078*
Disability grant	-0.888	0.464	0.056*
HIV_if_a_member_has_been_informed	-0.359	0.226	0.112

Inverse mills ratio (IMR)	0.040	0.113	0.724
Constant	0.513	0.406	0.206
Wald chi2(14	30.73		
Prob> chi2	0.0061		
Pseudo R2	0.0060		
Log pseudo-likelihood	-976.31617		

Note: ***, **, * Indicate significance at 1%, 5%, and 10% level, respectively. Source: Authors' own analysis.

The results show that the household size had a positive influence on the level of participation of smallholder farmers with a statistical significance of level 10%. Contrary to the first-hurdle model, the coefficient of the gender of the household head was negative and statistically significant in influencing market participation. The results also revealed that both marital status and access to information were statistically significant at level 5%, even though their coefficients were opposite (marital status had a positive coefficient whereas access to information had a negative coefficient). It was also revealed that the number of indigenous crops sold in the market was positively influenced by the access to extension services, with a 1% of the significance level. This study showed that the disability grant had a negative impact on the level of participation to the market by smallholder farmers with the significance level of 10%.

4.6. Discussion

The objective of the study was to determine the factors influencing the extent of the commercialization of indigenous crops among smallholder farmers.

4.6.1. Factors influencing smallholder farmers' decision to participate in the market.

The positive coefficient sign in the gender of the household head implies that gender plays a huge role in the commercialization of indigenous crops. It also provides a clear implication that when men and women work together, they achieve a positive outcome. Sebatta et al. (2014) asserted that men hold the responsibility of deciding whether to participate in the market or not and how much. On the other hand, women become more active in the marketing of arable crops. However, the results of this study differ from what Hill and Vigneri (2014) found in

their study as they reported that men practice cash crop farming for the sake of taking care of their families, whereas women produce crops mainly for consumption purposes. This implies that they do not work together in the production of indigenous crops.

Gaining access to information is a key factor that mostly influences farmers' decisions to participate in the marketing of a product. Farmers with access to information can make informed decisions concerning production, crops to grow, and marketing-related information (Dlamini-Mazibuko et al., 2019). Access to information offers farmers the opportunity to make proper decisions relative to favourable product prices and transaction costs (Key et al., 2000). Having access to market information plays a huge role in the decision-making process of the farmers, about how much to sell and on which market. Farmers require such information to make the appropriate decision on the quantity of produce to market and the price to charge and also to have an idea of the market competition. As revealed from the result of this study, access to market information has a positive and statistically significant influence on commercialization among indigenous vegetable farmers. The result of this study aligns with the study of Dlamini-Mazibuko et al. (2019) who, in their study on factors affecting the choice of marketing outlet selection strategies by smallholder farmers in Swaziland, found a positive influence of market information, on the decision to participate in the market.

The positive coefficient implies that the involvement of indigenous crop farmers in off-farm income opportunities increases their likelihood of commercializing indigenous crops. This implies that regardless of households' other means of making income, they still manage to produce crops and participate in the market. Usually, households that have other means of making income are business-minded and can multitask. Other than farming, females always get involved in other streams of generating income, especially in female-headed households. They partake in casual jobs to take care of their families' needs. The results of this study corroborate that of Mthembu (2013) who from their findings showed that women were not only involved in the production and marketing of indigenous crops but also worked as road maintainers, with others sewing and making grass mats.

The negative coefficient result indicates that a household with a member infected with HIV is likely not to participate in the market. This could be attributed to the fact that farmers tend to spend more time taking care of the sick and less time trying to make produce. From the study conducted by Khapayi and Celliers (2016), having a sick member could reduce labour which negatively impacts the decision to participate in the market because smallholder production

depends highly on family labour in the production of crops. This result is consistent with Adenegan and Adewusi (2007) who concluded that if the number of HIV-infected households increases in the rural areas then their survival strategies together with food security get threatened as well.

4.6.2. The Determinants of the Level of Market Participation of Smallholder Farmers

The coefficient of access to extension had a statistically positive influence on the household level of commercialization. This study aligns with the study of Ojo and Baiyegunhi (2020) who found a positive relationship between access to extension service and the farmers' choice of the adoption of a climate change adaptation strategy. Extension services improve the understanding of farmers, which leads to higher production, a higher probability of participating in the market, and the commercialization of indigenous crops. The results of this study comply with the study of Martey et al. (2012) who indicate that the extent of commercialization is determined by farmers' access to extension services. Therefore, the importance of providing timely access to extension services would significantly contribute to how farmers make their decisions when planning to commercialize the production and marketing of indigenous crops.

The positive coefficient illustrates that as the number of household members' increases, so does the quantity sell in the market. These results are in contrast with what Kyaw et al. (2018) reported. In their findings, they discovered that the size of the household had a negative impact and it was statistically significant. It was then concluded that large households are associated with fewer agricultural products to sell in the market due to prioritizing the consumption needs of the household. The findings were substantiated by Siziba et al. (2011) who posited that the larger the number of households in the family the lesser the chances of them marketing the quantity that is beyond their consumption satisfaction.

The coefficient of the gender of the household head was negatively signed and statistically significant. It was no surprise that the results came out negative, and this is mainly because female-headed households are more likely to be involved in the market of indigenous crops as compared to their male counterparts who are mostly involved in the harvesting and marketing of cash crops. The result is in tandem with other studies conducted by Shackleton and Shackleton (2006); Avocèvou-Ayisso et al. (2009) in South Africa and Nigeria respectively. This study found the gender of the household head to be a significant determinant in the marketing of indigenous crops. In the same vein, the findings of Sinyolo et al. (2017) revealed

that female-headed households sold more quantities of maize than male-headed households. However, the results of this study were in variance with those of the past numerous studies (Boughton et al., 2007; Hlongwane et al., 2014; Sigei et al., 2014) who posited that female-headed households not only lack extension services but also suffer from limited information access on trends and the inability to secure greater contracts that could help provide them with better markets for their crops.

Contrary to the first hurdle, access to market information indicated a negative impact on the volume of the indigenous crops to be sold in the market. The result shows that the more the indigenous crops farmers have access to the market information, the volume offered for sale reduces. This is unexpected from the economic point of view. However, the plausible reason could be attributed to inadequate or unqualified staff members and poor organization, which could limit the efficient dissemination of market information (De et al., 2005; Ojo and Baiyegunhi et al., 2019; Bello et al., 2020). As a result, market information might not be disseminated as efficiently as expected. This could be the fact that most indigenous crop farmers reside in remote areas with a lack of good quality infrastructure, skills in agricultural activities, and inadequate storage facilities and transport (Minot and Sawyer, 2016). This not only impedes their opportunity for competing in the international markets but also deprives them of the opportunities of earning a living through the commercialization of indigenous crops. Also, this infers that being unable to sell their produce, smallholder farmers could end up not partaking in the agricultural sector at all.

The positive relationship between the access to extension services and farmers' commercialization of indigenous crops implies that having access to extension services provides the smallholder farmers with the privilege of being aware of market availability. It also comes in handy in enhancing their knowledge of production by making them aware of information on improved varieties. These results manifest the importance of the urgency of implementing not only improved technology but also support services in the promotion of market sales. Apind et al. (2015) found similar positive results to this study specifying that the extension services had a positive coefficient and significantly influenced the volume of rice that the smallholder farmers sold in the market. Alemu et al., (2012) added that the access to extension services in Ethiopia increased the probability of smallholder farmers opting for the contract market rather than settling for the spot market.

The negative coefficient on disability grants implies that the rise in the income of households that receive the disability grant may entrench an entitlement and culture of dependency among them. This could result in them being lazy or even not growing crops, let alone engaging in income-generating ventures. Similar findings were also reported by (Aliber, 2012; Tirivayi et al., 2016). However, not participating in the market could also be due to the physical condition of the smallholder farmer.

4.7 Conclusion and recommendations

The participation of smallholder farmers in the marketing of produce can play a critical role in meeting their goals such as food and nutrition security, poverty alleviation and sustainable agriculture. This study found that the market participation and sales ratio of smallholder indigenous crop farmers are constrained by numerous factors, such as socioeconomic, market and institutional factors. The commercialization of the indigenous crop for smallholder farmers in the market was affected by gender, educational level, off-farm income, agricultural information, and a member being infected by HIV. The household size, gender of household head, access to market information, extension services and disability grant were found to highly influence the extent of commercialization among the smallholder indigenous vegetable farmers.

To fully realize the optimum contribution of indigenous crops to household food and nutrition security, support from the stakeholders must be geared towards the smallholder indigenous farmers through the provision of farm training for an effective and efficient grasp of agricultural and marketing information. To improve smallholder farmers' access to markets, the government also needs to ensure that their support for the production of indigenous crops is timely and well-targeted to upscale its production for consumption and commercialization. Extension officers also, need to be involved in providing the smallholder farmers with all the necessary equipment that they need to make their agricultural production a success. Much attention and support need to be given to women's involvement in market participation, and they also need to be empowered by the government and other interested stakeholders to participate fully in the decision making relating to the price of their produce and where to sell it. More workshops especially for young people and women need to be conducted in rural areas to raise awareness on the nutritional importance of indigenous crops and the need to include these indigenous crops into South Africa's dietary guidelines.

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CHAPTER 5

Impact of commercialization of indigenous crops on household food security of smallholder farmers in Limpopo and Mpumalanga Provinces of South Africa

5.1. Abstract

Market participation of indigenous crops holds significant potential for the alleviation of food insecurity and poverty amongst rural households. Smallholder farmers play a vital role in the production and marketing of indigenous crops in South Africa. However, despite that smallholder farmers continue remaining among the food insecure populations. This study aims to analyse the impact of commercialization of indigenous crops have on the household food security of smallholder farmers in the Limpopo and Mpumalanga provinces of South Africa. It was based on 209 indigenous crops producers extracted from 1520 analysable sample sizes of smallholder farmers. The findings were analysed using the description analysis, Household Food Insecurity Access Scale (HFIAS) and Poisson regression model with endogenous treatment model. The household size, marital status, household member leaving with HIV and extension services were found to be positive and significant in determining household food security, whereas disability of a household member was significant but negative. It was clear that there is still a need for government intervention in the indigenous crops production sector through the provision of trained extension officers to assist smallholder farmers in rural areas. Furthermore, policymakers need to develop policies that specifically represent the interests of household food security of smallholder farmers so that their food security status level can improve.

Keywords: indigenous crops, smallholder farmers, HFIAS, Poisson regression model, food (in)security.

5.2. Introduction

Food insecurity is a global challenge that needs to be met with the development of better food production systems, education, conflict resolution and other world hunger solutions. Food security according to Food and Agriculture Organization (FAO) (2012) is “Nutrition security

exists when all people at all times consume food of sufficient quantity and quality in terms of variety, diversity, nutrient content and safety to meet their dietary needs and food preferences for an active and healthy life, coupled with a sanitary environment, adequate health, education and care". Although South Africa is regarded as being food secure at a national level, food insecurity is still a major challenge for many households and individual persons (Chakona and Shakleton, 2019) and the country faces serious food security challenges compared to countries with similar income levels such as Angola, Algeria, Brazil, Malaysia, etc. (Lehmann et al., 2008). The country is deemed food secure nationally, as a result of its ability to produce sufficient staple food for all the citizens or the ability to import enough nutritious food (Masipa, 2017). This, however, contradicts the food security status at the household level, with a huge number of households residing in both rural and urban areas still suffering from food insecurity. The number of people vulnerable to food insecurity increased by 2.2 million in 2020 from 11.4 million in 2019 to 13.6 million in 2020 (Stats SA, 2021). The percentage of households with food access problems increased from 17.8% in 2019 to 20.6% in 2020, indicating a 2,8% increase. Likewise, the percentage of people with inadequate and severely inadequate access to food also increased from 19.5% to 22.8% during the same period, indicating a 3,3% increase (Stats SA, 2021). The deleterious level of food security challenges in the country has been heightened by the current COVID-19 situation. The swift assessment of the impact of COVID-19 on food and nutrition security showed that about 48.9% of individuals have moderate to severe food insecurity (Reliefweb, 2021).

The country is implementing a multi-sectoral National Food and Nutrition Security Plan – NFNSP (2018 – 2023) in part of responding to the food security problems. Several policy decisions and programmes have been implemented to address food and nutrition insecurity over time. For instance, the Government has intervened by promoting the development of agricultural projects which lead to job creativities and household generation incomes. Statistics South Africa (2021) reported that nationally the poverty line has increased from R585 per person in 2020 to R624 in April 2021 per person, monthly. This means that a huge number of households in South Africa live beneath the poverty line. Furthermore, about nearly 14 million South African households are susceptible to food insecurity (Sekhampu, 2013). This is a result of factors such as limited salaries relative to the sky escalating living costs, extensive unemployment, as well as dependent ratios for people. Furthermore, poverty is the main food insecurity factor in most developing countries such as Zimbabwe, Zambia, Kenya, South Africa and Ethiopia, more especially, the rural communities in these countries (Abdalla, 2007; Lukwa

et al., 2020; Nkomoki et al., 2019; Mota et al., 2019; Olielo, 2013; Teka Tsegay, 2014; Oxford, 2018). However, indigenous crops can be a solution to the underlying issue.

These indigenous crops are popular for being highly nutritious and are an excellent source of nutrients such as protein, vitamins A and C, iron, calcium, and dietary fibre (Akinola et al., 2020). Indigenous crops are defined as plant species that are either genuinely native to a particular region, or which were introduced to that region for long enough to have evolved through natural processes or farmer selection (Mahlangu, 2014:1). These vegetables are generally consumed by the rural population and are easily accessible with high nutritional value, yet are underutilized (Hlatshwayo et al., 2021). Underutilization of these crops is becoming a critical issue in South Africa, due to a lack of knowledge about the nutritional and medicinal benefits of these crops. Furthermore, their limited availability also makes it difficult for a massive number of households to obtain and consume them.

A huge number of African rural households have been dependent on these for sustenance. Indigenous crops in the country are mostly produced in rural areas for household consumption with a little surplus that reaches the informal market in some cases through intermediaries. However, the availability of indigenous crops is limited compared to other food choices, it is therefore very important to commercialize them because through commercializing them we are making them be available. Smallholder agriculture in South Africa has been known as the vehicle through which the objectives of poverty reduction and rural development can be achieved (Akroyd, 2017). Smallholder farmers are the ones who are more involved in the commercialization of these crops. Also, they have been producing and consuming these crops, it's just that they are not well recognised. As a result, the availability of indigenous crops could enhance food and nutrition security due to their nutritional benefits. Utilizing these crops could diversify food choices within the food system and also address household food insecurity and enhance livelihoods.

Furthermore, the production and consumption of these crops help enhance the Sustainable Development Goals (SDGs) namely, improved nutrition, ending hunger, achieving food security, and promoting sustainable agriculture (Mugambiwa and Tirivangasi, 2017). The commercialization of indigenous crops can help stimulate the income for smallholder farmers so that they can be able to purchase other food choices and be food secure. This leads to improved livelihoods and income of the households. Selling these crops continuously cannot

only allow sustainability among the livelihoods of smallholder farmers but also can reduce their food insecurity because they are diverse on their own (Ojo et al., 2021).

Most of the indigenous crops are still largely collected from the wild and hardly consumed by households, let alone seen as a potential for income generation for the household. While some studies have been conducted in Africa on a number of agricultural experiments with regard to indigenous crops and their economic potential (Muhanji et al., 2011; Ojiewo et al., 2013; Ezeanya-Esiobu et al, 2018; Knaepen, 2018; Nyaruwata, 2019), South Africa does not have much information on the potential income that could be created through commercialization of indigenous crops and the impact that it would have on reducing food insecurity in the country. The insufficient context-specific information about the commercialization of these crops has resulted in farmers not only being oblivious of their potential contribution to the stability of income and food availability but also how it could contribute to their nutritional statuses. This has led most households to perceive the trade of indigenous crops as only a temporary activity. Mahlangu (2014) reported that there is a market for indigenous crops and therefore it is important to understand the impact of market participation on household food security of the smallholder farmers in South Africa. Therefore, the commercialization of indigenous crops in South Africa can play a huge role in helping close the food security gap between the national and household levels.

The intervention of smallholder farmers through the provision of these crops cannot only enhance the food security status at the household level but also provide them with sustainable income opportunities to improve their livelihoods as well. Several studies have been conducted on the commercialization of indigenous crops (Muhanji et al., 2011; Mwema and Crewett, 2019; Nwafor, 2020). On the other hand, numerous studies have been conducted on the potential of indigenous crops in improving their food security status level (Ayodele et al., 2009; Mavengahama, 2013; Taylor et al., 2014; Akinola et al., 2020; Mahlangu et al., 2020). There is rather limited information that links both the commercialization of indigenous crops together with their potential in improving food security. It is in light of this situation that this study aimed at providing evidence-based information on how the commercialization of indigenous crops can improve the household food security of smallholder farmers in Limpopo and Mpumalanga, South Africa.

5.3. Materials and Methods

5.3.1. Area of the study, methods of data collection and sampling methods

Chapter 3 provides detailed information about the above subtopics.

5.3.2 Econometric analytical tools

The HFIAS indicators were used to distinguish between food secure and food insecure households, while Poisson regression was used to analyse the determinants of household food insecurity among smallholder farmers. Food access, which dwells on the demand side of food security, has as of late been assigned as one of the significant supporters of food insecurity (Crush and Frayne, 2010). In 2006, the Academy for Educational Development the Food and Nutrition Technical Assistance (FANTA) Project was funded by the United States Agency for International Development (USAID) to specifically publish a tool that can be used to measure the access constituent of household food insecurity (Maziya et al., 2017). The main purposes of the tool development were for it to be applicable, easy to use and simple as possible, with just minor adaptations to various sociocultural contexts (Maziya et al., 2017).

However, several different metrics can be used to measure the household access to food namely, the Household Hunger Scale (HHS), food consumption score, Household Dietary Diversity Score (HDDS), household consumption and expenditure surveys, as well as Household Food Insecurity Access Score (HFIAS) (FANTA III and USAID, 2007; Jones et al., 2013; Izraelov and Silber, 2019). In this study, we adopted Household Food Insecurity Access Scale (HFIAS). This is because HFIAS is more comprehensive than all the other measurement tools (FANTA III and USAID, 2007). Also, while HHS primarily looks at the most severe end of the food security spectrum, the HFIAS specifically captures the conditions ranging from mild to severe food insecurity status levels (FANTA III, 2007).

HFIAS is a legitimate and approved method that is applied in measuring household food access and has been revealed to also measure food insecurity with a satisfactory standard in a few less developed countries (Mohammadi et al., 2012; Mango et al., 2014; Makate et al., 2016; Awodele and Olajide, 2020). It has also been proved to be a success in measuring South African food insecurity through a few studies (Shisanya and Mafongoya, 2016; Maziya et al., 2017; Oluwatayo and Rachoene, 2017). Furthermore, even a developed country such as the United States of America has used the HFIAS in measuring the food insecurity access component (Gundersen, 2013).

HFIAS was the perfect tool for this study's research because unlike the Household Dietary Diversity Score that surveys households based on a 24-hour-recall period of dietary diversity; it measures an experience of food insecurity that might have occurred within 30 days. Even though the HDDS may be appropriate in promoting a healthy-eating pattern through the emphasis on enough consumption of different food groups, but also does not necessarily provide any intra-household food distribution information (Cordero-Ahiman et al., 2021). This is due to the data being collected at the household level. In that way, it provides no information on the utilization of various food groups or comprehensive dietary diversity by individual people in the household (Cordero-Ahiman et al., 2021). On the other hand, the information collected from HFIAS was used to assess the frequency of household food insecurity together with the over-time changes amongst the population. This is extremely beneficial in terms of food access related issues that specifically target, program monitor and evaluate the population (Gebreyesus et al., 2015). Even though it can be said to be a "benefit" bias, but it is less expensive and allows for decentralization (Nathalie, 2012).

Therefore, the food security status of rural households from Limpopo and Mpumalanga Provinces of South Africa was assessed using the HFIAS tool. The levels of food security were determined through the creation of the HFIAS score indicator (Coates et al., 2007). The HFIAS score measures continuously the experience of food insecurity (access) occurring within the past month. Each household had to indicate whether the experience of food insecurity was as a result of a lack of food or funds to purchase food in the previous month. Then the score of each household was calculated by tallying the coded prevalence for all the questions concerning food access at the household level, one by one (Coates et al., 2007). The standard scoring procedure was 1 (yes) points for occurrence whereas 0 (no) for non-occurrence. However, besides the occurrence, if the answer of the respondent was "yes" to the occurrence question then they had to specify the frequency of the occurrence (never, rarely, sometimes and often), check Table 5.1 below. During the tallying of scores from the 9 questions respectively, all the responses were included in the results. The higher scores indicated that the household was food insecure while the lower scores meant that the household was food secure.

Table 5.1: Frequency of occurrence of food access difficulty among the surveyed households in Limpopo and Mpumalanga.

	Last 30 days

Do You or Your Household Members Have the Following Problems with Ensuring Food Security Due to Financial Problems/ lack of resources:	Never	Rarely (1 – 2 times)	Sometimes (3 – 10 times)	Often (more than 10 times)
Worry about not having enough food	378	488	504	150
Do not eat your kinds of preferred food	216	511	548	182
Limit the diversity/quality of meals	260	517	240	283
Consume some foods that you really did not want to eat	263	513	535	208
Limit eaten food portions	401	516	467	136
Limit the number of meals	452	482	431	153
No food to eat of any kind in your household	866	331	254	69
Go to sleep at night hungry	1132	209	109	70
Go a whole day and night without eating anything	1227	147	94	52

Source: author's own analysis

Theoretical model

The study used Endogenous Poisson model as the theoretical model.

Following the literature, Terza (1998); Bratti and Miranda (2010), regard the *ith* household that was selected from a random sample $I = \{1.....n\}$. Contingent on a vector of explanatory variables xi, a random term εi, an endogenous dummy ci, the dependent variable *yi* normally referred to a count is assumed to follow a standard Poisson distribution:

$$f\left(\frac{yi}{\varepsilon}\right) = \frac{\exp\{-\exp(xi\beta + \gamma ci + \varepsilon i)\}\{\exp(xi\beta + \gamma ci + \varepsilon i)\}yi}{yi!} \quad (0.9)$$

Where β and γ coefficients are to be estimated. Noteworthy, the unobserved and omitted variables including any measurement error are measured by the error term εi. Considering a vector explanatory variable zi (that might be containing some elements of xi), ci is characterised by an index process

$$ci = \begin{Bmatrix} 1 if\ zi\alpha + vi > 0 \\ 0\ otherwise \end{Bmatrix} \quad (0.10)$$

Empirical model

Considering equation (1.1) above, the study's dependent variable (yi) is the household food (in)security status level of the smallholder farmers. It follows a Poisson distribution variable since it is a count variable. This is postulated to be determined by the commercialization of indigenous crops to the market (ci) including institutional and demographic variables (xi). *Ci* is also affected by some institutional and demographic variables, which, for the intention of clarity is represented by zi. Certainly, both ci and yi may also be determined by some unobserved variables, such that if the equations for the two variables were estimated separately, the true effect of ci could not be measured, including other variables on *yi* .

The models of Terza's (1998) and Miranda's (2004) offer a solution same as that of Heckman's (1979) Treatment effect model that amends for problems of bias selectivity in some simultaneous equation models. Furthermore, it should however, be noted, that it is not automatic that there is endogeneity between market access and production. The empirical model to be estimated to measure the effect of commercialization of indigenous crops on the household food security of smallholder farmers is given as follows:

$$Commercialization = \alpha_0 + \alpha_1 AgeFM + \alpha_2 HHSFM + \alpha_3 GenderFM + \alpha_4 EducFM + \alpha_5 MaritalStFM$$

$$Food\ \text{sec}urity\ status = \beta_0 + \beta_1 AgeFM + \beta_2 HHSFM + \beta_3 GenderFM + \beta_4 EducFM + \beta_5 MaritalStFM$$

Furthermore, the study needed to create and present dummy variables that were useful in the selected socio-economic knowledge of indigenous crops. The study used the independent variables that are illustrated in Table 4.1 from the previous chapter (Chapter 4).

5.4. Results

Even though the food security status level can be estimated scientifically through scales, like the Household Insecurity and Access Scale (HFIAS), this paper intended to outline the qualitative aspects of the effect that the production and marketing of indigenous crops had on household food security of smallholder farmers. The findings are based on comprehensive knowledge that was gathered through interviews, questionnaires with rural farming households.

5.4.1. Demographic and socioeconomic characteristics of the households involved in the commercialization of indigenous crops

In this sub-section of the study, we represent the demographic and socioeconomic features of the respondents that participated in the survey. From an analysable sample size of 1520 households, 209 were indigenous crops' producers. Out of the smallholder farmers that were involved in the production of indigenous crops (209), only 41 participated in the market through commercializing these identified indigenous crops (Table 3.1 found in Chapter 3). As illustrated from the table found in the previous chapter (Table 4.3), amongst all the other crops pumpkin was the most produced indigenous crop of them all (4.9%). Leafy vegetables were ranked the second most-produced (4.1%). Furthermore, the results revealed that sorghum was the least produced indigenous crop (0.06%). A possible explanation for this could be the fact that sorghum is mainly used as an ingredient compared to other indigenous crops that are practised.

The different types of indigenous crops that smallholder farmers sold in the market are presented in table 4.4 (please refer to Chapter 4 for this table). Surprisingly, the findings revealed unexpected results when leafy vegetables became the most sold indigenous crops whereas pumpkin was the most produced indigenous crop (Table 4.3). Furthermore, the results also revealed that some of the indigenous crops were not sold to the market (millet, eggplant and cowpea). This could be as a result of the limited production of these indigenous crops, inadequate for both consumption and selling.

Access to agricultural assistance appears to protect smallholder farmers from food insecurity. The results revealed that about 48% of the smallholder farmers were market participants, while 43% were non-market participants. The results insinuated that the ones that participated in the market were equipped with the necessary skills and knowledge to improve their production, which leads to improved food security status. On the other hand, regarding a family member that worked on the farm, the results indicated a higher average for the market participants (66%) and lower for the non-market participants (55%). This is because in most cases smallholder farmers in rural areas mainly rely on family labour for crop production. Having household members that actively participate in agricultural activities plays a huge role in enhancing productivity and reducing the vulnerability to hunger since agriculture provides for the livelihoods of those households and help towards ensuring household food security. Furthermore, as expected, the irrigation type of the market participants showed higher results

(58%) than those of the non-market participants (36%). The results proved that irrigation is important in ensuring that households attained food security. Also, this implied that the market participants did not only rely on the rainfall for their crop yields but also had other means to irrigate their crops which assisted in promoting their crop production. Irrigation plays a significant role in reducing the risks of crop failure (Oni et al., 2011).

5.4.2 The food security situation among the surveys (farming) households

The Household Food Insecurity Access Scale, which is aimed at determining households' access to food, revealed that an overall 85% of the sampled households were food insecure and only 15% was food secure, indicating that the majority of the households were experiencing difficulties when it comes to food access while only a few percentages had no difficulties in accessing food. Figure 5.1 showed that when the food (in)security is categorized into four as determined by the HFIAS tool, the majoring of the households was moderately food insecure, with 38% of the households being found in this category. This was followed by mildly food insecure households, with 35% of the household being in this category. More worrying is that 13% of the households were found to be severely food insecure, indicating serious problems relating to access to food by those surveyed households.

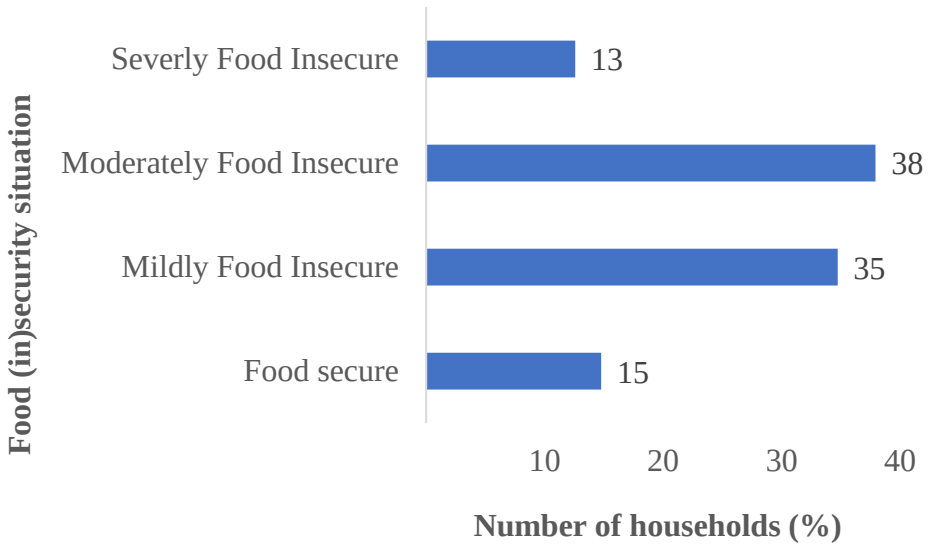

Figure 5.1: The food (in)security situation of the sampled households

Analysis of the food security situation amongst the indigenous crop farmers revealed that the majority of the farmers were food insecure, with only 16% of the indigenous farmers found to be food secure (Figure 5.2). When categorized, the results indicated that most of the indigenous crops' farmers were mildly food insecure, with 37% of the households being in this category.

The mildly food secure households were struggling with the availability of limited diversity and quality of food intake. While 35% of the indigenous crops' farmers were found to be moderately food insecure, which could be associated mainly with the need to consume the kinds of quality food or the challenge of consuming less preferred food. It was also revealed that about 13% of these farmers were severely food insecure, demonstrating that some of them experienced difficulties in accessing food.

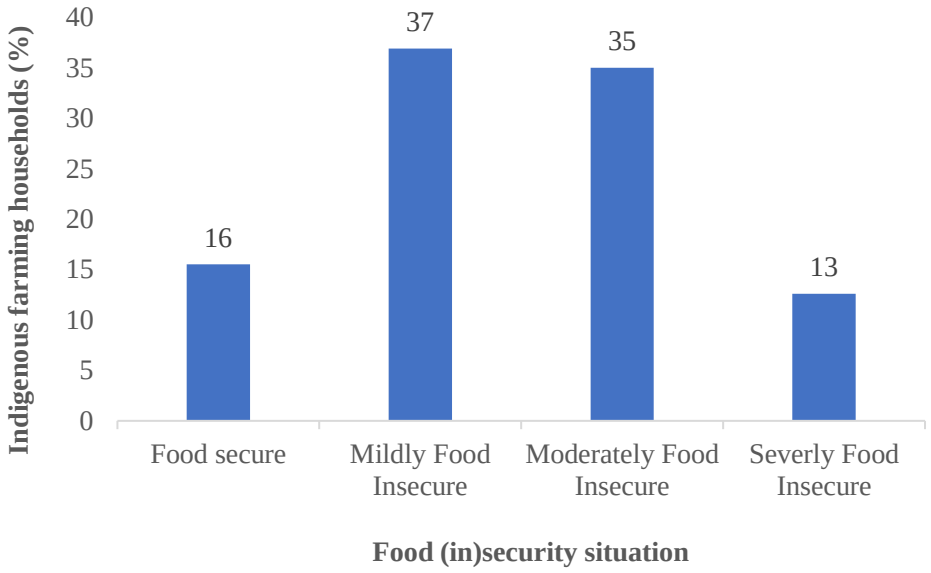

Figure 5.2: The food (in)security situation of the indigenous crop farmers

The results in Table 5.2 highlight the impact of commercialization of indigenous crops on household food security of the surveyed smallholder farmers. The results revealed that the household size, marital status of a family member, HIV status of a family member, access to extension services were all significant with positive coefficients. Furthermore, even though disability, if a member receives a grant for being disabled, was significant but it had an unexpected negative coefficient.

The results indicated that the household size had a positive impact on the commercialization of indigenous crops household food security status level of smallholder farmers and was statistically significant at level 1%. The marital status of a family member also showed a positive impact with a 10% level of statistical significance. The results of a member that

received a disability grant indicated a negative impact but statistically significant at level 10%. HIV if a member has been informed revealed a positive impact on the commercialization of indigenous crops on household food security status level of smallholder farmers and statistically significant at 10% level. Access to extension services also indicated a positive impact with a 1% level of statistical significance.

Table 5.2: Determinants of household food security of smallholder farmers- Poisson with an endogenous treatment model

HFIAS	Coef	Std.Err.	P-value
Age of the household head	-0.000	0.000	0.616
Household size	0.014	0.003	0.000***
Gender of the household head	-0.003	0.033	0.918
If the household head reside in	-0.125	0.080	0.120
Education of the household head	0.148	0.091	0.102
Marital status of the household head	0.321	0.164	0.051*
Access to agricultural assistance	-0.026	0.024	0.274
Ownership of livestock	-0.121	0.113	0.285
If member worked for a wage salary	-0.013	0.064	0.837
WEATHINDEX	-0.019	0.039	0.632
HH received advice from government	0.029	0.028	0.296
Disability if a member receives grant	-0.312	0.169	0.065*
A family member with HIV	0.151	0.080	0.059*
1.Commercialization	0.393	0.036	0.000***
_cons	2.474	0.151	0.000***
Commercialization			
Access to extension	0.137	0.028	0.000***
_cons	0.243	0.034	0.000***
/athrho	-2.845	0.238	0.000***
/lnsigma	-1.591	0.073	0.000***
rho	-0.993		

sigma	0.204
Wald test of indep. eqns. (rho = 0): chi2(1)	142.71
Prob > chi2	0.0000***

Note: ***, **, * Indicate significance at 1%, 5%, and 10% level, respectively.
Source: authors' own analysis

5.5 Discussion

This study investigated the impact that producing and selling indigenous crops in the market had on the household food security of smallholder farmers. The study's motivation was to acquire information that could not only be useful and documented but also used to promote the consumption of indigenous crops. Noteworthy, the results showed that partaking in the

commercialization of indigenous crops plays a significant role in the household food security of smallholder farmers, even though there was a higher number of food insecure smallholder farmers. This is due to them mainly focusing more on commercialization than consumption.

The results of this study indicated that the household size was positive and significant, suggesting that the size had a higher probability of influencing the study's participants' food security status. Normally, the smallholder farmers in rural areas mainly depend on family labour for the production of indigenous crops (Sabo et al., 2017). Therefore, households with more members can overcome labour by dividing the agricultural activities and indigenous crops to be grown among themselves. Also, more members mean that they can overcome financial constraints (from non-farm income activities), which then promotes the affordability of their diverse food choices that provides their bodies with nutritional benefits. Thus, this study's results indicated that there is more diverse produce of indigenous crops enough for both consumption and surplus to be sold to the market. This allowed the households to buy and consume all their nutritious diets, hence food secure. This was contrary to the findings of Omotayo and Aremu (2020) where the size of the household had a negative coefficient but was significant. Omotayo and Aremu (2020) concluded that the lesser the number of members in the household the lesser the demand for food. Moreover, Rubhara (2017) found that household size positively influenced household food security and was significant. However, his justification was that the increase in the household size will inevitably increase the demand for food and the available food may not be adequate to satisfy the increased demand.

In addition, from the results, it was also revealed that the marital status of the household head increased the chances of being food secure. The marital status' coefficient was positive and significant. The possible explanation for these results is that married households made informed joint decisions about the production of indigenous crops. Also, the diversity of the crops produced and sold to the market. Therefore, that provided them with income enough to purchase a variety of food for their diets. Similar findings were reported by Chege et al. (2016) and Yusuf et al. (2017). Their results revealed that the marital status of the household head and food security had a positive and significant relationship. The justification in these studies was that joint relationships strive to provide the households with diverse nutritious food, which enhance the chances of being food secure. However, these findings seem to contradict those that were found by Echebiri et al. (2017); Omotayo and Aremu (2020) and Getane et al. (2022), which had a negative impact and were not significant.

The results showed that the disability grant received by a household member had a negative coefficient but was significant. The negative coefficient indicated that the dependence on disability grants had a negative impact on households' decisions to grow indigenous crops. Initially, the grants were meant for promoting livelihoods and improving the economic activities of the households by easing their financial constraints. Furthermore, it was for their living standards to improve. However, a possible explanation for the results of this study could be that households are no longer interested in growing indigenous crops but completely dependent on the grant for their livelihoods. These results were consistent with the results of earlier studies (Aliber and Hart, 2009; Aliber and Hall, 2012) that found that households no longer cultivate land because they receive a social grant. However, Sinyolo et al. (2016) found contrasting results. They found that social grant was not significant and did not affect the households' food security nor relax their financial constraints.

Furthermore, Human Immunodeficiency Virus (HIV) variable revealed interesting results. A household with HIV positive members positively influenced household food security and significance. As a result of people living with HIV having to maintain a balanced healthy diet, the results implied that in such households they diversified their diets through being involved in the production of indigenous crops. Furthermore, this also indicated that the households cultivated a greater diversity of indigenous crops enough for consumption, and sold the surplus to the market to generate additional income. This, however, appears to protect households from food insecurity. This is in line with a study that was conducted by Pienaar et al. (2017), which discovered that HIV-infected households prioritized growing vegetables and consumed food choices that would provide them with the requirements of the body. However, Ladzani (2009) and Kerr et al. (2019) found contrasting results and postulated that HIV jeopardizes the livelihoods of the households because it minimizes their working capacity and productivity, hence most of them are food insecure.

As expected, the study found that the extension services were significant and positively influenced the food security of smallholder farmers. A possible explanation for this could be the fact that such services advise and encourage smallholder farmers to be involved in the production of indigenous crops and provide them with information on new technologies and market access. Furthermore, extension services not only provide ways to increase the productivity level of farmers but also application of relevant knowledge in response to diseases and pests. Therefore, the increment of productivity means more produce being sold to the market and more income. This then leads to them buying diverse diets of their food choices.

The results were substantiated by earlier findings by Swanson (2008) who reported that extension services also help provide smallholder farmers with agricultural skills, intelligence and knowledge to facilitate market access and trade. Furthermore, Oduniyi and Chagwiza (2021) also found similar results. Justus et al. (2015) revealed that the extension services provide the smallholder farmers with the inability of consuming nutritious diverse diets.

5.6 Conclusion and recommendation

Even though smallholder farmers play a crucial role in contributing to food security in South Africa, especially at the household level, they account for a considerable portion of the food insecure. So, focusing on the above sub-groups not only help provide an opportunity to fathom the cause of the remaining food insecure, but also the likelihood of finding possible pathways to enhance their status of food security. This study found that the commercialization of indigenous crops had both negative and positive impacts on the household food security of smallholder farmers. The key factors that positively contributed to household food security of smallholder farmers include the household size, marital status of the household head, extension services and a family member with HIV, whereas in the households where a member received a disability grant their household food security was negatively affected. This, therefore, means that participation in indigenous crops' commercialization does influence the household food security of smallholder farmers. The results pointed out that the grant receivers were completely dependent on the grant that they received for their livelihoods, and seem to neglect growing indigenous crops as well as commercializing them. This could be due to laziness or lack of awareness about the nutritional benefits that they provide. The results also revealed that the quantity of the indigenous crops sold was less than the quantity of indigenous crops produced. This could be due to them mostly being located in remote areas, which makes it difficult for them to reach the markets and sell their produce. Therefore, since some of the smallholder farmers that produce indigenous crops are non-market participants their livelihoods are negatively affected which leads to them ending up not being sustainable because the indigenous crop production sector forms their main income source. Therefore, enhancing the households' income can have a great impact on improving their food security.

Therefore, in an attempt to fight off the high level of food insecurity succumbing the smallholder farmers, there is a need for government intervention in the indigenous crops production sector through the provision of trained extension officers to assist smallholder farmers in rural areas. Therefore, the extension officers will need to revisit all their issues

regarding the commercialization of indigenous crops, which could help enhance their food security status. This could be done through the implementation of co-operatives which would enable the households with less number of members to make a profit out of their produce as well. Moreover, the current policies make little mention of the impact that the commercialization of indigenous crops has on smallholder farmers' food security status level. So, the policy makers need to develop policies that specifically represent the interests of household food security of smallholder farmers. This will not only expose their vulnerability to food insecurity but also help the government to implement strategies and intervene through providing timely support to the smallholder farmers who need it the most, in order to enhance both their production and productivity levels. Furthermore, there is a need for more workshops for the households, especially the young generation to raise awareness on the benefits and importance of growing and consuming indigenous crops on their livelihoods. Since smallholder farmers remain susceptible and vulnerable to food insecurity both policies and government interventions should be alarmed about the challenges that smallholder farmers face, having in mind of the factors contributing mostly to their vulnerability of food insecurity.

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CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

The study sought to investigate factors influencing the extent of the commercialization of indigenous crops among smallholder farmers in the Limpopo and Mpumalanga Provinces of

South Africa. This chapter presents an overall summary of the study and concludes based on the findings of the study. It also provides policy recommendations, studies limitations as well as further research suggestions.

6.2 Conclusion

The involvement of smallholder farmers in the commercialization of indigenous crops can play a significant role in addressing their issues such as poverty, hunger, malnutrition and help them achieve sustainable agriculture. This study researched the commercialization of indigenous crops and their impact on the household food security of the smallholder farmers. It was revealed that as a result of few barriers to entry smallholder farmers ended up producing mainly for informal markets. This is because from the study area there was insufficient market information being disseminated amongst smallholder farmers about how they can ingress, enter and participate in the profitable formal markets. Therefore, formal market access remained a challenge for many due to financial constraints and transaction costs. The smallholder farmers that were sampled mainly prioritized their consumption due to the above-mentioned challenges.

The study employed the double hurdle model for modelling all the factors that affect the decision of the smallholder farmers to participate in the market and the intensity of participation. The results then revealed that gender, access to market information as well as off-farm income had a significant influence on the decisions of the smallholder farmers to participate in the market. On the other hand, access to extension services, household size as well as access to extension services were said to highly influence the extent of commercialization of indigenous crops among smallholder farmers.

There are diverse livelihood strategies that households adopt to sustain their food security such as local support system, employment, food production and reliance on food schemes from the government. Social security grants are one of the sources of livelihood for the vast majority of rural households, despite their involvement in agriculture. A majority of smallholder farmers in the rural areas prioritise their consumption and are prone to food insecurity. This is because their production levels are critically low which makes it difficult for them to be able to their food insecurity issue on their own. Smallholder farmers are faced with various constrained that hinder their potential, growth and ability to successfully contribute to food security. This then leads to the agricultural performance decline which becomes a driving force behind the

escalating poverty and food insecure smallholder farmers. Therefore, an agricultural recovery could offer a possibility for them to alleviate poverty and food insecurity.

6.3 Recommendations

Commercialization of indigenous crops can improve and positively influence both livelihoods and food insecurity of smallholder farmers. However, this requires unity from all the necessary stakeholders to support and improve the smallholder farmers' agricultural industry. Some factors affect the commercialization of indigenous crops; the extent of commercialization of indigenous crops and their impact on household food security of smallholder farmers. Therefore, it is the responsibility of the policymakers to point out, analyse and understand those factors and the influence that they have, before implementing policies regarding smallholder farmers and indigenous crops' commercialization.

First and foremost, access to lucrative markets highly influences the improved outcomes of smallholder farmers and their level of success. Therefore, an appropriate market-let strategy for farmer development is recommended and must be adopted to enhance the farmers' commercial prospects while also improving food security. Moreover, the policymakers must ensure that all the interests of the smallholders' household food security are well presented.

Evidence revealed that households with a member that received a disability grant did not grow indigenous crops but completely depended on the grant for their livelihoods. As food costs continue to rise, affecting the affordability of food products for poor rural households who currently spend a large amount of their income on food, this is yet another critical issue that demands the intervention of the government and extension officers. Education plays a huge role in influencing households' decisions about their livelihoods. Awareness must be provided to the rural households about the nutritional benefits of the indigenous crops because lack of knowledge sometimes makes people ignore these crops. There need to be seminars where they are being taught about the impact that these have on their food security status level. These workshops can also influence the smallholder farmers to participate in the market and improve their living standards. Even the young generation can benefit from these workshops about the importance and benefits of growing and consuming these crops.

It is recommended that the extension officers assist the smallholder farmers according to what they have been taught. They are expected to revisit all the challenges that smallholder farmers are facing and come up with appropriate solutions on how they can overcome them. The provision of training on how they can successfully improve their agricultural produce and sell

to the market is one of the solutions they can assist with. Furthermore, the formation of co-operatives could also be another solution. However, the government also must ensure that all these extension officers are well trained, informed and consists of all the knowledge to specifically deal with the issues of indigenous crops' smallholder farmers. This can also help the smallholder farmers gain access to lucrative markets resulting in the rise of income and consequently alleviating food insecurity.

6.4 Limitations of the study

The study was initially supposed to use both primary and secondary data, but due to the Covid-19 outbreak, the study ended up making use of the secondary data only. Furthermore, the study was limited to only two of nine provinces of South Africa namely; Limpopo and Mpumalanga due to available data and Covid-19. Therefore, information about other provinces was not available.

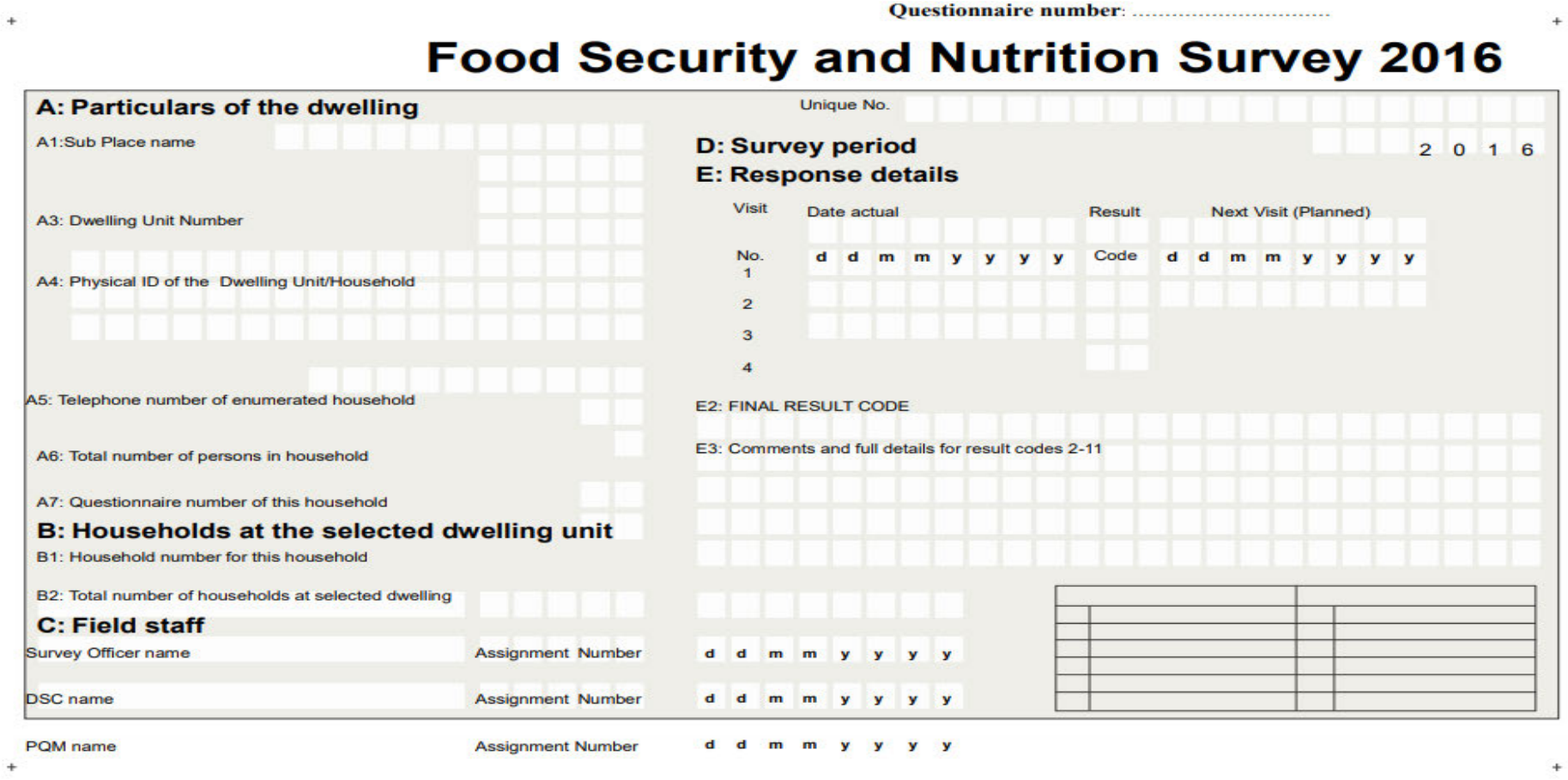
The data that was used in the study was collected in 2016. Since there has been a lot of changes in South Africa regarding the smallholder farmers and the commercialization of indigenous crops both negative and positive, the researcher was constrained by the Covid-19 pandemic outbreak and could not conduct their research to find out about the progress and development that has taken place in the agricultural sector.

6.5 Suggestions for further research

The SGDs proposed the development and empowerment of the smallholder farmers as a strategy to alleviate poverty and food insecurity at the regional and national levels of government. This is because with the potential that they have the growing population can be fed, poverty eradicated and food security increased. However, given the Covid-19 pandemic outbreak, the systems of the local food have been disrupted and food insecure households' numbers have risen, especially where these farmers operate. Therefore, further research should be conducted using both primary and secondary data to provide the provide progress, challenges that smallholder farmers are currently facing given the underlying issue of the Covid-19. There should also be strategies on how to overcome the challenges. The research should not be limited to only two provinces, but also other provinces as well should be documented. This will provide comparable findings about the agricultural progress and smallholder farming industry.

APPENDICES

APPENDIX A: Food Security and Nutrition Survey 2016



Questionnaire number: .....

Food Security and Nutrition Survey 2016

A: Particulars of the dwelling

Unique No.

A1:Sub Place name

A3: Dwelling Unit Number

A4: Physical ID of the Dwelling Unit/Household

A5: Telephone number of enumerated household

A6: Total number of persons in household

A7: Questionnaire number of this household

B: Households at the selected dwelling unit

B1: Household number for this household

B2: Total number of households at selected dwelling

C: Field staff

Survey Officer name — Assignment Number — d d m m y y y y

DSC name — Assignment Number — d d m m y y y y

PQM name — Assignment Number — d d m m y y y y

D: Survey period 2016

E: Response details

Visit No.	Date actual	Result Code	Next Visit (Planned)
1	d d m m y y y y		d d m m y y y y
2			
3			
4			

E2: FINAL RESULT CODE

E3: Comments and full details for result codes 2-11

Questionnaire number: .....

Acknowledgement to University of Pretoria's Institute for Food, Nutrition and Well-being for providing the questionnairre

Questionnaire number: .....

The following information must be obtained for every person who is considered a member of the household. Only add persons who had stayed here for at least four nights on average per week for the last four weeks. ***Do not forget babies.***
If there are more than 10 persons in the household, use a second questionnaire.

INTERVIEW START TIME

		01	02	03	04	05	06	07	08	09	10
A	**First name and surname** ***First name:*** *Write down first name and surname of each member of the household, starting with the head or acting head. If more than one head take the oldest.*										
	Surname:										
B	Has ..... stayed here (in this household) for at least four nights on average per week during the last four weeks?										
	1 = Yes	1	1	1	1	1	1	1	1	1	1
	2 = No ***If "No", End of interview***	2	2	2	2	2	2	2	2	2	2
C	**Is ... a male or a female?**										
	1 = Male	1	1	1	1	1	1	1	1	1	1
	2 = Female	2	2	2	2	2	2	2	2	2	2
D	**What is ...?'s date of birth and age in completed years?**										
	Day of Birth:	d d	d d	d d	d d	d d	d d	d d	d d	d d	d d
	Example of day 05										
	Month of birth:	m m	m m	m m	m m	m m	m m	m m	m m	m m	m m
	Example of month 11										
	Year of birth:	y y y y	y y y y	y y y y	y y y y	y y y y	y y y y	y y y y	y y y y	y y y y	y y y y
	Example of year 2007										
	Age in years										
	Less than one year = 0										

Questionnaire number: .....

			01	02	03	04	05	06	07	08	09	10
F	Does the head reside in this household		Yes No									
G	If no to F, provide the following; Code:gender 1=M; 2=F Use code for education	name										
		Age in years										
		gender										
		education										

SECTION 1: HOUSEHOLD SPECIFIC CHARACTERISTICS

This section covers particulars of each person in the household

		01	02	03	04	05	06	07	08	09	10
1.2	**What is ……'s present marital status?** 1 = Legally married 2 = Living together like husband and wife 3 = Divorced 4 = Separated, but still legally married 5 = Widowed 6 = Single, but have been living together with someone as husband/wife before 7 = Single and have never been married/never lived together as husband/wife before										
1.4	**Is…… an orphan?** 1 = Yes 2 = No	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2
	Is…… A vulnerable child? 1 = Yes 2 = No	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2

Questionnaire number: .....

EDUCATION

Ask for all household members. Read out: Now I am going to ask you questions related to education for each member of the household

	Ask for all household members above 5 yrs	01	02	03	04	05	06	07	08	09	10
1.4	**What is the highest level of education that ..... has successfully completed?** *Diplomas or certificates must be of six months plus study duration full-time (or equivalent) to be included* 98 = No schooling 00 = Grade R/0 01 = Grade 1/ Sub A/Class 1 02 = Grade 2 / Sub B/Class 2 03 = Grade 3/Standard 1/ ABET 1(Kha Ri Gude, Sanli) 04 = Grade 4/ Standard 2 05 = Grade 5/ Standard 3/ ABET 2 06 = Grade 6/Standard 4 07 = Grade 7/Standard 5/ ABET 3 08 = Grade 8/Standard 6/Form 1 09 = Grade 9/Standard 7/Form 2/ ABET 4 10 = Grade 10/ Standard 8/ Form 3 11 = Grade 11/ Standard 9/ Form 4 12 = Grade 12/Standard 10/Form 5/Matric (No Exemption) 13 = Grade 12/Standard 10/Form 5/Matric (Exemption *) 14 = matric plus Diploma or degree										

	Ask for all household members aged 0-5	01	02	03	04	05	06	07	08	09	10
1.5	**Which of the following does the child currently attend?** 1 = Grade R 2 = Pre-school / nursery school/ Grade 00/Grade 000 3 = Creche / educare centre / ECDs 4 = Day-mother – out of home care 5 = None 6 = Do not know										

Questionnaire number: .....

Ask for all school going children

		01	02	03	04	05	06	07	08	09	10
1.6	**Does…. attend a school where food is given to the children?** 1 = Yes 2 = No ***xxxxxx*** 3 = Do not know ***Go to Q2.1***	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3

		01	02	03	04	05	06	07	08	09	10
1.7	**How many days in a week does …. eat the food provided at school?** *If yes, specify how regularly food is eaten.* 1 = number of times per week 2 = Do not know										

SECTION 2: ECONOMIC ACTIVITY STATUS

Ask for all household members. Read out: Now I am going to ask you questions related to occupation for each member of the household

		01	02	03	04	05	06	07	08	09	10
2.1	**What is your Economic activity Status?** 01=Subsistence farmers 02=Subsistence farmers 03=Commercial farmers 04=Parastatal employees 05=Formal sector private employees, 06=Formal sector public employees, 07=Self-employed outside agriculture, 08=Unpaid family worker 09=Workers not elsewhere classified, based on employment status 10=Unemployed, 11=Inactive, those whose main current activity was not										

Questionnaire number: .....

ECONOMIC ACTIVITIES

Ask for all household members 15 years and older

		01	02	03	04	05	06	07	08	09	10
2.2	**During the last 12 months did ….. work for a wage, salary, commission or any payment in kind (including paid domestic work), even if it was for only one hour?** *Examples: a regular job, contract, casual or piece work for pay, work in exchange for food or housing, paid domestic work.* 1 = Yes 2 = No 3 = Do not know	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
2.3	**During the last 12 months did … run or do any kind of business, big or small, for yourself or with one or more partners, even if it was for only one hour?** *Examples: Commercial farming, selling things, making things for sale, construction, repairs, guarding cars, brewing beer, collecting wood or water for sale, hairdressing, etc.* 1 = Yes 2 = No 3 = Do not know	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
2.4	**During the last 12 months did …… do any work for which they were paid in some way besides cash?** *Examples: Commercial farming, production of agricultural produce to sell, help to sell things, make things for sale or exchange, doing the accounts, cleaning up for the business, etc.* 1 = Yes, ate food on site 2 = Yes, was given a food ration to take home 3 = Yes, was given non-food items 4 = Do not know	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3

Questionnaire number: .....

		01	02	03	04	05	06	07	08	09	10
2.5	**What is ……'s total salary/pay at his/her main job?** *Including overtime, allowances and bonus, before any tax or deductions. Give amount in whole figures, without any text or decimals.* If "NONE", "REFUSE" **or** "DO NOT KNOW write 999 999 999										
2.6	**Ask only if an amount is given in Q2.5** **Is this….** 1 = Per week 2 = Per month 3 = Annually	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3

SECTION 3: HEALTH AND GENERAL FUNCTIONING

Ask for all household members. Read out: Now I am going to ask you health-related questions for each member of the household

		01	02	03	04	05	06	07	08	09	10
3.1	**Has …..been unable to perform their usual duties (housework, employment) for 30 days or more during the past year due to illness?** *Read all the options* 01 = Yes 02 = No										

Questionnaire number: .....

		01		02		03		04		05		06		07		08		09		10	
3.2	**Has…been informed by a medical practitioner or nurse that he/she suffers from any if the following conditions?** *Read all the options*	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
	1 =Asthma	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
	2 = Diabetes	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
	3 = Cancer	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
	4 = HIV and AIDS	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
	5 = Hypertension/high blood pressure	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
	6 = Arthritis	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
	7 = Stroke	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
	8 = Heart attack / myocardial infection	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
	9 = Tuberculosis	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
	10 = Others (specify in the box)	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2

Read out: I am now going to ask about the general functioning of persons within the household

SECTION 4: SOCIAL GRANTS AND SOCIAL RELIEF

Ask for all household members

Read out: I am now going to ask about the use of social grants and social relief

			01	02	03	04	05	06	07	08	09	10
4.1	**Does anyone in this household receive a social grant, pension or social relief assistance from the Government?**											
	1 = Yes		1	1	1	1	1	1	1	1	1	1
	2 = No	***xxxxx***	2	2	2	2	2	2	2	2	2	2
	3 = Do not know	***xxxx***	3	3	3	3	3	3	3	3	3	3

Questionnaire number: .....

4.2	*If "Yes" in Q4.1a* **Does … receive a(n).....?** *Answer for each person who qualified for the grant and NOT for the person who applied on behalf of/physically receives the money. Someone who used to work for the Government and receive a pension do* ***not get*** *an old age grant* *Read all the options*	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
	1 = Old-age grant	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
	2 = Disability grant	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
	3 = Child support grant	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
	4 = Care dependency grant	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
	5 = Foster child grant	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
	6 = War veterans grant	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
	7 = Grant-in-aid	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
		1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2

4.3 Does the household receive any social relief of distress ? Code: 1=Yes; 2=No _____

Questionnaire number: .....

SECTION 5: ANTHROPOMETRY: the following measurements should be recorded for all children under 5 years of age and the person who cares for them

		01	02	03	04	05	06	07	08	09	10
5.1	**Is any female in the household pregnant?** 1 = Yes 2 = No	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3	1 2 3
5.2	**Is the person older than 0 months and under 5 years of age (<60 months) at home?** 1 = Yes 2 = No	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2
	Measure weight of (household member name). Measure twice with a digital scale. Measurements are recorded in kilograms with two decimals.										
	Weight measurement 1										
	Weight measurement 2										
5.3	**M**easure height of children who are 0 – 5 years (household member name). Measure twice with stadiometer in centimeter (cm).										
	Height measurement 1										
5.4	Height measurement 2										
5.5	Mid-upper arm circumference (MUAC) for the children under 5: Measure twice with narrow tape in centimeters (cm). Measures (4-5) should only be done to children under the age of 5 (60 months).										
	MUAC Reading 1 (force entry)										
	MUAC Reading 2 (force entry)										
5.6	Last entry on the Road to Health booklet of children under 5 years of age										
	Date of entry										
	Age of the child in months										
	Weight of the child in kg, 2 decimal places										
5.7	How many meals did this child eat yesterday?										
5.8	Does this child breastfeed? 1=Yes 2=No	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2
5.9	Did this child breast feed yesterday? 1=Yes 2=No	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2
5.10	Is this child under exclusive breast feeding?	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2

Questionnaire number: .....

SECTION 6: GENERAL HOUSEHOLD INFORMATION AND SERVICE DELIVERY

Ask a responsible person in the household to answer on behalf of the household.

HOUSING *Ask all households*

6.1 Indicate the type of main dwelling that the household occupies 01 = Dwelling/house or brick/concrete block structure on a separate stand or yard or on farm 02 = Traditional dwelling/hut/structure made of traditional materials 03 = Dwelling/house/flat/room in backyard 04 = Informal dwelling/shack in backyard 05 = Informal dwelling/shack not in backyard, e.g. in an informal/squatter settlement or on farm 06 = Room/flatlet on a property or a larger dwelling/ servants' quarters/granny flat 07 = Caravan/tent 08 = Other (specify)	**Main Dwelling**	**Other Dwelling**

6.2 What is the main material used for the walls and the roof of the main dwelling? 01 = Bricks 02 = Cement block/concrete 03 = Corrugated iron/zinc 04 = Wood 05 = Plastic 06 = Cardboard 07 = Mud and cement mix 08 = Wattle and daub 09 = Tile 10 = Mud 11 = Thatching/grass 12 = Asbestos 13 = other (specify)	**Walls**	**Roof**

Questionnaire number: .....

Ask all households +

6.4 **What is the household's main source of drinking water?**

01 = Piped (tap) water in dwelling/house
02 = Piped (tap) water in yard
03 = Borehole in yard
04 = Rain-water tank in yard
05 = Neighbour's tap
06 = Public/communal tap
07 = Water-carrier/tanker
08 = Borehole outside yard
09 = Flowing water/stream/river
10 = Stagnant water/dam/pool
11 = Well
12 = Spring
13 = Other (specify)

6.7 **Is the water from the main source of drinking water before any treatment .....**
Read all the options

	Yes	No
1 = S a f e to drink?	1	2
2 = C l e a r (has no colour / free of mud)?	1	2
3 = G o o d in taste?	1	2
4 = F r e e from bad smells?	1	2

6.8 **Do household members treat the water used for drinking?** *This may include boiling, adding chlorine or other chemicals, filtering.*

1 = Yes, always 1
2 = Yes, sometimes 2
3 = No, never 3

6.9 **Does the household pay for water?**

1 = Yes 1
2 = No 2

SANITATION - ***Ask all households***

6.10 **What type of toilet facility does this household use?**

1 = Flush toilet connected to a public sewerage system
2 = Flush toilet connected to a septic tank
3 = Chemical toilet
4 = Pit latrine/toilet with ventilation pipe
5 = Pit latrine/toilet without ventilation pipe
6 = Bucket toilet
7 = None
8 = Other (specify)

11 = Well
12 = Spring

ENERGY - ***Ask all households***

6.12 **Does thishousehold have access to/use electricity?**

1 = Yes 1
2 = No 2
3 = Do not know 3

2 = 201 - 500 metres 2
3 = 501 metres - 1 kilometre 3

6.13 **What is the main source of energy/fuel for cooking in this household?**

01 = Electricity from mains
02 = Electricity from generator
03 = Gas
04 = Paraffin
05 = Wood
06 = Coal
07 = Candles
08 = Animal dung
09 = Solar energy
10 = Other, (specify)
11 = None

6.11 **Is the toilet facility in the dwelling, in the yard or outside the yard?**

1 = In dwelling 1
2 = In yard 2
3 = Outside yard 3

Questionnaire number: .....

SECTION 7: HOUSEHOLD FOOD SECURITY

7.1	**In the past four weeks, did you worry that your household would not have enough food??** 1 = Never 2 = Rarely (1 – 2 times a month) 3 = Sometimes (3 – 10 times a month) 4 = Often (more than 10 times a month)	No:___
7.2	**In the past four weeks, were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?** 1 = Never 2 = Rarely (1 – 2 times a month) 3 = Sometimes (3 – 10 times a month) 4 = Often (more than 10 times a month)	
7.3	**In the past four weeks, did you or any household member have to eat a limited variety of foods due to a lack of resources?** 1 = Never 2 = Rarely (1 – 2 times a month) 3 = Sometimes (3 – 10 times a month) 4 = Often (more than 10 times a month)	
7.4	**In the past four weeks, did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food?** 1 = Never 2 = Rarely (1 – 2 times a month) 3 = Sometimes (3 – 10 times a month) 4 = Often (more than 10 times a month)	

7.5	**In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?** 1 = Never 2 = Rarely (1 – 2 times a month) 3 = Sometimes (3 – 10 times a month) 4 = Often (more than 10 times a month)	No: ___
7.6	**In the past four weeks, did you or any other household member have to eat fewer meals in a day because there was not enough food?** 1 = Never 2 = Rarely (1 – 2 times a month) 3 = Sometimes (3 – 10 times a month) 4 = Often (more than 10 times a month)	No: ___
7.7	**In the past four weeks, was there ever no food to eat of any kind in your household because of lack of resources to get food?** 1 = Never 2 = Rarely (1 – 2 times a month) 3 = Sometimes (3 – 10 times a month) 4 = Often (more than 10 times a month)	No: ___
7.8	**In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?** 1 = Never 2 = Rarely (1 – 2 times a month) 3 = Sometimes (3 – 10 times a month) 4 = Often (more than 10 times a month)	No: ___

Questionnaire number: .....

7.9	**In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?** 1 = Never 2 = Rarely (1 – 2 times a month) 3 = Sometimes (3 – 10 times a month) 4 = Often (more than 10 times a month)	
7.11	How many times in a typical day do adults eat?	No____
7.12	How many times in a typical day do children under 5 years eat?	No____

Household Hunger Scale questions

	7.14a In the past [4 weeks/30 days], was there ever no food to eat of any kind in your house because of lack of resources to get food? 1 = Yes 2=No (if No skip to 7.15a)	**7.14b How often did this happen in the past [4 weeks/30 days]?** 1= Rarely (1–2 times) 2= Sometimes (3–10 times) 3 = Often (more than 10 times)
7.13	**7.15a In the past [4 weeks/30 days], did you or any household member go to sleep at night hungry because there was not enough food?** 1 = Yes 2=No (if No skip to 7.16a)	**7.15b How often did this happen in the past [4 weeks/30 days]?** 1= Rarely (1–2 times) 2= Sometimes (3–10 times) 3 = Often (more than 10 times)
	16a In the past [4 weeks/30 days], did you or any household member go a whole day and night without eating anything at all because there was not enough food? 1 = Yes 2=No	**7.16b How often did this happen in the past [4 weeks/30 days]?** 1= Rarely (1–2 times) 2= Sometimes (3–10 times) 3 = Often (more than 10 times)

8.1	***Ask about the food consumption of household members***	**Did household members eat this food yesterday?**	**Did any child 6-23 months old eat this food yesterday?**	How often is this food group usually eaten in the household? Think of the past year, and then fill in the number of times: either per week OR per month OR per year.			Where was the food obtained from (source)?		
		Yes - tick	Yes - tick	Per week	Per month	Per year	Produced (e.g. from own garden)	In kind/donations/ event Gift/food bank/school feeding	Bought (name store)
	01 = Cereals: maize, rice, wheat, sorghum, millet, and any other foods made from cereals such as porridge, bread and noodles								
	02 = White roots and tubers - Potatoes, white sweet potato and cassava								
	03 = Orange-flesh vegetables: Pumpkin, carrot, butternut or sweet potato								
	04 –Dark green leafy vegetables, including wild/indigenous vegetables								
	05 – Other vegetables (tomato, onion, green beans, gem squash, eggplant, including wild/indigenous vegetables								
	06 - Orange-coloured fruit (e.g. ripe mango, apricot, spanspek, papaya, dried peach and 100% fruit juice made from these)?								
	07 - Other fruit (e.g. oranges, banana, apple, pear etc.), including wild/indigenous fruits?								
	08 - Organ meat (liver, kidney, heart or other organ meats or blood-based foods)								
	09 - Meat (e.g. beef, goat, sheep, poultry, pork, fish, insects 10 - Eggs from any animal								
	11 - Fish and seafood (fresh, tinned or dried and shellfish)								
	12 - Dried beans, peas, lentils, nuts, seeds or foods made from these (e.g. peanut butter)?								
	13 - Milk and milk products (e.g. yoghurt, maas cheese)								
	14 - Oils and fats(e.g. sunflower, rama, lard, butter added to food or used for cooking								
	15 - Sweets (e.g. sugar, honey, sweetened juices or fizzy drinks, sugary foods such as chocolate, cookies, cakes)								
	16 - Spices (e.g. pepper and salt), condiments (e.g. tomato sauce), coffee, tea, alcoholic beverages								

Questionnaire number: .....

Section 9: Months of Adequate Household Food Provisioning (MAHFP) for Measurement of Household Food Access

9.0	Months of hunger experiences		
9.1	In the past 12 months, were there months in which you did not have enough food to meet your family's needs? [1=Yes, 0=No]		
9.2	If yes, which were the months (in the past 12 months) in which you did not have enough food to meet your family's needs?		
A	January	A.....	
B	February	B.....	
C	March	C.....	
D	April	D.....	
E	May	E.....	
F	June	F.....	
G	July	G.....	
H	August	H.....	
I	September	I.....	
J	October	J.....	
K	November	K.....	
L	December	L.....	

9.3 How does the household cope with major income shocks (e.g. drought, death of a breadwinner, job loss, etc.) (Please tick where appropriate)			
Sell livestock	☐ Y ☐ N	Take on additional work	☐ Y ☐ N
Sell other assets	☐ Y ☐ N	Reduce spending	☐ Y ☐ N
Use own cash savings	☐ Y ☐ N	Reduce food consumption	☐ Y ☐ N
Borrow money from relatives	☐ Y ☐ N	Reduce or stop debt repayments	☐ Y ☐ N
Borrow money from stokvel	☐ Y ☐ N	Other: Please specify	☐ Y ☐ N
Receive help from friends or relatives	☐ Y ☐ N		

Questionnaire number: .....

SECTION 9B: CONSUMPTION COPING STRATEGIES INDEX

	Behaviours: In the past 7 days, if there have been times when you did not have enough food or money to buy food, how many days has your household had to: Yes or no	Number of days out of the past seven (use numbers 0 – 7 to answer number of days Use NA for not applicable
a. Rely on less preferred and less expensive foods?		
b. Borrow food, or rely on help from a friend or relative?		
c. Purchase food on credit?		
d. Gather wild food, hunt, or harvest immature crops?		
e. Consume seed stock held for next season?		
f. Send household members to eat elsewhere?		
g. Send household members to beg?		
h. Limit portion size at meal times?		
i. Restrict consumption by adults in order for small children to eat?		
j. Feed working members of HH at the expense of non-working members?		
k. Reduce number of meals eaten in a day?		
l. Skip entire days without eating?		

Questionnaire number: .....

SECTION 10: Food and Non Food Expenditure: I will know ask about household food and non-food expenditure for last 12 months

0. Where do you normally get this item? **Codes** *1...supermarket* *2...small shop/restaurant/takeaway* *3..Informal market / street vendors* *4...Own production* *5...Food aid* *6...Remittances*		1.Since March 2012 to this day, did the household spend money on the following food items?**Codes** *1...yes* *2...No* **go to next item**	2. If yes, how frequent were these purchased? Code *1...daily* *2...weekly* *3...monthly* *4.... quarterly* *5...annually* *6...other (specify)*	3. Number of purchases per period? number of times P= Number of Purchase M=Number of Months		4. How much money was normally spent per each purchase?	5. Quantity bought of this item Per purchase in Kgs
Item	*Code*			P	M	*Rand*	
01 Mealie meal, maize products							
02 Rice							
03 Millet							
04 Sorghum							
05 Wheat, wheat flour, etc							
06 Vegetables, Tomato,							xxxxx
07 Sugar, tea, coffee, etc							xxxxx
08 Salt, Spices, etc							xxxxx
09 Cooking oil, margarine, butter,							xxxxx
10 Cassava, sweet potatoes, Irish potatoes (root and tubers)							
11 Beans, peas (Pulses)							
12 Fish							
13 Meat							
14 Milk, milk products, etc							
15 Fruits							
16 Yam							
17 Bread							
18 Other (specify							

Questionnaire number: .....

SECTION 10B: Non- Food Expenditure

1. Did the household spend money on the following items in the past 12 months? Code4 1...yes 2...No go to next item		2. If yes, how frequent were these purchased Codes 1...daily 2...weekly 3...monthly 4....quarterly 5...annually 6...other (specify)	3. Number of purchases per period?	4. How much money is normally spent per each purchase?
01 Electricity (bills, light bulbs,				
02 Batteries				
03 Firewood				
04 Charcoal				
05 Petrol / diesel				
06 Kerosine				
07 Candles, matches, etc				
08 Security				
09 Telephone (calls, handsets,				
10 Transport				
11 General body hygiene				
12 Make up and hair dressing				
13 Shaving, nail cleaning, etc				
14 School fees				
15 Uniform				
16 Pocket money				

1. Did the household spend money on the following items in the past 12 months? Code 1...yes 2...No go to next item		2. If yes, how frequent were these purchased Codes 1...daily 2...weekly 3...monthly 4....quarterly 5...annually 6...other (specify)	3. Number of purchases per period? Put the number of times	4. How much money is normally spent per each purchase?
Item				
17 Writing materials				
18 Father's clothes				
19 Mother's clothes				
20 Children's clothes				
21 Clothes and shoes				
22 Pots				
23 Plates, spoons,				
24 Cups				
25 Baskets				
26 Loan repayment				
27 Remittances				
28 Gifts				
29 Religious Offerings				
30Wedding ceremony				
31 Funeral expenses				
32 Dowry (lobola etc)				
33 Entertainment				

Questionnaire number: .....

	Section 10: HOUSEHOLD LIVELIHOODS AGRICULTURAL ACTIVITIES *Ask all households*	
10.1	**Has the household been involved in the production of any kind of food or agricultural products during the past twelve months? (e.g. livestock, crops, poultry, food gardening, forestry, fish, etc.)** 1 = Yes 2 = No	1 2
10.2	**What kind of food production/agricultural activities is the household involved in?** *Read all the options*	Yes No
	01 = Livestock production (cattle, goats, sheep, pigs, etc.)	1 2
	02 = Poultry production (chickens, ducks, geese, guinea fowl, etc.)	1 2
	03 = Grains and food crops (maize, wheat, beans, sorghum, millet, Groundnuts etc.)	1 2
	04 = Industrial crops (e.g. tea, coffee, cotton, sugar, tobacco)	1 2
	05 = Fruit and vegetable production	1 2
	06 = Fodder, grazing/pasture or grass for animals	1 2
	07 = Fish farming/aquaculture	1 2
	08 = Forestry	1 2
	09 = Game farming	1 2
	10 = Other	1 2
10.3	**Why do you grow farm produce or keep livestock for the household in the past year?** 1 = As a main source of food for the household 2 = As the main source of income/earning a living 3 = As an extra source of income 4 = As an extra source of food for the household 5 = As a leisure activity or hobby e.g. gardening	1 2 3 4 5
10.4	**Did your household sell any of its produce or livestock in the last year?** 1 = Yes 2 = No	1 2

10.5	Do you store any foods for later use? **1=yes 2=no**	If yes, what foods?
10.5b	If yes, how do you store your food? Tick appropriate	1=Refrigerate 2=Drying 3=Fermenting 4=Pickling 4=Dry salting 5=Smoking 6=Sealing 7=Cellaring 8=Other (specify)
10.6	Do you process any foods? **1=yes 2=no**	If yes, what foods?

Questionnaire number: .....

10.7	**If produce is sold, to whom does your household sell most of its produce?** *Read all the options* 1 = Local buyers from this district 2 = Buyers from neighboring cities and towns 3 = Formal markets in South Africa 4 = Export agencies in international buyers. 5 = Other	1 2 3 4 5
10.8	**Has your household received any of the following kinds of agricultural related assistance from the government during the past 12 months?** *Read all the options* 1 = Training 2 = Advice from government extension officers 3 = Grants (money that does not have to be paid back) 4 = Loans (money that has to be paid back) 5 = Inputs (seed, fertilizer, etc.) as part of a loan 6 = Inputs (seed, fertilizer, etc.) for free 7 = Dipping and vaccination services for livestock from State veterinarian or other Department 8 = Other (specify) **Go to Q10.9 if households answered yes to any of the categories above, else go to Q10.10**	Yes No 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2
10.9	**Did your household find this agriculture-related assistance:** 1 = Very useful 2 = Somewhat useful 3 = Not useful	1 2 3
10.10	**Did your household receive agriculture-related assistance from any other entity than government?** 1 = Yes 2 = No	1 2

10.11	**How many of the following does the household own?** *Please mark the most appropriate category with an x.* 1 = Cattle for food or investment 2 = Donkeys and mules 2 = Sheep 3 = Goats 4 = Pigs 5 = Poultry 6 = Other (specify)	**Number**

Continue if the household planted grains/vegetables/fruits/trees (forestry)/pastures/ industrial crops. Otherwise, go to Q10.14

10.12	**Where does the household practice its crop planting activities?** *Read all the options* 1 = Farm land (communal or private) 2 = Backyard garden (can include, vegetables, fruits, grains) 3 = School garden (can include, vegetables, fruits, grains) 4 = Communal garden (more than one household involved, can include vegetables, fruits, grains) 5 = On verges of roads and unused public/municipal land 6 = Other	Yes No 1 2 1 2 1 2 1 2 1 2 1 2

Questionnaire number: .....

10.13	**Approximately how big is the land that the household uses for production? Estimate total area if more than one piece.** 1 = Less than 500m² (approximately one soccer field) 2 = 500m² to 9 999m² (between one soccer field and one hectare) 3 = 1 but less than 2 hectares 4 = 2 but less than 5 hectares 5 = 5 but less than 10 hectares 6 = 10 but less than 20 hectares 7 = 20 or more hectares 8 = Do not know	

10.14	**On what basis does this household have access to the land used for crop production? If more than one kind of tenure system applies for different pieces of land, give an answer for the biggest piece.** 1 = Owns the land 2 = Rents the land 3 = Sharecropping 4 = Tribal authority 5 = State land 6 = Other (specify) 7 = Do not know	

10.15	**If the household receives an income from remittances, please specify approximately how much they receive per month?** *If no income received from remittances write 0.*	
10.16	**If the household receives an income from pensions (do not include income from old age grants), please specify approximately how much they receive per month?** *If no income received from pensions, write 0.*	
10.17	**What was the total household expenditure in the last month?** *Include money spent on food, clothing, transport, rent and rates, alcohol and tobacco, school fees, entertainment and any other expenses.*	

10.18	**How many of the following does the household own?**	Number
	01 = Bed with mattress	01 =
	02 = Sofa Set	02 =
	03 = Table (dining/desk)	03 =
	04 = Pay TV (M-Net / DSTV / Top TV) Subscription	04 =
	05 = Radio-working condition	05 =
	06 = Mobile Phone	06 =
	07 = Tape or CD/DVD	07 =
	08 = Television	08 =
	09 = Motor vehicle	09 =
	10 = Refrigerator	10 =
	11 = Washing machine	01 =
	12 = E lectric Stove / Gas Stove	11 =
		12=

Questionnaire number: .....

SECTION 12: CROPS PRODUCED in the 2013/14 season (X month 2013 to this month 2014)

12.1	Crops grown	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12

Crops planted and harvested	Total area planted	Total harvest	Price per unit	Did the household consume this crop?	Was any sold? Where?	Income	Was this processed in any way?	How much was stored for home consumption?	Was the crop irrigated?	If irrigated, what kind of irrigation? • buckets form a river, • treadle pump, • flood irrigation • irrigation scheme, • municipal water	If irrigated, what is the water source?	Did you use any inputs? Improved seeds? Fertilizer? Manure?	Is mechanized farming used? Tractor? Harvester?

Questionnaire number: .....

12.2			
	Do you apply crop rotation? Y/N	**1=Yes 2=No**	**Why?**
	Is there un-used land? Why?	**1=Yes 2=No**	**Why?**
	Is there follow land? Why?	**1=Yes 2=No**	**Why?**
	Do you have access to water?	**1=Yes 2=No**	**Why?**
	Do you use it for irrigation?	**1=Yes 2=No**	**Why?**
	Do you have enough water?	**1=Yes 2=No**	**Why?**
	What are you not growing and would like to?		
	Have you had poor success with a crop? Why?	**1=Yes 2=No**	**Why?**

Thank the respondent!

INTERVIEW END TIME

APPENDIX B: Letter of permission for use of SAVAC datasets

agriculture, land reform
& rural development
Department:
Agriculture, Land Reform and Rural Development
REPUBLIC OF SOUTH AFRICA

OFFICE OF THE DIRECTOR: SUBSISTENCE FARMING
Private Bag X833, Pretoria, 0001; 503 Steve Biko Road, Pretoria, 0001
Tel: 012 – 319 7331; E-mail: MolateloMAM@daff.gov.za; Website: www.drdlr.gov.za

Dr M Ngidi

Centre for Food Security
University of KwaZulu-Natal
Private Bag X01
PIETERMARITZBURG, 0028

Dear Dr Ngidi

RE: PERMISSION FOR USE OF SAVAC DATASETS

Thank you for your letter dated 29 January 2021, in which you request the Department of Agriculture, Land Reform and Rural Development (DALRRD) to **use the SAVAC datasets for PhDs, Masters and publication of papers.** Permission is granted expressly for use in the Masters and PHD as listed in your letter. The data remains the property of the South African Vulnerability Assessment Committee (SAVAC) as the originator. Users are expected to respect the intellectual property rights of the SAVAC. It is therefore expected that the analysis and insights emanating from the use of this data will be shared with the SAVAC Chairperson.

Yours Faithfully,

[redacted]

MR M MAMADI
DIRECTOR: SUBSISTENCE FARMING
DATE: 25 Feb 2021