Assessing the impact of the 2020 Presidential Economic Stimulus Initiative on smallholder farmers` household food security status: Empirical evidence from Ngaka Modiri Molema District, South Africa

By

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DEDICATION

I dedicate this thesis to myself, my family, and friends who have been supportive throughout my whole life.

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As the candidate's supervisors, we agree to the submission of this thesis:

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DECLARATION 2: CONFERENCE CONTRIBUTIONS AND PUBLICATIONS

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ABSTRACT

Persistent poverty and food insecurity remain critical global challenges despite numerous efforts by various stakeholders to address them. These issues are particularly acute in rural regions, where the majority of the affected population depends on agriculture and related activities for their livelihoods. Enhancing agricultural productivity has been widely recognized as a means of increasing household income and improving household food security among smallholder farmers. In line with this, input subsidy programs, such as the Presidential Employment Stimulus Initiative (PESI), have been implemented to provide smallholders with essential agricultural inputs, including seeds and fertilizers, thereby raising productivity levels.

This study examines smallholder farmers' perceptions of PESI, identifies the factors influencing these perceptions, and assesses the program's impact on household food security. A total of 231 smallholder households, comprising both program beneficiaries and non-beneficiaries, were selected for the study. Data were collected using a structured questionnaire. Descriptive statistics were used to assess overall perceptions, while an ordered probit model was employed to determine the factors influencing perceptions. Propensity Score Matching (PSM) and Average Treatment Effect on the Treated (ATT) were used to estimate the program's impact on household food security.

The findings reveal that smallholder farmers generally hold favourable perceptions towards PESI, indicating its potential acceptability within agricultural policy frameworks. Significant determinants of perception included gender, age, education level, communication channels, and household total income. The ATT results indicate that the program has had a positive effect on household food security. The study recommends that the government enhance program effectiveness by improving beneficiary targeting mechanisms to ensure resources are directed towards those who are most in need and are best positioned to deliver the intended outcomes, ensuring agro-dealers charge accordingly, enhancing outreach and support, and improving program evaluation and monitoring.

Keywords: Smallholder farming, PESI, Ordered Probit, Average Treatment Effect on the Treated, Household food security.

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LIST OF ABBREVIATIONS

CASP- Comprehensive Agricultural Support Programme

DAFF- Department of Agriculture Forestry and Fisheries

DALRRD- Department of Agriculture Land Reform and Rural Development

DID- Difference in Difference

ERP- Expenditure Performance Review

ESR- Endogenous Switching Regression

FISP- Farmer Input Support Program

FNS-Food and Nutrition Security

FSP- Farmer Support Program

FIES- Food Insecurity Experience Scale

GDP- Gross Domestic Product

GHS- General Household Survey

MAFISA- Micro Agricultural Financial Institution of South Africa,

NAIVS- National Agricultural Input Voucher Scheme

NMMD- Ngaka Modiri Molema District

DPME- Department of Performance Monitoring and Evaluation

PDA- Provincial Department of Agriculture

PESI- Presidential Employment Stimulus Initiative.

SA- South Africa

SL- Sustainable Livelihood

SLF- Sustainable Livelihood framework

SSA- Sub-Saharan African

FCS- Food Consumption Score

ATT- Average Treatment Effect on the Treated

ATE- Average Treatment Effect

ICT- Information and Communications Technology

TPB- Theory of Planned Behaviour

HDDS- Household Dietary Diversity Score

GTAC- Government Technical Advisory Centre

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CHAPTER ONE: INTRODUCTION

1.1. Introduction

Agriculture remains one of the key sectors contributing to the development of rural economies and the sustenance of livelihoods. The sector remains a key provider of employment opportunities to the majority of rural residents who are relatively less educated (McCullough, 2017). Fan and Rue (2020) indicated that approximately 2.6 billion people worldwide are directly dependent on agriculture, with the majority being smallholder farmers in developing countries. Goedze et al. (2019) stated that in most African countries, over 60% of the population practice smallholder farming. According to Bread for the World (2023), approximately 80% of the food available in Sub-Saharan Africa (SSA) is produced through smallholder farming, which plays a crucial role in ensuring food security and reducing hunger. These statistics indicate the importance of smallholder agriculture to rural livelihoods.

In South Africa, smallholder farming is often regarded as an activity that is consciously undertaken at various levels of operation, primarily for the purposes of household food consumption and income generation. According to Müller (2021), 93% of all VAT-registered farms are small micro-operations that contribute 23% of household income and 37% of employment in the South African agricultural sector. Additionally, there has been a 29% increase in the number of people relying on smallholder farming over the past ten years in the country (Bolleurs, 2022). This indicates that the South African smallholder farming sector has the potential to make a positive contribution to enhanced livelihoods in rural communities. This is further affirmed by various policies and programs such as the Comprehensive Agricultural Support Programme (CASP), ILIMA\Letsema, and Micro Agricultural Financial Institutions of South Africa (MAFISA) that continue to position the development of smallholder farming systems as a solution towards reducing poverty and food insecurity in the country, particularly in current times of high unemployment rates of 31.9% (Statistics South Africa (Stats SA), 2025) and slow economic growth (National Treasury, 2024).

Even though smallholder farming has a positive impact in South Africa, the sub-sector faces multiple challenges that hinder its productivity and profitability. These challenges include limited access to essential production resources, such as land, fertilizer, seeds, pesticides, and herbicides, necessary for improved yields (Kabane, 2020). Smallholder farmers also lack access to proper on and off-farm infrastructure to maintain the quality of their produce. These challenges are further made worse by their lack of access to finance (Baloyi, 2010). Mbuli et al. (2021) also stated that, amid the risks and shocks associated with climate change, smallholder farmers are further exposed to possible damage to their produce. Bread for the World (2023) also mentioned the lack of training as a challenge faced by smallholder farmers in South Africa. Collectively, this hinders their access to markets, directly affecting their income and influencing their household food security.

Mthembu et al. (2022) stated that the above-mentioned challenges were exacerbated by the Covid-19 pandemic, further placing smallholder farmers in a position of disempowerment and heightened vulnerability to poverty. The pandemic disrupted supply chains, making it difficult for smallholder farmers to access markets for their products. Government imposed restrictions aimed at curbing the spread of the virus led to the closure of various industries, including the tourism and hospitality sectors, which significantly reduced the demand for fresh produce (Organization for Economic Co-operation and Development, 2020). Additionally, smallholder farmers were restricted from selling as hawkers despite this being their primary market channel. This further constrained their ability to generate income through farm sales.

Kaufmann (2020) further indicated that the pandemic also affected farm operations, reducing access to production resources. The majority of smallholder farmers could not obtain the necessary inputs due to a lack of income and lockdown restrictions (Mthembu et al., 2022). Access to credit was also limited as financial lending institutions became cautious due to economic uncertainty (Berger & Demirgüç-Kunt, 2021). Where lending was accessible, it came at a higher cost, reducing profit margins. In addition, the pandemic limited communication between smallholder farmers and extension officers, affecting their access to extension services.

In response to the worsened challenges faced by smallholder farmers during the Covid-19 pandemic, the Department of Agriculture, Land Reform, and Rural Development (DALRRD) introduced the Presidential Employment Stimulus Initiative (PESI) in December 2020, aiming to alleviate some of the challenges faced by smallholder farmers. The initiative aimed to contribute towards improving smallholder farmers` livelihoods and farm operations through the provision of financial support. The initiative targeted smallholder farmers, prioritizing farm dwellers, farmworkers, child-headed households, and military veterans (Business Insider Africa, 2021). The program was rolled out in the form of vouchers that can be redeemed for agricultural inputs, such as fertilizers and seeds, at selected agro-dealers (Food for Mzansi, 2022). The first call for PESI funds applications was made on December 10, 2020 (Matsimela, 2022), and the second phase was announced on November 30, 2021 (Chucks, 2023). The implementation of such programs contributes to the Sustainable Development Goal (SDG) of Zero Hunger (SDG 2) by providing smallholder farmers with access to agricultural inputs, which can increase their agricultural productivity and income, which ultimately improves household food security. Additionally, PESI can support SDG 8 (Decent Work and Economic Growth) through promoting agricultural productivity and entrepreneurship.

1.2. Problem Statement

Unsustainable livelihoods and food insecurity are common problems faced by people living in rural areas of developing countries, particularly in SSA countries (Baloyi, 2020). Smallholder farming is viewed as a feasible activity that enhances food and nutrition security in local food systems. However, various factors continue to hinder smallholder farmers from deriving benefits from the sub-sector. The Covid-19 pandemic further exacerbated these challenges, leading to increased poverty and food insecurity among rural smallholder farming households. The implementation of PESI by the South African government aimed to assist smallholder farmers in recovering and improving their farming operations amid the direct and indirect effects of the pandemic. Although a relatively new approach in South Africa, this voucher-based intervention has been practiced for some time across many developing countries as a mechanism to support smallholder farmers (Obayelu, 2016).

Over the years, various countries across the SSA region have adopted voucher-based interventions to improve smallholder farming operations. This includes the National Agriculture Input Voucher Scheme (NAIVS) in Tanzania, the Farmer Input Support Programme (FISP) in Malawi and Zambia, and the Agricultural Voucher Input Programme in Nigeria. Studies assessing the impact of these programs have reported inconclusive findings. For instance in Zambia, Mason and Jayne (2011) stated that FISP enhanced welfare and reduced poverty among smallholder farmers by 17%. In the same country, Bwalya et al. (2023) reported that FISP is less effective in reducing poverty compared to other anti-poverty programs. Allan (2021) indicated that the implementation challenges of FISP included late delivery of inputs, limited choice of inputs, and poor targeting of beneficiaries. In Tanzania, Malimi (2023) found that NAIVS was effective in increasing crop yields and productivity in maize-planted plots. However, Giné et al. (2019) stated that the impact of NAIVS had a limited impact on food security and farm income, particularly in the short run. Implementation challenges encountered during the implementation of NAIVS included farmers' inability to pay the required additional fees for redeeming vouchers, as well as their tendency to exchange vouchers for monetary value (Giné et al., 2019).

Although the majority of the studies assessing these programs highlight positive results (Kodamaya, 2011; Mason & Jayne, 2011; Liverpool-Tasie & Takeshima, 2013; Wossen et

al., 2017; Malimi, 2023; Giné et al., 2019), the overall impact remains inconclusive. With the voucher-based intervention being implemented in South Africa for the first time, it remains necessary to understand the program's impact on smallholder farmers and identify any challenges experienced during its implementation. This is particularly important considering that various government interventions previously implemented to improve smallholder farming yielded low to no results (Business Enterprises, 2015; Nkgudi et al., 2022). Exploring and understanding the direct impact of this program in South Africa remains a crucial step toward creating interventions that have a significant impact on improving smallholder farming. To the author's knowledge, no empirical research has investigated the impact of these programs on the livelihoods of smallholder farmers in South Africa. Most of the available knowledge on PESI and its impact on smallholder farmers is of non-academic nature (Ludoph, 2022; Matsimela, 2022; Mcwango, 2023; Ntombela, 2022; Phillip, 2022), emphasizing the need to address this gap through empirical insights. On this note, this study aims to understand the impact of PESI on the household food security of smallholder farmers and to understand further the farmers' perceptions of its effectiveness in addressing the challenges they face. These insights will serve as a foundation for policymakers and agricultural stakeholders seeking to strengthen and improve the lives of smallholder farmers. Additionally, these insights can serve as a basis for the formation and/or review of existing programs aimed at improving smallholder farmers' farm income and food security, thereby contributing to progress in achieving the Sustainable Development Goals (SDGs).

1.3. Research Questions

Considering the above problem statement, the study aims to answer the following research questions:

a) What are the perceptions of smallholder farmers towards the PESI program and what factors influence their perceptions?
b) What is the impact of the PESI program on smallholder farmers` household food security?

1.4. Research Objectives

The main objective of the study is to investigate the impact of the 2020 PESI program on the household food security levels of smallholder farmers in the Ngaka Modiri Molema District.

The specific objectives include:

a) To understand smallholder farmers perceptions of the PESI program and determine factors influencing those perceptions.
b) To assess the impact of the PESI program on smallholder farmer`s household food security.

1.5. Thesis Structure

Chapter 1: This chapter introduces the topic, outlines the importance of smallholder farmers and their challenges. The chapter contains the problem statement and the significance of studying the topic. The chapter motivates the research problem and presents the objectives of the study.

Chapter 2: This chapter contains the literature review of the relevant literature. It gives an overview of the term "food security" and its measures, defining smallholder farming in South Africa and beyond, and their livelihoods before and after the Covid-19 pandemic. The chapter details perceptions of farmers towards agricultural support programs and reviews voucher-based support programs in other SSA countries. A summary is included to close off the chapter.

Chapter 3: This chapter contains the breakdown and analysis of objective one of the study. The description of the study site and data collection procedures of the study are included in this chapter. This chapter also entails the theoretical and conceptual framework of the objective and the empirical methods for data analysis. The chapter contains empirical results and discussions on objective one of the study. A conclusion and recommendations are included in this chapter. The chapter is closed off by a summary of everything included in it.

Chapter 4: This chapter presents a detailed breakdown and analysis of the second objective. The description of the study site and data collection procedures of the study are included in chapter three. This chapter outlines the theoretical and conceptual framework relevant to the objective, as well as the empirical methods used for data analysis. The chapter further discusses the empirical findings and interpretation in relation to objective two. the chapter concludes with key recommendations and a summary of the whole chapter is included.

Chapter 5: This chapter revisits the purpose of the study, gives the conclusion and recommendations for the whole study. The chapter is closed off by giving the future research focus.

CHAPTER TWO: LITERATURE REVIEW

2.1. Introduction

This chapter reviews the literature. Section 2.2. provides an understanding of the term “Food Security” and its dimensions and measures. Section 2.3. contains an overview of smallholder farming in South Africa and beyond while section 2.4. includes a summary of support programs implemented by the South African government for smallholder farmers. Section 2.5. and 2.6. details various voucher-based smallholder input support programs in SSA countries and smallholder farmers` perceptions towards agricultural input support programs respectively. Section 2.7. gives a summary of the chapter.

2.2. Understanding the Term "Food Security: Dimensions and Measures

The concept of food security has undergone significant evolution, both in its definition and in its operationalization in policy and research. The FAO (2001) offers one of the most widely accepted definitions: a condition where all people, at all times, have access to sufficient, safe, and nutritious food for a healthy and active life. This definition expanded in 2009 to include -stability-, recognizing that food systems must be resilient against shocks, including economic crises and climate-related events. Early framings of food security prioritized macro-level food availability and price stability, mainly in response to global agricultural disruptions in the 1970s. However, as global food crises persisted, the focus shifted toward human rights and individual-level access, particularly among the poor and marginalized (FAO, 2008).

While this conceptual expansion has improved theoretical understanding, a disconnection remains between global definitions and how food security is experienced and measured at the household level, particularly among smallholder farmers in rural contexts. This poses a challenge for assessing the impact of programs like PESI, which aim to improve food access and utilization through local, micro-level interventions. The literature provides a strong theoretical foundation, but few empirical studies in South Africa have investigated how such safety nets influence all four food security dimensions in an integrated manner, particularly stability, which is crucial in post-crisis recovery and resilience-building among smallholders.

Therefore, this study aims to fill a critical gap by examining the full multidimensional scope of how PESI affects household-level food security.

2.2.1 Dimensions of Food Security

Food security has four interdependent pillars: availability, accessibility, utilization, and stability (FAO, 2008). Availability concerns the physical presence of food through production or imports; accessibility relates to households' ability to acquire sufficient food through income, production, or aid (Gross et al., 2000); utilization addresses the body's ability to ingest and metabolize nutrients; and stability underlines the importance of temporal consistency across the other three dimensions (FAO, 1996). A major critique in the literature is that many interventions focus on one or two pillars, typically availability or access while neglecting utilization and, in particular, stability. For example, input support programs often increase yields but fail to ensure long-term resilience against climate or market shocks, which limits their contribution to sustainable food security.

Moreover, most existing analyses assess food security at either the national or household level without distinguishing between the two. This leads to the flawed assumption that national-level food security implies individual or household-level security, which is not always the case, particularly in regions with pronounced socioeconomic inequalities, such as rural South Africa. For PESI, which is a national-scale program operating in highly localized rural environments, this distinction is critical. Understanding household dynamics, infrastructure access differences, and socioeconomic barriers is crucial for determining whether PESI promotes food-secure outcomes or merely addresses short-term deficits.

2.2.2. Measures of Food Security

While the four-pillar framework is widely accepted, measuring food security remains a contested issue. Researchers have long debated not only which indicators best capture food insecurity but also how temporal, cultural, and methodological differences skew results (Barret, 2010). For instance, self-reported experiences of food insecurity can differ based on social desirability bias or memory recall, whereas consumption-based measures may miss subjective experiences of hunger and anxiety. This is particularly relevant in assessing interventions like PESI, where both objective improvements (e.g., yield, dietary diversity) and subjective perceptions (e.g., confidence in food access) matter for program evaluation.

Several instruments are used globally, each emphasizing different aspects. The Household Food Insecurity Access Scale (HFIAS) measures experiential access over a 30-day recall period (Cafiero, 2019). The Food Consumption Score (FCS) captures dietary diversity and meal frequency, while the FAO's Food Insecurity Experience Scale (FIES) measures perceived access to food. While most tools focus on short-term or access-related indicators and rarely integrate the full complexity of all four food security dimensions. Furthermore, few instruments contextualize food insecurity within broader livelihood shocks, such as the Covid-19 pandemic, which have profoundly altered access, stability, and resilience among smallholder farmers.

In South Africa, especially when evaluating programs like PESI, no consensus exists on a standard for measurement. Many evaluations have prioritized quantitative yield increases while overlooking whether these improvements translate into nutritional benefits or reduce long-term vulnerability. This study employs a dual-measurement approach, integrating both HFIAS and FCS to assess food access and provide qualitative insights into utilization and stability, thereby addressing a gap in the existing literature that relies on unidimensional metrics. By doing so, the study contributes to a more nuanced understanding of food security outcomes linked to public safety net interventions.

2.3. Smallholder Farming in South Africa and Beyond

Agriculture remains central to the livelihoods of rural populations, particularly among the 80% of the world's poor who reside in these areas (World Bank, 2025). In South Africa, smallholder farming is consistently cited as a potentially transformative sector for reducing poverty, enhancing food security, and generating employment (DAFF, 2012; Kamara et al., 2019). However, this potential remains largely unrealized. Despite government efforts to support smallholder farmers through input schemes and land reform initiatives, systemic challenges such as inadequate infrastructure, insecure land tenure, and weak market access continue to hinder meaningful transformation. This stagnation raises important questions about the efficacy of policy interventions, such as PESI, CASP, and MAFISA, which were implemented to address these very constraints.

Critically, most literature focuses on the theoretical role of smallholder farming in rural development but lacks grounded evaluations of actual program impact, especially in terms of farmer perceptions and household-level outcomes. Moreover, studies often treat smallholders as a homogeneous group, ignoring the heterogeneity in access to land, experience, market orientation, and vulnerability to shocks. This undermines the relevance and targeting of support programs. Therefore, this study not only evaluates the impact of PESI on food security outcomes but also addresses a clear gap by interrogating how smallholder farmers themselves perceive the program's effectiveness, utility, and relevance in their lived context.

2.3.1. Defining the term "smallholder farmer"

There is no universally agreed-upon definition of a smallholder farmer. Definitions vary across agro-ecological zones, nations, and even within countries, reflecting divergent social, economic, and environmental contexts (Chamberlin, 2007; Nagayets, 2005). Common themes include limited land ownership, low capital input, minimal use of mechanization, and family-based labour systems. In South Africa, government institutions such as DAFF (2012) attempt to standardize definitions by distinguishing between "subsistence" and "emerging" smallholders. However, this binary oversimplifies a complex spectrum of producers, from those farming purely for consumption to those intermittently engaging in local markets (Ramogodi, 2022; Achmad et al., 2022).

The lack of definitional clarity presents significant challenges when designing and evaluating interventions like PESI. Without a nuanced understanding of who smallholders are, policymakers risk delivering "one-size-fits-all" support packages that fail to address differentiated needs. Furthermore, most literature offers typologies but does not critically assess how smallholders perceive themselves within these labels, an omission this study directly tackles through its second objective. Capturing farmer perceptions is essential not just for policy design but for building trust and participation in government programs.

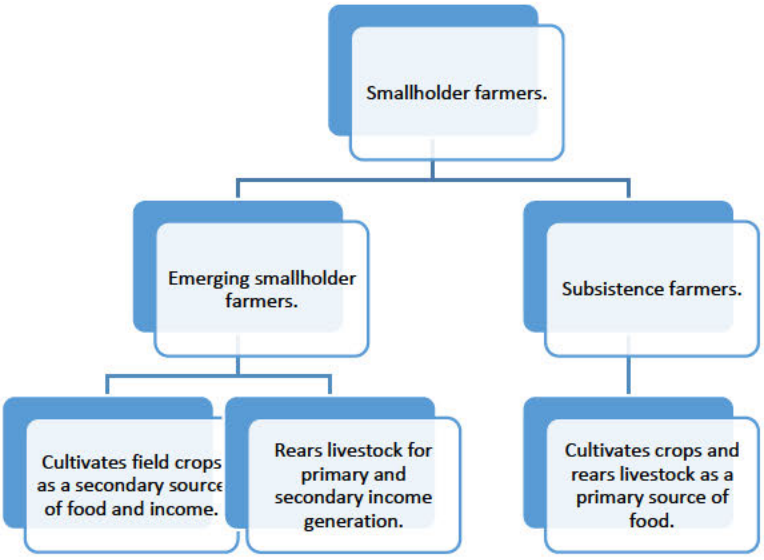

Figure 2.1. Graphical representation of the subdivision of the term "smallholder farmer" in South Africa

Adapted from: DAFF (2012); Achmad et al. (2022)

2.3.2 Smallholder Farmers` Livelihoods in South Africa

2.3.2.1. Livelihoods of Smallholder Farmers in South Africa Before Covid-19

Households in rural areas adopt various livelihood strategies that seem to be conducive given the opportunities and limitations of their specific environment. This livelihood diversification among households in rural areas is a process whereby different groups of activities are chosen by households with hopes of improving their standard of living. Rural livelihood strategies are influenced by past legacies and current changes which include factors like social grant assistance (Neves & Du Toit, 2013). The majority of people living in rural areas are either directly or indirectly involved in agriculture, and their livelihood options can either be farm-related, off-farm-related, or non-farm-related (Asare, 2018).

According to Pienaar (2013), the majority of smallholder farmers' households in former homelands are typically poor and part of the previously disadvantaged racial groups. Their main aim is to produce a staple food suitable for household consumption and can be produced on the available agricultural land (Ritchie, 2021). There is a considerable variation of land sizes for smallholder cultivation and the sizes are very small. According to GHS (2021), there is a high percentage of smallholder households who rely on their agricultural activities for food compared to those who rely on agricultural activities for income.

However, few studies prior to Covid-19 investigated how state-led support programs influenced smallholder livelihoods beyond income, particularly regarding resilience, self-reliance, or long-term food stability. Moreover, existing assessments largely rely on quantitative data, with little engagement with farmers' lived experiences or program feedback. This study addresses that limitation by integrating farmer narratives into the evaluation of PESI.

2.3.2.2. Livelihoods of Smallholder Farmers in South Africa During Covid-19

Even though the Covid-19 pandemic was a global occurrence heavily affecting livelihoods, the degree of its severity and impact on different groups and sectors was different. The South African government announced the level 5 lockdown restrictions on the 23rd of March 2020 to reduce the spread of Covid-19 (Made et al., 2021). The lockdown restrictions included movement limitations, only allowing one family member to go shopping for essential goods. Transport was limited to a few hours a day and travel permits were required when one travelled outside their immediate area (Peden & Kobusingye, 2019). Small and large businesses including the agricultural sector were unable to function optimally due to this law. There was also a disturbance in service delivery which highly impacted the affordability of goods and services in the food supply chain which ultimately affected the food security of many rural communities (Béné et al., 2021). Smallholder farmers were largely impacted by the Covid-19 lockdown as they are vulnerable to unfavourable natural disasters and health-related shocks as these affect their production levels (Nchanji & Lutomia, 2021).

During the Covid-19 pandemic, many smallholder farmers were unable to reach their optimum production levels due to a combination of interrelated challenges. Various literature sources state that illness among family members and limited household labour significantly

reduced on-farm productivity, while a loss of income constrained the ability to purchase essential agricultural inputs (Milken Institute, 2022; Matakanure, 2021; Kaberia & Mauthe, 2021). Beyond these issues, supply chain disruptions severely limited access to markets and led to increased prices for inputs such as seeds and fertilizer, with some farmers resorting to uncertified, low-yielding seed varieties (Milken Institute, 2022). Additionally, the suspension of agricultural extension services deprived farmers of crucial guidance needed for agricultural activities (Mutenje et al., 2022). Labor shortages also arose from government-imposed mobility restrictions, limiting access to seasonal and hired labour (Andam et al., 2022). Financial constraints were further exacerbated by limited access to credit and delayed payments, undermining farmers' ability to invest in their production cycles (TechnoServe, 2020). Compounding these factors, households experienced increased living expenses, particularly for food and transportation, which diverted resources away from agricultural investment (Fanzo et al., 2024). These multidimensional constraints underscore the structural vulnerabilities within smallholder farming systems and the need for resilient, inclusive support mechanisms during global crises.

While literature acknowledges these disruptions, most studies generalize impacts without disaggregating how different groups of smallholders. e.g., elderly, women, youth, experienced and responded to the crisis (Touch et al., 2024; Fanzo et al., 2024). Moreover, minimal attention has been given to how emergency support programs such as PESI were perceived and whether they effectively mitigated these challenges. This study contributes by evaluating how smallholders viewed PESI during and after Covid-19, and which socio-economic factors shaped these perceptions.

2.3.2.3. Livelihoods of Smallholder Farmers in South Africa After Covid-19

The livelihoods of smallholder farmers in South Africa were largely affected by the Covid-19 pandemic. The majority of smallholder farmers, particularly the elderly and those in rural areas were severely affected due to their high reliance on agriculture (Touch et al., 2024). Delardas et al. (2022) stated that the Covid-19 pandemic led to a decline in economic activities, which resulted in reduced income and increased food prices, which excessively affected vulnerable communities. The Covid-19 pandemic worsened the already dire challenges faced by smallholder farmers in South Africa, including an increase in food

insecurity in rural areas where many households rely on smallholder farming for subsistence (Mthembu et al., 2022). The Covid-19 pandemic has severely impacted smallholder farmers` income generation, household food security, access to health care, and access to essential inputs in South Africa, highlighting their vulnerability to shocks, and this underscores the need for sustained government support and innovative solutions.

2.4. Overview of Smallholder Farmer Support Programs in South Africa

Over the past two decades, the South African government has implemented a series of support programs aimed at revitalizing the smallholder farming sector as a means to address rural poverty, food insecurity, and agricultural underdevelopment. These programs have produced mixed results, largely due to inconsistent implementation, poor monitoring, inadequate farmer engagement, and systemic governance weaknesses. This section reviews four support programs, critically assessing their objectives, outcomes, and implementation challenges. More importantly, it highlights a persistent gap in the literature: the voices and lived experiences of smallholder farmers. This study seeks to fill that gap through a direct inquiry into smallholder perspectives of the PESI program and how such perceptions relate to food security outcomes.

2.4.1. Comprehensive Agricultural Support Program (CASP)

The Comprehensive Agricultural Support Program (CASP) is a key initiative aimed at supporting agricultural development in South Africa, particularly for smallholder farmers. Established in 2004 following the failure of the Broadening of Access to Agriculture Thrust (BATAT), CASP seeks to improve access to farmer support and enhance agricultural services. The program focuses on six pillars: information and knowledge management, regulatory services, technical assistance, marketing and business development, training, and infrastructure development. Over the years, CASP has allocated significant funds to provincial departments of agriculture, spending 87% of its budget by 2012 and supporting thousands of projects with hundreds of thousands of beneficiaries (Business Enterprises, 2014; Mncina & Agholor, 2021).

Despite its positive contributions, CASP has faced challenges, including a heavy emphasis on infrastructure development, which limited its broader impact. Issues also arose with aligning systems and budgets between different departments, as well as integrating various agricultural programs. Nevertheless, the program has made notable progress in capacity building, with positive outcomes such as improved livelihoods for smallholder farmers, especially in Gauteng, where income generation increased. CASP has also positively impacted food security for 50% of its beneficiaries, led to increased part-time employment, and enabled 33% of participants to transition to commercial farming status, showcasing its

potential for long-term agricultural development (Mncina & Agholor, 2021; Public Service Commission, 2011).

2.4.2. Micro Agricultural Financial Institutions of South Africa (MAFISA)

MAFISA was implemented by the government in 2004, to facilitate the provision of equal access to financial services by rural communities (Ward, 2016). MAFISA`s policy is to financially empower producers, processors, and micro-entrepreneurs at micro levels. The loans are to be used for agriculture, forestry and fishing by the beneficiaries to improve their livelihoods. According to Chapman et al. (2021), MAFISA was regarded as the component of the financial assistance pillar of CASP. DAFF had concerns that the program was not being implemented according to plan, and an Expenditure and Performance Review (EPR) was commissioned by the national treasury. The EPR results indicated that there was a lack of capacity to oversee projects, mismanagement of funds by the provincial and national departments, low loan repayment rates due to poor lending methods and funds not being used for MAFISA-related activities (Carter et al, 2014).

The MAFISA support was reported to have decreased personal loans taken and loan shark services by 95% (Oladele & Ward. 2017). According to Department of Performance Monitoring and Evaluation (2016), MAFISA loans have helped its beneficiaries to earn sustainable livelihoods, contributed to food production locally, encouraged new entrants to farming, improved credit access, increased household consumption, stimulated entrepreneurial development, and facilitated the diversification of farming activities.

An independent impact evaluation of the Micro Agricultural Financial Institutions of South Africa (MAFISA) was commissioned by the Department of Performance Monitoring and Evaluation (DPME) in collaboration with the Department of Agriculture, Forestry and Fisheries (DAFF). Conducted by Business Enterprises at the University of Pretoria, in partnership with the Centre for Inclusive Banking in Africa and Infusion Knowledge Hub, the evaluation assessed the effectiveness and sustainability of MAFISA between 2013 and 2015 (DPME, 2016). The findings indicated that while MAFISA played a significant role in improving access to financial services for smallholder farmers and contributed to job creation, the sustainability of its impacts remains questionable. For instance, only 43% of the sampled loan recipients reported having repaid their loans, pointing to poor loan recovery and potential weaknesses in the program’s accountability mechanisms (Mmbengwa, 2016).

Additionally, challenges such as ineffective targeting of beneficiaries and limited post-loan support were identified as key constraints to the long-term realization of benefits beyond the loan disbursement period. These issues suggest that although MAFISA has had some positive short-term effects, its long-term sustainability is hindered by operational inefficiencies and the absence of a robust monitoring and support framework.

2.4.3. ILIMA-Letsema Program

The ILIMA-Letsema program was introduced by the South African government to reduce poverty through increasing food production initiatives (Boatemma et al., 2018). The program aimed to achieve this through giving grants to smallholder (emerging) farmers to increase their agricultural production (Nkgudi et al., 2022). Ngam (2021) stated that the program was implemented to achieve agricultural development by offering services such as financial assistance, information and knowledge management, regulatory services, technical and advisory assistance, marketing and business development, training and capacity building, production inputs, and on-farm and off-farm infrastructure to the previously disadvantaged people.

The program was initiated to promote sustainable agricultural activities and improve the livelihoods of households involved in agricultural activities. According to Nkgudi et al. (2022), the ILIMA-Letsema program had an objective of utilizing 1000000 hectares of unused land and creating one million jobs (NDP Vision 2030). Nkgudi et al. (2022) further states that the program significantly increased net farm income and created jobs for beneficiaries, however, it primarily benefited farmers who were already above the upper-bound poverty line, with limited impact on those below the food poverty line. Parliamentary Monitoring Group (PMG) (2012) reported that, 14 029 jobs were created through the program in 2011/12. Challenges included frequent lack of detailed plans on the duration of project support, and a proper exit strategy. Additionally, despite having an average expenditure of 97% of allocated funds, only 10% of projects were monitored due to the program's broad scope and limited oversight capacity. This discrepancy raises concerns about whether funds were utilized effectively and whether the program achieved its intended outcomes.

2.4.4. Presidential Employment Stimulus Initiative (PESI)

The Department of Agriculture launched the Presidential Employment Stimulus Initiative (PESI) as a response to the severe challenges smallholder farmers faced during the Covid-19 pandemic. The initiative aimed to support farmers in rural and peri-urban areas by providing financial relief to help them purchase agricultural inputs such as seeds and fertilizers. The National Treasury allocated R1 billion for phase one in 2020 and R750 million for phase two in 2021. Priority was given to women (50%), youth (40%), military veterans (5%), and disabled people (5%). Smallholder farmers applied for funding using a USSD code and received vouchers via their phones to redeem within 30 days at selected agricultural retailers (National Treasury, 2020; Ntombela, 2022).

While PESI aimed to facilitate quicker access to essential agricultural supplies, the initiative faced significant challenges. Smallholder farmers reported issues such as being over charged and vouchers expiring before being redeemed. Additionally, some suppliers were not paid on time for vouchers redeemed at their stores, leading to frustrations in the Eastern Cape (Ludoph, 2022). Despite these challenges, smallholder farmers remained hopeful for improvements in future rollouts of the initiative (Mcwango, 2023). These difficulties highlighted the inefficiencies in the implementation of PESI, contrasting with the positive intentions behind the program.

Due to the reported challenges, including delayed payments and logistical hurdles, the then Department of Agriculture Land Reform and Rural Development (DALRRD) decided to temporarily discontinue the PESI program in for two years (2022 and 2023) after being active for two consecutive years. The department acknowledged the need to review, reengineer, and redesign the initiative to address the complaints from beneficiaries and improve its effectiveness in future phases. The decision to halt PESI was made to ensure that these issues were properly addressed before resuming the program, to provide more effective support to smallholder farmers in the future (Matsimela, 2022; Ludoph, 2022). According to Food for Mzansi (2024) Phase Three of PESI was launched on the 21st of November 2024, and to date, no further information has been provided.

2.4.5 Synthesis: Key Gaps and Relevance to This Study

Across all four programs, a pattern emerges: misaligned priorities, weak accountability, inadequate monitoring, and limited engagement with smallholder farmers. These issues result

in support that is often poorly targeted, inconsistently delivered, and unevenly impactful. Most evaluations emphasize inputs and outputs: how much money was spent, how many projects were launched, but fail to assess outcomes and perceptions, particularly at the household level.

This literature review highlights a critical knowledge gap: how smallholder farmers perceive the support they receive, how this affects their willingness or ability to participate in future programs, and what role such support plays in enhancing food security. By focusing on PESI as a recent and relevant case, this study seeks to produce findings that inform both program design and policy implementation, ensuring future interventions are both effective and farmer-centred.

2.5. Voucher-based Support Programs in SSA Countries: Successes and Challenges

The following programs were selected to highlight the existing work on government initiatives implemented in SSA countries that share certain similarities with PESI. These studies will also be used to shape the structure and methodology of the study.

Voucher-based programs have gained prominence in many SSA countries as a mechanism to improve smallholder farmer access to agricultural inputs. The rationale behind these programs is to facilitate the provision of subsidized inputs (seeds, fertilizers, etc.) through vouchers that are redeemed at designated agro-dealers, thereby promoting agricultural productivity, food security, and rural development. This section explores three major voucher-based programs such as FISP, NAIVS, and Nigeria's e-voucher Input Subsidy Program, drawing comparisons to South Africa's PESI. By critically examining the successes and challenges of these programs, this section highlights both lessons learned and potential pitfalls that can inform the design and implementation of PESI, especially in relation to farmer perceptions and sustainability.

2.5.1. Zambia`s Farmer Input Support Program (FISP)

The FISP electronic voucher initiative, introduced by Zambia's Ministry of Agriculture during the 2015/16 farming season, was designed to improve the distribution of subsidized agricultural inputs to smallholder farmers. Supported by NGOs, the program aimed to increase agricultural productivity, reduce poverty, and enhance household food security and income levels. Through the provision of seeds, fertilizers, and farm equipment, the initiative

also sought to stimulate the private sector input supply chains. Over time, the program evolved, incorporating digital technologies to improve transparency and efficiency (Chibbompa, 2018; Kaoma & Mpundu, 2023; Resnik & Mason, 2016).

Studies have demonstrated that FISP has had positive effects on smallholder farmers, increasing agricultural production and improving food security and income levels. Households participating in the FISP experienced enhanced welfare, and poverty among smallholder farmers was reduced from 76% to 59% (Mason & Jayne, 2013). Furthermore, FISP created employment opportunities for rural youth in input distribution and extension services and promoted gender equality by ensuring equal access to resources and training for female farmers (Kodamaya, 2011; Kuntashula & Mwelwa-Zgambo, 2022; Ngoma et al., 2021). However, challenges such as inefficient resource allocation, lack of technical expertise, and market access issues have hindered the program's full potential. Despite being a key poverty reduction strategy, the impact on rural poverty has been limited, with some criticisms of mismanagement and underperformance in achieving sustainability (Allan, 2021; Burke et al., 2012).

2.5.2. The National Agricultural Input Voucher Scheme (NAIVS) in Tanzania

NAIVS was introduced by the Tanzanian government in 2008 as a response to the 2008-2009 food insecurity caused by volatile food prices (Ncube et al., 2016). It was implemented to increase the production of maize and rice among smallholder farmers and thus enhance food security. Mather et al. (2016) stated that a 50% subsidy voucher was provided by the Ministry of Agriculture, Food Security and Cooperatives (MAFC). Priority was given to poor smallholder farmers, first-time fertilizer users, and female-headed households. When the scheme started only 730 667 households benefited across 11 regions, the world bank then increased the grants, and in the next rollout, 1.5 million households benefited across 12 regions in Tanzania (Malimi, 2023). Towards the end of the program, there was a low participation rate because graduating farmers were not being replaced with new beneficiaries (Malimi, 2023).

The initial plan was to make this scheme a temporary program, with farmers graduating from other programs such as credit subsidies after 3 years. An evaluation revealed that there was a mixed impact of NAIVS on smallholder farmers` livelihoods. Giné et al (2019) stated that there were increased input usages and yields in areas where beneficiaries were chosen.

However, the impact on food security, income, or education attainment in the short term was low. In all villages where voucher distribution among female-headed households was randomized, yields and outputs increased. Even though female farmers had positive views towards this scheme and its ability to boost their yields, a lot of them could not afford to pay the additional fee that was required with the vouchers which resulted in them not participating. There was sharing and selling of vouchers. Malimi (2023) found that NAIVS was effective in increasing crop yields and productivity in maize-planted plots. He also stated that the scheme was effective in increasing farm labor and land productivity. In addition, the World Bank (2014) stated that NAIVS was successful in achieving its main objective from a public policy perspective.

2.5.3. Nigeria`s e-voucher Input Subsidy

The Nigerian government adopted the E-voucher program in 2012, as an attempt to go beyond the "smart" subsidy program (Wossen et al., 2017). This program provides subsidized electronic vouchers for purchasing improved seeds and fertilizers for farmers. The vouchers were sent through mobile phones, with a specification of the number of seeds and fertilizer allocated to them as well as the designated agro-dealer. The program was implemented to promote food security and agricultural production by making fertilizers and seeds more accessible and affordable to smallholder farmers (Liverpool-Tasie & Takeshima, 2013). The program assigned certain private agro-dealers to allow smallholder farmers to redeem their e-vouchers in exchange for the inputs they need. Smallholder farmers were able to get 90% off a 50kg bag of improved rice or maize seeds and 50% off two 50kg bags of fertilizers which can be urea or NPK (Wossen et al., 2017). The e-voucher program was implemented as a method to enhance transparency and efficiency in the distribution of agricultural inputs among farmers. The intention of transitioning from paper-based voucher systems to an electronic voucher system was to reduce fraud, enhance the tracking of inputs, and ensure that the vouchers reached the designated beneficiaries.

Wossen et al. (2017) found that the program improved smallholder farmers' income and productivity levels, and there was also an improvement in the welfare of the e-voucher recipients. Nwaobiala and Ubor (2016) stated that the common problems that were associated with the implementation of this program included network connectivity, technology adoption, and ensuring that the intended beneficiaries have the necessary infrastructure and

skills to effectively participate. Factors such as lack of clarity on the selection of beneficiaries and households living closer to the state capital being more likely to receive vouchers may have contributed to the program`s low impact on the beneficiary`s welfare improvement.

2.5.4 Synthesis: Implications for PESI and SSA Voucher Programs

Across all three case studies, key themes emerge, while voucher-based programs offer short-term boosts to agricultural production, their long-term effectiveness hinges on a robust support framework that includes technical expertise, market access, and sustainable financial models. The challenges faced by FISP, NAIVS, and Nigeria's e-voucher program reveal that infrastructure issues, ineffective beneficiary targeting, and poor post-distribution support are consistent barriers to the success of voucher programs in SSA.

Moreover, the equity of access, particularly for vulnerable groups like women and remote farmers remains a significant issue. These findings strongly suggest that while electronic voucher system has potential, its implementation must carefully consider local contexts, technological access, and post-voucher support mechanisms. The issues of monitoring, accountability, and farmer engagement, seen in the SSA programs, should be avoided to ensure that PESI achieves its intended objectives and does not inadvertently create dependency.

This review highlights the necessity of integrating farmer-centered design and feedback loops into voucher programs to ensure that they move beyond mere input provision and contribute to sustainable, inclusive agricultural development. The lessons from FISP, NAIVS, and Nigeria's e-voucher program offer critical insights into the potential and pitfalls of voucher-based support in SSA, which are highly relevant to the design and assessment of South Africa's PESI.

2.6. Smallholder Farmer`s Perceptions Towards Agricultural Input Support Programs.

Smallholder farmer's perceptions of agricultural input support programs are multifaceted and influenced by different factors. Smallholder farmers' perception of how effective agricultural input support programs are a result of the past, present, and future experiences which incorporate their context, expectations, needs, and goals. According to Ayansina (2011), perception is the transformation of information received from an individual`s environment into psychological awareness. Therefore, investigating perceptions of smallholder farmers is important because it helps them convey their understanding of how and why they see their experiences with agricultural input support programs about how their needs are being met. Smallholder farmers' perceptions of agricultural input support programs play a critical role in determining the success and sustainability of these interventions.

Smallholder farmers' perceptions of agricultural input support programs are shaped by a combination of direct experiences with these programs and broader contextual factors that influence their expectations, trust, and willingness to participate. These programs, which provide subsidized or free agricultural inputs such as fertilizers, improved seeds, and pesticides, are generally perceived as beneficial, especially when they lead to improved yields and reduced production costs (Lunduka et al., 2013). In contexts such as Malawi and Zambia, farmers have associated input support with enhanced food security and resilience during crises (Mason & Ricker-Gilbert, 2013). However, perceptions vary significantly depending on factors such as timeliness and quality of delivery, transparency in beneficiary selection, and alignment with local agroecological conditions. For example, if inputs arrive late in the planting season or are not suited to local soils, farmers may view the programs as ineffective or even harmful (Takeshima & Liverpool-Tasie, 2015). Furthermore, gender, education level, land tenure security, and access to extension services can all mediate how farmers perceive and engage with these programs (Chirwa & Dorward, 2013).

These differing perceptions can be analytically framed using the Theory of Planned Behaviour (TPB), which posits that an individual's behaviour is influenced by attitudes, subjective norms, and perceived behavioural control (Ajzen, 1991). Applied to this context, a farmer's intention to participate in or positively engage with an input support program is shaped not only by their attitudes towards the program's perceived benefits but also by the

influence of community norms (e.g., whether participation is seen as common or beneficial) and their perceived control over accessing and utilizing the inputs.

2.7. Impact Assessment Approaches and Application

Evaluation processes aim to address three core types of questions: descriptive, normative, and cause-and-effect (Imas & Rist, 2009). Descriptive questions explore relationships among stakeholders; normative questions examine whether program inputs, activities, and outputs are realized; and cause-and-effect questions assess whether desired outcomes occur and the impact they have on the target population. Specifically, impact evaluation focuses on the cause-and-effect dimension, seeking to attribute changes in outcomes such as food security, income, and perceptions of smallholder farmers to a particular intervention (Gertler et al., 2011).

Central to impact evaluation is the concept of causal inference, which aims to determine what would have happened to a population in the absence of the intervention. This challenge is encapsulated in the concept of the counterfactual, or the hypothetical scenario that did not occur. Because it is impossible to observe the same individual in both treated and untreated conditions simultaneously, evaluators attempt to solve this problem by using control or comparison groups (Ferraro, 2009). An ideal control group shares all relevant characteristics with the intervention group, except for the intervention itself. Failure to ensure this comparability can lead to biased estimates of impact (Winters et al., 2010).

To address the counterfactual problem, researchers use either experimental or non-experimental methods. Experimental methods, such as randomized controlled trials, randomly assign participants to treatment and control groups, allowing for straightforward impact estimation. However, real-world constraints often limit the feasibility of such designs. In such cases, non-experimental approaches (such as PSM, Difference in Difference and covariate matching) are employed, using statistical methods to construct a comparison group that closely mirrors the treatment group (Winters et al., 2011).

2.8. Summary

Agricultural Input Support Programs are critical tools for reducing poverty and enhancing agricultural development in Sub-Saharan Africa (SSA). These programs offer subsidized or free inputs such as seeds, fertilizers, and pesticides to smallholder farmers, aiming to boost productivity, improve food security, and generate rural income. Case studies from Zambia, Tanzania, and Nigeria reveal the mixed outcomes of these interventions. Voucher-based models have been widely adopted to address inefficiencies in input distribution. Zambia's FISP improved productivity and food security, yet struggled with mismanagement, poor market access, and limited sustainability. Tanzania's NAIVS increased maize yields but faced challenges like low participation and weak long-term income impact. Nigeria's e-voucher system enhanced access to inputs and improved farmer incomes, though it was hindered by technological barriers and unclear beneficiary selection.

Farmers' perceptions significantly affect AISP effectiveness. Positive experiences are shaped by timely input delivery, relevance to local conditions, and transparency. Conversely, delays or poor-quality inputs can create distrust. Demographic factors such as gender, education, and land tenure security also influence perceptions and participation. The Theory of Planned Behaviour (TPB) helps explain how farmers' attitudes, community norms, and perceived access shape their willingness to engage with support programs. Rigorous impact assessment is crucial for evaluating program effectiveness. While randomized controlled trials (RCTs) offer strong causal insights, logistical constraints often necessitate alternative methods like propensity score matching. These evaluations must carefully address the counterfactual problem understanding what would have occurred without the intervention to avoid bias and guide evidence-based decision-making. Overall, AISPs in SSA have delivered tangible benefits but continue to face issues of efficiency, inclusivity, and long-term impact. Insights from these case studies underscore the need for better program design, transparent implementation, and strong monitoring systems. Future interventions, including South Africa's PESI, can be strengthened by incorporating these lessons to ensure more sustainable and equitable outcomes for smallholder farmers.

CHAPTER THREE: SMALLHOLDER FARMERS` PERCEPTIONS TOWARDS THE PESI PROGRAM

3.1. Introduction

This chapter is focused on objective one of the study. Section 3.2. contains the description of the study area while section 3.3. entails the data collection procedures. Section 3.4. details the theoretical and conceptual framework of the study. Section 3.5. contains the empirical methods for data analysis and section 3.6. contains the results and discussion. Section 3.7. contains the conclusion and recommendations while section 3.8. gives a summary of the chapter.

3.2. Description of the Study Area

3.2.1. Ngaka Modiri Molema District

According to Municipalities of South Africa (2025), the Ngaka Modiri Molema District (NMMD) is situated centrally within the North West province and shares an international border with Botswana. The district is comprised of 5 municipalities: Ratlou, Tswaing, Mahikeng, Ditsobotla, and Ramotshere Moiloa. The district is home to Mahikeng, which was previously known as Mafikeng, which is the capital city of North West province. Agriculture, tourism, and mining are the main economic sectors in the district. The district covers an area of approximately 28,114 km^2 with an estimated population of 961,960, approximately 1.6% of South Africa`s population and 23.3% of the North-West province (Cooperative Governance and Traditional Affairs, 2020).

Figure 3.1. Map of the Ngaka Modiri Molema District in the North West province
Source: Municipalities of South Africa (2025)

3.2.2. Justification of the Study Site

The Ngaka Modiri Molema District was selected as the study area for this research because it is predominantly rural (Kgori & Jakobo, 2022). NMMD is comprised of 268 099 households, with 13.4% child-headed households and 41.2% households headed by women (Cooperative Governance and Traditional Affairs, 2020). The above-mentioned statistics are relevant as the PESI program aimed to prioritize marginalized households in rural areas, and the NMMD has significantly high levels of those groups.

3.3. Data Collection Procedures

At different stages the study employed a combination of purposive, stratified, random, and snowball sampling techniques to select participants. Initially, purposive sampling was used to identify smallholder farmers within the Ngaka Modiri Molema District who were relevant to the study's focus. Stratified sampling was used to divide the farmers into two strata: those who had received PESI vouchers and those who had not. Within each stratum, random sampling was applied to select participants in an unbiased manner. However, due to the limited number of PESI beneficiaries accessible through random sampling, snowball sampling was subsequently used to supplement the sample. This involved asking identified beneficiaries to refer other eligible farmers who had also participated in the PESI program. In total, 231 smallholder farmers were interviewed across both beneficiary and non-beneficiary groups.

Primary data was collected through individual interviews using a structured questionnaire (attached as annexure 2) within one week. The questionnaire captured information relating to various aspects of the study, including the socio-economic characteristics of the farmers, human capital, social capital, financial capital, physical capital, natural capital, psychological capital and household food security. The questionnaire was written in English and translated to the native language (Setswana) during administration. Enumerators were trained before the data collection process to ensure mutual understanding of the questions and correct translation of questions. The completed questionnaires were checked by the primary researcher to see if they were filled out correctly. Enumerators and the researcher had frequent meetings during the data collection process to address any challenges encountered.

Pretesting was done before the actual data collection. This was to evaluate and validate the consistency, reliability, and relevance of the questionnaire to smallholder farmers. Additionally, pretesting was done to ensure that there were no missed or repeated variables as well as to verify that the questions did not get misinterpreted while being translated from English to the native language. Amendments were made where necessary after pretesting. The data was then coded, captured, and analysed using SPSS and STATA. The data collection instrument was checked and approved by the Human and Social Sciences Research Ethics Committee (HSSREC) of the University of KwaZulu-Natal (Protocol reference number: HSSREC/00007776/2024). It is attached as annexure 3, and informed consent was obtained from each respondent.

3.4. Theoretical and Conceptual Framework

The Theory of Planned Behaviour (TPB), developed by Ajzen (1991), is a widely applied psychological framework for understanding human behaviour in a variety of social contexts. The theory has been used in impact evaluation studies, particularly in agriculture and development research, to assess how individuals form intentions and respond to interventions, policies, or support programs (Fishbein & Ajzen, 2011). A TPB-based conceptual framework offers a structured lens for understanding smallholder farmers' perceptions of PESI and the factors influencing those perceptions(Figure 2).

Individual factors such as age, education levels, and settlement type can influence behavioural patterns of smallholder farmers, which in turn can affect their perceptions about PESI. For instance, better educated smallholder farmers may understand the program`s benefits better and navigate its implementation challenges (online applications, redeeming vouchers at agreed rates, etc.), leading to positive perception. Additionally, younger smallholder farmers, who are more digitally literate and versatile, might navigate the application process better than older farmers, further influencing their perceptions of the program (Alkali & Amichai-Hamburger, 2004). Also, in some rural communities, often governed by patriarchal systems, men are normally the preferred beneficiaries of agricultural programs (Beuchelt, 2016), which may lead to varying perceptions of smallholder farmers towards PESI.

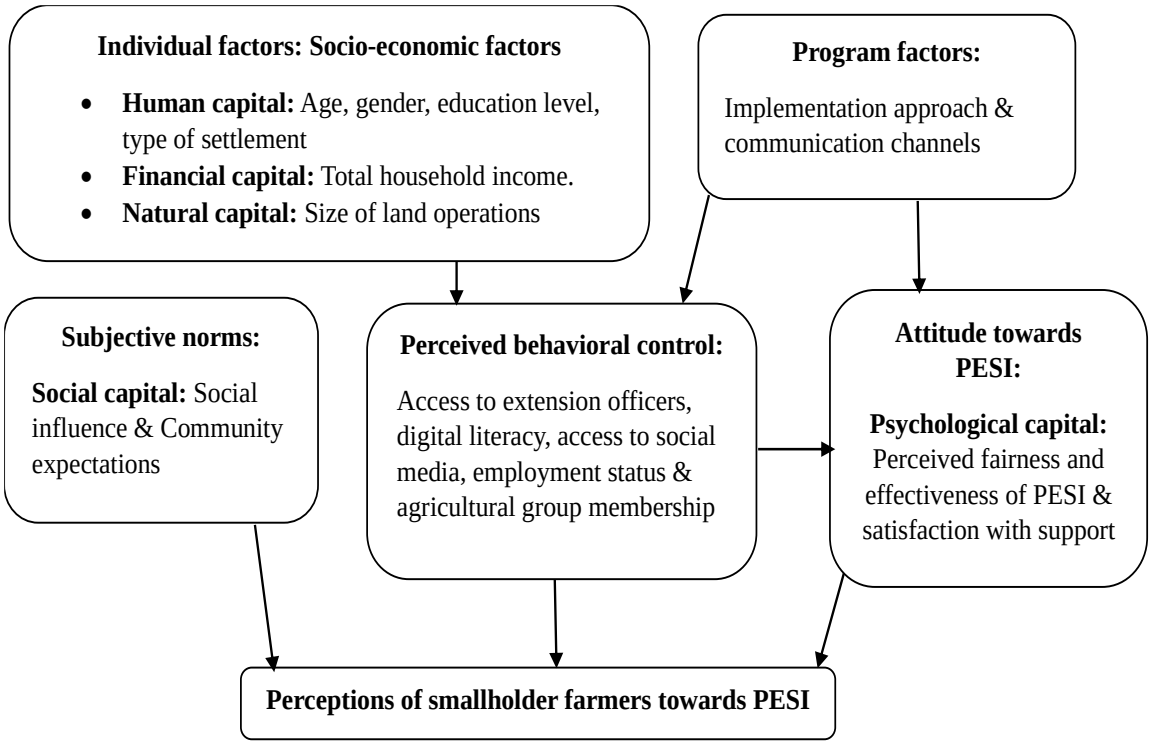

Figure 3.2. An illustration of how various factors, norms, attitudes, and behavioural controls influence perceptions of smallholder farmers towards PESI

Adapted from: Ajzen (1991); Fishbein and Ajzen (2011)

Subjective norms such as community expectations and social influence can also affect smallholder farmers' perceptions towards PESI. For instance, if fellow farmers perceive the program as beneficial, it can influence how one perceives the program, highlighting the importance of social capital and social validation in behavioural patterns (Baloyi, 2020). Furthermore, program factors such as the implementation approach and communication channels can also affect smallholder farmers' attitude and perceptions towards the program. The roll-out method can influence perceived fairness and effectiveness, ultimately impacting satisfaction among participants. For instance, an online-based roll-out method may be seen as unfair to those who are not digitally literate, leading to negative perception ratings. Additionally, smallholder farmers who stay far from the selected agro-dealers may perceive the program as ineffective as they will incur higher transactional costs to redeem the voucher. Generally, various factors, internal and external to the farmer, can influence their perceptions regarding a program. By understanding these interactions, policymakers can refine the PESI

program to better meet smallholder farmers' needs, enhance their perceptions, and ultimately improve livelihood outcomes in the sector.

3.5. Empirical Methods for Data Analysis

3.5.1. Descriptive Statistics

Descriptive statistics such as frequency distributions, percentages, dispersion measures, and inferential statistics were used to explain and quantify smallholder farmers' perceptions of the PESI and their socio-demographic, economic, and resource endowment characteristics. This will include how smallholder farmers view the program, its effectiveness, and its perceived impact on farm operations and the livelihoods of smallholder farmers.

3.5.2. Ordered Probit Model

Ordinary Least Squares (OLS) and the logit model were not chosen as OLS assumes continuous and normally distributed dependent variables, but perception scores are ordinal, while logit models are more suitable for binary outcomes and will lead to the loss of valuable information by dichotomizing ordinal perception scores. In contrast, the ordered probit model was chosen because it gives more consistent results where populations have an order and there are individual effects. To determine the perception of farmers towards the PESI program, the farmers were requested to rate the program based on 8 statements relating to the program on a Likert Scale with five ranks (with 1= Strongly Disagree and 5 = Strongly Agree). The ratings from the statements were summed up and grouped into 3 ranks: 1= Negative perception (scores from 8 - 18); 2 = Neutral perceptions (scores 19 - 31); and 3 = Positive perceptions (scores 32 - 40). The statements are attached in section 3.3. An ordered probit model was then used to determine the relationship between perceptions and the factors hypothesized to influence them. The first model was estimated with PESI beneficiaries only and Model 2 non-beneficiaries. The model was estimated twice because although non-beneficiaries were not directly involved in the intervention, their views offer valuable insights into the program's reputation and its perceived impact within the broader farming community. The questions used to assess these perceptions were designed in an observational format, by asking non-beneficiary farmers to share their views on the observable impact of the program on fellow farmers who had participated. This approach aligns with the concept of revealed preferences, as it captures actual perceptions based on observed changes rather than hypothetical or assumed outcomes. Therefore, the model can be expressed as:

$$y*=\beta'X+e$$

where $y*$ is the farmers` perception ranging from 1 (negative) to 3(positive), β is the parameter to be estimated and *e* is the error term that is normally distributed with a mean of zero and variance of one. The choices will thus be:

$$y* \ \{\{1, if y = 1y\ 2, if\ 1 < y \leq \mu 2\ 3, if \mu 2 < y \leq \mu 3$$

where μ's are unknown parameters to be estimated. The probability of a farmer's choice falling between each category is:

$$\text{Pr}ob\ y{=}1|\ \text{X} = F(\mu 1\ -\beta'\text{X},)$$

$$\text{Pr}ob\ y{=}2\ \text{X}) = F(\mu 2 - \beta'\text{X})\ - F(\mu 1 - \beta'\text{X}),$$

$$\text{Pr}ob\ y{=}3\ \text{X} = F(\ \mu 3 - \beta'\text{X})\ - F(\mu 2 - \beta'\text{X}),$$

where F (.) is the cumulative probability distribution written as:

$$Pi{=}F\ \beta'\text{X} = 1\ 2\pi\ e - z22\beta'\text{X} - \infty dz,\ (z{\sim}\ N\ 0{,}1)$$

Since the maximum likelihood estimation is used to estimate β and μ, the probability equation can be reduced to:

$$\text{Prob}\ y{=}n = \Phi\ \mu n - \beta'\text{X}\ - \Phi\ \mu n - 1 - \beta'\text{X},\ \text{n=1}\cdots 3$$

where Φ is the cumulative distribution function, μ0=0 and μ4=+∞ and μ0,μ1,μ2,μ3, and μ4are the five thresholds between which the categorical responses are estimated with a maximum likelihood function (Mckelvey & Zavoina, 1975):

$$L{=}\ \Phi\ \mu j{-}\beta'\text{X}i\ {-}\Phi(\mu j{-}1{-}\beta'\text{X}i)\ Zijmj{=}1ni{=}1$$

However, the estimated coefficients do not represent the effect of an individual variable on the farmer's perception. Hence the marginal effects will be calculated to establish the effect (Greene, 2002). The marginal effect is calculated as:

$$\partial\text{Prob}\ (y{=}n)\ \partial\text{X} = -\ \Phi\ \mu n - \beta'\text{X}\ - \Phi(\mu n - 1 - \beta'\text{X})\ \beta,\ n{=}1\ldots 3$$

The goodness of fit is calculated as:

$$\text{p2}{=}1 - \ln LblnL0$$

where Lb is the log-likelihood at convergence and L0 is the log-likelihood computed at zero, and $0 \leq p2 < 1$. If all the coefficients are zero, the goodness of fit is zero. The goodness of fit cannot be equal to one, but a value close to one indicates a very good fit (Duncan *et al.*, 1998). The model is specified as:

Model A:

$$Perception = \beta 0 + \beta 1 AGE + \beta 2 GENDER + \beta 3 EDUCATION + \beta 4 INCOME + \beta 5 LANDSIZE + \beta 6 EXT.SERVICES + \beta 7 AGRIGROUP + \beta 8 APESI1 + \beta 9 PESI2 + \beta 10 VOUCHER1 + \beta 11 VOUCHER2 + \beta 12 FRIENDS\&FAMILY + \beta 13 TV\&RADIO + \beta 14 SOCIALMEDIA + \beta 15 INSIGHTS + \beta 16 MEETINGS + \beta 17 ICTUSAGE + \beta 18 EMPLOYMENT + \beta 19 SETTLEMENT + \beta 20 EXPERIENCE + \beta 21 COST + e$$

Model B:

$$Perception = \beta 0 + \beta 1 AGE + \beta 2 GENDR + \beta 3 EDUCATION + \beta 4 INCOME + \beta 5 LANDSIZE + \beta 6 EXT.SERVICES + \beta 7 AGRIGROUP + FRIENDS\&FAMILY + \beta 9 TV\&RADIO + \beta 10 SOCIALMEDIA + \beta 11 INSIGHTS + \beta 12 MEETINGS + \beta 13 ICTUSAGE + \beta 14 EMPLOYMENT + \beta 15 SETTLEMENT + \beta 16 EXPERIENCE + \beta 17 COST + e$$

Where perception is the dependent variables, $\beta 1$, $\beta 2 \ldots \beta n$ is the parameter to be determined and e is the error term. Table 3.1. below details the description of the variables included in the model.

Table 3.1. Description of variables employed to explain smallholder farmers' perceptions of the PESI program.

Dependent variable	***Description***	
A summation of Likert scale statements that measure smallholder farmers' perceptions of PESI	1 = Negative perception, 2 = Neutral perception, 3= Positive perception	
Independent variables	**Description**	**Expected sign**
Gender	0 = Male, 1 = Female	+
Age	Age in years	+
Education	Years of school	+
Income	Total household Income in Rands	+
Land Size	Total hectares of land owned	-
Ext. services	Extension services received: 0 = No, 1 = Yes	-
Agri group	Agricultural group membership: 0 = No, 1 = Yes	+
PESI 1	Phase one beneficiary: 0 = No, 1 = Yes	+
PESI 2	Phase two beneficiary: 0 = No, 1 = Yes	-
Voucher 1	Value of voucher in Rands	+
Voucher 2	Value of voucher in Rands	-
Family & friends	PESI information source- 0 = No, 1 = Yes	+
TV & radio	PESI information source- 0 = No, 1 = Yes	+
Social media	PESI information source- 0 = No, 1 = Yes	-
Insights	Fellow farmers: 0 = No, 1 = Yes	+
Meetings	Attendance at community meetings 0 = No, 1 = Yes	-
ICT usage	0 = No, 1 = Yes	+
Employment	0 = Unemployed, 1 = Employed	+
Settlement	1 = Rural, 2 = Peri urban	+
Experience	Agricultural experience in years	-
Cost	Cost of acquiring agricultural information in rands	-

3.6. Empirical Results and Discussions

3.6.1. Typologies of Smallholder Farmers

The sample drawn comprises two different strata of smallholder farmers. Smallholder farmers that were PESI beneficiaries, and smallholder farmers that were not PESI beneficiaries. For simplicity, smallholder farmers that were PESI beneficiaries will be referred to as "PESI beneficiaries" and smallholder farmers that were not PESI beneficiaries will be labelled as "non-PESI beneficiaries". Table 3.2 below shows the frequencies of the two strata in the three municipalities where data were collected. The majority of the data was collected in Mahikeng due to its characteristic of having a high number of rural areas. Additionally, due to logistics, time constraints, and difficulty in locating PESI beneficiaries, less data was collected at Ramotshere Moiloa.

A total of 231 smallholder farmers were interviewed. Stratified sampling was employed to minimize bias, enhance comparability, reduce variance, improve estimates, and ensure representation of each stratum. The empirical analysis in 3.6.2. and 3.6.3. will include both strata to understand their perceptions towards PESI and also understand factors influencing those perceptions.

Table 3.2. Strata of smallholder farmers(n=231)

Strata	***Mahikeng***	***Ditsobotla***	***Ramotshere Moiloa***	***Total***
PESI Beneficiaries	64	34	14	112
Non-PESI beneficiaries	66	52	1	119
Total	130	86	15	231

Source: Survey data (December 2024)

3.6.2. Descriptive Statistics

a) Socio-demographic characteristics

The data reveal that PESI beneficiaries tend to be younger, with higher annual household income, more years of education, and significantly more land under operations, suggesting that the PESI program may have been more accessible to young, better-educated, and emerging smallholder farmers. Despite having slightly less agricultural experience, PESI beneficiaries show higher engagement with extension officers and use various sources of PESI information, particularly informal and digital channels such as friends and family, social media, implying greater openness to innovation or better access to knowledge networks. They also incur a lower cost in acquiring agricultural information, further reinforcing the idea of more efficient information flow among PESI participants. However, PESI beneficiaries report lower attendance at community meetings, suggesting either weaker ties to traditional communal structures or a shift toward alternative forms of engagement.

Table 3.3. Descriptive statistics for socio-demographic characteristics

Variables Name	Averages			Chi-Square test
	Beneficiaries (n =112)	Non – beneficiaries (n = 119)	Whole Sample (n = 231)	
Gender	0.53	0.51	0.52	0.05*
Age	48.99	53.79	51.46	63.01
Education	9.89	9.08	9.47	13.67
Income	63219.98	57311.92	60176.39	130.55
Land Size	8.81	2.46	5.54	21.23
Ext. services	0.17	0.06	0.11	7.09
Agri group	0.13	0.13	0.13	0.03**
PESI 1	0.44	-	0.44	0.00***
PESI 2	0.12	-	0.12	0.00***
Voucher 1	3405.36	-	3405.36	0.00***
Voucher 2	3307.14	-	3307.14	0.00***
Family and friends	0.38	0.18	0.28	12.40
TV and radio	0.09	0.06	0.07	0.79
Social media	0.21	0.03	0.12	13.09
Insights	0.29	0.34	0.32	0.46
Meetings	0.03	0.07	0.05	2.08
ICT usage	0.04	0.03	0.03	0.65
Employment	0.08	0.06	0.07	0.42
Settlement	1.06	1.03	1.05	1.06
Experience	11.40	13.84	12.66	29.84
Cost	0.01	0.29	0.16	2.00

Note: Figures in parentheses are the p>|z| values associated with the coefficients and marginal effects. ***P < 0.01, **P < 0.05, and *P <0.10 mean significant at 1%, 5%, and 10% probability levels, respectively.

Source: Survey data (December 2024)

b) Resource Endowment Disparities

The data highlights notable disparities in resource endowment between PESI and non-PESI beneficiaries. For non-PESI beneficiaries, social grants serve as the primary source of income, indicating a reliance on external support due to limited access to productive resources. In contrast, PESI beneficiaries have better access to key resources and services such as agricultural-related business training, livestock, and land. This disparity suggests that PESI beneficiaries are more likely to have the necessary tools and knowledge to improve their agricultural practices. Overall, the data suggest that PESI beneficiaries tend to possess more diverse resources, including human capital (knowledge and skills), financial resources (assets and income), social capital (network and community support), and physical capital (land and livestock). These additional resources might have played a role in enabling their access to PESI and may lead to an improved overall perception of PESI. This is different for non-PESI beneficiaries, who face more limitations in accessing such resources and, as a result, are more dependent on external sources of income like social grants.

Table 3.4. Descriptive statistics for resource endowment disparities

Demographic characteristics		*Strata of smallholder farmers*		*Totals (n=231)*
		PESI beneficiary (%)	**Non-PESI beneficiary (%)**	
Agricultural-related business training	Yes	20.5	9.20	34
	No	79.5	90.80	197
Livestock ownership	Yes	83.00	89.9	200
	No	17.00	10.1	31
Land ownership	Yes	70.5	63.00	154
	No	29.5	27.00	77
Beneficiary of social grants	Yes	86.6	89.1	203
	No	13.4	10.9	28

Source: Survey data (December 2024)

c) Financial Resource Endowment Disparities

Table 3.5 presents key economic indicators for smallholder farmers, shedding light on their income, asset ownership, and access to financial resources. The mean values for total estimated agricultural income were R5, 831.73 and R5, 159.87 per annum, for PESI and non-PESI beneficiaries, respectively. This suggests that PESI beneficiaries have a high agricultural income compared to non-PESI beneficiaries. The mean for the total value of

assets was R110, 599.16 for PESI beneficiaries and R61, 888.68 for non-PESI beneficiaries. This indicates that PESI beneficiaries may have better access to assets and resources.

The data also revealed that many smallholder farmers do not have access to credit, with many expressing a reluctance to incur debt. This could indicate financial insecurity or a cultural preference to avoid borrowing. Furthermore, most smallholder farmers do not have any form of savings. However, when comparing PESI and non-PESI beneficiaries, the results indicate that PESI beneficiaries are more likely to have savings compared to non-PESI beneficiaries.

Table 3.5. Descriptive statistics for financial endowment disparities

Demographic characteristics		*Strata of smallholder farmers*		*Totals*
		PESI beneficiaries	**Non-PESI beneficiaries**	
Savings	Yes	31.3	27.7	68
	No	68.7	72.3	163
Access to credit	Yes	0.9	3.4	5
	No	99.1	96.6	226
		Mean value	**Mean value**	**Totals**
Total agricultural income (R)		5831.73	5159.87	231
Total value of assets owned (R)		110599.16	61888.68	231

Source: Survey data (December 2024)

This suggests that the PESI program may have contributed to improving financial security among its beneficiaries. In summary, these findings highlight significant disparities in income and asset ownership among smallholder farmers, as well as differences in access to credit and savings between PESI and non-PESI beneficiaries. The results suggest that while smallholder farmers generally face financial challenges, those participating in PESI may have better financial management practices and more opportunities to accumulate savings.

d) Program Implementation Challenges

Figure 3.3 illustrates the challenges encountered by PESI beneficiaries, while Figure 3.4 depicts those faced by non-PESI beneficiaries. The primary challenge reported by PESI beneficiaries was being overcharged by the selected agro-dealers, whereas the main issue for non-PESI beneficiaries was a lack of awareness about the program. A significant portion of PESI beneficiaries expressed dissatisfaction with the value of the vouchers they received, noting that they were insufficient, while others encountered difficulties in traveling to the

designated agro-dealers to redeem their vouchers. The least common challenge among PESI beneficiaries was the expiration of the vouchers before they could be redeemed, followed by issues related to the distance to the agro-dealers. For non-PESI beneficiaries, the second most common challenge was applying for the program but receiving no response, followed by difficulties in applying or a lack of assistance with the application process. The least frequent challenges for non-PESI beneficiaries included issues with network connectivity, which hindered the application process, and a lack of access to a physical phone. These distinct implementation challenges experienced by both PESI and non-PESI beneficiaries provide valuable insights into the effectiveness of the program's implementation strategy and its ability to reach the intended target groups.

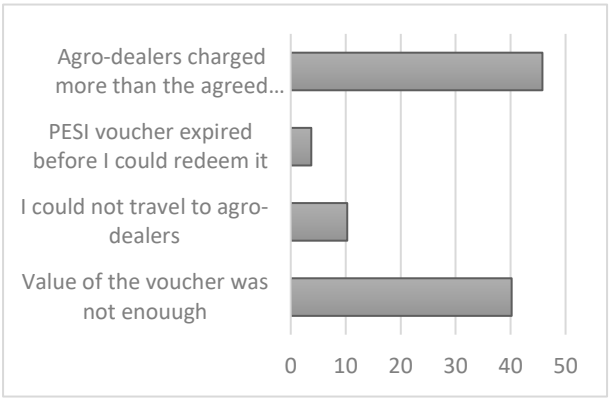

Figure 3.3. Implementation challenges experienced by PESI beneficiaries
Source: Survey data (December 2024)

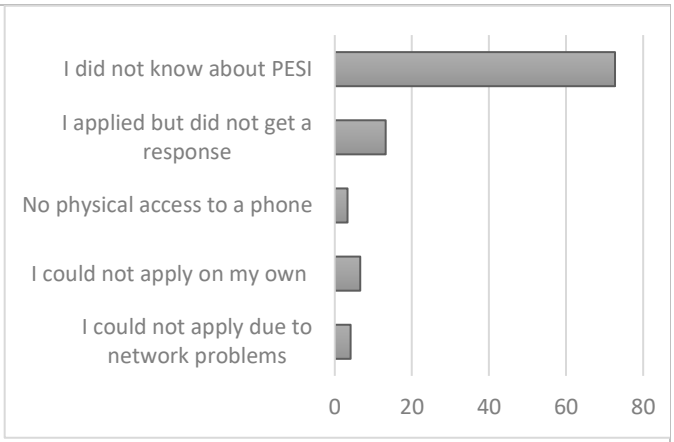

Figure 3.4. Implementation challenges experienced by non-PESI beneficiaries
Source: Survey data (December 2024)

e) Distribution of PESI Phases Among Beneficiaries

Figure 3.5 reveals that a larger proportion of participants were from both phase one and phase two (44.60%), with only a slight difference from the Phase One beneficiaries (0.8%). The number of phase two participants was notably low (11.60%), which can be attributed to the study's focus on phase one beneficiaries. However, due to challenges in locating these individuals, including issues such as some being unwilling to participate, others being deceased, and time constraints, phase two beneficiaries were also included in the study. Moreover, many beneficiaries from phase one were also part of the phase two group, which

accounts for the higher percentage observed for both phases. The difference between the two PESI phases was just the year of implementation. Phase one was when the program was first introduced in 2020 and phase two of the program was implemented in 2021.

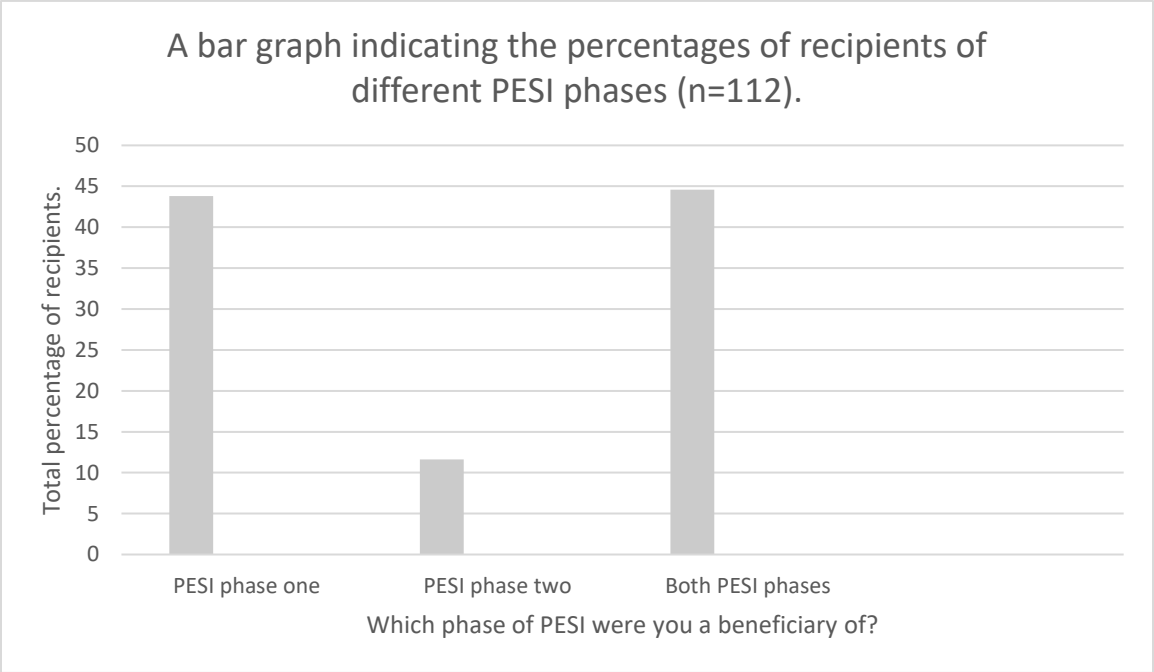

Figure 3.5. A bar graph representing the percentages of recipients of different PESI phases
Source: Survey data (December 2024)

It is important to note that the value of phase two vouchers was higher than that of phase one vouchers. The results show that the minimum value for phase one vouchers was R1, 000.00 and the maximum was R12, 000.00, while for phase two, the minimum voucher value was R2, 000.00 and the maximum was R15, 000.00. The median for phase one vouchers was R2, 200.00 while for phase two the median was R2, 500.00; this suggests that phase two vouchers provided more financial support to smallholder farmers. This discrepancy may reflect the complaints from phase one beneficiaries regarding being overcharged and the insufficiency of their vouchers, which could have led to an increase in the voucher value for phase two.

Table 3.6. Frequency distribution of PESI voucher values

PESI phase	Minimum voucher value (R)	Maximum voucher value (R)	Median voucher value (R)
Phase one	1000	12000	2200
Phase two	2000	15000	2500

Source: Survey data (December 2024)

f) Smallholder farmers' perceptions of the PESI program

i. Reliability test on perceptions provided for smallholder farmers to rate using the Likert scale

The Likert scale has been widely used in economics to gather information about attitudes, feelings, and perceptions. It ranks the responses on a scale and helps the researcher to order them. The responses were subjected to a reliability test to check if they were consistent in measuring perception using Cronbach's alpha. Cronbach (1951) defined Cronbach's alpha as:

$$\alpha = Kc$$

$$v + K-1\,c$$

Where K is the items to be summed, c is the average of all covariances between the items across the sample, v is the average variance of each item and 1 is a constant. The Cronbach`s alpha reliability coefficient ranges between 0 and 1. The closer the Cronbach`s alpha coefficient is to one, the greater the internal consistency. If the Cronbach`s alpha is > 0.9, the internal consistency is excellent, if it is between 0.89 – 0.80, it is good, if it is between o.79 – 0.70 it is acceptable, if it is between 0.69 – 0.60 it is questionable, if it is between 0.59 – 0.50 it is poor, and if it is < 0.50 it is unacceptable (George & Mallery, 2003).

The Cronbach's alpha coefficient of the eight perceptions provided for smallholder farmers to rate on a Likert scale is equal to 0.87. This value indicates that the questions regarding perception have good internal consistency.

ii. Perceptions of smallholder farmers towards PESI.

The study assessed the perceptions of both beneficiaries and non-beneficiaries of the program. The perceptions are presented in tables 3 and 4 below.

a. Perceptions of non-PESI beneficiaries

A cross-tabulation of the results regarding the perceptions of non-PESI beneficiaries revealed some notable trends. Over 50% of non-PESI beneficiaries expressed a highly positive perception of four out of the eight perceptions provided. However, perception H was rated neutrally by 36.1% of smallholder farmers, indicating a mixed or average view of the statement. On the other hand, perceptions E to G were predominantly rated poorly, with over 60% of non-PESI participants classifying them as either "poor" or "fair."

Table 3.7. Perception ratings of non-PESI beneficiaries

Perception	**Perception rating (%)**		
	Negative perception	**Neutral Perception**	**Positive perception**
a. The program has helped smallholder farmers to increase their productivity.	9.3	25.2	65.5
b. The program has helped smallholder farmers to increase household food security.	9.3	26.9	63.8
c. The program has increased smallholder farmers` farm income.	13.5	27.7	58.8
d. The program increased smallholder farmers` access to agricultural inputs.	22.7	23.5	53.8
e. The program was easily accessible to every smallholder farmer.	65.5	16.8	17.7
f. Extension officers were helpful during the implementation of the program.	68.9	15.1	16.0
g. The implementation approach of the program was suitable for smallholder farmers.	66.4	12.6	21
h. The program empowered vulnerable groups (women, child-headed households, disabled people, etc.) of smallholder farmers.	23.5	36.1	40.4

Source: Survey data (December 2024)

The low ratings of perceptions E to G can likely be attributed to the fact that these smallholder farmers are not PESI beneficiaries. As a result, they may view the program as not easily accessible to all farmers and perceive the implementation approach as unsuitable for their needs. Moreover, the low rating of perception F may stem from the impact of strict lockdown conditions, which significantly restricted interactions between smallholder farmers and extension officers, potentially hindering their ability to engage with the program and access the necessary support.

b. Perceptions of PESI beneficiaries

A cross-tabulation of the results regarding PESI beneficiaries' perceptions revealed that seven of the listed perceptions were rated positively (4 – 5), indicating a generally positive view of the program. However, perception F, regarding the helpfulness of extension officers during program implementation, was rated negatively (1 – 2). The low ranking of perception F is understandable, given that both phases of the PESI program were implemented during the Covid-19 pandemic when strict lockdown measures were in place. These restrictions severely limited movement and contact between individuals, likely hindering interactions between smallholder farmers and extension officers.

Table 3.8. Perceptions of PESI-beneficiaries towards PESI

Perception	**Perception rating (%)**		
	Negative perception	**Neutral Perception**	**Positive perception**
a. The program has helped smallholder farmers to increase their productivity.	5.4	26.8	67.8
b. The program has helped smallholder farmers to increase household food security.	7.2	25.0	67.8
c. The program has increased smallholder farmers` farm income.	7.1	28.6	64.3
d. The program increased smallholder farmers` access to agricultural inputs.	11.6	25.0	63.4
e. The program was easily accessible to every smallholder farmer.	24.2	25.0	50.8
f. Extension officers were helpful during the implementation of the program.	36.7	20.5	42.8
g. The implementation approach of the program was suitable for smallholder farmers.	25.9	23.2	50.9
h. The program empowered vulnerable groups (women, child-headed households, disabled people, etc.) of smallholder farmers.	11.6	25.9	62.5

Source: Survey data (December 2024)

Despite this, the high ratings for the other perceptions (classified as good or excellent) suggest that PESI beneficiaries recognized significant benefits from the program. This indicates that, overall, beneficiaries were able to recognize positive outcomes from their involvement in PESI, even though the pandemic's restrictions may have affected certain aspects of the program's implementation.

c. Perceptions of Smallholder Farmers (Both Strata)

A cross-tabulation of the results regarding the perceptions of smallholder farmers revealed that over 50% of both PESI and non-PESI beneficiaries rated five out of the eight perceptions highly. However, perceptions E to G were largely rated poorly, with 40%-55% of both strata classifying them as either poor (1) or fair (2). The high ratings for five of the perceptions indicate that smallholder farmers recognized the benefits of being a PESI participant and were able to identify the positive impacts the program had on the livelihoods of its beneficiaries.

Table 3.9. Combined perception ratings of both strata of smallholder farmers

Perception	**Perception rating (%)**		
	Negative perception	**Neutral Perception**	**Positive perception**
a. The program has helped smallholder farmers to increase their productivity.	7.4	26	66.6
b. The program has helped smallholder farmers to increase household food security.	8.2	26	65.8
c. The program has increased smallholder farmers` farm income.	10.4	28.1	61.5
d. The program increased smallholder farmers` access to agricultural inputs.	17.3	24.2	58.5
e. The program was easily accessible to every smallholder farmer.	45.4	20.8	33.8
f. Extension officers were helpful during the implementation of the program.	53.3	17.7	29
g. The implementation approach of the program was suitable for smallholder farmers.	46.7	17.7	35.6
h. The program empowered vulnerable groups (women, child-headed households, disabled people, etc.) of smallholder farmers.	17.8	31.2	51

Source: Survey data (December 2024)

In contrast, the low rankings for perceptions E to G point to several challenges experienced during the implementation of the program. The strict lockdown conditions during PESI's implementation are likely to affect the availability of extension officers, limiting their ability to assist smallholder farmers. To add on, smallholder farmers may have perceived the program's implementation approach as unsuitable or not easily accessible, due to various demographic, social, and economic factors that differ across individual farmers.

3.6.3. Model Test Results and Discussions

a) Tests for Multicollinearity and Heteroscedasticity

Tests for multicollinearity and heteroscedasticity were done to ensure that the statistical tests of significance (t-test, Chi-square test, Probit) are valid. The Variance Inflation Factor (VIF) was used to test for multicollinearity in the independent variables against perception as a dependent variable. Gujarati (2004) defined the Variance Inflation Factor as:

$$VIF\ (x_i)=1/1-R_i^2$$

Where VIF (xi) is the variance inflation factor for explanatory variable xi and R_i^2 is the square of the multiple correlation coefficients obtained from regressing xi on the remaining explanatory variables. If the Variable Inflation Factor is above 10, there is multicollinearity. However, the VIF values obtained were between 1.20 to 4.05, showing no obvious presence of multicollinearity, and the tolerance values are all > 0.20, indicating moderate to low multicollinearity. The results are shown in Appendix 3.

However, heteroskedasticity tests were not run due to the nature of the models used in this study. A study done by Williams (2009) found that heteroskedasticity does not affect the model since the level of overconfidence and coverage rates for a homoscedastic ordered probit and a heteroscedastic ordered probit are close to the ideal and hence give negligible differences. A study by Zhao (2005) also found that heteroskedastic error terms have little influence on the estimated treatment effect in propensity score matching. Since these two models were used in this study, there was no need to run heteroskedasticity tests for variables in these two models.

B) Ordered Probit Results and Discussions

As per Greene (2002) and Hogarth and Anguelov (2004), ordered probit coefficients cannot be interpreted directly; instead, marginal effects provide a clearer understanding of how changes in explanatory variables shift the probability of a given perception category. These marginal effects are calculated at the means of all other explanatory variables, with a positive sign indicating an increase in the likelihood of a specific category and a negative sign indicating a decrease. Category 2 (neutral perception) was excluded as the base category in

the analysis. It is also important to note that Model B excludes variables such as PESI phase beneficiary status and voucher values due to a skip rule applied in the questionnaire.

Model fit statistics indicate the robustness of both models. The likelihood ratio chi-squared statistics (Model A = 102.68, Model B = 113.09, $p < 0.01$ for both) demonstrate that the models significantly explain the variation in perception ratings. Pseudo R^2 values suggest that Model A accounts for approximately 50% of the variance in perceptions among PESI beneficiaries, while Model B accounts for 43% of the variation among non-beneficiaries. Model A is likely to show more influencing factors than Model B (non-beneficiaries) because beneficiaries' direct experience with the program makes their perceptions more responsive to a wider range of personal, informational, and contextual variables, whereas non-beneficiaries, lacking firsthand exposure, form more generalized views influenced by fewer factors.

Key findings reveal notable differences between beneficiaries and non-beneficiaries. The two groups were compared to see which factors influence their perceptions as the descriptive statistics showed distinct characteristics (age, education levels, etc) among the two groups. Looking only into the factors influencing the beneficiaries' perceptions may not provide a broader insight into future programs when it comes to the program's inclusivity. Gender influences perceptions in opposite directions across the two groups. Among beneficiaries (Model A), being female significantly increases the likelihood of negative perceptions by 7% and decreases the likelihood of positive perceptions by 13%. Among non-beneficiaries (Model B), being female significantly increases the likelihood of positive perceptions by 10% and decreases the likelihood of positive perceptions by 9%. An increase in age significantly increased the likelihood of negative perceptions in both models, aligning with findings from Nikolopoulou *et al*. (2021) that younger individuals are more receptive to policy innovations. Education, likewise, positively influences perceptions across both models, an increase in education level increases the probability of positive perceptions by 6% and 7% for model A and model B respectively. This aligns with prior studies (Anang *et al*., 2020; Adegun *et al*., 2010) that higher education is linked with greater openness and positive perceptions to new initiatives.

Household income is negatively associated with perceptions in both models. The marginal effects indicate that as income increases, the likelihood of negative perceptions increases by, while the probability of positive perceptions decrease. This supports findings by Banerjee *et*

al. (2015), who observed that higher-income households may perceive less value in targeted assistance programs like microfinance.

Additional insights from Model A highlight the role of information sources and digital engagement. Receiving PESI information from family or friends is positively associated with perceptions, decreasing the probability of negative perceptions by 8% and increasing the probability of positive perceptions by 15%. This finding relates to the finding by Brown *et al*. (2007), who stated that interpersonal communication, especially from trusted sources, can significantly shape perceptions. ICT usage reduces the likelihood of negative perceptions by 18% and increases the probability of positive perceptions by 33%. These results underscore the importance of informal and digital communication channels in building trust and understanding of voucher-based programs. However, certain socio-economic characteristics are associated with more negative perceptions. Employed beneficiaries are significantly more likely to view the program negatively, with a 11% probability of increasing negative perceptions and a 19% probability of decreasing positive perceptions. This could reflect discontent among employed individuals who may not have expected to benefit or who feel underserved by the program's targeting criteria. This is contrary to a study by Kiratu (2014), who found that farmers who had non-farm incomes were more likely to have high perceptions towards the Kilimo Plus program. Similarly, those living in rural areas are more likely to hold negative views, potentially due to limited access to program-related services like agro-dealers and other factors such as distance to agro-dealers and limited communication channels.

Phase 1 participation is associated with significantly more positive perceptions, with a likelihood of a 31% decrease in negative perceptions and a 55% probability of increasing positive perceptions. This strong effect suggests that early program exposure may have fostered positive perceptions. Interestingly, the value of the Phase 1 voucher is negatively associated with perceptions, while the value of the Phase 2 voucher shows a positive marginal effect. Complaints regarding insufficient voucher amounts in the first phase may explain the negative association, while improved satisfaction in the second phase is likely to contribute to more positive perceptions.

Table 3.10. Ordered Probit Results

Independent variables	*Model A: PESI beneficiaries (n=112)*			*Model B: Non-PESI beneficiaries (n=119)*		
	Coeffi cients	**Marginal effects**		**Coeffici ents**	**Marginal effects**	
		Negative (1) dy/dx	**Positive (3) dy/dx**		**Negative (1) dy/dx**	**positive (3) dy/dx**
Gender	-0.77*	0.07*	-0.13*	0.53*	-0.09*	0.10*
Age	-0.05***	0.00**	-0.01***	-0.05***	0.01***	-0.01***
Education	0.39***	-0.04***	0.06***	0.37***	-0.06***	0.07***
Agri experience	-0.01	0.00	-0.00	0.01	-0.00	0.00
Income	-8.27**	7.90**	-1.41**	-3.72*	6.16*	-7.21**
Land size	0.01	-0.00	-0.00	-0.02	0.00	-0.00
Ext. services	0.12	-0.01	0.02	-0.18	0.03	-0.04
Agri group	-0.03	0.00	-0.01	0.23	-0.04	0.04
Family & friends	0.86*	-0.08*	0.15*	0.53	-0.01	0.10
TV & radio	-0.07	0.01	-0.01	-0.42	0.07	-0.08
Social media	0.44	-0.04	0.07	0.61	-0.10	0.12
Cost	-7.39	0.71	-1.26	0.12	-0.02	0.02
Insights	0.26	-0.02	0.04	-0.45	0.07	-0.09
Meetings	0.76	-0.07	0.13	-1.02*	0.17*	-0.20*
ICT usage	1.88**	-0.18**	0.32**	-2.12**	0.35**	-0.41***
Employment	-1.15*	0.11*	-0.19*	0.41	-0.07	0.08
Settlement	-1.38*	0.13*	-0.24*	-1.28	0.21	-0.25
PESI 1	3.24***	-0.31***	0.55***	-	-	-
PESI2	0.82	-0.08	0.14	-	-	-
Voucher 1	-0.00**	0.00**	-0.00***	-	-	-
Voucher 2	0.00**	-0.00**	0.00**	-	-	-
/cut1	-0.36			-1.39		
/cut2	1.22			0.26		
LR chi2	102.68			113.09		
Prob >chi2	0.00			0.00		
Pseudo R2	0.50			0.43		
Log-likelihood	-51.44			-73.78		

Note: Figures in the parentheses are the p>|z| values associated with the coefficients and marginal effects. ***P < 0.01 and **P < 0.05, and *P <0.10 mean significant at 1%, 5%, and 10% probability levels, respectively.

Source: Survey data (December 2024)

ICT usage and participation in community meetings are both linked to more negative perceptions. ICT use is associated with a 35% probability of increasing negative perceptions and a 41% probability of decreasing positive ones, suggesting that digital exposure may intensify feelings of exclusion as other smallholder farmers are more digitally literate. Similarly, receiving agricultural information through community meetings increases the

likelihood of negative perceptions by 17% and reduces the likelihood of positive perceptions by 20%, indicating that such forums may serve as spaces for voicing discontent, especially in rural settings. This may be because community meetings often serve as spaces for voicing discontent, especially when expectations raised during meetings such as fairness, transparency, or timely delivery are not met.

The lack of significance for access to extension services and agricultural group membership in the ordered probit models is intriguing, given their established importance in the literature. Access to extension services, often crucial for enhancing farmers' knowledge and engagement with agricultural policies (Hamasalih & Layeeq, 2023), was also not significant, which may reflect the availability of alternative information channels, such as mobile-based platforms, that could have overshadowed the role of extension services. Agricultural group membership, typically associated with improved social capital and better information dissemination (Davis, 2006), was found to be insignificant, suggesting that in this context, group membership may not be as effective in shaping perceptions of PESI. These findings highlight the complexity of factors influencing farmers' perceptions and suggest that the impact of gender, access to extension services, and other variables may be context-dependent, requiring further investigation into how these factors interact with program-specific features to shape perceptions.

3.7. Summary

The study recognizes that perceptions of smallholder farmers towards PESI are influenced by a range of factors, e.g., household income, age, education, access to extension services, and involvement in social networks. PESI beneficiaries reported more positive perceptions, highlighting the importance of program participation. Non-PESI beneficiaries reported four positive perceptions surrounding the improvement of the livelihoods of smallholder farmers, and one neutral perception rating. This suggests that even though they were not PESI beneficiaries, they could see the positive impact PESI had on the livelihoods of its beneficiaries. The other three negatively rated perceptions mainly revolved around the fact that they are not participants, which may have led to the perception that the program was not easily accessible to every smallholder farmer and that the implementation strategy was ineffective. Additionally, the overall negative perception rating could have been due to lockdown restrictions, which restricted contact between extension officers and smallholder farmers. However, older farmers, farmers with low educational attainment, smallholder farmers with non-farm income, and those with more household income tend to rate the program less favourably. The findings also indicate that information sources, particularly from community meetings, phones, fellow farmers, and social media, have mixed effects on perceptions, with information from community meetings, phones, and fellow farmers associated with more favourable views among PESI beneficiaries and vice versa for non-PESI beneficiaries. Ultimately, these results suggest that designing agricultural programs with the specific needs of smallholder farmers in mind, such as through age-sensitive approaches, targeted education and demographic factors, targeted information strategies, and improved access to resources, is key to enhancing their impact and perception.

CHAPTER FOUR: ASSESSING THE IMPACT OF THE 2020 PESI PROGRAM ON SMALLHOLDER FARMERS` HOUSEHOLD FOOD SECURITY

4.1. Introduction

This chapter is focused on objective two of the study. The description of the study area and data collection procedures is similar to those in Chapter 3. Section 4.2 details the conceptual framework of the study. Section 4.3 discusses the methods employed for data analysis, and Section 4.4 contains empirical results and discussion. Section 4.5 provides the conclusion and recommendations, while Section 4.6 gives a summary of the chapter.

4.2. Conceptual Framework

The Sustainable Livelihood Framework (SLF) remains a fundamental approach to understanding and improving rural livelihoods (Baloyi, 2020). The framework emphasizes the importance of livelihood assets and their interactions with external factors (policies and vulnerability contexts such as shocks) to achieve sustainable livelihood strategies. According to Serat (2017), SLF is based on advancing the understanding of how the vulnerable live their lives, that is, how they cope and recover from shocks, and maintain and improve their assets and capabilities, with the aim of achieving a sustainable livelihood outcome. Mc Lean (2015) critiqued the approach for inflexibility and its ignorance of the prevailing power relations. However, according to the Department for International Development (DFID) (1999), the SLF remains fundamental in providing an understanding of factors that constrain or improve livelihood outcomes, particularly for the vulnerable. The SLF theory guides the conceptual framework of this study, as depicted in Figure 4.1. The approach emphasizes that households require different assets to achieve sustainable livelihoods, namely: Human Capital (HC), Social Capital (SC), Natural Capital (NC), Physical Capital (PC), and Financial Capital (FC). The endowment of each capital asset plays a crucial role in enhancing and maintaining livelihood outcomes. Furthermore, the framework suggests that different policies and interventions can influence the endowment of these assets, indirectly influencing livelihoods.

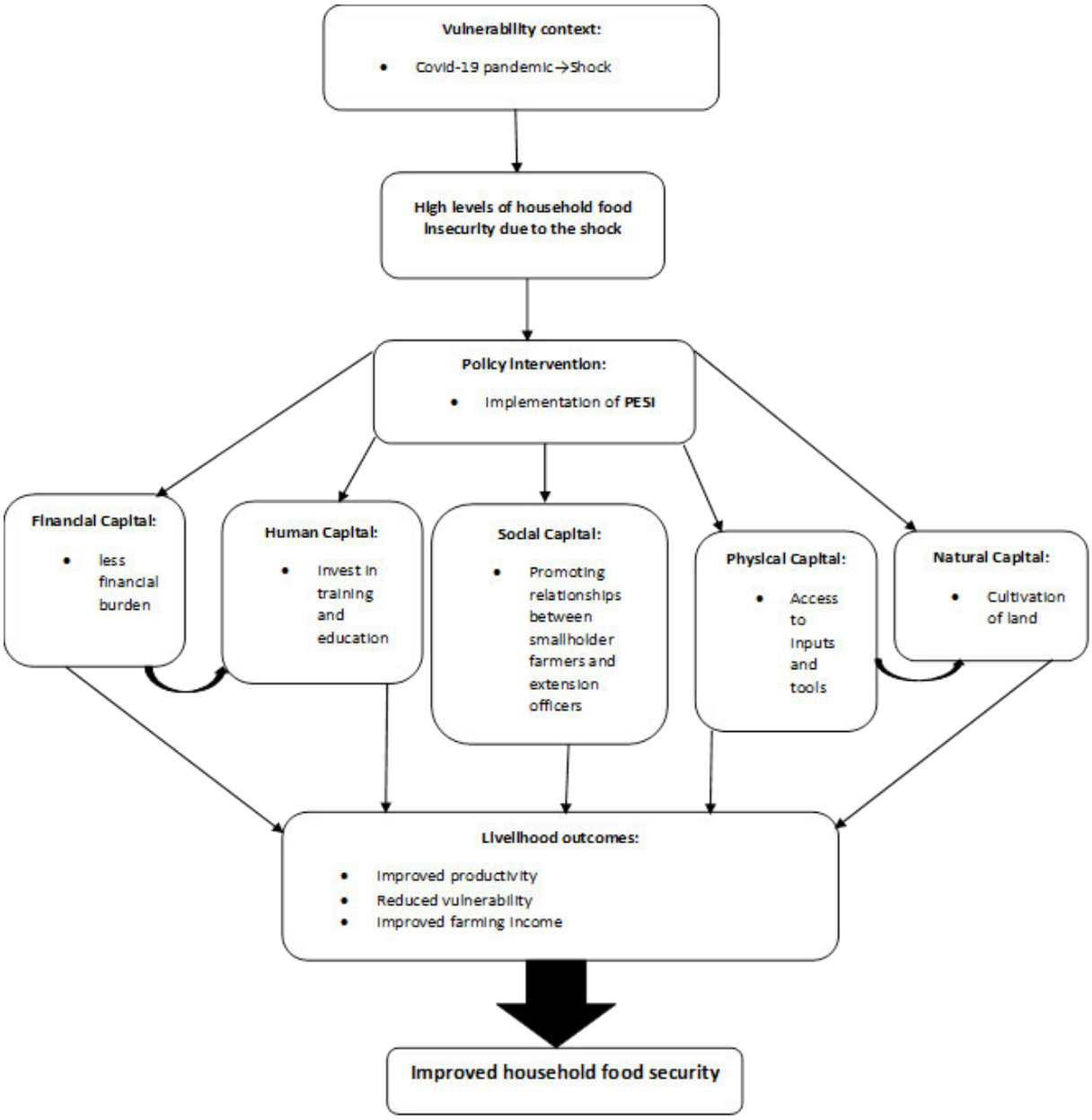

Figure 4.1. Illustration of how PESI strengthens smallholder farmers' capital assets, leading to improved household food security
Adapted from: Baloyi (2020); Serat (2017); DFID (1999)

Given this understanding, interventions such as PESI can enhance smallholder farmers` livelihood outcomes by strengthening their assets. For instance, the program can improve financial capital by alleviating financial constraints relating to attaining agricultural inputs. This allows farmers access to improved production inputs for increased production. Also, increased financial capital can indirectly boost human capital as smallholder farmers can invest in self-development activities such as training (Zhong et al., 2022). The program can

further foster social capital by promoting relationships between agricultural extension officers, agro-dealers, and smallholder farmers. Endowment in social capital increases access to agricultural information and markets, leading to improved farm production and income (Kehinde, 2021). Additionally, PESI can assist in boosting physical capital by promoting improved access to agricultural tools and inputs. PESI can further improve the natural capital of smallholder farmers by enabling them to cultivate their land due to improved access to agricultural inputs, tools, and equipment, leading to less soil erosion and more soil fertility. Collectively, endowment in livelihood assets has the potential to increase and improve farm production, which leads to increased farm income and improved household food security.

4.3. Empirical Methods for Data Analysis

4.3.1. Descriptive Statistics

Descriptive statistics such as (frequency distributions, central tendency measures, percentages, dispersion measures, and inferential statistics) were used to assess whether the program had an impact on the household food security levels of smallholder farmers who benefited from the program.

4.3.2. Propensity Score Matching (PSM)

Propensity Score Matching (PSM) was chosen over an Endogenous Switching Regression (ESR) model because it is relatively straightforward to implement, requires fewer assumptions, and provides a transparent way to construct a comparison group that closely mirrors the treated group. In contrast, ESR requires stronger assumptions, such as the identification of valid instruments to correct for selection on unobservables, which may not be readily available or reliable in food security contexts. Therefore, when unobserved heterogeneity is not a major concern, PSM offers a practical alternative for estimating treatment effects. PSM is chosen because it assumes that farmers who receive treatment and those who do not differ not only in treatment but also in characteristics that affect participation and the outcome. It thus seeks untreated farmers who have the same characteristics as the treated farmers and matches them using propensity scores, thus creating a quasi-experiment because the control group (untreated farmers) is statistically equivalent to the treated farmers (Winters *et al.,* 2010). The propensity score was used to estimate the probability of receiving treatment (Pi = 1) given observed characteristics (X):

$$\Pr Pi = \Pr(Pi=1|X)$$

Since 0 < Pi < 1, the conditional probability of participation (propensity score) was estimated using a probit model where the dependent variable is a dummy variable equal to one if the farmer participated and zero otherwise (Wooldridge, 2002). The independent variables are the characteristics that determine program participation, thus replicating the selection process. By using these characteristics, selection bias is solved since we are using the administrative rules in the program, and hence, the farmers do not self-select in the program.

PSM was used as suggested by Rosenbaum and Rubin (1983), to match the scores of those who were treated and those who were not treated. The outcome of the treated and untreated groups and the difference between the two is the measure of the impact attributable to the PESI program. Taking the mean of these individual impacts thus yields the estimated ATE (Gertler *et al.*, 2011):

$$ATE=E\,Y1\ t{=}1,D{=}1\ -Y0(t{=}1,D{=}0)$$

Where *Y1* is the outcome for the treated, *Y0* is the outcome for the non-treated, *t=1* represents the period post-treatment, *D=1* represents project participation, and *D=0* represents non-participation.

i. Algorithm to Estimate Propensity Score

This study employed Propensity Score Matching (PSM) to assess the impact of PESI on the household food security of smallholder farmers. One of the primary problems that is faced when using data from random selection is selection bias due to non-overlapping distributions. This means that if the treatment and control groups have underlying characteristics, random selection may lead to biased estimates. Therefore, the propensity score matching, which was introduced by Rosenbaum and Rubin (1983), aims to minimize the potential bias resulting from the selection problem by using non-experimental data. According to Pan and Bai (2015), four steps are followed when using the PSM, namely: (a) the estimation of the propensity scores either by using a logistic or Probit model; (b) matching of the propensity scores, to have a comparison group; (c) evaluating the quality of the matching and (d) evaluation of the outcome.

The PSM can be expressed as follows:

$$p(X) = Pr\ (X) = E\ (X)$$

Where D_i = (0,1) is the dummy for access to PESI and X is the vector of household characteristics. The conditional distribution of X, given the propensity score p(X), is similar in both groups, namely, of those with access to PESI and those PESI access. After estimating the propensity scores, the average treatment effect on the treated (ATT) can then be estimated as:

$$\text{ATT} = \text{E}\ (D_i = 1)$$

$$\text{ATT} = \text{E}\ [E(Y_{1i} - Y_{2i}|D_i = 1, \text{P}\ (X)$$

$$\text{ATT} = \text{E}\ [Y_{1i}\ |D_i = 1, P\ (X)) - E\ (Y_{2i}|D_i\ = 0, P\ (X))]$$

where Y_{1i} is the expected household food security if household i has access PESI; Y_{2i} is the expected household food security of household i without access to PESI; Di = (0,1) is the dummy for access to PESI, and X is the vector of the household characteristics.

ii. Empirical Estimation

To analyse the factors affecting access to PESI smallholder farmers and to estimate the propensity score Pr(X) = Pr (D =1X) for assessing the effect of PESI on household food security levels of smallholder farmers, the study made use of a Probit model as suggested by Wooldridge (2002).

PESI targeted smallholder farmers, prioritizing farm dwellers, females, child-headed households, and military veterans. Also, the program was implemented during the Covid-19 pandemic, leading to the department using a non-traditional implementation method. As such, variables were selected based on the implementation approach of PESI and used in the matching techniques since they are observable characteristics and thus provide a good basis for matching those in the program and those without**.** Age is important because younger individuals may be more comfortable with technology, while older individuals might face challenges in using mobile phones or participating in remote programs (Adereti et al., 2024). According to Smidt and Jokonya (2022), the level of education can impact the ability to comprehend and engage with the program's content, as well as the openness to adopting new agricultural initiatives.

Access to extension services is another relevant factor, as individuals who already receive agricultural support may be more knowledgeable (FAO, 1985) and likely to benefit from the program. The farmers register variable captures whether individuals are part of formal agricultural databases, which might indicate better access to institutional support and resources. Access to social media reflects technological engagement, which is critical for understanding how individuals receive program information. Including these variables in the matching process ensures that the treatment and control groups are comparable, minimizing biases related to differences in access, technology use, and prior experience, and providing a more accurate estimate of the program's impact.

Table 4.1. Description of variables used in the Probit regression model

Dependent variable	***Measurement***	***Expected sign***
PESI ben	1 = Yes, 0 = No (Dummy)	
Independent variables		
Gender	1 = Female, 0 = Male	+
Age	Age of beneficiary in years	-
Education	Highest grade completed	+/-
Ext. services	Access to extension services: 1 = Yes, 0 = No	+
Register	Farmers register: 1 = Yes, 0 = No	+
Social media	Access to social media: 1 = Yes, 0 = No	+
Grants	Social grants beneficiary: 1 = Yes, 0 = No	-
land size	Total hectares of land owned	+
Income	Annual agricultural income in rands	-
ICT usage	1 = Yes, 0 = No	+/-
Agro-dealers	Access to agro-dealers: 1 = Yes, 0 = No	-

4.3.3. Average Treatment Effect

Average Treatment Effect (ATE) and Difference in Difference model (DID) are both causal inference models used to estimate treatment effects. The study will use ATE due to the model`s flexibility and generalizability. ATE provides an average effect of the treatment on the outcome variable, allowing policymakers to understand the overall impact of the program. This study is interested in the impact of the program on the individuals who participated in it, which is the Average Treatment Effect on the Treated (ATT). While ATE compares the mean outcome if the entire population had received treatment to the mean outcome if the

entire population had not received treatment, the ATT compares mean outcomes for individuals who, in reality, received treatment to the mean outcomes if these same individuals had instead not received treatment (DuGoff *et al.*, 2013). Thus, the study is interested in the impact of the PESI program on the individual household rather than the population.

If D denotes the value if treated or not, such that D = 1 if treated and D = 0 if not, then:

$$ATT = E\,(Y_1 - Y_0 | D = 1)$$

But since the average of differences is the difference of averages, then ATT can be written as:

$$ATT = E[\,Y_1 |\, D = 1] - [Y_0 | D = 1]$$

However, we cannot observe the second term in equation 2 since it is a counterfactual of the outcome of the individual who was treated if they had not been treated. But we can observe the term E (Y0|D=0), which is the value of Y0 for the untreated individuals, and thus get the difference as:

$$\Delta = E\,[Y_1 |\, D=1] - E\,[Y_0 | D=0]$$

The difference in equation 3 is the selection bias, which is the difference between the counterfactual for treated individuals and the observed outcome for the untreated. This can be shown by adding and subtracting the term $E(Y0|D=1)$ in equation 2 as shown below:

$$\Delta = E\,[Y_1 |\, D = 1] - E\,[Y_0 |\, D = 1] \quad + E\,[Y_0 |\, D = 1] - E\,[Y_0 | D = 0]$$

Thus:

$$\Delta = ATT + \lambda$$

The symbol λ is the selection bias. If λ is zero, then ATE is an unbiased estimator of ATT:

$$ATE = E\,[Y_1 |\, D = 1] - E\,[Y_0 | D = 0]$$

However, the term λ is often not equal to zero because farmers self-select themselves in a program due to characteristics such as access to level of education, size of operation, ICT usage, and access to extension services, and thus the difference in means (ATE) will be a biased estimator of ATT. This is the main challenge of evaluation in trying to make the selection bias equal to zero. This is done through random assignment, which ensures that the treatment status (D) is not correlated with other observable or unobservable variables, and thus, the outcomes are statistically independent of the treatment category (Winters *et al.*,

2010). This makes sure that the characteristics of the treated and the untreated are the same (statistically equivalent), thus the groups will be identical except for the treatment category:

$$E\ [Y_0|\ D = 1] = E[Y_0|D = 0]$$

Therefore, it is possible to replace the unobservable term $E\ Y0\ D = 1$ with the observable term $E\ Y0\ D = 0$ to estimate ATT by ensuring the selection bias is equal to zero.

4.4. Empirical Results and Discussions

4.4.1. Descriptive Statistics

a) Produce Utilization: Consumption vs Sales

The results presented in Table 4.1 offer a comparison between PESI beneficiaries and non-PESI beneficiaries in terms of the percentage of produce consumed and sold. For consumption, the average percentage for PESI beneficiaries is 46.82%, whereas for non-PESI beneficiaries, it is 66.91%. The median percentage of produce consumed for PESI beneficiaries is 31.50%, while for non-PESI beneficiaries it is 26.00%. This suggests that, on average, non-PESI beneficiaries consume a higher percentage of their produce compared to PESI beneficiaries. This could be caused by PESI beneficiaries producing higher-quality yields and gaining improved access to markets, facilitated by enhanced availability of agricultural inputs through PESI. Additionally, these beneficiaries are more likely to have cultivated market-oriented and high-yield crop varieties, which encourages greater sales of their produce.

Table 4.2. Produce utilization among smallholder farmers

PESI beneficiaries		
Statement	Mean	Median
Percentage of produce consumed	46.82	31.50
Percentage of produce sold	53.18	68.50
Non-PESI beneficiaries		
Percentage of produce consumed	66.91	74.00
Percentage of produce sold	33.22	26.00

Source: Survey data (December 2024)

For the percentage of produce sold, PESI beneficiaries sell, on average, 53.18%, relative to 33.22% for non-PESI beneficiaries. The median for PESI beneficiaries is 68.50%, while for non-PESI beneficiaries, it is 26.00%, further suggesting that PESI beneficiaries tend to sell a higher proportion of their produce compared to non-PESI beneficiaries. These results indicate

that PESI beneficiaries tend to consume a lower percentage and sell a higher percentage of their produce compared to non-PESI beneficiaries. The distribution of both consumption and sales percentages also varies between the two groups, with PESI beneficiaries showing a more concentrated pattern of higher sales and lower consumption, while non-PESI beneficiaries display a more even distribution in both consumption and sales.

b) Agricultural Inputs and Agro-Dealers Accessibility

The results presented in Table 4.2 highlight the significant difference in access to agricultural inputs between PESI beneficiaries and non-PESI beneficiaries following the Covid-19 pandemic. Over 70% of PESI beneficiaries reported improved access to agricultural inputs, whereas less than 25% of non-PESI beneficiaries experienced similar improvements. This skewed distribution underscores the positive impact PESI had on enhancing smallholder farmers' access to essential agricultural inputs, a critical factor for sustaining agricultural productivity.

Table 4.3. Smallholder farmers` access to inputs and agro-dealers

Statement	Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)
PESI beneficiaries (n=112)					
I have improved access to agricultural inputs since I got PESI	8.00	73.20	15.20	1.80	1.80
It was easy to access the selected agro-dealers selected for PESI recipients	10.70	67.00	13.40	7.10	1.80
Non-PESI beneficiaries (n=119)					
I have improved access to agricultural inputs after the Covid-19	1.60	20.20	31.10	38.70	8.40
It is easy to access the agro-dealers for agricultural inputs	3.30	45.40	26.10	18.50	6.70

Source: Survey data (December 2024)

Similarly, access to agro-dealers for purchasing agricultural inputs displayed a comparable pattern. A higher percentage of PESI beneficiaries indicated that they were able to easily access the selected agro-dealers, while a significantly lower percentage of non-PESI beneficiaries reported the same. This further emphasizes the role PESI played in facilitating not only access to inputs but also in ensuring smallholder farmers could obtain these inputs

through reliable agro-dealers, particularly in the challenging context of the Covid-19 pandemic. The findings presented in this table highlight the significant contribution of the PESI program in improving access to both agricultural inputs and agro-dealers, which is crucial for supporting the livelihoods and productivity of smallholder farmers during a period of economic and logistical disruption caused by the pandemic.

c) Perceived Impact of PESI on Household Food Security

The results presented in Table 4.1 illustrate the impact of the PESI program on smallholder farmers' perceived household food security status, as assessed by their responses to statements regarding food access, food availability, and the ability to maintain a balanced diet. Over 60% of PESI beneficiaries reported improved household food access and availability following the pandemic, suggesting a positive contribution of the PESI program in terms of enhancing household food security. In contrast, less than 45% of non-PESI beneficiaries agreed that their food access and availability had improved following the Covid-19 pandemic, indicating a significant disparity between the two groups.

Table 4.4. Smallholder farmers` perceived food access, availability, and balanced diet preparation and consumption.

	PESI beneficiaries (n = 112)				
Statement	Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)
My household food access improved after I got PESI	8.00	71.40	17.90	2.70	0.00
My household food availability improved after I got PESI	8.00	69.60	18.80	2.70	0.90
We can prepare and consume a balanced meal in my household	7.10	62.50	24.10	4.50	1.80
Non-PESI beneficiaries (n=119)					
My household food access has improved after the Covid-19 pandemic	3.40	44.50	32.80	16.80	2.50
My household food availability improved after the Covid-19 pandemic	3.40	41.20	27.70	25.20	2.50
We can prepare and consume a balanced meal in my household	3.40	43.70	26.10	24.40	2.40

Source: Survey data (December 2024)

Furthermore, the ability to prepare and consume a balanced meal after the pandemic also showed significant differences between the two groups. Less than 45% of non-PESI

beneficiaries reported having the ability to prepare a balanced meal, which is lower compared to PESI beneficiaries (more than 60%), where a greater percentage agreed that they were able to eat a balanced diet. These findings suggest that PESI played a crucial role in improving food security outcomes, particularly in terms of access, availability, and diet quality, in comparison to non-PESI beneficiaries during the pandemic. This indicates that PESI had a significant positive impact on improving food access, availability, and the ability to maintain a balanced diet among its beneficiaries, in contrast to the more limited improvements experienced by non-PESI beneficiaries.

d) Household Food Insecurity Access Scale Across the Two Strata

The Household Food Insecurity Access Scale (HFIAS), a widely recognized tool for assessing food insecurity, measures the degree of food insecurity within households and is commonly used for monitoring and evaluating food security and nutrition programs. HFIAS consists of nine questions that ask about the frequency of food insecurity experiences. HFIAS can range between 0 and 27. The categories for HFIAS are food secure (0-1), mildly food insecure (2-7), moderately food insecure (8-14), and severely food insecure (15-27). Figure 4.2 illustrates the percentage distribution of HFIAS scores between the two strata of smallholder farmers, specifically comparing PESI beneficiaries with non-PESI beneficiaries.

The results indicate that 71.40% of PESI beneficiaries are classified as food secure, with only 16.1% falling into the mildly food insecure, 9.8% being moderately food insecure, and 2.7% being severely food insecure. These findings demonstrate that PESI beneficiaries have a significantly higher level of household food security compared to their non-PESI counterparts. In contrast, 40.30% of non-PESI beneficiaries report being food secure, a substantially lower percentage compared to PESI beneficiaries. Additionally, 26.90% of non-PESI beneficiaries are mildly food insecure, 25.20% are moderately food insecure, and 7.60% are severely food insecure. This data highlights the relatively higher levels of food insecurity among non-PESI beneficiaries, particularly in the moderate to severe categories, compared to those who received support through PESI. The results suggest that the PESI program has had a significant positive impact on improving household food security, with a much larger proportion of PESI beneficiaries being food secure and fewer facing food insecurity. Further

analysis on this is reported in Section 4.4.2, accounting for issues such as selection bias and factors affecting access to PESI.

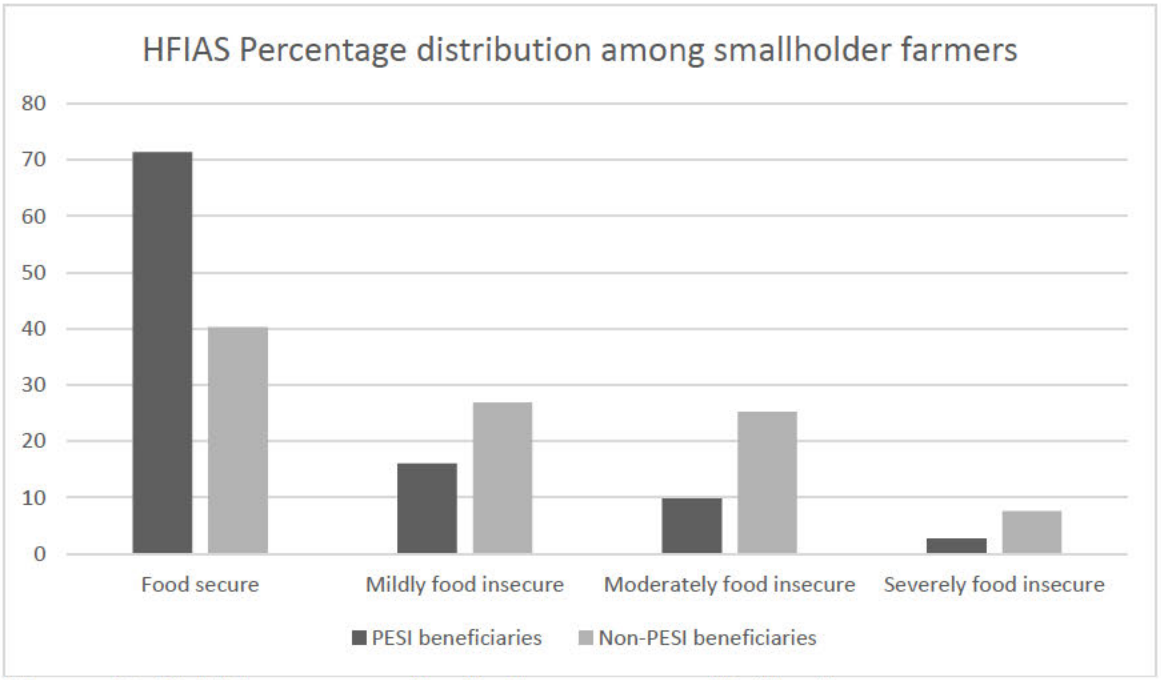

Figure 4.2. HFIAS percentage distribution among smallholder farmers
Source: Survey data (December 2024)

The results presented in Table 4.4 provide a detailed comparison of the Household Food Insecurity Access Scale (HFIAS) frequency distribution between PESI beneficiaries and non-PESI beneficiaries. The mean HFIAS value for PESI beneficiaries is 2.17, significantly lower than the mean score of 5.28 for non-PESI beneficiaries, indicating that PESI beneficiaries, on average, experience less household food insecurity. The median HFIAS score for PESI beneficiaries is 0.00, suggesting that a large portion of PESI beneficiaries report little to no household food insecurity. In contrast, the median for non-PESI beneficiaries is 4.00, indicating a higher level of household food insecurity among this group. This difference in medians highlights the more favourable household food security status of PESI beneficiaries compared to non-PESI beneficiaries.

Table 4.5. Frequency distribution of HFIAS among smallholder farmers

Strata	Mean	Median	Maximum
PESI beneficiaries	2.17	0.00	20.00
Non-PESI beneficiaries	5.28	4.00	23.00

Source: Survey data (December 2024)

The maximum HFIAS value for PESI beneficiaries is 20.00, while for non-PESI beneficiaries, it is 23.00, further illustrating that non-PESI beneficiaries tend to experience more severe food insecurity compared to PESI beneficiaries, who are less likely to report extreme levels of household food insecurity. The results in Table 4.4 highlight the relatively lower levels of household food insecurity among PESI beneficiaries, as reflected by their lower mean, median, as well as the maximum HFIAS values. In contrast, non-PESI beneficiaries show higher levels of household food insecurity across all measures, underscoring the positive impact of the PESI program on improving household food security outcomes for smallholder farmers.

e) Food Consumption Score Across the Two Strata

The Food Consumption Score (FCS) is a commonly used metric for assessing the dietary diversity and food security of households. It is calculated based on the frequency of consumption of different food groups over 7 days. The FCS categories are as follows: 0-21 is considered a poor consumption score, 22-35 is a borderline consumption score, and 35+ is an acceptable consumption score.

The results show significant differences in FCS between PESI beneficiaries and non-PESI beneficiaries. Notably, none of the PESI beneficiaries had a poor consumption score, indicating that all PESI beneficiaries had a minimum level of food security and dietary diversity. In contrast, 8.40% of non-PESI beneficiaries had a poor consumption score, suggesting that a small proportion of non-PESI beneficiaries experienced low dietary diversity and food insecurity. In terms of the borderline consumption score, 7.10% of PESI beneficiaries fell into this category, whereas 13.4% of non-PESI beneficiaries were classified as having a borderline score. This demonstrates that PESI beneficiaries experienced relatively

better food consumption patterns compared to non-PESI beneficiaries, with fewer individuals in the borderline category.

The majority of PESI beneficiaries, 92.90%, had an acceptable consumption score, indicating a high level of food security and dietary diversity among this group. On the other hand, 78.2% of non-PESI beneficiaries achieved an acceptable consumption score, which is substantially lower than the proportion of PESI beneficiaries in this category. These results highlight the positive impact of the PESI program on improving household food security and dietary diversity. A larger proportion of PESI beneficiaries fall into the acceptable food consumption category, with no beneficiaries classified as having poor consumption scores, while non-PESI beneficiaries show a higher percentage in both the poor and borderline categories. This suggests that PESI has effectively enhanced food consumption and household food security among smallholder farmers, particularly in terms of dietary diversity.

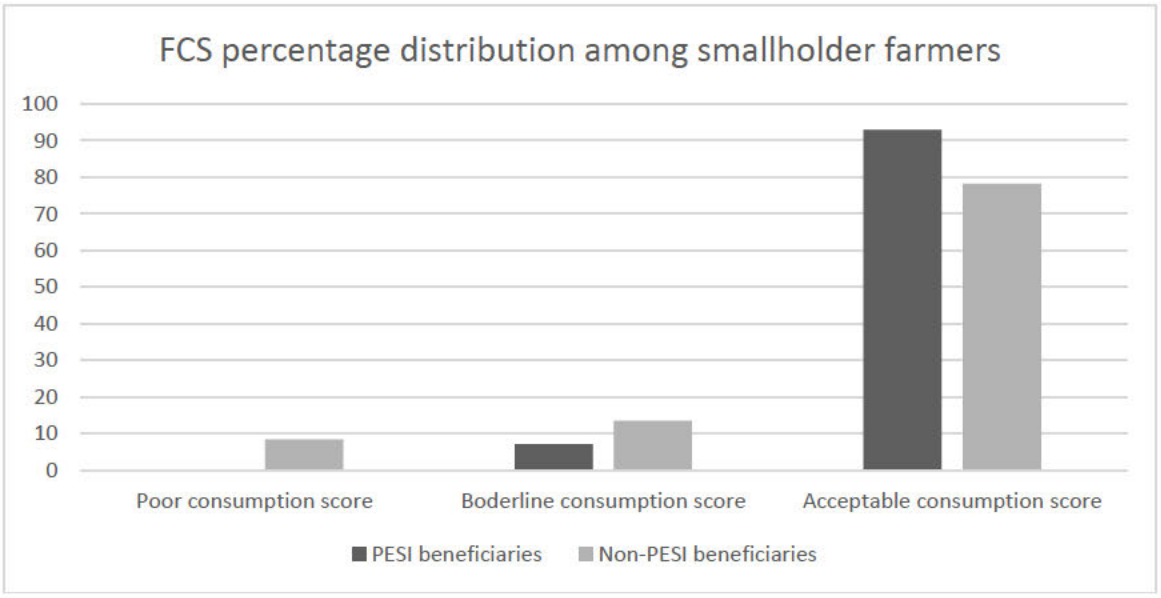

Figure 4.3. FCS percentage distribution among smallholder farmers
Source: Survey data (December 2024)

The results presented in Table 4.5 display the frequency distributions of the FCS among smallholder farmers, comparing PESI beneficiaries with non-PESI beneficiaries. The mean FCS for PESI beneficiaries is 58.31, which is notably higher than the mean of 49.60 for non-PESI beneficiaries, indicating that, on average, PESI beneficiaries experience better food security. This suggests that PESI beneficiaries have higher food security scores compared to their non-PESI counterparts. The median FSC for PESI beneficiaries is 56.50, while for non-

PESI beneficiaries, it is 50.00. This further demonstrates that the central tendency of the food security scores is higher among PESI beneficiaries, suggesting more favourable food security conditions overall for this group. The results in Table 4.5 highlight the overall better food security of PESI beneficiaries, as reflected in their higher mean, median, and maximum FSC values. The lower minimum score for non-PESI beneficiaries and the higher skewness for PESI beneficiaries suggest that PESI beneficiaries are more likely to experience better food security, with fewer extreme cases of low food security.

Table 4.6. Frequency distribution of FCS among smallholder farmers

Strata	Mean	Mode	Minimum	Median	Maximum
PESI beneficiaries	58.31	49.00	28.00	56.50	93.00
Non-PESI beneficiaries	49.60	49.00	19.00	50.00	89.00

Source: Survey data (December 2024)

4.4.2. Model Test Results and Discussion

a. Stage 1: Probit Regression Results and Discussion.

To generate the propensity scores for the matching process, the probability of smallholder farmers` access to PESI was estimated using the probit model. The results from the probit model shed light on the factors that influence the likelihood of being a PESI beneficiary. Being part of the farmers' register, access to social media, size of land owned, and access to agro-dealers were all significant factors influencing participation in the PESI program.

Registration of farmers on the farmers register was statistically significant at the 5% level and indicated a positive relationship. This means that farmers who are registered in the DARD farmers register have a higher likelihood of participating in the program compared to their counterparts. This could be because registration provides a formal record that makes it easier for program administrators to reach farmers. Another significant factor is access to social media at 5%, with a coefficient that indicates a positive relationship. These findings are similar to Sebotsa et al. (2021) who reported that access to social media has a positive influence on farmer participation in various programs. This might be because social media has proven to be an effective channel for disseminating information faster (Lin, 2022).

Table 4.7. Probit results of factors affecting access to PESI

Treatment	*Coefficient*	*Standard error*	*z*
Gender	0.27	0.19	1.44
Age	-0.01	0.01	-1.47
Education	-0.03	0.03	-1.07
Grants	0.15	0.29	0.53
Ext. services	0.16	0.11	1.55
Farmers register	0.46**	0.19	2.46
Social media	0.48**	0.22	2.15
land size	0.02*	0.01	1.82
ICT usage	0.37	0.47	0.77
Income	-5.24	4.50	-1.16
Agro-dealers	0.70**	0.25	2.83
-cons	-0.97		

Source: Survey data (December 2024)

Note: Figures in parentheses are the $p > |z|$ values associated with the coefficients and marginal effects. ***P < 0.01 and **P < 0.05, and *P <0.10 mean significant at 1%, 5%, and 10% probability levels, respectively.

Land size was also significant at 10%. This suggests that farmers with more land have an increased likelihood of participating in the program. This is among the consistent study findings of Manenzhe and Lahiff (2017). Increased land size increases the opportunity costs of poor productivity (Mmbengwa et al., 2011). Farmers with more land might be more engaged with extension officers and more up-to-date and well-informed about new programs that might benefit their farms. Access to agro-dealers was also significant at 5%. This suggests that farmers who have access to agro-dealers are more likely to participate in the program. This is consistent with existing literature (Aliance for Green Revolution in Africa, 2019; Nyakundi, 2022) that reported a positive relationship between access to agro-dealers and agricultural program participation. Agro-dealers were also used as channels to disseminate information about the program. The limited influence of factors such as gender, age, education, income, and access to services on participation can be attributed to the program's design. Implemented in 2020 during the Covid-19 pandemic, the voucher-based initiative required online applications, which likely excluded many farmers lacking internet access, digital literacy, or necessary devices. This created a digital barrier that cut across

traditional demographic lines, resulting in a self-selected group of participants. As a result, typical socioeconomic factors had minimal impact, as the main determinant of participation was the ability to navigate the online application system.

b. Stage 2: The Impact of PESI on Household Food Security of Smallholder Farmers

The impact of PESI on household food security among smallholder farmers was evaluated using the Average Treatment Effect on the Treated (ATT), as presented in Tables 4.8 and 4.9. To estimate the ATT, three alternative matching methods were employed: nearest neighbor matching, radius matching, and kernel matching. The analysis was conducted within the framework of common support to ensure that the distributions of treated and control units fell within the same domain. A significant difference between PESI beneficiaries and non-beneficiaries was observed, as supported by the model's t-statistic exceeding two. The findings indicate that respondents enrolled in the PESI program experienced a 3.61 increase in household food access through the nearest neighbor and Kernel matching method, and a 3.60 increase in household food access through the Caliper matching method. This suggests that participation in PESI facilitated improved food access for smallholder farmers compared to those not enrolled in the program. These results align with Kiratu (2014), who found that the Killimo Plus program increased food access for smallholder farmers by 6.82.

Table 4.8. Nearest neighbor matching method for HFIAS results

Matching method	Treated	Control	ATT	t-statistic
Nearest neighbor and Kernel	112	119	3.61	11.72***
Caliper	112	119	3.60	12.16***

Source: Survey data (December 2024)

The Food Consumption Score (FCS) was used alongside the Household Food Insecurity Access Scale (HFIAS) to provide a more specific measure of food quality and dietary diversity of smallholder farmers. While HFIAS focuses on the access to and frequency of food insecurity experiences, FCS evaluates the variety and frequency of food consumption, offering a deeper insight into dietary diversity within the treated group. The integration of

both tools enables a more comprehensive assessment of food insecurity, addressing both the quantity and quality of food access. The results reveal significant differences between PESI beneficiaries and non-beneficiaries, with PESI participants exhibiting a higher FCS of 2.93 compared to their non-PESI counterparts for all three matching methods.

Table 4.9. Nearest neighbor matching method for FCS results

Matching method	Treated	Control	ATT	t-statistic
Nearest neighbor and Kernel	112	119	2.93	7.34***
Caliper	112	119	2.93	7.90***

Source: Survey data (December 2024)

The results regarding the impact of PESI program on household food security are consistent with the findings of Chirwa et al. (2011), who identified a positive relationship between access to agricultural subsidies and food consumption in Malawi. Similarly, Holden and Lunduka (2010) found that the Smart Subsidy in Malawi significantly enhanced household food security, with 66.1% of respondents reporting improved food security at the household level and 68.9% at the community level. Additionally, Abay et al. (2020) noted that households receiving support through Covid-19 policy interventions were more food and nutrition secure compared to those not receiving such interventions. Amare et al. (2020) further emphasized the strong relationship between food security and access to targeted policy interventions during the Covid-19 pandemic.

c. Stage 3: Test of Matching Quality

To further assess the reliability of the reported estimates, balancing tests based on nearest neighbor matching were conducted, with the results presented in Table 4.10. According to Caliendo and Kopeinig (2008), valid matching is achieved when there are no significant differences between the treated and control groups.

The results in Table 5.7 indicate that, following matching, no statistically significant differences were found between PESI and non-PESI beneficiaries. Additionally, Peikes et al. (2008) emphasize that for matching to be considered successful, the bias for all covariates in the model must be less than 20%. The percentage bias for the mean values of all covariates

between the two groups is below 20%, suggesting that the balancing requirement has been satisfactorily met.

Table 4.10. Test of matching quality results

Variables	*Means*		*% Bias*	*t-tests*	
	Treated	**Untreated**		**t**	**p> |t|**
Gender	0.52	0.44	16.80	1.23	0.22
Age	49.52	51.52	-13.40	-0.95	0.35
Education	9.88	9.67	6.00	0.45	0.65
Grants	0.87	0.90	-11.40	-0.86	0.39
Ext. services	2.56	2.39	19.20	1.48	0.14
Farmers register	0 .63	0.69	-13.40	-1.01	0.32
Social media	0.70	0.79	-17.75	-1.41	0.16
Income	54.00	7458.60	-9.60	-0.63	0.53
land size	3.71	3.68	0.1	0.03	0.98
ICT usage	0.04	0.07	-15.20	-0.92	0.36
Agro-dealers	0.91	0.89	5.10	0.45	0.65

Source: Survey data (December 2024)

4.5. Summary

The study understands that smallholder farmers` households have different capital assets ,and that PESI improved those capital assets. This study assessed the impact of the PESI program on household food security among smallholder farmers. The descriptive statistics indicated that PESI beneficiaries had improved access to agricultural inputs and -dealers. Additionally, PESI beneficiaries tend to sell more of their produce compared to non-PESI beneficiaries. HFIAS and FCS revealed that PESI beneficiaries had acceptable food consumption scores and were food secure compared to non-PESI beneficiaries. The study employed the ATT model to determine the impact PESI had on household food security levels of smallholder farmers. The analysis compared the Food Consumption Score and Household Food Insecurity Access Scale across treated and control groups. Results indicated that the treated group experienced an increase in their HFIAS and FCS, with significant differences between the treated and untreated groups . The use of FCS as an additional tool alongside HFIAS provided a more comprehensive measure of food security. While HFIAS measures food access and availability, FCS captures dietary diversity and frequency of consumption, thus offering a more complete picture of food security. Ultimately, these results indicate that such programs have the capacity to improve household food security levels of smallholder farmers and improving or increasing the total reach of the program can have positive impacts on rural development and meaningfully contribute to achieving SDG goal 2 which is Zero Hunger.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1. Recapping the Purpose of the Research

Food insecurity and unsustainable livelihoods remain critical challenges in rural South Africa, particularly among smallholder farmers who are part of the local food systems. Despite numerous government interventions aimed at improving agricultural productivity and rural livelihoods, the sector continues to face persistent barriers such as limited access to inputs, markets, finance, and extension services. These challenges were further intensified by the Covid-19 pandemic, which disrupted supply chains, reduced demand for produce, and limited support services, deepening the vulnerability of smallholder farmers to poverty and food insecurity. In response, the government introduced PESI, a voucher-based support program aimed at helping smallholder farmers recover and improve their farming operations.

While the program marked a significant shift in agricultural support strategy, little empirical evidence exists on its impact and effectiveness in the South African context. Most of the available information is non-academic sources. Thus, this study was conducted to investigate the impact of the PESI program on household food security among smallholder farmers and to assess farmers' perceptions of the program. Specifically, the study aimed to: (i) explore the perceptions of smallholder farmers toward the PESI initiative and the socio-economic factors shaping those perceptions, and (ii) assess the program's effectiveness in improving food security outcomes at the household level. These findings are intended to inform policy and future programming in ways that more effectively support rural livelihoods and contribute to national food security goals. The rest of the chapter presents the conclusion and recommendations in Section 5.2 and 5.3, respectively. The directions for future research are detailed in Section 5.4.

5.2. Conclusion

The study provides evidence that PESI had a significant impact on smallholder farmers. The empirical findings indicate that PESI beneficiaries sell larger quantities of their produce and have improved access to agricultural inputs and agro-dealers compared to non-beneficiaries, who tend to consume a greater proportion of their output and face more limited access to these services. Food security outcomes, measured using the Household Food Insecurity Access Scale (HFIAS) and the Food Consumption Score (FCS), show that PESI beneficiaries

are notably more food secure and have better dietary diversity. HFIAS revealed that there was a 31.40% difference between PESI and non -PESI beneficiaries under the food secure category, with PESI beneficiaries reporting higher percentages, however non-PESI beneficiaries reported higher percentages under the mildly food secure, moderately food secure and severely food secure categories compared to PESI beneficiaries. FCS revealed that 0.00% of PESI beneficiaries had poor consumption score while non-PESI beneficiaries reported over 5% poor consumption score. Additionally, PESI beneficiaries had a higher acceptable consumption score (14.70%) compared to non-PESI beneficiaries. This underscores the program's critical role in improving food access. The Average Treatment Effect on the Treated (ATT) analysis further confirmed PESI's positive impact on household food access and nutrition.

At the same time, data analysis revealed that perceptions of PESI are shaped by demographic and contextual factors such as age, education, income, settlement type, and information sources. Beneficiaries generally viewed the program positively, especially those who participated in earlier phases or received information through informal networks and digital platforms. However, issues such as inadequate voucher values, overcharging by agro-dealers, and limited program awareness among non-beneficiaries reduced satisfaction and trust. Non-beneficiaries often expressed negative or mixed perceptions, citing difficulties in accessing the program and perceived inequities in its implementation. Additionally, the probit model highlighted that access to agro-dealers, digital platforms, land ownership, and inclusion in the farmer register significantly influenced the likelihood of benefiting from the program. These findings demonstrate the program's tangible benefits in promoting agricultural productivity and household food security.

These findings underscore that the effectiveness of rural development initiatives like PESI depends not only on material benefits but also on how equitably the program is delivered. Perceived fairness, accessibility, and inclusiveness are critical to the success and sustainability of such interventions.

Overall, the findings underscore the value of context-sensitive, inclusive, and well-communicated agricultural support programs like PESI in enhancement on household food security levels due to its responsiveness to local agricultural challenges faced by smallholder farmers, inclusion of marginalised groups such as women and child headed households. How

the program was communicated also has significant impacts of perception rating as evidenced by the Ordered Probit model. Scaling up and adapting such interventions with attention to demographic and socio-economic diversity can strengthen their effectiveness and contribute meaningfully to achieving Sustainable Development Goal 2: Zero Hunger.

5.3. Recommendations

Based on the study's findings, the following recommendations are made:

- DALRRD can regulate agro-dealers to ensure fair pricing of the agricultural inputs that can be redeemed by PESI vouchers.
- DALRRD can redesign PESI in a way that it leverages community structures and networks, especially in areas where social capital is strong.
- PESI`s implementation approach can be refined to better accommodate the diverse needs of smallholder farmers, particularly those in remote or marginalized communities.
- DALRRD can enhance monitoring and evaluation of the PESI program.
- DALRRD can conduct periodic impact assessments and foster continuous feedback loops with beneficiaries to adapt and improve the program based on evolving needs and on the ground realities.

5.4 Future Research Focus

Due to resource and time constraints, this study used data collected in one district. Future research can be expanded to other districts and provinces. This will assist in understanding perceptions of smallholder farmers towards PESI and identifying factors that influence those perceptions. This will also give a wider view of the impact of PESI on household food security of its beneficiaries. This is essential in assisting policymakers in structuring future programs that are aimed at assisting smallholder farmers, particularly voucher-based input support programs.

Furthermore, future research can aim to qualitatively analyse and gain a deeper understanding of perceptions of smallholder farmers as it will enable the researchers to explore the nuances of smallholder farmers' lived experiences, uncovering insights into how they interpret and respond to such interventions. This depth of understanding is valuable when designing interventions or policies that are meant to be relevant to smallholder farmers. Additionally, future research can also investigate factors influencing participation in PESI, as this study

only touched on that point as a step in generating the propensity scores for ATT. Future research can also use different household food security measuring tools from this study to cover other dimensions of food security. Future social protection programs must, therefore, be sensitive to local contexts, proactively address communication and access barriers, and ensure that both program design and implementation reflect the diverse needs of smallholder communities.

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ANNEXURE 1: Informed Consent Form

Discipline of Agricultural Economics

School of Agricultural, Earth and Environmental Sciences

College of Agriculture, Engineering and Science

University of KwaZulu-Natal

Informed Consent Document

Dear Participant,

My name is Reabetswe Moipolai (*223153539*). I am a Masters candidate studying at the University of KwaZulu-Natal, Pietermaritzburg Campus. The title of my research is: **Assessing the impact of the 2020 Presidential Economic Stimulus Initiative (PESI) on smallholder farmers` livelihoods: Empirical evidence from Ngaka Modiri Molema District, South Africa.** The study aims to assess the impact of PESI on smallholder farmers` livelihoods, mainly focused on household food security. It also aims to understand smallholder farmer`s perceptions towards the PESI program and understand factors influencing those perceptions. I am interested in interviewing you so as to share your experiences and observations on the subject matter.

Please note that:

- The information that you provide will be used for scholarly research only.
- Your participation is entirely voluntary. You have a choice to participate, not to participate or stop participating in the research at any time. You will not be penalized for taking such an action.
- Your views in this interview will be presented anonymously. Neither your name nor identity will be disclosed in any form in the study.
- The interview will take about 1 hour.
- The record as well as other items associated with the interview will be held in a password-protected file accessible only to myself and my supervisors. After a period of 5 years, in line with the rules of the university, it will be disposed by shredding and burning.

- If you agree to participate please sign the declaration attached to this statement (a separate sheet will be provided for signatures)

I can be contacted at: University of KwaZulu-Natal, Pietermaritzburg Campus, Scottsville, Email: 223153539@stu.ukzn.ac.za, Phone: [redacted].

My supervisor is Ms Raesetse Baloyi, who is located at the Pietermaritzburg Campus of the University of KwaZulu-Natal. Contact details: email: BaloyiR@ukzn.ac.za, Phone:033 260 5494.

The Humanities and Social Sciences Research Ethics Committee contact details are as follows: Ms Phumelele Ximba, University of KwaZulu-Natal, Research Office, Email: ximbap@ukzn.ac.za, Phone:031 260 3587.

Thank you for your contribution to this research.

DECLARATION

I…… *(full names of participant*) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project.

- I understand that I am at liberty to withdraw from the project at any time, should I so desire. I understand the intention of the research. I hereby agree to participate.
- I consent / do not consent to have this interview recorded (if applicable)

SIGNATURE OF PARTICIPANT:

DATE:

ANNEXURE 2: QUESTIONNAIRE SAMPLE

HOUSEHOLD SURVEY QUESTIONNAIRE

Per the signed declaration form on the consent form, the information to be captured in this questionnaire is strictly confidential and will be used for research purposes by students and staff of the University of KwaZulu-Natal. The information will be used for an MSc study titled "**Assessing the impact of the 2020 Presidential Employment Stimulus Initiative on smallholder farmers livelihoods: Empirical evidence from Ngaka Modiri Molema District, South Africa**". There are no wrong or right answers to these questions. Participation is voluntary and you are under no obligation to participate. You are free to withdraw at any time during the completion of this questionnaire without giving a reason. Your personal details will be given a code, and you will be referred to in this way in any publications or other research reporting outlets, such as conference proceedings.

Do you agree to participate in this survey? 1=Yes 0=No _____

Signature: _____

Date of survey:	Enumerator`s name:
Municipality:	Rural/Peri-urban area:
Farmer Name:	Contact:
Questionnaire no:	

SECTION A: HOUSEHOLD SOCIO-ECONOMIC CHARACTERISTICS

A1. Gender	
A2. Age	
A3. Marital status	
A4. Highest level of education	
A5. Do you have post high school education?	
A6. Total number of the members of your household **(**Please include only those who stay in the household for 3 or more days per week and eat together)?	
A7. what is the total number of household members that are below 10 years of age?	
A8. What is the total number of household members that are between 10 and 15 years of age?	
A9. What is the total number of household members that are over 70 years of age?	
A10. What is the total number of household members that ae disabled or permanently sick with no labor contribution to the household?	
A11. What is your main occupation? (Multiple answers possible)	
A12. How many years of experience in agriculture?	

Codes: A1: 0=Male, 1=Female; **A3:** 1=Single, 2=Married, 3=Widowed, 4=Cohabiting; 5=Divorced **A5:** 0=No, 1=Yes; **A11:** 1=Fulltime Farmer, 2=Part-Time Farmer, 3=Regular Salaried Job, 4=Temporary Job, 5=Self-Employed, 6=Student, 7=Retired, 8=Unemployed, 9=Other (specify)

A13. Have you received/are you a beneficiary of any agricultural support program?_____ 1=Yes, 0=No

If "Yes" to **A13,** please complete the following table.

	A13a. Program name:	**A13b. Type of assistance:**	**A13c. Who was providing?**	**A13d. Satisfaction with support:**
a.				
b.				
c.				

Codes: A11b: 1=Financial/Funding, 2=Inputs (specify), 3=Training (specify), 4=Other (specify); **A11c:** 1=Government, 2=Private Sector, 3=Non-Governmental Organization (NGO), 4=Other (specify); **A11d:** 1=Very Unsatisfactory, 2=Unsatisfactory, 3=Neutral, 4=Satisfactory 5=Very Satisfactory

SECTION B: HUMAN CAPITAL

B1. Have you ever received any farming or agriculture business related training?_____ 1=Yes 0=No

B2. If "Yes" to **B1**, please complete the table below for at most 3 important trainings received. If "No" skip to section C.

	Training 1	**Training 2**	**Training 3**
a. Type of training received?			
b. Who offered the training?			
Please rate the statements below as relevant to you:			
c. I attended all the training sessions			
d. I fully understood contents of the training session.			
e. I was able to put into practice all the advice I received from the training session.			
f. The training I received was relevant.			

Codes: a: 1=Crop Production, 2=Water Management/Climate Change Coping Strategies 3= Proposal Writing and Business Planning, 4=Financial Management/Bookkeeping, 5=Agricultural Commodity Marketing (includes pricing), 6=Value Addition (processing and packaging), 7= Other (please specify); **b:** 1=Government, 2= Fellow Farmers, 3= Private Company, 4=NGO, 5=Parents/Relative Knowledge, 6=Self-taught, 7=Other (specify); **c-f:** 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree

SECTION C: FINANCIAL CAPITAL

Type of household income	**C1: Source of household income (please tick those that apply to you)**	**C2: Number of times you received this income in a year (e.g.: once, twice, monthly, etc.)**	**C3: Average income each time (Rand)**
a. Remittances			
b. Arts and crafts			
c. Permanent employment			
d. Temporary employment			

e. Other (specify)			

C4: Is any of the household members a beneficiary of the social grants program? _____ 1=Yes, 0=No

If :"Yes" to **C4**, please fill in the following table. If "No", please skip to **C7**

Type of social grant	**C5. Please tick the type of social grant being received in the household**	**C6. Total number of beneficiaries**
a. Childcare grant		
b. Foster care grant		
c. Old persons grant		
d. Care dependency grant (grants for people who take care of severely disabled children in need of full-time special care)		
e. Grant in aid (if you live on social grants but need someone to take care of you)		
f. War veterans grant		
g. Disability grant		
h. Social Relief Distress (SRD)		
i. Other (specify)		

C7: Do you have any form of savings? _____ 1=Yes, 0=No

C8: If "Yes" to **C7**, which type of savings? _____ 1=Formal, 2=Informal (i.e. stokvel), 3=Both

C9: Have you ever taken credit or used any loan facility in the past 12 months?____ 1=Yes, 0=No

If "Yes" to C9, please fill in the following table if "No" skip to C13:

	Credit 1	**Credit 2**	**Credit 3**
C10: Type of credit			
C11: Source of credit			

C12: Purpose of credit			

Codes: C10: 1= Consumption (e.g. food), 2= Agricultural Production , 3= Other Investment Credit (please specify); **C11:** 1= Relative or Friend, 2= Money Lender, 3= Savings Club (e.g. stokvel or internal savings and lending schemes), 4= Input Supplier, 5= Output Buyer, 6= Banks, 7= Government, 8= Microfinance Institutions, 9 = Other (specify); **C12:** 1= Family Needs-Consumption, 2= Agricultural Purposes, 3= Family Emergency-Consumption, 4= Other (specify);

C13: If "No" to **C9**, please specify the reason(s) for not taking and/or using credit (multiple answers possible): _____

1=The interest rate is high, 2=I couldn't secure the collateral, 3=I have got my own sufficient money, 4=It isn't easily accessible, 5=I do not want to be indebted, 6=Other (specify)

SECTION D: PHYSICAL CAPITAL

Complete the following table on ownership and access to assets

Assets	**D1:** Number of assets owned	**D2:** Estimated value of the asset in Rands if you were to sell it	**D3:** Which ones do you own or have access to as a group? **(Please tick)**
a. Cell phone (non-smart)			
b. Smart phone/iPad			
c. Radio			
d. Television			
e. Computer/Laptop			
f. Trailer/cart			
g. Water tank			
h. Motor vehicle in running order			
i. Plough			
j. Planter, harrow or cultivator			
k. Tractor			
l. Other (specify)			
m. Other (specify)			

n. Other (specify)			

D4. Do you own any livestock? _____ 1=Yes, 0=No

If "Yes" to **D4**, complete table below on livestock ownership. If "No" go to Section E

Type of livestock	**D5:** Number owned	**D6:** Number sold in the previous six months	**D7:** Value of each livestock if you were to sell (Rands)	**D8:** Main market for selling livestock
a.				
b.				
c.				
d.				

Codes: D8: 1=Local Butchery, 2=Supermarket, 3=Neighbours, 4=Hawkers, 5=Auction, 6=Other (specify)

Please fill in the following table if "Yes" to **D4**

D9: Livestock commodity	**D10:** Type of inputs used P.A	**D11:** Estimated quantity of inputs used P.A	**D12:** Estimated value of input in rands P.A	**D13:** Main market for accessing input
a.	Feeds			
	Medication			
	Labour			
	Other			
b.	Feeds			
	Medication			
	Labour			
	Other			
c.	Feeds			
	Medication			
	Labour			
	Other			

d.	Feeds			
	Medication			
	Labour			
	Other			

Codes: D13: 1=NWK, 2=Sac Feeds, 3=Mafikeng Lucerne wholesalers, 4=Commercial Farmers, 5=Other

D14. What is your main purpose of keeping livestock? (***multiple answers possible***)	
D15. What are your main challenges in livestock production? (**multiple answers possible**)	

Codes: D9: 1=Sales (income), 2=Consumption, 3=Wealth, 4=Draught Power, 5=Cultural Reasons, 6=Other (specify); **D10:** 1=Disease Outbreaks, 2=Unable to Vaccinate Due to Financial Constraints, 3=Limited Grazing Area, 4=No Access to Grazing Area, 5=No Access to Support Services (e.g. veterinary services, etc), 6=Others (specify)

SECTION E: NATURAL CAPITAL

E1. Do you own or have access to land?_____ 1=Yes, 0=No

(If "Yes" proceed to **E2**, otherwise go to **Section F**)

E2. If "Yes" to **E1**, what is your total number of plots? _____

E3. How much land in hectares do you own/have access to (N.B. including land rented)? _____

Please complete the following table regarding the land that you own/have access to.

Plot	**E4:** Size of plot (Hectares)	**E5:** Means of ownership	**E6:** Amount per ha per year if plot is leased/rented	**E7:** Plot quality (fertility and drainage
Plot 1				
Plot 2				
Plot 3				
Plot 4				

Codes: E5: 1=Owned, 2=Leased or Rented, 3=Borrowed, 4=Received from the Chief on a Temporary Basis, 6=Other (specify); **E7:** 1=Very Bad, 2=Bad, 3=Neutral, 4=Good, 5=Very Good

SECTION F: CROP PRODUCTION AND MARKETING INFORMATION

Complete table for crops grown in the recent cropping season (Please indicate units for each crop)

F1: Crop grown	**F2:** Quantity harvested in units (crates, kgs, sacks, head)	**F3:** Total quantity sold in units (crates, kgs, sacks, head)	**F4:** Total quantity consumed in units (crates, kgs, sacks, head)	**F5:** Average price per unit sold (Rands)	**F6:** Market outlet for selling crops
a.					
b.					
c.					
d.					

Codes: F6: 1=Farm Gate, 2=Hawkers, 3=Local Shops, 4=Shops in Town, 5=Van Traders, 6=Road Side, 7=Other (specify)

F7. Do you sell some of your produce as a group? _____ 1=Yes, 0=No

F8. Do you sell some of your produce individually? _____ 1=Yes, 0=No

F9a. What is the distance to the nearest source of major variable inputs(seeds, fertilizer, pesticides, etc.) (minutes)? _____

F9b. What is the distance to the nearest point of sale of your produce (minutes)? _____

F10a. What type of road do you use to access your major variable input markets? _____ 1=Paved Road, 2=Gravel Road

F10b. What type of road do you use to access your major output markets? _____1= Paved Road, 2=Gravel Road

F11a. Please rate the accessibility of your major road to the variable input markets? _____ 1=Not accessible at all, 2= not accessible during rainy season, 3=accessible

F11b. Please rate the accessibility of your major road to the output markets? _____ 1=Not Accessible at all, 2=Not Accessible During Rainy Season, 3=Accessible

F12. Complete the following table for production inputs used for each crop in the last six months

Crop	**Inputs**	**F12a. Unit of input**	**F12b. Quantity of inputs used or number of units**	**F12c. Cost per unit**
a.	Seeds			
	Labor			
	Fertilizer			

	Manure			
	Tractor/Ox			
b.	Seeds			
	Labor			
	Fertilizer			
	Manure			
	Tractor/Ox			
c.	Seeds			
	Labor			
	Fertilizer			
	Manure			
	Tractor/Ox			
d.	Seeds			
	Labor			
	Fertilizer			
	Manure			
	Tractor/Ox			

Codes: F18a: 1=Kilograms, 2=Gram, 3=Rands, 4=Other (Specify)

SECTION G: Presidential Employment Stimulus Initiative (PESI) INFORMATION

G1. Are you a PESI beneficiary?_____ 1=Yes, 0=No

Question:	**Code:**
G2. How did you know about PESI?	

Codes: G2: 1=Family & Friends, 2=Social Media, 3=Television & Radio, 4=Extension Officer; 5= I did not know about PESI

If "Yes" to G1, please answer the following questions, otherwise skip to G8

Question:	**Code:**
G3. How easy was the application process?	

Codes: 1= Difficult 2=Somewhat Difficult, 3=Easy

G4. Were you a beneficiary of the 2020 (Phase 1), 2021 (Phase two) or both programs ? _____
1=Phase One, 2=Phase Two, 3=Both

G5a. What was the value of your phase one PESI voucher? R_____

G5b. What was the value of your phase two PESI voucher? R_____

G6. Please rate the statements below as relevant to you:

Statements:	**Answer**
1. My household's **access** to food improved since participating in the PESI program.	
2. My household's **food availability** has improved since participating in the PESI program.	
3. We are able to prepare and consume a healthy balanced diet that meets my nutritional needs.	
4. My crop yields have increased since participating in the PESI program.	
5. My income from farming activities has increased since participating in the PESI program.	
6. There has been an improvement in my access to agricultural inputs (seeds, fertilizers, pesticides, etc.) since participating in the PESI program.	
7. It was easy for me to access the selected agro-dealers.	
8. I have received agricultural extension services to follow up on my progress since participating in the PESI program.	

Codes: 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree

G7. Challenges encountered after being approved to receive a PESI voucher (Please rate the statements below as relevant to you):

G7a. The value of the voucher was not enough.	
G7b. I got the PESI voucher, but I could not redeem it because I could not travel to the selected agro-dealers` location.	
G7c. My voucher expired before I could redeem it.	
G7d. I got the PESI voucher, but I could not redeem it because I stay far from agro-dealers.	
G7e. The agro-dealer charged more than the agreed rates with the department.	
G7f. Any other challenges you would like to mention?	

Codes: 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree

If "No" to G1 answer the following questions, otherwise skip to G10

G8. Challenges encountered during the implementation of PESI (tick a statement or statements that applies to you):

G8a. I could not apply due to network problems	
G8b. I could not apply on my own and did not have anyone to help me	
G8c. I did not have physical access to a phone to apply	
G8d. I did not know about the program	
G8e. I am not registered on the department`s farmer register	
G8f. My farm is not registered for VAT	
G8g. Any other challenges you would like to mention?	

G9. To what extent do you agree or disagree with the following statements?

Statement	**Answer**
1. My household has adequate access to food.	
2. We have enough variety of foods available to meet my family's dietary needs.	
3. We are able to prepare and consume a balanced diet that meets my nutritional needs.	
4. I have adequate access to agricultural inputs.	
5. It is easy to access agro-dealers.	
6. I have received quality agricultural extension services in the past six months.	

Codes: 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree

G10. Please rate the following perceptions on a Likert scale of one to five with regards to the impact of the 2020 PESI program on your livelihoods.

GENERAL SMALLHOLDER FARMERS PERCEPTION OF PESI

PERCEPTION	RANK
G10a. The program has helped smallholder farmers to increase their productivity.	
G10b. The program has helped smallholder farmers to increase household food security.	
G10c. The program has increased smallholder farmers` farm income.	
G10d. The program increased smallholder farmers` access to agricultural inputs.	
G10e. The program was easily accessible to every smallholder farmer.	
G10f. Extension officers were helpful during the implementation of the program.	
G10g. The implementation approach of the program was suitable for smallholder farmers.	
G10h. The program empowered vulnerable groups (women, child-headed households, disabled people, etc) of smallholder farmers.	

Codes: 1=Poor, 2=Fair, 3=Average, 4=Good, 5=Excellent

SECTION H: HOUSEHOLD FOOD SECURITY

H1. HOUSEHOLD FOOD INSECURITY ACCESS SCALE

No.	Question **In the past 7 days:**	Code
1	Did you worry that your household would not have enough food?	
1A	If 1 to **Q1,** how many days would this happen within a week?	
2	Were you or any household unable to eat the kinds of foods you preferred because of a lack of resources?	
2A	If 1 to **Q2,** how many days would this happen within a week?	
3	Did you or any household member have to eat a limited variety of foods (less kinds of food on the plate) due to a lack of resources?	
3A	If 1 to **Q3,** how many days would this happen within a week?	

4	Did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food?	
4A	If 1 to **Q4,** how many days would this happen within a week?	
5	Did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?	
5A	If 1 to **Q5,** how many days would this happen within a week?	
6	Did you or any other household member have to eat fewer meals in a day because there was not enough food?	
6A	If 1 to **Q6,** how many days would this happen within a week?	
7	Was there ever no food to eat of any kind in your household because of lack of resources to get food?	
7A	If 1 to **Q7,** how many days would this happen within a week?	
8	Did you or any household member go to sleep at night hungry because there was not enough food?	
8A	If 1 to **Q8,** how many days would this happen within a week?	
9	Did you or any household member go a whole day and night without eating anything because there was not enough food?	
9A	If 1 to **Q9,** how many days would this happen within a week?	
HFIAS SCORE		

Codes: Q1-Q9: 1=Yes, 0=No

H2. FOOD CONSUMPTION SCORE (FCS).

Food item	**Days consumed in a week (0-7)**	**Sources of food**	
		Primary	**Secondary**
a. Maize			
b. Rice			
c. Bread\wheat			
d. Tubers			
e. Groundnuts and pulses			
f. Fish (eaten as main food)			

g. Fish powder (used for flavour only)			
h. Red meat (beef, goat, sheep)			
i. White meat (poultry)			
j. Vegetable oil fats			
k. Eggs			
l. Milk and dairy products (as main foods)			
m. Milk in tea in small amounts			
n. Vegetables including leaves			
o. Fruits			
p. Sweets, sugar			
Any other? Please specify			
FCS			

Codes: 1=Own Production; 2=Purchased; 3=Traded Goods, Services/Battered; 4=Borrowed; 5=Received as a Gift; 6=Food Aid; 7=Other (specify)

SECTION I: SOCIAL CAPITAL

Question:	**Response:**
I1. Are you registered in the Department of Agriculture and Rural Development farmer register?	
I2. If "No" to **F1**, why? (multiple answers are allowed)	

Codes: I1: 1=Yes, 0=No; **I2:** 1=I have never heard of a farmers register, 2=I do not see the need to register, 3= I am not comfortable with sharing my farm details with an extension officer, 4= Other (specify)

	Source 1	**Source 2**	**Source 3**
I3. Information source about agricultural information			
I45. Any cost involved in acquiring the information?			
I5. How reliable is the information received?			
I6. How useful is the information received?			

Codes: I3: 1=Extension Officers, 2=Fellow Farmers, 3=Irrigation / Scheme Committees, 4= Cooperative Leaders, 5=Traditional Leaders, 6=Non-Governmental Organizations (NGOs), 7= Media (newspapers, radio, TV), 8=Training Workshops, 9=Community Meetings, 10=Phone, SMS and Text, 11=Social Media (Facebook, WhatsApp, etc.), 12=Other (specify); **I4a:** 1=Yes, 0=No; **I6a:** 1=Not Reliable, 2=Reliable, 3=Very Reliable; **I6a:** 1=Not Useful, 2=Useful**,** 3=Very Useful

I7. How often do you get in contact with government extension officers or other industry role players?_____ 1 =Never, 2=Rarely, 3=Sometimes, 4=Often, 5=Always

I8. Are you a member of an agricultural group? _____ 1=Yes, 0=No

I9. Do you use social media? ____ 1=Yes, 0=No

I10. If "Yes" to **I9**, please fill in table **I10a**, if no skip to table **I10b**

Table I10a.

	Question	Response
1.	Which social media platforms are you active on? (multiple answers possible).	
2.	How many hours (per day) do you spend on your phone?	
3.	How much money do you spend on data and airtime per month?(Rands).	

Codes: Q1: 1=WhatsApp, 2=Facebook, 3= Twitter/X, 4=Other (Specify)

Table I10b

(Please tick a statement or statements that apply to you)

Question		Response
1.	Cell phones are too expensive and unaffordable.	
2.	The high costs of data bundles affects my access to the internet.	
3.	Poor network/connectivity is a major constraint to the use of cell phones and social media.	
4.	Lack of knowledge on how to use a cell phone affects the use of cell phones for productive purposes.	
5.	I am not interested in having social media	

Do you have any further comments regarding any aspect of your farming:

_____

_____

_____

_____

**** Thank you for your participation and time. ****

ANNEXURE 3: Ethical Clearence Letter

12 November 2024

Reabetswe Moipolai
(223153539) School of Agri
Earth & Env Sc
Pietermaritzburg Campus

Dear R Moipolai,

Protocol reference number: HSSREC/00007776/2024

Project title: Assessing the impact of the 2020 Presidential economic stimulus initiative on smallholder farmers` livelihoods: Empirical evidence from Ngaka Modiri Molema district, South Africa

Degree: Masters

Approval Notification – Expedited Application

This letter serves to notify you that your application received on 30 September 2024 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted **FULL APPROVAL**.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

Incidents of adverse events and serious adverse events (AEs and SAEs) should be reported in writing to HSSREC, the study sponsors, and any regulatory authority (where appropriate), within 7 working days of the occurrence for local sites and 14 days for all other South African sites.

This approval is valid until 12 November 2025.

To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

HSSREC is registered with the South African National Health Research Ethics Council (REC-040414-040). Yours sincerely,

[redacted]

Professor Dipane Hlalele (Chair)
/nng

ANNEXURE 4: SPSS and STATA Results

Case Processing Summary

		N	%
Cases	Valid	231	100,0
	Excluded[a]	0	,0
	Total	231	100,0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
,869	8

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	1,542	,460		3,350	,001		
	Gender of participant	-,162	,108	-,107	-1,498	,138	,795	1,259
	Age of participant	-,011	,004	-,234	-2,805	,006	,583	1,714
	Highest level of education	,146	,019	,627	7,700	<,001	,610	1,638
	Household total income per annum	-1,334E-6	,000	-,110	-1,502	,137	,758	1,320
	How much land in hectares do you own or have access to	,002	,002	,112	1,523	,131	,755	1,324
	What was the value of your phase one PESI voucher	-2,279E-5	,000	-,085	-1,003	,319	,561	1,784
	What was the value of your phase two PESI voucher	1,305E-5	,000	,065	,504	,616	,247	4,053
	Cost involved in getting the information	-1,610	,557	-,201	-2,892	,005	,843	1,187
	How often do you get in contact with a government extension officer	,055	,060	,069	,924	,358	,734	1,363
	Are you a member of an agricultural group	-,074	,161	-,033	-,459	,648	,768	1,302
	Does smallholder farmer stay in a rural or Peri urban area	-,132	,217	-,042	-,607	,545	,834	1,199
	PESI_INFO_FAMILY	,252	,133	,162	1,893	,062	,551	1,815
	PESI_INFO_social_media	,099	,152	,054	,651	,517	,593	1,686
	PESI_INFO_TV_RADIO	,100	,196	,038	,508	,613	,741	1,350
	EMPLOYMENT_STATUS	-,240	,206	-,086	-1,163	,248	,735	1,360
	GENERAL_AGR_SC_FELLOW_FARMERS	,031	,131	,019	,240	,811	,648	1,543
	GENERAL_AGR_SC_COMMUNITY_MEETINGS	-,024	,324	-,005	-,074	,941	,845	1,183
	GENERAL_AGR_SC_SMS_TEXT	,270	,248	,074	1,089	,279	,878	1,139
	Are_you_phase1	,236	,180	,155	1,309	,194	,288	3,469
	Are_you_phase2	,076	,200	,032	,382	,704	,561	1,782

a. Dependent Variable: Final Perception Ratings

```
. oprobit PERCEPTIONS_FINAL Gender Age Education AGR_EXP HH_TOTAL_INC VALUE_PHASE_ONE VALUE_PHASE_TWO COST_INFO EXT_SV_RCVD AGR_GRP_MEM TYPE_SETTLEMENT
> PESI_INFO_FAMILY PESI_INFO_social_media PESI_INFO_TV_RADIO EMPLOYMENT_STATUS GENERAL_AGR_SC_FELLOW_FARMERS GENERAL_AGR_SC_COMMUNITY_MEETING GENERAL_AG
> R_SC_SMS_TEXT Are_you_phase1 Are_you_phase2 SIZE_ACCESS_LAND

Iteration 0:  Log likelihood = -102.77722
Iteration 1:  Log likelihood =  -56.72379
Iteration 2:  Log likelihood = -51.993187
Iteration 3:  Log likelihood = -51.444058
Iteration 4:  Log likelihood = -51.438569
Iteration 5:  Log likelihood =  -51.43807
Iteration 6:  Log likelihood = -51.437985
Iteration 7:  Log likelihood = -51.437969
Iteration 8:  Log likelihood = -51.437966

Ordered probit regression                       Number of obs =    112
                                                LR chi2(21)   = 102.68
                                                Prob > chi2   = 0.0000
Log likelihood = -51.437966                     Pseudo R2     = 0.4995
```

PERCEPTIONS_FINAL	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
Gender	-.7693285	.4089148	-1.88	0.060	-1.570787	.0321298
Age	-.0487769	.0165563	-2.95	0.003	-.0812266	-.0163273
Education	.3785895	.0695448	5.44	0.000	.2422842	.5148947
AGR_EXP	-.006486	.0300962	-0.22	0.829	-.0654734	.0525014
HH_TOTAL_INC	-8.27e-06	3.84e-06	-2.15	0.031	-.0000158	-7.35e-07
VALUE_PHASE_ONE	-.0002478	.0000885	-2.80	0.005	-.0004212	-.0000744
VALUE_PHASE_TWO	.0004682	.000194	2.41	0.016	.0000879	.0008484
COST_INFO	-7.387776	279.6275	-0.03	0.979	-555.4476	540.6721
EXT_SV_RCVD	.1249033	.2007332	0.62	0.534	-.2685265	.518333
AGR_GRP_MEM	-.0312681	.5306506	-0.06	0.953	-1.071324	1.008788
TYPE_SETTLEMENT	-1.380826	.7121511	-1.94	0.053	-2.776616	.0149646
PESI_INFO_FAMILY	.8599748	.4507221	1.91	0.056	-.0234242	1.743374
PESI_INFO_social_media	.4377815	.5332907	0.82	0.412	-.6074491	1.483012
PESI_INFO_TV_RADIO	-.0687255	.6808285	-0.10	0.920	-1.403125	1.265674
EMPLOYMENT_STATUS	-1.154209	.6143173	-1.88	0.060	-2.358249	.0498305
GENERAL_AGR_SC_FELLOW_FARMERS	.256446	.4340775	0.59	0.555	-.5943302	1.107222
GENERAL_AGR_SC_COMMUNITY_MEETING	.7646149	1.012177	0.76	0.450	-1.219216	2.748445
GENERAL_AGR_SC_SMS_TEXT	1.881694	.9068578	2.07	0.038	.1042854	3.659103
Are_you_phase1	3.235547	1.086258	2.98	0.003	1.10652	5.364575
Are_you_phase2	.8210901	.7395593	1.11	0.267	-.6284194	2.2706
SIZE_ACCESS_LAND	.0137526	.009402	1.46	0.144	-.0046749	.0321802
/cut1	-.3582321	1.44622			-3.192772	2.476307
/cut2	1.216089	1.467383			-1.659928	4.092107

```
. margins, dydx (*) predict (outcome(1))

Average marginal effects                                  Number of obs = 112
Model VCE: OIM

Expression: Pr(PERCEPTIONS_FINAL==1), predict(outcome(1))
dy/dx wrt:  Gender Age Education AGR_EXP HH_TOTAL_INC VALUE_PHASE_ONE VALUE_PHASE_TWO COST_INFO EXT_SV_RCVD AGR_GRP_MEM TYPE_SETTLEMENT
            PESI_INFO_FAMILY PESI_INFO_social_media PESI_INFO_TV_RADIO EMPLOYMENT_STATUS GENERAL_AGR_SC_FELLOW_FARMERS
            GENERAL_AGR_SC_COMMUNITY_MEETING GENERAL_AGR_SC_SMS_TEXT Are_you_phase1 Are_you_phase2 SIZE_ACCESS_LAND
```

	Delta-method dy/dx	std. err.	z	P>|z|	[95% conf.	interval]
Gender	.0735315	.0401165	1.83	0.067	-.0050954	.1521583
Age	.004662	.0017026	2.74	0.006	.0013249	.0079992
Education	-.0361851	.0055626	-6.51	0.000	-.0470877	-.0252826
AGR_EXP	.0006199	.0028706	0.22	0.829	-.0050064	.0062462
HH_TOTAL_INC	7.90e-07	3.68e-07	2.15	0.032	6.92e-08	1.51e-06
VALUE_PHASE_ONE	.0000237	8.84e-06	2.68	0.007	6.35e-06	.000041
VALUE_PHASE_TWO	-.0000447	.000019	-2.35	0.019	-.0000821	-7.44e-06
COST_INFO	.7061145	26.72634	0.03	0.979	-51.67654	53.08877
EXT_SV_RCVD	-.0119381	.0191203	-0.62	0.532	-.0494131	.0255369
AGR_GRP_MEM	.0029886	.0506839	0.06	0.953	-.09635	.1023272
TYPE_SETTLEMENT	.1319776	.0695083	1.90	0.058	-.0042562	.2682114
PESI_INFO_FAMILY	-.0821953	.0417606	-1.97	0.049	-.1640446	-.0003461
PESI_INFO_social_media	-.0418426	.050994	-0.82	0.412	-.1417891	.0581039
PESI_INFO_TV_RADIO	.0065687	.0651099	0.10	0.920	-.1210444	.1341818
EMPLOYMENT_STATUS	.1103179	.0613623	1.80	0.072	-.0099501	.2305859
GENERAL_AGR_SC_FELLOW_FARMERS	-.0245108	.0413914	-0.59	0.554	-.1056364	.0566148
GENERAL_AGR_SC_COMMUNITY_MEETING	-.0730809	.0972922	-0.75	0.453	-.2637702	.1176084
GENERAL_AGR_SC_SMS_TEXT	-.17985	.0863715	-2.08	0.037	-.349135	-.010565
Are_you_phase1	-.3092496	.1072653	-2.88	0.004	-.5194857	-.0990135
Are_you_phase2	-.0784788	.070518	-1.11	0.266	-.2166915	.059734
SIZE_ACCESS_LAND	-.0013145	.0008844	-1.49	0.137	-.0030478	.0004189

```
. margins, dydx (*) predict (outcome(2))

Average marginal effects                                  Number of obs = 112
Model VCE: OIM

Expression: Pr(PERCEPTIONS_FINAL==2), predict(outcome(2))
dy/dx wrt:  Gender Age Education AGR_EXP HH_TOTAL_INC VALUE_PHASE_ONE VALUE_PHASE_TWO COST_INFO EXT_SV_RCVD AGR_GRP_MEM TYPE_SETTLEMENT
            PESI_INFO_FAMILY PESI_INFO_social_media PESI_INFO_TV_RADIO EMPLOYMENT_STATUS GENERAL_AGR_SC_FELLOW_FARMERS
            GENERAL_AGR_SC_COMMUNITY_MEETING GENERAL_AGR_SC_SMS_TEXT Are_you_phase1 Are_you_phase2 SIZE_ACCESS_LAND
```

	Delta-method dy/dx	std. err.	z	P>|z|	[95% conf.	interval]
Gender	.0578158	.0294095	1.97	0.049	.0001742	.1154575
Age	.0036656	.0010721	3.42	0.001	.0015644	.0057669
Education	-.0284514	.0073793	-3.86	0.000	-.0429146	-.0139882
AGR_EXP	.0004874	.0022753	0.21	0.830	-.0039722	.004947
HH_TOTAL_INC	6.21e-07	2.99e-07	2.08	0.038	3.55e-08	1.21e-06
VALUE_PHASE_ONE	.0000186	6.30e-06	2.96	0.003	6.28e-06	.000031
VALUE_PHASE_TWO	-.0000352	.0000142	-2.49	0.013	-.0000629	-7.44e-06
COST_INFO	.5551991	21.0149	0.03	0.979	-40.63324	41.74364
EXT_SV_RCVD	-.0093866	.0152824	-0.61	0.539	-.0393395	.0205663
AGR_GRP_MEM	.0023498	.0399405	0.06	0.953	-.0759321	.0806317
TYPE_SETTLEMENT	.1037705	.0531062	1.95	0.051	-.0003157	.2078567
PESI_INFO_FAMILY	-.064628	.0365602	-1.77	0.077	-.1362846	.0070286
PESI_INFO_social_media	-.0328997	.0403247	-0.82	0.415	-.1119348	.0461353
PESI_INFO_TV_RADIO	.0051648	.0511463	0.10	0.920	-.0950801	.1054097
EMPLOYMENT_STATUS	.08674	.0418046	2.07	0.038	.0048045	.1686756
GENERAL_AGR_SC_FELLOW_FARMERS	-.0192722	.0327578	-0.59	0.556	-.0834764	.044932
GENERAL_AGR_SC_COMMUNITY_MEETING	-.0574616	.0755075	-0.76	0.447	-.2054535	.0905303
GENERAL_AGR_SC_SMS_TEXT	-.1414113	.0700851	-2.02	0.044	-.2787755	-.0040471
Are_you_phase1	-.2431547	.080917	-3.00	0.003	-.4017491	-.0845603
Are_you_phase2	-.0617058	.0562003	-1.10	0.272	-.1718564	.0484448
SIZE_ACCESS_LAND	-.0010335	.0007275	-1.42	0.155	-.0024594	.0003923

```
. margins, dydx (*) predict (outcome(3))

Average marginal effects                                  Number of obs = 112
Model VCE: OIM

Expression: Pr(PERCEPTIONS_FINAL==3), predict(outcome(3))
dy/dx wrt:  Gender Age Education AGR_EXP HH_TOTAL_INC VALUE_PHASE_ONE VALUE_PHASE_TWO COST_INFO EXT_SV_RCVD AGR_GRP_MEM TYPE_SETTLEMENT
            PESI_INFO_FAMILY PESI_INFO_social_media PESI_INFO_TV_RADIO EMPLOYMENT_STATUS GENERAL_AGR_SC_FELLOW_FARMERS
            GENERAL_AGR_SC_COMMUNITY_MEETING GENERAL_AGR_SC_SMS_TEXT Are_you_phase1 Are_you_phase2 SIZE_ACCESS_LAND
```

	Delta-method dy/dx	std. err.	z	P>|z|	[95% conf.	interval]
Gender	-.1313473	.0667315	-1.97	0.049	-.2621387	-.0005559
Age	-.0083277	.0024971	-3.33	0.001	-.013222	-.0034334
Education	.0646365	.0092398	7.00	0.000	.0465269	.0827461
AGR_EXP	-.0011074	.0051433	-0.22	0.830	-.0111881	.0089734
HH_TOTAL_INC	-1.41e-06	6.32e-07	-2.23	0.026	-2.65e-06	-1.72e-07
VALUE_PHASE_ONE	-.0000423	.0000138	-3.07	0.002	-.0000693	-.0000153
VALUE_PHASE_TWO	.0000799	.000031	2.58	0.010	.0000192	.0001406
COST_INFO	-1.261314	47.74086	-0.03	0.979	-94.83168	92.30905
EXT_SV_RCVD	.0213247	.0342554	0.62	0.534	-.0458146	.088464
AGR_GRP_MEM	-.0053384	.0906209	-0.06	0.953	-.1829521	.1722753
TYPE_SETTLEMENT	-.2357481	.1174397	-2.01	0.045	-.4659257	-.0055705
PESI_INFO_FAMILY	.1468233	.0752913	1.95	0.051	-.0007448	.2943915
PESI_INFO_social_media	.0747424	.0906312	0.82	0.410	-.1028915	.2523762
PESI_INFO_TV_RADIO	-.0117335	.116243	-0.10	0.920	-.2395655	.2160985
EMPLOYMENT_STATUS	-.1970579	.0991269	-1.99	0.047	-.3913431	-.0027728
GENERAL_AGR_SC_FELLOW_FARMERS	.043783	.0738594	0.59	0.553	-.1009788	.1885448
GENERAL_AGR_SC_COMMUNITY_MEETING	.1305426	.171695	0.76	0.447	-.2059734	.4670585
GENERAL_AGR_SC_SMS_TEXT	.3212613	.1489031	2.16	0.031	.0294165	.613106
Are_you_phase1	.5524043	.1690864	3.27	0.001	.2210011	.8838075
Are_you_phase2	.1401846	.1249717	1.12	0.262	-.1047556	.3851247
SIZE_ACCESS_LAND	.002348	.0015735	1.49	0.136	-.000736	.005432

```
. oprobit PERCEPTIONS_FINAL Gender Age Education AGR_EXP HH_TOTAL_INC SIZE_ACCESS_LAND COST_INFO EXT_SV_RCVD AGR_GRP_MEM TYPE_SETTLEMENT PESI_INFO_FAMIL
> Y PESI_INFO_social_media PESI_INFO_TV_RADIO EMPLOYMENT_STATUS GENERAL_AGR_SC_FELLOW_FARMERS GENERAL_AGR_SC_COMMUNITY_MEETING GENERAL_AGR_SC_SMS_TEXT

Iteration 0:  Log likelihood = -130.32577
Iteration 1:  Log likelihood =  -76.15461
Iteration 2:  Log likelihood = -73.836342
Iteration 3:  Log likelihood = -73.782682
Iteration 4:  Log likelihood = -73.780441
Iteration 5:  Log likelihood = -73.780395
Iteration 6:  Log likelihood = -73.780394

Ordered probit regression                       Number of obs =    119
                                                LR chi2(17)   = 113.09
                                                Prob > chi2   = 0.0000
Log likelihood = -73.780394                     Pseudo R2     = 0.4339
```

PERCEPTIONS_FINAL	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
Gender	.5317424	.3133916	1.70	0.090	-.082494	1.145979
Age	-.0462356	.0129442	-3.57	0.000	-.0716059	-.0208654
Education	.3657447	.0739288	4.95	0.000	.2208469	.5106425
AGR_EXP	.0061195	.0183325	0.33	0.739	-.0298116	.0420506
HH_TOTAL_INC	-3.72e-06	1.89e-06	-1.97	0.049	-7.42e-06	-1.57e-08
SIZE_ACCESS_LAND	-.0208903	.0187313	-1.12	0.265	-.0576031	.0158224
COST_INFO	.1185423	1043.562	0.00	1.000	-2045.224	2045.462
EXT_SV_RCVD	-.1847844	.1855538	-1.00	0.319	-.5484631	.1788943
AGR_GRP_MEM	.2318869	.3770748	0.61	0.539	-.5071662	.9709399
TYPE_SETTLEMENT	-1.282303	.7924929	-1.62	0.106	-2.83556	.2709549
PESI_INFO_FAMILY	.5385391	.4507592	1.19	0.232	-.3449326	1.422011
PESI_INFO_social_media	.6099091	.7671659	0.80	0.427	-.8937084	2.113527
PESI_INFO_TV_RADIO	-.4198394	.5543975	-0.76	0.449	-1.506439	.6667597
EMPLOYMENT_STATUS	.4097366	.6238948	0.66	0.511	-.8130747	1.632548
GENERAL_AGR_SC_FELLOW_FARMERS	-.4532953	.3056572	-1.48	0.138	-1.052372	.1457818
GENERAL_AGR_SC_COMMUNITY_MEETING	-1.020868	.5843396	-1.75	0.081	-2.166153	.1244162
GENERAL_AGR_SC_SMS_TEXT	-2.122801	.773959	-2.74	0.006	-3.639733	-.6058695
/cut1	-1.390839	1.508549			-4.347541	1.565863
/cut2	.2610869	1.499183			-2.677258	3.199432

```
. margins, dydx (*) predict (outcome(1))

Average marginal effects                        Number of obs = 119
Model VCE: OIM

Expression: Pr(PERCEPTIONS_FINAL==1), predict(outcome(1))
dy/dx wrt:  Gender Age Education AGR_EXP HH_TOTAL_INC SIZE_ACCESS_LAND COST_INFO EXT_SV_RCVD AGR_GRP_MEM TYPE_SETTLEMENT PESI_INFO_FAMILY
            PESI_INFO_social_media PESI_INFO_TV_RADIO EMPLOYMENT_STATUS GENERAL_AGR_SC_FELLOW_FARMERS GENERAL_AGR_SC_COMMUNITY_MEETING
            GENERAL_AGR_SC_SMS_TEXT
```

	Delta-method dy/dx	std. err.	z	P>|z|	[95% conf.	interval]
Gender	-.0880471	.0510686	-1.72	0.085	-.1881398	.0120455
Age	.0076558	.0021109	3.63	0.000	.0035186	.011793
Education	-.0605609	.0090559	-6.69	0.000	-.0783101	-.0428116
AGR_EXP	-.0010133	.0030339	-0.33	0.738	-.0069595	.004933
HH_TOTAL_INC	6.16e-07	3.10e-07	1.98	0.047	7.29e-09	1.22e-06
SIZE_ACCESS_LAND	.0034591	.0031273	1.11	0.269	-.0026703	.0095884
COST_INFO	-.0196285	172.7953	-0.00	1.000	-338.6923	338.653
EXT_SV_RCVD	.030597	.0306492	1.00	0.318	-.0294743	.0906684
AGR_GRP_MEM	-.0383964	.062204	-0.62	0.537	-.160314	.0835213
TYPE_SETTLEMENT	.2123267	.1300902	1.63	0.103	-.0426454	.4672987
PESI_INFO_FAMILY	-.0891726	.0747665	-1.19	0.233	-.2357123	.0573671
PESI_INFO_social_media	-.1009902	.1271153	-0.79	0.427	-.3501315	.1481512
PESI_INFO_TV_RADIO	.069518	.0911943	0.76	0.446	-.1092196	.2482555
EMPLOYMENT_STATUS	-.0678451	.1029404	-0.66	0.510	-.2696046	.1339144
GENERAL_AGR_SC_FELLOW_FARMERS	.0750577	.0507314	1.48	0.139	-.024374	.1744893
GENERAL_AGR_SC_COMMUNITY_MEETING	.1690378	.0966244	1.75	0.080	-.0203425	.358418
GENERAL_AGR_SC_SMS_TEXT	.3514984	.1264057	2.78	0.005	.1037477	.5992491

```
. margins, dydx (*) predict (outcome(2))

Average marginal effects                                  Number of obs = 119
Model VCE: OIM

Expression: Pr(PERCEPTIONS_FINAL==2), predict(outcome(2))
dy/dx wrt:  Gender Age Education AGR_EXP HH_TOTAL_INC SIZE_ACCESS_LAND COST_INFO EXT_SV_RCVD AGR_GRP_MEM TYPE_SETTLEMENT PESI_INFO_FAMILY
            PESI_INFO_social_media PESI_INFO_TV_RADIO EMPLOYMENT_STATUS GENERAL_AGR_SC_FELLOW_FARMERS GENERAL_AGR_SC_COMMUNITY_MEETING
            GENERAL_AGR_SC_SMS_TEXT
```

	Delta-method dy/dx	std. err.	z	P>|z|	[95% conf.	interval]
Gender	-.0149865	.0125108	-1.20	0.231	-.0395073	.0095343
Age	.0013031	.0007602	1.71	0.087	-.0001869	.0027931
Education	-.0103081	.0072691	-1.42	0.156	-.0245552	.0039391
AGR_EXP	-.0001725	.0005258	-0.33	0.743	-.001203	.0008581
HH_TOTAL_INC	1.05e-07	7.77e-08	1.35	0.177	-4.75e-08	2.57e-07
SIZE_ACCESS_LAND	.0005888	.0005527	1.07	0.287	-.0004946	.0016721
COST_INFO	-.003341	29.41147	-0.00	1.000	-57.64876	57.64208
EXT_SV_RCVD	.0052079	.0059089	0.88	0.378	-.0063732	.0167891
AGR_GRP_MEM	-.0065354	.0114411	-0.57	0.568	-.0289595	.0158886
TYPE_SETTLEMENT	.0361401	.0294156	1.23	0.219	-.0215135	.0937937
PESI_INFO_FAMILY	-.015178	.0145139	-1.05	0.296	-.0436247	.0132686
PESI_INFO_social_media	-.0171895	.0232652	-0.74	0.460	-.0627884	.0284094
PESI_INFO_TV_RADIO	.0118326	.0175317	0.67	0.500	-.0225288	.046194
EMPLOYMENT_STATUS	-.0115479	.019151	-0.60	0.547	-.0490831	.0259873
GENERAL_AGR_SC_FELLOW_FARMERS	.0127756	.0103136	1.24	0.215	-.0074388	.0329899
GENERAL_AGR_SC_COMMUNITY_MEETING	.0287719	.0216251	1.33	0.183	-.0136125	.0711563
GENERAL_AGR_SC_SMS_TEXT	.0598285	.0379771	1.58	0.115	-.0146052	.1342621

```
. margins, dydx (*) predict (outcome(3))

Average marginal effects                                  Number of obs = 119
Model VCE: OIM

Expression: Pr(PERCEPTIONS_FINAL==3), predict(outcome(3))
dy/dx wrt:  Gender Age Education AGR_EXP HH_TOTAL_INC SIZE_ACCESS_LAND COST_INFO EXT_SV_RCVD AGR_GRP_MEM TYPE_SETTLEMENT PESI_INFO_FAMILY
            PESI_INFO_social_media PESI_INFO_TV_RADIO EMPLOYMENT_STATUS GENERAL_AGR_SC_FELLOW_FARMERS GENERAL_AGR_SC_COMMUNITY_MEETING
            GENERAL_AGR_SC_SMS_TEXT
```

	Delta-method dy/dx	std. err.	z	P>|z|	[95% conf.	interval]
Gender	.1030336	.0593273	1.74	0.082	-.0132457	.219313
Age	-.0089589	.0021421	-4.18	0.000	-.0131574	-.0047604
Education	.0708689	.0130945	5.41	0.000	.0452042	.0965336
AGR_EXP	.0011857	.0035484	0.33	0.738	-.005769	.0081405
HH_TOTAL_INC	-7.21e-07	3.53e-07	-2.04	0.041	-1.41e-06	-2.89e-08
SIZE_ACCESS_LAND	-.0040478	.0035505	-1.14	0.254	-.0110068	.0029111
COST_INFO	.0229695	202.2068	0.00	1.000	-396.2951	396.341
EXT_SV_RCVD	-.0358049	.0355788	-1.01	0.314	-.105538	.0339281
AGR_GRP_MEM	.0449318	.0728848	0.62	0.538	-.0979198	.1877834
TYPE_SETTLEMENT	-.2484667	.1490485	-1.67	0.096	-.5405965	.043663
PESI_INFO_FAMILY	.1043506	.0858244	1.22	0.224	-.0638622	.2725634
PESI_INFO_social_media	.1181797	.1477484	0.80	0.424	-.1714019	.4077613
PESI_INFO_TV_RADIO	-.0813506	.1070787	-0.76	0.447	-.2912211	.1285198
EMPLOYMENT_STATUS	.0793931	.1206678	0.66	0.511	-.1571116	.3158977
GENERAL_AGR_SC_FELLOW_FARMERS	-.0878332	.0574544	-1.53	0.126	-.2004417	.0247752
GENERAL_AGR_SC_COMMUNITY_MEETING	-.1978096	.1090801	-1.81	0.070	-.4116026	.0159833
GENERAL_AGR_SC_SMS_TEXT	-.4113269	.1375475	-2.99	0.003	-.6809149	-.1417388

Probit regression — Number of obs = 231
LR chi2(11) = 42.18
Prob > chi2 = 0.0000
Log likelihood = -138.92283 — Pseudo R2 = 0.1318

PESI_BEN	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
Gender	.2670294	.185183	1.44	0.149	-.0959226	.6299813
Age	-.0107042	.0073049	-1.47	0.143	-.0250215	.0036131
Education	-.0372027	.0347526	-1.07	0.284	-.1053165	.0309112
S_G_BEN	.1534492	.2877218	0.53	0.594	-.410475	.7173735
SIZE_ACCESS_LAND	.0174443	.0095882	1.82	0.069	-.0013483	.0362368
FARMERS_REGISTER	.4600551	.1869123	2.46	0.014	.0937137	.8263964
EXT_SV_RCVD	.1647387	.1063563	1.55	0.121	-.0437159	.3731933
USE_S_MEDIA	.4777655	.2217474	2.15	0.031	.0431485	.9123824
TOTAL_AGR_INC	-5.24e-06	4.50e-06	-1.16	0.244	-.0000141	3.58e-06
GENERAL_AGR_SC_SMS_TEXT	.3655936	.4743384	0.77	0.441	-.5640925	1.29528
AGRO_DEALER_ACCESS	.7049408	.2494094	2.83	0.005	.2161075	1.193774
_cons	-.9674464	.7340464	-1.32	0.188	-2.406151	.4712581

. psmatch2 PESI_BEN, outcome(HFIAS_RECODED) pscore (pscore) neighbor (1)

Variable	Sample	Treated	Controls	Difference	S.E.	T-stat
HFIAS_RECODED	Unmatched	3.60714286	2.25210084	1.35504202	.08835742	15.34
	ATT	3.60714286	1.97321429	1.63392857	.13936395	11.72

. psmatch2 PESI_BEN, outcome(HFIAS_RECODED) pscore (pscore) bw (0.05)

Variable	Sample	Treated	Controls	Difference	S.E.	T-stat
HFIAS_RECODED	Unmatched	3.60714286	2.25210084	1.35504202	.08835742	15.34
	ATT	3.60714286	1.97321429	1.63392857	.13936395	11.72

. psmatch2 PESI_BEN, outcome(HFIAS_RECODED) pscore (pscore) caliper (0.05)

Variable	Sample	Treated	Controls	Difference	S.E.	T-stat
HFIAS_RECODED	Unmatched	3.60714286	2.25210084	1.35504202	.08835742	15.34
	ATT	3.59813084	1.97196262	1.62616822	.133682793	12.16

. psmatch2 PESI_BEN, outcome(FCS_RECODED) pscore (pscore) neighbor (1)

Variable	Sample	Treated	Controls	Difference	S.E.	T-stat
FCS_RECODED	Unmatched	2.92857143	1.79831933	1.1302521	.074120591	15.25
	ATT	2.92857143	1.89285714	1.03571429	.141189936	7.34

. psmatch2 PESI_BEN, outcome(FCS_RECODED) pscore (pscore) bw (0.05)

Variable	Sample	Treated	Controls	Difference	S.E.	T-stat
FCS_RECODED	Unmatched	2.92857143	1.79831933	1.1302521	.074120591	15.25
	ATT	2.92857143	1.89285714	1.03571429	.141189936	7.34

. psmatch2 PESI_BEN, outcome(FCS_RECODED) pscore (pscore) caliper (0.05)

Variable	Sample	Treated	Controls	Difference	S.E.	T-stat
FCS_RECODED	Unmatched	2.92857143	1.79831933	1.1302521	.074120591	15.25
	ATT	2.93457944	1.88785047	1.04672897	.132571719	7.90

. pstest Gender Age Education S_G_BEN SIZE_ACCESS_LAND FARMERS_REGISTER EXT_SV_RCVD USE_S_MEDIA TOTAL_AGR_INC GENERAL_AGR_SC_SMS_TEXT AGRO_DEALER_ACCESS

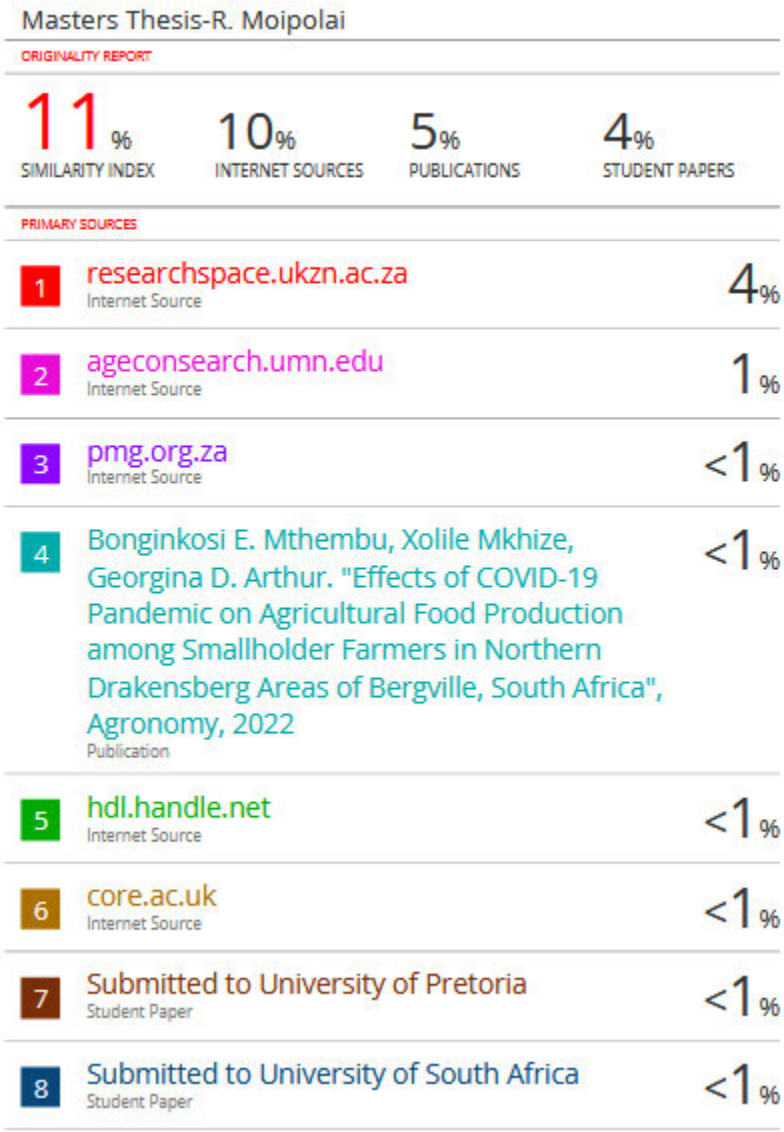
Variable	Mean Treated	Mean Control	%bias	t-test t	t-test p>|t|	V(T)/ V(C)
Gender	.52336	.43925	16.8	1.23	0.220	.
Age	49.421	51.523	-13.4	-0.95	0.345	0.79
Education	9.8785	9.6729	6.0	0.45	0.651	0.95
S_G_BEN	.86916	.90654	-11.4	-0.86	0.389	.
SIZE_ACCESS_LAND	3.7089	3.678	0.1	0.03	0.979	1.52*
FARMERS_REGISTER	.62617	.69159	-13.4	-1.01	0.315	.
EXT_SV_RCVD	2.5607	2.3925	19.2	1.48	0.139	2.07*
USE_S_MEDIA	.70093	.78505	-17.5	-1.41	0.161	.
TOTAL_AGR_INC	5386	7458.6	-9.6	-0.63	0.526	0.42*
GENERAL_AGR_SC_SMS_TEXT	.03738	.06542	-15.2	-0.93	0.355	.
AGRO_DEALER_ACCESS	.90654	.88785	5.1	0.45	0.654	.

* if variance ratio outside [0.68; 1.47]

Ps R2	LR chi2	p>chi2	MeanBias	MedBias	B	R	%Var
0.053	15.79	0.149	11.6	13.4	55.6*	1.24	60

* if B>25%, R outside [0.5; 2]

ANNEXURE 5: Plagiarism Report



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