Socio-economic factors influencing farmers decision to participate in the Agro-processing industry in Gauteng Province.

SOCIO-ECONOMIC FACTORS INFLUENCING SMALLHOLDER FARMERS' DECISION TO PARTICIPATE IN THE AGRO-PROCESSING INDUSTRY IN GAUTENG PROVINCE

By

THULISILE MAVIS KHOZA

(215672174)

A dissertation submitted in partial fulfilment of the requirements of the degree of

MAGISTER TECHNOLOGIAE: AGRICULTURE

Department of Crop Sciences

Faculty of Science

TSHWANE UNIVERSITY OF TECHNOLOGY

Tshwane, Gauteng

South Africa

Supervisor : Prof P SOUNDY

Co-supervisors : Dr G M SENYOLO

: Prof V M MMBENGWA (NAMC)

March 2019

DECLARATION 1

I, **Thulisile Mavis Khoza** (215672174), hereby declare the dissertation for Magister Technologiae in Agriculture at Tshwane University of Technology, hereby submitted by me, has not been submitted previously for a degree at this or any other institution, that it is my own work in design and in execution, and that all reference material contained therein has been duly acknowledged.

Researcher: ………………………………….. Date: …………………………

(Ms Thulisile Mavis Khoza)

DECLARATION 2: CONFERENCES AND PUBLICATIONS

Khoza T.M, Senyolo G.M, Nekhavhambe E. and Mmbengwa V.M (2018). Factors affecting smallholder farmers' participation in agro-processing industry. The paper was presented at the 56th annual conference of the Agricultural Economics Association of South Africa (AEASA), held at Lord Charles hotel, Somerset West, 25 - 27 September 2018.

Khoza T.M, Senyolo G.M, Mmbengwa V.M and Soundy P. (2019). Socio-economic factors influencing smallholder farmers' decision to participate in agro-processing industry in Gauteng Province. The paper has been accepted by *Cogent Social Sciences*.

ABSTRACT

Smallholder farmers in South Africa have not been linked successfully to sustainable agro-processing value chains. Hence, their participation in agro-processing is deemed minimal and insignificant. The aim of the study was to identify smallholder farmers participating in agro-processing and factors influencing their choice of participation, as well as the extent of participation. The study was conducted in Gauteng Province, South Africa, on a purposive selected sample of 102 smallholder farmers. Data was collected through a structured questionnaire that was administered face-to-face with respondents. The double-hurdle model was used to analyse factors influencing the decision to participate and the extent of participation. This model was used because it accounts for whether or not smallholder farmers participate in the agro-processing industry, and the extent of their participation. The results revealed that only 19% of the sampled respondents participated in the agro-processing industry of Gauteng Province, and that factors such as farming experience, land tenure, distance to market, and information have a positive influence on agro-processing participation; however, off-farm income negatively influenced the decision to participate. The study also revealed factors that influenced the extent of participation, this is, age, household size, area under production, labour, training, and type of enterprise (grain and livestock farming). Moreover, factors influencing both the decision to participate and the extent of participation were uncovered (educational level and livestock farming). However, there are challenges that need to be addressed in order for them to participate to their potential (this is, lack of access to agro-processing training, lack of access to information, and distance to market). The study recommends development of strategies that could realistically increase access to friendly investment capital to the younger generation to start their own small-scale agro-processing businesses, intensification of awareness of farmers on micro-financing institutions, encouraging and creating a conducive environment for smallholder farmers, building local agro-processing plants and make efforts in capacitating graduates with agro-manufacturing or processing knowledge and skills as a way of obtaining intellectual insights into agricultural development, which is otherwise unfairly identified by the less educated.

Keywords: Agro-processing industry; Smallholder farmers; Double-hurdle model; Participation.

ACKNOWLEDGEMENTS

I would like to express my deep and whole-hearted gratitude and indebtedness to my supervisor, Prof P. Soundy, and co-supervisors, Dr. G.M Senyolo and Prof V.M Mmbengwa, for their guidance and support throughout the course of this study; their vital and valuable input and suggestions are worthy of being mentioned here. Without their support and endless understanding, this study would not have had its present dimension, thus, they deserve special thanks.

I gratefully acknowledge the Gauteng Department of Agriculture and Rural Development (GDARD) for all the financial help that I received from them, extension officers in Gauteng Province where the study was conducted, most importantly Ms Tlou Molebo and Ms Juliet Rakuambo for their support. I also thank all the farmers in Gauteng Province who participated, as without them this project would not have been successful. I wish to thank all my work colleagues at National Agricultural Marketing Council (NAMC) for their constant support and encouragement, in particular Elekanyani Nekhavhambe, Kayalethu Sotsha and Hangwelani Mathagu - the motivation they gave me was worth it.

The understanding, support and encouragement that I received from my family was a driving force throughout my studies.

Lastly, but importantly, I would like to thank God for all the guidance and protection, for with Him all things are possible.

DEDICATION

I dedicate this dissertation to my family. A special word of gratitude goes to my deceased parents, Ritta Thobela and Ben Khoza, my siblings, Maria and Idah Khoza, and my husband, Walter Mokoena, whose words of encouragement and push for tenacity kept ringing in my ears, and last but not least, my son, Bayanda Mokoena, from whom I gained strength and the reason to wake up. A special dedication goes to my co-supervisor, Dr Grany Senyolo, without her support this project would have not been a success.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND ACRONYMS

DAFF	Department of Agriculture, Forestry and fisheries
GDARD	Gauteng Department of Agriculture and Rural Development
GDP	Gross Domestic Product
HAACP	Hazard Analysis and Critical Control Points
ICM-FFS	Integrated Crop Management Farmer Field School
IPAP	Industrial Policy Action Plan
Localg.a.p	Local Good Agricultural Practices
NAMC	National Agricultural Marketing Council
NDP	National Development Plan
NGP	New Growth Path
SAGAP	South African Agricultural Practices
STATA	Software for Statistic and Data Science
StatSA	Statistics South Africa

CHAPTER 1: INTRODUCTION

1.1 Background

Agro-processing is known to contribute significantly to the alleviation of socio-economic challenges, as its activities can contribute to sustainable livelihoods through improved incomes, employment, food availability and nutrition, social and cultural well-being (Mhazo et al., 2012). This industry plays a considerable role in contributing to the total output of the manufacturing sector (Department of Agriculture, Forestry and Fisheries {DAFF}, 2012).

Currently in South Africa, commercial agriculture is the main player in the agro-processing industry, whereas smallholder farmers are playing a limited role despite receiving support from government (Mmbengwa et al., 2011). This is due to the fact that smallholder farmers have not been linked successfully to sustainable value chains. According to Mapiye et al. (2007), despite the developmental efforts initiated in most rural areas of South Africa, there has been little or no effort to add value to the existing primary agricultural products.

Commercialisation of agricultural and food systems are increasing worldwide and the agro-processing industry is one of the main sectors dominating the increasing food industry (Vermeulen et al., 2008). The influence of the farmer, small traders and neighbourhood stores is however declining, even though the farmers' participation is an important factor for sustainable agriculture (Botlhoko & Oladele, 2013). Thindisa (2014) records that participation by smallholder farming entrepreneurs in agro-processing activities is likely to contribute to increased profitability and sustainability of enterprises. Moreover, the exploitation of agro-processing business opportunities has the potential to enhance competitive advantage of farming enterprises.

The existence of smallholder farming in Gauteng is severely limited by the shortage of land and high land purchase prices. With growing immigration in Gauteng, the need for smallholder farming for food security and job creation is inevitable. Gauteng Province has a host of numerous industries, including agro-processing industry, which makes this integral in its quest to promote transformation in the participation of agro-processing industry. According to Gauteng's agro-processing strategies, South Africa's agro-processing activities are concentrated in Gauteng Province (GDARD, 2015), and the province has the largest agro-processing value addition (28.5% in 2013) and significant job creation (23% or 124 000 jobs in 2013). The challenges are that this industry is untransformed and the participants still do not reflect demographic representation of the province or the country.

The GDARD agro-processing strategies regard this industry as being dominated by a few large players who own large proportions of the market share (GDARD, 2015). New role-players in the smallholder farming are few and their participation is skewed toward the previously advantaged individuals. Lack of access to lucrative markets, technologies and skills are some of the challenges limiting smallholder enterprises from progressing to value-adding activities (GDARD, 2015). Inadequate infrastructure and limited incentives further hinder entry and growth of smaller processors into the market.

Musvoto et al. (2015) argue that job creation, in the context of agriculture, is also connected to agro-processing. Briefly, the more farmers increase their participation into the agro-processing sector, the more jobs will be created, thereby increasing agricultural contribution to the economy. Moreover, these authors argued that the agricultural sector is robust and if linked to markets, this would expand agro-processing opportunities. Delgado and Siamwalla (1997) suggest that promoting growth in smallholder agriculture by selling high value-added items would require significant vertical integration of smallholder farmers to processing and marketing firms. This can be achieved through the strengthening of farm and non-farm linkages by adding value to products of smallholder farmers through processing and distribution (Machethe, 2004). Moreover, this could contribute to the generation of employment and income. Taking into account the advantages of the smallholder farming, and their strategic positioning compared to the commercial farming, it can be deduced that involving smallholder farming in the mainstream agro-processing would provide a comparative advantage to the South African economy, considering the value of processed agricultural products exceeds that of the basic commodity (Louw et al., 2008).

The potential for agro-processing industry in South Africa is enormous since agricultural economy is largely based on primary production of horticulture and livestock (Machethe, 2004). It is of concern that smallholder farmers have been marginalised and seem to find it difficult to process their own farm produce and also to participate in the commercial agro-processing value chain (Mmbengwa et al., 2012), this is, to sell their produce to manufactures or processors who are the big role players in the value chain and also processing their produce. This indicates there is a gap that requires in-depth investigation and understanding, especially to respond to the following overarching question, 'What are the socio-economic factors influencing smallholder farmers' decision to participate and the extent of participation in agro-processing in Gauteng Province?'

1.2 Definition of agro-processing

Agro-processing can be defined as the transformation of harvested natural resources by biological or chemical processes, changing the physical state or appearance of the product and usually adding value to it (McNeill, 2005). Conversely, DAFF (2016) referred to agro-processing as the activities that change the form of agriculture, forestry and fisheries products into various forms to facilitate easier handling and increase shelf life and market access. Mhazo et al. (2012) and Kamuzora (2013) define agro-processing as a set of techno-economic activities carried out on an agricultural commodity for the purposes of making it usable as food, feed, fibre, fuel or industrial raw material. This study defines agro-processing as the conversion of the physical form of an agricultural raw material by preservation and treatment, which include, amongst others, milling, grinding, chilling, fermentation, and drying. This can be done by the farmer or by sending his produce to an agro-processor.

It is worth noting that agro-processing is part of value addition, however, some value addition activities may not be part of agro-processing; various studies refer to value addition as agro-processing. Mhazo et al. (2012) classify agro-processing into two major categories, this is, primary (crop drying, shelling/threshing, cleaning, grading, and packaging) and secondary (milling grain into flour, grinding groundnuts into peanut butter, pressing oil out of vegetable seeds, pressing juice out of fruit, and making cheese out of milk) processing operations. The primary processing operations are mainly carried out at the farm and only transform the commodity into a slightly different form prior to storage, marketing or further processing, while the secondary processing operations entails increasing nutritional or market value of the commodity and the physical form or appearance is often totally changed from the original (Mhazo et al., 2012). These authors treat some value addition activities that are not part of agro-processing as primary processing activities, such as cleaning, grading, and packaging.

The agro-processing industry can be described as one that adds value to agricultural raw materials, both food and non-food, by processing them into products and dealing with the supply, processing and distribution (Laudat, 2015). According to DAFF (2016), the agro-processing industry is defined as a subset of manufacturing that processes raw materials and intermediate products derived from the agricultural sector, and again as an industry that transforms products originating from the agriculture, forestry and fisheries sectors. The agro-processing industry, broadly deals with post-harvest activities involving manufacturing of primary agricultural products. Typically, agricultural produce increases in importance relative to agriculture and occupies a dominant position in manufacturing (Wilkinson & Rocha, 2008).

1.3 Research problem and justification of the study

Due to being marginalised in the past, smallholder farmers may not possess the necessary requisites to own or participate in the commercial agro-processing value chain (Mmbengwa et al, 2012), thus smallholder participation in the commercial agro-processing may be minimal and insignificant. There is a need to prioritise smallholder participation in agro-processing in order to yield better results in terms of increased farm income generation and employment. Gauteng Province is known to be the most densely populated province, with massive agro-processing activities relative to other metropolitan provinces (GDARD, 2015). The agro-processing concept note for the Gauteng Department of Agriculture and Rural Development (GDARD) has revealed that agro-processing requires massive input costs, such as feed, machinery, logistics and packaging (GDARD, 2015).

In October 2015, GDARD came up with agro-processing strategy with the aim to reform, develop and increase the number of investors and participants in the sector (GDARD, 2015). However, there is still no evidence of smallholder farming participation in agro-processing. Again, research topics are limited to the agro-processing sector, particularly with regard to opportunities and challenges experienced in rural agro-processing initiatives (Mandiriza et al., 2016). The gap reflects the need for technical and strategic intervention informed by empirical investigation; without the investigation, the agro-processed products supplied by smallholder farmers will continue to be minimal and insignificant.

Gauteng Province is considered the economic hub, with negligible primary agricultural production (GDARD, 2015). The GDARD agro-processing strategies regards this industry as being dominated by a few large players who own large proportions of the market share (GDARD, 2015). Smallholder participation in the commercial agro-processing is minimal and insignificant hence the study identified socio-economic factors that could enhance participation. The lack of a profile of smallholder farmers participating in agro-processing will hinder GDARD in developing appropriate tailor-made support programmes for these farmers; they may offer support that may not benefit the specified farmers.

The identification of factors that enhance their participation, as well as their level of participation in agro-processing, could also be of assistance in this regard. On a practical level, it may imply that smallholder farmers in Gauteng are unique and require a particular set of factors that makes them participate in this sector. Moreover, a criterion for participation could be created and used to mainstream these farmers in the South African economy. This process is important in creating an environment for smallholder job creation at the agro-processing level. Again, it may put farmers in a position to contribute towards the alleviation of the socio-economic challenges of South Africa. Existing literature shows there are more benefits when commodities are traded processed compared to when there is less processing (Mlambo et al. 2016). This implies that agro-processing could significantly contribute to the country’s growth in terms of Gross Domestic Product (GDP) as well as food security status. Additional job opportunities could also be created through further processing of commodities.

1.4 Aim and objectives

The aim of the study is to identify socio-economic factors influencing smallholder farmers’ participation in agro-processing industry in Gauteng Province. This will be achieved through the following specific objectives:

i. To identify smallholder farmers linked with agro-processing industry in Gauteng Province.
ii. To determine socio-economic factors influencing smallholder farmers' decision to participate in agro-processing industry in Gauteng province.
iii. To assess the extent of participation of smallholder farmers who are participating in agro-processing industry in Gauteng Province.

1.5 Hypotheses of the study

i. There are no socio-economic factors influencing smallholder farmers' decisions to participate in agro-processing industry in Gauteng Province.
ii. There is a low level of participation in the agro-processing industry amongst the smallholder farmers in Gauteng Province.

1.6 Organisation of the Dissertation

The remainder of the thesis is organised as follows:

Chapter 2 presents the literature review.

Chapter 3 contains a discussion of the methods of analysis employed in the study.

Chapter 4 presents the discussion of the study results. This includes the characteristics of the respondents, the factors influencing smallholder farmers' decision to participate and the extent of participation in agro-processing industry.

Chapter 5 summarises the study and discusses the major conclusions and recommendations.

The next chapter looks at literature on agro-processing industry in South Africa and factors influencing smallholder farmers' participation thereof.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter presents the overview of the agro-processing industry in South Africa and the role of this industry towards smallholder farmers' development. It further presents a review of the factors that influence smallholder farmers to participate in agro-processing industry, as well as factors influencing the extent of participation.

2.2 Overview of the agro-processing industry in South Africa

In South Africa, the agro-processing industry is generally of strategic importance to the economy due to its high positive effect towards job creation and its backward linkage with primary agriculture, hence it is among the sectors identified by the Industrial Policy Action Plan (IPAP), the New Growth Path (NGP) and the National Development Plan (NDP). This industry transforms products that originate from agriculture, forestry and fisheries (DAFF, 2016). According to Mhazo et al. (2012), the agro-processing industry is a potential solution to smallholder commercialisation in South Africa, and elsewhere in the world where smallholder farmers lack access to high value markets.

A report undertaken by DAFF (2016) classified agro-processing industry according to the standard industrial classification with 11 divisions: food products, beverages, tobacco, textiles, wearing apparel, leather and leather products, footwear, paper and paper products, wood and wood products, rubber and furniture. Food, tobacco and wood divisions of the agro-processing sector have a strong backward linkage with the primary industry since they obtain their primary output from the agricultural sector, while further processing, such as furniture, footwear and leather, have a strong backward linkage with the secondary sectors. However, another report by DAFF (2012) argued that the structure of all divisions in the agro-processing industry shows the backward linkage with tertiary sectors, which consists of trade, transport and finance, and it is becoming more significant depicting an increasing trend.

The processing industry is concentrated around large companies, which produced 91% of the income of the processing industry in 2008 while employing 75% of the staff (Harcourt, 2011). The skill level of employees in all divisions of the agro-processing industry is largely dominated by semi-skilled and unskilled labour (DAFF, 2012). In 2008, the food processing industry was highly concentrated in meat and dairy companies, and processing seemed not to be of focus in the fruit sector, because of the lower value of fruits used for processing compared to the unprocessed fruit sold or exported (Harcourt, 2011).

The contribution of the agro-processing industry to the real value (GDP) added by the manufacturing sector and the economy accounted for 32.2% and 4.4%, respectively, during 2016, while the contribution to the real output of the manufacturing sector and the economy was 31.6% and 7.7% respectively (DAFF, 2016). The industry's share of real domestic fixed investment in the manufacturing sector and the economy were 14.3% and 1.8%, respectively, during the same period (DAFF, 2016). Additionally, the total agro-processing exports relative to manufacturing sector and the economy were 19.1% and 10.9%, respectively, while total imports relative to the manufacturing sector and the economy were 18.2% and 9.7% respectively (DAFF, 2016).

2.3 The role of agro-processing industry towards smallholder farmers' development

The increasing importance of processed agricultural products is a long-run trend observed across regions and countries (Wilkinson & Rocha, 2008). The agro-processing industry in general plays a critical role for development, especially in developing countries (DAFF, 2012). According to Wilkinson and Rocha (2008), this industry plays a fundamental role in the creation of income and employment opportunities in developing countries. Moreover, agro-processing plays a decisive role in pro-poor development strategies to the extent that it can promote decentralised growth and generate non-farm activities in rural areas (Wilkinson & Rocha, 2008). The national development plan (NDP) has revealed that participation in the agro-processing industry could have a positive impact towards the reduction of poverty and joblessness.

Thindisa (2014) attested that participation of smallholder farming entrepreneurs in agro-processing activities is minimal as they are currently confined to exploitation by large agro-processors who are distinct from actual farming operations. Moreover, the involvement of smallholder farmers in agro-processing has the potential to contribute significantly to sustainable livelihoods through food availability emanating from improved shelf life, improved income from increased profitability, employment, social and cultural well-being from limited land (Thindisa, 2014; Wilkinson & Rocha, 2008). The agro-processing industry is an important market segment for smallholder farmers, as according to Mhazo et al. (2012), it is the potential solution to the challenge of lack of access to markets.

Participation of smallholder farming entrepreneurs in agro-processing activities may also create niche markets, which are currently limited (Thindisa, 2014). According to Alene et al. (2008) and Aphane (2011), the benefits associated with the participation in agro-processing are varied and range from improved cash flow and market access to viable farming entities.

Processed agricultural products fetch a higher price on the market floor compared to basic and unprocessed agricultural products (Thindisa, 2014), therefore the success of this industry in both urban and rural areas could contribute to the farmers' market access and an influence in the enhancement of sustainability of smallholder farming. Farmers' participation generally gives them the right to be consulted, involved, and informed by other stakeholders (Smith, 1983). This gives the farmers the potential to enrich their decision-making processes and to be influenced by other farmers. Furthermore, this can build trust and a network amongst the participating farmers. The agro-processing industry certainly plays a significant role in job creation and sustainability of the economy as it is one of the industries that has the potential to alleviate poverty in South Africa.

2.4 Factors affecting the participation and the extent of participation

The participation of smallholder farmers in high rewarding markets is not only a local challenge, but affects smallholder agriculture sub-sector in the world at large (Haggblade, 2004). The author further highlighted that livelihoods of most smallholder farmers are often limited due to lack of access to lucrative markets and limited skills for adding value to their primary products. This section reflects literature concerning the socio-economic factors under consideration on participation.

2.4.1 Demographic factors

Grover (2003) has argued that male farmers are highly competitive in agricultural practices as they practice commercial farming, compared to their female counterparts who usually focus on small-scale agriculture for household food security. This could be the possible reason why women tend to focus on primary agriculture rather than on secondary agriculture, which encompasses agro-processing activities. Henson and Cranfield (2009) identified the greater participation of women in the paid labour force as one of the main mega trends at national and international levels that drive the growth of the agro-processing industry globally. Concerning the effect of gender on technological adoption, Morris and Doss (1999) found no enormous association between gender and likelihood to engage in improved technological practices in Ghana. However, it is worth noting that in some instances, men tend to have more access to resources than do their counterparts; in this instance, the adoption of technology will not be equally beneficial. Contrarily, Obisesan (2014) found that gender was positively significant to the adoption of improved cassava production in Nigeria. Results concurred with the study by Lavison (2013), which revealed that male farmers were more likely to apply improved fertiliser compared to their female counterparts. Other studies that suggested gender may have a significant influence on technology adoption were Tesfaye et al. (2001), Astatkie (2005), Omonona et al. (2005), and Mignouna et al. (2011). These studies indicated gender influences technology adoption, since the head of the family is the foremost decision maker and men have extra access to and control over imperative manufacturing assets than do females due to socio-cultural values and norms.

Older farmers, compared to young farmers, were mostly challenged by a lack of new technical skills and innovation, which are the critical elements for transformation (Alam et al., 2009). Chi and Yamada (2002) argued that age is a prominent factor that could influence or hamper farmers to adopt technology and innovation. They further indicated that young farmers have a higher probability of adopting technology in their business operations compared to their elderly counterparts. Mwangi and Kariuki (2015) stated that as farmers grow older, the probability of becoming risk averse increases, however the interest of investing in their farms decreases. The authors indicated that younger farmers are normally less risk-averse and are more likely to explore new technologies. Similar to these results, Alexander and Van Mellor (2005) found that as younger farmers gain more experience, the likelihood of adoption of genetically modified maize and stock of human capital increases compared to older farmers. On the contrary, Mignouna et al. (2011) revealed that the evaluation of technological information is more improved in older compared to younger farmers, considering they have gained more knowledge and experience over time.

Household size has a likelihood of influencing social and economic status, including labour availability, and ability to tolerate risks by smoothing income fluctuations over time (Naik, 1997). Household size generally has an influence in household per capita expenditure; an increase in household size has the probability of leading to an increase in household expenditure. Like other human capital resources, household size is the degree of labour accessibility, it would affect the adoption of technology in a business operation process in that, a larger family size has the potential to reduce the labour constraints during the introduction of new technology (Mignouna et al., 2011; Bonabana-Wabbi, 2002). Ironkwe et al. (2016) determined factors influencing adoption of Root and Tuber Technologies and the results revealed that farmers with larger household sizes were likely to adopt technologies. Chepng'eno et al. (2012) investigated the socio-economic factors affecting the adoption of improved agricultural technologies among women; in their results, household size had a significant and positive association with the adoption of agricultural technologies.

A study by Alam et al. (2009) argued that highly educated farmers are more likely to have better business techniques than their less educated counterparts. Education generally assists in the improvement of market information interpretation, which may further enhance the ability of farmers to adopt new technologies or innovations. Many studies have also shown that education has a positive impact on farmers' managerial skills and technology adoption (Ortmann, 2005). According to Chi and Yamada (2002), farmers who went to school find it easy to adopt new technology into their farming activities, compared to those who are not educated; this is because they know how to read, which is vital for understanding any technological application.

This finding is also supported by Botlhoko and Oladele (2013), who argued that educated farmers are likely to adopt innovations compared to illiterate farmers, hence, their productivity increases resulting in greater farm returns. Literature confirms that educational level is amongst the determinants of technology adoption. Martey et al. (2012), Matsane and Oyekale (2014) and Diale (2011) highlighted that an educational background was a crucial factor in smallholder transformation. Tologbonse et al. (2013) conducted a study to assess the level of women's participation in Women in Agriculture programmes, and their overall performance in terms of output and income levels with those of non-participating farmers. The results showed that education is significantly associated with the level of participation.

2.4.2 Economic factors

The action of an individual to participate in off-farm activities is influenced by the market wage and the reservation wage (Beyene, 2008). When the reservation wage is lower than the market wage, individuals tend to participate in off-farm work (Benjamin & Guyomard, 1994). Abdullah et al. (2017) argued that if a farmer is participating in a secondary market, his motivating force to work within the field diminishes, and this will lead to off-farm expansion. Off-farm income has been reported to have a positive influence on the adoption of technology. Diiro (2013) reported a significantly higher adoption intensity on households receiving off-farm income compared to farmers not receiving off-farm income.

The majority of farmers receiving off-farm income, generated from off-farm activities, use the income for their own consumption (Beyene, 2008) whilst very few use this income for farm investment. This has an implication on the growth of smallholder enterprises. Efforts should be made to promote the smallholder sector so that farmers can achieve a sufficient amount of income, which in turn will be used for investment in their farms. Following that the non-farm business or income contributes to smallholder farmers' growth, it could enable and fast track their farm capital and boost their farm financial structure.

2.4.3 Farming characteristics

Studying the farming enterprise as a governance structure becomes the key for understanding its sustainability (Bachev, 2016). Currently, functioning of enterprises takes place under the conditions of an unstable market environment (Bachev, 2016). Smallholder farming enterprises, often cannot meet the standard of a minimum volume of investment (Kincl, 2003), hence it is difficult for them to participate in agro-processing activities. Mmbengwa et al. (2013) suggest that the viability of these enterprises requires the capacity building programmes aimed at consolidating and developing entrepreneurial capacity to prioritise innovation, risk taking, financial and infrastructural capacities. Smallholder production is severely affected by limited land for farming (Ncube et al., 2018). This has an impact on many famers in South Africa who apply mixed farming enterprise practices, which also limit crop intensification (Betek & Jumbam, 2015). The Gauteng Agro-processing Policy identifies five priority sectors, grains, horticulture, red meat, poultry and piggery (GDARD, 2018). Smallholder farming, which is engaged in these priority enterprises stand a better chance to participate in agro-processing industry because there is a support model in place for these specific enterprises.

Farm size has a direct impact on the farm income, as the larger farm is expected to generate more income and reduce the cost of production (Moloi, 2008). Hailua et al. (2015) noted that the size of land is very important in determining farmer participation in output markets. Farmers with a large farm size are assumed to have the likelihood of segregating part of their land to try new technology compared to those with less farm size hence they are more likely to adopt new technology (Uaiene et al., 2009). This suggests that if farmers have limited farming areas, they are less likely to realise economies of scales that are a necessity for the agro-processing industry; some farmers may foresee no reason to process small amounts of their produce, taking into account high cost of technology adoption. Other authors who have reported a significant relationship between farm size and agricultural technology adoption are Ahmed (2004), Uaiene et al. (2009), Mignouna et al. (2011) and Magugu et al. (2018). Land size also influences the extent of technology adoption (Kariyasa & Dewi, 2011; Lowenberg-DeBoer, 2000). Bonabana-Wabbi (2002) suggested that the relationship between technology adoption and farm size could be explained by determining the total land area appropriate to the new technology against the total area of land.

Farming experience is perceived to be important for the success of farming enterprise and can boost management skills (Peach, 2015). Shabanali (2006) studied the characteristics of rural women in relation to their participation in mixed farming activities, and the results revealed that farming experience is positively significant to the decision to participate in mixed farming activities and the overall extent of participation. Ele et al. (2013) assessed the degree of commercialisation of smallholder farms and found farming experience was a critical factor in assessing the level of commercialisation. Whether farming experience enhances or discourages agricultural technology adoption remains unclear in existing studies (Knowler & Bradshaw, 2007). Much of the empirical literature on the adoption of agricultural technologies reports mixed relationships between the adoption rate of agricultural technologies and farming experience. Tarawali et al. (2012) studied the factors influencing adoption of improved cassava varieties and the results suggested that the probability of adopting improved cassava varieties increased with farming experience. These authors further argued that farmers with greater experience could become less risk averse to the application of a new technology. Hence, there is more likelihood of farmers with more farming experience to adopt improved technology approaches in their farming practices.

South African agriculture is still labour intensive therefore it is important to consider this factor carefully in a farming enterprise. Labour intensiveness favours smallholder organisations, whereas both economies of scale and heavy investment requirements in production produce the opposite effect (Delgado, 1999). Peach (2015) queried reasons behind the decrease in number of farm labourers between 1980 and 2010 (see Figure 2.1) and noted that in the 1980s, the number of permanent farm employees was 1,235 million which declined to 628 000 permanent employees in agriculture in 2010. The author revealed increased mechanisation and technology developments as some of the factors influencing the agricultural sector employment during the past century.

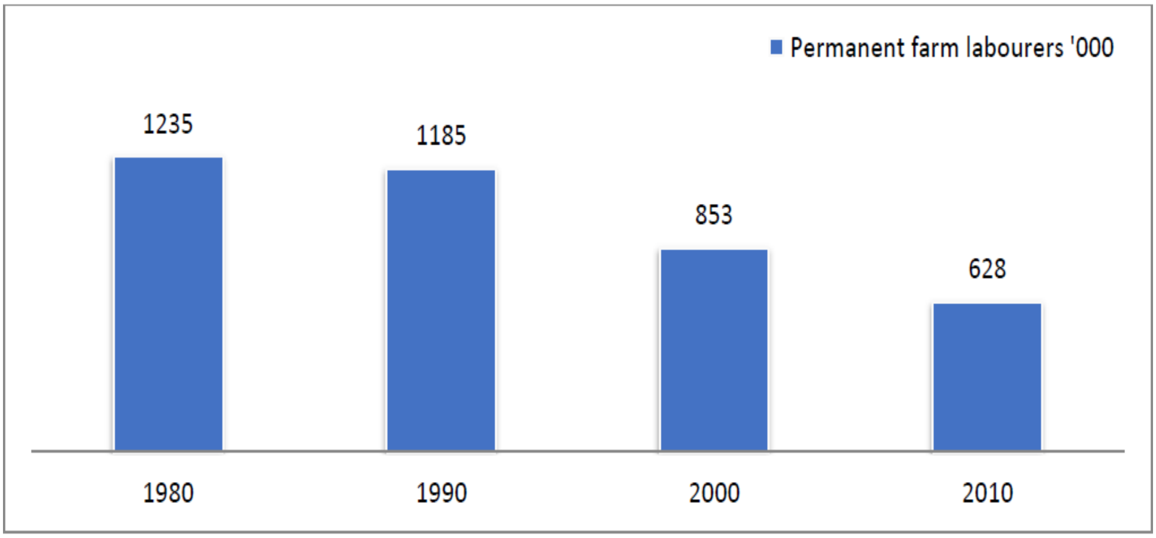

Figure 2.1: Number of permanent farm labourers in South Africa
Source: Peach (2015)

Labour is one major factor of production, especially when production is aimed for the market. Labour assists in making the performing of daily activities of the farm easier in the absence of the technology (Bonabana-Wabbi, 2002). Technology adoption in a farm operation therefore helps save time and labour costs. Although technology adoption is viewed as costly, in the end it may reduce costs of labour and improve returns. Makokha et al. (2001) conducted a study to determine factors influencing the use of fertiliser and manure in maize production in Kenya, and found that labour cost is one of the main constraints to fertilizer adoption. Similar results were reported by Ouma et al. (2002), who reported that the cost of hired labour is one of the factors constraining adoption of fertiliser.

In another study by Ogeto et al. (2013) in Kenya, it was noted that access to land ownership stimulates growth in farming practices. Another study by Matsane and Oyekale (2014) revealed that farmers acquired their land through communal tenure. These authors argued that land tenure is a predominant pattern of land ownership, which determines security and sustainability of land use essential for farm investment and returns. Access to land is mostly considered as one of the determinants of people's involvement in agricultural activities. The likelihood of smallholder communal farmers investing in agro-processing is low since agro-processing requires massive investment.

Mwangi and Kariuki (2015) concluded that the decision to adopt technology is highly dependent on access to resources, which includes, among others, access to land. In a study by Tarawali et al. (2012), land ownership was found to be negatively associated with the adoption of technological improvement of cassava varieties. The authors argued that the increase in the number of farmers, who rented, leased or mortgaged land increased the chances of adopting improved cassava varieties. This implies that farmers who have title deeds are not pressured to adopt improved technology in order to produce high value products compared to their counterparts who do not have title deeds

2.4.3 Support services

Distance to market is one-factor influencing smallholder farmers' decision on where to sell. The issues relating to transportation of raw farm produce is isolating smallholder farmers from high value markets, therefore they sell their produce to informal markets, in their local areas (Mudhara, 2010). Distance to market has a bearing on the level of transaction costs faced by smallholder farmers (Louw et al., 2008), and so transportation costs need to be addressed for smallholder farmers to transform towards agro-processing industry and other rewarding markets. Kariyasa and Dewi (2011) analysed the determinants of adoption of integrated crop management farmer field school (ICM-FFS) by rice farmers in swampy areas of Indonesia. The results show that distance to output markets does not affect the probability of adoption of the ICM-FFS technology. However, the correlation analysis showed a negative association, indicating that the further the distance to the output market from the farmer's location, the less likelihood of ICM-FFS to be applied by rice farmers. Milkias and Abdulahi (2018) investigated the intensity of adoption of improved highland maize varieties, and distance to market was found to have a negatively significant association with the probability of such adoption and intensity of use.

Training is considered as one of the processes farmers could use to acquire skills and attitude shift (Sajeev et al., 2012). Salami et al. (2010) support the need for training, especially as a strategy to enhance and encourage technology adoption and innovation. Regarding farmers' education and skills training in South Africa, commercial farmers, who are generally well educated, have acquired appropriate skills for their operations, compared to smallholder farmers (Ortmann, 2005). The decision for a farmer to adopt technology is mostly affected by the needs of technical training programmes (Singha, 2011). This suggests that extensive training programmes are critical to bring about desirable changes in the adoption behaviour of farmers towards their application of technological approaches in different enterprises. Another study by Kinyangi (2014) revealed that training has a probability of influencing the adoption of technologies among smallholder farmers, and the degree of adoption of technologies. This is an indication that potential farmers need to be trained on issues relating to agro-processing markets.

Agricultural market information is very important for the farmers who would like to trade their commodities and participate in lucrative markets. It can assist farmers in identifying profitable markets for their commodities and help with the identification of profitable commodities. According to Mundy and Sultan (2001), market information can help smallholder farmers to predict strategies, plan and act expediently, rationally and efficiently. With market information, farmers can make informed decision within the supply chain networks, thus reducing the business risks and transaction costs. This will inform the farmers on the exact amount due to the farm given the investment made in the production process. Obi et al. (2011) state that many smallholder farmers do not have access to the right amount of information and technical support that would make a difference in their farming business, such as improving yields, production practices, receipt and use of inputs, and delivery of produce to markets. This makes it difficult for them to participate in lucrative markets.

The lack of access to information is one of the constraining factors towards the development of smallholder agriculture (Hailua et al., 2015). Acquisition of information about new technology is another factor influencing the decision to apply innovation (Mwangi & Kariuki 2015). The authors further argued that information diminishes the vulnerability around a technology's execution, moreover it contributes to the adoption and effective use of technology by farmers. A study by Magugu et al. (2018) revealed that access to information has a significant positive correlation with agro-forestry technology adoption.

2.5 Summary

Socio-economic factors seem to have an influence towards the farmer's decision to participate, as well as the extent of participation. These factors are crucial for smallholder participation in lucrative markets and commercialisation. The major determining factors influencing farmer's participation in the market are gender, age, farming experience, household size, educational level, distance to the nearest marketing channel, access to training, information and non-farm income, and the type of farming enterprise. The probability of participating in output markets depends on these factors and requires consideration for improvements in market participation. This is necessary to link smallholder farmers to markets in order to improve market participation, thereby creating opportunities for income generation. The next chapter presents the methodology that was used in the study.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the research methodology used to collect the data and analyse the variables that were considered to influence smallholder farmers' participation in agro-processing in Gauteng Province. The rest of the chapter is organised as follows: the study area, sampling, data collection, and data analysis, which consists of the descriptive and the double hurdle model. The chapter concludes with a summary.

3.2 Study area

The study was conducted in Gauteng Province (West Rand, City of Johannesburg, City of Tshwane, Sedibeng and Ekurhuleni) South Africa. The motivation behind the selection of the study area is that, this study is part of a research study mandated by GDARD conducted for GDARD Gauteng was formed from part of the historic Transvaal Province post 1994. Amounting to a total area of 16 548 square kilometres, which accounts for a share of 1.4% of South Africa's total land area, Gauteng is the smallest of the country's nine provinces, yet, according to 2011 census, it has the highest population of approximately 12.3 million (StatSA, 2012). Furthermore, it generates 33.9% of South Africa's GDP (StatSA, 2012). Main economic activities are mining, manufacturing, technology and agriculture.

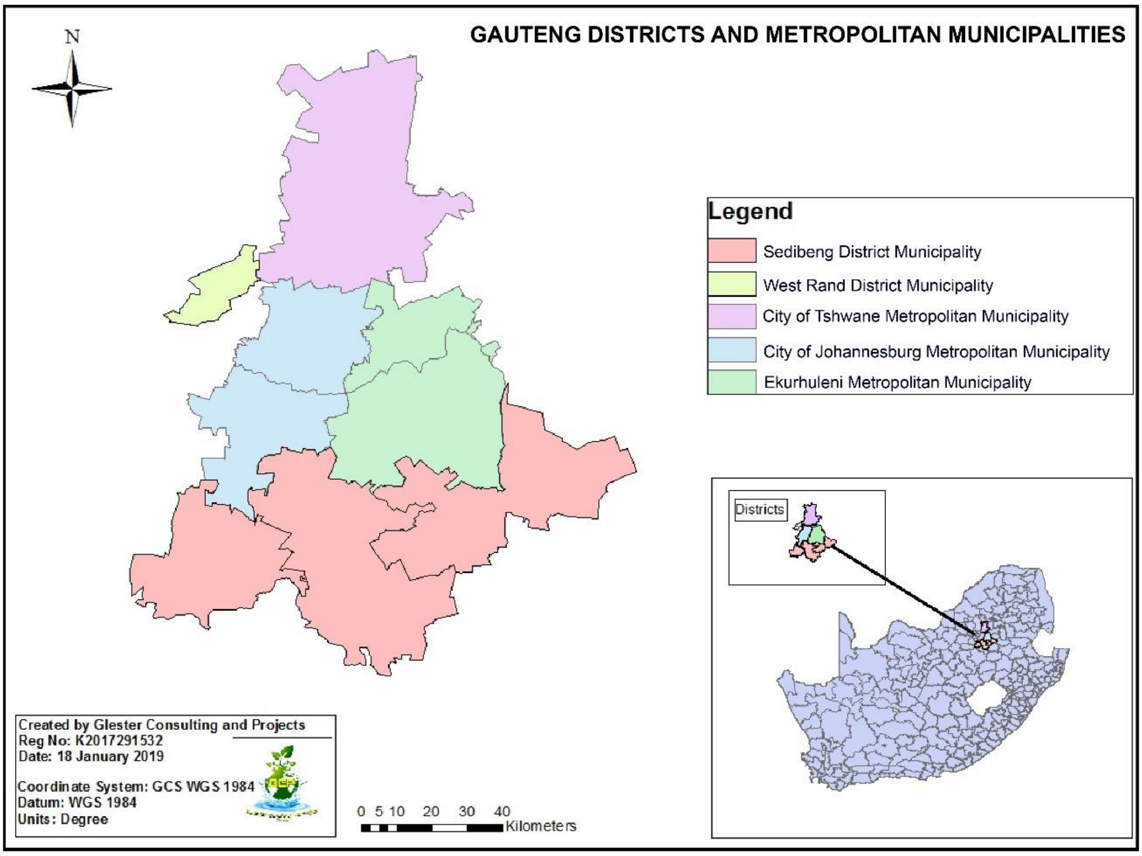

Figure 3.1: Map of Gauteng Province

Source: Glester Consulting and Projects (2019)

3.3 Sampling

This study forms part of a bigger study that was conducted by the NAMC for GDARD. A purposive sampling technique was used where by smallholder farmers linked with GDARD were sampled. A sample of 102 smallholder farmers was conveniently selected in 2017 with the help of GDARD. Only smallholder farmers who were willing to participate in the study were interviewed. Sampled smallholder farmers were involved in grain, vegetable, poultry, piggery and cattle farming in Gauteng Province, South Africa.

3.4 Data collection

The data was collected in 2017, through face-to-face interviews across the Gauteng Province, using a pre-tested, structured questionnaire. The questionnaire included three categories of socio-economic information: demographic characteristics (included gender, age, household size, level of education, and non-farm income), farm characteristics (type of farm enterprise, farm size, farm experience, number of workers and land tenure) and support services (distance to market, access to training, and access to information). Extension Officers from GDARD assisted in translating the questionnaire to local language when administering the questionnaire to respondents.

3.5 Data analysis

3.5.1 Descriptive statistics

Descriptive statistics, by way of means and standard deviation, was used to summarise the data using the Software for Statistics and Data Science (STATA 15) software.

3.5.2 Double-hurdle model

A double-hurdle model, proposed by Cragg (1971), was used to analyse socio-economic factors influencing smallholder farmers' decisions to participate and the extent of participation in the ago-processing industry. This model is a modified count model in which two processes of generating the zeros and the positives are not constrained to be the same (Cameron & Trivedi 2013). The idea underlying the hurdle formulations is that a binomial probability model governs the binary outcome of whether a count variate has a zero or a positive realisation (Mullahy, 1986). A study by Jones (1989) stated the logic of the double-hurdle models was that individuals must pass two separate hurdles before they are observed with a positive level of participation. Concisely, the double-hurdle considers the probability of zero outcomes in the second hurdle even after first-stage hurdle is passed.

According to the double-hurdle model, a farmer faces two hurdles when deciding to participate in agro-processing. The first is to decide whether to participate in agro-processing. The first hurdle of double-hurdle model corresponds to a probit model. The hypothesis of the model is that there is some probability of an incidence (participation in the agro-processing industry) at any given circumstance of socio-economic variables within smallholder farmers in the study area. Participation of smallholder farmers in the agro-processing industry can be described in different ways, but for the purpose of this study, participation means whether farmers sell or do not sell their produce in mainstream agro-processing markets, whether the farmer adds value to the produce by changing its physical form. The dependent variable considered takes the form of a binary variable (this is, either 1 or 0), where 1 denotes that a farmer participates in agro-processing and 0 denotes that a farmer does not participate.

The second hurdle is to decide on the level of participation. In this study, the extent of participation was measured by the percentage of produce processed. Given the nature of market participation level, the farmers are said to be market participant if their proportion of value sold is more than 75% (Goletti, 2005; Ohen et al., 2013). The second hurdle corresponds to the tobit model developed by James Tobin in 1958. This model, also called the censored regression model, assumes that both the participating decision and the level of participation are determined by the same variables, assuming that a variable that increases the probability of participation also increases the level of participation (Matshe & Young, 2004; Greene, 2008; Mathebula, 2015).

The model integrates and simultaneously estimates the probit model to determine the probability of participation and the truncated normal model for level of participation. The model assumes the existence of two latent variables: y^*_{i1} associated with the individual's decision to participate in agro-processing and y^*_{i2} associated with the level of participation in agro-processing.

If we observe the farmers participating in agro-processing industry, there is an indication that it must have been decided on a positive level of participation. This is expressed as:

$y^*_{i1} = w_i'\alpha + v_i$	Farmer decision
$y^*_{i2} = x_i'\beta + \mu_i$	Participation level
$y_i = x_i'\beta + \mu_i$	if $y^*_{i1} > 0$ and $y^*_{i2} > 0$
$= 0$	Otherwise

where y^*_{i1} is a latent variable describing the farmers' decision to participate in agro-processing, y^*_{i2} is a latent variable describing farmers' participation level in agro-processing, w_i' is a vector of factors explaining the participation (Yes/No) decision, x_i' is a vector of variables explaining the participation level decision, and v_i and μ_i are the respective error terms assumed to be independent and distributed as $v_i \sim N(0,1)$ and $\mu_i \sim N(0,\sigma^2)$. Table 3.1 shows the description of the variables used in both the participation decision model and the level of participation model.

Table 3. 1 Definition of variables included in the analysis of both models

Variable	Unit	Description	Expected Sign	
			Participation decision model	**Participation level model**
Dependent variables				
PARTCI	Binary	1- if a farmer participates in agro-processing, 0 - otherwise		
LEVPART	%	Percentage of products processed or sent for processing		
Independent variables (Xi – Xn)				
GEND	Binary	1 - if male, 0 - otherwise	+	+
AGE	Years	Age of the farmer	-	-
AGE^2	Years	Age squared	-	-
HHLS	Number	Number of people in the household	+	-
EDUC	Binary	1- if the farmer has secondary education, 0 - otherwise	+	+
OFFINC	Binary	1- if the farmer receives non-farm activities, 0 - otherwise	+	
CRPF	Binary	1- if the farmer is producing crops, 0 - otherwise	+	+
GRAF	Binary	1- if the farmer is producing grains, 0 - otherwise	+	+
LIVF	Binary	1- if the farmer is producing livestock, 0 - otherwise	+	+
FSIZ	Ha	Total area under production	+	+
FEXP	Years	Farmers' farming experience	+	+
LABO	Number	Total number of permanent workers	+	+
LANT	Binary	1- if farmers' own the land, 0 - otherwise	+	+
DISM	Km	Distance to the agro-processing market	-	-
TRAI	Binary	1- if agro-processing training received, 0 - otherwise	+	+
INFO	Binary	1- if there is access to agro-processing information, 0 - otherwise	+	+

Source: Survey data, (2017)

3.6 Summary

The section discussed econometric models employed in the study, which assisted in determining whether smallholder farmers participate or not in the agro-processing industry. These made it possible to analyse the factors influencing farmers' decisions to participate as well as the level of participation. The two hypotheses proposed in Chapter 1 were tested with the use of the econometric models discussed. The results of the analyses are presented in the next chapter. The next chapter presents the results of the study.

CHAPTER 4: RESULTS AND DISCUSSION[1]

4.1 Introduction

This chapter aims to present the profile of smallholder farmers who are linked to GDARD. This information provides some insight into the characteristics of the smallholder farmers and includes demographic and farming characteristics as well as support services. This chapter also presents the results of the double-hurdle model in determining the socio-economic parameters that influence smallholder farmers to participate, or not, in the agro-processing industries and the extent of participation. For the purpose of this study, farmers were asked if they participated, or not, in agro-processing industry. The latter gives two binary responses, this is, yes or no. Farmers who sold their produce to processors of raw farm commodities were the ones regarded as participants in the agro-processing industry, as well as those who process their produce, and those who responded "no" were those who were not selling their farm produce direct to the processors and were not involved in any form of processing.

The double-hurdle regression analysis revealed seven factors influencing the decision to participate in agro-processing (educational level, farming experience, land tenure, distance to market, information and off-farm income). The model also revealed eight factors determining the level of participation in agro-processing (age, household size, education level, area under production, labour, training, grain and livestock farming). Table 4.5 presents the double-hurdle analysis results, and the significant factors are discussed in this chapter. The information is derived from the descriptive analysis of the data collected as described in Chapter 3. The data used in this study was obtained from sampled smallholder farmers involved in grain, vegetable,

[1] This chapter was presented at the 56th annual conference of the Agricultural Economics Association of South Africa (AEASA) as a poster, held at Lord Charles hotel, Somerset West, 25 - 27 September 2018.

poultry, piggery and cattle farming in Gauteng Province, South Africa. The total sample size was 102 smallholder farmers. Results are presented in tabular form with interpretations.

4.2 Multicollinearity estimates

A check for the possible presence of multicollinearity of the continuous variables in the estimated models was conducted by means of a variance inflation factor (VIF). The results presented in Table 4.1 illustrate the highest value is 1.3, implying that multicollinearity is not a concern in the estimated models. Furthermore, the mean VIF is <5 (1.16), indicating that none of the variables will cause collinearity problems since they are not highly correlated, this is, there will not be bias in the results, therefore all variables under consideration can be included in the model.

Table 4. 1: Variance inflation factor (VIF) for variables in the models

Variable	**VIF**	**1/VIF**
AGE	1,3	0,76775
FEXP	1,3	0,768957
DISM	1,1	0,906573
LABO	1,09	0,913242
FSIZ	1,08	0,930165
HHLS	1,05	0,948505
Mean VIF	**1,16**	

Source: Survey data, (2017)

The strength of correlation between variables used in the model was estimated and the results presented in Table 4.2. The highest correlation coefficient was 0.31 (31%) between Variable TRAI and LIVF. The rest of the variables had weak positive/negative correlation. This is an indication of a very low correlation between variables included in the model, and confirms that none of the variables will cause multicollinearity problems due to the low correlation. Hence, all variables under consideration were included in the model.

Table 4. 2: Correlation between variables used in the models

Variable	**GEND**	**EDUC**	**LANT**	**TRAI**	**INFO**	**OFFINC**	**CRPF**	**GRAF**	**LIVF**
GEND	1								
EDUC	0,141	1							
LANT	-0,028	-0,132	1						
TRAI	0,051	0,209	-0,039	1					
INFO	0,121	0,120	-0,140	0,266	1				
OFFINC	0,011	0,097	0,222	0,133	0,111	1			
CRPF	-0,127	0,023	0,054	-0,186	0,161	0,111	1		
GRAF	0,027	0,125	-0,075	0,167	-0,021	0,029	-0,177	1	
LIVF	0,117	-0,046	-0,076	0,310	0,146	-0,070	-0,2357	0,088	1

Source: Survey data, (2017)

4.3 Characteristics of smallholder farmers in Gauteng Province

Descriptive statistics of the independent variables used in the analysis illustrated that 19% of the respondents participated in agro-processing industry and the extent of the processed produce was approximately 59.37% of the total volume produced.

Table 4.3 shows the descriptive statistics of socio-economic factors of the sampled smallholder farmers. The mean age of the sampled respondents was 52 years. Age is one of the most important determining factors for active participation in farming, as it can provide an indication of whether the farmers are able to adopt new technologies, interact with industries' stakeholders and search for the lucrative markets. Further interrogation was done on elderly farmers, and it was found they were no longer active on the daily activities of the farm. However, they had ownership of land and assets with extensive experience in farming. The study established that many farmers in the surveyed areas were becoming older, which limited their active participation.

The average household size was found to be approximately 6 people per household. A bigger household size has the probability to lead to an increase in household expenditure. Gauteng's average household size was recorded as 4.6 people in 2007 against other provinces with an average 5.6 people, and only 7% of households had only one individual (Landau & Gindrey, 2008). The average total production area was 32.8ha. The production area has a direct impact on the farm income, the larger the area under production the higher the chances of generating more income and reducing production costs.

The results indicated that sampled smallholder farmers had more than 17 years farming experience. Farming experience forms the basis for farmer's ability to make informed decisions regarding production and marketing matters. It gives the farmer confidence to select the best combination of enterprises and farming systems that will generate the most profitable output.

It also assists in making decisions on how to mitigate production-related risks, as well as the reliable markets offering good prices. The sampled respondents were employing at least 1 permanent worker to perform the daily activities of the farm. The minimum number of workers was 0, indicating that some smallholder farmers did not have permanent workers in their farms. This implied these farmers could be using family labour, which is unpaid labour, to minimise production costs.

The overall mean distance to market for the sampled respondents was approximately 23km. Distance to market is associated with transportation costs. High transaction costs are one of the major factors constraining the growth of smallholder agriculture. Distance to the markets is also one factor determining access to input and output markets. Generally, long-distance markets provide low-income margins since farmers have to pay the transportation costs.

Table 4. 3: Comparison of continuous variables between participants and non-participants in agro-processing

Variable	Participants (N=19)		Non-Participants (N=83)		Total (N=102)	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
AGE	48.89	17.486	53.14	13.397	52.35	14.247
AGE^2	2680.37	1733.357	3001.65	1450.349	2941.80	1503.018
HHLS	5.84	3.9195	5.86	2.741	5.85	2.973
FSIZ	73.32	266.752	23.49	89.905	32.77	140.085
FEXP	19.53	13.188	16.86	18.903	17.35	17.950
LABO	2.37	3.715	1.42	1.835	1.60	2.309
DISM	18.05	14.393	25.01	15.908	23.72	15.805

Source: Survey data, (2017)

Table 4.4 shows the descriptive statistics of categorical variables used in the study. The results show that 59.80% of the total sampled respondents were males, indicating that in Gauteng Province men tend to dominate participation. The results clearly show that the agricultural sector is still dominated by male farmers in terms of land ownership and participation in mainstream markets; gender therefore needs to be carefully considered in decision-making. In the South African agricultural sector, the issue of gender inequality is now a minimal concern as female farmers are now engaging in the sector. However, gender studies are important for designing and implementing the relevant training programmes aimed at attracting both male and female participation.

The results showed that most respondents (54.90%) had secondary education. This confirms the results by Antwi and Seahlodi (2011) that in Gauteng, the majority of farmers have grade 12 and tertiary level of education. This is an indication that farmers in Gauteng Province have the ability to interpret market information and application of this information on their business operations, as well as the ability to adopt new technologies.

The majority (88.24%) of farmers received off-farm income, which could imply they were engaged in other off-farm business and were not dependent on agriculture as a source of their income or employment. The remaining 11.76% of farmers indicated their focus was on agriculture, for both employment and income. In terms of the main farming enterprises, 20.59% of the sampled respondents were producing cash crops, 10.78% were producing grains and 17.65% were rearing livestock. Livestock farmers were referred to as cattle farmers only.

This study acknowledged that approximately half (47.06%) of the sampled farmers were farming on their own land. The tenure status affects smallholder farmer’s access to credit. The fact there were few farmers renting or leasing the land confirmed these farmers were practicing towards commercialisation, or agro-processing where applicable. The findings revealed that few (11.76%) farmers had access to agro-processing training facilitated by their local agricultural advisors, who are the common source of training to smallholder farmers amongst other private institutions, such as agricultural commodity organisations. Access to information was also a major concern to the farmers, as only 20.56% had access to information.

Table 4. 4: Categorical variables description of participants and non-participants in agro-processing

Variable	Category	Participants (N=19)	Non-participants (N=83)	Total (N=102)
GEND	Male	73.68	56.63	59.80
	Female	26.32	43.37	40.20
EDUC	No education	5.26	10.84	9.80
	Primary	0.00	18.07	14.71
	Secondary	73.68	50.60	54.90
	Tertiary	21.05	19.28	19.61
	Other	0.00	1.20	0.98
OFFINC	Yes	78.95	90.36	88.24
	No	21.05	9.64	11.76
CRPF	Yes	26.32	19.28	20.59
	No	73.68	80.72	79.41
GRAF	Yes	15.79	9.64	10.78
	No	84.21	90.36	89.22
LIVF	Yes	36.84	13.25	17.65
	No	63.16	86.75	82.35
LANT	Lease	21.05	15.66	16.67
	Own	57.89	44.58	47.06
	PTO	10.53	27.71	24.51
	Other	10.53	12.05	11.76
TRAI	Yes	31.58	7.23	11.76
	No	68.42	92.77	88.24
INFO	Yes	36.84	16.87	20.59
	No	63.16	83.13	79.41

Source: Survey data, (2017)

4.4 Factors affecting smallholder farmers' decision to participate and the extent of participation in agro-processing industry in the Gauteng Province

Table 4.5 shows the maximum likelihood estimates of the double-hurdle model in terms of the decision to participate in agro-processing, as well as the extent of participation. The value of the log-likelihood (-104.340), and the LR Chi^2 (significant at the 1% level) indicate the specifications of the two models provided a good fit to the data. In addition, the explanatory variables used in the models collectively explain smallholders' decision to participate in agro-processing industry, as well as the participation level in the study area. The results show that five factors influenced the participation decision, while seven influenced the extent of participation. Factors that only influenced the participation decision but not the extent of participation were socio-economic characteristics (FEXP, LANT, DISM, INFO and OFFINC). Factors that influenced the extent of participation but not the participation decision were AGE, AGE^2, HHLS, PFSIZ, LABO, TRAI and GRAF. Factors that influenced both the participation decision and the extent of participation were EDUC and LIVF.

The age variable (AGE) only affected the extent of participation in agro-processing, but did not have any influence on the decision of whether or not to participate in agro-processing. The results implied that older respondents were likely to process more volume of produce or send more volume of produce to processors compared to younger ones. AGE^2 revealed a negative association between age and the extent of participation, indicating older farmers were less likely to increase the level of participation in agro-processing. Therefore, the younger age group could be the target group for competitiveness in the agro-processing industry as they could acquire more business techniques. An argument by Alam et al. (2009), in this regard, is that as farmers grow in age, it could discourage them from adopting new increased productive technologies, especially the use of mechanisation, new information collection techniques and physical energy to perform farming activities. Another study by Senyolo et al. (2014) reported that age negatively influence the consumers' potential willingness to pay higher prices for African Leafy Vegetables. This is an indication that older people tend to have more dependents and more subsistence activities which reducing their capital investment.

The household size variable (HHLS) was also found not to have an influence on the decision to participate in agro-processing, yet it did on the extent of participation. This implied that smallholder farmers with more people in the household were more likely to have higher extent of participation compared to those with fewer numbers of people in their households. The results concur with Agrawal and Gupta (2005), who found that household size, bears a strong statistically significant relationship with levels of participation, meaning that smallholder farmers with high numbers of people in their household are most likely to increase their extent of participation in agricultural production and adoption of value added approaches. A study by Chirwa and Matita (2012) examined the determinants influencing the decision to participate in commercialisation initiatives. The results indicated that the degree of market participation of smallholder farmers depends on many factors, including household size.

Table 4. 5: Parameter estimates of the double-hurdle model for agro-processing participation in Gauteng Province, 2017

	Participation				Level of participation			
Variables	**Coef**	**Std. Err.**	**z**	**P>z**	**Coef**	**Std. Err.**	**z**	**P>z**
GEND	0.150	0.437	0.34	0.731	-3.465	8.751	-0.4	0.692
AGE	-0.028	0.021	-1.33	0.184	10.472***	3.506	2.99	0.003
AGE^2					-0.103***	0.033	-3.11	0.002
HHLS	-0.031	0.081	-0.39	0.697	5.774***	1.312	4.4	0.000
EDUC	1.353***	0.518	2.61	0.009	-42.979***	12.093	-3.55	0.000
OFFINC	-2.190**	0.710	-3.09	0.002				
CRPF	0.460	0.586	0.79	0.432	-17.285	13.183	-1.31	0.19
GRAF	0.250	0.663	0.38	0.706	65.425*	36.451	1.79	0.073
LIVF	1.334**	0.591	2.26	0.024	20.642*	10.982	1.88	0.06
FSIZ	0.000	0.002	-0.24	0.807	0.084**	0.034	2.48	0.013
FEXP	0.033*	0.017	1.91	0.056	-0.242	0.491	-0.49	0.622
LABO	0.066	0.091	0.73	0.468	2.622**	1.303	2.01	0.044
LANT	1.386**	0.547	2.54	0.011	-8.367	9.875	-0.85	0.397
DISM	-0.037**	0.017	-2.16	0.031	-1.347	0.903	-1.49	0.136
TRAI	0.982	0.598	1.64	0.1	39.859**	15.860	2.51	0.012
INFO	1.268**	0.581	2.18	0.029	14.104	14.474	0.97	0.33
_cons	-0.133	1.241	-0.11	0.915	-161.126	72.603	-2.22	0.026
sigma					12.819	2.114	6.06	0.000
Number of obs	102							
Wald $chi^2(15)$	18.46							
log likelihood	-104.340							
Prob > chi^2	0.239							

Notes: ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

Source: Survey data, (2017)

The dummy variable, educational level (EDUC), affected the decision to participate in agro-processing positively significant and that of the level of participation negatively significant. This implied that smallholder farmers with at-least secondary education were more likely to participate in agro-processing, however, they were less likely to increase the extent of participation. A study by Antwi and Seahlodi (2011) revealed that in Gauteng Province, the majority of the farmers had grade 12 and tertiary level of education. This is an indication that these farmers could have the ability to access information, especially that originating from the print and electronic media, however extra training and adult education could be more vital to this group. High education level is important, as it has the possibility of leading to the reduction of searching, screening and information costs. Another study by Alam et al. (2009) revealed that highly educated farmers were not only advanced in the adoption processes, but also better off in terms of applying business techniques than their counterparts. Singha et al. (2011) found that education was positively significant to technology adoption of different enterprises under the rice-based farming system. Morris and Doss (1999) found that education has an influence on the adoption of improved technologies on the production of modern maize varieties.

Off-farm income (OFFINC) was statically significant and had a negative influence on the agro-processing participation of smallholder farmers. This means that an increase in non-farm income reduces the probability of a smallholder farmer being a participant in the agro-processing industry. This conforms to the findings of Rios et al. (2008) in that the relationship between off-farm income and agricultural commercialisation is negatively related, since all available time is devoted to off-farm activities and there is less time for agricultural production. These results could be attributed to the fact that the source of off-farm income that the sampled respondents received was social grants and not enough to boost the level of production and capital in order to participate in the highly commercialised market. In a nutshell, social grants are not enough to invest in agro-processing, which concurs with Sinyolo's (2016) findings that access to social grants has a negative relationship with participation in agriculture. Another factor could be that the majority of farmers receiving off-farm income use the income for their own consumption (Beyene, 2008); very few farmers use the off-farm income for investment in farms. Off-farm income will only lead to the growth of an enterprise if it is invested in the technology adoption and enterprise improvement (Alene et al., 2008). The results imply that as much as the majority of the sampled respondents were receiving off-farm income, they were not investing it in the growth of the farms.

The type of enterprise has an impact on the decision whether to participate or not, and the extent of participation in the agro-processing industry. The variable grain producers (GRAF) had no influence on the decision to participate in agro-processing, but it did have an influence on the extent of participation. This implied that grain-producing smallholder farmers were more likely to increase the amount of produce processed or sent for processing. In addition, the variable livestock producers (LIVF) were associated with both the decision to participate and the extent of participation in agro-processing. This means that smallholder farmers rearing livestock were more likely to participate in agro-processing and to increase the amount of produce processed or sent for processing. Montshwe (2006) found that producing only cattle increased the probability of participation in the mainstream cattle markets.

Area under production variable (PFSIZ) did not have an influence on the decision to participate in agro-processing, but did on the extent of participation. This implies that smallholder farmers with more production areas are more likely to increase the extent of participation in agro-processing. These results concur with findings by Gebreselassie and Sharp (2007), who revealed that the area under production has a positive and significant impact on a household's extent of market participation. Singha et al. (2011) also revealed that operational land holding had a significant influence on the extent of adoption of improved rice cultivation practices.

Regarding the farming experience variable (FEXP), the results showed that smallholder farmers with more farming experience were more likely to participate in agro-processing, but did not have an influence on the extent of participation in agro-processing. The results concur with Okoye et al. (2009), who found that a farmer with more farming experience becomes less averse to the risk implied by adopting a new technology. This was also supported by Tarawali et al. (2012) who argued that farming experience has an influence on the adoption of improved technologies.

The total number of workers (LABO) employed on a permanent basis on the farm did not affect the participation decision but affected the extent of participation. This implied that smallholder farmers with more permanent workers were more likely to increase the amount of products to be processed or sent to processing. The results concur with Rao et al. (2012) who revealed positive and significant effects of labour on the value of vegetable output.

The variable land tenure (LANT) had a significant influence on the decision to participate in agro-processing but not the extent of participation. The results indicated that smallholder farmers with title deeds were more likely to participate in agro-processing. Land ownership had an influence on the decision to participate in considered agricultural production (Altman et al., 2009). The lack of private land ownership reduced the possibility of farmers to invest in their farming land, which also reduced the probability of participating in agro-processing. Ghimire et al. (2015) revealed that land type positively influenced the decision to produce improved rice varieties among rural farm households. This implies land ownership has an influence on the decision to apply new technology in agricultural practices.

Distance to market (DISM) was associated with the decreasing probability of the decision to participate in agro-processing only. This implies that a 1 km increase in distance to agro-processing markets will decrease the probability of smallholder farmers' participating in the agro-processing industry. The implication of this negative relationship is that if the distance between farm and the market area is longer, the farmers will be discouraged from the application of agro-processing value addition in their primary production. Baloyi (2010) recorded that long-distance markets offer low profit margins since farmers have to pay the transportation costs. Therefore, much needs to be done with the development of local agro-processing units, not only in Gauteng Province but throughout the country where agricultural activities take place.

Access to agro-processing-related training (TRAI) did not have an influence on the decision to participate in agro-processing but was positively significant on the extent of participation. This implied that access to training, relating to agro-processing, increased the extent of smallholder farmers' participation in agro-processing. Smallholder processors are consequently reliant on extension services, which are usually inadequate both in training and in availability (Rolle & Satin, 2002), although training is one of the most important support issues influencing the ability to adopt technology (Armstrong, 1996).

Access to information was statistically the smallholder farmers' decision to participate in agro-processing, which implied that smallholder farmers with access to agro-processing-related information were more likely to participate in agro-processing. A study by Khapayi and Celliers (2015) revealed that farmers without access to market information were unlikely to participate in the market due to being uninformed about what was happening in the markets. Meena et al. (2009) argued that lack of access to sufficient information about scientific methods limit rural agro-processors in adopting modern post-harvest technologies.

4.5 Summary

This chapter discussed demographic characteristics of smallholder farmers in the study area. The demographic results are the basis for the profile of smallholder farmers in Gauteng Province. Moreover, the discussion of inferential analyses from the double-hurdle model to explore socio-economic factors that would influence smallholder farmers' participation, and the extent of such, in agro-processing in Gauteng Province. The results revealed five factors (FEXP, LANT, DISM, INFO and OFFINC) predicted to influence the participation decision and seven factors (AGE, AGE^2, HHLS, FSIZ, LABO, TRAI and GRAF) predicted to have an influence on the extent of participation. In addition, two variables (EDUC and LIVF) were predicted to have an influence on both the participation decision and the extent of participation. The next chapter presents the summary of the study, conclusions and recommendations.

CHAPTER 5: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The aim of the study was to assess the factors that would influence smallholder farmers to participate in agro-processing industry in Gauteng Province, South Africa. The specific objectives of the study were to identify the socio-economic factors influencing smallholder farmers' participation in agro-processing industry, and to determine socio-economic factors influencing smallholder farmers' extent of participation in agro-processing industry. This chapter provides the study summary, conclusions and recommendations on the main findings. It summarises and briefly discusses the results with respect to the descriptive and inferential statistical analysis, and gives suggestions on future research opportunities.

5.2 Summary

The summary of the study is based on both descriptive and inferential analyses carried out to assess or identify the factors that would assist smallholder farmers to participate in agro-processing industry. A sample of 102 smallholder farmers linked with GDARD was achieved and a double hurdle model was used to analyse the data. The results revealed only 18.6% of the respondents were participating in the agro-processing industry; the majority of farmers were non-participants. The majority of interviewed smallholder farmers were males, with a mean age over 50 years. Many of the farmers had attained secondary level of education compared to their primary and tertiary counterparts, whilst a few had no education. The findings regarding the lack of youth and high educational background could impede participation of smallholder farmers in the agro-processing industry in Gauteng Province, because high-educated and old-aged farmers may not be interested in adding value to their products and applying modern technology in their enterprises since the majority were no longer active in the farm's daily activities and were heading towards retirement.

The finding regarding off-farm income shows the majority of farmers had off-farm income, the source of which was social grants, which was not enough to invest in agro-processing. Several challenges were identified by smallholder farmers in Gauteng Province; the majority pointed to high transportation costs demonstrated by distance to market, lack of access to agro-processing-related training, lack of access to agro-processing information, as the major impediments to their farming activities.

The inferential statistical analysis, using the double-hurdle model, predicated five socio-economic factors that would influence smallholder farmers to participate in the agro-processing industry, farming experience, land tenure, distance to market, information and off-farm income. The model revealed seven factors which had the probability to influence the extent of participation, age, age^2, household size, area under production, labour, training, and grain farming). The model also revealed two factors, educational level and livestock farming, were predicted to have an influence on both the participation decision and the extent of participation. These factors could be taken into consideration by policy makers as to how they could be addressed within the smallholder sector in order to improve smallholder participation in agro-processing industry.

5.3 Conclusions

This study used a double-hurdle model to determine the socio-economic factors influencing the decision to participate and the extent of participation in agro-processing industry. This study revealed only a small proportion of smallholder farmers participated in the agro-processing industry. Therefore, the study fails to reject the null hypothesis that says there is a low level of participation in the agro-processing industry amongst the smallholder farmers in Gauteng Province. This low participation could have been due to several challenges, such as lack of access to agro-processing-related training and information, and distance to agro-processing market. The model predicated five socio-economic factors that would influence smallholder farmers to participate in agro-processing industry, this is, farming experience, land tenure, distance to market, access to information, and non-farm income. Moreover, it revealed six socio-economic factors affecting the extent of participation, age, household size, area under production, permanent worker, access to training and grain farming. Lastly, it revealed two socio-economic factors affecting both the decision to participate and the extent of participation, educational level and livestock farming). This study has proven than indeed there are socio-economic factors influencing smallholder farmers' decision to participate in agro-processing in Gauteng Province. Therefore, the study rejects the working null hypothesis that says there are no socio-economic factors influencing smallholder farmers' decisions to participate in agro-processing industry in Gauteng Province.

Understanding socio-economic factors that matter in determining participation and level of participation of farmers in agro-processing, enables more informed and better targeted policy responses and tailor-made farm support programmes. Empowering smallholder farmers to participate in agro-processing is still a huge task in South Africa. Smallholder famers need to be equally represented in all decision-making structures, but it will also be important to monitor and evaluate the process of intervention, such as the services and infrastructure provided. This could mean South African smallholder financial policies instruments need to be adjusted to facilitate an effective participation in the agro-processing industry, and participation in high market value chains. The study also identified the need to encourage and create a conducive environment and development of local agro-processing plants as a strategy of lowering costs of transportation and storage for farmers who have to take their farm produce to far distanced manufactures or processors.

Smallholder farmers are limited by lack of access to lucrative markets, technologies and skills, therefore they fail to progress to value-added activities. Other challenges include, amongst others, inadequate infrastructure and limited incentives, which impede their entry to the agro-processing industry. The growth of the agricultural sector can be achieved by promotion of value addition to high valued agricultural commodities. Although processing of produce, value added products address specialised markets, the requirements, such as quality and safety standards, packaging and volumes, hinder smallholder producers from participating in alternative markets. Measures should be taken to ensure smallholder farmers are not excluded from complying with these standards if they are to compete successfully in the agricultural value chain.

It is unfortunate that the majority of farmers in this study had limited knowledge on agro-processing-related information, including norms and standard relating to agro-processing. In this regard, government agents, in particular extension officers, need to be exposed to this knowledge so they can disseminate such knowledge to these farmers. The latter could encompass knowledge on cold chain process, hazard analysis and critical control points (HAACP), South African Good Agricultural Practices (SAGAP) and Local Good Agricultural Practices (Localg.a.p), amongst other agro-processing industry norms and standards.

5.4 Recommendations

In view of the findings of this study, recommendations are made and GDARD should take the lead in the process of implementing the recommendations. However, these recommendations can also be replicated nationally. The following recommendations are made:

- The government and other development partners should develop and facilitate models that will realistically increase access of friendly investment capital to the younger generation, to enable them to start their own small-scale agro-processing businesses. Furthermore, this will make agriculture attractive to the youth and help create self-employment for the jobless majority. It could also benefit the elderly farmers.
- Agricultural extension service providers should intensify awareness training of farmers on the importance of credit financing, while at the same time facilitating the development of farmer-friendly credit packages by micro-financing institutions. The agricultural extension office need not only focus on credit finance, but also on disseminating relevant knowledge regarding agro-processing, in particular, knowledge of norms and standards of which the majority of smallholder farmers are unaware.
- There is a need to encourage, create conducive environments and build-up of local agro-processing plants as a strategy to lower costs of transportation and storage when farmers take their farm produce to distant manufactures or processors. Each province of South Africa should establish an agro-technology development centre to address agro-manufacturing needs of the local farmers as a way of decentralising industrialisation.
- Efforts should be made to target graduates of tertiary institutions with agro-manufacturing or processing knowledge and skills as a way of obtaining intellectual insights into agricultural development, which is otherwise unfairly identified with the less educated.

- Future research on the analysis of all value chain actors in agro-processing would be critical to assist on the development of relevant models which will enhance participation of smallholder farmers within the entire agro-processing value chain.

REFERENCES

Abdullah R.F., Ahamad, R., Ali, S., Chandio, A.A., Ahmad, W., Ilyas, A., & Din, I.U. (2017). Determinants of commercialization and its impact on the welfare of smallholder rice farmers by using Heckman's two-stage approach. *Journal of the Saudi Society of Agricultural Sciences*. Available online at http://dx.doi.org/10.1016/j.jssas.2017.06.001.

Agrawal, A., & Gupta, K. (2005). Decentralization and participation: The governance of common pool resources in Nepal's Terai. *World development,* 33(7), 1101-1114.

Ahmed, S. (2004). Factors and constraints for adopting new agricultural technology in assam with special reference to Nalbari District: An Empirical Study: *Journal of Contemporary Indian Policy*.

Alam, G.M., Hoque, K.E., Khalifa, T. B., Siraj, S.B., & Ghani, M.F.B. A. (2009). The role of agriculture education and training on agriculture economics and national development of Bangladesh. *African Journal of Agricultural Research,* 4(12),1334-1350.

Alene, A.D., Manyong, V.M., Omanya, G., Mignouna, H.D., Bokanga, M., & Odhiambo, G. (2008). Smallholder market participation under transactions costs: Maize supply and fertilizer demand in Kenya. *Food policy,* 33(4), 318-328.

Alexander, C., & Van Mellor, T. (2005). Determinants of corn rootworm resistant corn adoption in Indiana. *AgBioForum-Journal of Agrobiotechnology Management and Economics,* 8(4), 197-204.

Altman, M., Hart, T. G., & Jacobs, P. T. (2009). Household food security status in South Africa. *Agrekon,* 48(4), 345-361.

Antwi, M., & Seahlodi, P. (2011). Marketing constraints facing emerging small-scale pig farmers in Gauteng Province, South Africa. *Journal of Human Ecology,* 36(1), 37-42.

Aphane, M.M. (2011). Small-scale mango farmers, transaction costs and changing agro-food markets: evidence from Vhembe and Mopani districts, Limpopo Province. Masters in economics, University of Western Cape, Cape Town, Republic of South Africa.

Armstrong, G. (1996). One approach to motivating faculty to use multimedia. *The Journal,* 23(10), 69-71.

Astatkie, M. (2005). Analysis of factors influencing adoption of triticale and its impact. The Case Farta Wereda. Masters Dissertation,Alemaya University.

Bachev, H. (2016). A framework for assessing sustainability of farming enterprises. *Journal of Applied Economic Sciences,* 11(39), 24-43.

Baloyi, J.K. (2010). An analysis of constraints facing smallholder farmers in the Agri-business value chain: A case study of farmers in the Limpopo Province. Doctoral dissertation, University of Pretoria.

Benjamin, C., & Guyomard H. (1994). Off-farm work decisions of French agricultural households. In: Caillavet F, Guromard H & Litran R (eds). Agricultural household modelling and family economics. Amsterdam: Elsevier. 65-85.

Betek, C.K.E., & Jumbam, N. D. (2015). Small scale vegetable production: A case study of Port St Johns, Eastern Cape Province, South Africa. *Transactions of the Royal Society of South Africa,* 70(1), 41-45.

Beyene, A.D. (2008). Determinants of off-farm participation decision of farm households in Ethiopia. *Agrekon,* 47(1), 140-161.

Bonabana-Wabbi, J. (2002). Assessing factors affecting adoption of agricultural technologies: The Case of integrated pest management (IPM) in Kumi District, Eastern Uganda. Masters Dissertation, Virginia Polytechnic Institute and State University.

Botlhoko, G.J., & Oladele, O.I. (2013). Factors affecting farmers' participation in agricultural projects in Ngaka Modiri Molema District North West Province, South Africa. *Journal of Human Ecology*, 41(3), 201-206.

Cameron, A.C., & Trivedi, P.K. (2013). Regression analysis of count data (Vol. 53). Cambridge University press.

Chepng'eno, W., Koech, P., Chumo, C., & Sulo, T. (2012). Socioeconomic factors affecting the adoption of improved agricultural technologies among women in Marakwet County Kenya. *Journal of Emerging Trends in Economics and Management Sciences*, 3(4), 312-317.

Chi, T.T.N., & Yamada, R. (2002). Factors affecting farmers' adoption of technologies in farming system: A case study in OMon district, Can Tho province, Mekong Delta. Japan International Research Center for Agricultural Sciences, Tsukuba, Ibaraki 305-8686 Japan.

Chirwa, E.W., & Matita, M. (2012). From subsistence to smallholder commercial farming in Malawi: A case of NASFAM commercialisation initiative. Policy brief/paper.

Cragg, J. (1971). Some statistical models for limited dependent variables with application to the demand for durable goods. *Econometrica,* 39(5), 829–844.

Delgado, C.L. (1999). Sources of growth in smallholder agriculture in Sub-Saharan Africa: the role of vertical integration of smallholders with processors and marketers of high-value items. *Agrekon* (special issue--May): 165-189.

Delgado, C.L., & Siamwalla, A. (1997). Rural economy and farm income diversification in developing countries. Paper presented at a Plenary Session of the XXIII International Conference of Agricultural Economists, August 10-16, Sacramento, CA, USA.

Department of Agriculture Forestry and Fisheries (DAFF), (2016). National Policy Framework on the support and development of small and medium Agro-Processing Enterprises in the Republic of South Africa .2014/30. Arcadia, Pretoria. Republic of South Africa (RSA).

Department of Agriculture, Forestry and Fisheries (DAFF), (2012). Linking smallholder farmers to markets programme. Directorate Marketing, Pretoria, Republic of South Africa.

Diale, N.R. (2011). Socio-economic indicators influencing the adoption of hybrid Sorghum: The Sekhukhune District perspective. South African. *Journal of Agricultural Extension,* 39(1), 75-85.

Diiro, G. (2013). Impact of off-farm income on technology adoption intensity and productivity: Evidence from rural maize farmers in Uganda. International Food Policy Research Institute, Working Paper 11.

Ele, I.E., Omini, G.E., & Adinya, B.I. (2013). Assessing the extent of commercialization of smallholding farming households in cross-river states, Nigeria. *Journal of Agriculture and Veterinary Science* (IOSR-JAVS), 4(2), 49-55.

Gauteng Department of Agriculture and Rural Development, (2015). Concept paper on agro-processing. Agro-processing Unit. Johannesburg, Republic of South Africa.

Gauteng Department of Agriculture and Rural Development, (2015). Gauteng agro-processing strategy: Final draft. Johannesburg, RSA.

Gauteng Department of Agriculture and Rural Development, (2018). Agro-processing policy: final draft. Johannesburg, RSA.

Gebreselassie, S., & Sharp, K. (2007). Commercialisation of smallholder agriculture in selected Tef-growing areas of Ethiopia. *Ethiopian Journal of Economics*, 16(1), 55-86.

Ghimire, R., Huang, W-C., & Shrestha, R.B. (2015). Factors affecting adoption of improved rice varieties among rural farm households in Central Nepal. *Rice Science*, 22(1), 35-43.

Glester Consulting and Projects. (2019). Map design for study area. Sunnyside, Gauteng Province, Republic of South Africa.

Goletti, F. (2005). Agricultural commercialization, value chains and poverty reduction, making markets world better for the poor: Discussion Paper no.7, Hanoi, Asian Development Bank.

Greene, W.H. (2008). The econometric approach to efficiency analysis. *The Measurement of Productive Efficiency and Productivity Growth*, 1(1), 92-250.

Haggblade, S. (Ed.)., (2004). Building on successes in African agriculture. International Food Policy Research Institute, Washington, D.C, USA.

Hailua, G., Manjure, K. & Aymutc, K., (2015). Crop commercialization and smallholder farmers` livelihood in Tigray region, Ethiopia. *Journal of Development and Agricultural Economic*, 7(9), 314-322.

Harcourt, D.A. (2011). The South African food processing industry. Embassy of the Kingdom of the Netherlands, Pretoria, South Africa.

Henson, S., & Cranfield, J. (2009). Building the political case for agro-industries and agri-business in developing countries. Agro-industries for development, pp, 10-46.

Ironkwe, A.G., Ezebuiro, N.C., & Ewuziem, J.E. (2016). Adoption of root and tuber technologies disseminated by the National Root Crops Research Institute in Anambra State. *Journal of Agricultural Extension*, 20(1), 39-52.

Jones, A.M. (1989). A double-hurdle model of cigarette consumption. *Journal of Applied Econometrics*, 4(1), 23-39.

Kamuzora, M. (2013). Strategies for enhancing the growth of small and medium enterprises in the agro processing industry in Tanzania. Doctoral dissertation, The Open University of Tanzania.

Kariyasa, K., & Dewi, A. (2011). Analysis of Factors Affecting Adoption of Integrated Crop Management Farmer Field School (Icm-Ffs) in Swampy Areas. *International Journal of Food and Agricultural Economics*, 1(2), 29-38.

Khapayi, M., & Celliers, P.R. (2015). Issues and constraints for emerging farmers in the Eastern Cape Province, South Africa. *African Journal of Agricultural Research*, 10(41), 3860-3869.

Kincl, M. (2003). Investment incentives as a form of state aid. Prague, Czech Republic: Linde Publishing, Ltd.

Kinyangi, A.A. (2014). Factors influencing the adoption of agricultural technology among smallholder farmers in Kakamega North sub-county, Kenya. Masters dissertation, University of Nairobi.

Knowler, D., & Bradshaw, B. (2007). Farmers' adoption of conservation agriculture: A review and synthesis of recent research. *Food policy*, 32(1), 25-48.

Landau, L., & Gindrey, V. (2008). Migration and population trends in Gauteng Province 1996–2055. Migration Studies Working Paper Series, 42.

Laudat, J.A. (2015). Challenges to the development of agro-processing enterprises in Antigua and Barbuda. Proceedings of the 30th West Indies Agricultural Economics Conference: 53-61.

Lavison, R. (2013). Factors influencing the adoption of organic fertilizers in vegetable production in Accra, Masters Dissertation, University of Ghana.

Louw, A., Jordaan, D., Ndanga, L., & Kirsten, J.F. (2008). Alternative marketing options for small-scale farmers in the wake of changing agri-food supply chains in South Africa, *Agrekon: Agricultural Economics Research, Policy and Practice in Southern Africa*, 47(3): 287-308.

Lowenberg-DeBoer, J. (2000). Comments on site-specific crop management: Adoption patterns and incentives. *Review of Agricultural Economics*, 22(1): 245-247.

Machethe, C.L. (2004). Agriculture and poverty in South Africa: Can agriculture reduce poverty. Apaper presented at the Overcoming Underdevelopment Conference held in Pretoria (Vol. 28, p. 29).

Magugu J.W., Feng S., Huang Q., & Ototo O.G. (2018). Socio-economic factors affecting agro-forestry technology adoption in Nyando, Kenya. *Journal of Water and Land Development*, 39: 83–91.

Makokha, S., Kimani, S., Mwangi, W., Verkuijl, H., & Musembi, F. (2001). Determinants of fertilizer and manure use for maize production in Kiambu District, Kenya. CIMMYT (International Maize and Wheat Improvement Center) Mexico.

Mandiriza-Mukwirimba, G., Kritzinger, Q., & Aveling, T. (2016). A survey of brassica vegetable smallholder farmers in the Gauteng and Limpopo provinces of South Africa. *Journal of Agriculture and Rural Development*, 117(1), 35–44.

Mapiye, C., Chimonyo, M., Muchenje, V., Dzama, K., Marufu, M.C., & Raats, J.G. (2007). Potential for value-addition of Nguni cattle products in the communal areas of South Africa: A review. *African Journal of Agricultural Research,* 2(10), 488-495.

Martey, E., Al-Hassan, R.M., & Kuwornu, J.K., (2012). Commercialization of smallholder agriculture in Ghana: A Tobit regression analysis. *African Journal of Agricultural Research*. 7(14), 2131–2141.

Mathebula, J.H. (2015). Determinants of household participation in agricultural production in Shatale Region of the Bushbuckridge Local Municipality, Mpumalanga Province. Masters Dissertation, University of Limpopo.

Matsane, S.H., & Oyekale, A.S. (2014). Factors affecting marketing of vegetables among small-scale farmers in Mahikeng Local Municipality, North West Province, South Africa. *Mediterranean Journal of Social Sciences,* 5(20), 390-397.

Matshe, I., & Young, T. (2004). Off-farm labour allocation decisions in small-scale rural households in Zimbabwe. *Agricultural Economics,* 30(3), 175-186.

McNeill, M. (2005). Ergonomics in post-harvest agro-processing. *African Newsletter on Occupation Health and Safety,* 15(1), 11-13.

Meena, M. S., Prasad, M., & Singh, R. (2009). Constraints perceived by rural agro-processors in adopting modern post-harvest technologies. *Indian Research Journal of Extension Education*, 9(1), 1-5.

Mhazo, N., Mvumi, B.M., Nyakudya, E., & Nazare, R.M. (2012). The status of the agro processing industry in Zimbabwe, with particular reference to small-and medium-scale enterprises. *African Journal of Agricultural Research,* 7(11), 1607-1622.

Mignouna, B., Manyong, M., Rusike, J., Mutabazi, S., & Senkondo, M. (2011). Determinants of adopting Imazapyr-resistant maize technology and its impact on household income in Western Kenya: AgBioforum. *Journal of Agrobiotechnology Management and Economics,* 14(3), 158-163.

Milkias, D. & Abdulahi A. (2018). Factors influencing intensity of adoption of improved highland maize varieties: The case of Toke Kutaye District, West Shewa Zone, Oromia Regional State, Ethiopia. *Journal of Economics and Sustainable Development*, 9(15), 10-17.

Mlambo. C., Mukarumbwa, P., & Megbowon, E., (2016). To process or not to process: An investigation of the contribution of processed and unprocessed agricultural exports to economic growth in South Africa. Contribution Paper to the 54th AEASA Conference, Muldersdrift, Gauteng.

Mmbengwa, V.M., Groenewald, J.A., & Van Schalkwyk, H.D. (2013). Evaluation of the entrepreneurial success factors of small, micro and medium farming enterprises (SMMEs) in the peri-urban poor communities of George municipality, Western Cape Province, RSA. *African Journal of Business Management,* 7(25), 2459-2474.

Mmbengwa, V.M., Khoza T.M., Rambau K., & Rakuambo J., (2018). Assessment of the participation of smallholder farmers in agro-processing industries of Gauteng Province. *OIDA International Journal of Sustainable Development,* 11(2), 11-18.

Mmbengwa, V.M., Ramukumba, T., Groenewald, J.A., van Schalkwyk, H.D., Gundidza, M.B., & Maiwashe, A.N. (2011). Evaluation of essential capacities required for the performance of farming small, micro and medium enterprise (SMEs) in South Africa. *African Journal of Agricultural Research,* 6(6), 1500-1507.

Mmbengwa, V.M., Ramukumba, T., Groenewald, J.A., van Schalkwyk, H.D., Gundidza, M.B. & Maiwashe, A.N., (2012). Analysis of the socio-economic factors that contribute to land and agrarian reform which initiated and supported small, micro, and medium farming enterprises (SMMES) in South Africa. *African Journal of Business Management,* 6(24),,7158-7169.

Moloi, M.J. (2008). A comparison of socio-economic characteristics that determine the farm income of emerging livestock and horticultural farmers in South Africa. MSc thesis. University of Limpopo: Polokwane.

Montshwe, B. D. (2006). Factors affecting participation in mainstream cattle markets by small-scale cattle farmers in South Africa. Doctoral dissertation, University of the Free State.

Morris, M.L., & Doss, C.R. (1999). How does gender affect the adoption of agricultural innovations? The case of improved maize technology in Ghana. In annual meeting of the American Agricultural Economics Association, Nashville, August (pp. 8-11).

Mudhara, M. (2010). Agrarian transformation in smallholder agriculture in South Africa: A diagnosis of bottlenecks and public policy options. Conference paper presented at Overcoming inadequate and structural poverty in South Africa: Towards inclusive growth and development, 20-22 September 2010, Johannesburg, South Africa.

Mullahy, J. (1986). Specification and testing of some modified count data models. *Journal of Econometrics*, 33(3), 341-365.

Mundy, P., & Sultan, J. (2001). Information revolutions. How information and communication management is changing lives of rural people. Chicago Transit Authority, Wageningen.

Musvoto, C., Nortje, K., De Wet, B., Mahumani, B.K., & Nahman, A. (2015). Imperatives for an agricultural green economy in South Africa. *South African Journal of Science,* 111(1-2), 01-08.

Mwangi, M., & Kariuki, S. (2015). Factors determining adoption of new agricultural technology by smallholder farmers in developing countries. *Journal of Economics and Sustainable Development,* 6(5), 208-218.

Naik, G. (1997). Joint forest management: Factors influencing household participation. *Economic and Political Weekly, 32(48),* 3084-3089.

Ncube, P. (2018). The Southern African poultry value chain: Corporate strategies, investments and agro-industrial policies, *Development Southern Africa,* 35(3), 369-387.

Obi, A., Pote, P., & Chianu, J. (2011). Market access: Components, interactions, and implications in smallholder agriculture in the former homeland area of South Africa. A paper presented at a conference titled "Innovations as Key to the Green Revolution in Africa", pp 1161-1167

Obisesan, A. (2014). Gender differences in technology adoption and welfare impact among Nigerian farming households, MPRA Paper No. 58920.

Ogeto, R. M., Cheruiyot, E., Mshenga, P., & Onyari, C. N. (2013). Sorghum production for food security: A socioeconomic analysis of sorghum production in Nakuru County, Kenya. African Journal of Agricultural Research, 8(47), 6055-6067.

Ohen, S.B., Etuk, E.A., & Onoja, J.A. (2013). Analysis of Market Participation by Rice Farmers in Southern Nigeria, *Journal of Economics and Sustainable Development,* 4(7), 6-11.

Okoye, B.C., Okoye, A.C., Dimelu, M.U., Agbaeze, C.C., Okoroafor, O.N., & Amaefula, A.B. (2009). Adoption scale analysis of improved cocoyam production, processing and storage technologies across gender in Enugu North Agricultural Zone of Enugu State, Nigeria. St Louis, MI: IDEAS.

Omonona, B., Oni, O., & Uwagboe, O. (2005) Adoption of improved Cassava varieties and its impact on Rural Farming Households in Edo State, Nigeria. *Journal of Agriculture and Food Information*, 7(1), 40-45.

Ortmann, G.F. (2005). Promoting the competitiveness of South African agriculture in a dynamic economic and political environment. *Agricultural Economics Research, Policy and Practice in Southern Africa*, 44(3), 286-320.

Ouma, J., Murithi,F., Mwangi, W., Verkuijl, H., Gethi M, & De Groote, H. (2002). Adoption of maize seed and fertilizer technologies in Embu District, Kenya. CIMMYT (International Maize and Wheat Improvement Center), Mexico, D.F.

Peach, Y. (2015). An investigation of the success factors of black commercial farmers in the North West Province.Masters dissertation, North-West University.

Rao, E.J., Brümmer, B., & Qaim, M. (2012). Farmer participation in supermarket channels, production technology, and efficiency: The case of vegetables in Kenya. *American Journal of Agricultural Economics*, 94(4), 891-912.

Rios, A.R., Masters, W.A., & Shively, G.E. (2008). Linkages between market participation and productivity: results from a multi-country farm household sample. In: Paper Presented at the American Agricultural Economics Association Annual Meeting, Orlando, Florida, USA.

Rolle, R., & Satin, M. (2002). Basic requirements for the transfer of fermentation technologies to developing countries. *International Journal of Food Microbiology*, 75(3), 181-187.

Sajeev, M.V., Singha, A.K., & Venkatasubramanian, V. (2012). Training needs of farmers and rural youth: An analysis of Manipur State, India. *Journal of Agricultural Sciences*, 3(2): 103-112.

Salami, A., Kamara, A.B., & Brixiova, Z. (2010). Smallholder agriculture in East Africa: Trends, constraints and opportunities. Tunis: African Development Bank.

Senyolo, G.M., Wale, E., & Ortmann, G.F. (2014). Consumers' willingness-to-pay for underutilised vegetable crops: The case of African leafy vegetables in South Africa. *Journal of Human Ecology*, 47(3), 219-227.

Shabanali F.H. (2006). Relationship between different characteristics of rural women with their participation in mixed farming activities. *Journal of Agricultural Science and Technology,* 8(1), 107-117.

Singha, A.K., Baruah, M.J., Bordoloi, R., Dutta, P., & Saikia, U.S. (2011). Analysis on influencing factors of technology adoption of different land based enterprises of farmers under diversified farming system. *Journal of Agricultural Science*, 4(2): 139-146.

Sinyolo, S. (2016). The impact of social grants on rural households' incentives to farm, market participation and farm entrepreneurship: Evidence from KwaZulu-Natal, South Africa. Doctoral dissertation, University of KwaZulu-Natal.

Smith, L.G. (1983). Alternative mechanisms for public participation in environmental policymaking. *Environments,* 14(3), 21-34.

Statistics South Africa (StatsSA). (2012). Census in brief: Census 2011. Pretoria, South Africa. Report No. 03-01-41.

http://www.statssa.gov.za/census/census_2011/census_products/Census_2011_Census_in_brief.pdf.

Tarawali G, Iyangbe, C., Udensi, U.E., Ilona, P., Osun, T., Okater, C., & Asumugha G.N. (2012). Commercial-scale adoption of improved cassava varieties: A baseline study to highlight constraints of large-scale cassava based agro-processing industries in Southern Nigeria. *Journal of Food, Agriculture & Environment*, 10 (3&4), 689-694.

Tesfaye, Z., Girma, T., Tanner, D., Verkuijl, H., Aklilu, I. & Mwangi, W. (2001). Adoption of improved bread wheat varieties and inorganic fertilizer by small-scale farmers in Yelma Dansa and Farta Districts of Northern Ethiopia: Ethiopian Agricultural Research Organization (EARO) and International Maize and Wheat Improvement Centre (CIMMYT): Mexico, D. F, pp. 5-12.

Thindisa, L.M.V. (2014). Participation by smallholder farming entrepreneurs in agro-processing activities in South Africa. Masters dissertation, University of the Witwatersrand.

Tologbonse, E. B., Jibrin, M. M., Auta, S. J., & Damisa, M. A. (2013). Factors influencing women’s participation in women in agriculture (WIA) Programme of Kaduna State Agricultural Development Project Nigeria. *International Journal of Agricultural Economics and Extension*, 1(7): 47-54.

Uaiene, R., Arndt, C., & Masters, W. (2009) Determinants of agricultural technology adoption in Mozambique. Discussion papers No. 67E.

Vermeulen, H., Kirsten, J., & Sartorius, K. (2008). Contracting arrangements in agri-business procurement practices in South Africa. *Agrekon*, 47(2): 198-221.

Wilkinson, J., & Rocha, R. (2008). The agro-processing sector: Empirical overview, recent trends and development impacts. Plenary paper, Global Agro-Industries Forum, Indian Government.