THE IMPACT OF OUTSOURCED EXTENSION SERVICES ON THE PERFORMANCE OF SMALLHOLDER FARMERS IN MSINGA, KWAZULU-NATAL, SOUTH AFRICA.

By: Zipo-zihle Pilela Majokweni

Submitted in fulfilment of the academic requirements of the degree
Master of Science in Agricultural Economics

School of Agricultural Earth and Environmental Sciences
College of Agriculture, Engineering and Science
University of KwaZulu-Natal
Pietermaritzburg

Supervisor: Dr Lloyd Baiyegunhi
Co-supervisor: Dr Stuart Ferrer

APRIL 2018

DEDICATION

To my late grandparents. 2016 took you away. I miss you every day.

DECLARATION

I, Zipo-zihle Pilela Majokweni, declare that:

(i) The research reported in this thesis is my original research work;

(ii) this thesis has never been submitted for any degree or examination at any other university or institution of higher learning;

(iii). This thesis does not contain other authors' data, pictures, tables, graphs or other information, unless specifically acknowledged as being sourced from those authors. Where other written sources were quoted:

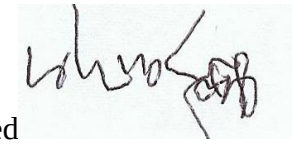
a. they were rephrased and duly referenced;
b. general information attributed to them were duly referenced; and
c. phrases quoted verbatim were placed in quotation marks and duly referenced;

(iv). This thesis does not contain text, graphics or tables copied from the Internet without having been specifically acknowledged and the source details mentioned in the reference section.

Name  Date 09/03/2018

Zipo-zihle Pilela Majokweni
(MSc Candidate)

As the candidate's main supervisor, I, Dr LJS Baiyegunhi, agree to the submission of this thesis;

Signed  Date 13/03/2018

As a candidate's co-supervisor, I, Dr SRD Ferrer, agree to the submission of this thesis;

Signed  Date 14/03/2018

ABSTRACT

Smallholder farmers are considered the potential drivers of growth and poverty eradication in Africa. Agricultural extension services play a vital role in linking farmers to information, adoption of new technologies, access to markets and so on. In recent years, there has been a shift from purely public extension to a more pluralistic approach, with the private sector providing extension services in specific project areas. The aim of this study was to assess the impact of outsourced extension services on the performance of smallholder farmers in Msinga, KwaZulu-Natal. The study also sought to estimate the indirect impact of outsourced extension services by investigating the presence of positive externalities among the sampled farmers.

A random sampling technique was used to sample 300 smallholder farmers in the study area. Descriptive statistics were used to compare the differences between farmers who are beneficiaries of Lima Rural Development Foundation extension services and those who are non-beneficiaries. Factors such as years of farming experience, years of formal schooling, the amount of labour available to a household, livestock value, ownership of an irrigation tool and access to credit influenced participation in Lima extension services. The Propensity Score Matching (PSM) method was employed to estimate the impact of the outsourced extension services provided by Lima Rural Development Foundation on the farmers' performance, measured by farm income per smallholder farmer. Various estimators, namely the Kernel, nearest neighbour and stratification, were used to ensure the robustness of the obtained results. Also, a Rosenbaum bounds sensitivity analysis test (rbounds) was done to test the data's level of sensitivity to unobserved heterogeneity.

The results of the econometric model indicated that outsourced extension services have a positive impact on smallholder farmers' performance. Private extension services have a positive and significant impact on household crop income, net crop income and the inputs and services purchased. When compared to farmers who were not beneficiaries of Lima extension services, Lima beneficiaries received R3000 and R2600 more for total crop and net crop income per year respectively. Further analysis showed an evidence of positive externalities of outsourced extensions, due to farmer-to-farmer interactions and contact. Farmers who had received help or advice from a Lima beneficiary appeared to have an income that was an average R2 400 higher than the income of non-Lima beneficiaries. The results suggest that private extension services play

a crucial role in improving the performance of smallholder farmers, and highlight the need for improved access to inputs and markets. The study recommends that the involvement of the private sector in smallholder support programmes is encouraged and sustained. Furthermore, the formation of structures such as co-operatives that encourage farmer interactions should be promoted and should be farmer led and farmer driven.

Key words: smallholder farmer, farm income, impact, Propensity Score Matching, outsourced agricultural extension.

LIST OF ACRONYMS

ACB	Agricultural Credit Board
ADP	Agricultural Development Programme
APP	Abalimi Phambili Programme
ATT	Average Treatment Effect
DAFF	Department of Agriculture, Forestry and Fisheries
FAO	Food and Agriculture Organisation
FFS	Farmer Field Schools
HLPE	High Level Panel of Experts
NAADS	National Agricultural Advisory Services
NDA	National Department of Agriculture
NGO	Non-governmental organization
OLS	Ordinary Least Squares
PSM	Propensity Score Matching
Rbounds	Rosenbaum bounds
SA	South Africa

ACKNOWLEDGEMENT

I would like to thank God for making all this possible; everything is made perfect in His time. Thank you to the University of KwaZulu-Natal for granting me the opportunity to do this degree. I would like to extend my deepest gratitude to my supervisors, Dr Lloyd Baiyegunhi and Dr Stuart Ferrer, for their guidance and support throughout the time of completing this study.

Special thanks to the National Research Foundation (NRF) and Mandela Rhodes Foundation (MRF) for their financial support. These acknowledgements would not be complete without mentioning the director of Lima Rural Development Foundation, Mr Duncan Stewart, for his support in funding my fieldwork, and the Lima staff, who were always ready to offer assistance when needed. I would like to express my gratitude to Mr Kwazi Mbhele, who was my great support and often went above and beyond the call of duty during survey work.

I would like to thank my friends and colleagues Hassan, Lerato, Unity and Skhu, and the rest of my colleagues in Room 336, Rabie Saunders, for their support; your guidance and assistance is appreciated more than you realise. Last but never least, I would like to express my utmost gratitude to my family; your unwavering love and support carried me through a bittersweet period in my life.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1
INTRODUCTION

1.1 Background of the study

Agricultural development is at the core of achieving and sustaining development in less developed countries (Birkhaeuser *et al.* 1999). In rural development literature, agriculture is considered the most effective way to reduce rural poverty (Umali-Deininger & Schwartz, 1994; Machethe 2004; Ringler *et al.* 2014). In most developing countries, agriculture and agriculture-related activities provide most of the employment in rural areas (Machethe *et al.* 2004). According to Machethe *et al.* (2004), farming is one of the most vital sources of income in poor rural households, contributing an estimated 20 percent of total household income. Collier and Dercon (2014) argued that to contribute positively to poverty eradication through farming practices is not often recognised. The definition of the smallholder farmer varies per context, country, and ecological zone (Department of Agriculture, Forestry and Fisheries 2012). In South Africa, smallholder farmers are perceived as non-productive, non-commercial, subsistence farmers who are located in the former homeland areas (Kirsten & Van Zyl 1998).

According to Davis *et al*. (2014), agricultural extension services play a role in providing opportunities to help strengthen the resilience of small-scale farmers by increasing their level of access to tangible and intangible resources, such as inputs and knowledge; extension services are critical to the promotion of agricultural and rural development. The availability of competent extension service support is critical to the success of farming enterprises (Mnkeni *et al.* 2010). Agricultural extension services play a vital role in assisting in the development of agriculture in developing countries. The major role of extension is to provide advisory services, quality inputs and essential tools that aid in increasing productivity for farmers (Zhou & Babu 2015).

In an attempt to reduce poverty in urban and rural communities in South Africa, Lima Rural Development Foundation (hereafter referred to as Lima) has been providing rural development services to both rural and urban communities for the past 28 years. Lima is a non-governmental and non-profit organisation that aims to establish appropriate institutions and projects to empower

rural people; much of Lima's focus is directed toward transforming the agricultural sector, and thus it has implemented farmer support services. Lima has two programmes serving smallholder farmers in the area, namely, the Abalimi Phambili Programme (APP) and the Tugela Ferry Irrigation Scheme.

In 2003, the Abalimi Phambili Programme (APP) was initiated by Lima to provide integrated farmer support services to smallholder farmers in South Africa's rural areas. It links farmers to developed markets, with the aim of improving productivity and reducing business transaction costs. The implementation of APP arose from the need to assist smallholder farmers, as they have been historically underserviced and face competition from commercial farmers in markets. Furthermore, smallholder farmers face isolation from the vital business services needed for the development of successful farming enterprises. Farming activities undertaken by the Abalimi Phambili Programme include dry land cropping, intensive irrigated vegetable farming and broiler production. Recently, limited small livestock activities were also introduced. Msinga in northern Kwazulu-Natal is one of the rural areas where the APP is implemented. The APP in Msinga has four core focuses; project identification, linking farmers with input suppliers and market opportunities, linking farmers with credit providers and providing extension support. The first phase of the project in the area came to an end in September 2016, and the second phase is currently underway.

For the purposes of this study, extension services are considered as a bundle of services, as opposed to discrete components such as information, material input, access to credit, etc. Much research has been conducted on extension services and the study builds on work done previously by Jonas (2014), who conducted an economic assessment of outsourced agricultural extension services rendered by Lima in uMzimkhulu, KwaZulu-Natal. The impact of extension services may very well have been understated by Jonas (2014), as in her study the spill-over effects of Lima's services to farmers who are not direct Lima beneficiaries were not considered. The key point of this study is to assess the impact of these services, but on a broader scale, by also investigating positive externalities that may result from farmer-to-farmer contact in Msinga. The previous study by Jonas (2014) was done in uMzimkhulu in KwaZulu-Natal on dry land farmers. While acknowledging that study, this study will focus on a different area; Msinga, in KwaZulu-Natal.

1.2 Problem statement

In about two-thirds of developing countries there are three billion rural people who live in households that participate in smallholder farming. Many of these farmers are poor, food insecure and malnourished, with limited access to inputs and markets (Aliber & Hall 2012). According to Mudhara (2010), the majority of farming households are characterised by unemployment, high levels of poverty, low levels of employment and poor remuneration. There are approximately four million people practising agriculture at some level in South Africa, whether commercial or small-scale farming; however only a small percentage of these receive any type of support (Aliber & Hall 2012).

The past years of economic reform in South Africa established the need to improve the access of resource-poor farmers to land, water and institutional support systems as a means of alleviating rural poverty (Magingxa & Kamara 2003). However, because of the policies of the apartheid system, the agricultural sector is dominated by large commercial farms that are owned by a relatively small number of individuals. The apartheid government restricted smallholder farmers to homelands, and they did not have access to cooperative services like inputs and marketing (Magingxa & Kamara 2003; Ortmann & King, 2007), which the established commercial farmers enjoyed.

Shange (2014) noted that amongst many others, some of the notable challenges that South African smallholder farmers face are inappropriate land management practices. Ortmann and King (2010) also cited limited access to factors of production, credit and information. Smallholder are faced with high transaction costs in input and product markets. According to Marinova *et al.* (2008), lack of economic incentive is one of the major barriers to the adoption of improved technology by smallholder farmers. They are also politically marginalised, as sometimes the support for agricultural activities is urban based; this makes it extremely difficult for farmers to access the essential resources vital for production.

High transaction costs are one of the major challenges inhibiting the growth of smallholder agriculture, which stems from poor infrastructure. Inadequate infrastructure in rural areas, especially in South Africa's former homelands, is a major challenge to smallholder farmers' agricultural growth (Machethe 2004). In addition to infrastructural challenges, smallholder farmers

in developing countries encounter several challenges with market access. This includes their ability to get the necessary farm inputs and services, and their ability to deliver produce to consumers (Tilburg *et al.* 2012).

1.3 Objectives

This study seeks to assess the impact of outsourced extension services on the performance of smallholder farmers in Msinga, KwaZulu-Natal Province, South Africa. The specific objectives are to:

i. determine the socioeconomic factors influencing the participation of smallholder farmers in outsourced extension services offered by Lima Rural Development Foundation;
ii. assess the impact of outsourced extension services on the smallholder farmers' performance (measured as farm income);
iii. estimate the extent, if any, of positive externalities that arise from Lima Rural Development Foundation's extension services through farmer interactions;
iv. estimate the costs and benefits of Lima Rural Development Foundation's extension service in Msinga.

1.4 Motivation for the study

Government and non-government organisations (NGOs) establish programmes and projects to support households with the types of goods and services that are unaffordable to them. It has been acknowledged that increasing agricultural growth in many African economies is a key strategy to reduce poverty and hunger (Dercon *et al.* 2008). The agricultural sector is important for developing rural areas and contributes significantly to the alleviation of poverty. Strong extension services, led by government's operations with the relevant role-players in partnership, are thus needed (NDA 2005).

The goals of agricultural extension are inclusive of transferring information from the global knowledge base, including local researchers, to farmers, which assists them in making decisions aimed at increasing agricultural productivity (Anderson & Feder 2004). Farmers are more exposed to risk and uncertainty when they lack information about weather, inputs, management practices, the market and so on. Therefore, a farmer who receives quality information that is up-to-date, and

can use it, may be able to reduce risks (Davis *et al.* 2014). Extension services facilitate the adoption of technologies that are much improved through the creation of awareness, the dissemination of information, and training, all of which contribute to increased agricultural productivity (Elias *et al.* 2013).

Marinova *et al.* (2006) say that removing barriers such as low education levels, poor infrastructure, limited access to extension services and credit could contribute to better technological choices. Removing such barriers could also improve the diversification of farming activities in households and increase farmers' income. Machethe (2004) further highlights that improved provision of farmer support services is a prerequisite for attaining growth in smallholder farming.

Although considerable research has been conducted to assess the impact of outsourced extension (Jonas 2014; Sikwela & Mushunje 2013; Uddin 2013; Kidd *et al.* 2000), there is limited literature on the wider benefits of extension services in respect of their indirect benefits. In a review of the economic impact of agricultural extension, Feder and Slade (1991) highlighted that in order to understand the true value of extension, the various distortions and dynamics of development need to be considered. They further argued that the impact of extension services is contingent upon raising the knowledge levels of farmers to the levels advanced by research. Therefore, this study sought to go beyond assessing the benefits of extension services to Lima-beneficiary farmers; the indirect impact of extension services upon non-Lima beneficiaries was of interest and also investigated. There is currently limited attention directed to the non-tangible positive externalities of extension services in South Africa that arise from farmer-to-farmer contact. The study sought to fill that gap. Previous studies have focused on the direct beneficiaries of these services and due to this, the impact of extension services may possibly have been understated. Much of the literature that mentions positive externalities treat is as a potential bias, rather than part of the impact of extension services.

Several studies (Waddington *et al.* 2009; Anderson & Feder 2004; Machila *et al.* 2015) have focused on assessing the impact of extension services on agricultural productivity and found a positive impact. Birkhaeuser *et al*. (1991) found a significant relationship between knowledge diffusion, the adoption of improved technologies and productivity. Machila *et al.* (2015), using Propensity Score Matching, measured the impact of outsourced agricultural extension and found

evidence that supported the prevailing view, i.e., that agricultural extension services contribute positively to increased levels of farmer income and the creation of employment opportunities in rural areas.

1.5 Outline of the study

Chapter 1 of this study comprises the introduction, background, the research problem, motivation and objectives of the study. Chapter 2 provides a literature review of the context of smallholder farmers in Africa and the role of extension services with reference to positive externalities in agricultural extension. Chapter 3 describes the study area and the methodology for obtaining and analysing the data. Chapter 4 provides the results of the survey work and a summary of the socioeconomic characteristics of the households in the sample. Chapter 5 is a summary of the empirical results. Chapter 6 provides a summary, conclusion and recommendations, based on the empirical results.

1.6 Summary

This chapter included a description of smallholder farmers and a summary of some of the challenges they face, such as limited access to information and resources, infrastructure and support services. The potential contributions that smallholder farmers could make to the economy, such as poverty alleviation, were highlighted. The chapter highlighted the importance of extension services and the role these services play in assisting smallholder farmers in their growth and development, and described how the impact of extension services may possibly be currently insufficiently understood.

CHAPTER 2
LITERATURE REVIEW

The purpose of this chapter is to review the literature that has been covered on outsourced agricultural extension services. The chapter begins by defining the 'smallholder farmer' in South Africa and then gives an overview of the constraints upon smallholder farmers' agricultural productivity. The chapter includes a description of extension services and their role in development in South Africa. Furthermore, it explores the case of positive externalities as part of agricultural extension services.

2.1 Smallholder farmer definition in the South African context

The World Bank Development Report (2008) defined smallholder farming as small-scale farming operated by a household in which hired labour is limited. Nepal and Thapa (2009) described smallholder farming as farming done on less than two hectares (2ha) of land. It is dependent on household members for labour, in which the primary goal of production is the household's own consumption. Louw *et al.* (2013) highlighted that the smallholder sector is characterised by small farm sizes, intensive labour, the use of traditional production techniques, often with no institutional support. Kirsten and Van Zyl (1998), however, rejected the idea of basing the definition of smallholder farming on land size, and maintained that other attributes, such enterprise type, should be considered. Kirsten and Van Zyl (1998) argued that the land-size definition excludes farms that are not the 'viable size'. The majority of smallholder farming households in South Africa (SA) are headed by females, with approximately five people per household (Pienaar & Traub 2015). The main source of income for most of these farming households is social grants, in particular pensions and child welfare grants (Vink & van Rooyen 2009).

Statistics South Africa (Stats SA) estimated that the smallholder sector consisted of 2.5 million black households in almost all former homelands in the year 2007 (Aliber & Hall 2012). The small-scale farming household relies on various livelihood strategies, and farming production makes a small but considerable contribution to their welfare, (Vink & van Rooyen 2009). Aliber *et al.* (2009) further argued that even though there is a lack of distinct information on the classification of 'smallholder', 'subsistence' and 'emerging' farmers, the common clear theme is that the

households ensure their food security through agricultural production and that it is a crucial component of rural livelihood strategies. Where possible, most smallholder farmers diversify income and sources of livelihood in order to manage risk and poverty. Some income might come from agricultural production, while other sources might include renting animals for traction, the sale of labour and off-farm, full-time and part-time employment in rural towns or commercial farms (Aliber & Hall 2009).

The National Department of Agriculture (NDA 2005) described the major characteristics of smallholder farmer production systems in SA as simple, outdated technologies, low returns and high seasonal labour fluctuations. Due to constrained production resources, smallholder farmers often face high transaction costs trying to access inputs, machinery, technical expertise and so on. Their low levels of development are also associated with a lack of appropriate technologies and a lack of technology adoption. The challenges faced by smallholder farmers do, however, vary, depending on geographical location, age, education, farm size, type of crop, etc.

2.2 Challenges to agricultural extension development

According to Belay and Abebaw (2004), the lack of competent extension officers in some developing countries presents a problem for agricultural extension services. The effectiveness of extension lies in the transferral of competencies such as skills, knowledge, attitude and behaviours. An analysis by Swanson and Samy (2002) showed that officers in some developing countries have low levels of formal education and training. Even though in-service training is provided, it does not compensate for poor training received before an extension officer joins the extension services, because in many countries training is irregular, too theoretical and inadequately coordinated. For extension services to be effective, they require extension officers who are qualified, motivated, committed and responsive to the rapidly changing social, economic and political environment in which agriculture exists (Belay & Abebaw 2004).

Mangheni *et al.* (2003) argued that there is a dearth of extension services in developing countries that have platforms for them. Those that have extension services often do not have enough services on their platforms. The lack of sufficient services often results in extension officers operating ‘in silos’, unconnected to one another. In addition, accountability is often skewed, with extension officers feeling accountable to their supervisors rather than to the farmers. Even this accountability

is a challenge, because supervisors cannot easily monitor and evaluate their performances, and thus extension officers end up being accountable to no-one.

Feder *et al.* (1999) argued that the dependence of extension services on other policies is another challenge in developing countries. Citing Van den Ban (1986), they state that agricultural extension is often combined with other policy instruments to achieve agricultural development. Institutional frameworks may not give sufficient attention to the rural sector, and thus underinvest in technology development and fail to maintain existing infrastructure or invest in new infrastructure. Consequently, the lack of resources and ineffective agricultural services hinder the impact and development of extension services.

The inadequate funding translates to further cuts in the operational budgets of extension services, which prevents effective operations from reaching farmers for optimum impact. This in turn results in a lack of appropriate technologies being used that might assist in improving productivity. This lack of appropriate and up-to-date technology is a challenge to extension services, and is a result of the generally resource-poor environments in which these services are offered (Gebremedhin *et al.* 2006). These challenges to agricultural extension development eventually limit smallholder farmer development by being a challenge to various welfare indicators. For the purposes of this study, markets, access to credit, technology adoption and food security will be focused on as some of the main challenges facing smallholder farmers.

2.2.1 Markets

Smallholders in developing countries tend to sell their products at local markets because of their proximity and the fact that they are immediately paid for the produce delivered. Increasingly, they also perceive opportunities in both national and international markets and supply chains to sell their surpluses. Market access is a means for ensuring that smallholder producers of agricultural products are effectively integrated into the mainstream of national economies, especially in developing countries (Obi *et al.* 2012). Market access includes the ability to obtain necessary farm inputs and farm services, and the ability to deliver farm products to consumers (Tilburg *et al.* 2012).

Smallholder farmers in developing countries encounter several challenges regarding market access; these include the availability and accessibility of resources and competencies which are required to deliver the products that consumers demand (Ingenbleek & Van Tilburg 2009; Van Tilburg *et al.* 2012). Another challenge is the level of organisation required for smallholder farmers to meet the quantities and qualities that their supply chain partners and the consumer market demand. Additional constraints include the limited access smallholders have to market information and to necessary services such as working capital to manage their operations properly (Van Tilburg *et al.* 2012).

Factors such as poor infrastructure (e.g. poor road conditions, water systems, schools and electricity), lack of market transport, a shortage of market information, insufficient expertise regarding the use of grades and standards, an inability to conclude contractual agreements and poor organisational support have led to inefficient use of markets, which results in commercialisation blockages. Moreover, smallholder farmers lack vertical linkages in the marketing channels, which result in their exclusion from formal markets (Fenwick & Lyne 1999). Lahiff and Cousins (2005) highlighted that markets in South Africa, both upstream and downstream, are monopolised and lack regulation; hence they largely serve the needs of large-scale commercial producers. As a result, relatively few smallholder producers make it to the local or any other market.

Sikwela and Mushunje (2013) argued that smallholder farmers that operate in partnership with other organisations are better off in terms of access to markets. The partnerships come in the form of programmes which give farmers a chance to produce quality that is demanded by the market. Farmers who receive no support have a harder time accessing markets that pay well and instead sell 'at the farm gate'. Smallholder farmers receiving support do not have much trouble marketing their produce because they have the necessary market information and can make rational decisions.

2.2.2 Access to credit

The literature suggests that credit plays a significant role in agricultural efficiency and increasing productivity. It assists productivity by facilitating the purchase of otherwise costly inputs; access to credit has close links to decreased cost efficiencies and increased productivity (Awotide *et al.* 2015a; Ayaz & Hussain 2011). Credit is used by farmers for purchasing agricultural inputs and

even for family emergencies. Access to credit further guarantees that farmers can secure inputs which subsequently lead to increased farm revenues (Sinyolo *et al*. 2014; Hazarika & Alwang 2003). Credit provision is critical for any efforts aimed at integrating smallholder farmers with corporate value chains. The lack of credit is clearly a barrier to entry in capitalist commodity relations. Providing credit to smallholder farmers has been increasingly regarded as a vital tool of raising the income of rural communities (Greenberg 2013).

Wynne and Lyne (2003) argued that one of the major factors that hinder the farming operations of smallholder farmers in South Africa is a lack of access to credit. The inadequate access to credit had negative results for various aggregate and household level outcomes, such as technology, agricultural productivity, health, food security, nutrition and the general welfare of households. According to Hazarika and Alwang (2003), a farmer's level of technical and allocative efficiency may be increased by their access to credit. The farmer could be able to adopt more capital-intensive methods production methods through purchasing more machines that are a more improved technology. Farmers with more credit access may also be more open to adopting more profitable but riskier technologies or high value crops due to increased risk bearing ability.

According to Machethe (2004), establishing parastatal institutions with the intention of credit channelling to smallholder farmers is an approach that governments use in developing countries for the promotion of smallholder agricultural development. The Land Bank and the now non-operational Agricultural Credit Board (ACB) were created in order to address needs of farmers regarding credit. Aliber and Hall (2012) highlighted that the Micro Agricultural Financial Institutional Scheme of South Africa, which was adopted in 2008, was to be used as a financing model that the government would use to channel funds through the Land Bank and other intermediary institutions to provide credit to farmers. Records have since shown that from April 2009 to November 2009, the institution released R27 million to an estimated 600 farmers. While the Land Bank was able to give loans to some farmers, credit access is still a challenge for a majority of smallholder farmers. Horezeanu and Mallory (2015) argued that collateral requirements might be of assistance for lenders in differentiating between good and bad borrowers, but this places the smallholder farmer at a disadvantage in several ways. Firstly, they are often unable to secure collateral as a loan requirement because they cannot afford it and they are often faced with disputed land titles which are an unfavourable factor in loan applications. Furthermore,

Huppi and Feder (1990) highlighted that funds from the government and other financial institutions have been skewed towards commercial farmers due to the perception that they are a lower risk compared to smallholder farmers because commercial farmers can offer more collateral.

2.2.3 Technology adoption

From as early as the 1940s, rapid technological changes have been taking place in agriculture; these advances have played a role in boosting agricultural production, and have shown how crucial rapid and efficient transfer of knowledge is to the farmer (Feder *et al.* 1991). Rising agricultural productivity has been attributed to agricultural transformation. The process of agricultural transformation inherently requires that new technologies are adopted and continuous adaptations are made to institutions. Thus, a vital way to increase agricultural productivity is to introduce improved agricultural technologies for smallholder farmers (Zhou & Babu 2015).

Even though there have been advances in technology, agricultural productivity remains low for many smallholder farmers in Africa (Adejobi & Kassali 2013). This can be attributed to the low adoption of appropriate technologies due to their expense and to the levels of skills required. If a technology requires complex manipulation, such as the ability to read and write or daily change routines, the adoption by some farmers may be slow, regardless of the benefits (Mpepereki 2010). In addition, Mpepereki (2010) argued that smallholder farmers do not adopt technologies because there is poor targeting, poor matching of technology to the needs of beneficiaries and the level of socioeconomic development of the farmers is low.

The majority of farmers in homelands are female, as males leave the rural areas to find jobs in urban areas in an attempt to provide for their households (Bekker 2006). Quisumbing et al. (2010) highlighted that women in sub-Saharan Africa tend to be more disadvantaged, lack access to resources and have lower education levels than their male counterparts. This is one of the factors contributing to poor technological adoption. Unfortunately, increased agricultural productivity for smallholder farmers is limited because the research/extension service/farmer linkages are not adequate. Research is often not demand driven and farmers continue to use outdated technologies that are not as effective for optimum production and efficiency (Oladele & Wakatsuki 2005).

2.2.4 Food security

Altman *et al.* (2009) supported the notion that South Africa seems to be food secure at the national level but the same cannot be said about households in rural areas. The rural poor can advance their living standards by establishing food security. One of the avenues to achieving this is smallholder agriculture and appropriate agricultural extension to foster smallholder farming (Abdu-Raheem & Worth 2011). The World Food Summit in 1996 defined food security as '…when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life' (Food and Agriculture Organization 2006, p1). Smallholder farmers often live in a state of food insecurity due to insufficient self-provision of food (High Level Panel of Experts 2013). According to Abdu-Raheem and Worth (2011), extension services are one of the vehicles that can be used to combat food insecurity in South Africa. Extension services can enable smallholder farmers to integrate sustainable natural resource management and viable agricultural production with their food production systems.

In South Africa, the majority of smallholder farmers farm in order to procure an extra source of food. When farmers produce, a large amount of the produce is for home consumption and a small portion is for market sales. This is to secure a source of food that is not largely dependent on cash incomes (Baiphethi & Jacobs 2009). Despite smallholder production being vital for household security, smallholder agricultural production tends to be low (Baiphethi & Jacobs 2009). Altman *et al.* (2009) suggest that support is needed to advance levels of smallholder production and ensure long-term food security. To achieve an increase in smallholder productivity, farmers have to be encouraged to pursue sustainable intensification of production by using improved inputs. FAO (2006) noted that if there is no comprehensive farmer support, the role that is played by agriculture in sustaining livelihoods will remain limited and the chances of smallholder farmers escaping poverty will be much reduced.

According to the Department of Agriculture, Forestry and Fisheries (DAFF 2011), the majority of those who live in hunger in the world are smallholder farmers; they argued that food security is closely linked to the livelihood strategies of those farming households. DAFF (2011) also noted that smallholder production enables the diversion of income to other household requirements by contributing directly to a household's food security by being a source of food. HLPE (2013) noted

that even though smallholder farmers have limited access to production inputs and are challenged with regard to food security, smallholder agricultural development is still a good way to reduce poverty, increase food production, raise rural income, improve access to food and consequently improve food security. Because agricultural production constitutes a significant share of smallholder farmer income, increasing agricultural productivity is closely related to increasing food security (Machethe 2009).

2.3. Background to private agricultural extension services

Extension services vary in their roles or objectives. The various services afforded by extension include disseminating knowledge and information to farmers to encourage technology adoption and training. The main aim of extension services is to assist farmers to produce at an optimum level (Uddin & Qijie 2013). Extension services are categorised into public extension and private extension, with many developing countries increasingly using both. Although the differences between the two can be indistinct, private extension tends to be more demand driven and focused on input supply and output delivery or marketing. It is run by non-governmental organisations (Schwartz 1994). Simply put, private extension services are those that are carried out by a private individual, company or organisation (Shekara 2001).

Traditionally, the concept of extension services, as described by Schwartz (1994), involves a professional body of agricultural experts who are government employees teaching improved methods of farming, demonstrating innovations and organising farmer meetings on a variety of topics. Sometimes public extension services are used as a way to introduce and enforce agricultural policies. The role of public sector extension in developing countries has changed substantially over the past decades (Swanson & Samy 2002). The changing roles, additional responsibilities and limitations of resources within public extension services have created an opening that is being closed by private extension services. The need for private extension may have stemmed from several reasons, including the various challenges faced by public extension in reaching the majority of farmers. There are also services that public extension services do not traditionally cover that are covered by private extension, such as input supply, market support, processing etc. (Shekara 2001).

According to Swanson and Samy (2002), the decline in government expenditure results in the inability of public extension systems to provide adequate educational and technical support for farmers. Much of this inability can be attributed to difficulties and complications that are increasing in agricultural technology. Apart from providing technology, duties of agricultural extension officers also include disseminating information and skills that are necessary for increasing production in a sustainable manner (Zhou & Babu 2015). However, the lack of qualified specialists in public extension is a challenge in most countries; public extension has been ineffective in its response to smallholder needs for basic and technical education because of insufficient resources (Swanson & Samy 2002).

According to Zhou and Babu (2015) and Feder and Slade (1985), additional reasons of reforming extension in developing countries include the quality and coverage of public extension services. The quality and coverage of the services tends to be limited and needs to be improved in order to achieve the desired impact. The services are, moreover, unable to reach sufficient farmers with their varying needs. Thus, Shekara (2001) pointed out two reasons that are considered the root causes of private extension services:

- Public extension is at times unable to reach all farmers. Aliber and Hall (2010) reported that only about 11% of rural households have contact with an extension officer in a year, leaving a gap that is, over time, being closed by private extension.
- Some services, like market support, processing, input supply, etc. cannot be supplied by public extension and are therefore carried out by private extension.

Reform in agricultural extension in developing countries is attributed to several factors. These include the limited government funding available for technical and advisory services in the sector. Much improvement is needed in both the quality and coverage of agricultural extension services if desired impact is to become a reality. Moreover, improvements in capacity, motivation and competence are crucial (Zhou & Babu 2015).

2.3.1 The shift from public extension services to private extension services

Public extension services are how many farmers get their information. However, Anderson and Feder (2004) argued that public extension is not necessarily very efficient. In areas where farmers are geographically dispersed, reaching all can prove challenging. In addition, high illiteracy rates and limited access to electronic mass media means that face-to-face interaction remains the main way of interaction, which drives up the cost of reaching large numbers of farmers. According to Rivera and Cary (1997), the unit cost of extension staff in the majority of countries is high, and due to financial concerns, countries are making alternative arrangements like the privatisation of extension services and reducing the expenditure of public-sector extension services. Governments have taken various steps to shift from public to private extension, such as shifting the services to private entities while maintaining oversight and basic funding of delivery, or following cost-recovery alternatives to pay for the services (Rivera & Cary 1997).

Extension information can be categorised per its economic character, and characterised as either a public or private good. This classification is based on the economic principles of rivalry and excludability. The traditional view of agricultural extension services as being a 'public good' has been the reason why governments in the past took exclusive responsibility for delivering extension services (Umali-Deininger 1997). However, Marsh and Pannell (2000) noted that more policy makers now view agricultural information to be a 'private good' or to have characteristics of a private good. Since farming is becoming increasingly specialised, farmers increasingly require information for their specific technical, management and marketing needs. In the past, economists used 'public good' characteristics to justify government investment in agricultural extension; however, when information is of value only within a local region or to a single farm, it lacks the characteristics of a public good. Countries are working towards the reduction, recovery or shifting of the costs incurred in providing public extension services, specifically, transferring 'private good' functions to the private sector (Rivera & Cary 1997).

The role assumed by non-governmental organisations (NGOs) in agricultural extension services has grown. Their focus has also been on the areas that are neglected by government, and Umali-Deininger (1997) argued that the success of NGOs in this area may be attributed to their community-based focus. According to Farrington (1995), the opportunities for smallholder farmers to acquire information from sources other than the public sector has increased. Improved

transport networks have enabled the expansion of NGOs and the private sector into remote areas.

Furthermore, there are cutbacks in public extension programmes that arise from fiscal crises and budget reductions in the general economy. Fiscal crises and budget reductions that arise from structural adjustment programmes have compelled governments to reduce the budgets for public extension programmes (Umali-Deininger 1997). Umali-Deininger (1997) also noted that the unsatisfactory performance of public extension services has led to a search for alternative approaches that will improve extension services. Anderson and Feder (2003) suggest that outsourced extension services can reduce the fiscal burden on public extension services in developing countries. The success of agricultural extension services is contingent upon the partnerships and complementary actions of both the public and private sector. Such a partnership and complementarity lowers the burden on government and results in more relevant services to farmers. Because smallholder farmers still view extension service as a public good and cannot pay for the services, the complete withdrawal of public extension services does not fit the current socioeconomic status of developing countries (Uddin & Qijie 2013). Even though public extension is clouded by challenges, the effectiveness of private extension has not been without debate and scrutiny.

2.3.2 Benefits and limitations of private agricultural extension

According to Adejo *et al.* (2012), the shift from public to private extension is backed by the necessity and expectation of more efficiency due to the involvement of private markets. The underlying principle is the narrative of a demand-driven extension service. Private extension is being recognised as a more efficient alternative for serving participants than its public counterpart, as one of the aims of outsourced extension is cost reduction and a focus on cost-effectiveness (Anderson & Feder 2010). However, some authors (Zhou & Babu 2015; Faure *et al*. 2012) highlighted several reasons why outsourced extension services might not be positive for smallholder farmers. Challenges such as geographical disparity and small farm sizes contribute to the unprofitability of private extension services. One of the differences between public and private extension services is that public extension invests in long-term training, while private extension is unlikely to invest in long-term training due to a lack of resources for such programmes. A further difference is that private extension contracts tend to be shorter compared to their public counterparts (Manghenhi *et al.* 2003).

As efficient as private extension is in comparison to public extension, a greater factor to be considered is the fee involved with private extension. Privatisation efforts carry a certain expectation that the user will pay a portion of the cost for the service (Kidd *et al.* 2000). This means that the service is less favourable and disadvantaged farmers will not have as much access to private services as they may desire. Furthermore, the desired outcome of increased agricultural productivity by private extension services may not be realised. The requirement to pay may also carry socially undesirable implications; poor farmers will tend to undervalue the information received from extension services due to their inability to prejudge its value (Anderson & Feder 2003). However, some private sector extension providers in the last decade have provided their services to farmers at no cost (Marsh *et al.* 2009). On a broader level, Anderson and Feder (2003, p2354) argued that "even though public financing for extension is often justifiable, the general trend towards fiscal restraint and a reduced role for the public sector has led to financial crisis in many extension services".

Despite some of the pitfalls highlighted in the literature, Anderson and Van Crowder (2000) list several benefits that are anticipated from outsourced extension services that can potentially attract investors. The benefits are:

- There is more accountability with outsourced extension officers;
- Private extension services are more efficient and cost effective than public extension services;
- Various providers can render their services to deliver a greater variety of extension services.

Private extension services are considered a crucial option to remedy the decrease in public funding as well as address the general administration and organising of public extension services (Adejo *et al.* 2012). Regardless of the cutbacks in services provided by public agencies, public agencies are still considered providers of extension services. The increased involvement of the private sector in extension is beneficial in a number of ways, including that it enables the freeing up of some public-sector resources and enables the public sector to focus on less manageable extension problems (Marsh & Pannell 2013).

2.4. Agricultural extension services in South Africa

The South African agricultural sector has been characterised as having 'two agricultures' or two main categories of farmers; smallholder farmers in the former homelands and large-scale commercial farmers (Kirsten & Van Zyl 1998). The differences between these two groups stem from the instruments that were used by the South African State to support white commercial farmers, and the measures that were used to regulate agricultural production and land use in former homelands. Unsurprisingly, the extension service in South Africa was historically one of the ways that the government of the day expressed the policy of apartheid, with large-scale commercial agriculture comprehensively supported and farmers in the former homelands largely neglected or provided with inferior extension support. The homelands were characterised by inadequate market access, poor infrastructure and poor support services (Van Zyl *et al.* 1996).

Within the country's agricultural sector, a two-track extension system developed, consisting of well-developed extension support for larger-scale commercial farmers together and services for smallholder farmers in rural areas (Hall *et al.* 2003). When the homeland system was abolished, there was a merger between the former homeland departments of agriculture and the newly formed provincial departments of agriculture. Despite the homeland system having been abolished, agricultural extension capacity varies greatly across the country's provinces. Provinces such as Limpopo and the Eastern Cape inherited their former homeland departments and have a large number of extension officers as a result, but there are major differences in their quality and efficiency. Extension services in the country are now provided to the entire agricultural sector. However, approaches differ; services in the commercial sector are more reactive, responding to events after they have happened, while in the emerging farmer sector they are more proactive, striving to eliminate problems before they appear (Hall *et al.* 2003).

The government, through the Department of Agriculture, is still mainly responsible for agricultural extension in South Africa (David & Samuel 2014). Extension services in the country are facing challenges due to socio-economic and agricultural reforms, challenges such as inadequate financial resources and a lack of capacity in the provinces. Government extension services, in particular, are facing challenges such as having to facilitate land reform, obtaining financial support and creating sufficient initiatives that focus on the development of the smallholder farmer (Koch & Terblanché 2013; David & Samuel 2014). The changes in the country present agricultural extension services

with enormous challenges regarding adequate responses and the achievement of their objectives.

One of the major challenges is interpreting, developing and implementing strategies for optimum farmer participation in technology processes (Davis & Terblanché 2016). According to Makapela (2015) there are still parts of the country that do not receive agricultural extension because there is a poor extension staff to farmer ratio of 1:1500 (citing the Extension Recovery Implementation Plan 2008). Davis and Terblanché (2016) argued that the failure of the government to allocate necessary funds to run extension programmes has a negative impact on service delivery and leaves many farmers un-serviced.

According to Koch and Terblanché (2013), the involvement of the private and semi-private sectors in extension services is gradually increasing. Similarly, the commercial farming sector is decreasing its dependence on government extension services and is becoming more reliant on the private sector for extension support. The government encourages and promotes the integration of public and private sector extension in order to meet increasing food demands and to overcome the effects of its own limited resources (NDA 2005). Makapela (2015) further noted that there is a need to recruit more extension officers and more participation of NGOs in extension services to increase farmers' access to extension services.

2.5 Agricultural extension services in other African countries

Developing countries are increasingly changing how extension services are carried out in their agricultural sectors. This section presents findings from the literature on how other African countries, namely Nigeria, Uganda, Kenya and Malawi, are shifting from public to private extension services.

2.5.1 Nigeria

Agricultural extension services in Nigeria have been mainly public, the major provider being the Agricultural Development Programme (ADP) (Saliu and Age 2009). The country has had a growing campaign to increase private participation due to changing trends in the delivery of agricultural extension services, but the transition to private extension services has been a challenge, particularly because the campaign has been publicly funded (Oladoja 2004). Furthermore, weak institutions in Nigeria, together with counterproductive behaviours, have weakened the impact of

service delivery. This translates to increased costs of carrying out public extension services. In light of the constraints militating against the efficiency and effectiveness of publicly funded extension, the privatisation of extension services is advocated for.

As a means to ensure that payment is willingly granted, improvements are needed in the frequency of extension contact with farmers. There is also an informal private sector in which private organisations provide extension services at no charge. They provide extension services in areas such as agro-chemicals, micro financing, farm tools, and general consultancy that are both agricultural and non-agricultural in nature (Adetayo & Bamishaye 2013). Some Nigerian farmers are paying fees indirectly for the extension services they receive from informal private organisations at the expense of purchasing inputs (Saliu & Age 2009).

Studies (Adetayo & Bamishaye 2013; Ogbonna *et al.* 2016) have mentioned that privatised agricultural extension services in Nigeria are not without challenges. Many extension staff have job insecurity fears and are inadequately trained; in addition, there is poor government legislation backing up the privatisation process. Further challenges include input-related constraints, sustainability constraints and organisational constraints such as limited information on improved technologies. Despite these challenges, the private sector is generally able to fill gaps left by an inefficiently functioning public extension sector (Zhou & Babu 2015).

2.5.2 Kenya

There are two extension systems from which smallholder farmers in Kenya benefit; the government system, the focus of which is solely food crop and livestock, and the commodity-based system that is run by government parastatals, companies and co-operatives. This system is focused mostly (but not exclusively) on commercial crops like coffee, tea, pyrethrum and sisal (Muyanga & Jayne 2008). According to Nambiro *et al.* (2006), throughout the 1990s, modes of delivery that were well established started to shift to favour farmers that were prioritised by the services. This re-orientation of extension in the direction of participatory processes was catalysed by the realisation that effective and efficient programmes could only be achieved with increased participation of the end users.

Nambiro *et al.* (2006) divide extension services in Kenya into four broad forms of delivery:

- Public delivery and public finance

  This is comprised mainly of the traditional government agricultural extension, even though it is to a large extent diminished and is affected by inadequate funding.
- Public delivery and private finance

  In this form of delivery, private companies source the government in order to deliver extension services.
- Private delivery and private finance

  Suppliers are provided by commercial bodies with extension services that are needed to improve technical efficiencies. This mode of delivery is often practised by commodity out grower schemes; it is also predominant in high-value agriculture.
- Private delivery and public finance

  The responsibility of extension delivery is outsourced by government to private company providers such as NGOs and CBOs.

Apart from the evolution from centralisation to diversification with multiple actors, extension services in Kenya have also moved from supply-led, transfer of technology models to integrated technology development and transfer models. The roles of public extension have also changed from direct service provision to facilitation and linkage of farmers to researchers and other extension service providers. Public extension services in Kenya have been lacking and subsequently, private extension services have been emerging. Private extension services consist of private companies, NGOs, community-based and faith-based organisations (Munyanga & Jane 2008). However, the effectiveness of the pluralistic agricultural extension system has been under scrutiny for the methods used to reach farmers and produce results.

Nyambo *et al.* (2009) mentioned the challenges faced by government funded extension services. Extension officers are assigned to large areas and must work with sparsely located farmers, transport is not available and consequently the extension officers fail to provide quality services. Furthermore, many extension officers in the public-sector lack business and group management skills which are essential in managing groups of farmers. Lastly, the services provided by public extension services through contract farming are often considered unsustainable.

2.5.3 Uganda

In the beginning of the 1990s, developing countries experienced a reform in agriculture and Uganda was no exception. These reforms included among others the liberalisation of trade in agricultural inputs, services and output; privatisation of state-owned enterprises that supported production and marketing; and down-sizing of civil servants who provided extension services. In 2001 Uganda established the National Agricultural Advisory Services (NAADS) Programme Act with the aim of reforming the public extension system for a demand-driven contract system (Mangheni *et al.* 2003). NAADS was also centred on increasing the effectiveness, efficiency and sustainability of Ugandan farming. Furthermore, it focused on increasing farmers' access to knowledge, information and communication, and sustaining it. It also aimed at having positive effects on technology adoption, creating and strengthening the links with the general extension services and making sure that extension is aligned with government policy (Benin *et al.* 2007).

According to Mangheni *et al.* (2003), the key challenges to the success of the NAADS programme were; insufficient capacity to implement market-oriented extension services, no coordination of the institutions involved, weak farmer institutions and political pressures. These led to the termination of the programme due to unsatisfactory performance. However, according to Benin *et al.* (2007), there is evidence of the positive impact of NAADS on the quality and the availability of extension services for farmers. It promoted the adoption of new livestock and crop enterprises and it encouraged farmers to use modern agricultural production technologies and practices. However, despite all the perceived benefits brought by NAADS, the growth and performance of the agricultural sector had not been increasing.

Currently, advisory services in the country are provided by public extension services, NGOs and private providers. The latter specialise in advisory services while the former provide traditional advisory services (Afranaakwapong & Nkonya 2015). James *et al.* (2011) noted that there is still minimal willingness to pay for extension services; however, they reported that introducing a no-fee service targeting the poor in order to reduce farmers' vulnerability was a necessary step. Farmers will likely perceive the benefits of the service and this will translate into a general willingness to pay.

2.5.4 Malawi

Malawi has undergone several reforms in its agricultural system; it was not until the 1990s, due to political changes, that agricultural extension services in Malawi stopped being the responsibility of the government only. In 2000, a policy to promote pluralistic and demand-driven extension services was launched. The policy document was titled 'Agricultural Extension in the New Millennium: Towards Pluralistic and Demand-Driven Services in Malawi'. According to Kamputa (2000), the aim of the policy was to respond to the growing needs of farmers and to coordinate all players providing extension services in Malawi. Changes began to take place in the way extension services were provided in the country, one of these being that the participation of service providers other than the government was allowed (Masangano & Mthinda 2012). Providers of extension services in the country now include NGOs, private sector organisations, farmer-based organisations (FBOs) and other multilateral organisations.

However, according to Ragasa *et al.* (2015), the outcomes have been unsatisfactory. One of the reasons is the high presence of international NGOs which offer extension services. Ragasa *et al.* (2015) argued that they could be considered only as donors and not as service providers, due to the short-term nature of external funding that these NGOs depend on. Their sustainability thus becomes a concern. Furthermore, the pluralism in Malawian extension has also resulted in competition between providers; this has been evident in coordination challenges that do not address the needs of smallholder farmers (Chowa *et al.* 2010).

Although there are other players delivering extension services in Malawi, the government is still the largest player in terms of staff and spread. Government services are, however, characterised by resources that are limited and field staff with low qualifications. Even so, other extension organisations like NGOs do not have enough staff and thus use government extension services to reach farmers. Government extension employees are able to reach farmers directly in their villages (Masangano & Mthinda 2012). The private sector is challenged by the lack of an enabling business environment. Despite the capacity constraints to public extension in Malawi, it remains one of the main and more reliable extension providers for farmers and the agricultural extension sector would not be viable without State presence (Chinsinga and Cabral 2010).

2.6 Indirect impacts of agricultural extension services

When one's environment is affected by the actions of another, it can be inferred that the actions have an externality, which can be negative or positive. Schwartz (1994) noted that extension services could potentially produce positive externalities. According to Ravallion (2002), externalities have played an informal but very important role in economic development. In the rural development context, Ravallion (2002) noted that the external impacts of local economic activity are apparent at household level because many rural households tend to engage in multiple activities at the same time, including non-farm activities. Ravallion (2002) also points that because of the nature of the rural setting, externalities are highly likely. They often occur through farmers learning new techniques of production through other farmers' and neighbours' experiences.

In a study carried out in Northern India on the economic impact of agricultural extension, Feder and Slade (1985) noted that one of the main channels for the dissemination of agricultural knowledge is extension services, organised in diverse ways. According to Birkhaeuser *et al.* (1991), most farmers in areas that receive extension services cited other farmers amongst their sources of information. In some cases, farmers share the information they receive from extension officers almost as soon as they receive it. In such cases, there is minimal difference in the performance of both groups of farmers. Inter-farmer communication and relationships are often not considered, which understates the impact of extension services in cases where several direct contacts occur.

Furthermore, the effects of networking in the marketing of agricultural produce also play a role in generating externalities. Farmers can benefit from already existing infrastructure (Ravillion 2002). Ravillion (2002) described other sources of externalities by citing non-farm industries that encourage people to acquire knowledge that benefits local farmers and non-farmers through knowledge shared at the household level. In their paper evaluating the impact of farmer field schools (FFS) on farmers' knowledge in the Peruvian Andes, Godtland *et al.* (2004) pointed out that farmers actually seek information about technologies, such as new varieties and pesticides and fungicides from neighbours in the community. Evidence from studies (Feder & Slade 1985; Birkhaeuser *et al.* 1991; Foster & Rosenzweig 1995, Ravillion 2002; Gotdtland *et al.* 2004)

focusing on FFS support the existence of positive externalities due to interaction among farmers; however, the literature does not indicate that there have been any studies quantifying the indirect impacts of private extension services.

2.7 Summary

Smallholder farmers face a number of challenges that act as constraints to their productivity. Extension services are important in helping to overcome these constraints and improving the productivity of smallholder farmers. Due to public finance constraints and other shortfalls of public agricultural extension services, countries have been gradually shifting from purely public extension services to outsourced extension services or a combination of both. Outsourced extension services have been meeting the shortcomings of public extension services. Even though the literature does not show evidence of studies quantifying the indirect impacts of positive externalities in agricultural extension, it does show that there is an element of positive externalities that arise from how farmers share farming information with one another. Literature describing the background of private extension services was reviewed and discussed in this chapter, followed by a discussion of how private extension services are carried out in other African countries. Finally, the chapter included a review of the literature on the presence of positive externalities due to farmer interactions.

CHAPTER 3
RESEARCH METHODS

The aim of this chapter is to explain how the study was conducted to achieve the research objectives. The first section presents a description of the area of study. An explanation of the tools that were used for collecting data follows. The data analytical models are mentioned, the model for data processing is outlined and reasons are given why the model was chosen and how the finding may be used to achieve the research objectives of the study. Importantly, the chapter provides an explanation of how the data collection and analysis accounts for both beneficiaries of Lima outsourced extension services and non-Lima beneficiaries in Msinga, in order for the impact of Lima extension services to be assessed.

3.1. Study area

The study was conducted in Msinga, KwaZulu-Natal, a predominantly traditional area located about 200 km north of Durban and 120 km from Pietermaritzburg. The closest town to the area, Greytown, is 48 km away.

An estimated 70% of the area is a traditional area held in trust by the Ingonyama Trust. The remainder of the land is under freehold tenure and predominantly used for large-scale commercial farming. Msinga's population is 177 577, consisting of 37,724 households. Approximately 99% of the population lives in traditional areas (Statistics SA 2011). Like most predominantly traditional areas in South Africa, Msinga lacks infrastructure; particularly water, roads and electricity (Dearlove 2007).

The average age of the area's population is 24 years, with 49% of the population being between 15 and 64 years. Only 6% of the population is older than 65 and 45% are 14 years or younger, with women making up the majority (57%) of the population. Like other traditional areas in South Africa, the sources of livelihood in Msinga include cropping, livestock production and wage labour on large-scale commercial farms. The area has an unemployment rate of 50% and a few households are engaged in other small-scale enterprises such as spaza shops and local taxi services (Cousins 2012). In 2011, an estimated 25 651 households in the area had a monthly income of less than

R2300. There is a dependence on social welfare grants; old age pensions and child support grants are a vital source of income for many (Dearlove 2007; Cousins 2012). A map of the study area is presented in Figure 3.1.

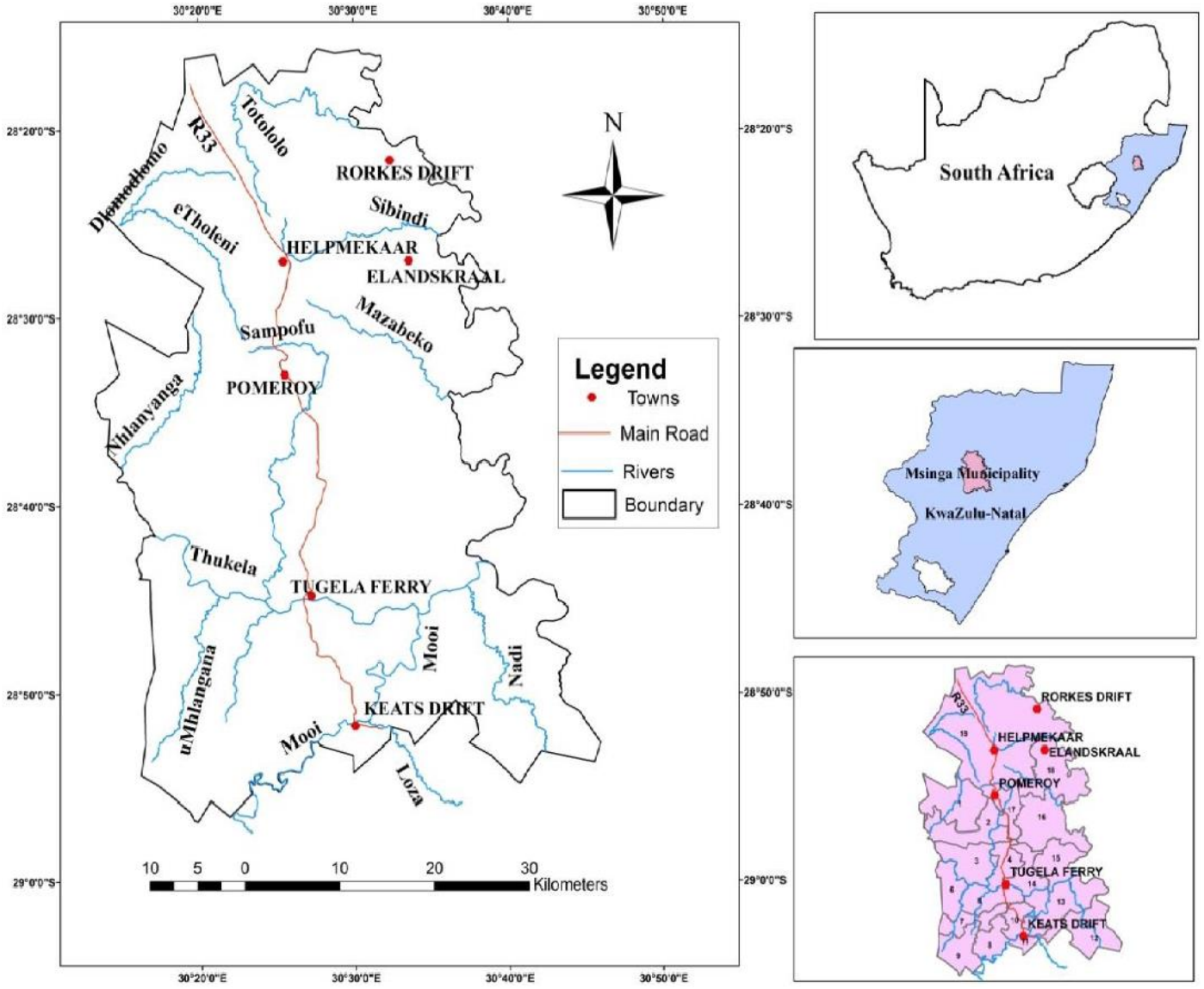


Figure 3.1 Map of Msinga Local Municipality (Sinyolo et al. 2014)

Msinga is a dry to semi-arid zone with a mean rainfall of 600–700 mm per annum and high temperatures that can reach 44^0 C in summer. Agricultural development in the area is limited, which can be attributed to the area's poor soil quality, adverse climatic conditions and poor agricultural practices (Cousins 2012). Despite the above-mentioned challenges in Msinga, various commercial farming opportunities are available, such as selling agricultural perishable products to

local markets in nearby municipalities, vegetable agro-processing opportunities and livestock farming (Msinga Municipality Integrated Development Plan 2014).

The majority of the households practise their farming activities on land divided into nine blocks, namely 1, 2, 3, 4A, 4B, 5, 6, 7A and 7B. The nine blocks originally received irrigation water from the main canal on the south bank, a syphon across the river to the north side feeding a second main canal to the end of Block 7B. The blocks are divided into five municipal wards (ward 3, 4, 5, 6 and 14) under three traditional authorities, namely Mthembu, MaBaso and Ngubane. Block 1 to 4 falls under the Mthembu Traditional Authority located in Sijozini, Mbabane and Malomeni communities. Blocks 5 and 6 are in the Mabaso chieftaincy and Blocks 7A and 7B are located in the Ngubane and Ezingulubeni communities (Golder Associates 2015). The locations are shown in Figure 3.2.

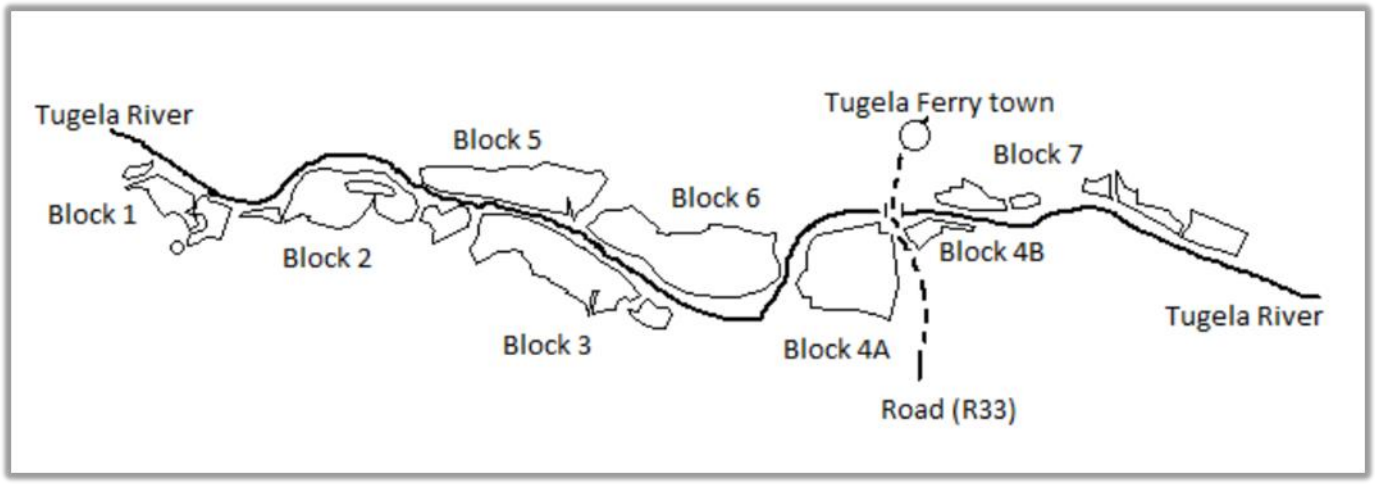


Figure 3.2 Msinga map with the irrigation blocks (Golder Associates 2015)

The blocks comprise plots that were originally distributed to the farmers based on KwaZulu-Natal traditional authorities' methods. The plots are 1000 m^2 or 0.1ha each and farming activities are practised on four plots per farmer, which equates to a farm size of 0.4ha each; approximately 2000 farmers are involved in the irrigation scheme (Golder Associates 2015). There is a greater number of women plot holders than men and many obtain rights to plots through marriage. The plots are considered family property rather than individual property and thus many owners have inherited their plots (Cousins 2012).

Crop production is practised in areas close to Tugela and Mooi Rivers. The most popular crops in the area are maize, tomatoes, sweet potatoes, cabbages and spinach. Others, like beans, butternut, squash, green peppers, potatoes and onions, are planted in relatively smaller quantities (Cousins 2012). Farmers can cultivate about three crops a year through the practice of common crop rotation. The majority of the crops are grown for commercial purposes; the produce is sold on the roadside or supplied to local consumers from areas that are close to the scheme. Farmers also hire vehicles to transport produce to small towns to sell to hawkers and sometimes traders purchase large quantities of produce from the farmers. Even though the majority of the crops are grown for commercial purposes, considerable quantities of the produce are for home consumption (Cousins 2012).

3.2 Sampling procedure

A quantitative research approach to estimate the impact of Lima's outsourced extension services in Msinga was adopted for this study. The primary data needed were generated from two samples in the study area. The first sample represented all farming households in Msinga and was designed to be representative of all. The study area was divided into Primary Sampling Units (PSU), with eight wards selected as the PSUs, with probability proportionate to an estimate of their size. Households were then randomly selected within the PSUs as secondary sampling units, using a constant sampling fraction of 0.5. The size of the sampling fraction was sufficiently large to generate a total sample of 240 farming households. The process yielded a representative sample which is self-weighting with the same probability of selection for every household in the area. Lists maintained by extension officers and block chairpersons were used to randomly sample the households.

Furthermore, a second sample was randomly drawn from a list of Abalimi Phambili Programme (APP) participants. The second sample comprised 60 households who were participants in the APP in the year 2014/15. In total, the sample size for the study consisted of 300 farmers. The generic sampling design is shown in Figure 3.3.

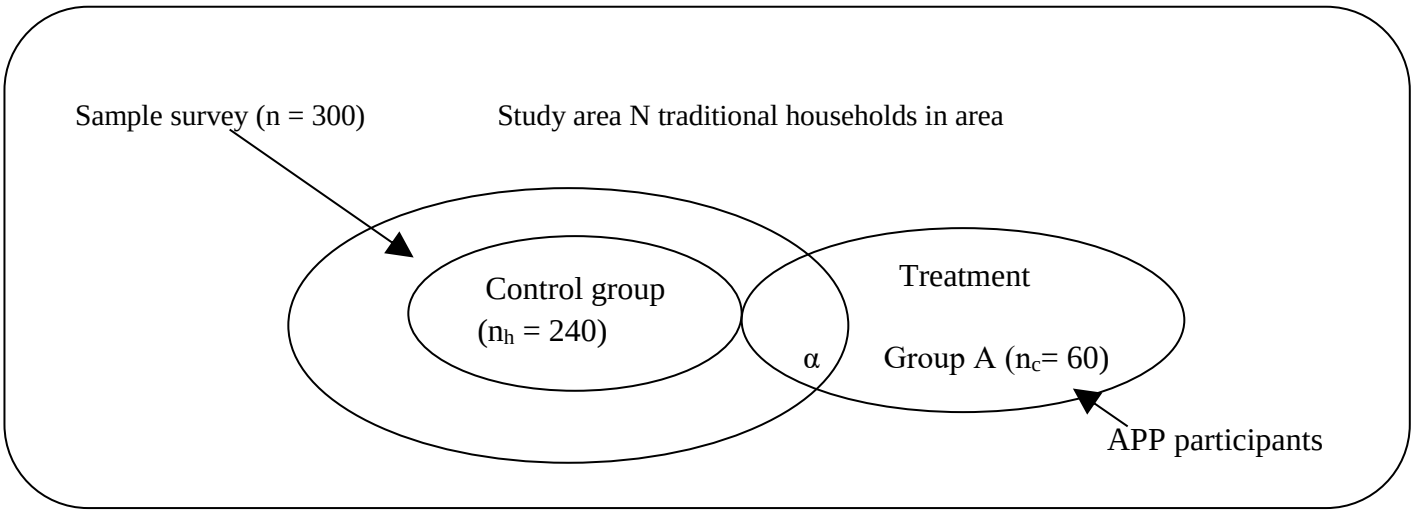


Figure 3.3: Sample size for the study

In Figure 3.3, α depicts the proportion of households in the representative household sample that were APP participants in the 2014/15 farming season in the study area. The use of this sample statistic is to provide useful information about APP's operation when estimating the financial costs and benefits of Lima's extension services in Msinga.

3.3 Method of data collection

The study used both a quantitative and qualitative approach for data collection. Structured questionnaires comprising both open-ended and closed-ended questions were used to collect cross-sectional data from smallholder farmers in Msinga, KwaZulu-Natal. The data were collected over a period of three weeks (15 working days). A pilot study was carried out before the survey and the questionnaire edited for length and ambiguity. The questionnaires were administered to the respondents in *isiZulu* during interviews run by hired enumerators. The questions were answered by the main decision maker, resource allocator or household head, or alternatively, the person responsible for farming activities. The questionnaires were used to collect information on:

i. Socioeconomic characteristics (age, sex, formal education, family size);
ii. Factors of production (land, labour, capital, human and natural resources);
iii. Amount of crop harvested and income;
iv. Challenges to agricultural productivity.

To determine if there were any positive externalities that arose from the outsourced extension services rendered by Lima, questions determining the extent of farmer-to-farmer interactions were also included in the questionnaire.

3.4 Analytical techniques

This section focuses on the different econometric models used to achieve the objectives of the study. The models are explained and a description of the variables is given.

3.4.1 Descriptive analysis

Descriptive statistics (such as means, slopes, etc.) were used to describe household demographic characteristics. This was done using means to compare beneficiaries of Lima extension services to non-beneficiaries. Summaries of the samples and measures are provided with cross tabulation. Descriptive statistics (means, t-tests, percentages, standard errors) were used in this study to describe the socioeconomic characteristics of the smallholder farmers in the area.

3.4.2 Propensity Score Matching

3.4.2.1 Theoretical framework

The ultimate aim of agricultural extension is to increase the productivity of farmers and so boost their monthly income. Agricultural extension can be defined as a set of organisations supporting and facilitating people that are engaged in agricultural production by assisting them to obtain information, skills and technologies with the aim of improving their livelihoods (Anderson 2008). The inception of agricultural projects is often driven by the goal of poverty and hunger reduction through an improvement of production and farm income (White 2006).

White (2006) defined positive impact as evidence of a positive relationship between an indicator (farm income) relevant to the impact and the treatment (outsourced extension services). When the relationship between the indicator and treatment is negative or non-statistically significant, the impact is considered a negative impact. Impact can be assessed through various indicators such as yields (production or labour per total area of cultivated land), income (earnings from all activities), production (the amount of farm production cultivated and farmed) and finally, profit (marginal gains or net benefits). The average impact of an intervention can be calculated by measuring the

differences in the incomes of beneficiaries and non-beneficiaries; however, this is only ideal in randomised experiments. Since participation in Lima's extension services is voluntary, this approach might have produced biased results (Abebaw *et al.* 2010). According to Khandker *et al.* (2010) and Rosenbaum and Rubin (1983), randomised evaluations raise a number of concerns, despite the method being deemed appropriate for impact evaluation.

Impact evaluations are a problem because of missing data, since the outcomes of a programme cannot be observed if the participant of the programme was not a direct beneficiary. Since the information on the counterfactual is missing, the best alternative is to compare outcomes for the participants (treatment group) with those of non-participants (control group). This allows for a control group with similar characteristics to be picked, and thus those who received treatment will have outcomes similar to those in the control group, even in the absence of exposure to the programme (Khandker *et al.* 2010).

The major methodical challenge to estimating the impact of outsourced extension services is selection bias. Selection bias occurs due to the unobservable characteristics of farmers. Unobservable characteristics may affect the decision to participate and impact on outcomes. According to Khandker *et al.* (2010), selection bias can result in inconsistent estimates of the effect of outsourced extension services on farmer performance. Farmers who are beneficiaries of Lima's extension services may have distinctive characteristics that distinguish them from those who are non-beneficiaries, and they may have decided to participate based on these characteristics. The potential selection bias can be addressed by Propensity Score Matching (PSM) techniques estimating the average treatment effect (ATT). The ATT has been viewed as a relatively better indicator when measuring the appropriateness of intervention projects on smaller groups such as smallholder farmers than when measuring population-wide effects. Several studies (Smith & Todd 2005; Abebaw *et al.* 2010; Abebaw & Haile 2013) have employed PSM to control for selection bias.

The impact of Lima outsourced extension services on the performance (measured as crop revenue) was estimated using the Propensity Score Matching method (PSM). An impact assessment of an intervention requires drawing a conclusion about what would have occurred had the programme beneficiaries not participated in the programme (Smith & Todd 2003). Due to the absence of

randomisation, this study made use of Propensity Score Matching (PSM), which allows a comparison between households with similar characteristics in both the treated and the non-treated groups. A balancing property was selected for estimating the propensity scores.

3.4.2.2 Empirical framework

The study follows the approach of Rosenbaum and Rubin (1983), Abebaw and Haile (2013), Smith and Todd (2005) and Heckman *et al.* (1998), where the mean impact of a treatment is measured by computing the difference between the mean values of the outcome variables of interest for the treatment and control groups. The method specifically allows the estimation of the average treatment effect (ATT) between the treated group (Y_1) and control group (Y_0). The requirement before the calculation of the programme treatment effect is to calculate the propensity score *P(Z)* if the observed covariates that affect participation also affect the result. It is therefore essential to find similar comparison points in the two groups, beneficiaries and non-beneficiaries. Observed covariates are automatically accounted for when the scores of the treated and control subjects have the same propensity score. Should there be any differences between the treated and control groups, they will be accounted for and will not be a result of the observed covariates (Khandker *et al.* 2010). The validity of the PSM method lies in the fact that the treated and control groups have similar characteristics, except for participation in the programme. This ensures that PSM gives us an accurate result of the impact of the project (Ravallion 2005; Mapila *et al.* 2012).

The PSM method was applied to quantify the impact of outsourced extension services on the performance of smallholder farmers using cross-sectional data. The method was done because it enables the non-beneficiaries of Lima, who have similar characteristics to Lima beneficiaries, to be identified. The first step in the application of the PSM is estimating the predicted probability that a household is a beneficiary of Lima extension services. The propensity score can be estimated as follows:

$$P(Z_i) = \Pr ob(D_i = 1 | Z_i) \quad (1)$$

Where the propensity score $P(Z_i)$ is estimated by a probit model which regresses being a Lima beneficiary (1 = Lima beneficiaries, 0 = non-Lima beneficiaries) on observed household, farm and location characteristics.

The next step in the application of the PSM method is to choose a matching estimator. A good estimator does not eliminate a majority of the original observations from the final analysis; it should, however, yield statistical equal covariate means for the households in the treatment and control groups. This study employed three estimators, namely the kernel, the nearest neighbour and the radius, to pair Lima beneficiaries to similar non-Lima beneficiaries using the estimated propensity scores.

Following Becker and Ichino (2002), the average treatment effect (ATT), which is the average impact of Lima extension services on the performance of smallholder farmers, can be estimated as follows:

$$ATT = E\left[\Delta_i \middle| D_i = 1\right] = E\left[Y_{1i,t} \middle| D_i = 1\right] - \left[Y_{0i,t} \middle| D_i = 1\right] \quad (2)$$

Where Y_1 and Y_0 are outcomes of interest for Lima beneficiaries and non-beneficiaries, D_i takes on two values, where i refers to the households and $D_i = 1$ if the household is a beneficiary of Lima extension services and $D_i = 0$ if the household is not a beneficiary, and $E\left[\Delta_i \middle| D_i = 1\right]$ is the expected treatment effect. The ATT captures the change in incomes realised by farmers who are beneficiaries of Lima extension services. The statistical significance was tested using bootstrapped standard errors which take into account the variations caused by the matching process.

Because the study further sought to find out if outsourced extension services had any indirect impact on non-beneficiaries through the interactions they shared with Lima beneficiaries, the same approach was followed to estimate the presence and impact of positive externalities. Y_1 and Y_0 were the outcomes of interest for farmers who had received help or information from Lima beneficiary and those who had not, $D_i = 1$ if a farmer had received help or information from a Lima farmer and $D_i = 0$ if they had not received any.

If there are any unobservable characteristics that affect both being a beneficiary of Lima extension services and the outcome variable of interest, a hidden bias might occur for which matching estimators are not robust enough (Rosenbaum 2002). The sensitivity of the average income effects to hidden bias was tested using the Rosenbaum bounds sensitivity test (rbounds); the test indicates how strongly an unobservable characteristic reverses the findings based on the matching of the

observables. Previous studies on group membership impacts such as that of Abebaw and Haile (2013) and Tilahun *et al.* (2016) have used this approach to test for hidden bias when estimating impact.

The impact estimation described assumes a homogenous treatment effect among the beneficiaries. However, studies (Abebaw *et al.* 2010; Abebaw & Haile 2013; Tilahun *et al.* 2016) have explained that the effects of a treatment tend to differ across different socioeconomic groups within the same treatment group. The extent to which the treatment effect varies among the group members was tested using Ordinary Least Squares regression (OLS).

3.4.3 Description of variables used in the empirical model

The dependent variable used to measure the impact of Lima extension services was farm income. The different socioeconomic variables that were used as independent variables and their descriptions in the different models are presented in Table 3.1. Most of the variables that are presented in the table are straightforward in their derivation. Labour endowment [1]was derived using recommended scales. The age of the farmers was included in a square form, to determine if the income from farming (crop revenue) decreases as farmers grow older. An index was created for farmers' various responses to categorise the type of help or information that the farmers exchanged.

[1] Labour endowment = number of adults ≤ 65 years of age + (0.5 * number of adults ≥ 65 years of age).

Table 3.1 Description of variables used in empirical model

Variables	Variable description	Expected sign
Dependent variables		
Total crop revenue	Total crop income per household	+
Net crop revenue	Net crop income per household	+
Total input costs	Total cost of input per household	+
Independent variables		
Participation in Lima extension services	1= if yes, 0 = otherwise	+
Gender	Gender of household head (1=female, 0=male)	+
Age	Household head age (years)	+
Age square	Age of household head in square	+
Educational level	Household head educational level (years of formal schooling)	+
Labour endowment	Amount of labour available to a household	+
Household size	Number of people in household	+
Land size	Area of land cultivated (ha)	+
Livestock value	Household livestock value in Rands (R)	+
Access to extension office	Access to extension office (1=Yes, 0=No)	+
Irrigation tool ownership	Irrigation tool ownership (1=Yes, 0=No)	+
Credit use	1=Yes, 0=No	+
Distance to extension office	Distance to Lima extension office (km)	+
Usefulness of information/help received from other farmers	1=not useful, 2= somewhat useful, 3= useful, 4= very useful	+
Usefulness of information/help received from extension officers	1=not useful, 2= somewhat useful, 3= useful, 4= very useful	+
Type of information/help received from other farmers	1= improved farming techniques, 2= input sharing, 3=pest management/chemical application	+

Gender was expected to be positively associated with being a beneficiary of Lima's extension services. Studies like Bernard *et al.* (2008) and Abebaw and Haile (2013) reported the likelihood of participation increasing with a male household head. However, in this study, the likelihood was expected to increase with a female household head. This is because the majority of rural households have female heads, with males more likely to migrate to urban areas to seek formal employment (HLPE, 2013). Age was anticipated to have a positive relationship with participation in Lima extension services. Age is an important variable that can determine commitment to agricultural practices. Furthermore, older farmers are likely to be more knowledgeable and have more resources at their disposal (Musemwa *et al.* 2008).

Education was expected to have a positive influence on participation. Farmers with more years of education are likely to process information more easily than uneducated farmers. According to Bester *et al.* (1999), more formally educated farmers are likely to try alternative means to improve their farming and are more open to adopt new technologies. Labour endowment is the amount of labour available to a household. It is expected that households with higher availability of labour would be more likely to participate. A positive relationship was expected between land size and participation. The larger the land size, the higher the chances of increased production levels. Farmers who have more land are likely to participate in extension programmes in an attempt to use land optimally.

Livestock value, irrigation tools and access to credit were expected to positively influence participation. Bernard *et al.* (2008) and Bernard and Spielman (2009) regarded physical as well as financial assets to have an influence on participation. Households owning these assets will have larger gains due to the assets being complementary and enhancing agricultural production. Access to extension officers and distance to the Lima office were expected to increase the likelihood of participation. This is because the ease of access to the extension office increases how farmers acquire relevant information such as the benefits of participating in extension services (Abebaw & Haile 2013). Furthermore, extension officers can influence farmers to join more easily and farmers are able to see work done by extension officers.

3.4.4 Financial costs and benefits of Lima extension services

In order to estimate the financial costs and benefits of Lima's extension services, an estimation of net cash income for the 'without project' can be computed for the study area using the equation specified below:

$$\hat{Y}_0 = N(\ddot{y}C) \qquad (3)$$

Where N is the number of households enumerated in the study area and ÿC is the average net cash income computed for households who are not beneficiaries of Lima extension services. Following this, a net cash farm income can be computed for the 'with project', estimated using the equation specified below:

$$\hat{Y}_1 = N\alpha(\ddot{y}T.M) + (1-\alpha)\ddot{y}c \qquad (4)$$

Where ÿT is the mean net cash income for beneficiaries of Lima extension services, M is the local economic multiplier estimated to be 1.28 by Hendricks and Lyne (2003), and α is the estimated fraction of the APP farmers. If there are no Lima APP participants in the selected sample, ($\alpha = 0$), that would mean $\hat{Y}_1 = \hat{Y}_0$, and that there is no estimated increased benefit for Lima's extension services. The true value of $\hat{Y}_1$ would exceed the value of $\hat{Y}_1$ if the rest of the Lima participants experienced gains due to new information and support provided by Lima for all participants. $\hat{Y}_1$ can therefore be described as a conservative estimate of financial benefits generated by the project because it understates the true value of $\hat{Y}_1$ in the presence of dynamic productivity gains.

It follows that $\hat{Y}_1 - \hat{Y}_0$ provides a conservative estimate of the increased financial benefits of Lima in Msinga for the 2014/15 season. Thus $\otimes PB = (\hat{Y}_1 - \hat{Y}_0) - C$ can be computed as the net incremental benefit of the service, where C is the cost to the funder of the support that Lima provided in the Msinga in the period 2014/15.

3.5 Summary

This chapter provided a description of the statistical methods proposed to measure the impact of Lima extension services and to identify factors affecting participation. Also included were a description of Msinga. The study area and the data collection methods used for the study were presented. Primary data were collected using a structured questionnaire, administered by respondents through interviews in *isiZulu*, the local language. The data were analysed using descriptive statistics with the use of t-tests and econometric techniques employing the PSM; a similar approach was used to estimate the impact of positive externalities. The robustness was checked using the Rosenbaum bounds tests and OLS was used to estimate impact heterogeneity among the farmers receiving treatment.

CHAPTER 4
SOCIO-ECONOMIC AND DEMOGRAPHIC CHARACTERISTICS OF THE SAMPLED HOUSEHOLDS

This chapter contains descriptive summaries of observations of sampled households' socioeconomic and demographic characteristics in Msinga. The socioeconomic characteristics considered were household size, household labour, age, years of farming experience, educational level of the household head and the area of land cultivated.

The household socioeconomic and demographic characteristics presented in Table 4.1 are a representation of the sampled households in the study area. The total number of respondents are 300 households, comprising 121 Lima participants and 179 non-Lima participants.

Table 4.1 Household demographics and socioeconomic characteristics

Variable	Whole sample		Non-Lima participants		Lima participants		
	Mean	SE	Mean	SE	Mean	SE	T-test
Household size	7.22	0.23	7.17	0.30	7.30	0.38	2.60
Number of males	3.02	0.13	2.93	0.15	3.15	0.23	0.82
Number of females	4.05	0.14	4.02	0.17	4.08	0.23	0.22
Number of children (<15 years)	2.78	0.15	2.65	0.16	2.98	0.26	1.13
Number of adults (15-65 years)	3.86	0.13	3.90	0.17	3.80	0.19	0.38
Number of pensioners (>65 years)	0.65	0.08	0.78	0.14	0.45	0.07	1.88
Number of family members working on farm	1.49	0.04	1.42	0.05	1.60	0.07	1.87
Number of family members working off-farm	0.49	0.05	0.46	0.06	0.53	0.09	0.63
Age of *de facto* household head (years)	54.01	0.81	54.54	1.02	53.30	1.20	0.75
Years of formal schooling of the *de facto* household head (years)	3.08	0.24	2.69	0.30	3.65	0.39	1.95
Households with a male *de facto* household head (%)	27.3	0.026	25	0.03	31	0.04	1.30
Farming experience of the *de facto* household head (years)	21.66	0.80	20.78	1.04	22.98	1.26	1.34
Area of land cultivated (ha)	0.46	0.02	0.43	0.16	0.51	0.30	2.84
Total livestock value (R)	1568.03	144.01	1303.80	165.08	1958.93	257.25	2.25

Household survey, 2016

The demographics of the households were not expected to vary significantly as all households were from the same area. On average, the sampled households had seven members, with four being adults, implying that almost half the members of each household were dependants. The results presented in Table 4.1 show that the average household head was 54-years old; Lima participants were found to be younger than non-Lima participants but this difference was not significant. The results also show that only an estimated 27% of households in the sample had male household heads, while 31% and 25% of households were headed by males for Lima participants and non-participants respectively. This result is consistent with Desai and Bernaji (2008) who argued that the reason for the majority of households in rural areas having female household heads is that males migrate to urban areas to seek formal employment.

On average, survey respondents planted on four plots of land which were equivalent to 0.4 hectares of land; this finding is consistent with that of Golder Associates (2015) who reported that farmers in the area use about 0.4 hectares to plant four plots for farming activities. There was a statistically significant difference in the amounts of land cultivated by non-Lima participants (0.4ha) compared to the Lima participants (0.5ha). Generally, there were low educational levels amongst the sampled household heads; on average, a household head had only three years of formal schooling. This result is consistent with the Stats SA 2012 report on low education levels in the area. From the significantly higher years of formal schooling for respondents that were Lima beneficiaries, it can be suggested that the likelihood of farmers in Msinga being Lima beneficiaries increases with the level of education. Even though livestock value for respondents in the area was relatively low, respondents that were beneficiaries of Lima extension services had significantly higher values of livestock than respondents who were not beneficiaries of Lima extension services.

4.1. Household farming operations in Msinga

This section focuses on the farming operations of the sampled households in Msinga. A summary of the farming operations is presented in this section. These include crops grown and livestock owned in the area, revenue from farm enterprises and finally input and services expenditure.

4.1.1 Crops and livestock enterprise

Farm revenues from crop and livestock sales for the 2014/15 cropping season are presented in Table 4.2 while Table 4.3 is a summary of the costs of inputs and services purchased. The estimates are based largely on the farmers' recall, although some farmers could produce receipts in support of their claims. In Table 4.2, a summary of the main crops grown by the sampled households is presented. The crops include maize, tomato, cabbage, spinach and potatoes. A relatively smaller number of households planted sweet potatoes (45%), beans (42%), onions (30%), butternuts (18%) and green pepper (10%).

Table 4.2 Crops grown and livestock owned by the sampled households

	Households (%)		
Crops grown	Whole sample (n_h=300)	Non-Lima participants (n_h=179)	Lima participants (n_h=121)
Cabbage	60.0	63.1	55.4
Tomato	65.3	62.6	69.4
Spinach	53.3	56.4	48.8
Potatoes	52.0	43.6	64.5
Onions	29.5	29.1	30.6
Beans	41.9	39.3	44.6
Maize	85.7	87.7	82.6
Butternut	17.6	12.3	24.8
Green pepper	9.7	7.3	13.2
Sweet potato	44.6	45.8	42.1
Others	3.0	3.9	-
Livestock ownership			
Goats	55.7	50.8	62.8
Cattle	17.0	14.5	20.7
Chickens	55.7	54.2	57.9
Pigs	0.3	0.6	-
Sheep	-	-	-

Household survey, 2016

Msinga is a dry and sparsely populated area with minimal vegetation. The arid environment is not conducive for livestock; however, goats thrive in this kind of environment (IDP 2015), hence an estimated 56% of households in the sample owned more goats than any other type of livestock. From the households sampled, none reported owning sheep, while only 0.3% had pigs and only 17% owned cattle. This can also be attributed to the landscape of the area being one of the most land degraded and eroded in KwaZulu-Natal.

Table 4.3 Farm income from crop and livestock sales

Revenue from crop and livestock sales (R)	Whole sample (n_h=300)		Non-Lima members (n_h=179)		Lima members (n_h=121)		
	Mean	S. E	Mean	SE	Mean	SE	T-test
Cabbage	1655.26	185.75	1648.97	186.80	2752.99	496.06	2.45
Tomato	2340.25	233.50	2241.74	217.21	3673.10	558.58	2.68
Spinach	419.58	58.88	595.83	107.39	445.42	79.99	0.97
Potatoes	1743.60	238.90	1104.63	151.32	2661.22	478.37	3.17
Onion	532.31	115	399.46	94.49	891.62	281.15	1.92
Beans	246.67	51.96	239.75	72.75	391.68	110.94	1.19
Maize	1709.34	127.55	1608.73	114.48	2238.00	289.15	2.32
Butternut	1099.19	299.59	657.27	361.78	2009.50	587.17	1.79
Green pepper	682.43	130.59	696.15	240.76	1012.50	182.77	1.06
Sweet potato	816.65	75.37	1085.54	116.72	1051.57	133.44	1.19
Other crops	376.92	202.91	444.44	293.97	225.00	75.00	0.48
Total crop income	7164.87	582.45	5649.79	367.19	9406.20	1315.19	3.21
Goats	140.80	34.75	150.05	46.20	129.33	53.00	0.30
Cattle	182.69	105.50	269.23	188.58	96.15	96.15	0.82
Chickens	49.51	20.62	29.49	9.80	76.90	46.28	1.16
Total livestock income	179.68	38.76	110.11	31.14	201.20	59.97	1.47

Household survey 2016

The results presented in Table 4.3 indicate that the total crop income for the sampled households was R7164. Tomato sales contributed 32% (R2340) to the total crop revenue, potato sales contributed 24% (R1734) while maize, cabbage and onions contributed 24% (R1709), 32% (R1655) and 7% (R532) respectively. There is a statistically significant difference between the total crop income of respondents that are Lima beneficiaries and that of respondents who are not Lima beneficiaries. The total crop revenue for Lima beneficiaries was R9406 while for non-beneficiaries it was R5649. The higher total crop income for Lima beneficiaries suggests that being a Lima beneficiary improves the chances of participating in relatively more profitable farming activities. Other crops such as beetroot, carrots and *masihlalisane* contributed about 5% (R376) to the total crop income. The results show that the livestock contribution to total farm income is low. The low livestock contribution can be attributed to the landscape of the area. Msinga is an arid area and vegetation is scarce (IDP, 2015), thus the majority of farmers do not own livestock and if they do, it is not for commercial purposes.

Table 4.4 Expenditure on the inputs and services used in the 2014/15 cropping season

Crops inputs and services (R)	Whole sample (n_h=300)		Non-Lima members (n_h=179)		Lima members (n_h=121)		
	Mean	SE	Mean	SE	Mean	SE	T-test
Fertilizer	527.50	25.74	478.31	25.14	600.88	51.45	2.35
Chemical	444.10	28.15	412.60	33.54	491.78	49.13	1.38
Hired tractor	268.76	14.22	238.14	15.11	311.49	26.36	2.57
Hired labour	218.03	16.43	206.94	18.45	233.68	29.89	0.80
Manure cost	424.36`	29.89	363.93	26.62	501.10	58.12	2.30
Other inputs	450.59	131.14	534.17	175.22	250	130.35	0.98
Total input	3049.37	116.77	2811.83	132.13	3400.75	210.23	2.50
Seeds							
Cabbage	310.05	2364	306.90	29.18	314.69	39.76	0.16
Tomato	473.96	41.05	482.71	49.69	461.07	70.49	0.26
Spinach	68.28	8.96	75.86	12.51	57.06	12.28	1.03
Potato	165.88	18.81	106.85	15.43	253.21	39.45	3.90
Onion	22.50	3.34	23.77	4.57	20.63	4.81	0.46
Beans	51.35	6.73	50.30	8.81	52.90	10.46	0.19
Maize	188.28	9.41	194.23	12.20	179.46	14.83	0.77
Butternut	20.93	4.59	9.77	3.03	37.44	10.30	2.99
Green pepper	38.04	7.85	22.66	7.60	60.79	15.70	2.40
Sweet potato	0.56	0.29	0.64	0.40	0.44	0.41	0.35
Other seeds	9.60	6.35	12.84		5.34	4.25	0.59
Total cost seeds (R)	1345.15	65.60	1279.40	78.88	1442.41	113.12	1.22

Household survey, 2016

In terms of the costs incurred by smallholder farmers in Msinga, the results in Table 4.4 show that the average production costs were estimated at R3049 for the 2014/15 planting season. Lima participants were found to have statistically significant higher input costs when compared to non-Lima participants. This could suggest that Lima participants farm more intensively than their non-Lima counterparts and thus use more inputs. The APP could also contribute to Lima participants' higher expenditure; the credit component of the programme means that farmers have better access to inputs.

4.2 Challenges to farming activities in Msinga

A summary of the challenges faced by farmers in the sample is presented in Table 4.5. The challenges include lack of access to information, markets, credit, etc.

Table 4.5 Challenges to the farming activities of sampled farmers

Challenge	Percentage of respondents		
	Whole sample	Non-Lima participants	Lima participants
Lack of information	56.9	64.2	42.2
Access to markets	74.7	70.3	81
Poor infrastructure	45.6	45.3	46.3
Lack of skills and training	42.6	48	34.7
Shortage in funding	65	64.8	65.2
Insufficient water	50	45.8	56.2
Insufficient land	43	44.1	41.3
Access to credit	41.1	31.9	50.3
Unavailability of input	42.7	43	42.4
Unaffordable input prices	65.3	64.2	66.9
High cost of labour	59.7	58.7	61.2

Household survey 2016

It appears that accessing markets is one of the key constraints to farming activities in the area. About 50% of the farmers mentioned water scarcity as another key constraint to their farming activities, resulting in either low or no yields for some farmers. Dearlove (2007) noted that, even though the area is surrounded by the Tugela Ferry and Mooi Rivers, it still faces a shortage of water during dry seasons, coupled with high soil erosion and low land carrying capacity. Only about 43% of the farmers reported that insufficient land was a challenge; this is not surprising, as most farmers farm for subsistence purposes only; this is consistent with the findings of the IDP (2015) that stated that most households in Msinga practise farming primarily for subsistence purposes.

Generally, a lack of access to information is a challenge for the sampled households; however, only an estimated 42% of farmers that were Lima participants in the sample reported experiencing this challenge. The results and discussions with the farmers indicated that a lack of availability of inputs (43%) in the area was not a key constraint; 65% reported that the unaffordable prices of the inputs made it difficult to access them. Compared to non-Lima beneficiaries, a relatively higher percentage of Lima farmers reported the high cost of labour as a challenge.

4.3 Sharing of farming information between farmers

The results summarised in Table 4.6 show how the farmers perceived the farming information they received from other farmers and how it was of assistance to them. The results also show the various ways in which farming information had been useful to them.

Table 4.6 Usefulness of farming information shared between sampled farmers

Rating aspect of information/help	Percentage (%)
Not useful	13
Somewhat useful	12
Useful	41
Very useful	34
Ways in which information/help has been useful (n_h = 260)	
Improved farming techniques	56.75
Input sharing	4.4
Pest management/chemical application	9.5
Better outputs obtained	12.9
None	16
Has production increased due to information from other farmers?	
Yes, production has increased	84
No, my production levels are the same	14.7

Household survey (2016)

The majority (75%) of the respondents felt that the farming information was useful in their farming activities, while about 12% found the information to be only 'somewhat useful', implying that it could be better; an estimated 13% found the information of no use to them. Discussions with the farmers revealed that when the farming information was not useful to them it was because of various factors such as drought, expensive inputs and other issues that contributed to them being unable to put the information received to any good use. About 57% of farmers reported that the information they received from fellow farmers resulted in improved farming techniques, while 4% reported that other farmers assisted them by sharing inputs. Furthermore, about 10% of the farmers received information that aided them in pest management or the correct application of chemicals. Subsequently, about 84% of the sampled farmers stated that the information they received from other farmers contributed to increases in their production.

4.4 Sampled farmers' asset ownership

The incidence of asset ownership for households in the area is presented in Table 4.7.

Table 4.7 Asset ownership amongst sampled households

Asset (%)	Whole sample	Non-Lima beneficiaries	Lima beneficiaries
Plough	20.7	26.8	11.6
Planter	10	10.6	9.1
Cultivator	3	2.3	4.1
Tractor	0.7	0.6	0.8
Trailer	12	2.8	5.8
Sprayer	57.3	49.7	68.4

Household survey, 2016

The majority of households in the area used traditional farming methods and, in some cases, hired tractors during planting and harvesting seasons. This could be a plausible explanation for the low percentages of households owning tractors, planters, cultivators and trailers.

4.5 Summary

The results presented in this chapter describe average households from 300 sample households in Msinga. Consistent with previous studies (Cousins 2012; Golder Associates 2015; Dearlove, 2007; Stats SA 2012) conducted in the area, the results based on the selected sample show that farmers in the area are an average 54 years of age, with 27 years of farming experience and some primary school education. Although the results indicate that the households in the sample had similar socioeconomic characteristics and demographic patterns, Lima participants nevertheless had a higher farm income compared to non-Lima participants. The results indicate that the data are a good fit for econometric analysis using PSM as the analysis technique because it requires similar socioeconomic patterns but different outputs (in this case, farm income level).

CHAPTER 5
IMPACT OF OUTSOURCED EXTENSION SERVICES ON THE PERFORMANCE OF SMALLHOLDER FARMERS

Results of the econometric analysis to estimate the impacts of private extension services provided by Lima are presented and discussed in this chapter. The objective is to identify factors influencing farmers' decisions to participate in Lima extension services and to estimate the impacts of Lima extension services on the participating farmers (presented in Section 5.1). Furthermore, the extent, if any, of positive externalities that arise from Lima extension services will be estimated, e.g. by way of participating farmers sharing information with non-beneficiaries (presented in Section 5.2). The last section of the chapter presents an analysis of the costs and benefits of extension services provided by Lima in Msinga under the APP.

5.1 Determinants of smallholder farmer participation in Lima's outsourced extension services

The binary probit model was used to estimate socioeconomic characteristics that influence the farmers' participation in Lima's extension services. The results presented in Table 5.1 are not only associated with participation but were also used to compute the propensity scores for the impact. The dependent variable in the model takes a value of 0 and 1 for non-beneficiaries and beneficiaries respectively. The estimated probit model was statistically significant at the 1% level and further predicted the sampled observations 77% correctly, confirming that the model fits the data well.

Table 5.1 Determinants of Lima extension services participation

Variable	Estimated coefficient	Standard error	Marginal effect
Age (years)	0.017	0.041	0.006
Age square	-0.001	0.0003	0.0001
Gender	0.177	0.193	0.066
Farming experience (years)	0.014*	0.008	0.005
Formal schooling (years)	0.068**	0.023	0.025
Land (log)	0.079	0.123	0.045
Labour endowment (log)	-0.479*	0.291	0.178
Irrigation tool	0.298*	0.173	0.109
Livestock value (Rands)	0.00008***	0.00004	0.00003
Credit use	0.746***	0.174	0.277
Constant	-2.96***	1.19	0.015
Psuedo R^2	0.25		
LR χ^2 (11)	99.73***		
% predicted correctly	76.69		

*Note: ***, **, * denote statistical significance at 1%, 5% and 10% respectively*.

Overall, the results of the probit model suggest that factors such as years of farming experience, years of formal education, labour endowment, livestock wealth, irrigation equipment ownership and access to credit are significant determinants of participation in Lima extension services. The results indicate that a one-year increase in a respondent's farming experience increases the probability of their participation by 0.5%. This implies that farmers with more years of farming experience are more likely to be participants of Lima services. This could be because the farmers with more years of farming experience are likely to have received assistance from an extension officer before and thus consider becoming participants of private extension as an aid to increasing their farm income.

Smallholder farmers with more years of formal schooling were found to be among the likely beneficiaries of Lima extension services. Increasing years of education was found to increase the probability of being a participant in the Lima project. A one-year increase in the years of formal schooling increased the probability of being a participant by 2.5% for the respondents.

This result is consistent with *a priori* expectations and was consistent with the literature (e.g. Tekana & Oladele 2011a). A rationale for the relationship is that the process of information is catalysed by education, which leads to the farmer exploring various ways of getting more information about technology and agriculture. More educated farmers are, therefore, likely to be more open to more innovation and adopting more modern inputs (Weir & Knight 2007; Bester *et al.* 1999). The result also implies that more educated farmers have a higher capability to access and process information.

Most of the covariates in the probit model had the expected signs and were consistent with the literature. Labour endowment, however, had an unexpected negative sign, suggesting that a unit increase in the labour available to a household decreased the probability of the respondent being a Lima beneficiary. Increasing family size was expected to increase the probability of being a Lima participant as larger family size would mean increased availability of labour for the household. A plausible explanation for the probability of being a Lima participant decreasing with increased labour endowment could be the capacity of smallholder farming to absorb a limited amount of labour; if it increases beyond a certain point, the labour returns are reduced. Therefore, larger families might tend to look for other opportunities that might yield higher returns for their labour.

The probit results showed a positive relationship between Lima participation and households' livestock value. This result is consistent with the findings of Ndoro *et al.* (2014), who found that livestock in rural areas is regarded as a form of wealth; wealthier farmers are expected to be able to bear the risk of new technologies and henceforth are more likely to participate in technology transfer programmes. In the sample, households with more livestock were more likely to be beneficiaries of Lima extension services than their counterparts with little livestock. The results also indicate that irrigation equipment ownership increases the chance of being a Lima beneficiary by about 0.3, with a marginal effect of 0.1 (10%). Owning equipment was expected to promote participation because farmers with equipment are likely to be more serious and dedicated to farming and thus are likely to make use of private extension services. A farming tool is expected to assist the process of production and farmers who produce more are likely to benefit from the participation (Organisation for Economic Co-operation and Development 2011).

Access to credit was found to positively influence participation. Access to credit improved the likelihood of being a Lima beneficiary by 28%, which could be attributed to Lima's APP having a revolving credit fund service. This is an expected result, since participation gains are usually higher if a household owns a complementary asset, whether physical or financial, that enhances the probability of participation. Several studies (Abebaw & Haile, 2013; Bernard & Spielman 2009; Tilahun *et al.* 2016) have shown the positive correlation of participation and physical and financial capital.

5.2. Average Treatment Effect on the treated group

The Average Treatment Effect measures the average difference between the farm income of Lima participants and non-Lima participants. The results shown in Table 5.2 were used to compare the farm income of the treated and non-treated groups before matching.

Table 5.2 Comparison of means before matching

Variable	Treatment (n = 121)		Control (n = 179)		T-statistic
	Per adult equivalent	Per household	Per adult equivalent	Per household	
Revenue from all crops	2482.15	9406.20	1699.25	5649.79	10.71***
Costs of input and services	934.36	3400.75	854.99	2811.84	21.22***
Net crop revenue	1547.78	6005.45	844.26	2837.95	6.97***
Revenue from livestock	46.50	201.20	35.20	110.11	3.46

*Note: ***, **, * denote statistical significance at 1%, 5% and 10% respectively*.

However, the results computed using univariate t-tests could be misleading because they do not account for any observed and unobserved characteristics related to the project. Therefore, the PSM was employed to estimate the impact of private extension services on total crop income, net crop income and inputs and services purchased, using different matching estimators to ensure robustness; nearest neighbour, kernel and radius matching. An estimator is considered a 'good' estimator if it does not drop many of the original treatment variables (Becker & Caliendo 2005). To be able to estimate the propensity scores of Lima beneficiaries and non-Lima beneficiaries, the region of common support was computed and ranged from 0.03482042 and 0.90267511.

Following Becker and Ichino (2002), any observations, which had propensity scores that were not in the specified range, were dropped from the sample. Only observations that fell within the region of common support were used for each estimator. Eight respondents were dropped from the sample because their scores did not fall within the defined range. The results of the impact estimation are presented in Table 5.3.

Table 5.3 Average Treatment Effect on the Treated (ATT) private extension services on outcomes

Matching estimator	**ATT for outcome variables**		
	Total crop income	**Net crop income**	**Expenditure on inputs and services**
Kernel matching (bwidth= 0.06)	2862.22 (1497) **	2479.88(1283.58) **	322.35(275.68) ***
Radius matching (caliper = 0.05)	3199.25(1540) ***	2862.45(1522.17) ***	300.80(339.03) ***
Nearest 3 neighbour	3163.25 (1429) ***	2754.75(1291.22) **	445.14(273.94) ***

*Note: ***, **, * denote statistical significance at 1%, 5% and 10% respectively*.

The results from the PSM method present the estimated impact of Lima extension services on the performance of the sampled smallholder farmers. The results indicate that being a beneficiary of Lima's extension services had a positive, significant impact on farmers' total crop income, net crop income and inputs and services purchased. The impact on the treated group was estimated using the three estimators mentioned above. The results presented in Table 5.3 show minimal differences in the outcomes from different algorithms, implying that the results are robust. The consistency of the ATTs over different matching techniques is an indication of the robustness of the PSM estimates (Verhofstadt and Maertens 2014). Specifically, the results indicate that smallholder farmers would have made approximately R3000 and R2700 less in their total and net crop incomes respectively had they not been Lima participants. The analysis is consistent with the results computed before matching, in which farmers using Lima outsourced extension services were shown to have higher revenues. The results also showed that Lima beneficiaries incurred higher expenditure on inputs and services. An explanation for this could be the greater farming intensities of Lima beneficiaries versus non-beneficiaries. Farmers who seek other means of

support, in this case Lima private extension services, are expected to have a higher expenditure as they require more inputs and services for their farming activities.

The increase in inputs and services purchased also bodes well for local economic growth, according to Hendricks and Lyne (2003); the local growth multiplier, estimated to be 1.28 for KwaZulu-Natal, is associated with increased agricultural earnings in the district. For this study, the cash gains generated by Lima beneficiaries were largely driven by the commercial production of tomatoes, potatoes and maize. The reliability of the above estimates needed to be evaluated to check whether the balancing requirements of PSM were satisfied for the data. Thus, several tests were carried out through the balancing test based on Kernel matching (bandwidth = 0.06) to check if there were no statistical differences between members and non-members. The results for matching quality are presented in Table 5.4. It can be inferred after matching that the treated and control groups had statistically similar characteristics.

Table 5.4 Result of matching quality test after matching

Variables	Mean		% bias	t-test	
	Treated	Control		t	p>t
Age	53.25	52.80	3.3	0.24	0.807
Age square	3004.7	2989.1	1.0	0.08	0.938
Gender	0.286	0.265	4.6	0.35	0.728
Farming experience	22.232	22.435	-1.6	-0.12	0.905
Formal schooling	3.536	4.158	-14.8	-1.01	0.312
Labour endowment	0.902	0.894	1.4	0.24	0.814
Land	0.142	0.153	-9.8	-0.69	0.493
Livestock value	1747	0.415	8.3	0.62	0.535
Irrigation tool	0.667	0.610	12.3	0.93	0.356
Credit use	0.598	0.619	-4.4	-0.32	0.751
Summary of distribution of bias Min = 1.0, Max = 14.8 Mean = 6.4 Psuedo R^2 = 0.014 LR χ^2 = 4.35, P (χ^2) 0.959					

Valid matching is achieved when there are no significant differences between the treated and control group (Caliendo & Kopeinig 2008). The results in Table 5.4 indicate that after matching, there were no statistically significant differences between Lima participants and non-participants. Rosenbaum and Rubin (2008) suggest successful matching can be declared if the result in bias is less than 20% for all covariates in the model. None of the standardised bias percentages between members and non-members for the covariates in the model were over 20%, nor were any significant. Results of matching quality suggest that the propensity score for the two groups of farmers, Lima beneficiaries and non-Lima beneficiaries, was balanced and that bias was substantially reduced after the matching process. This is evidence that the balancing requirement was adequately satisfied.

5.2.1. Robustness of results to hidden bias

Even though PSM can remove most selection bias arising from observables when estimating ATT, one of the mentioned disadvantages of PSM is that it does not account for unobserved positive characteristics. Therefore, it is necessary to check the robustness of the estimates to selection on unobservables. The Rosenbaum bounds (rbounds) sensitivity analysis test is used for continuous outcomes to check the robustness of the estimates to unobservable covariates. The test estimates how much the unobserved bias influences the estimated results. In other words, it estimates the extent of bias that would reverse or undermine the findings of the PSM. The rbounds sensitivity analysis was therefore run for all three outcome variables to ensure that the impact was not overstated and was not sensitive to hidden bias. The result of the sensitivity analysis is presented in Table 5.5.

Table 5.5 Rosenbaum bounds sensitivity analysis

	Total crop revenue		Net crop revenue		Inputs and services expenditure	
Gamma	Upper bound significance level	Lower bound significance level	Upper bound significance level	Lower bound significance level	Upper bound significance level	Lower bound significance level
1	0.000	0.000	0.000	0.000	0.000	0.000
1.05	0.002	0.000	0.002	0.000	0.002	0.000
1.1	0.004	0.000	0.004	0.000	0.004	0.000
1.15	0.007	0.000	0.007	0.000	0.007	0.000
1.2	0.011	0.000	0.011	0.000	0.011	0.000
1.25	0.018	0.000	0.018	0.000	0.018	0.000
1.3	0.027	7.100	0.027	7.100	0.027	7.100
1.35	0.038	3.100	0.038	3.100	0.038	3.100
1.4	0.054	1.300	0.054	1.300	0.054	1.300
1.45	0.073	5.500	0.073	5.500	0.073	5.500
1.5	**0.096**	**2.300**	**0.096**	**2.300**	**0.096**	**2.300**
1.55	0.122	9.700	0.122	9.700	0.122	9.700
1.6	0.152	4.008	0.152	4.008	0.152	4.008

Note: The numbers in bold refer to the Rosenbaum bounds critical gamma cut-off value

The results presented suggest that the positive and significant impact is not sensitive to hidden bias or unobservables. Under the assumption of positive hidden bias, the bounds for all three outcomes reach a significance level of 50%, which means that bias would reverse the conclusion that Lima outsourced extension services have a significant, positive impact on smallholder farmer crop farm income in Msinga, at gamma = 1.5. Therefore, it can be concluded that the impact of Lima outsourced extension services is not overstated and has a significant and positive impact on total crop income. The results from the rbounds sensitivity test indicate that the positive and significant impact on smallholder farmers' crop farm income is not sensitive to hidden bias.

5.2.2. Impact of heterogeneity among Lima beneficiaries

When estimating the ATT, PSM assumes that there is no variation in the impact across beneficiaries of the intervention. However, impact differs within the group members themselves due to their different socioeconomic characteristics. To determine if the effect varies depending on household characteristics, an OLS regression was used to estimate the impact heterogeneity. Studies (Abebaw & Haile 2013; Ali & Abdulai 2010) have used the same approach to investigate the extent of the variation of impact amongst the beneficiaries of a programme. The results of the impact of heterogeneity are presented in Table 5.6.

Table 5.6 Heterogeneous impacts among beneficiaries of Lima extension services

Variables	Total crop revenue		Net crop revenue		Inputs and services purchased	
	Coefficient	S E	Coefficient	S E	Coefficient	S E
Age (years)	-443.61	631.09	-614.11	569.02	170.50*	104.08
Age square	4.07	5.58	5.54	5.04	-1.46	0.921
Gender	3729.68	2787.96	3305.506	2513.78	424.176	459.81
Farming experience (years)	291.04**	142.92	265.8833**	128.87	25.16	23.57
Formal schooling (years)	501.35	340.79	356.0633	307.27	145.28***	56.21
Land (log)	6643.09***	1841.60	5924.906***	1660.49	718.19**	303.73
Labour endowment (log)	1925.53	4662.58	1843.23	4204.04	82.30	768.10
Livestock value (R)	-0.277	0.474	-.0255	0.428	-0.023	0.078
Irrigation tool	1217.48	2947.10	1504.23	2658.08	-286.75	486.21
Credit access	2558.65	2863.75	2244.46	2582.12	314.19	472.32
Constant	24356.13	17893.96	25240.17	16134.21	-884.04	2951.24
N R^2 F	118 0.20 2.65***		118 0.20 2.63**		118 0.15 1.82***	

*Note: ***, **, * denote statistical significance at 1%, 5% and 10% respectively*.

In addressing the question 'does impact vary from farmer to farmer?' the results in Table 5.6 suggest that the impact is not the same for all Lima beneficiaries. Impact is particularly significant for farmers with more years of farming experience and larger areas of land to cultivate. This means that the impact of being a beneficiary is higher, on average, among more experienced farmers. Farmers with more farming experience are more likely to have built a stronger and larger network and better farming techniques, hence the greater impact.

The impact of being a beneficiary of Lima extension services is also larger for farmers who cultivate larger areas of land. Even though farm size does not influence participation, farmers with more land are likely to produce more and subsequently sell more; thus, it makes sense that the gain from the programme is greater for these farmers. For the inputs and services purchased variable, the impact is significant for older farmers who have more years of formal schooling and cultivate larger areas of land.

5.2.3 Comparison of revenue between Lima beneficiaries; irrigation scheme and APP farmers

A comparison of crop income between all Lima beneficiaries was done. The crop revenue for APP participants and irrigation scheme farmers was compared. The results presented on Table 5.7 are a summary of the total crop revenues.

Table 5.7 Comparison of revenues between sampled Lima beneficiaries (irrigation scheme and APP farmers).

Group	Frequency	Mean	Standard error	T-test
APP farmers	77	11228.64	1995.23	
Irrigation scheme farmers	44	6216.96	768.08	1.85**

Household survey, 2016

The results indicate the APP farmers have a significantly higher crop income than the irrigation scheme farmers. APP farmers make an estimated R5000 more than irrigation scheme farmers. This can be attributed to the revolving credit aspect of APP; the positive relationship between income and credit has been shown by several studies (Feder *et al.* 1989; Awotide *et al.* 2015a; Reyes *et al.* 2012). Farmers with access to credit are more likely to produce more because they can secure more

inputs. Improved credit access enables farmers to raise their living standards through engaging in more lucrative farming activities.

5.2.4 Improvements and perceived benefits received by APP beneficiaries

This section focuses on household improvements and perceived benefits received by APP participants. These benefits include farmers' perceptions on improvement and various wellbeing indicators. The incidence of APP participants' improvements in socioeconomic indicators is presented in Table 5.8.

Table 5.8 Perceived household improvements by APP beneficiaries (n_c = 77)

Variable	Participants that perceived an improvement (%)
Farm income	78
Access to inputs	83
Cheaper inputs	66
Hired farm labour	48
Access to credit	57
Transport to receive and distribute crops	29
Better diet and health	78
Market information	23
Availability of land for farming	36
Family food security	88

Household survey, 2016

The results in Table 5.8 indicate that the majority of APP beneficiaries attributed improvements in socioeconomic indicators to the outsourced extension service. About 78% of the farmers had an improved farm income, an estimated 83% perceived an improved access to inputs and about 88% of households had improved family food security. Other additional benefits perceived by Lima APP participants specific to farming activities are reported in Table 5.9.

Table 5.9 Perceived farm improvements by APP beneficiaries (n_c = 77)

Variable	Percentage of farmers who perceived an improvement (%)
Taste	50.4
Level of disease	77.6
Lifespan	54.6
Sales	57.2
Size	70.2
Storability	20.5
Type of seed	80.5
Level of production	88.5

Household survey, 2016

Nearly 90% of the farmers experienced an improvement in their level of production, 81% perceived an improvement in their seed type, 78% reported an improvement in the level of disease in their produce and 70% reported an improvement in the size of their produce, since joining Lima's APP.

Table 5.10 Farmer to farmer relations (nc = 77)

Farmer to farmer relations	Percentage
Farmers who have created employment opportunities (permanent or hired) since joining APP	61
Farmers who would recommend Lima services to other farmers, friends or family	88
Farmers who value the opportunity of networking with experts and other participants	86

Household survey, 2016

An estimated 61% of the APP farmers created some form of employment for other people in the 2014/15 farming season (Table 5.10). About 88% of the farmers said that they would recommend Lima to other farmers, friends or family, which can be regarded as a measure of satisfaction. An estimated 86% of the sampled APP farmers valued the opportunity of networking with experts and amongst each other. The results reporting the levels of participants' satisfaction can be found in Table 5.11.

Table 5.11 Participant's attitudes towards APP (nc = 77)

	not at all (%)	slightly (%)	somewhat (%)	mostly (%)	completely (%)
Information being what you expected to receive	5.2	9.1	3.9	44.2	37.7
Accuracy of information	3.9	3.9	9.1	48.1	35.1
Information being easy to understand	2.6	-	2.6	28.6	66.2
Timeliness of the information (received on time to be useful)	2.6	3.9	10.4	28.6	54.5
Helpfulness of the information in decision making	3.9	1.3	9.1	41.6	44.2
Relevance of examples used	1.3	2.6	11.7	39.0	44.2
Lima Instructor's knowledge level	2.6	3.9	9.1	37.7	46.8
Lima Instructor's response to questions	3.9	6.5	6.5	24.7	58.4
Meeting location in terms of ease of listening and participation	5.2	6.5	10.4	27.3	50.6
Assistance with market linkages	41.6	10.4	20.8	15.6	11.7
Assistance with input linkages	6.5	11.7	10.7	31.2	40.3

Household survey, 2016

A high level of dissatisfaction was only apparent with respect to the assistance with market linkages. Overall, Msinga smallholder farmers who are part of Lima APP are either mostly or completely satisfied with APP, and the results suggest that farmers are indeed benefitting from participation.

5.3 Positive externalities of private extension

This section focuses on the shared interactions between farmers and positive externalities that might arise from those interactions. The section is divided into two subsections; the first presents results of the farmers' responses on the information they shared with each other; the second presents the empirical results of the econometric analysis, estimating the impact of farmer-to-farmer relations and thus giving evidence of positive externalities. The results presented on Table 5.12 are a summary of Lima beneficiaries' interactions and information sharing with non-Lima beneficiaries.

Table 5.12 Lima beneficiaries' information sharing (n_h = 121)

Farmers who have used Lima services	Frequency		Percentage (%)	
	Yes	**No**	**Yes**	**No**
To your knowledge are there any non-Lima members benefitting from Lima services?	79	42	65	35
Have you ever purposefully disseminated info from Lima to assist other farmers?	100	21	82.6	17.4
Have farmers sought advice from you as a Lima beneficiary?	83	38	68.8	31.2
In your opinion are there any farmers who have adopted some practices as introduced by Lima?	59	62	48.9	51.1
Farming practice adopted (n_h = 68)		Frequency	Percentage	
Improved farming techniques		41	65.1	
Pest management\chemical application		20	31.7	
Access to different markets		2	3.2	

Household survey (2016)

An estimated 65% farmers who are Lima participants know other non-Lima farmers who have benefitted from the services of Lima somehow, and 83% of Lima participants had disseminated information they obtained from Lima to assist other farmers. However, only an estimated 69% reported having been asked for assistance based on their Lima membership; about 49% reported knowing other farmers who had adopted practices introduced by Lima services, such as farming techniques (65%) and chemical application (32%). About 3% of farmers could access new markets based on the information they had received from Lima beneficiaries. The results on Table 5.13 are a summary of interactions of non-Lima beneficiaries with farmers that benefit from Lima services. The results indicate that half of the farmers who were non-Lima beneficiaries reported having received help/advice/ information from a farmer who was a Lima beneficiary. Furthermore, about 95% of those who had received information from Lima participants regarded it as useful to their farming activities

Table 5.13 Non-Lima beneficiaries' information sharing (n_h = 179)

Have you ever received help or information from a farmer who is a Lima participant? (n_h = 179)	**Frequency**	**Percentage**
Yes	89	49.72
No	90	50.28
Usefulness of help or information (n_h = 89)		
Not useful	4	4.8
Somewhat useful	13	14.3
Useful	49	55.6
Very useful	23	25.4
Ways in which help/information was useful (n_h = 85)		
Improved farming techniques	23	25.84
Input sharing	20	23.52
Pest management	19	22.35
Better outputs obtained	24	28.24
Do you actively seek out information you believe might be useful from Lima farmers?		
Yes	52	32.1
No	110	67.9

Household survey (2016)

The various ways in which the information had proved useful included improved farming techniques for about 26% of the farmers, increased access to inputs for about 24% of farmers, improved ways of applying chemicals and better pest management for about 22%, and better outputs for 28.24% of farmers.

5.3.1 The impact of interaction with Lima farmers (positive externality) on non-beneficiaries' farm income

In order to uncover whether there were any positive externalities arising from farmer interactions, a subgroup was created from the non-Lima beneficiaries (the control group), in which those who had received help from Lima beneficiaries were compared to those who reported not to have received help from Lima beneficiaries. The differences in incomes of both sub-groups were compared to estimated positive externalities. The result of the probit model estimating the factors influencing interaction (Y_0= no interaction, Y_1 = interaction) between Lima beneficiaries and non-beneficiaries are presented in Table 5.14.

Table 5.14 Factors influencing interaction with Lima farmers

Assistance from Lima farmer (n_c = 179) (positive externality)	Coefficient	Standard error	Marginal effects
Age (years)	-0.009	0.010	-0.004
Gender	-0.199	0.244	-0.079
Formal schooling (years)	-0.002	0.028	-0.0008
Farming experience (years)	-0.009	0.009	-0.004
Land (ha)	-0.299	0.842	-0.119
Access to Lima office	-1.186**	0.533	-0.372
Distance to Lima office (km)	0.004	0.022	0.004
Lima awareness	0.659***	0.222	0.659
Usefulness of extension	0.217**	0.107	0.217
Usefulness of info from other farmers	0.208*	0.110	0.208
Constant	0.573	0.831	0.573
Psuedo R^2 LR χ^2 (11) P (χ^2) % predicted correctly	0.13 29.24 0.0021 68.05		

*Note: ***, **, * denote statistical significance at 1%, 5% and 10% respectively*.

The results in Table 5.14 indicate that access to the Lima office, farmers' awareness about Lima, and the level to which extension services and information from other farmers had been useful influenced farmers in getting information and help from Lima beneficiaries. Farmers with more access to the Lima office were found to be less likely to have received assistance from Lima farmers. This result suggests that the non-Lima beneficiaries might be exposed to the information and the services provided by Lima and perhaps attend some information sessions that Lima extension officers provide.

Awareness of Lima extension services positively influenced respondents' interactions with Lima beneficiaries. Smallholder farmers who were aware of Lima's extension services were found to be more likely to seek or receive assistance from Lima beneficiaries. Even though the farmers were not Lima beneficiaries for various reasons, due to their knowledge about Lima or its services they still sought information and were open to receiving information from Lima beneficiaries.

Farmers who had received information, which they regarded as useful from extension officers, had a 21% likelihood of having received help or information from a Lima participant. This implies that the farmers were more likely to trust the information they received from Lima participants when they knew that the information originated with an extension officer. Having received useful

information from other farmers increased the chances of having received information or help from a Lima beneficiary by 20%. This suggests that because the famers have received information they regarded as useful from other farmers in their network, they were likely to trust and ask for information from Lima beneficiaries.

5.3.2 Average Treatment Effect (ATT) of interaction with Lima beneficiaries

After the Probit model, a region of common support was computed in which propensity scores of farmers who had similar characteristics in the control group were estimated. PSM computed a counterfactual that is similar to the treated group in the sub-sample, the major difference being whether the respondent had received any information/help from a Lima beneficiary or not. The estimators (Kernel, radius and nearest neighbour) were used to estimate if there was any impact of the information given by Lima participants to other farmers.

Table 5.15 ATT of interaction with Lima farmers

Matching estimator	**Total crop income**	**Net crop income**
Kernel matching (bwidth= 0.06)	2046 (790) **	1781.88(675) ***
Radius matching (caliper = 0.05)	2891.81 (913.35) ***	2096.89(767.61) ***
Nearest 3 neighbour	2255.31(730.41) ***	2047.10(654.83) ***

*Note: ***, **, * denote statistical significance at 1%, 5% and 10% respectively*.

The results of the ATT presented in Table 5.15 indicate that interactions with Lima beneficiaries had a positive, significant impact on the crop income of the farmers who were not beneficiaries of Lima extension services. The different estimators also yielded similar results which is evidence of robustness. The results show that, on average, farmers who have received information or help from Lima beneficiaries make an average of R2400 on total crop income more than farmers who have not received any information or help. Similarly, farmers who have interactions with Lima beneficiaries made approximately R2000 in their net crop revenue more than their counterparts. More importantly, it can be concluded that there is a trace of positive externalities that arise from Lima private extension services in the study area.

The validity and reliability of the estimates were tested with the balancing test. Mostly, there were no significant differences between the farmers who had interacted with Lima beneficiaries and those who had not, after matching. Following that, the Rosenbaum bounds sensitivity analysis was carried out; two outcomes, to test the extent to which hidden bias influenced the results. The rbounds sensitivity test showed that the PSM result would change if bounds statistic gamma = 1.9 for total crop revenue and 0.4 for net crop revenue. This implies that it would take 90% and 40% of hidden bias (for total crop revenue and net crop revenue respectively) to change the conclusion that Lima private extension services have an indirect, positive impact on farmers who are not their direct beneficiaries.

Finally, the impact of heterogeneity showed that farmers who benefit more from shared interactions with Lima beneficiaries are farmers with more land and farmers who perceived the assistance they received from Lima farmers as useful. As expected, access to more land allows a farmer to be able to produce more and thus sell more, which results in higher farm incomes. Furthermore, farmers who regarded the help they received from extension officers as useful gained more from the information received from Lima farmers. A plausible explanation for this could be that the non-Lima beneficiaries had received valuable assistance from extension officers in the past, and thus knew that anyone who had been exposed to such information was likely to have reliable and valuable information.

5.4 Financial costs and benefits of Lima APP extension services

In an attempt to estimate the financial costs and benefits of Lima extension services, the total population of the households was counted. The total population of the households counted in the study area is N = 13 313, with a net crop revenue of R2837.95 per household in the control income ($\ddot{y}_C$); from this information, the 'without project' net cash income can be estimated as:

$$Y_0 = N(\ddot{Y}C) = 13313\ (2837.95) = \text{R}37781628.35 \qquad (5)$$

Lima extension services did not have an impact on livestock revenue and therefore cash earned from livestock revenue was excluded from this equation. From Table 5.2, the mean net crop revenue for participating households is $\ddot{y}_T = 6005.45$.

This value is substituted into the 'with project' net cash farm income which is estimated as:

$$\hat{Y}_1 = N\alpha(\hat{y}T.M) + N(1-\alpha)\ddot{y}c = [(13\ 313^* \ 0.071^* 6005.45^* \ 1.28)] + [13313(1- \ 0.071)\ 2837.95]$$

$$= \text{R } 42300487.90 \qquad (6)$$

Where $\hat{y}T$ is the mean net crop revenue for Lima participant households in the treatment group, α represents the fraction of APP participants in the study area and M is the local multiplier growth, as estimated by Hendricks and Lyne (2003). In this study, the fraction of APP participants identified in the household sample was 7.1% (α = 0.071). The estimated incremental benefit of Lima extension services for the 2014/15 season was then estimated as $\hat{Y}_1$-$\hat{Y}_0$ (R4518859.55). The net incremental benefits of Lima extension services in Msinga can subsequently be estimated as ($\hat{Y}_1$-$\hat{Y}_0$) – C, where C is the cost to the donor of the support that Lima provided in Msinga between September 2014 and August 2015. Lima estimated the cost as R445 036.65. The net incremental benefit of Lima's extension services is therefore conservatively estimated as R4073822.90 (R451 8859.55 – 445036.65), with an estimated return on investments of about 107% made by the donors to finance the services.

Considering that Lima only provided services for 7% of the population in Msinga, it is believable that the financial benefits presented will be reaped for years to come, with the extension of the service to more households. Furthermore, the additional benefits mentioned in Section 5.1 should be taken into account; benefits such as improvements in food quality, better diets, improved food security and employment creation.

5.5. Conclusion

This chapter covered the important results of the study pertaining to the impact of Lima's outsourced extension services in Msinga. Even though the household demographics did not differ significantly, Lima participants were found to have higher farm incomes than their non-Lima counterparts. The significantly higher crop income results estimated by the PSM highlight the significant role played by private extension services in the performance and productivity of smallholder farmers. It can therefore be inferred that participating in Lima extension services is linked to higher crop revenues. Furthermore, the impact of Lima extension services was found to

give rise to positive externalities. This means that non-Lima participants, through Lima participants, indirectly benefit from Lima's extension services. The results also indicate that the majority of APP participants perceived many benefits and it can be concluded that APP participants are very satisfied with the programme. This means that considerable support from NGOs such as Lima and other private institutions is essential for improving smallholder farmers' crop revenues.

CHAPTER 6
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary of findings

The study's general objective was to evaluate the impact of outsourced extension services on the performance of smallholder farmers, using crop revenue as a proxy for performance, with two impact evaluation parts. The second objective was to investigate if the outsourced extension services had any 'spill over' effects to non-beneficiaries. Thus, the study sought to estimate positive externalities arising from the connections shared by the sampled farmers in the area. The second evaluation aspect distinguishes this study from others that have not considered the spill over effects or indirect impacts of outsourced extension services.

A total sample of 300 farmers was generated through random sampling. The data analysis used a combination of both descriptive and econometric techniques. The comparison of means, t-tests and chi-squares were used for descriptive analysis, while the PSM, OLS and Rosenbaum bounds were used for the econometric analysis. The qualitative data, collected from farmers during interviews, were used in the contextual interpretation of the quantitative results from the econometric models. The study found that the sampled farmers had similar demographic patterns. Factors such as years of farming experience, labour endowment, livestock value, ownership of irrigation equipment, use of credit and Lima awareness were all found to influence participation in Lima extension services. Using Propensity Score Matching, the results suggest that being a Lima beneficiary has a statistically significant and positive impact on the income of smallholder farmers. Specifically, membership improves total crop and net revenue by R3000 and R2500 respectively. Testing for impact heterogeneity, it was found that impact was greater for more educated farmers with more land and years of farming experience. Results from the Rosenbaum bounds sensitivity analysis test indicated that the average treatment effect of membership on crop revenues and costs are robust for the impact of unobserved confounding factors, confirming that the impact was not overstated during the estimation.

Furthermore, the results indicated that there was indeed a presence of positive externalities of private extension services arising from farmer-to-farmer interactions. Lima participants from the sample who had shared an interaction with a non-Lima farmer, whether by means of information sharing or giving help, had a higher crop revenue of R2046 and R1781 for total and net crop farm income. The impact of the interaction was greater on farmers who had more hectares of land and those who had received assistance from an extension officer in the past. This highlights the indirect impact that non-Lima participants experience through the services of Lima, and shows that the impact is greater than often considered. Even though the majority of the farmers in the sample who were Lima farmers felt dissatisfied with market linkages and access to markets in general, overall the sampled Lima participants reported satisfaction with the services rendered to them. An analysis of the financial costs and benefits of the outsourced extension service in the study area suggest an annual net incremental benefit of R4073822.90; this presents an 107% return on the investment made by donors to finance the services.

6.2 Conclusion

From the study, it can be concluded that outsourced agricultural extension services play a crucial role in increasing the revenue of smallholder farmers. Farmers who participate in Lima extension services were found to have higher revenues than non-beneficiaries, and it can be concluded that being a Lima member has a positive impact on other smallholder farmers in Msinga. Outsourced extension services play a vital role in assisting smallholder farmers to improve their farm performance in terms of increasing crop revenue. Increased crop revenues subsequently lead to better access of farm inputs and better productivity. With increased crop revenue, farmers may be in a better position to access inputs and thus improve their farm productivity and reduce their poverty levels. Thus, the findings of the study suggest that there is a need for external support from NGOs and other private organisations to sustain and improve smallholder farming.

Previous studies have looked only at one dimension of extension impact. From this study, it can be established that extension services have wider benefits than initially stated, having a positive indirect impact that is often not considered when impact is being evaluated. The shared interactions between the farmers enable information sharing that assists in improving farming techniques and activities generally and subsequently, overall farm performance for an area. Overall, the results from the study highlight the importance of access to support services for improving the

performance of smallholder farmers. This finding also emphasises the importance of farmer networks and the usefulness of the interactions farmers have with one another, as they result in sharing of vital information on farming techniques. The results of the analysis of the costs and benefits of Lima's extension services suggest donors should continue identifying and assisting areas such as Msinga, where agricultural activities are practised and have the potential to reduce poverty.

6.3 Recommendations

The literature suggests that smallholder crop farming success is dependent on several input factors such as training, information and market support and some inherent socioeconomic factors such as education, geographical access to markets, etc. There is a need for support programmes to motivate and inform individual farmers; therefore, the involvement of outsourced extension services should be encouraged and sustained, for such services empower smallholder farmers, both directly and indirectly.

The services rendered by outsourced extension services should be demand driven; in other words, respond to the targeted farmers' needs. Furthermore, policies should fit the needs of farmers and community. Since private extension has limited coverage in terms of implementation, collaborations between government and private extension should be improved in an attempt to strengthen the implementation of relevant policies and define the areas in which private extension should work. Furthermore, because extension services play a vital role in the development of farming activities, there is a need for checks and balances in terms of quality control and the standardisation of extension service approaches.

Finally, this study has highlighted the importance and advantage of interactions and information sharing amongst farmers for improving smallholder performance. Thus, the notion of associations such as farmer co-operatives and other groupings that encourage shared interactions should be promoted; such formations and associations should be farmer led and farmer driven. For greater impact, policy makers should encourage group formation and participation among smallholder farmers.

With regards to areas of future research, several areas were mentioned in the literature review; some of these areas were covered in this study but others remain to be exploited. Agricultural extension services have many facets and the element of their indirect impact, and ways to measure this, could be researched further. Further studies might also investigate key factors affecting farmer interactions and their role in improving smallholder farming.

REFERENCES

Abdu-Raheem, K.A. and Worth, S.H., 2011. Household food security in South Africa: evaluating extension's paradigms relative to the current food security and development goals. *South African Journal of Agricultural Extension*, *39*(2): 91-103.

Abebaw, D. and Haile, M.G., 2013. The impact of cooperatives on agricultural technology adoption: Empirical evidence from Ethiopia. *Food policy*, *38*(1): 82-91.

Abebaw, D., Fentie, Y. and Kassa, B., 2010. The impact of a food security program on household food consumption in Northwestern Ethiopia: A matching estimator approach. *Food Policy*, *35*(4) 286-293.

Adejo, P.E., Okwu, O.J. and Ibrahim, M.K., 2012. Challenges and prospects of privatization of agricultural extension service delivery in Nigeria. *Journal of Agricultural Extension and Rural Development*, *4*(3), 63-68.

Adejobi, A.O. and Kassali, R., 2013. Markets and rural services as determinants of improved seeds usage by crop farmers in Osun State, Nigeria. *African Crop Science Journal*, *21*(2): 143-152.

Adetayo, A.J. and Bamishaye, E.I., 2013. Privatization of agricultural extension services in Nigeria: A fallacy. *Asian Journal of Agricultural Extension, Economics & Sociology*. 2(1): 14-22.

AfranaaKwapong, N. and Nkonya, E., 2015. Agricultural extension reforms and development in Uganda. *Journal of Agricultural Extension and Rural Development*, *7*(4): 122-134.

Ali, A. and Abdulai, A., 2010., The adoption of genetically modified cotton and poverty reduction

Aliber, M and Hall, R., (2012). Support for smallholder farmers in South Africa: Challenges of scale and strategy, *Development Southern Africa*, 29(4): 548-562.

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

Anderson, J. and Van Crowder, L., 2000. The present and future of public sector extension in Africa: contracting out or contracting in? *Public Administration and Development*, *20*(5): 373-384.

Anderson, J.R. and Feder, G. (2004). Agricultural extension: Good intentions and hard realities. *The World Bank Research Observer*, *19*(1): 41-60.

Anderson, J.R., 2008. Agricultural Advisory Services, A background paper for "Innovating

through science and technology". *Background paper for the World Development Report*. Washington DC. The World Bank.

Antonelli, C. and Gehringer, A., 2015. Knowledge externalities and demand pull: The European evidence. *Economic Systems*, *39*(4): 608-631.

Awotide, B.A., Abdoulaye, T., Alene, A. and Manyong, V.M., 2015a. Impact of Access to Credit on Agricultural Productivity: Evidence from Smallholder Cassava Farmers in Nigeria. In *2015 Conference, August 9-14, 2015, Milan, Italy* (No. 210969). International Association of Agricultural Economists.

Awotide, D.O., Kehinde, A.L. and Akorede, T.O., 2015b. Metafrontier Analysis of Access to Credit and Technical Efficiency among Smallholder Cocoa Farmers in Southwest Nigeria. *International Business Research*, *8*(1): 132.

Ayaz, S. and Hussain, Z., 2011. Impact of institutional credit on production efficiency of farming sector: A case study of District Faisalabad. *Pakistan Economic and Social Review*, 149-162.

Baiphethi, M.N. and Jacobs, P.T., 2009. The contribution of subsistence farming to food security in South Africa. *Agrekon*, *48*(4): 459-482.

Becker, S.O. and Caliendo, M., 2007. Mhbounds-sensitivity analysis for average treatment effects. *The Stata Journal*, 7(1): 71- 83.

Becker, S.O. and Ichino, A., 2002. Estimation of average treatment effects based on propensity scores. *The Stata Journal*, *2*(4): 358-377.

Bekker, S., 2006 'Migration from South Africa's rural sending areas: changing policies and changing destinations' in Gallo-Mosala S. (ed.) *Migration to South Africa within International Migration Trends.* Cape Town: The Scalabrini Centre.

Belay, K. and Abebaw, D. (2004). Challenges Facing Agricultural Extension Agents: A Case Study from South-western Ethiopia. *African Development Review*, *16*(1): 139-168.

Benin, S., Nkonya, E., Okecho, G., Pender, J., Nahdy, S. and Mugarura, S., 2007. *Assessing the impact of the National Agricultural Advisory Services (NAADS) in the Uganda rural livelihoods*. International Food Policy Research Institute.

Bernard, T. and Spielman, D.J., 2009. Reaching the rural poor through rural producer organizations? A study of agricultural marketing cooperatives in Ethiopia. *Food policy*, *34*(1): 60-69.

Bernard, T., Gabre-Madhin, E. and Taffesse, A.S., 2008. Heterogeneous Impacts of Cooperatives on Smallholders' Commercialization Behavior: Evidence from Ethiopia. In *2007 Second International Conference, August 20-22, 2007, Accra, Ghana* (No. 52161). African Association of Agricultural Economics (AAAE).

Bester, B.J., Belete, A. and Doni, T.M., 1999. An application of probit analysis to factors affecting small-scale farmers 'decision to participate in the farmer support program: A case study in The Eastern Cape Province of South Africa. *Agrekon*, *38*(1): 46-52.

Birkhaeuser, D., Evenson, R.E. and Feder, G., 1991. The economic impact of agricultural extension: A review. *Economic development and cultural change*, 39(3): 607-650.

Caliendo, M. and Kopeinig, S., 2008. Some practical guidance for the implementation of propensity score matching. *Journal of Economic Surveys*, *22*(1): 31-72.

Chinsinga, B. and Cabral, L., 2010. The limits of decentralised governance: the case of agriculture in Malawi. *Policy Brief.* http://agris.fao.org/agris-search/search.do?recordID=GB2012112456 (29 March 2017).

Chowa, C., Garforth, C. and Cardey, S., 2013. Farmer experience of pluralistic agricultural extension, Malawi. *The Journal of Agricultural Education and Extension*, *19*(2): 147-166.

Collier, P. and Dercon, S., 2014. African Agriculture in 50Years: Smallholders in a Rapidly Changing World? *World Development*, (*63):*92-101.

Cousins, B., 2012. Smallholder irrigation schemes, agrarian reform and 'accumulation from above and from below' in South Africa. *Journal of Agrarian Change*, *13*(1), 116-139.

David, M.M. and Samuel, H.S., 2014. The role of agriculture extension in the 21 century: reflections from Africa. *International Journal of Agricultural Extension, 2*(1): 89-93.

Davis, K., Babu, S.C. and Blom, S., 2014. *The role of extension and advisory services in building resilience of smallholder farmers* (13). International Food Policy Research Institute.

Davis, K.E. and Terblanché, S.E., 2016. Challenges facing the agricultural extension landscape in South Africa, Quo Vadis?. *South African Journal of Agricultural Extension, 44*(2): 231-247.

Dearlove, P.D., 2007. Msinga municipality integrated development plan. Msinga municipality. http://devplan.kzncogta.gov.za/idp_reviewed_2007_8/IDPS/KZ244/Adopted/Msinga%20IDP.pdf (27 September 2015).

Department of Agriculture, 2005. Norms and standards for extension and advisory services in agriculture. http://www.daff.gov.za/daffweb3/Branches/Food-Security-Agrarian-Reform/National-Extension-Support/Norms-and-standard (09 September 2015).

Department of Agriculture, Forestry and Fisheries. 2012. *Annual report 2011/12*. http://www.daff.gov.za/doaDev/topMenu/AnnualReports/2011_12/AR2012.pdf (22 August 2015).

Department of Agriculture, Forestry and Fisheries., 2011. *Food Security*. http://www.nda.agric.za/docs/genreports/foodsecurity.pdf (17 March 2017).

Dercon, S., 2008. Fate and fear: Risk and its consequences in Africa. *Journal of African Economies*, *17*(2): 97-127.

Desai, S. and Banerji, M., 2008. Negotiated identities: male migration and left-behind wives in India. *Journal of Population Research*, *25*(3): 337-355.

Elias, A., Nohmi, M., Yasunobu, K. and Ishida, A., 2013. Effect of Agricultural Extension Program on Smallholders' Farm Productivity: Evidence from Three Peasant Associations in the Highlands of Ethiopia. *Journal of Agricultural Science*, *5*(8): 163.

Ellis, F. and Freeman, H. A. (2004) Rural Livelihoods and Poverty Reduction Strategies in Four African Countries. *The Journal of Development Studies*, 40:(4)1-30.

Farrington, J., 1995. The changing public role in agricultural extension. *Food Policy*, *20*(6): 537-544.

Faure, G., Desjeux, Y. and Gasselin, P., 2012. New challenges in agricultural advisory services from a research perspective: a literature review, synthesis and research agenda. *The Journal of Agricultural Education and Extension*, *18*(5): 461-492.

Feder, G. and Slade, R. (1985). The role of public policy in the diffusion of improved agricultural technology. *American Journal of Agricultural Economics*, 67(2): 423-428.

Feder, G., Lau, L.J., Lin, J.Y. and Xiaopeng, L., 1989. Agricultural credit and farm performance in China. *Journal of Comparative Economics*, *13*(4): 508-526.

Feder, G., Willett, A. and Zijp, W., 1999. Agricultural extension: Generic challenges and some ingredients for solutions. *Policy Research Working Paper*, 2129. The World Bank, Washington, DC.

Fenwick, L.J. and Lyne, M.C., 1999. The relative importance of liquidity and other constraints inhibiting the growth of small-scale farming in KwaZulu-Natal. *Development Southern Africa*, *16*(1): 141-155.

Food and Agriculture Organisation., 2009. The State of Food Insecurity in the World. *Economic crises – impacts and lessons learned*. Italy, Rome.
http://www.fao.org/docrep/012/i0876e/i0876e00.htm (23 October 2016).

Foster, A.D. and Rosenzweig, M.R., 1995. Learning by doing and learning from others: Human capital and technical change in agriculture. *Journal of political Economy*, *103*(6): 1176-1209.

Gebremedhin, B., Hoekstra, D. and Tegegne, A., 2006. *Commercialization of Ethiopian agriculture: Extension service from input supplier to knowledge broker and facilitator*. International Livestock Research Institute.

Godtland, E.M., Sadoulet, E., de Janvry, A., Murgai, R. and Ortiz, O., 2004. The impact of farmer field schools on knowledge and productivity: A study of potato farmers in the Peruvian Andes. *Economic Development and Cultural Change*, *53*(1): 63-92.

Golder Associates Golder Associates Africa (Pty) Ltd., 2015. *Four prioritised irrigation schemes in KwaZulu-Natal: Feasibility Assessment and Business Plan report for Tugela Ferry Irrigation Scheme (Revision 2).* Durban, South Africa.

Greenberg, J.B., 2013. Microfinance, Law, and Development: A Case Study in Mali. *Arizona Journal of International and Comparative Law.*, 30: 135.

Hall, R., Jacobs, P. and Lahiff, E., 2003. Evaluating land and agrarian reform in South Africa. *Occasional Paper Series*, *10*.

Hazarika, G. and Alwang, J., 2003. Access to credit, plot size and cost inefficiency among smallholder tobacco cultivators in Malawi. *Agricultural Economics*, *29*(1): 99-109.

Heckman, J., Ichimura, H., Smith, J. and Todd, P., 1998. *Characterizing selection bias using experimental data* (6699). National Bureau of Economic Research.

Hendriks, S.L. and Lyne, M.C., 2003. Agricultural growth multipliers for two communal areas of KwaZulu-Natal. *Development Southern Africa*, *20*(3): 423-444.

High Level Panel of Experts. 2013. Investing in smallholder agriculture for food security. *A report by the High-Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security*, Rome.

Horezeanu, L. and Mallory, M., 2015. Why formal credit eludes African smallholder farmers and the role of village moneylenders. *Policy Matters*. Univerisy of Illinois. http://policymatters.illinois.edu/why-formal-credit-eludes-african-smallholder-farmers-and-the-role-of-village-moneylenders/ (10 October 2017).

Huppi, M. and Feder, G., 1990. The role of groups and credit cooperatives in rural lending. *The World Bank Research Observer*, *5*(2): 187-204.

Ingenbleek, P.T. and van Tilburg, A., 2009. Marketing for pro-poor development: deriving opportunities for development from the marketing literature. *Review of Business and Economics*, *54*(3): 327-344.

James, P.A., Smart, J.C., Smith, J., Bulling, M.T., Beed, F.D. and Luwandagga, D., 2011. The effect of participation in the Ugandan National Agricultural Advisory Services on willingness to pay for extension services. *African Journal of Agricultural and Resource Economics*, *6*(1): 1-19.

Jonas, N., 2014, August. *An Economic Assessment of Outsourced Agricultural Extension Services in the uMzikhulu District of KwaZulu-Natal, South Africa*. MSc Thesis, Agricultural Economics, University of KwaZulu-Natal, KwaZulu-Natal.

Kamputa, D.D., 2000. Agricultural extension in the New Millennium: towards pluralistic and demand-driven services in Malawi. *Policy document, Governemt of Malawi, Ministry of Agriculture and Irrigation, Department of Agricultural Extension Services, Malawi*. http://g-fras.org/en/2015-05-28-15-50-27/australia-15/file/306-agricultural-extension-in-the-new-millennium-towards-pluralistic-and-demand-driven-services-in-malawi.html?tmpl=component (15 March 2017).

Khandker, S.R., Koolwal, G.B. and Samad, H.A., 2010. *Handbook on impact evaluation: quantitative methods and practices*. World Bank Publications.

Kidd, A.D., Lamers, J.P.A., Ficarelli, P.P. and Hoffmann, V., 2000. Privatising agricultural extension: caveat emptor. *Journal of Rural studies*, *16*(1): 95-102.

Kirsten, J.F. and Van Zyl, J., 1998. Defining small-scale farmers in the South African context. *Agrekon*, *37*(4): 551-562.

Koch, B.H. and Terblanché, S.E., 2013. An overview of agricultural extension in South Africa. *South African Journal of Agricultural Extension*, *41*(1): 107-117.

Kydd, J. and Dorward, A., 2001. The Washington consensus on poor country agriculture: analysis, prescription and institutional gaps. *Development policy review*, *19*(4): 467-478.

Lahiff, E. and Cousins, B., 2005. Smallholder agriculture and land reform in South Africa. *IDS Bulletin*, 36(2): 127-131.

Louw, A., Vermeulen, H., Kirsten, J. and Madevu 1, H., 2007. Securing small farmer participation in supermarket supply chains in South Africa. *Development Southern Africa*, *24*(4): 539-551.

Lyne, M.C., Hendricks, S.L. and Chitja, J.M., 2009. Agricultural growth and food security. *Does food security improve when smallholders access a niche market*. 1-10.

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

Machethe, C.L., Mollel, N.M., Ayisi, K., Mashatola, M.B., Anim, F.D.K. and Vanasche, F., 2004. Smallholder irrigation and agricultural development in the Olifants River Basin of Limpopo province: management, transfer, productivity, profitability and food security Issues. *Report to the Water Research Commission on the Project "Sustainable Local Management of Smallholder Irrigation in the Olifants River Basin of Limpopo Province,"* Water Research Commission, Pretoria, South Africa. 112

Machila, M., Lyne, M. and Nuthall, P., 2015. Assessment of an outsourced agricultural extension service in the Mutasa district of Zimbabwe. *Journal of Agricultural Extension and Rural Development*, (7)5: 142- 149.

Magingxa, L.L. and Kamara, A.B., 2003. Institutional perspectives of enhancing smallholder market access in South Africa. In *41st Annual Conference of the Agricultural Economic Association of South Africa held in Pretoria*.

Makapela, M., 2015. *Effectiveness of agricultural extension organisation in rural areas: the case of Amathole District Municipality, Eastern Cape.* Doctoral dissertation. University of South Africa.

Mangheni, M., Mutimba, J. and Biryabaho, F., 2003. Responding to the Shift from Public to Private Contractual Agricultural Extension Service Delivery: Educational Implications of Policy Reforms in Uganda. In *19th Annual AIAEE Conference, Raleigh, North Carolina, 8_12 April*. http://knowledge.cta.int/content/download/60834/903465/file/Mangheni_Private+extension_EN_CTA.pdf . (31 January 2016).

Mapila, M.A., Kirsten, J.F. and Meyer, F., 2012. The impact of agricultural innovation system interventions on rural livelihoods in Malawi. *Development Southern Africa*, *29*(2), 303-315.

Marinova, D., Annandale, D. and Phillimore, J. (2008). *The international handbook on environmental technology management*. Edward Elgar Publishing.

Marsh, S.P. and Pannell, D., 2000. Agricultural extension policy in Australia: the good, the bad and the misguided. *Australian Journal of Agricultural and Resource Economics*, *44*(4): 605-627.

Masangano, C. and Mthinda, C., 2012. Pluralistic extension system in Malawi. *International Food Policy Research Institute Discussion Paper 01171*.

Matshe, I., 2009. Boosting smallholder production for food security: some approaches and evidence from studies in sub-Saharan Africa. *Agrekon, 48*(4): 483-511.

Mendola, M., 2007. Agricultural technology adoption and poverty reduction: A propensity-score matching analysis for rural Bangladesh. *Food Policy*, *32*(3): 372-393.

Mnkeni, P.N.S., Chiduza, C., Modi, A.T., Stevens, J.B., Monde, N., Van der Stoep, I. and Dladla, R.W., 2010. Best management practices for smallholder farming on two irrigation schemes in the Eastern Cape and KwaZulu-Natal through participatory adaptive research. WRC Report No. TT 478/10. *Water Research Commission, Pretoria*.

Mpepereki, S., 2010. Technology adoption by smallholder farmers: Lessons from the soyabean research/promotion program in Zimbabwe. In *Second RUFORUM Biennial Regional Conference on" Building capacity for food security in Africa", Entebbe, Uganda, 20-24 September 2010* (pp. 1703-1708). RUFORUM.

Msinga Municipality. 2014. Integrated Development Plan 2014-2015. http://www.msinga.org/phocadownload/DevPlanning/msinga%20idp%202014%202015.pdf (26 September 2015).

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

Msinga Municipality, E.D., 2013. Integrated Development Plan 2013-2014. *Found at www. westerncape. gov. za/text/2014/April/eden-draft-idp-2014-15. pdf (accessed 26 September 2014)*.

Musemwa, L., Mushunje, A., Chimonyo, M., Fraser, G., Mapiye, C. and Muchenje, V., 2008. Nguni cattle marketing constraints and opportunities in the communal areas of South Africa: Review. *African Journal of Agricultural Research, 3*(4): 239-245.

Muyanga, M. and Jayne, T.S., 2008. Private agricultural extension system in Kenya: practice and policy lessons. *Journal of Agricultural Education and Extension*, *14*(2): 111-124.

Mwaura, F., Muwanika, F.R. and Okoboi, G., 2010. Willingness to pay for extension services in Uganda among farmers involved in crop and animal husbandry. In *African Association of Agricultural Economists (AAAE) and 48th Agricultural Economists Association of South Africa (AEASA) Conference*.

Nambiro, E., Omiti, J. and Mugunieri, L., 2006. Decentralization and access to agricultural extension services in Kenya. In *International Association of Agricultural Economists Conference, Australia.*

Ndoro, J.T., Mudhara, M. and Chimonyo, M., 2014. Cattle commercialization in rural South Africa: Livelihood drivers and implications for livestock marketing extension. *Journal of Human Ecology*, *45*(3): 207-221.

Nepal, R. and Thapa, G.B., 2009. Determinants of agricultural commercialization and mechanization in the hinterland of a city in Nepal. *Applied Geography*, *29*(3): 377-389.

Nyambo, B., Sief, A., Varela, A.M., Löhr, B., Cooper, J. and Dobson, H., 2009. Private extension-service provision for smallholder horticultural producers in Kenya: an approach. 94-102.

Obi, A., 2012. Governance structures for supply chain management in the smallholder farming systems of South Africa. *Unlocking markets to smallholders: lessons from South Africa*. Netherlands: Wageningen Academic Publishers, 10 (1): 193 – 218.

Ogbonna, O.I., Onwubuya, E.A., Iwuchukwu, J.C. and Akinnagbe, O.M., 2016. Evaluating effectiveness and constraints of private sector agricultural extension services of the Green River Project in Imo and Rivers States, Nigeria: original research. *African Evaluation Journal*, *4*(1): 1-9.

Okoboi, G., Kuteesa, A. and Barungi, M., 2013. The impact of the National Agricultural Advisory Services Program on household production and welfare in Uganda. *African Growth Initiative. Working Paper*, *7*.

Oladele, O.I. and Wakatsuki, T. 2005. *South African Journal of Agricultural Extension*. 39 (2): 79-90.

Oladoja, M.A., 2004. Changing trends and challenges facing agricultural extension delivery in Nigeria. In *Lead Paper Presented at the first South West AESON Conference, Ayetoro Dec*.

Organisation for Economic Co-Operation and Development., 2001. *Adoption of Technologies for Sustainable Farming Systems.* Wageningen Workshop Proceedings. http://www.oecd.org/greengrowth/sustainable-agriculture/2739771.pdf. (Accessed 29 October 2015).

Ortmann G.F and King R.P., 2010. Research on agri-food supply chains in Southern Africa involving small-scale farmers: Current status and future possibilities, *Agrekon: Agricultural Economics Research, Policy and Practice in Southern Africa*, 49(4): 397-417

Ortmann, G.F. and King, R.P., 2007. Agricultural cooperatives II: can they facilitate access of small-scale farmers in South Africa to input and product markets? *Agrekon, 46*(2): 219-244.

Pienaar, L. and Traub, L., 2015. Understanding the smallholder farmer in South Africa: Towards a sustainabile livelihoods classification.*Conference, August 9-14, 2015, Milan, Italy* (No. 212633). International Association of Agricultural Economists.

Quisumbing, A.R. and Pandolfelli, L., 2010. Promising approaches to address the needs of poor female farmers: Resources, constraints, and interventions. *World Development, 38*(4): 581-592.

Ragasa, C., Mazunda, J. and Kadzamira, M., 2015. *The National Extension Policy of Malawi—Lessons from Implementation*. International Food Policy Research Institute.

Ravallion, M., 2002. Externalities in rural development: Evidence for China. World Bank Policy Research Working Paper 2879, August 2002. www.papers.ssrn.com (29 November 2015).

Reyes, A., Lensink, B.W., Kuyvenhoven, A. and Moll, H., 2012. Impact of Access to Credit on Farm Productivity of Fruit and Vegetable Growers in Chile. *International Association of Agricultural Economists (IAAE) Triennial Conference.* Foz do Iguaçu, Brazil

Ringler, C., Cenacchi, N., Koo, J., Robertson, R.D., Fisher, M., Cox, C.M., Perez, N.D., Garrett, K. and Rosegrant, M.W., 2014. *Sustainable agricultural intensification: The promise of innovative farming practices* (43-52). International Food Policy Research Institute (IFPRI).

Rivera, W.M. and Alex, G., 2004. The continuing role of government in pluralistic extension systems. *Journal of International Agricultural and Extension Education, 11*(3): 41-52.

Rivera, W.M. and Cary, J.W., 1997. Privatizing agricultural extension. *BE Swanson, RP, 250*. 203-211. http://www.fao.org/docrep/W5830E/w5830e0o.htm (15 September 2016).

Rosenbaum, P.R. and Rubin, D.B., 1983. The central role of the propensity score in observational studies for causal effects. *Biometrika*. 70(1): 41-55.

Rosenbaum, P.R., 2002. Observational studies. *In: Observational studies Springer series in Statistics*, New York.

Saleem, M.A. and Farzard, J.A., 2011. The impact of agricultural credit on agricultural productivity in Dera Ismail Khan (District) Khyber Pakhtonkhawa Pakistan. *European Journal of Business and Management*, *3*(2): 38-44.

Saliu, O.J. and Age, A.I., 2009. Privatization of agricultural extension services in Nigeria: Proposed guidelines for implementation. *Journal of Sustainable Development in Africa*, *11*(2): 160-176.
Schwartz, L.A., 1994. *The role of the private sector in agricultural extension: Economic analysis and case studies* .54-54. London: ODI.

Shange, N., 2014. *Analysis of the challenges and opportunities for smallholder farmer value chain integration in the Western Cape: A public and private sector organisation perspective* (Doctoral dissertation, Stellenbosch: Stellenbosch University).

Shekara, C., 2001. Private extension: Indian way. *Private Extension: Indian Experiences, National Institute of Agricultural Extension Management (MANAGE), Hyderabad*.

Sikwela, M.M. and Mushunje, A., 2013. The impact of farmer support programmes on household income and sustainability in smallholder production: A case study of the Eastern Cape and KwaZulu Natal farmers, South Africa. *African Journal of Agricultural Research*, *8*(21): 2502-2511.

Sinyolo, S., Mudhara, M. and Wale, E., 2014. The impact of smallholder irrigation on household welfare: The case of Tugela Ferry irrigation scheme in KwaZulu-Natal, South Africa. *Water SA*, *40*(1): 145-156.

Smith, J.A. and Todd, P.E., 2005. Does matching overcome LaLonde's critique of nonexperimental estimators? *Journal of Econometrics*, *125*(1) 305-353.

Statistics South Africa., 2011. Census 2011 *Municipal report KwaZulu-Natal*. Pretoria. http://www.statssa.gov.za/census/census_2011/census_products/KZN_Municipal_Report.pdf (17 October 2015).

Swanson, B.E. and Samy, M.M., 2002. Developing an extension partnership among public, private, and nongovernmental organizations. *Journal of International Agricultural and Extension Education*, *9*(1), 5-10.

Tekana, S.S. and Oladele, O.I., 2011(a). Impact analysis of Taung irrigation scheme on household welfare among farmers in North-West province, South Africa. *Journal of Human Ecology*, *36*(1) 69-77.

Tekana, S.S. and Oladele, O.I., 2011(b). Qualitative analysis of strategies for maximizing the utilization of Taung irrigation scheme, South Africa by farmers. *Journal of Food, Agriculture & Environment*, *9*(3&4): 907-911.

Tilahun, M., Maertens, M., Deckers, J., Muys, B. and Mathijs, E., 2016. Impact of membership in frankincense cooperative firms on rural income and poverty in Tigray, Northern Ethiopia. *Forest Policy and Economics*, *62*: 95-108.

Tilburg, A.V., Obi, A., Fraser, G. and Schalkwyk, H.D.V., 2012. *Unlocking markets to smallholders: lessons from South Africa*. 10. Netherlands: Wageningen Academic Publishers.

Uddin, M.E. and Qijie, G. (2013). Prospects and challenges of privatization of agricultural extension service in Bangladesh. *Asian Journal of Agriculture and Rural Development*, *3*(7) 477.

Umali-Deininger, D. and Schwartz, L.A., 1994. *Public and private agricultural extension: Beyond traditional frontiers* (236). World Bank Publications.

Umali-Deininger, D., 1997. Public and private agricultural extension: partners or rivals? *The World Bank Research Observer*, *12*(2): 203-224.

Van Zyl, J., Kirsten, J. and Binswanger, M.P., 1996. *Agricultural land reform in South Africa: Policies, markets and mechanisms*. Cape Town (South Africa) Oxford University Press.

Verhofstadt, E. and Maertens, M., 2014. Can agricultural cooperatives reduce poverty? Heterogeneous impact of cooperative membership on farmers' welfare in Rwanda. *Applied Economic Perspectives and Policy*, *37*(1): 86-106.

Vink, N., van Rooyen, J. and Karaan, M., 2012, September. Farmer support programmes: Lessons from implementation. In *Strategies to overcome poverty and inequality: towards Carnegie III" Conference, Cape Town* (4).

Waddington, S.R., Li, X., Dixon, J., Hyman, G. and De Vicente, M.C., 2010. Getting the focus right: production constraints for six major food crops in Asian and African farming systems. *Food Security*, *2*(1): 27-48.

Weir, S and Knight, J. 2007. Production externalities of education: evidence from rural Ethiopia. *Journal of African Economies*, 16: 134–65.

White, H., 2006. *Impact evaluation: the experience of the Independent Evaluation Group of the World Bank.* MPRA Paper. https://mpra.ub.uni-muenchen.de/id/eprint/1111 . (07 April 2017).

World Bank .2007. *World Development Report 2008: Agriculture for Development*. New York: Oxford University Press.

Wynne, A.T. and Lyne, M.C., 2003. An empirical analysis of factors affecting the growth of small-scale poultry enterprises in KwaZulu-Natal. *Development Southern Africa*, *20*(5): 563-578.

Zhou, Y. and Babu, S., 2015. *Knowledge Driven Development: Private Extension and Global Lessons*. Academic Press, Elsevier.

APPENDICES

Appendix 1: Questionnaire used for data collection

IMPACT ASSESSMENT OF OUTSOURCED AGRICULTURAL EXTENSION ON FARMER PERFOMANCE IN MSINGA KWAZULU-NATAL

The information that will be collected from this questionnaire is strictly confidential and is to be used only for research purposes for the project titled above.

Name of interviewer			
Name of respondent			
Location			
Respondent is household head (yes/no)			
Project member		Non-project member	

A. HOUSEHOLD DEMOGRAPHIC INFORMATION

	Question	**Response**
A.1	Gender of household head *(1= male, 2= female)*	
A.2	Marital status of household head *(1=single, 2= married, 3= widowed,4=divorced)*	
A.3	Age of farmer (years)	
A.4	Years of formal schooling	
A.5	Household size (total number of people in household)	
A.6	Number of people <15	
A.7	Number of people between 15 and 65	
A.8	Number of people >65	
A.9	Number of males	
A.10	Number of females	
A.11	Number of people attending school	
A.12	Number of people working on farm	
A.13	Number of people working off farm	

A.14 Information for person responsible for farming activities

Farmer	Age	Gender	Highest education obtained	Years of experience with farming

B. FARM ENTERPRISE(S)

B.1 List the main crops/fruit you grow and provide the information for the 2014/15 cropping season

Name of crop/fruit	Planted (Y or N)	Reason for planting *	Area (Ha)	Quantity produced	Income from sales (R)
Cabbage					
Tomato					
Spinach					
Potatoes					
Onions					
Beans					
Maize					
Butternut					
Green pepper					
Sweet potato					
Others(specify)					

**1= only for household consumption, 2= mainly for household consumption, 3= equally for household consumption and income, 4= mainly for cash income, 5= only for cash income*

(a) If selling, who do you sell your produce to?*.....

**1= community, 2= customers calling to collect produce, 3= spazas, 4= chain stores, 5= other (specify)*

B.2 Cost of input purchased or hired in the year 2014/15

Input	Used (Y or N)	Total cost (R)
Fertilizer		
Pesticides		
Planting (hired tractor)		
Weeding (hired/family labour)		
Manure		
Others (specify)		
Seeds:		
Cabbage		
Tomato		
Spinach		
Potatoes		
Onions		
Beans		
Maize		
Butternut		
Green pepper		
Sweet potato		
Other (specify)		

B.3 Livestock

Type of livestock	Number owned by household	Approximate value per unit (R)	2014/15 Total income from animal sales (R)	2014/15 Total income from product sales
Goats				
Cattle				
Chickens				
Pigs				
Sheep				
Others (specify)				

B.4 Farm equipment used in 2014/15

Asset	Do you own it (Y or N)	Source*
Plough		
Planter		
Cultivator		
Tractor		
Trailer		
Irrigation tool		
Other (specify)		

**1= bought, 2= borrowed, 3= hired, 4= Lima, 5= Government*

B.5 What kind of challenges do you face in your farming activities?

Challenges	**Response***
Lack of information (market information, inputs, pricing)	
Poor markets	
Poor infrastructure	
Lack of skills and training	
Shortage in funding	
Insufficient water	
Insufficient land	
Lack of access to credit	
Lack of access to input	
Large increase (unaffordable) in input prices	
High cost of labour	

* 1= strongly disagree, 2= disagree, 3= neutral, 4= agree, 5= strongly agree

B.6 What type of farming are you engaged in?

Dry land farming		Irrigation farming		Livestock farming	

C. EXTENSION SERVICES

C.1 Is there an extension office in your area (Y/N)…….

C.2 Who among the following provides you with farming advice (basic support structures)?

Source	**Main source of information*[(a)]**	**Frequency of visits*[(b)]**
advice or training on crop or livestock production		
help to access input like seed, fertilizer and chemicals		
help to market farm product		
advice or help on loans or credit to purchase input or equipment		
Other (specify)		

*(a)*1 =government extension officer, 2=Lima, 3= other farmers/ friends, 4= others (specify)*
*(b) *1=never, 2=once a year, 3= once in six months, 4= once a month, 5= twice a month, 6= once a week*

C.3 (a) Has the information from extension services been useful in improving your farming practices?*…….

**1= not useful, 2= somewhat useful, 3= useful, 4= very useful*

(b) Why? (reason for answer above)
……
……

(c) Has your production improved due to assistance from source mentioned? (Y/N)……

C.4 (a) Has the information received from other farmers/friends been useful in improving your farming practices?*…….

**1= not useful, 2= somewhat useful, 3= useful, 4= very useful*

(b) Why? (reason for answer above)
……
…….....

(c) Has your production improved due to assistance from source mentioned? (Y/N)……

C.5 If you **<u>have</u>** used Lima's extension services:

(a) To your knowledge, are there any non-Lima members in your farming community who benefit from the services of Lima in any way? (Y/N) ……..

(b) Have you ever purposefully disseminated information you have obtained from Lima to non-Lima clients to help them improve their farming practices? (Y/N)…….

(c) Have there been other farmers who seek farming advice from you as a Lima beneficiary? (Y/N)……

(d) In your opinion are there any non-members who have adopted some of the practices introduced by Lima for use in their own farming activities? (Y/N) …….

(e) If yes, what practices are those?

.....
.....

C.6 If you **<u>have not</u>** used Lima extension services:

a) Have you heard of Lima's "Abalimi Phambili Programme"? (Y/N)……
b) Have you ever considered using Lima's services? (Y/N) ……...
c) For either Y/N please explain reasons for not joining
   ……
   ……
d) Have you ever received information/advice/help from a farmer who is a Lima client? (Y/N)……..…
e) If yes, did you find that information/advice/help useful?*……..
   **1= not useful, 2= somewhat useful, 3= useful, 4= very useful*
f) How did it help improve your farming activities?
   .....
   .....
g) Do you actively seek out information that you believe might be beneficial from Lima clients to assist in improving your farming operations? (Y/N)……

C.7 Credit

a) Have you used credit for any other farming purpose in the past two years? (Y/N)…….
b) If yes, where did you obtain the credit from? ……
   1= Lima, 2= government, 3= bank, 4= stokvel, 5= friend, 6= others (specify)

c) Have you been able to pay the credit back since obtaining it? (Y/N) .....

d) If no, what are some of the challenges faced with repayment?

.....

.....

e) What was the purpose of the credit obtained?* ……
**1= purchase of fertilizer, 2= purchase of farm equipment, 3= purchase of chemicals, 4= purchase of seeds, 5= purchase for grain consumption, 6= social obligation, 7= other (specify)*

D. LIMA RURAL DEVELOPMENT FOUNDATION BENEFICIARIES

D.1 How many times in the 2014/2015 season did you receive advice/training from Lima?*
.....
**0 = Never, 1 = once in six months, 2 = once in a year, 3 = once in a month, 4 = twice in a month, 5 = once in a week, 6 = twice in a week, 6 = everyday*

D.2 Which of Lima's services is most beneficial to you?
……
……..

D.3 Overall, how satisfied are you with Lima's Agricultural extension programme "Abalimi Phambili Programme"?*.....

**1 = not at all, 2 = slightly, 3 = somewhat, 4 = mostly, 5 = completely*

D.4 How satisfied are you with the following aspects of Lima's extension services?

	not at all	slightly	Somewhat	mostly	completely
Information being *what you expected* to receive					
Accuracy of information					
Information being *easy* to understand					
Timeliness of the information (received on time to be useful)					
Helpfulness of the information in decision making					
Relevance of examples used					
Lima Instructor's *knowledge level*					
Lima Instructor's *response* to questions					

Meeting location in terms of ease of listening & participation					
Assistance with market linkages					
Assistance with input linkages					

D.5 Based on information provided by Lima, what is the likelihood that you would recommend Lima extension services to your family and friends or other farmers?*.....

**1 = not likely, 2 = likely, 3 = neutral, 4 = more likely, 5 = very likely*

D.6 How *valuable* to you is the opportunity to network with experts and other participants with similar interests?*.....

** 1 = not at all, 2 = slightly, 3 = somewhat, 4 = quite, 5 = extremely*

D.7 Overall, how *valuable* to you is the information and programs provided by Lima?*.....
1 = not at all, 2 = slightly, 3 = somewhat, 4 = quite, 5 = extremely

D.8 Who did you sell your products to *before* joining the Lima project?*.....
**1 = community, 2 = hawkers who call & collect their products, 3 = spazas, 4 = pension points, 5 = chain stores (supermarkets, Boxer, Shoprite etc.)*

D.9 Who did you sell your products to *after* joining the Lima project?*.....
**1 = community, 2 = hawkers who call & collect their products, 3 = spazas, 4 = pension points, 5 = chain stores (supermarkets, Boxer, Shoprite etc.)*

D.10 Since joining Lima, have you hired, whether permanent or hired labour to assist with farming activities? (Y/N) ……
D.11 What do you wish Lima could change or improve?
.....
.....
.....
D.12 Indicate availability of inputs and information on farming now and if there are any changes since Lima's APP was introduced in your community:

	Available in the community? (Y/N)	Change in availability since Lima was introduced in the community?*
Availability of information on:		
Improved crop production practices		
Improved livestock production practices		
Market information (prices, markets, etc)		

on crops/livestock		
Credit information.		
Physical availability of agricultural production inputs:		
Improved seeds/planting material		
Improved livestock breeds		
Fertilizers		
Pesticides/ herbicides		
Farm equipment and tools		

**1 = reduced a lot, 2 = reduced a little, 3 = no change, 4 = improved a little, 5 = improved a lot*

D.13 How has your product quality changed since joining the Lima APP project?

	Response*
Taste	
Level of disease	
Lifespan	
Sales	
Size	
Storability	
Type of seed	
Level of production	

**1 = reduced a lot, 2 = reduced a little, 3 = no change, 4 = improved a little, 5 = improved a lot*

D.14 How has your household experienced the following changes since becoming a part of Lima APP in 2014/15?

Impact	How has it changed?*
Farm income	
Access to inputs	
Cheaper inputs	
Hired farm labour	
Access to credit	
Transport to receive & distribute crops	
Better diet and health	
Market information and knowledge on market channels (information on where to sell & who to sell to)	
Level of production	
Availability of land for farming	
Family food security	

**1 = reduced a lot, 2 = reduced a little, 3 = no change, 4 = improved a little, 5 = improved a lot*

Appendix 2: Household sampling design

Wards	Population (estimated number)	Range	Probability	Random number
Ward 3	2030	1 – 2030	0.152	
Ward 4	2235	2131 - 4265	0.169	3671
Ward 5	3247	3248 - 7512	0.244	
Ward 6	2150	7513 - 9662	0.161	8501
Ward 8	1533	9663- 11195	0.115	
Ward 14	2118	11196 -13313	0.159	
	13313			

Appendix 3: Probit analysis of factors affecting interaction with Lima farmer (np = 179)

Assistance from Lima farmer (n_c = 179) (positive externality)	Coefficient	Standard error	Marginal effects
Age	-0.009	0.010	-0.004
Gender	-0.199	0.244	-0.079
Formal schooling	-0.002	0.028	-0.0008
Farming experience	-0.009	0.009	-0.004
Land	-0.299	0.842	-0.119
Access to Lima office	-1.186**	0.533	-0.372
Distance to Lima office	0.004	0.022	0.004
Lima awareness	0.659***	0.222	0.659
Usefulness of extension	0.217**	0.107	0.217
Usefulness of info from other farmers	0.208*	0.110	0.208
Constant	0.573	0.831	0.573
Psuedo R^2	0.13		
LR χ^2 (11)	29.24		
P (χ^2)	0.0021		
% predicted correctly	68.05		

*Notes: ***, **, and * mean significant at 1%, 5% and 10% levels respectively.*

Appendix 4: Test of matching quality between non-Lima beneficiaries

	Mean			**t-test**	
Variable	Treated	Control	%bias	t	p>t
Age	52.253	54.644	-17.6	-1.28	0.201
Gender	0.21839	0.10345	26.4	2.08	0.039
Formal schooling	2.6897	3.1954	-12.3	-0.80	0.424
Farming experience	19.759	21.103	-9.7	-0.65	0.518
Land	0.12328	0.11176	9.3	0.72	0.475
Type of help received from other farmers	1.9425	2.2759	-20.4	-1.30	0.195
Access to Lima office	0.94253	0.94253	0.0	0.00	1.000
Distance to Lima office	9.023	8.7816	5.0	0.34	0.737
Lima awareness	0.72414	0.71264	2.4	0.17	0.867
Usefulness of extension	2.908	3.023	-11.3	-0.75	0.456
Usefulness of info from other farmers	3.0575	3.1724	-11.3	-0.76	0.451

Summary of distribution of bias
Min = 0.0, Max = 26.4
Mean = 11.4 Std. Dev = 1.19
Psuedo R^2 = 0.093
LR χ^2 = 9.17, P (χ^2) 0.6

Appendix 5: Sensitivity to bias test

	Total crop revenue		Net crop revenue	
Gamma	Upper bound significance level	Lower bound significance level	Upper bound significance level	Lower bound significance level
1	0.000048	0.000048	0.003209	0.003209
1.1	0.000215	8.8e-06	0.009576	0.00092
1.2	0.000738	1.6e-06	0.022886	0.000254
1.3	0.002049	2.8e-07	0.046147	0.000068
1.4	0.004816	5.0e-08	0.081502	0.000018
1.5	0.009912	8.7e-09	0.129597	4.6e-06
1.6	0.018317	1.5e-09	0.18943	1.2e-06
1.7	0.030987	2.6e-10	0.258623	2.9e-07
1.8	0.048709	4.4e-11	0.33395	7.2e-08
1.9	0.071998	7.4e-12	0.411919	1.8e-08
2	0.101031	1.3e-12	0.489256	4.3e-09
2.1	0.135631	2.1e-13	0.563234	1.0e-09

2.2	0.175306	3.6e-14	0.631832	2.5e-10
2.3	0.219309	6.0e-15	0.693755	6.1e-11
2.4	0.266715	1.0e-15	0.74836	1.5e-11
2.5	0.316507	1.1e-16	0.795539	3.5e-12
2.6	0.367649	0	0.835575	8.2e-13
2.7	0.419149	0	0.869013	1.9e-13
2.8	0.470108	0	0.896551	4.6e-14
2.9	0.519749	0	0.918944	1.1e-14
3	0.56743	0	0.936951	2.6e-15

Note: Bold is a reference to the Rosenbaum bounds critical gamma cut-off value

Appendix 6: Impact heterogeneity among farmers who have received information from Lima farmers

Variable	**Total crop revenue**		**Net crop revenue**		**Inputs and services purchased**	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Age	20.71972	60.32059	-24.72823	57.09536	45.44795***	15.64181
Gender	867.5991	1470.512	404.6046	1391.886	462.9946	381.3204
Formal schooling	145.6501	153.9556	52.80431	145.7238	92.8458***	39.92242
Farming experience	68.82304	60.22829	53.8763	57.00799	14.94673	15.61788
Land	21091.7***	5910.969	17889.27***	5594.92	3202.433**	1532.781
Access to Lima office	772.0342	2215.095	268.7846	2096.658	503.2496	574.3992
Distance to Lima office	29.17211	128.9346	-40.19168	122.0407	69.36378**	33.4342
Lima awareness	-1552.678	1429.826	-1910.362	1353.376	357.6838	370.7701
Usefulness of extension	1303.733*	669.2559	1218.302*	633.472	85.43095	173.5456
Usefulness of info from other farmers	125.912	678.505	57.871	642.2266	68.04097	175.944
Constant	-1801.408	4351.412	73.47364	4118.75	-1874.882	1128.37

*Notes: ***, **, and * mean significant at 1%, 5% and 10% levels respectively*