

EFFECT OF NUCLEUS FARMER-OUTGROWER SCHEMES ON INPUT USE
EFFICIENCY AND PROFITABILITY AMONG SMALLHOLDER FARMERS IN THE
NORTHERN REGION OF GHANA

BY

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DECLARATION

I, George Agana Akuriba, hereby declare that with the exception of references to other people's work which have been duly acknowledged, the work contained in this thesis "Effect of Nucleus Farmer-Outgrower Schemes on Input Use Efficiency and Profitability among Smallholder Farmers in the Northern Region of Ghana" is the result of the research carried out by me under supervision in the Department of Agricultural Economics and Agribusiness, University of Ghana, Legon from August 2016 to July 2017. This thesis has not been presented either in whole or in part for any other degree in this university or elsewhere.

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DEDICATION

This thesis is dedicated foremost to God Almighty for His mercies, favours and grace bestowed on me to carry out this piece of work.

The next dedication goes to my mother, Mrs. Janet A. Adongo, father, Mr. James Adongo of blessed memory, sister, Margaret A. Akuriba and all my family members and friends whose selfless love and sacrifices have made me what I am today.



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ABSTRACT

The study assesses the effect of nucleus farmer-outgrower schemes on input use efficiency and profitability among smallholder farmers in the Northern Region of Ghana. Simple random sampling technique was employed to sample three districts from the Northern Region and a total of 330 smallholder farmers made up of 150 outgrowers and 180 non-outgrowers were interviewed using structured questionnaires. A comparative analysis is made between outgrowers and non-outgrowers. The study employs the binary logit regression model to identify the factors influencing participation in nucleus farmer-outgrower schemes and the translog production function and efficiency ratios to estimate the input use efficiency among smallholder farmers. The propensity score matching technique is employed to estimate the effect of nucleus farmer-outgrower schemes on profitability of smallholder farmers. The study reveals that the factors that significantly influence smallholder farmers' participation in nucleus farmer-outgrower schemes are gender, marital status, farm size, membership of an FBO and extension contact. The gender and marital status of a farmer have negative influence on participation whilst farm size, membership of an FBO and extension contact have positive influence on participation. The study also reveals that outgrowers had significantly higher level of access to inputs and mechanized services than non-outgrowers. For the input use efficiency, the study reveals that both outgrowers and non-outgrowers are not efficient in utilizing the input resources available to them except for fertilizer where outgrowers are efficient in utilizing it. Finally, the study reveals that nucleus farmer-outgrower schemes have significant positive effect on smallholder farmer's gross margins, net margins and returns on investment. The study recommends that, nucleus farmers and other stakeholders who are involved in developing outgrower schemes or similar initiatives should take into consideration the social and demographic characteristics of the target farmers to enhance participation. Nucleus farmers are also encouraged to offer more extension services to outgrowers on the efficient utilization of input resources. Outgrowers are advised to increase their seed and agrochemical use and reduce labour whilst Non-outgrowers are advised to increase fertilizer and labour use and reduce seed and agrochemical use so as to increase their efficiency and profitability. Government, NGOs and other private individuals and organizations who work to support farmers are advised to emulate the nucleus farmer-outgrower model.

TABLE OF CONTENT

DECLARATION	i
DEDICATION	ii
ACKNOWLEDGMENT	iii
ABSTRACT.....	iv
TABLE OF CONTENT	v
LIST OF TABLES	viii
LIST OF FIGURES	ix
ACRONYMS	x

CHAPTER ONE - INTRODUCTION

1.1 Background	1
1.2 Problem Statement	4
1.3 Objectives of the Study	8
1.4 Relevance of the Study.....	8
1.5 Organization of the Study	10

CHAPTER TWO - LITERATURE REVIEW

2.1 Introduction	11
2.2 Overview of Outgrower Contract Schemes	11
2.3 Types of Outgrower Contract Scheme	12
2.3.1 The Centralized Model of Outgrower Schemes	13
2.3.2 The Nucleus Estate Model.....	14
2.3.3 The Multipartite Estate Model.....	15
2.3.4 The Intermediary Model	16
2.3.5 The Informal Model.....	17
2.4 Outgrower Schemes in Ghana.....	18

2.4.1 The Integrated Tamale Fruit Company (ITFC) Outgrower Scheme	18
2.4.2 The Ghana Oil Palm Development Company Limited (GOPDC) Scheme.....	20
2.4.3 The Rubber Outgrowers' Plantation Project (ROPP).....	21
2.4.4 The Guinness Sorghum Project	22
2.5 Benefits of Outgrower Schemes.....	23
2.6 Factors Influencing Participation in Outgrower Contract Schemes.....	27
2.7 Input use Efficiency among Smallholder Farmers.....	29
2.8 Effect of Outgrower Schemes on Profitability and Incomes of Smallholder Farmers.....	32
2.9 Effects of Credit Constraint on the Resource Use Efficiency among Smallholder Farmers	34
2.10 Conclusion.....	35

CHAPTER THREE - METHODOLOGY

3.1 Introduction	37
3.2 Theoretical Framework	37
3.3 Conceptual Framework	40
3.4 Method of Data Analysis	42
3.4.1 Factors Influencing Participation in Nucleus Farmer-Outgrower Schemes.....	42
3.4.2 Level of Access to Inputs and Mechanized Services by Smallholder Farmers.....	45
3.4.3 Estimation of Input use Efficiency among Smallholder Maize Farmers.....	47
3.4.4 Computing for the Efficiency Ratios of Inputs and the Decision Rule	49
3.4.5 Estimation of Effect of Outgrower Schemes on Profitability of Smallholder Maize Farmers	51
3.5 Description of the Study Area	55
3.6 Research Design, Sources of Data and Sampling Procedure	57
3.6.1 Research Design	57
3.6.2 Sources and Type of Data.....	57

3.6.3 Sampling Procedure.....	58
3.7 Data Collection Instrument	60
CHAPTER FOUR - RESULTS AND DISCUSSION	
4.1 Introduction	61
4.2 How the Nucleus Farmer-Outgrower Schemes Operate	61
4.3 Social, Demographic and Production Characteristics of Farmers.....	62
4.3.1 Social and Demographic Characteristics	63
4.3.2 Production Characteristics of Farmers	67
4.4 Factors Influencing the Decision of Smallholder Farmers to Participate in a Nucleus Farmer-Outgrower Scheme	69
4.5 Level of Access to Inputs and Mechanized Services	72
4.6 Timeliness of inputs Acquired for Production	76
4.7 Input Use Efficiency among Smallholder Maize Farmers	77
4.8 Marginal Value Product (MVP), Marginal Factor Cost (MFC) and Efficiency Ratios (r). 80	
4.9 Effect of Nucleus Farmer-Outgrower Schemes on Profitability	82
CHAPTER FIVE - CONCLUSION AND RECOMMENDATIONS	
5.1 Introduction	86
5.2 Summary of Findings	86
5.3 Conclusion.....	88
5.4 Policy Recommendations.....	89
REFERENCES	91
APPENDIX.....	98

LIST OF TABLES

Table 3.1: Description of Variables Used in the Binary Logit Regression Model	43
Table 3.2: Description of Variables for the Translog Function	48
Table 3.3: Summary of Sample Size.....	60
Table 4.1: Social and Demographics Characteristics of Farmers	64
Table 4.2: Other Social and Demographic Characteristics of Farmers	67
Table 4.3: Production Characteristics of Farmers	68
Table 4.4: Binary Logit Regression Model Results for Factors Influencing the Decision of Smallholder Farmers to Participate in Nucleus Farmer-Outgrower Scheme	71
Table 4.5: Proportions (%) of Farmers who had Access to the Various Inputs and Mechanized Services	74
Table 4.6: Ratings of Level of Access to Inputs and Mechanized Services	76
Table 4.7: Results from the Translog Production Function for Input Use	79
Table 4.8: Results for the Marginal Value Cost (MVP), Marginal Factor Cost (MFC) and Efficiency Ratios (r) of Outgrowers and Non-Outgrowers	81
Table 4.9: Summary of Cost and Returns used in the PSM Estimation (GHC)	82
Table 4.10: Covariates Balance Indicators before and after Matching on Profitability	83
Table 4.11: PSM Results for the Effect of Nucleus Farmer-Outgrower Schemes on Profitability.....	85

LIST OF FIGURES

Figure 3.1: Conceptual Framework	41
Figure 3.2: Map of Northern Region	56
Figure 4.1: Levels of Access to Inputs and Mechanized Services by Outgrowers and Non-outgrowers	75
Figure 4.2: Timeliness of Input Acquired for Production (Percentage of Respondents Reporting Input Acquisition is timely).....	77



ACRONYMS

ADVANCE	Ghana Agricultural Development and Value Chain Enhancement
AFD	French Development Agency
CSIR	Council for Scientific and Industrial Research
EUCORD	European Cooperative for Rural Development
FAO	Food and Agriculture Organization
FBO	Farmer Based Organization
FIML	Full Information Maximum Likelihood
GCAP	Ghana Commercial Agriculture Project
GDP	Gross Domestic Product
GGBL	Guinness Ghana Brewery Limited
GOPDC	Ghana Oil Palm Development Company
GREL	Ghana Rubber Estates Limited
GSS	Ghana Statistical Service
IFAD	International Fund for Agricultural Development
ITFC	Integrated Tamale Fruit Company
MOFA	Ministry of Food and Agriculture
MOU	Memorandum of Understanding
NES	Nucleus Estate and Smallholder
NGO	Non-Governmental Organization
NRGP	Northern Rural Growth Programme

OLS	Ordinary Least Squares
PSM	Propensity Score Matching
ROPP	Rubber Outgrowers' Plantation Project
ROU	Rubber Outgrower Unit
SARI	Savannah Agricultural Research Institute
WASVCD	West African Sorghum Value Chain Development



CHAPTER ONE

INTRODUCTION

1.1 Background

Agriculture contributes significantly to the economies of most developing countries employing several people across the continent (Breisinger *et al*, 2008). In Ghana, it contributes immensely to employment especially in the rural areas, Gross Domestic Product (GDP), income generation, and as well, foreign exchange earnings through the exportation of commodities such as cocoa and other cash crops (Breisinger *et al*, 2008).

Farming in Ghana is dominated by smallholder farmers who rely primarily on family land and labour for both crop and animal production. About 80% of the total agricultural production in Ghana is accounted for by smallholder farmers (MOFA, 2011). The smallholder farmers often rely on rain-fed agriculture whilst using rudimentary technologies for production (MOFA, 2011). Therefore their productivity and production are low (ACDI/VOCA, 2012). Smallholder farmers' low productivity in Ghana particularly in northern Ghana is as a result of poor access to inputs and production technologies (ACDI/VOCA, 2012).

The amount of resources smallholder farmers invest in their farms is often insufficient to support all their farming activities. They rely on self-financing which remains the most common form of financing amongst smallholder farmers since access to external capital such as loans and donor support remains a challenge (Anang *et al*, 2015; Dittoh, 2006 and FAO, 2002). In sub-Saharan Africa, particularly Ghana, farmers' reliance on personal savings in support of their farming business is a challenge as most farmers earn very low incomes and so are unable to save enough to support their farm activities and to cover family expenses (FAO, 2002).

Actors across the agribusiness value chain (from input supply through to the marketing of the final produce) are increasingly becoming more consolidated and integrated in response to the needs of farmers particularly in providing them access to external credit, inputs, mechanized services and market opportunities (Peterson *et al.*, 2001). According to Peterson *et al.* (2001), spot or cash market transactions between trading partners of the supply chain are increasingly replaced by more coordinated modes of business relationships. Hybrid coordination strategies of formal nature such as outgrower schemes are increasing (Peterson *et al.* 2001).

Outgrower scheme is the generic term that covers various contractual arrangements between companies and smallholder farmers. It often relates to agricultural production system where farmers, mostly smallholders produce according to a prior agreement with a buyer where the buyer in turn commits to purchasing the produce upon harvest (Vaeth and Kirk, 2010). Outgrower schemes generally vary with respect to the kind of relationship that exists between the buyer or supporting agent and the farmer.

A more recent outgrower arrangement is the nucleus farmer-outgrower scheme which evolved from the nucleus estate-outgrower schemes. The nucleus farmer-outgrower scheme is where a large farmer (nucleus farmer) is well resourced and is supported by development partners such as NGOs to take charge of smaller farmers by providing them with the necessary training on agronomic practices and some inputs such as seed, fertilizer, agrochemicals and mechanized services for production (Paglietti and Sabrie, 2012).

Outgrower schemes are usually adapted by contractors or nucleus farmers to help solve the problems of capital and ready market for farmers (Felgenhauer and Wolter, 2009). The nucleus farmer is often expected to provide some farm inputs (improved seeds, fertilizer, agrochemicals

among others) and mechanized services such as tractor services for land preparation, shelling, threshing, harvesting among others to support the farm activities of their outgrowers (Baumann, 2000; Woodend, 2003; Ntsiful, 2010 and Rudy, 2010). This is usually accompanied with extension services whiles linking outgrowers to market opportunities with support from both governmental and non-governmental organizations (Baumann, 2000; Woodend, 2003; Ntsiful, 2010 and Rudy, 2010).

The primary motive for smallholders to become outgrowers is to have access to inputs and mechanized services and to increase production and subsequently increase their income earnings (Ntsiful, 2010 and Rudy, 2010). Smallholders are often constrained with ready cash to afford these production services at the time of production. The nucleus farmer therefore helps reduce the cash flow constraint of smallholder farmers by providing inputs and mechanized services on credit basis to outgrowers (Ntsiful, 2010 and Rudy, 2010). In this case, payment for the services rendered by the nucleus farmer is delayed and farmers pay after harvest.

The type of outgrower scheme the study focuses on is the nucleus farmer-outgrower scheme implemented by individual nucleus farmers and supported by some agricultural projects in Northern Ghana. The nucleus farmers provide similar services to their outgrowers mainly tractor services, inputs provision such as improved seed, fertilizer and agrochemicals and extension services under similar conditions. The crop supported by the nucleus farmers are primarily maize, rice and soybean with the predominant crop being maize (ACDI/VOCA, 2012 and IFAD, 2011). The nucleus farmers provide these services on credit to their outgrowers where payment is often made later after harvest. Farmers are free to participate or not to participate in the schemes (ACDI/VOCA, 2012 and IFAD, 2011). The agricultural projects that support the nucleus farmers were: the Ghana Commercial Agriculture Project (GCAP), the Ghana

Agricultural Development and Value Chain Enhancement (ADVANCE) programme and the Northern Rural Growth Programme (NRGP). GCAP which started in 2012 is still operating in the Accra Plains and the SADA Zone by supporting nucleus farmers with matching grants to invest in needed infrastructure and equipment (e.g. in land, warehouses, irrigation systems, boreholes, packhouses and greenhouses), so that the nucleus farmers can remove binding constraints and better support smallholders in terms of inputs, extension services and markets. The ADVANCE programme which was implemented in 2009 and still in operation aims at promoting maize, rice and soya production in Northern Ghana by supporting nucleus farmers to acquire tractors, inputs and extension services who in turn support smallholder farmers with the services (ACDI/VOCA, 2012). The NRGD which was an 8 year programme and completed in 2016 was an initiative of the Ministry of Food and Agriculture (MOFA) and the International Fund for Agricultural Development (IFAD) to support outgrower schemes with loan facilities for the purchase of inputs (IFAD, 2011).

As smallholder farmers participate in nucleus farmer-outgrower schemes to benefit from the services provided under the schemes, the study seeks to assess the effect of these schemes on the input use efficiency and profitability of smallholder farmers in the Northern Region.

1.2 Problem Statement

African agriculture is dominated by smallholder farmers working on fields of less than three hectares using rudimentary technologies which results in low productivity (Felgenhauer and Wolter, 2009 and Chamberlin, 2007). This is because smallholder farmers lack access to input such as improved seed, fertilizer, agrochemicals, extension services and as well, mechanized services to enhance their efficiency and productivity (Felgenhauer and Wolter, 2009 and World

Bank, 2010). Engaging with scattered individual farmers to address their challenges and also for large processing companies to secure supplies of their raw material is often difficult (Felgenhauer and Wolter, 2009). However, one way to deal with this challenge effectively is through outgrower schemes.

Outgrower schemes ensure that farmers are better organized and work as group and are supported with inputs and extension services to which they would otherwise not have access. Several researchers such as Woodend (2003), Ntsiful (2010) and Rudy (2010) have argued that outgrower schemes are panacea to the challenges faced by smallholder farmers in developing countries and that outgrower schemes provide access to inputs and also serve as means of transferring technologies to smallholder farmers, while securing reliable supply of raw materials for processing companies. However, some outgrower schemes do not actually transfer the technology and inputs expected to be transferred to outgrowers despite massive implementation of such schemes across the continent (World Bank, 2014).

In Ghana, several outgrower schemes have been implemented and evaluated over time. Whilst some outgrower schemes have been successful and offered enormous benefits to smallholder farmers, others have been less successful due to some challenges. A typical example of a successful outgrower scheme in Ghana is the rubber outgrower scheme in the Western Region. The Rubber Outgrower Plantation Project (ROPP) was started in 1995 to increase the raw material supply of Ghana Rubber Estate Limited (GREL) through outgrower arrangement (Amevenku, *et al.*, 2012 and Paglietti and Sabrie, 2012). The scheme has a tripartite structure made up of the financial institutions providing loans to outgrowers, GREL providing planting materials and technical assistance and finally the outgrowers providing land and labour for the cultivation of the rubber. A study by Paglietti and Sabrie (2012) on the ROPP revealed that

outgrowers who participated on the scheme were able to significantly increase their profitability and income levels. This was as a result of adoption of improved agricultural and management practices and access to improved planting materials and efficient technical assistance (Paglietti and Sabrie, 2012).

On the other hand, the Guinness Sorghum Project which was implemented in 2001 by Technoserve in Northern Ghana was not too successful due to some challenges (EUCORD, 2008 and Paglietti and Sabrie, 2012). The structure of the scheme was a multipartite comprising of Guinness Ghana Brewery Limited (GGBL) as the main buyer of the sorghum, Technoserve Ghana providing technical services and inputs, nucleus farmers serving as intermediary between the outgrowers and the other parties on the scheme, the outgrowers and the Savannah Agricultural Research Institute (SARI) which provides agronomic support. The scheme provides improved seed, fertilizer, agronomic support and technical services to outgrowers and payment is often made at the time of harvest. A study by Paglietti and Sabrie (2012) revealed that though farmers who participated in the Guinness Sorghum Project were able to increase yield from 0.8 tonnes/ha to 1.7 tonnes/ha, sustainability of the project was a problem due to the fact that the inputs given under the project were significantly subsidized. Some challenges faced by outgrowers were; inadequate participation in price setting, increasing production cost as a result of subsidy withdrawal, pest problems among others.

Other similar studies so far on the effect of outgrower schemes on profitability and incomes of smallholder farmers have revealed both positive and negative effects. Boliwig (2009), Bellemare (2012), and Schuphach (2014) revealed a positive effect of outgrower schemes on the incomes and profitability of smallholder farmers whereas Wendimu *et al.* (2016) reported a negative effect of the large-scale agriculture and outgrower schemes on smallholder farmers in

Ethiopia. In a related study by the World Bank (2014), most outgrower schemes discriminate against women participation. Available literature also suggests that smallholder farmers are inefficient in the use of input (World Bank, 2010; Sienso *et al.*, 2013 and Awunyo-Vitor *et al.*, 2016).

It is however unclear whether similar outgrower schemes in Northern Ghana such as those the study focuses on are able to provide outgrowers with access to inputs, whether the extension services and inputs given under the schemes are able to improve the input use efficiency of outgrowers and whether the schemes enhance the profitability of smallholder farmers. As outgrower arrangements are very heterogeneous and may have diverse effects, there is a legitimate concern as to whether all kinds of outgrower arrangements offer economic benefits to participating smallholder farmers (Oya, 2012 and Sivramkrishna and Jyotishi, 2008). These raise questions which need to be addressed.

The main research question that arises is: what is the effect of nucleus farmer-outgrower schemes on the input use efficiency and profitability among smallholder farmers?

The specific questions are:

1. What are the factors influencing the decision of smallholder farmers to participate in a nucleus farmer-outgrower scheme?
2. What are the levels of access to inputs and mechanized services by outgrowers and non-outgrowers?
3. What is the effect of the nucleus farmer-outgrower schemes on the input use efficiency of smallholder farmers?

4. What is the effect of the nucleus farmer-outgrower schemes on smallholder farmers' profitability?

These are the issues that the study addresses.

1.3 Objectives of the Study

The main objective of the study is to assess the effect of nucleus farmer-outgrower schemes on input use efficiency and profitability among smallholder farmers in the Northern Region.

The specific objectives are:

1. To identify the factors influencing the decision of smallholder farmers to participate in a nucleus farmer-outgrower scheme.
2. To compare the levels of access to inputs and mechanized services by outgrowers and non-outgrowers.
3. To compare the input use efficiency between outgrowers and non-outgrowers.
4. To estimate the effect of nucleus farmer-outgrower schemes on smallholder farmer's profitability.

1.4 Relevance of the Study

Nucleus farmers with support from government and other NGOs have intervened to support smallholder farmers with input credit and other production services to enhance their efficiency and increase their profitability. The intervention is aimed at providing smallholder farmers with access to inputs to which they would otherwise not have. It is important to assess the operations of these schemes with regards to their effect on access to inputs, input use efficiency and

profitability of smallholder farmers, to establish whether the nucleus farmer-outgrower schemes are indeed beneficial to smallholder farmers.

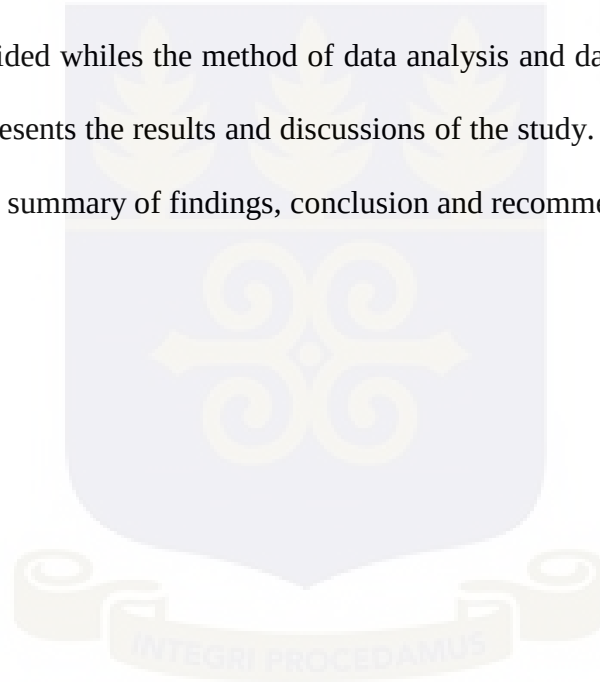
Also, earlier studies such as Paglietti and Sabrie, (2012), Amevenku, *et al.*, (2012) and Bellemare, (2012) have concentrated on contract and outgrower schemes involving tree crops such as mango, rubber, oil palm and other export oriented crops such as pineapple and cocoa with little attention on cereal crop such as maize soya beans and rice which are mostly produced by smallholder farmers in the Northern Region. Even though some internal assessment might have been made by scheme facilitators for the purposes of internal management and control, little independent studies has been conducted regarding the operations of outgrower schemes and its effect on participants particularly in the Northern region. It is this gap that this study fills. The study will therefore contribute to knowledge by filling the existing gap in literature regarding the effect of nucleus farmer-outgrower schemes on smallholder farmers' input use efficiency and profitability.

The study will be beneficial to stakeholders in outgrower or similar schemes particularly nucleus farmers, government and NGOs in current projects and in designing similar programmes in the future. Findings from the empirical analysis of the input use efficiency will help the smallholder farmers and nucleus farmers to know which inputs are being utilized efficiently and which ones are not. This will help them to develop strategies toward enhancing the efficient utilization of the inputs. Also, findings from the profitability analysis will help outgrowers to know whether they are better off on the outgrower schemes or not with regards to their profitability. It will also give direction to non-outgrowers with regards to their decision to participate in similar schemes based on the outcome of the study. The findings of the study will also inform Government and other NGOs who support outgrower schemes about the

performance of outgrower schemes on input use efficiency and profitability. This may help them in taking remedial actions depending on the outcome of the study.

1.5 Organization of the Study

The study is organized into five chapters. Following chapter one which provides the background to the study including introduction, problem statement, objectives of the study and relevance of the study, chapter two provides review of literature relevant to the study. Chapter three presents the methodology of the study. The theoretical and conceptual framework and the research design are provided while the method of data analysis and data collection is discussed in detail. Chapter four presents the results and discussions of the study. Chapter five which is the final chapter presents the summary of findings, conclusion and recommendations from the study.



CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of relevant literature on outgrower schemes. The chapter is organized in sections as follows: Section 2.2 presents an overview of outgrower contract schemes; section 2.3 reviews the types of outgrower models; section 2.4 reviews the various outgrower schemes in Ghana; section 2.5 reviews the benefits of outgrowers schemes to contractors and outgrowers; section 2.6 reviews the factors influencing participation in outgrower contract schemes whereas section 2.7 reviews input use efficiency among smallholder farmers; section 2.8 finally reviews the effect of outgrower schemes on incomes and profitability with conclusion on the chapter presented in section 2.9

2.2 Overview of Outgrower Contract Schemes

Outgrower schemes and contract farming are often used interchangeably in literature (Glover, 1990; Warning and Key, 2002 and Vaeth and Kirk, 2010). There are however some differences between the two schemes depending on how the arrangement is made and who initiates and controls the scheme. Glover (1990) makes a distinction between contract farming and outgrower schemes where contract farming is classified into private-led schemes while outgrower schemes are schemes managed by public enterprises. The distinction made by Glover seems to be losing relevance as private companies now also engage in outgrower arrangements other than the usual contract farming (Warning and Key, 2002 and Vaeth and Kirk, 2010).

Warning and Key (2002) and Vaeth and Kirk (2010) tend to expand the scope of the outgrower scheme arrangements by defining the concept in a broader perspective. Warning and

Key (2002) for example defined outgrower contract schemes to involve various contractual arrangements between a company or an individual and smallholder farmers for which the companies provide inputs to smallholder farmers in exchange for a market agreement. The market arrangement could include price setting and production management to ensure that produce meet the required market specifications (Warning and Key, 2002). Whilst Glover (1990) defined the concept focusing on its market aspect, Warning and Key (2002) tend to cover both the production (inputs supply) and as well, the market aspect. Vaeth and Kirk (2010) also defined outgrower contract scheme in line with the definition given earlier by Warning and Key (2002). They define outgrower schemes to be an extension of contracting firms' production activities where the firm provides inputs and extension services to smallholder farmers with some level of control in exchange for market (Vaeth and Kirk, 2010). The definition made by Vaeth and Kirk (2010) is in line with the earlier definition by Warning and Key (2002) in that both definitions reveal an arrangement where inputs and extension services are provided to smallholder farmers in exchange for a marketing arrangement.

Outgrower schemes are said to be the solution to the production challenges in agriculture mostly faced by smallholder farmers in developing countries where farmers often lack access to productive inputs resources (Ntsiful 2010 and Deininger *et al.*, 2011). The arrangements of outgrower schemes are such that input credit are provided to smallholder farmers on agreed terms where payment is made later at harvest (Ntsiful 2010 and Deininger *et al.*, 2011).

2.3 Types of Outgrower Contract Scheme

Outgrower contract schemes vary, depending on the kind of model one operates under (World Bank, 2006). The World Bank (2006) outlines five different types or models of

outgrower scheme (the centralized, the nucleus estate, the multipartite, the intermediary and the informal models). This categorization is based on mainly the kind of contractual relationship that exists between contractors and outgrowers with respect to the level of integration that contractors engage with outgrowers. The various types of outgrower schemes are reviewed as follows:

2.3.1 The Centralized Model of Outgrower Schemes

The centralized model arrangement of outgrower schemes is a form of a vertically coordinated model where a firm or company provides production and marketing services to smallholder farmers on their own land (Baumann, 2000). In line with the description of the centralized outgrower model given by Baumann, (2000), the World Bank (2006) describes the centralized model arrangement to be such that a firm enters into an agreement with smallholder farmers to produce a particular crop or commodity to be supplied to the firm where quality and quantity requirements are observed by the smallholder farmers. Under the centralized model, the firm provides inputs to farmers at the time of production where the farmers in turn sell their produce to the firm after harvest (Baumann, 2000 and World Bank, 2006).

Firms which contract with outgrowers under this model are often processing companies for which large volumes of produce are needed for processing (Eaton and Shepherd, 2001). Produce often contracted under this model include: milk and poultry produce, cotton, tea, sugarcane and coffee (Eaton and Shepherd, 2001 and D' silva *et al.*, 2009). According to Bijman (2008), firms often enter into this form of contractual arrangement with smallholder farmers due to the large volumes of produce required for processing. The centralized model is common in Africa in contracting out crops to smallholder farmers (Bijman, 2008). In the late 1980s for example,

Lonhro Company in Zambia contracted smallholder farmers to produce cotton for the company's ginnery which constitutes a typical centralized outgrower model (Springfellow, 1996).

With the centralized outgrower model, contracting companies do not need to acquire vast lands in order to produce enough crops to feed their factories since they rely on farmers in the surrounding communities. Critics are of the view that, instances where every farmer in the surrounding community wants to participate in this outgrowers arrangement, contracting companies often offer unattractive packages to farmers (Baumann, 2000 and World Bank, 2006). In this situation, farmers are often seen as labourers on their own farms for the companies.

2.3.2 The Nucleus Estate Model

Under the nucleus estate model arrangement, the firm often owns a plantation or estate and at the same time contracts with smallholder farmers in the neighbouring communities for more produce (World Bank, 2006). According to Eaton and Shepherd (2001), the nucleus-estate model is suitable for perennial crops such as oil palm and firms usually adopt the model when resettlement programs are required. Firms requiring huge volumes of produce for processing and marketing often contract with other smallholder farmers in the surrounding communities for more produce to augment what it produces so as to maintain a consistent and reliable supply of raw materials (Baumann, 2000).

An example of the nucleus estate model is that of the palm oil production in Indonesia. A typical example is the Nucleus Estate and Smallholder (NES) scheme in Indonesia (Spek and Goh, 2002). Under the NES scheme, NES has its own plantation farms and also contracts with individual smallholder farmers in the surrounding areas for more produce (Spek and Goh, 2002).

Another example of the nucleus estate outgrower model is the Ghana Oil Palm Development Company Limited (GOPDC) scheme. Under the GOPDC arrangement, the company has a plantation estate whiles engaging with smallholder farmers as outgrowers and supplying them with inputs and extension services for a reliable supply of fresh fruit bunches from the farmers (Loggoh, 2013).

Some challenges associated with this arrangement are the inability of outgrowers to meet quality and quantity standards set by contracting companies and in some instances side-selling of produce to other buyers when prices in the open markets is higher than what is offered by contracting companies (Loggoh, 2013). Under this arrangement, contracting companies are able to secure reliable sources of their raw materials.

2.3.3 The Multipartite Estate Model

The multipartite estate model is a joint venture involving a public entity, a private firm and smallholder farmers. Under the multipartite estate arrangement, government or other contracting parties contract with smallholder farmers with support from private firms or entities who provide services to the farmers (Baumann, 2000; Eaton and Shepherd, 2001 and Bijman, 2008). These are usually government projects involving arrangements with other private entities such as the finance institution, research institution, among others for their services. According to Bijman (2008), the private entities usually provide financial services, extension services or input credit under the multipartite estate model.

Baumann (2000) contends that most of the multipartite estate models are practiced in developing countries. In Ghana, a typical example of the multipartite estate model is the

Guinness Sorghum Project implemented in Northern Ghana. The structure of the Guinness Sorghum Project comprises of Guinness Ghana Brewery Limited, Technoserve Ghana, nucleus farmers, the outgrowers and the Savannah Agricultural Research Institute (SARI) (Paglietti and Sabrie, 2012). Another example is the Rubber Outgrower Plantation Project comprising the financial institutions, Ghana Rubber Estate Limited and the outgrowers (FAO, 2012; Paglietti and Sabrie, 2012 and Amevenku, *et al.*, 2012). Also, The Cotton Outgrower Scheme which was implemented in Northern Ghana by government to promote cotton production in the country is a typical example of the multipartite estate outgrower model. The structure is made up of government agencies, private companies and smallholder farmers (Amevenku, *et al.*, 2012).

Under the multipartite arrangement, some private entities contracted by government to supply inputs to outgrowers often delivers less than expected which sometimes makes participants even worse off in accessing the inputs (Paglietti and Sabrie, 2012 and Amevenku, *et al.*, 2012).

2.3.4 The Intermediary Model

Under the intermediary model, firms do not contract directly with the farmers but does it through an intermediary (Eaton and Shepherd, 2001 and Mansur *et al.*, 2009). The firm sub-contract with intermarries who also contract directly with farmers. The intermediary could be farming committees or aggregators. The intermediary model is popular in Indonesia and Thailand where most firms sub-contract with intermediaries who work directly with the farmers. The contracting firm has limited control over the farmers and how the produce is produced (Eaton and Shepherd, 2001). In Thailand, for example, some processing companies usually contract with intermediaries who could be farm committees or “collectors” to supply them with

raw materials where these intermediaries do so on their own by also contracting smallholder farmers for the produce (Eaton and Shepherd, 2001).

The intermediary model ensures that a firm has time to focus on its core production activities whilst securing supplies (Eaton and Shepherd, 2001). However, there is a danger associated with this type of model in that, the company may lose control over the production process, quality standard and even the prices farmers receive for their produce (Eaton and Shepherd, 2001).

2.3.5 The Informal Model

Under the informal model, traders and in some instances smaller firms contract informally with farmers relying on mutual trust to supply them with produce at the time of harvest (Eaton and Shepherd, 2001). Parties engaged under this model do not sign legal contracts which affect the enforceability of the contract terms. The success of the informal model depends mainly on the amount of inputs and other production support services contractors are able to provide to smallholder farmers (Eaton and Shepherd, 2001). The inputs and services provided under the arrangement often serve as a binding between parties.

According to Baumann (2000), the informal model involves greater risk on both parties in terms of parties not adhering to the initial agreement binding them. Contracts are framed loosely in the Ghanaian pineapple industry which is often informal in nature (Suzuki *et al.*, 2008). Written contracts are uncommon so contractors and outgrowers do not usually state clearly the terms of the contract. According to Al-Hassan *et al.* (2006), informal contracts are successful in the production and marketing of staple foods such as cassava and maize and some horticultural products such as banana, pineapple, vegetables and citrus. Examples of the informal outgrower

model are those nucleus farmer-outgrower schemes in Northern Ghana which the study focuses on.

Under the informal model, there are often challenges such as side-selling of produce by farmers, lack of celerity on the roles and responsibility between parties and poor level of enforcement (Suzuki *et al.*, 2008 and Eaton and Shepherd, 2001). The informal model cannot be applied in arrangements where quality and quantity standard are required.

2.4 Outgrower Schemes in Ghana

Outgrower schemes have been practiced successfully and predominantly in the tree crop sector in Ghana over the years. Some of the tree crops include the oil palm, rubber, mango, among others. It has also been implemented in the other arable crops such as maize, soya beans, rice, and sorghum among others (Loggoh, 2013; Amevenku, *et al.*, 2012 and Bellemare, 2012). Among the notable schemes implemented and evaluated over time include the following:

2.4.1 The Integrated Tamale Fruit Company (ITFC) Outgrower Scheme

The ITFC Outgrower Scheme concept is a contractual arrangement between ITFC and smallholder mango farmers in Northern Ghana. The outgrower scheme was implemented in the year 2000, where smallholder farmers in the Savelugu-Nanton District were contracted by ITFC to produce fresh mangoes for the company (Amevenku, *et al.*, 2012 and Bellemare, 2012). The core objective of the scheme is to reduce poverty in the Northern Region by providing income generation opportunity to farmers through organic mango production whiles securing reliable organic mangoes for the company (Amevenku, *et al.*, 2012 and Bellemare, 2012).

Under the contractual engagement between ITFC and outgrowers, ITFC provides technical assistance and improved seedlings and also extends interest free loans to outgrowers where payment is made later at harvest. The company is also entitled under the contract terms to buy the produce upon maturity for export (Amevenku, *et al.*, 2012 and Bellemare, 2012).

A study by Amevenku, *et al.* (2012) revealed that as part of the contractual engagement that binds ITFC and individual outgrowers, ITFC helps the outgrowers in obtaining certification and licenses required for organic production and export. Also, a four year grace period is given to outgrowers to start repayment of loans given to them by IFTC and until the loan is fully paid, outgrowers are mandated to sell all their produce produced under the contract scheme to IFTC (Amevenku, *et al.*, 2012). The company had faced challenges in establishing the outgrower scheme in the past (Osei, 2007). Low literacy rates, introducing new farming practices and changing attitudes were some challenges ITFC encountered which affected the smooth implementation of the project (Osei, 2007). Amevenku, *et al.* (2012) also revealed that high labour demand, discouraging volumes of yields produced and lack of transparency in deductions from IFTC were some major constraints faced by outgrowers. Available literature suggests the scheme was still in operation as at the year 2012 (Amevenku, *et al.*, 2012 and Bellemare, 2012).

This type of contractual arrangement is beneficial to smallholder farmers who on their own cannot establish a mango plantation farm to generate income especially from Northern Ghana where poverty is an issue affecting smallholder farmers. However, with little transparency on interest charges and deductions on credit inputs and cash credit given to outgrowers by ITFC, outgrowers feels unsatisfied and may feel the company cheats them. Instances where yield levels fall, outgrowers may end up using all their produce to payback the loans without having enough to take care of the family expenses. This makes farmers poorer.

2.4.2 The Ghana Oil Palm Development Company Limited (GOPDC) Scheme

GOPDC is the largest oil palm producing company in Ghana. The company which started in the 1970s established an outgrower scheme in 1982 with 200-hectare area for outgrowers (Amevenku, *et al.*, 2012 and Loggoh, 2013). GOPDC has about 7000 farmers contracted to produce fresh fruit bunches to feed the central mill of the company (Loggoh, 2013). Due to unreliable supply of fresh fruits bunches required to feed the factory, the company engages with outgrowers to ensure reliability of supply (Amevenku, *et al.*, 2012; Loggoh, 2013 and Vāth and Gobien, 2014).

The contract between the GOPDC and the farmers stipulates that GOPDC provides inputs on credit to the farmers (at cost) and the farmers in return supplies 100% of their produce to GOPDC. Under the scheme, farmers enjoy a seven-year grace period on their loans, and start repayment when the trees are in full production (Amevenku, *et al.*, 2012; Loggoh, 2013 and Vāth and Gobien, 2014). The inputs supplied to farmers under the scheme include; palm seedlings, fertilizers, technical assistance, and pest management assistance (Amevenku, *et al.*, 2012 and Loggoh, 2013). The purpose of the scheme is for GOPDC to assist farmers with inputs and extension services to produce fresh fruit toward feeding the company (Amevenku, *et al.*, 2012 and Loggoh, 2013).

A study by Loggoh (2013) revealed that the major challenges of the company were side selling of fruits by its outgrowers especially during the lean season and land tenure problems. Due to land tenure problems, about 3000 ha of GOPDC's concession are still not developed due to litigation over land (Loggoh, 2013). Loggoh, (2013) also revealed that outgrowers under the

GOPDC scheme had increased their output significantly than non-outgrowers. Available literature suggests the scheme was still in operation as at the year 2013 (Loggoh, 2013).

This type of contractual arrangement helps smallholder farmers who ordinarily cannot afford inputs for an oil palm plantation. The contractual arrangement is such that prices of output sold to the company are pre-determined and outgrowers are expected to sell all their produce to the company. As such, farmers usually feel cheated when the market price of their produce exceed what is offered by the company and would divert to sell to the open market due to inadequate monitoring structures put in place by the company. This affects the smooth operations of the scheme.

2.4.3 The Rubber Outgrowers' Plantation Project (ROPP)

The Rubber Outgrower Unit (ROU) manages the ROPP and was launched in 1995 to engage farmers in the production of natural rubber to feed the company. The project was supported by the Government of Ghana, the World Bank, Germany's Reconstruction Credit Institute (GRCI) and the French Development Agency (AFD) (Paglietti and Sabrie, 2012 and Amevenku, *et al.*, 2012).

GREL contracts outgrowers in producing natural rubber toward feeding the company for processing. The company in conjunction with Ghana government and other donor partners provide loans and extension services to farmers where the farmers in return supply their natural rubber to the company under agreed terms (Paglietti and Sabrie, 2012 and Amevenku, *et al.*, 2012). Paglietti and Sabrie (2012) report that GREL supplies its outgrowers with high quality seedlings for planting. The farmers use part of their loan package to pay in full for the planting materials supplied by GREL. A seven year grace period is given to outgrowers to pay back loans

obtained under the scheme. The scheme as at the year 2012 was in operation (Paglietti and Sabrie, 2012 and Amevenku, *et al.*, 2012).

The scheme may be negatively affected due to the involvement of third parties to provide loan facilities to outgrowers. The scheme may suffer a collapse when the third parties to the contact (government and other development partners) withdraw their loan services to farmers.

2.4.4 The Guinness Sorghum Project

As part of initiatives toward developing the sorghum value chain, the West African Sorghum Value Chain Development Project (Ghana) in conjunction with Technoserve and other stakeholders such as Guinness Ghana Breweries developed the Guinness Sorghum Project in 2001 (Paglietti and Sabrie, 2012). The project aims at developing a high quality sorghum supply chain that will enable the beverage industry in Ghana particularly Guinness Ghana Breweries to substitute their imported grains with the locally produced sorghum. The project which targets farmers in Northern Ghana is expected to increase the income levels of farmers who participate in the project as outgrowers (Paglietti and Sabrie, 2012). The key stakeholders are Technoserve Ghana, Guinness Ghana Breweries, Savannah Agricultural Research Institute, nucleus farmers and outgrowers (WASVCD, 2008 and Paglietti and Sabrie, 2012).

The scheme operates in such a way that Technoserve Ghana provides technical services and inputs to outgrowers for production through nucleus farmers while Guinness Ghana Brewery Limited being the end user of the produce buys the sorghum from the outgrowers through the nucleus farmers. Each nucleus farmer has about 100 to 300 outgrowers. The inputs are given to outgrowers on credit at a subsidized amount and payment is made later after harvest. The implementation of the project saw an increment in outgrowers' yield and was described as quite

successful by management of the project (WASVCD, 2008). However, a study by Paglietti and Sabrie (2012) revealed that the project had problems with sustainability due to the fact that the inputs given under the project were hugely subsidized though admitted that outgrowers were able to increase yield under the scheme. Some challenges faced by outgrowers were; inadequate participation in price setting, increasing production cost as a result of subsidy withdrawal, pest problems among others. There were also problems about the quality of sorghum produced by outgrowers and the inability of Guinness Ghana Brewery Limited to absorb all the grain produced. Available literature suggests that the scheme was still in operation as at 2012 (Paglietti and Sabrie, 2012).

With this type of arrangement where inputs are subsidised for farmers, it may suffer a collapse whenever the subsidies are withdrawn. Also, outgrowers may face market failure whenever the company is unable to absorb all the produce from outgrowers since the prices offered by the company will be higher than the prevailing market price due to the high quality of grain produced by outgrowers.

2.5 Benefits of Outgrower Schemes

The concept of outgrower schemes is usually to help solve the many production challenges confronting smallholder farmers especially in developing countries where access to input resources remains a challenge. Various studies suggest how outgrower schemes continue to be an important feature in the development of agriculture in Africa (Ntsiful, 2010; Rudy, 2010; Bellemare, 2012 and Deininger *et al.*, 2011). They highlight several benefits outgrower models present to both the contractor and the smallholder farmer.

According to Deininger *et al.* (2011) outgrower schemes are seen to be a remedy to the challenges faced by smallholder farmers in developing countries where access to productive resources is limited. In most outgrower arrangements for example, the contractors usually supply productive input, credit, extension services and/or new technologies to outgrowers, which could increase food supply through increased production and/ or productivity (Deininger *et al.*, 2011).

For the Nucleus farmers or contractors who are often the initiators of the outgrower schemes, the benefits for them from such engagements appear to be substantial. Outgrower schemes offer the nucleus farmer or the company the opportunity to access more and reliable supplies of produce. It is also an opportunity for the contractors especially processing companies to diversify their sources of raw materials and therefore reduces the risk associated with raw material supply in the open market (Bellemare, 2012; Bolwig, *et al.*, 2009 and Mayers, 2000).

Areas where land is scarce, contractors often contract with farmers to produce their raw materials on the farmers' own land which would not have been available to the company (ActionAid, 2015). Companies requiring large areas of plantation or estate which requires resettlements usually engage with smallholder farmers on their own lands to produce the commodity for the company. Cotula, *et al.* (2009) are of the view that displacement of land users due to land acquisitions for large-scale farming could be avoided by making the current land owners outgrowers producing to feed the company. Under some outgrower schemes such as the Guinness Ghana sorghum project, the Integrated Tamale Fruit Company Outgrower Scheme among others, land and labour are usually provided by the smallholder farmer where the company/nucleus farmers provide inputs, technologies and extension services (Paglietti and Sabrie, 2012 and Cotula, *et al.*, 2009).

Baumann (2000) also found that outgrower schemes allow the nucleus farmer to delegate production to smallholders and have several advantages. The scheme assures the nucleus farmer of regular inputs of raw material from the smallholders so that he is able to meet the demand of companies he supplies to (Baumann, 2000). He is also of the view that the company would not be able to achieve this through purchases on the open market, whereas contracts can specify planting dates as well as total quantity to be delivered (Baumann, 2000).

Due to market failure and the challenges companies go through in accessing their raw material from the open market, they tend to integrate vertically with farmers in the form of outgrower arrangements to secure their raw material supply. Nucleus farmers on the other hand also benefit by way of making profit on the services they render to farmers and also being able to acquire large volumes of produce which they can supply to their clients (Baumann, 2000 and Mayers, 2000).

On the part of smallholder farmers, outgrower schemes provide them with access to market, inputs, technologies and with extension services that would not be otherwise available to them (Baumann, 2000; Woodend, 2003; Ntsiful, 2010 and Rudy, 2010). Smallholder farmers are unable to acquire these resources on their own and rely on external sources which outgrower schemes present an opportunity for them to explore (Ntsiful, 2010 and Rudy, 2010). These input credits are meant to enable the farmers improve upon their productivity so as to increase output and make good margins. Ntsiful (2010) observed that smallholder farmers are often motivated to participate in outgrower arrangements to have access to input resources which they will otherwise not have.

Outgrower schemes play an important role in enhancing the incomes and profitability of smallholder crop farmers and reducing market risk or market unavailability which often arises during bumper harvest (Larpar, *et al.*, 2008). By reducing market risk, smallholder farmers are able to obtain competitive prices for their produce leading to an improvement in their income generation. According to Deininger *et al.* (2011), outgrower schemes are avenues through which smallholder farmers could enhance their income and profitability through the efficient use of inputs coupled with market availability for their produce.

Outgrower schemes provide an opportunity for smallholder farmers to access credit from commercial banks to which they would otherwise not have access. It is easier and more efficient for financial institutions and other development partners to work with farmer groups such as outgrower groups than individual scattered farmers. Hence, farmers who belong to outgrower groups are usually more likely to get assistance from these bodies and institutions (Woodend, 2003).

While outgrower schemes promise significant benefits for growers in many cases, studies have highlighted circumstances in which members of the rural population have realized only limited gains, or have been directly or indirectly harmed by the scheme (Glover, 1990). It is not always the case that all outgrower schemes are able to provide smallholder farmers with all the benefits highlighted. The nature of scheme and the kind of contractual arrangement between parties can affect how much parties get to benefit from the contract. In some investment projects involving outgrower schemes and contract farming the actual transfer of technology is seldom up to the level announced by the investors (World Bank, 2014). Critics of outgrower schemes and contract farming reveal the unequal power relationship between a company and farmers. Farmers

often provide both the land and cheap labour, and at the same time carry most of the risk (Amevenku, *et al.*, 2012; World Bank, 2014).

2.6 Factors Influencing Participation in Outgrower Contract Schemes

There are several factors influencing smallholder farmers' decision to participate in outgrower schemes. These factors may be farmers' social and demographic characteristics or some other elements of motivation factors for which smallholder farmers are willing to participate in outgrower contract schemes. According to Ntsiful (2010), the primary motive for which smallholder farmers participate in outgrower schemes is to have access to input resources and or market for their produce.

Some critics are of the view that outgrower schemes are usually in favour of men than women such that, men have more access to the schemes than women. The World Bank/ UNCTAD's review of 24 agricultural investments in developing countries concluded that "virtually all outgrowers were men" with only 1.5% being women (Schneider and Gugerty, 2010 and World Bank, 2014). A study conducted by Porter and Phillips-Howard (1997) in evaluating contract farming schemes in Africa, found that very few women had formal contracts as outgrowers in the small barley outgrower scheme in Nigeria. Reasons could be that the scheme discriminates against women or that women are generally not attracted to or interested in the scheme. The study also found that the only outgrower contract scheme which had more women participating is the Njoro vegetable canning scheme in Kenya which has enhanced women's incomes and economic empowerment (Porter and Phillips-Howard, 1997). The nature of crop produced under the scheme being vegetable may be the influential factor for which women

participation was high. Vegetable farming is often done by women in Africa (Porter and Phillips-Howard, 1997).

Other studies on participation in outgrower contract schemes such as Sharma (2008), Sambuo (2014) and Njiru *et al.* (2013) have also found various social and demographic characteristics that influence participation in outgrower schemes and contract farming. According to Sharma (2008), farmers' educational level, age, farm size, and membership to an FBO significantly influence participation in outgrower contract schemes. Smallholder farmers' educational level, age, farm size and membership of an FBO has a positive relationship with participation. For example, farmers with higher educational levels are more likely to participate in outgrower schemes (Sharma, 2008). The implication is that the decision of a smallholder farmer to participate in an outgrower contract scheme is partly based on his/her social and demographic characteristics (Sharma, 2008). Sharma (2008) employed the probit regression model in identifying the factors that influence participation in outgrower contract schemes.

Also, Sambuo (2014) in assessing the tobacco contract farming participation and income in Urambo, found that the factors that significantly influence smallholder farmers' participation in outgrower contract schemes are farming experience, farm group (FBOs) and age of the farmers in that, farmers with higher farming experience, those who belong to FBOs and those who are older are more likely to participate in contract farming. Some of the findings of Sambuo (2014) corroborate that of Sharma (2008) particularly with respect to membership of an FBO and farm size that have positive effects on participation. Sambuo (2014) employed the probit model in identifying the factors influencing participation.

Njiru *et al.* (2013) on the other hand found that, access to extension services, number of school going children, agricultural land size and household's income have positive influence on participation in outgrower contract schemes. Farmers who had access to extension for example were more likely to participate in outgrower schemes. Also, farmers with higher number of school going children are more likely to participate in outgrower schemes in order to increase their income levels to support in the payment of school fees (Njiru *et al.*, 2013). Some of the findings of Njiru *et al.* (2013) conform to that of Sharma (2008). This is specifically with respect to the fact that farm size has positive influence on participation in that farmers with larger farm size are more likely to participate in outgrower schemes (Njiru *et al.*, 2013 and Sharma, 2008). Njiru *et al.* (2013) employed the logit regression model in identifying the factors influencing participation in outgrower contract schemes.

2.7 Input use Efficiency among Smallholder Farmers

According to the World Bank (2010), the Ghanaian agricultural sector is operating below its potential due to inadequate infrastructural development in the rural areas which account for majority of the food commodities produced in the country. In addition, the efficiency levels of farmers are very low due to limited access to credit which translates into low working capital, thus impeding their ability to purchase productive inputs such as improved seeds, fertilizers, agrochemicals, among others (World Bank, 2010).

Low technical efficiency and inefficient utilization of inputs among farmers translates into low average yield in agricultural production (MOFA, 2009; World Bank, 2010 and CSIR, 2012). This is evident from the fact that maize yield per hectare is on average, 1.5 metric tonnes which is far below the average potential yield of 5.2 to 6.4 metric tonnes per hectare (MOFA, 2009 and

CSIR, 2012). Smallholder farmers lack access to productive input resources and hence, limited use of inputs which leads to low yields (Amankwah, 1996 and Awunyo-Vitor *et al.*, 2016).

Awunyo-Vitor *et al.* (2016) in assessing the resource use efficiency among maize farmers in Ghana used the translog production function to analyse the determinants of maize output. Whilst estimating the efficiency ratios of the various inputs used by farmers, they found that farmers are inefficient in the utilization of all the inputs. The findings by Awunyo-Vitor *et al.* (2016) confirm earlier findings from Sienso *et al.* (2013) where they reported same. Sienso *et al.* (2013) in estimating the efficiency of maize farmers in Ghana also employed the translog production function approach where he revealed that maize farmers are inefficient in utilizing labour, fertilizer and seed.

Tambo and Gbemu (2012) in assessing the resource-use efficiency in tomato production in the Dangme West District, Ghana employed the Cobb Douglas production function because the assumptions underlying the use of the OLS could not be held. Whilst estimating the efficiency ratios of the various inputs used by farmers, they found that farmers are inefficient in the use of input in their farms. The findings of Tambo and Gbemu (2012) are in line with those of Awunyo-Vitor *et al.* (2016) and Sienso *et al.* (2013) though their methodological approaches in estimating the production function differ. However, they all employed the efficiency ratio approach in estimating the efficiencies of the various inputs used by farmers (Awunyo-Vitor *et al.*, 2016; Sienso *et al.*, 2013 Tambo and Gbemu, 2012).

Wongnaa and Ofori (2012) in assessing the resource-use efficiency in cashew production in Wenchi Municipality, Ghana used the Ordinary Least Square (OLS) criterion where they found that farmers are not efficient in utilizing the input resources available to them. Al-Hassan (2008)

in assessing the technical efficiency of rice farmers in Northern Ghana used the translog production frontier where he found that farmers are technically inefficient.

A study by Jirgi *et al.* (2007) on resource use efficiency in maize production in Kontagora Local Government Area, Niger State, Nigeria, used the budgeting technique and exponential production function. Jirgi *et al.* (2007) found that farmers are not efficient in utilizing inputs such as fertilizer and labour. A related study by Gani and Omonona (2009) on resource use efficiency among small-scale irrigated maize farmers in Northern Taraba State of Nigeria found that farmers are not efficient in the utilization of inputs available to them. Gani and Omonona (2009) used the Cobb Douglas production function to estimate the determinants of maize output and the efficiency ratio to estimate the efficiency of the various input resources used by farmers. The findings of Gani and Omonona (2009) and Jirgi *et al.* (2007) are in line with those of other researchers in Ghana such as Awunyo-Vitor *et al.* (2016) and Sienso *et al.* (2013) and Wongnaa and Ofori (2012) that inputs resources are not used efficiently by farmers.

Rupasena and Khan (2014) in a study on the resource use efficiency of maize production in Sri Lanka found that farmers were inefficient in the use of input resources and that profitability of maize farmers could be increased by reducing the use of agrochemicals and labour whilst increasing land, fertilizer and seed use. Rupasena and Khan (2014) used the translog stochastic frontier to estimate the mean technical efficiency of farmers.

It is observed from available literature on input use efficiency of farmers that all the researchers point to the same thing. The findings are that there is limited use of some inputs such as fertilizer by farmers and that the farmers are not efficient in utilizing the inputs available to them. However, it is clear that literature so far on the input use efficiency among smallholder

farmers has focused on smallholder farmers in general without specifically examining farmers who participate in outgrower schemes and other intervention to determine whether there will be an effect on their input use efficiency since these interventions are often toward enhancing the efficiency of participants. This creates a gap in literature which the study addresses.

2.8 Effect of Outgrower Schemes on Profitability and Incomes of Smallholder Farmers

Literature on the effect of outgrower schemes on profitability (gross margin, net margin and return on investment) is scanty but available literature focuses on the effect of outgrower schemes on incomes among smallholder farmers creating a gap in literature (Schuphach 2014; Bolwig, *et al.* 2009; Bellemare, 2012 and Wendimu, *et al.*, 2016). The researchers tend to focus on the effect of outgrower schemes on incomes of farmers without dealing with the specific issues that determine income generation such as profitability.

Schuphach (2014) reports a positive effect of participation in the sugar industry on farm income and (long-term) household wealth. Controlling for a range of factors and taking into account possible non-random selection through the use of the Propensity Score Matching (PMS) technique, Schuphach (2014) found a significant and sizeable positive effect of participation for both sugar cane outgrower schemes and employment on large-scale sugar estates on farms. In addition, results from propensity matching suggest an increase in the magnitude of 2.9 to 3.9 index points compared to (similar) small scale farmers unconnected to the sugar industry (Schuphach, 2014).

Also, Bolwig, *et al.* (2009) in a study on the economics of smallholder organic contract farming in Tropical Africa, find a positive individual effect for participation on net revenues of smallholder farmers. Scheme participation for example was associated with a 75% increase in

net coffee revenue. They attribute the positive effect on net revenues to the incentives given under the schemes and the training given on the processing of coffee (Bolwig, *et al.*, 2009). Bolwig, *et al.* (2009) employed the OLS regression model and a full information maximum likelihood (FIML) estimation in assessing the effect of smallholder organic contract farming on net revenue among others.

Moreover, Bellemare (2012) in assessing the welfare impacts of contract farming, found a positive effect on household income (Bellemare, 2012). Bellemare (2012) employed the contingent-valuation experiment to control for unobserved heterogeneity among smallholders in estimating the impacts of contract farming on household income among others.

However, Wendimu, *et al.* (2016) on the other hand in assessing the Sugarcane Outgrower Scheme found that participation in outgrower schemes has a huge negative effect on the income of outgrowers. This was due to the fact that farmers already had access to the most limiting resource in producing the sugarcane before the establishment of the contract scheme which did not really offer new technologies. Wendimu *et al.* (2016) in assessing the sugarcane outgrower scheme employed the PSM to analyze the effects of compulsory participation in the sugarcane outgrower scheme as used by Schuphach (2014).

The review of literature on the effect of outgrower schemes on the net margins and incomes of participants so far reveals that, there outgrower schemes have both positive and negative effects on the net margins and incomes of smallholder farmers participating in them.

2.9 Effects of Credit Constraint on the Resource Use Efficiency among Smallholder

Farmers

Credit is a key component of financial services and fundamental in all aspects of production, including agricultural production. A body of literature highlights the important role of credit in agricultural production (Chaovanapoonphol *et al.*, 2005; Ruben and Kolk, 2005; Dittoh, 2006; Martey *et al.*, 2015). These studies portray the key role of agricultural credit in efficiency and productivity of farm households. The role of credit in raising both the efficiency of agricultural production has been attested to by Chaovanapoonphol *et al.* (2005).

Farm households need credit to purchase external inputs, contract wage labour, acquire food and nonfood items and invest in education, among others (Ruben and Kolk, 2005). Access to credit also enables farmers to adopt more capital-intensive methods of production to improve their level of efficiency (Hazarika and Alwang, 2003). Alene and Hassan (2006) also indicate that the capacity of farmers to adopt improved production technologies can be constrained by resource limitations including credit constraints. Capital market imperfections as a result of asymmetric information and problems of incentive compatibility have been identified as the cause of credit constraint encountered by borrowers (Blancard *et al.*, 2006).

Lack of credit can serve as a critical factor limiting productivity and efficiency of production of farm households. Studies on the effect of credit on efficiency of production include Ayaz and Hussain (2011) who investigated the effect of institutional credit on the production efficiency of Pakistani farmers. The authors found credit to have a positive impact on technical efficiency. Pinheiro (1992) however found no effect of credit on technical, allocative and

economic efficiency of farmers in Dominican Republic, while Chaovanapoonphol *et al.* (2005) found credit to reduce technical inefficiency of rice farmers in Thailand.

On the effect of credit on resource use efficiency of Ghanaian farmers, Martey *et al.* (2015) found a positive effect of credit on technical efficiency of maize producers in northern Ghana. Abdallah (2016) also investigated agricultural credit and technical efficiency of maize farmers in Ghana and found a positive effect of credit on efficiency. Therefore, it is clear from literature that credit has an important role to play in determining resource use efficiency among farmers and its constraints negatively affect smallholder farmers who do not much access to input resources.

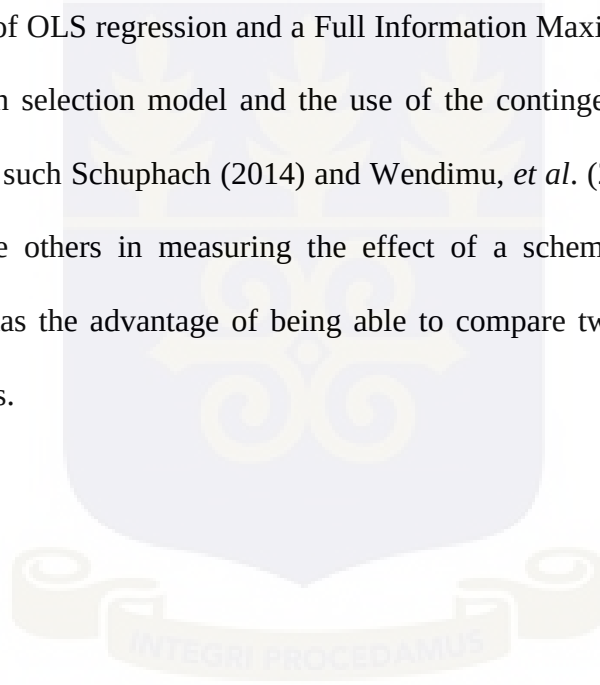
2.10 Conclusion

Literature so far on factors influencing participation in outgrower contract schemes reveals that socio-economic characteristics of farmers such as farm size, gender, farming experience, membership of an FBO and extension contact have significant positive influence on participation. There is no much difference in the approaches followed by researches in arriving at those findings as the probit and logit models were often used in identifying those factors.

On the issue of the input use efficiency of smallholder farmers, available literature points to smallholder farmers not being efficient in the utilization of input resources available to them. Various approaches such as the use of the trans-logarithmic (translog) production function with the use of efficiency ratios, Cobb Douglas production function with the use of efficiency ratios and then the use of the OLS are followed by researchers in estimating the input use efficiency of smallholder farmers. Several assumptions underlie the use of the OLS which are not easily observed and because of the limitations on the interaction terms of inputs posed by the Cobb

Douglas production function, current researchers such as Awunyo-Vitor *et al.* (2016) and Sienso *et al.*, (2013) now tend to employ the translog production function (Awunyo-Vitor *et al.*, 2016 and Sienso *et al.*, 2013).

Finally on the effects of outgrower schemes on incomes and profitability of farmers, literature points to both positive and negative effects on incomes and to some extent net margins except that most literature point to a positive effect. Various approaches were used by researchers in assessing the effect of outgrower schemes on smallholder farmers including the use of the PSM, the use of OLS regression and a Full Information Maximum Likelihood (FIML) estimate of the Heckman selection model and the use of the contingent-valuation experiment. However, current papers such Schuphach (2014) and Wendimu, *et al.* (2016) have employed the PSM technique over the others in measuring the effect of a scheme or an intervention on participants. The PSM has the advantage of being able to compare two groups based on their observable characteristics.



CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter focuses on the methodology of the study. The chapter is organized in sections as follows: Section 3.2 and 3.3 present the theoretical framework and conceptual framework respectively; section 3.4 presents the methods of analysis; section 3.5 presents a description of the study area; section 3.6 presents the research design, sources and type of data and the sampling procedure whilst section 3.7 finally presents a description of the data collection instrument.

3.2 Theoretical Framework

The theory that underlines the study is the production theory. The production function specifies a combination of factor inputs to produce a desired output. A rational producer will always want to maximise profit with limited combination of factor inputs. A profit maximizing firm chooses both its inputs and outputs levels with the sole goal of achieving maximum profits. Given a production function as:

$$Q=f(X_1, \dots, X_n) \quad (3.1)$$

Where Q is the quantity of output and $X_1, \dots, X_n$ are the quantities of input variables such as seed. With prices of inputs r for X_1 , then the firm's profit is given by:

$$\pi = pq(\cdot) - rX \quad (3.2)$$

Where p and q are the prices and quantities of output respectively. The optimal set of the production actions on inputs and output is characterised by the condition such that:

$$p \frac{\partial q(\cdot)}{\partial x} - r = 0 \quad (3.3)$$

For pq = revenue of the firm with its associated cost (C), then:

$$p \frac{\partial R(\cdot)}{\partial x} = \frac{\partial C(\cdot)}{\partial r} \text{ with the condition that } MR=MC \quad (3.4)$$

where R represents Revenue

Equation 3.4 specifies the profit maximization point in production where the marginal revenue is equal to the marginal cost. If $MR > MC$, there exist an optimal condition for the producer to increase production whereas if $MR < MC$, then the producer should decrease production since the addition cost incurred in producing the additional unit of output is greater than the added revenue obtained from the additional output.

In the firm's profit maximization strategies there exists technological constraint which concerns the feasibility of the production plan and market constraint which concerns the effect of actions of other agents in the market. Therefore, in a perfect competitive market, a firm will take into consideration the prices of factor inputs to maximise its output. Assume that P is a vector of prices for inputs, then the profit maximization of the firm is expressed as:

$$\pi(p) = \max pq(\cdot) \quad (3.5)$$

If the firm produces only one output, the profit function can be written as:

$$\pi(p, r) = \max pf(x) - rX \quad (3.6)$$

Where p is the (scalar) price of the output, r is the vector of the factor prices and the inputs are measured by the (non-negative) vectors:

$$X = (x_1, \dots, x_n)$$

Therefore, the first order condition which states that the production function with respect to a single input must be non-negative for an efficient production function is expressed as:

$$p \frac{\partial f(x^*)}{\partial x} = r_i \quad \text{for } i = 1, \dots, n \quad (3.7)$$

The condition expressed in Equation 3.7 depicts that the marginal product of each factor input must be equal to its price. Thus, the value addition to the product must be equal to the price of the factor input.

In the long run production, both the first order condition and the second order condition must be satisfied for an efficient production where the second order condition states that the second derivative of the production function with respect to a single input must be non-positive such that:

$$\frac{\partial^2 f(x^*)}{\partial x^2} < 0 \quad (3.8)$$

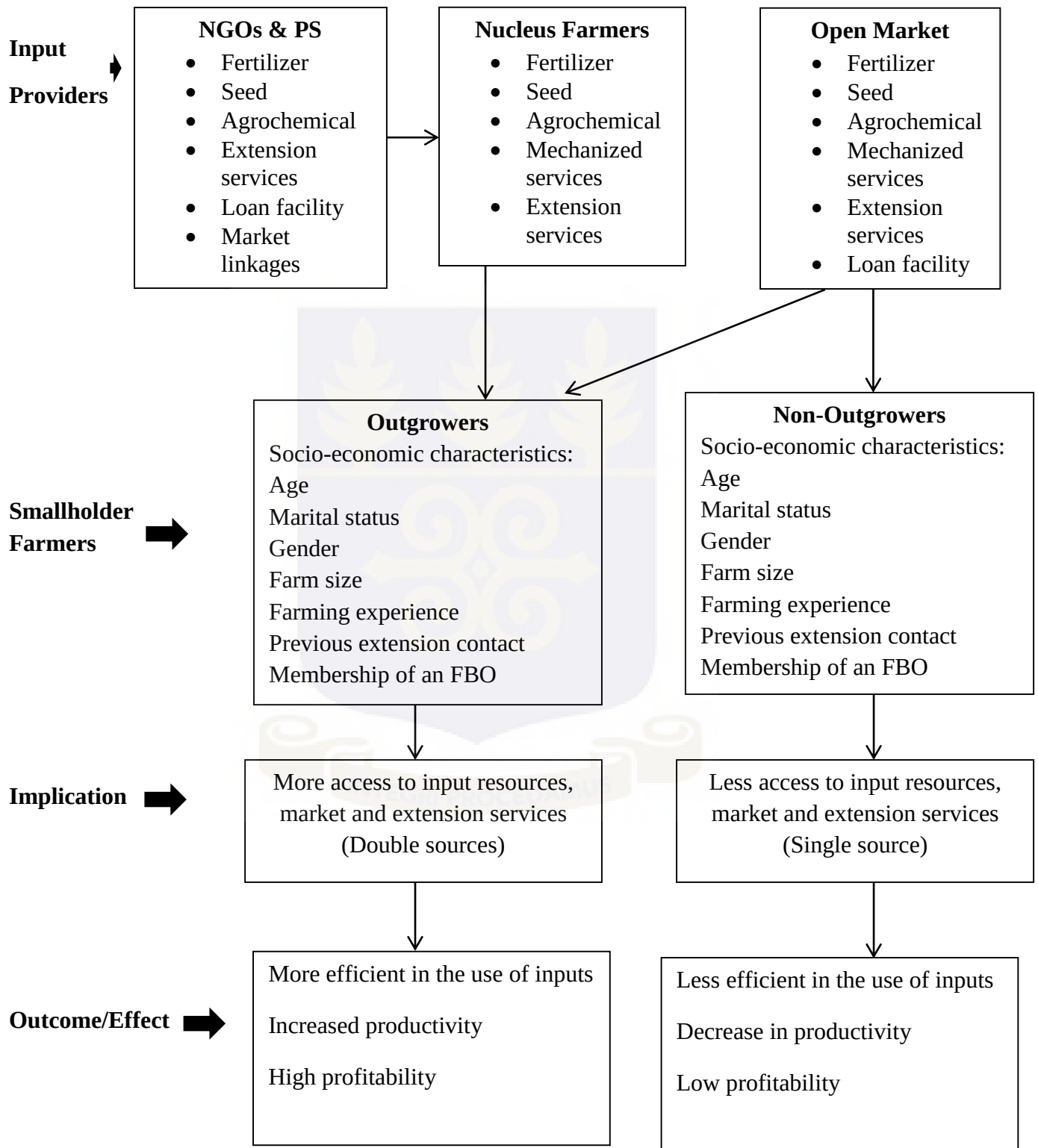
Therefore, in order for a rational producer to maximize profit, the condition is that the additional revenue derived from increasing production by a unit of input should equal the amount incurred on the input variable to increase production. This implies that a rational producer will not increase production if the cost of such increment is more than its corresponding gain. This theory seeks to guide the producer in making rational decision on the volumes of output it produces. From the context of the study, it is assumed that the smallholder farmers are rational and therefore will seek to maximise their profits through efficient utilization of the input variables available to them (Tocco *et al.*, 2013 and Miller, 2006).

3.3 Conceptual Framework

Figure 3.1 illustrates the conceptual framework of the study which describes how smallholder farmers (outgrowers and non-outgrowers) access input resources for production. The main sources of inputs available to the smallholder farmers are the nucleus farmers which are often supported by some agricultural projects and other development partners, and the open market. The socio-economic characteristics of farmers such as gender, age, farm size, farming experience, membership of an FBO among others, may influence the decision of farmers to participate in the nucleus farmer-outgrower schemes as outgrower.

Outgrowers are able to access their input resources and extension services from two sources (from nucleus farmers and the open market) and hence are expected to have more access to the inputs and extension services which is expected to have a positive effect on their input use efficiency and profitability. It is expected that farmers who have more extension contact on input use and adoption of new technologies coupled with access to inputs will be more efficient in utilizing the inputs. The inputs given under the schemes are often on credit basis making it more accessible to outgrowers. The extension services given by nucleus farmers ensure the efficient use of inputs by outgrowers. The non-outgrowers on the other hand are able to access their input resources and extension services from only one source (from the open market) which is often not available for credit purchase and as a result non-outgrowers who are cash constrained are unable to access the right quantities of these inputs and extension services timely. Loan facilities are also available in the open market for farmers but access to this facility by smallholder farmers is limited and so, only few farmers are able to access it. This may lead to inadequate input use which reduces productivity and accounts for low profitability.

Figure 3.1 Conceptual Framework



3.4 Method of Data Analysis

3.4.1 Factors Influencing Participation in Nucleus Farmer-Outgrower Schemes

As seen from the conceptual framework, it is clear that some socio-economic characteristics of farmers may influence the decision of smallholder farmers to participate or not to participate in outgrower schemes. The Binary Logit Regression Model is therefore used to identify the factors (socio-economic characteristics of farmers) that significantly influence participation in nucleus farmer-outgrower schemes among smallholder farmers. The logit model is specified as follows:

$$\log P_i / (1 - P_i) = \beta_0 + \sum_{j=1}^{12} \beta_j X_j + \varepsilon_i \quad (3.9)$$

Where;

P_i is the probability that a farmer (i) will participate in an outgrower scheme

β_0 = constant term

β_j = coefficient of explanatory variable X_j , (where $j = 1, 2, \dots, 9$)

ε_i = error term

The variables used in the logit model are further specified and described on Table 3.1

Table 3.1: Description of Variables Used in the Binary Logit Regression Model

Variable	Description	Specification/unit of measurement	A priori Expectation
P	Participation in a nucleus outgrower scheme (Dependent variable)	1= Participate, 0=otherwise	
X ₁	Gender	1=Male, 0=otherwise	+
X ₂	Age	In Years	+
X ₃	Age squared	In Years	-
X ₄	District	1=Karaga, 0=otherwise 1=Gusheigu, 0= otherwise	+/-
X ₅	Marital Status	1= Married, 0=otherwise	+
X ₆	Formal Educational Status	1=have formal education, 0=otherwise	+
X ₇	Farming Experience	In years	+
X ₈	Farming Experience Squared	In years	+
X ₉	Household size	Number	+
X ₁₀	Farm Size	In Hectares	+
X ₁₁	Member of an FBO	1=Member, 0=otherwise	+
X ₁₂	Extension Contact	1= Yes, 0=otherwise	+

The coefficients of the explanatory variables from the logit regression model show the likelihood or probability or odds of change in dependent variables versus independent variables.

A positive sign shows a likelihood of participation whilst a negative sign shows a likelihood of

non-participation. Since the coefficients of the explanatory variables from the logit regression results do not explain the effect of a unit change in an explanatory variable on the dependent variable, the marginal effects are computed to measure the effect of a unit change of an explanatory variable on the dependent variable. The marginal effect is estimated as follows:

$$\text{Marginal effects} = dP(Y_i=1|X_i) / dX_i = \beta_i(1 - P_i) \quad (3.10)$$

Where: i = number as in 1, 2 ... n , P_i = mean of the regressand variable, X_i = Regressors variables and β_i = Coefficients of regression

The marginal effects measure the effect of a unit change in an explanatory variable on the dependent variable. That is, the effects on the likelihood of participation due to a unit change in an explanatory variable such as an increase in age.

Test Statistics:

The t-statistics from the binary logit regression model results are used to test for the significance of the coefficients of the independent variables. The t-calculated (t-statistic) of each explanatory variable from the logit regression results are used to compare with their corresponding critical values on the t-table to determine their significance levels. If the test statistic of an explanatory variable is greater than its corresponding critical value, then that variable significantly influences participation. If the test statistic of a variable is less than its critical value, then that variable does not significantly influence participation.

The results from the logit regression model is used to identify the factors that significantly influence participation in outgrower schemes and their corresponding marginal effects used in explaining the effect of a percentage change in an explanatory variable on participation.

3.4.2 Level of Access to Inputs and Mechanized Services by Smallholder Farmers

Firstly, descriptive statistics such as frequencies and percentages are used to ascertain the proportions of outgrowers who had access to the inputs such as improved seed, fertilizer and agrochemicals and mechanized services such as tractor services for land preparation and shelling compared to the non-outgrowers. Difference in mean test is used to further test for any significant difference in the proportions of respondents who had access to the inputs between outgrowers and non-outgrowers. Access to inputs used in the study is defined to mean the availability of the input and the ability of the farmer to purchase the input when required.

Hypotheses:

H_0 : There is no significant difference between the proportions of outgrowers and non-outgrowers who have access to improved seed, fertilizer, agrochemical and tractor services for land preparation and shelling.

H_A : There is significant difference between the proportions of outgrowers and non-outgrowers who have access to improved seed, fertilizer, agrochemical and tractor services for land preparation and shelling.

Where H_0 is the null hypothesis and H_A is the alternate hypothesis.

Hypothesis Test:

The Difference in mean test is used to determine whether there is significant difference between the proportions of outgrowers and non-outgrowers who have access to improved seed, fertilizer, agrochemical and tractor services for land preparation and shelling. The test statistic is the z-scores formulated as follows:

$$Z = P_1 - P_2 / SE; SE = \sqrt{P(1-P)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)} \quad (3.11)$$

Where P_1 and P_2 are the proportions from sample of outgrowers and non-outgrowers represented as 1 and 2 respectively, SE is the standard error, P is the pooled sample proportion, n_1 and n_2 is the size of sample 1 and 2 respectively. The p-value (z-score) is then compared with the significance level of (0.05). If the p-value is less than the significance level, then the null hypothesis is rejected in favour of the alternate hypothesis meaning there is significant difference in the proportions of farmers who have access to improved seed, fertilizer, agrochemical and tractor services for land preparation and shelling. If the p-value is greater than the significance level, the null hypothesis is not rejected meaning that there is no significant difference in the proportions of farmers who have access to improved seed, fertilizer, agrochemical and tractor services for land preparation and shelling.

Secondly, the level of access to the various inputs is measured by computing for the proportions of outgrowers and non-outgrowers who have access to the inputs using the categories (levels) as follows: Access to only 1 input; access to 2 inputs; access to 3 inputs; access to 4 inputs; and access to all the five inputs. Proportions of farmers with the various levels of access was computed and compared between outgrowers and non-outgrowers.

Finally, a five point likert scale is used to obtain the ratings of respondents with regards to their level of access to the inputs and mechanized services (1=bad, 2=poor, 3=satisfactory, 4=good, 5=very good). The ratings were analysed by calculating the weighted mean scores for responses on each variable. The input variables were; improved seed, fertilizer, agrochemical and tractor services for land preparation and for shelling. Also, respondents were made to indicate a “yes” or “no” to the timeliness of inputs received/ purchased for production where the

proportions of outgrowers who receive the inputs timely is compared with that of the non-outgrowers to determine whether there are differences.

The results from the analysis of access to inputs and mechanised services by farmers is used to compare the proportions of outgrowers and non-outgrowers who have access to improved seed, fertilizer, agrochemical and tractor services for land preparation and shelling. The test-statistics determines whether there is significant difference in the proportions of outgrowers and non-outgrowers who have access to the inputs variables.

3.4.3 Estimation of Input use Efficiency among Smallholder Maize Farmers

The study is guided by the production theory which specifies a combination of factor inputs to produce a desired output. Profit is maximised when inputs resources are utilized efficiently to produce desired output. Therefore, input use efficiency is determined by first estimating the determinants of output and then estimating the efficiency ratios. The determinants of maize output of farmers were estimated using the translog production function whiles estimating the efficiency ratios for each input used by farmers as used by Awunyo-Vitor *et al.* (2016) and Sienso *et al.* (2013). The efficiency ratio is used to estimate the input use efficiency of the various inputs used by farmers in the study area to determine whether the inputs used by farmers are utilized efficiently or not. A translog production function has the advantages of being flexible and could help to examine the interactions between inputs in the different stages of production which the Cob Douglas production function lacks. The translog production function is specified as:

$$\ln Y_i = \ln \beta_0 + \sum_{r=1}^4 \beta_r \ln X_{ri} + \frac{1}{2} \sum_{r=1}^4 \sum_{v=1}^4 \beta_{rvi} \ln X_{ri} \ln X_{vi} + \varepsilon_i \quad (3.12)$$

Where:

$\ln$ = natural logarithm, Y_i = level of output (kilogram), $i = i^{\text{th}}$ farmer in k^{th} group, β = the unknown parameter to be estimated, X = the input variables, ε_i = error term

The other socio-economic variables which are included in the model have already been specified on Table 3.1 (gender, marital status, age, level of education and farming experience).

The remaining variables are specified on Table 3.2.

Table 3.2: Description of Variables for the Translog Function

Variable	Description	Unit of Measurement	A priori Expectation
Y^*	Output per hectare	Kg	
SEED	Quantity of seed used per hectare	Kg	+/-
FERT	Quantity of fertilizer used per hectare	Kg	+/-
AGROCHEM	Quantity of agrochemicals used per hectare	Litres	+/-
LABOUR	Labour used per hectare	Man days	+/-
NEXTC	Number of extension contact in a year	Number	+

The data regarding the variables used in the model was first normalized by their respective means before using to estimate for the determinants of maize output using the translog production function approach. This implies that the coefficients of the determinants (explanatory variables) could be interpreted as elasticities since the data was first normalized. Results from the translog production function are used to determine which variables have significant effect or influence on maize output of farmers. The determinants from the translog production function being interpreted as elasticities were further used to compute for the efficiency ratios of all the

input variables. The translog production function is estimated for both outgrowers and non-outgrowers respectively. The translog production function is also estimated for the pooled sample

3.4.4 Computing for the Efficiency Ratios of Inputs and the Decision Rule

Based on the various elasticities that were estimated from the translog production function, the marginal physical product (MPP) was estimated which was later used to estimate for the marginal value product (MVP). The MVP of a particular input variable was then used to compare with the marginal factor cost (MFC) of that input to establish the efficiency ratio of the input used by farmers. This was done to determine which input(s) were utilized efficiently between outgrowers and non-outgrowers. The estimation of the efficiency ratios of inputs was done for both outgrowers and non-outgrowers respectively. The efficiency ratio is estimated as:

$$\text{Efficiency ratio (r)} = \text{MVP/MFC} \quad (3.13)$$

Where MVP is the marginal value product of variable inputs, MFC is marginal factor cost

$$\text{MVP} = \text{MPP}_{x_i} * P_y \quad (3.14)$$

Where; MPP_{x_i} = marginal physical product of a unit of input x_i , P_y = unit price of output

$$\text{MPP}_{x_i} = dy/dx_i = \beta_i * \bar{Y}/\bar{X}_i \quad (3.15)$$

$\bar{Y}$ and $\bar{X}$ = mean value of the yield (Y) and input (X) respectively

β_i = estimated regression coefficients

The MVP of a particular input variable is obtained by multiplying its marginal physical product by its unit price. The marginal physical products of the input variables used in estimating

the MVP are computed using the elasticities obtained from the translog production function and the mean values of yield (output) and inputs as specified in Equation 3.15. The unit price of output is the unit price at which the produce is sold. The MFC is the unit price of each input variable purchased by farmers. For a farmer to be efficient in the utilization of a particular input variable, the MVP of the input should be equal to its MFC. That is, the additional cost of adding a unit of an input should be equal to the additional value added to output as a result of the unit of input added. Therefore, if the efficiency ratio of input $x_i = 1$, it implies that farmers are efficient in the use of x_i . If the efficiency ratio of input $x_i > 1$ or < 1 , it implies that farmers are not efficient in utilizing input x_i . If input $x_i > 1$, it implies that farmers are underutilizing input x_i since the MVP in this case is greater than the MFC and that an increase in the use of input x_i will lead to an increment in MVP. If input $x_i < 1$, it implies that farmers are overutilizing input x_i and that a decrease in the use of input x_i will lead to saving cost and maintaining or increasing output since in this case the MFC is greater than the MVP.

The results from the analysis of the input use efficiency among farmers particularly the estimated efficiency ratios are used to determine which inputs are utilized efficiently by outgrowers and non-outgrowers respectively so that a comparison is made between the two groups. It gives a basis to compare whether outgrowers are more efficient in utilizing the inputs available to them than the non-outgrowers.

Test statistic

The estimated efficiency ratios for the inputs are tested using a one sample t-test to determine whether their respective values are not significantly different from 1 since 1 is the basis for determining whether an input is utilized efficiently or not. The one sample t-test is formulated as:

$$t = \frac{\bar{x} - \mu}{\sqrt{s^2/n}} \quad (3.16)$$

Where; $\bar{x}$ is the sample mean, μ is the specified population mean, n is the sample size and s^2 is the sample variance. The p-value (t) is then compared to the significance level of (0.05). If the p-value of a particular efficiency ratio is greater than the significance level of (0.05), then it implies that there is no significant difference between that efficiency ratio and 1. If the p-value is less than the significance level of (0.05), then it implies that there is significant difference between that efficiency ratio and 1.

3.4.5 Estimation of Effect of Outgrower Schemes on Profitability of Smallholder Maize Farmers

3.4.5.1 Profitability of Smallholder Maize Farmers

The profitability indicators that were used in the PSM to estimate the effect of the nucleus farmer-outgrower schemes are; gross margin, net margin and return on investment. They are calculated per hectare of maize farm cultivated for the 2016 cropping year.

Gross Margin

$$\text{Gross Margin} = \text{Total revenue} - \text{Total variable cost of production} \quad (3.17)$$

The total revenue component comprised all revenue generated from a hectare of maize farm cultivated. It was calculated by taking into consideration the total output of maize obtained from a hectare of maize farm cultivated whether sold, consumed or given out as gift. The total quantity of maize harvested was multiplied by the average price at which they sold the maize per kg to obtain the total revenue.

For the total cost of production, all the variable cost incurred in cultivating a hectare of maize farm was taken into consideration. They included; input cost, labour cost, marketing cost and mechanized services cost. The quantities and prices of these variables used in the 2016 cropping year was obtained from respondents and subsequently used for the estimations.

Net Margin

$$\text{Net Margin} = \text{Gross Margin} - \text{Value of Depreciation of Fixed Assets} \quad (3.18)$$

Depreciation of fixed assets was calculated using the straight line method.

$$\text{Depreciation} = (\text{Asset Value})/(\text{Useful Life}) \quad (3.19)$$

The assets that were depreciated include: Hoes, cutlasses and knapsack sprayers. There were no salvage values for the assets.

Return on Investment

$$\text{Return on Investment} = (\text{Net Margin})/(\text{Total Cost of Production}) \quad (3.20)$$

The net margin is the value estimated from Equation 3.18. The total investment for this analysis is the same as the total cost of production estimated for the gross margin analysis.

3.4.5.2 The Propensity Score Matching (PSM) Model

The PSM is used to estimate the effect of outgrower schemes on profitability. In order to estimate for the effect of the outgrower schemes on profitability, three average treatments effects are estimated which are specified as follows:

The Average Treatment effect on the Treated (ATT) is expressed as:

$$ATT = E(\tau|D=1) = \{E[Y(1)|D = 1] - E[Y(0)|D = 0]\} \quad (3.21)$$

The average treatment effect on the treated measures the effect of the intervention on the participants. It measures the amount of incremental value in gross margin, net margin or return on investment that participants of the schemes (outgrowers) are able to make as a result of participation in the schemes. It could be negative or positive. A positive ATT shows that the schemes have positive effect on the profitability of participants and vice versa.

Another parameter estimated is the Average Treatment Effect (ATE), which is defined as:

$$ATE = E[Y(1) - Y(0)] \quad (3.22)$$

The average treatment effect is the overall effect on the selected variables of both participants and non-participant. It is the mean effect of the outgrower scheme on an individual who participates. It measures the general effect of the scheme on participation. Thus, the amount of incremental value smallholder farmers will make when they participate in the scheme. It could be positive or negative. A positive ATE implies that any smallholder farmer who participates in the schemes will see an increment in his profitability and vice versa.

Finally, the Average Treatment effect for Untreated Individuals (ATU) which is expressed as:

$$ATU = E\{Y(1)|D=0\} - \{E[Y(1)|D = 1] - E[Y(0)|D = 0]\} \quad (3.23)$$

The average treatment effect for untreated individuals measures the effect the intervention would have had on the non-participants (Caliendo and Kopeinig, 2005). It measures the incremental value of the profitability indicators that non-outgrowers would have made if they had participated. It is also referred to as the opportunity cost of non-participation. It could be

positive or negative. A positive ATU implies that non-outgrowers would have made more gains in terms of their profitability if they had participated while a negative ATU implies that outgrowers would have been worse off if they had participated in the outgrower schemes.

These parameters seek to explain the effect of the outgrower schemes on participation. In this study, the parameters were estimated using the Propensity Score Matching (PSM). The following steps are followed in the PSM estimation:

1. Estimating the Propensity Scores

The propensity score is estimated with the aid of a model and the variables of interest.

Model Choice

The Binary Logit Regression Model is used to estimate the propensity scores by estimating the probability of participation in outgrower schemes versus the probability of non-participation.

Choice of Variables

The outcome variables were gross margin, net margin and return on investment. The other variables for the logit model are those already specified on Table 3.1.

2. Choosing a Matching Algorithm

The next step after estimating the propensity scores is to select a matching technique where outgrowers are matched to non-outgrowers with propensity score values based on the chosen variable used in estimating the propensity score values. The Nearest Neighbour Matching algorithm was used in matching the propensity scores of the outgrowers as against the non-outgrowers. The Nearest Neighbour Matching algorithm randomly orders the treatment

(outgrowers) and the control (non-outgrowers) and then selects treatments and finds the control group with the closest propensity (Wainanai *et al.*, 2012). The individual from the outgrower group was chosen as a matching partner for a non-outgrower individual that is closest in terms of propensity score using the STATA software. When the propensity scores for both groups are similar, the near neighbor matching method often generates good pairs (Lapar *et al.*, 2011). The matching is done with replacement to ensure that there is strong matching especially in situations where there is limited overlap in the distribution of scores.

Results from the PSM particularly with the estimations of the ATT, ATU and ATE are used in determining the effect of the outgrower schemes on the selected profitability indicators (gross margin, net margin and return on investment) of smallholder farmers. The ATE for example gives the overall effect of the outgrower schemes and that a positive ATE will imply that the outgrower schemes have positive effect on the profitability of farmers with regards to participation whilst a negative ATE implies a negative effect.

3.5 Description of the Study Area

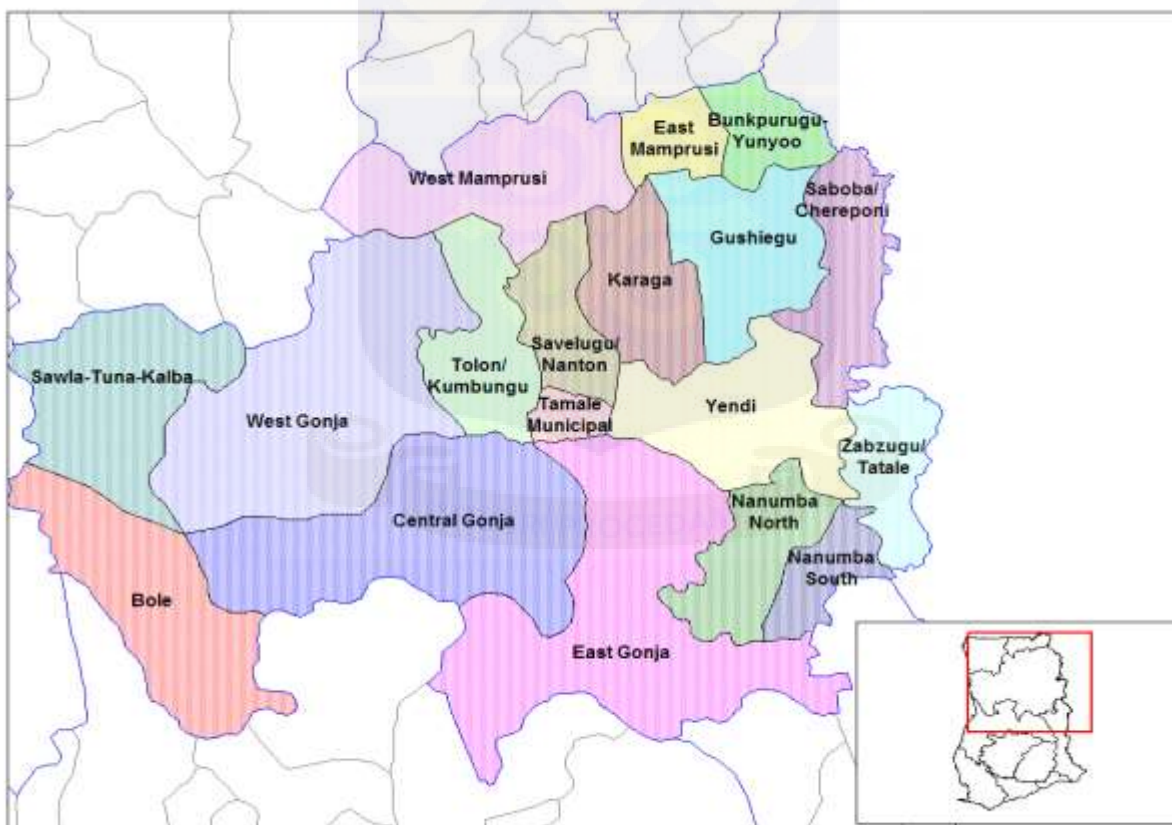
The study area was Northern Region of Ghana. In terms of land mass, Northern Region is the largest region in Ghana occupying an area of 70,384 square kilometres. It shares boundaries with the Brong Ahafo and the Volta regions to the south, the Upper East Region and the Upper West regions to the north, Togo to the east, and Côte d'Ivoire to the west (GSS, 2011). It lies between longitudes 0.15W and 2.25W, and latitudes 5.50N and 7.46N to the equator.

The climate of the region is relatively dry, with a single rainy season that begins in May and ends in October. The amount of rainfall recorded annually varies between 750 mm and 1050 mm. The temperatures can vary between 14 °C (59 °F) at night and 40 °C (104 °F) during the

day. The main vegetation is classified as vast areas of grassland, interspersed with the guinea savannah woodland, characterized by drought-resistant trees such as the acacia, baobab, shea nut, dawadawa, mango and neem.

The region is made up of 26 administrative districts with Tamale being the regional capital. Majority of people in the region are engaged in agriculture. The crops that are produced predominantly in the region include yam, maize, millet, guinea corn, rice, groundnuts, beans, soya beans and cowpea (GSS, 2011). Figure 3.2 presents the map of Northern Region.

Figure 3.2: Map of Northern Region



Source: (Wikimedia, 2015)

3.6 Research Design, Sources of Data and Sampling Procedure

3.6.1 Research Design

The study is an assessment of the effect of outgrower schemes on participants. The participants were smallholder farmers in the Northern Region participating in nucleus farmer-outgrower schemes to benefit from input credit, mechanized services and extension services. The nucleus farmers are often supported by government and NGOs such as ADVANCE, GCAP, and NRGF among others to provide these services to the outgrowers. A comparative analysis is made between outgrowers and non-outgrowers to establish any significant difference in some selected variables such as input use efficiency and profitability. The focus of the study is on the 2016 cropping year activities. Quantitative research approach was largely used to collect and analyse data to achieve the objectives of the study.

3.6.2 Sources and Type of Data

Data for the study was obtained from nucleus farmers and smallholder farmers which constitute outgrowers and non-outgrowers. The population for the smallholder farmers constituted all smallholder farmers under selected nucleus farmer-outgrower schemes in the Northern Region and all smallholder farmers (who are non-outgrowers) in the selected districts where nucleus farmer-outgrower schemes operate.

Primary data was collected from individual smallholder farmers (outgrowers and non-outgrowers) and nucleus farmers. Primary data on socioeconomic and demographic variables such as age, gender, household size, marital status, farming experience, educational level, access to credit and extension, membership of an FBO among others was gathered from smallholder farmers. Data regarding the nature of contract and contract terms were gathered from outgrowers

and nucleus farmers. In addition, data on access to inputs and mechanized services, production characteristics such as quantity of inputs used and their unit prices, labour used, total area of land cultivated, total output produced from maize farm, among others were gathered from smallholder farmers (both outgrowers and non-outgrowers respectively).

3.6.3 Sampling Procedure

A multistage sampling technique was used to sample the smallholder farmers. The first stage involved the selection of the districts in the region. Three districts were selected using the simple random sampling technique from the Northern Region where nucleus farmers operate. The selected districts were; Gushiegu, Karaga and East Mamprusi districts.

The second stage involved the selection of the nucleus farmers. Two nucleus farmers each were purposively selected from each of the selected three districts. The nucleus farmers were purposively selected to include nucleus farmers who were supporting smallholder maize farmers. The population of the nucleus farmers could not be ascertained. About six nucleus farms were selected for the study. The selected nucleus farms include; Alabani farms (Alabani Ibrahim) and Kharma Farms (Adam Issahaku) from Karaga; Dokorogu farms (Abukari Dokorogu) and Mr. Baba farms (Al-Hassan Mumuni Baba) from Gushiegu and Ben Awuni farms (Ben Awuni) and Sulemana Ibrahim farms (Sulemana Ibrahim) from East Mamprusi districts respectively in the Northern Region of Ghana.

The final stage involved the selection of smallholder farmers. The smallholder farmers under each district were stratified into two groups. That is, participants and non-participants of the nucleus farmer-outgrower schemes where samples were taken from each stratum. The total sample size for the study was 330 made up of 150 outgrowers and 180 non-outgrowers. The

number of non-outgrowers was more than the outgrowers in order to use the propensity score matching technique in estimating the effect of the schemes on smallholder farmers since the matching is done such that all members in the outgrower group must find their respective matches in the non-outgrower group. This demands that the control group (non-outgrowers) should be more than the treatment group (outgrowers) for the matching to be done very well without bias. The sample size determination is presented in Appendix I.

Under each nucleus farmer, a total of 25 outgrowers were randomly selected. A total of 50 outgrowers were selected from each district making a grand total of 150 outgrowers for the study. The list of outgrowers was not available from their nucleus farmers and so outgrowers were selected randomly from the communities with the assistance of the nucleus farmers or their agents. They were randomly selected by chance without any bias. Upon visiting a community, enumerators were dispersed to cover the entire community where samples were taken from every part in the community.

For the other non-outgrowers, 60 each of smallholder farmers respectively were randomly selected from each district. The list of non-outgrowers was not available at the time of visit. A total of 30 farmers each were selected randomly from each community where the selected nucleus farmer operates and was done in the same manner as was done in the selection of the outgrowers. A grand total of 180 non-outgrowers were selected from the 3 districts. Table 3.3 summarizes the sample size for the study.

Table 3.3 Summary of Sample Size

Region	District	Nucleus farmers	Outgrowers	Non-Outgrowers
Northern	Karaga	2	50	60
	Gusheigu	2	50	60
	East Manprusi	2	50	60
Total		6	150	180

3.7 Data Collection Instrument

Primary data was collected from the smallholder farmers with the use of well-structured questionnaires. The questionnaire was first pre-tested in Tamale where corrections were made before the final questionnaires were administered. The questionnaires were administered through a face to face interview with farmers either on their farms or places of residence. The questionnaires are attached in Appendix VI.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

Chapter four presents the results and discussions of the study. The chapter is organized in sections as follows: Section 4.2 describes how the nucleus farmer-outgrower schemes operate while section 4.3 presents the social, demographic and production characteristics of farmers. Following section 4.3 is section 4.4 which presents result on the factors influencing participation in nucleus farmer outgrower schemes and section 4.5 presents results and discussions on the level of access to inputs and mechanized services between outgrowers and non-outgrowers. Under sections 4.7 and 4.8, results and discussions on input use efficiency between outgrowers and non-outgrowers are presented. Finally, section 4.9 presents results from the PSM on the effect of nucleus farmer outgrower schemes on profitability are presented and discussed.

4.2 How the Nucleus Farmer-Outgrower Schemes Operate

The study contacted a total of 6 nucleus farmers from all the three selected districts in the Northern Region for the purposes of identifying how the schemes operate and also to interview their outgrowers. Under each district, 2 nucleus farmers were selected. It was observed that all the nucleus farmers were operating using similar approaches. The contracts between the nucleus farmers and their outgrowers were informal. The contracts were entered verbally between the nucleus farmers and the outgrowers relying on trust and so there were no legal documents supporting the contracts.

The schemes operate such that the nucleus farmers provide tractor services for land preparation and shelling of maize, fertilizer and in some cases, agrochemicals and improved

seeds to outgrowers where payment is often made in kind later after harvest using their produce. Among all the nucleus farms, tractor services for land preparation and shelling were given in full supply to outgrowers whereas fertilizer was given to limited outgrowers due to resource constraint faced by the nucleus farmers. Fertilizer was distributed to outgrowers based on the discretion of the nucleus farmers. Improved seed and agrochemicals were not provided under the schemes except for Karaga district where one nucleus farmer provided improved seed and agrochemicals to his outgrowers in the previous years but on a limited supply to limited outgrowers as applied in the fertilizer distribution. It stopped due to resource constraints on the part of the nucleus farmer. However, the nucleus farmers often arrange with private input dealers to supply their outgrowers with improved seed, agrochemicals and in some cases fertilizer upon request from the outgrowers where payment is made at the point of delivery by the outgrowers. The outgrowers are not mandated to sell their produce to the nucleus farmers except for payment of services rendered by the nucleus farmer.

Some agricultural projects such as ADVANCE Ghana, NRGF and GCAP assist the nucleus farmers in obtaining loans from banks to purchase tractors and in some cases fertilizer for their outgrowers. They also provide extension services and warehouse services to outgrowers through the nucleus farmers. GCAP for example has built a warehouse facility at Karaga district for outgrowers to store their produce.

4.3 Social, Demographic and Production Characteristics of Farmers

The social and demographic characteristics of farmers are presented on Tables 4.1 and 4.2 whiles the production characteristics of farmers presented on Table 4.3.

4.3.1 Social and Demographic Characteristics

From Table 4.1, it is observed that majority of smallholder farmers in the Northern Region were males representing 77.3%. For the outgrowers, male represent 68.7% and for the non-outgrowers, they represent 84.4%. Even though female smallholder farmers were in the minority; those who participated in the outgrower schemes were higher than the non-participants. It could be inferred that smallholder farmers in the Northern Region are dominated by males. This could be attributed to the fact that women perform other domestic and economic roles like housekeeping and marketing of agricultural produce in society and may not have equal time for farming like their male counterparts. This finding corroborates those of current studies such as Awunyo-Vitor *et al.* (2016) and earlier studies such as Amankwah (1996) that suggest that farming in Ghana is male dominated. This result also conforms to the assertion made by Schneider and Gugerty (2010) and World Bank (2014) that outgrower schemes are male dominated.

The Northern Region of Ghana is predominantly Muslims according to the 2010 Population and Housing Census (GSS, 2011). This also reflects in the religious background of smallholder farmers as presented on Table 4.1. Majority of the farmers were Muslims representing 91%. Muslims also dominate in both the outgrower and the non-outgrower groups. However, more Christians (6%) were found in the outgrower group than in the non-outgrower group (3.3%).

Table 4.1: Social and Demographics Characteristics of Farmers

Variable	Outgrowers		Non-Outgrowers		Pooled	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Gender						
Female	47	31.3	28	15.6	75	22.7
Male	103	68.7	152	84.4	305	77.3
Religion						
Christian	9	6	6	3.3	15	4.5
Muslim	133	88.7	167	92.8	300	91
Traditionalist	8	5.3	7	3.9	15	4.5
Marital Status						
Single	8	5.3	5	2.8	13	3.9
Married	142	94.7	175	97.2	317	96.1
Level of education						
Primary	24	16	16	8.9	40	12.1
JHS	2	1.3	3	1.7	5	1.5
SHS/Technical	5	3.3	5	2.8	10	6.1
Tertiary	2	1.3	1	0.6	3	0.9
None	117	78	155	86.1	272	82.4
Main Occupation						
Farming	144	96	172	95.6	316	95.8
Other	6	4	8	4.4	14	4.2
Member of an FBO						
Not a member	83	55.3	160	88.9	243	73.6
Member	67	44.7	20	11.1	87	26.4
Use of credit for Farming						
Do not use loans	134	89.3	138	76.7	272	82.4
Use loans	16	10.7	42	23.3	58	17.6
Extension contact						
Do not have extension contact	10	6.7	98	54.4	108	32.7
Have extension contact	140	93.3	82	45.6	222	69.3

Source: Author's Computation, Field Survey, 2017

From Table 4.1, it is seen that almost of the smallholder farmers in the study area were married. About 96.1% of the farmers were married with only few being single. It was observed that almost all those who were single were still in school. Both the outgrower and non-outgrower

groups also had married farmers dominating. Almost all the married farmers had children who are expected to help in their farming activities as family labour.

Smallholder farmers in Ghana generally have low level of formal education. From Table 4.1, it is seen that majority of the smallholder farmers in the Northern Region had no formal education representing 82.4%. For those who had formal education, majority had only basic primary education representing 12.1%. However, outgrowers had more primary education (16% respondents) than non-outgrowers (8.8% respondents). For Junior High School (JHS), Senior High/Technical (SHS) School and Tertiary Levels, only few farmers attained those levels which were almost the same for both groups.

From Table 4.1, it is observed that the main occupation for outgrowers and non-outgrowers was farming representing 96% and 95.6% of respondents respectively. This implies that the farmers rely on their farming activities for income generation and will endeavour to explore all avenues to improve upon their farming businesses. The other occupations farmers engaged in were mostly trading in animals and other food commodities and serving as tractor operators or labourers on other farms.

It is observed from Table 4.1 that most farmers do not belong to any FBO. However, the proportions of outgrowers who belong to FBOs other than the nucleus farmer outgrower scheme were higher (44.7%) than that of the non-outgrowers (11.1%). This implies that outgrowers were more interested in joining groups and associations that promote their wellbeing. Most of the FBOs farmers belong to were into welfare issues and mobilizing themselves for support that may come from government or NGOs. Most of these FBOs were formed by NGOs for various projects. They usually become dormant whenever the projects end.

Most farmers do not use external credit for their farming activities mainly due to lack of access. The proportion of outgrowers who used external credit for farming other than what was provided under the outgrower schemes (16%) were less than that of the non-outgrowers (23.3%). The non-outgrowers are often constrained with cash resources to afford tractor services for land preparations and subsequent purchase of inputs for farming. They therefore rely on family and friends for credit which is mostly inadequate or unavailable. The few outgrowers who obtained credit often do so to augment what is often provided under the outgrower schemes.

It is observed from Table 4.1 that majority of outgrowers had extension contact (93.3%) which was far more than that of the non-outgrowers (45.6%). This is because the nucleus farmers with support from NGOs and other governmental bodies assist outgrowers with extension services which are often not available to the non-outgrowers. The extension services were usually on good agronomic practices and the adoption of new farming technologies.

There is no significant difference in age, farming experience, household size and available labour force between outgrowers and non-outgrowers (Table 4.2). The average ages of the respondents were 40.1 and 39.7 years respectively for outgrowers and non-outgrowers. Smallholder farmers in the study area have relatively much experience in farming. Both groups had an average of 14 years' experience in the farming. This implies that the farmers were familiar with what they cultivate which is expected to impact positively on their productivity. This finding conforms to that of Awunyo-Vitor *et al.* (2016) who reported a mean farming experience of 14.07.

The average household size for both outgrowers and non-outgrowers was 13 whilst their available labour force was 10.5 and 10.1 respectively. Outgrowers had slightly higher labour

force than non-outgrowers. The farmers use family labour for most of their farm activities including sowing, weeding, fertilizer and agrochemical application, harvesting and on-farm and off-farm transportation of inputs and produce. It was observed from the field that hired labour was often employed by farmers on contract basis mostly for agrochemical application and weeding to supplement the family labour force.

Table 4.2 Other Social and Demographic Characteristics of Farmers

Variable	Outgrowers				Non-Outgrowers				t-stats	Sig.
	Min.	Max.	Mean	S.D	Min.	Max.	Mean	S.D		
Age	18	84	40.01	12.53	18	76	39.7	10.4	-0.26	0.798
Farming Experience	2	55	14	10.47	2	50	14.8	8.78	0.73	0.463
Household Size	5	26	12.98	4.14	5	24	13.0	3.74	0.10	0.923
Available Labour Force	3	24	10.5	3.95	3	22	10.1	3.40	-0.46	0.649
Number of times received extension services	0	9	2.9	1.40	0	6	0.9	1.29	-12.20	0.000

Source: Author's Computation, Field Survey, 2017

4.3.2 Production Characteristics of Farmers

From Table 4.3, it is observed that outgrowers and non-outgrowers had different farm sizes. The average agricultural landholding for outgrowers was 4.9 hectares while that of the non-outgrowers were 6 hectares. Non-outgrowers tend to have more landholding than outgrowers. However, outgrowers had higher cultivated area (2.7 Ha) than non-outgrowers (2.4 Ha). Resource constraint limits the ability of the farmers to cultivate their total agricultural landholding. The outgrowers were able to cultivate slightly higher area partly due to the tractor services and input credit they obtained under the nucleus farmers for which non-outgrowers had

limited access. The total land area used for maize farming by outgrowers was also significantly higher (1.9 Ha) than non-outgrowers (1.6 Ha).

Table 4.3: Production Characteristics of Farmers

Variable	Outgrowers				Non-Outgrowers				t-stats	Sig.
	Min.	Max.	Mean	S.D	Min.	Max.	Mean	S.D		
Total land size (Ha)	1.6	7.2	4.9	2.93	1.6	8	6.0	3.77	2.82	0.005
Total Cultivated										
Land Size (Ha)	1.6	3.0	2.7	1.60	1.6	2.72	2.4	1.44	-1.88	0.048
Maize Farm Size										
(Ha)	0.4	2.1	1.9	0.82	0.4	1.9	1.6	0.79	-3.13	0.002
Output per Ha (kg)	750	2187.5	1549.1	332.7	500	2125	1107	403.3	-10.72	0.000
Seed used per Ha										
(kg)	9.4	31.3	16.6	3.46	9.4	31.3	19.4	4.8	5.93	0.000
Fertilizer used per										
Ha (kg)	0	437.5	224.2	94.34	0	500	116.9	119.5	-8.92	0.000
Agrochemical used										
per Ha (litters)	0	5	2.3	0.94	0	5	2.2	1.32	-0.94	0.350
Total Man-days	8	30	20.6	3.91	7	30	18.7	4.58	-3.86	0.000

Source: Author's Computation, Field Survey, 2017

It is again observed from Table 4.3 that most of the production characteristics of outgrowers such as output, seed use, fertilizer use, and labour use were significantly different from that of the non-outgrowers. Outgrowers had more output per hectare (1549.1kg/Ha) than non-outgrowers (1107kg/Ha). This may be attributed to the amount of inputs invested in the maize farm particularly fertilizer application and some agronomic practices. Whiles outgrowers used 16.6 kg of maize per hectare for sowing, non-outgrowers use higher seed per hectare (19.4 kg/Ha). Depending on the maize variety, the recommended quantity of seed planted per ha should not exceed 25kg (Adu *et al.*, 2014 and MOFA, 2010).

In the case of fertilizer use, outgrowers used more fertilizer than non-outgrowers. Whilst outgrowers used 224.2kg per hectare of NPK, non-outgrowers used 116.9 kg per hectare of NPK. The recommended fertilizer use for maize is 210 kg/ha made up of 90kg of N, 60 kg of P and 60 kg of K (Adu *et al.*, 2014 and MOFA, 2010). The higher usage of fertilizer among outgrowers may be due to the fact that some amount of fertilizer was provided to them by the nucleus farmers or outgrowers were able to purchase fertilizer from the savings made on land preparation which is often done by the nucleus farmers on credit. The non-outgrowers on the other hand do not have such input credit opportunity and will often spend the money which they would have used for fertilizer on cost of tractor services for land preparation. For labour usage, outgrowers used more labour per hectare (20.6 man days) than non-outgrowers (18.7 man days).

Agrochemical use was not significantly different between the two groups. Outgrowers used an average of 2.3 liters per hectare while non-outgrowers used 2.2 liters per hectare. For number of extension contact, it is observed that outgrowers had significantly higher number of extension contact than non-outgrowers. This may be due to the fact that nucleus farmers with support from NGOs and other development partners were able to provide extension services to outgrowers. Most NGOs such as ADVANCE, NRGP, GCAP, among others who work to support smallholder farmers usually partner of nucleus farmers to provide extension services and other input credit assistance to farmers.

4.4 Factors Influencing the Decision of Smallholder Farmers to Participate in a Nucleus Farmer-Outgrower Scheme

Objective one was set out to identify the factors influencing the decision of smallholder farmers to participate in a nucleus farmer-outgrower scheme. The binary logit regression model

was used to identify the factors that significantly influence the decision of smallholder farmers to participate in a nucleus farmer-outgrower scheme. Results from the binary logit regression model are presented in Table 4.4. The Pseudo R squared value of 0.6389 connotes that 63.9% of the variations in farmer's decision to participate in a nucleus farmer-outgrower scheme is accounted for by the regressors (explanatory variables).

It is observed from Table 4.4 that some of the socio-economic variables of farmers, such as gender, marital status, farm size, membership of an FBO and previous extension contact significantly influence the decision of a farmer to participate in a nucleus farmer outgrower scheme. The variables stated were significant at the 1% level except for marital status which was significant at the 5% level. This implies that the stakeholders involved in designing these schemes will have to take into consideration some socio-economic characteristics of farmers in order to enhance participation.

For gender, it is observed from Table 4.4 that female farmers were more likely to participate in the nucleus farmer-outgrower schemes. A female farmer is 35.5% more likely to be an outgrower than a male farmer. This may be due to the fact that female farmers do not have access to productive resources compared to their male counterparts and hence will take advantage of the nucleus farmer-outgrower scheme to enable them have access to them.

In the case of marital status, it had a negative influence on participation which implies that farmers who are not married are more likely to participate in the nucleus farmer outgrower schemes than those who are married. A marginal effect of -0.3808 implies that the probability of a married person participating in the outgrower schemes is decreased by 38.08%% and vice versa. It is assumed that married people have their wives and children supporting them in their

farming activities both labour wise and financial and hence may not need to participate in the outgrower schemes for any assistance.

Table 4.4: Binary Logit Regression Model Results for Factors Influencing the Decision of Smallholder Farmers to Participate in Nucleus Farmer-Outgrower Scheme

Variable	Coef.	Std. Err.	P>z	Marginal Effects
Gender	-1.4889***	0.4034	0.000	-0.3559
Age	-0.1085	0.0884	0.219	-0.0261
Age Squared	0.0010	0.0010	0.318	0.0002
District (Karaga)	-0.5109	0.3684	0.165	-0.1203
District (Gusheigu)	-0.2194	0.3414	0.521	-0.0524
Marital Status	-1.6589**	0.9050	0.067	-0.3808
Formal Education	0.4393	0.3831	0.251	0.1078
Farming Experience	0.0178	0.0618	0.773	0.0043
Farming Experience Squared	0.0004	0.0015	0.775	0.0001
Household Size	-0.0283	0.0360	0.431	-0.0068
Farm Size	0.3034***	0.1106	0.006	0.0731
Membership of an FBO	1.3528***	0.3367	0.000	0.3255
Extension Contact	2.5821***	0.3978	0.000	0.5059
_cons	1.8480	1.9344	0.339	
No. of obs =330; LR chi2=143.79; Prob>chi2=0.000; Pseudo R2=0.316				

** and *** denotes significant levels of 5% and 1% respectively

Source: Author's Computation, Field Survey, 2017

Farm size has a positive influence on participation in nucleus farmer-outgrower schemes. This implies that as farmers increase their cultivated land size, they are more likely to be influenced into participating in the nucleus farmer-outgrower scheme. If for instance farm size is increased by 1 hectare, the probability of a farmer participating in the nucleus farmer-outgrower

scheme will increase by 7.31% as captured by its marginal effect. This may be due to the fact that as the farm increases, farmers will need more resources in order to cover the resultant cost increment and hence would want to participate to benefit from the credit scheme given by the nucleus farmers.

Also, membership of an FBO and extension contact both has positive influences on participation in nucleus farmer-outgrower schemes. Farmers who belong to FBOs other than the nucleus farmer-outgrower scheme are more likely to be influenced into participating in the nucleus farmer-outgrower scheme than non-members. Again, farmers with previous extension contact are also more likely to participate in the nucleus farmer-outgrower scheme. This may be due to the fact that extension contact could be a motivation factor for farmers to participate in the nucleus farmer-outgrower scheme. The results from the logit regression model conform to some of the findings made by Sharma (2008), Sambuo, (2014) and Njiru *et al.* (2013) where they identified factors such as farm size, membership of an FBO, extension contact among others to be influencing participation in outgrower contract schemes.

4.5 Level of Access to Inputs and Mechanized Services

The second objective of the study was to compare the level of access to inputs and mechanized services between outgrowers and non-outgrowers. The results of the analysis are presented on Tables 4.5 and 4.6 and Figures 4.1 and 4.2.

Outgrowers have significantly more access to all the input and mechanized services variables than the non-outgrowers (Table 4.5). Access was measured by the availability of the input and the ability of the farmer to purchase it when required. For improved seed, 52% of the outgrowers had access to it whilst that of the non-outgrowers was 36.7%. Outgrowers had access to fertilizer

than non-outgrowers. About 79.3% of the outgrowers had access to fertilizer compared to 67% of non-outgrowers with access. This may be due to the fact that the nucleus farmers provide some fertilizer to their outgrowers or outgrowers were able to save the money they would have used to pay for tractor services (land preparation) which was often provided to them by their nucleus farmers to purchase fertilizer.

Again for agrochemicals, 98.7% of outgrowers had access while 95.6% of the non-outgrowers had access. Though the proportion of outgrowers who had access to agrochemicals was significantly higher than that of the non-outgrowers, majority of both groups had access to agrochemicals. This may be due to the fact that agrochemicals were not too expensive and hence, majority of both groups were able to afford. Also for tractor services for land preparation and shelling of maize, all outgrowers had access. For the non-outgrowers, 78.3% had access to tractor services for land preparation while 75% had access to tractor services for shelling of maize which are significantly lower compared to the outgrowers. Once a farmer participates in a nucleus farmer-outgrower scheme, that farmer is assured of tractor services for land preparation and shelling services for maize which may account for the 100% access by the outgrowers. Non-outgrowers access to them is backed by the availability of the service and the ability to pay for the service when needed.

The null hypothesis which states that “There is no significant difference between the proportions of outgrowers and non-outgrowers who have access to improved seed, fertilizer, agrochemicals and tractor services for land preparation and shelling” is rejected in favour of the alternate that there is significant difference between the proportions of outgrowers and non-outgrowers who had access to improved seed, fertilizer, agrochemical and tractor services for land preparation and shelling since the t-stats for those variables are significant.

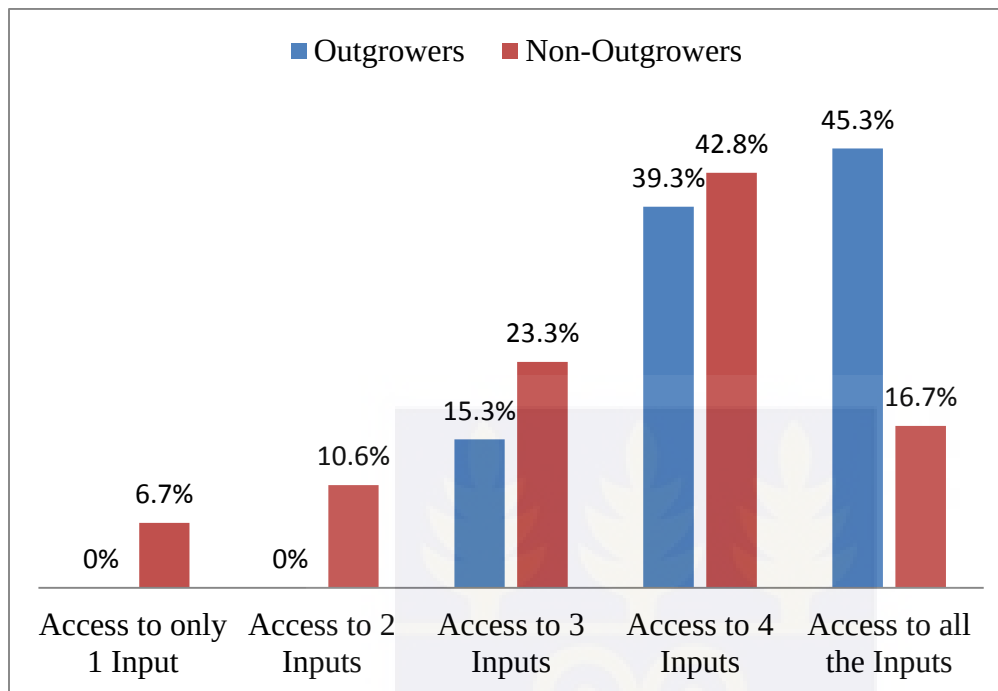
Table 4.5 Proportions (%) of Farmers who have Access to the Various Inputs and Mechanized Services

Variable	Non-			t-stats	Sig.
	Outgrowers n1=150	Outgrowers n2=180	Pooled N=330		
Improved Seeds	52	36.7	43.6	-2.812	0.005
Fertilizer	79.3	66.7	72.4	-2.617	0.009
Agrochemicals	98.7	95.6	97	-1.724	0.086
Tractor(Land preparation)	100	78.3	88.2	-7.036	0.000
Tractor (Shelling)	100	75	86.4	-7.724	0.000

Source: Author's Computation, Field Survey, 2017

The proportions of outgrowers and non-outgrowers regarding their levels of access to the inputs and mechanised services are presented on Figure 4.1. It was observed from Figure 4.1 that the proportions of outgrowers who had access to all the 5 inputs were higher than that of the non-outgrowers as shown on Figure 4.1. For the outgrowers, about 45.3% of them had access to all the 5 inputs, namely improved seed, fertilizer, agrochemicals, tractor services for land preparation and shelling. Only 16.7% of the non-outgrowers had access to all the 5 inputs. It was also observed that none of the outgrowers had access to less than 3 inputs whiles for the non-outgrowers, about 6.7% and 10.6% had access to only 1 and 2 inputs respectively. This implies that outgrowers had higher level of access to the inputs than non-outgrowers.

Figure 4.1: Levels of Access to Inputs and Mechanised Services by Outgrowers and Non-outgrowers



Source: Author's Computation, Field Survey, 2017

Table 4.6 presents the ratings of respondents with respect to their level of access to the input and mechanized services variables. The ratings was done using a five point Likert scale ranging from 1-5 where 1 implies bad and 5 implies very good. It is seen from Table 4.6 that outgrowers rated their level of access to all the input and mechanized services variables higher than the non-outgrowers. This is in line with the findings from Table 4.5 where the proportions of outgrowers who had access to the inputs and mechanized services variables were higher than the non-outgrowers. This implies that outgrowers were perceived to have more access to input and mechanized services than non-outgrowers which may be due to the fact that some of the input and mechanized services are provided to outgrowers by their nucleus farmers and therefore, making them more accessible to them.

Table 4.6 Ratings of Level of Access to Inputs and Mechanized Services

	Outgrowers N=150	Non-Outgrowers N=180	
Variable	Mean	Mean	t-stats
Tractor(Land preparation)	4.13	2.76	-4.13
Tractor(Shelling)	4.13	2.51	-4.87
Agrochemicals	3.91	3.45	-3.69
Fertilizer	3.45	2.67	-10.34
Improved Seeds	2.37	1.78	-12.7
Outgrowers: Kendall's W= 0.312			
Non-Outgrowers: Kendall's W= 0.273			

Source: Author's Computation, Field Survey, 2017

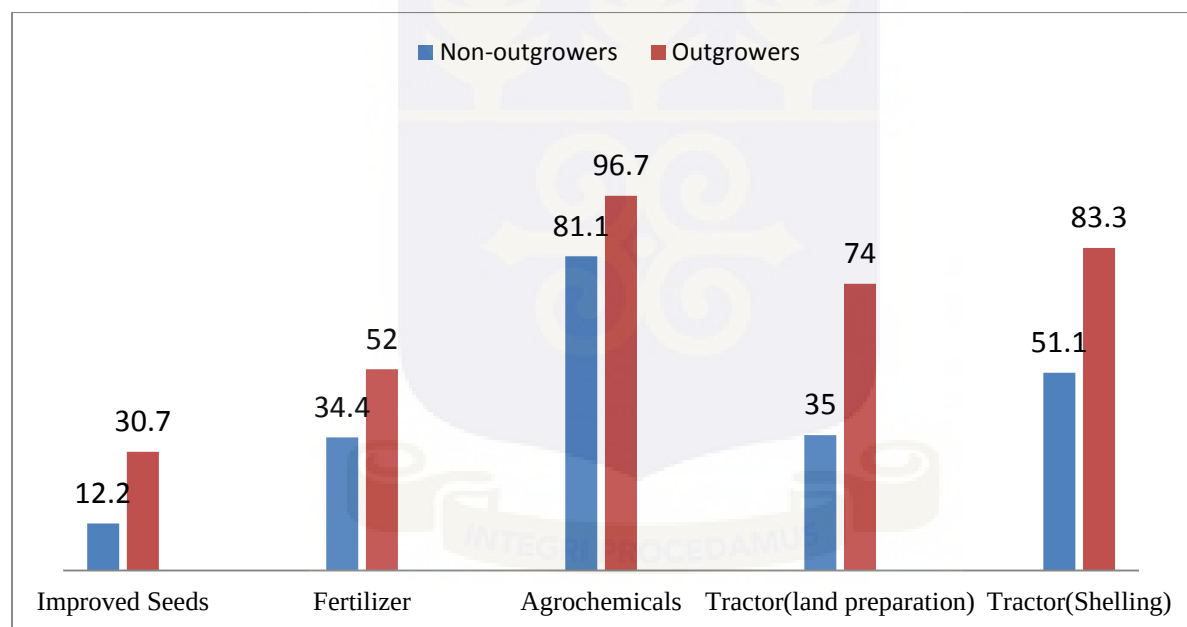
4.6 Timeliness of inputs Acquired for Production

Figure 4.2 presents the proportions of outgrowers and non-outgrowers who acquired the various inputs and mechanized services timely for production. It is observed that among all the input and mechanized services variables, the proportions of outgrowers who acquired them on time for production are higher than the proportions of non-outgrowers. This may be as a result of the fact that outgrowers had more access to them than the non-outgrowers.

In the case of tractor services for land preparation and for shelling of maize for instance, about 74% and 83.3% respectively of outgrowers received them timely while only 35% and 51.1% respectively of non-outgrowers received them timely. Tractor services was identified to be one of the motivation factors for which smallholder farmers were willing to be outgrowers mainly due to its scarcity since the smallholder farmers on their own cannot afford a tractor. Therefore, those who participate in the nucleus farmer-outgrower schemes (outgrowers) tend to receive tractor services timely from their nucleus farmers than the non-outgrowers. This is

because the tractors are limited in the area and hence, tractor owners (usually nucleus farmers) would usually serve their members first (outgrowers) before the other non-outgrowers except an outgrower is related a tractor owner or have enough resources to afford the service timely. Another reason why most non-outgrowers received improved seeds, fertilizer and tractor services for land preparation untimely may be as a result of not having enough funds to pay for them timely. For the outgrowers, most of these services such as the tractor services and fertilizer are provided to them on credit where payment is made later after harvest.

Figure 4.2: Timeliness of Input Acquired for Production (Percentage of Respondents Reporting Input Acquisition is Timely)



Source: Author's Computation, Field Survey, 2017

4.7 Input Use Efficiency among Smallholder Maize Farmers

The third objective of the study was to compare the input use efficiency between outgrowers and non-outgrowers. One other major component of the nucleus farmer-outgrower schemes is the provision of extension services to outgrowers on good agronomic practices to ensure that the

inputs provided under the schemes were used efficiently by farmers. Table 4.7 presents the results of the translog production function while Table 4.8 presents the marginal value product, marginal factor cost and efficiency ratios.

The translog production function was estimated for the analysis. The R squared values of 88.4% for outgrowers and 85.6% for non-outgrowers imply that about 88.4% and 85.6% of the variations in output was explained by the independent variables used in the model for outgrowers and non-outgrowers respectively. The overall fitness of the model which is explained by its F-stats was also very high for both groups and significant at 1% levels respectively.

The results from Table 4.7 revealed that only fertilizer had a significant positive effect on the yield of maize for both outgrowers and non-outgrowers. The rest of the inputs do not have significant effect on the yield of maize except labour for non-outgrowers which is significant at 5% level. The coefficients of all the input variables for outgrowers which could be interpreted as elasticities are positive while for non-outgrowers, all are positive except for seed which had a negative coefficient.

For the other socio-economic variables, farming experience and extension contact tend to have significant positive effect on maize output for both groups. Level of education tends to have a significant positive effect on maize output of outgrowers whereas age having a significant positive effect on maize output of non-outgrower. The elasticities for outgrowers with respect to seed, fertilizer, agrochemical and labour are 0.127, 0.301, 0.036 and 0.029 respectively while those of the non-outgrowers are 0.079, 0.322, 0.042 and 0.448 respectively for seed, fertilizer, agrochemicals and labour.

Table 4.7: Results from the Translog Production Function

Variable	Outgrowers		Non-Outgrowers		Pooled	
	coefficient	Sig.	coefficient	Sig.	coefficient	Sig.
LnSeed	0.127	0.524	-0.079	0.478	-0.095	0.215
LnFertilizer	0.301	0.000	0.322	0.000	0.362	0.000
LnAgrochemicals	0.036	0.361	0.042	0.307	0.046	0.117
LnLabour	0.079	0.597	0.448	0.067	0.183	0.108
LnSeed ²	-0.066	0.921	0.036	0.934	-0.200	0.472
LnFertilizer ²	0.081	0.000	0.079	0.000	0.089	0.000
LnAgrochem ²	0.009	0.527	0.007	0.643	0.009	0.419
LnLabour ²	1.338	0.006	-0.266	0.748	0.754	0.093
LnSeed*LnFertilizer	-0.066	0.497	-0.024	0.346	0.000	0.993
LnSeed*LnAgrochem	0.020	0.686	0.034	0.184	0.039	0.022
LnSeed*LnLabour	0.122	0.823	0.217	0.565	0.390	0.137
LnFertilizer*LnAgrochem	-0.006	0.100	0.002	0.529	0.000	0.796
LnFertilizer*LnLabour	0.061	0.209	0.100	0.034	0.056	0.034
LnAgrochem*LnLabour	0.016	0.696	-0.080	0.017	-0.064	0.009
Gender	-0.013	0.549	-0.008	0.839	-0.032	0.138
Age	0.000	0.866	-0.003	0.042	-0.002	0.070
Marital Status	-0.048	0.282	-0.158	0.071	-0.111	0.015
Level of education	0.041	0.084	-0.027	0.504	0.011	0.639
Farming experience	0.000	0.713	0.010	0.000	0.005	0.000
Extension contact	0.001	0.901	0.009	0.352	0.016	0.002
_con	0.076	0.174	0.008	0.939	0.051	0.372
R Squared=0.884		R Squared=0.856		R Squared=0.876		
Fcal=48.97		Fcal=47.45		Fcal=108.67		
Sig. 0.000		Sig. 0.000		Sig. 0.000		

Source: Author's Computation, Field Survey, 2017

4.8 Marginal Value Product (MVP), Marginal Factor Cost (MFC) and Efficiency Ratios (r)

Table 4.8 presents the ratios of the MVP to MFC for outgrowers and non-outgrowers. The t-statistics are comparing the significant difference between the efficiency ratios and 1. This is to determine which inputs are utilized efficiently since an input is utilized efficiently only when its efficiency ratio is equal to one or not statistically different from unitary (1).

For seed, the results from Table 4.8 revealed that both outgrowers and non-outgrowers were inefficient in utilizing it. The MPV (14.94) of seed for the outgrowers for instance was significantly higher than its MFC (2.90) leading to an efficiency ratio 5.15 which is significantly different from 1 implying that seed was underutilized by outgrowers. For the non-outgrowers as well, seed was underutilized since its MVP (5.152) was greater than the MFC (2.50) leading to an efficiency ratio of 2.43 which is significantly greater than 1. The underutilization of seed by both groups may be attributed to inadequate extension training on specifically the use of seed for sowing.

In the case of fertilizer, it is seen from Table 4.8 that outgrowers were efficient in its utilization while non-outgrowers were not. The MVP (1.764) of fertilizer for outgrowers was almost equal to its MFC (1.80) since the t-test for fertilizer shows that the efficiency ratio for fertilizer is not significantly different from 1. The MVP (2.133) of fertilizer for non-outgrowers was significantly higher than its MFC (1.80) implying that fertilizer was underutilized and that the efficiency ratio of 1.19 was significantly different from 1. The efficient use of fertilizer by outgrowers may be attributed to the extension services received by outgrowers for which non-outgrowers do not have equal access to. Also, the non-outgrowers might be underutilizing fertilizer because of inadequate access to fertilizer.

Table 4.8: Results for the Marginal Value Cost (MVP), Marginal Factor Cost (MFC) and Efficiency Ratios (r) of Outgrowers and Non-Outgrowers

Input	Outgrowers					Non-Outgrowers				
	MPP	MVP	MFC	r	t-stat	MPP	MVP	MFC	r	t-stat
Seed	16.6	14.94	2.9	5.15	32.95	6.75	6.075	2.5	2.43	15.67
Fertilizer	1.96	1.764	1.8	0.98	-1.61	2.37	2.133	1.8	1.19	3.92
Agrochemicals	23.13	20.817	19	1.10	4.36	12.68	11.412	19	0.60	-15.25
Labour	2.11	1.899	13	0.15	-218.72	29.7	26.73	13	2.06	17.89

Source: Author's Computation, Field Survey, 2017

Again from Table 4.8, it can be observed that agrochemical was underutilized by outgrowers with an efficiency ratio of 1.10 which is significantly greater than 1. The non-outgrowers had an efficiency ratio for agrochemical to be 0.59 which is significantly less than 1 implying that they were over utilizing it. This finding may also be attributed to the variation in extension contact between outgrowers and non-outgrowers.

Finally on labour, both groups were not efficient in utilizing labour. Outgrowers were over utilizing labour since the efficiency ratio was significantly less than unitary (0.15) while non-outgrowers were underutilizing labour since its efficiency ratio was significantly greater than unitary (2.06). Smallholder farmers in the study area mostly rely on their family labour for their farm activities and hence, the variation in the efficient utilization of labour between the groups may be attributed to the size of their labour force. Families with higher number of labour force will tend to use more labour on the field for various farm activities.

All the findings of the study on the input use efficiency corroborate those of Awunyo-Vitor *et al.*, (2016) and Amankwah (1996) which suggest that farmers are inefficient in the use of input

resources except for fertilizer which was utilized efficiently by outgrowers. The non-outgrowers as shown on table 4.8 were not efficient in utilizing any of the input resources available to them.

4.9 Effect of Nucleus Farmer-Outgrower Schemes on Profitability

The fourth objective of the study was to estimate the effect of the nucleus farmer-outgrower schemes on profitability of smallholder farmers. In estimating the effect, the propensity score matching technique was used which involved the use of logistic regression model to identify the propensity scores, after which matching analysis was done using the propensity scores followed by identifying the treatment effect on the outcome variables being gross margin, net margin and return on investment. The profitability indicators being gross margin, net margin and return on investment were estimated on per hectare of maize crop.

Table 4.9 shows a summary of the cost and returns used in the PSM estimation for gross margin, net margin and return on investment. It is clear from Table 4.9 that outgrowers incurred more cost in the production of maize than non-outgrowers. Outgrowers also make more returns on their cost than non-outgrowers.

Table 4.9 Summary of Cost and Returns used in the PSM Estimation (GHC)

Variable	Outgrowers	Non-Outgrowers
Total Revenue	1238.486	872.6766
Total cost of production	1028.547	750.5422
Gross margin	209.9389	122.1344
Depreciation	11.713	11.118
Net margin	198.2259	111.0164
Return on investment	0.192724	0.147915

Source: Author's Computation, Field Survey, 2017

The results of the binary logit regression model presented earlier on Table 4.4 show that most of the variables used for the estimation were significant factors in explaining farmers' participation in the nucleus farmer-outgrower schemes. This implies that outgrowers vary significantly from the non-outgrowers with respect to observable characteristics suggesting that there is self-selection.

The distribution of propensity scores before and after matching are shown in Appendix V for the gross margin, net margin and return on investment which indicate that estimating the p-score balances the treated and controlled groups.

A summary of the matching algorithm is presented on Table 4.10. The matching algorithms for all the profitability indicators are the same. It is observed that Pseudo R Squared after matching from Table 4.10 is lower than before matching and is not significant which implies that both groups have the same distribution in covariates after matching as stated in the study by Wainaina *et al.* (2012). The Chi Squared before matching (0.004) is significant implying that there was significant difference in the observable characteristics before matching whereas after matching (0.53) implies there are no longer statistically significant. From Table 4.10, the mean biases have also reduced (from 15.8 to 8.3) after matching.

Table 4.10: Covariates Balance Indicators before and after Matching on Profitability

Profitability Measure	Sample	Pseudo R ²	LRchi ²	P>chi ²	Mean Bias
Gross margin, net margin and return on investment	Unmatched	0.053	24.21	0.004	15.8
	Matched	0.02	8.04	0.53	8.3

Source: Author's Computation, Field Survey, 2017

The effect of nucleus farmer-outgrower schemes on gross margin, net margin and return on investment were estimated using the near neighbor matching method and results presented in Table 4.11. ATT of GHC 90.98 represents the effect of the participation in the nucleus farmer-outgrower schemes on gross margin. Therefore, the gross margin per hectare outgrowers make as a result of participation in the scheme is GHC 90.98. Non-outgrowers on the other hand would have made an extra of GHC 81.11 if they had participated. This represents the opportunity cost of non-participation to the non-outgrowers. ATE of GHC 85.56 represents the overall average treatment effect which implies that the general effect of an individual participating in the scheme will be GHC 85.45 in terms of increment in the gross margin. All the estimates are significant.

For the effect on net margin, an ATT of GHC 89.50 represents the gain outgrowers' make as a result of participating in the scheme whereas an ATU of GHC 79.37 represents the amount of net margin forgone by non-outgrowers for non-participation in the scheme. The overall average treatment effect is GHC 83.94 implying that the effect of participating in the nucleus farmer-outgrower scheme on net margin is positive and significant.

Also with respect to the effect of the scheme on return on investment, an ATE of 0.040 which is significant suggests a positive effect on return on investment for farmers who participate in the outgrower schemes. This implies that a smallholder farmer who participates in the nucleus farmer-outgrower scheme is likely to increase his return on investment by 0.04. The ATT is also positive and significant whilst the ATU is positive but not significant. This implies that the opportunity cost for non-participation is not significant.

The results of the effect of the schemes on profitability (gross margin, net margin and return on investment) are positive and statistically significant except for the ATU of the return on

investment which is not significant. This suggests that smallholder farmer' participation in nucleus farmer-outgrower scheme can lead to an improvement in the profitability of farmers such as an increment in their gross margin, net margin and return on investment. These results corroborate the findings of Schuphach (2014), Wainaina *et al.* (2012), Lapar *et al.* (2011) and Bolwig, *et al.* (2009), which indicated that outgrower schemes lead to increase in gross and margins of smallholder farmers.

This positive effect nucleus farmer-outgrower scheme had on smallholder maize farmers may be attributed to the fact that those who participated had more access to inputs, received inputs timely and as well used inputs more efficiently as found earlier in the other objectives of the study.

Table 4.12: PSM Results for the Effect of Nucleus Farmer-Outgrower Schemes on Profitability

Profitability Measure	Sample	Treated	Control	Difference	T-stat
Gross Margin per Ha (GHC)	ATT	212.24	121.26	90.98***	6.64
	ATU	122.07	203.18	81.11***	4.49
	ATE			85.56***	5.99
Net Margin per Ha (GHC)	ATT	200.42	110.93	89.50***	6.48
	ATU	111.06	190.43	79.37***	4.35
	ATE			83.934***	5.82
Return on Investment	ATT	0.214	0.163	0.051***	2.74
	ATU	0.151	0.182	0.0310	1.55
	ATE			0.040**	2.38

Source: Author's Computation, Field Survey, 2017 ** and *** denotes 5% and 1% significant levels respectively.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter is the final chapter of the study. It presents a summary of the findings discussed in chapter four, conclusion and policy recommendations.

5.2 Summary of Findings

The study was set out to assess the effect of nucleus farmer-outgrower schemes on input use efficiency and profitability among smallholder farmers in the Northern of Region. The logit regression model, the translog production function and the propensity score matching technique were used to analyse the key objectives of the study.

The study found that majority of both outgrowers and non-outgrowers were males, Muslims, married, had no formal education and do not belong to any FBO. Their major occupation was farming. More outgrowers had extension contact than non-outgrowers. The average ages of farmers were 40.1 years for outgrowers and 39.7 years for non-outgrowers whiles the average maize farming experience and household size for both groups were 14 years and 13 people respectively.

It was observed that gender, marital status, farm size, membership of an FBO and extension contact were the significant factors influencing smallholder farmers' participation in nucleus farmer-outgrower schemes. All the significant factors had positive influence on participation except for gender which had negative influence on participation.

The proportions of outgrowers who had access to improved seeds, fertilizer, agrochemicals and tractor services for land preparation and for shelling of maize were significantly higher than that of the non-outgrowers. The proportions of outgrowers who had access to all the input variables were higher than that of the non-outgrowers. Outgrowers also rated their level of access to the various inputs and mechanized services higher than the non-outgrowers. It was also observed that more outgrowers acquired the inputs they used for production timely than the non-outgrowers

The study found that, fertilizer was the only input variable that significantly contributes to output for both outgrowers and non-outgrowers. For the efficient utilization of the various input variables by outgrowers and non-outgrowers, it was observed that the efficiency ratio of seed for outgrowers was 5.15 whilst that of the non-outgrowers was 2.43. The efficiency ratios of fertilizer for outgrowers and non-outgrowers were 0.98 and 1.19 respectively. For agrochemicals, the efficiency ratios were 1.10 and 0.60 respectively for outgrowers and non-outgrowers whilst for that of labour, 0.15 and 1.2.06 respectively for outgrowers and non-outgrowers.

For the impact of the nucleus farmer-outgrower schemes on profitability (gross margin, net margin and return on investment), the study found that the overall average treatment effect (ATE) of the scheme on participation were GHC 85.56, GHC 83.93 and 0.040 respectively for gross margin, net margin and return on investment which were significant at 1% for gross margin and net margin and 5% for return on investment.

5.3 Conclusion

The following conclusions are drawn from the findings of the study.

On the issue of factors that influence participation in nucleus farmer-outgrower schemes, gender, marital status, farm size, membership of an FBO and extension contact were the significant factors. Females, farmers with larger farm size, farmers who belong to FBOs and farmers who had extension contact were more likely to be influenced into participating in nucleus farmer-outgrower schemes.

With respect to smallholder farmers' access to inputs and mechanized services, it can be concluded that outgrowers are better off in accessing inputs and mechanized services than non-outgrowers. Outgrowers had significantly higher level of access to inputs and mechanized services than non-outgrowers mainly due to the fact that some inputs and mechanized services are provided to outgrowers by nucleus farmers as part of the contract terms.

On the issue of input use efficiency, it can be concluded that both outgrowers and non-outgrowers are not efficient in utilizing the inputs resources available to them except for fertilizer where outgrowers are efficient in its utilization. It is therefore concluded that except for fertilizer, outgrowers and non-outgrowers are the same in terms of their input use efficiencies.

Finally on the effect of nucleus farmer-outgrower schemes on profitability, it can be concluded that the positive difference in gross margin, net margin and return on investment between outgrowers and non-outgrowers is as a result of participation in the nucleus farmer-outgrower schemes. The nucleus farmer-outgrower schemes have significant positive effect on smallholder farmer's gross margins, net margins and returns on investment.

5.4 Policy Recommendations

Nucleus farmers and other stakeholders involved in developing outgrower schemes or similar initiatives should take into consideration the social and demographic characteristics of the target farmers such as gender, marital status, farm size, membership of an FBO and extension contact so as to enhance participation. Nucleus farmers for example should target more female farmers, farmers with relatively larger farm sizes and farmers who belong to FBOs since they are more likely to participate in the schemes.

Production characteristics such as access to mechanized services and inputs and extension services are important factors that differentiate the outgrowers from the non-outgrowers and hence, nucleus farmers should focus on providing those services more efficiently and effectively.

Nucleus farmer-outgrower schemes are recommended for vulnerable smallholder farmers to participate in order to benefit from the input credit scheme so as to enhance their level of access to inputs and mechanized services. Participating in the nucleus farmer-outgrower schemes will enhance the timeliness of inputs acquired for production which has effect on productivity and efficiency.

Nucleus farmers and other stakeholders in the agricultural sector such as MOFA and NGOs should focus on providing more extension services to smallholder farmers on the efficient utilization of input resources. Outgrowers are recommended to increase their seed and agrochemical use and reduce labour whilst maintaining their fertilizer use. Non-outgrowers are recommended to increase fertilizer and labour use and reduce seed and agrochemical use so as to increase their output and profitability. Policies by government to support smallholder farmers with fertilizer to increase fertilizer use is recommended since fertilizer significantly influence

yield. This will be particularly beneficial for the non-outgrowers since they currently underutilize fertilizer probably due to inadequate access.

Government, NGOs and other private individuals and organizations who work to support farmers are recommended to emulate the nucleus farmer-outgrower arrangement. They are also encouraged to support and empower more nucleus farmers to be able to provide the services they give to smallholder farmers.



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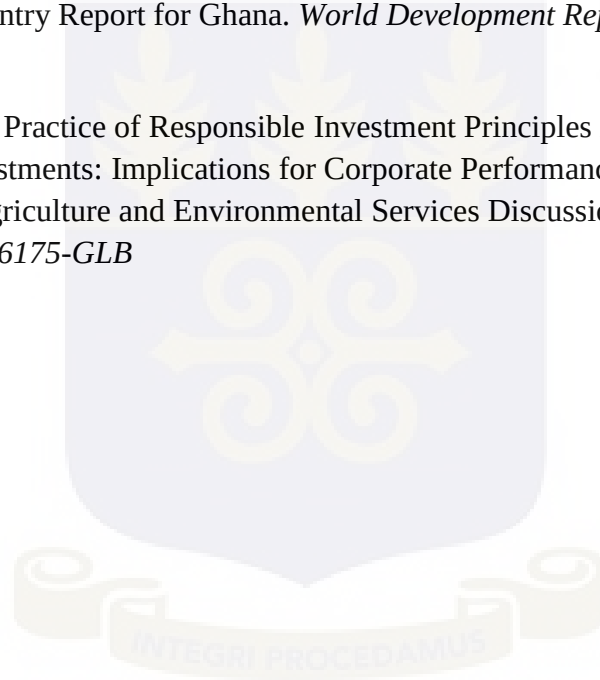
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APPENDIX

Appendix I: Sample Size Determination

$$N = t^2 * (p) (q) / d^2$$

Where; N = sample size, t= number of standard deviations for a chosen confidence level, p and q = proportion of the population of smallholder outgrowers and non-outgrowers respectively, d=allowable margin of error

The proportion of outgrowers and non-outgrowers based on a preliminary survey suggest 45: 55 respectively. The study accepts a 5.4 percent margin of error. Assigning a 95 percent confidence, the sample is determined as follows;

$$N = (1.96)^2 * (0.45) (0.55) / (0.054)^2$$

$$= 3.8416 (0.2475/0.002916)$$

$$= 326.06 \cong 330$$

$$\text{Therefore; outgrowers} = 0.45 * 330 = 148.5 \cong 150$$

$$\text{Non-outgrowers} = 0.55 * 330 = 181.5 \cong 180$$

Appendix II: Binary Logit Regression Results in Detailed

Variable	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Gender	-1.4889	0.4034	-3.690	0.000	-2.2794	-0.6983
Age	-0.1085	0.0884	-1.230	0.219	-0.2817	0.0647
Age2	0.0010	0.0010	1.000	0.318	-0.0010	0.0030
District (Karaga)	-0.5109	0.3684	-1.390	0.165	-1.2328	0.2111
District (Gusheigu)	-0.2194	0.3414	-0.640	0.521	-0.8886	0.4498
Marital Status	-1.6589	0.9050	-1.830	0.067	-3.4326	0.1148
Formal Education	0.4393	0.3831	1.150	0.251	-0.3116	1.1902
Farming Experience	0.0178	0.0618	0.290	0.773	-0.1033	0.1390
Farming Experience Squared	0.0004	0.0015	0.290	0.775	-0.0025	0.0034
Household Size	-0.0283	0.0360	-0.790	0.431	-0.0989	0.0422
Land Size	0.3034	0.1106	2.740	0.006	0.0866	0.5202
Membership of an FBO	1.3528	0.3367	4.020	0.000	0.6928	2.0128
Extension Contact	2.5821	0.3978	6.490	0.000	1.8024	3.3619
_cons	1.8480	1.9344	0.960	0.339	-1.9434	5.6394

Source: Author's Computation, Field Survey, 2017

Appendix III: Marginal Effects for the Logit Model

variable	dy/dx	Std. Err.	z	P>z	[95% C.I.]	X
Gender	-0.3559	0.0878	-4.060	0.000	-0.5279 -0.1839	0.7727
Age	-0.0261	0.0214	-1.220	0.221	-0.0680 0.0157	38.4879
Age2	0.0002	0.0003	1.000	0.319	-0.0002 0.0007	1610.390
District (Karaga)	-0.1203	0.0842	-1.430	0.153	-0.2853 0.0446	0.3333
District (Gusheigu)	-0.0524	0.0809	-0.650	0.517	-0.2110 0.1061	0.3333
Marital Status	-0.3808	0.1632	-2.330	0.020	-0.7006 -0.0611	0.9606
Formal Education	0.1078	0.0948	1.140	0.256	-0.0780 0.2936	0.1758
Farming Experience	0.0043	0.0149	0.290	0.773	-0.0249 0.0335	15.0091
Farming Experience Squared	0.0001	0.0004	0.290	0.775	-0.0006 0.0008	305.9120
Household Size	-0.0068	0.0086	-0.790	0.429	-0.0238 0.0101	13.3879
Land Size	0.0731	0.0267	2.740	0.006	0.0208 0.1253	3.5903
Membership of an FBO	0.3255	0.0761	4.280	0.000	0.1765 0.4746	0.2636
Extension Contact	0.5059	0.0514	9.850	0.000	0.4052 0.6066	0.6727

Source: Author's Computation, Field Survey, 2017

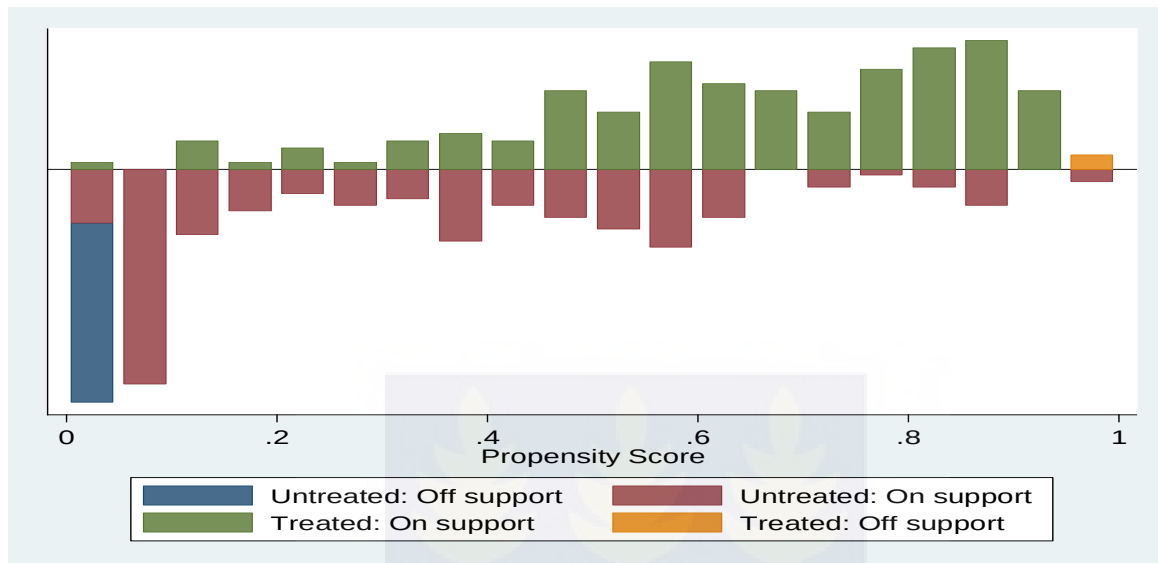
Appendix IV: Production Cost per Hectare of Maize Farm (GHC)

Cost item	Outgrowers	Non-outgrowers
Material cost:		
Seed	27.56	28.57
Fertilizer	408.85	170.65
Agrochemical	69.76	62.87
Total material cost	506.17	262.09
Labour cost:		
Sowing	91.92	99.77
Fertilizer Application	44.88	46.56
Agrochemical Application	13.90	13.45
Weeding	87.07	88.59
Harvesting	60.53	54.88
Total labour cost	298.30	303.25
Mechanized services cost:		
Land Preparation	131.18	124.92
Shelling Cost	92.90	60.29
Total mechanized services cost	224.08	185.21
Total Cost of Production	1028.55	750.54

Source: Author's Computation, Field Survey, 2017

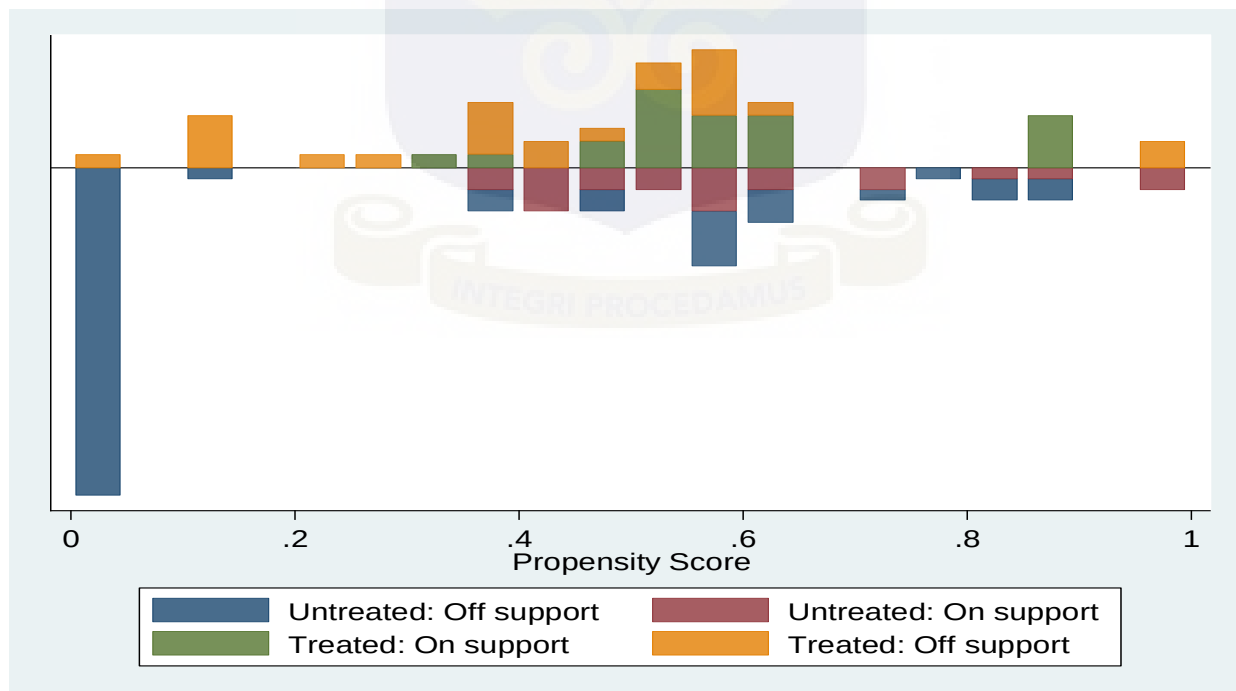
Appendix V: Before and After Matching Qualities for Gross Margin, Net Margin and Return on Investment

Before Matching for Gross Margin



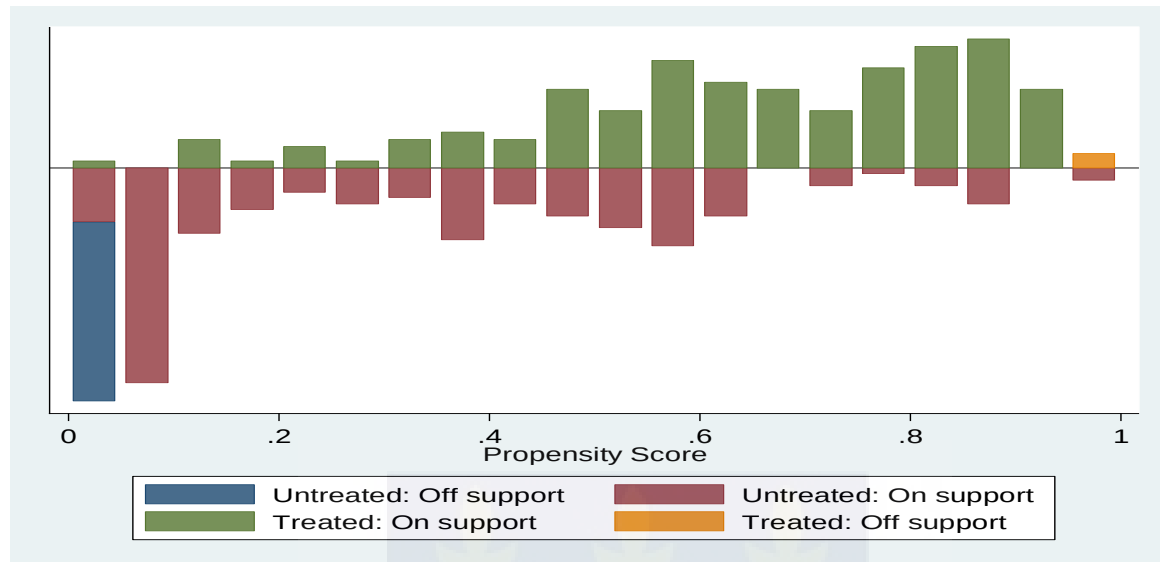
Source: Author's Computation, Field Survey, 2017

After Matching for Gross Margin



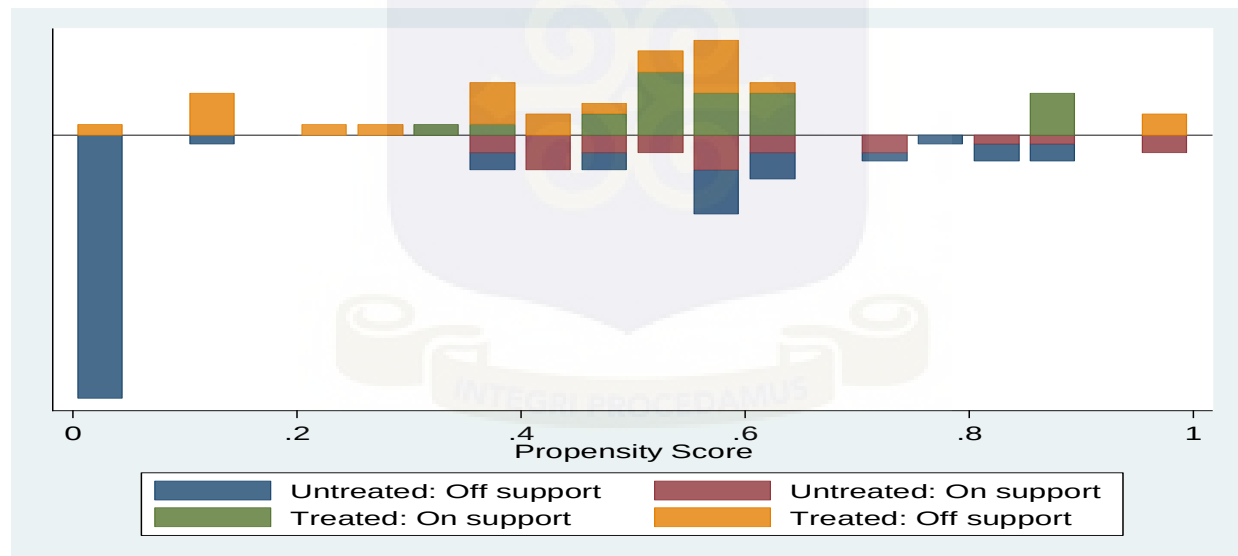
Source: Author's Computation, Field Survey, 2017

Before Matching for Net Margin



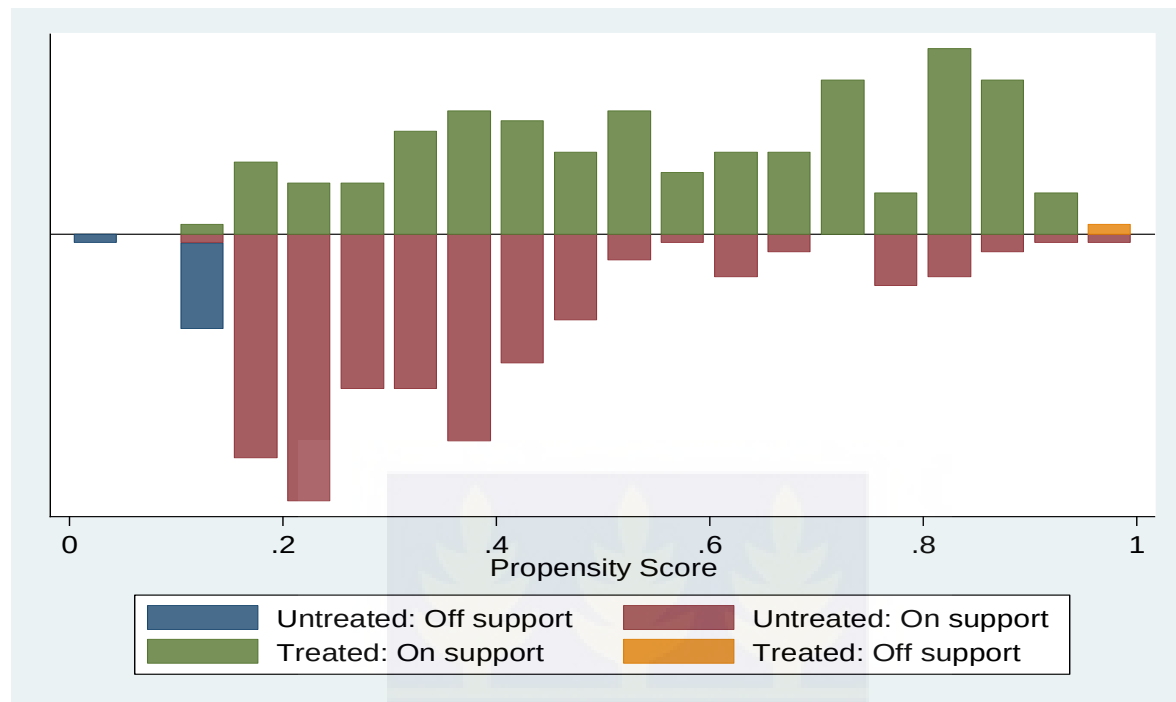
Source: Author's Computation, Field Survey, 2017

After Matching for Gross and Net Margins



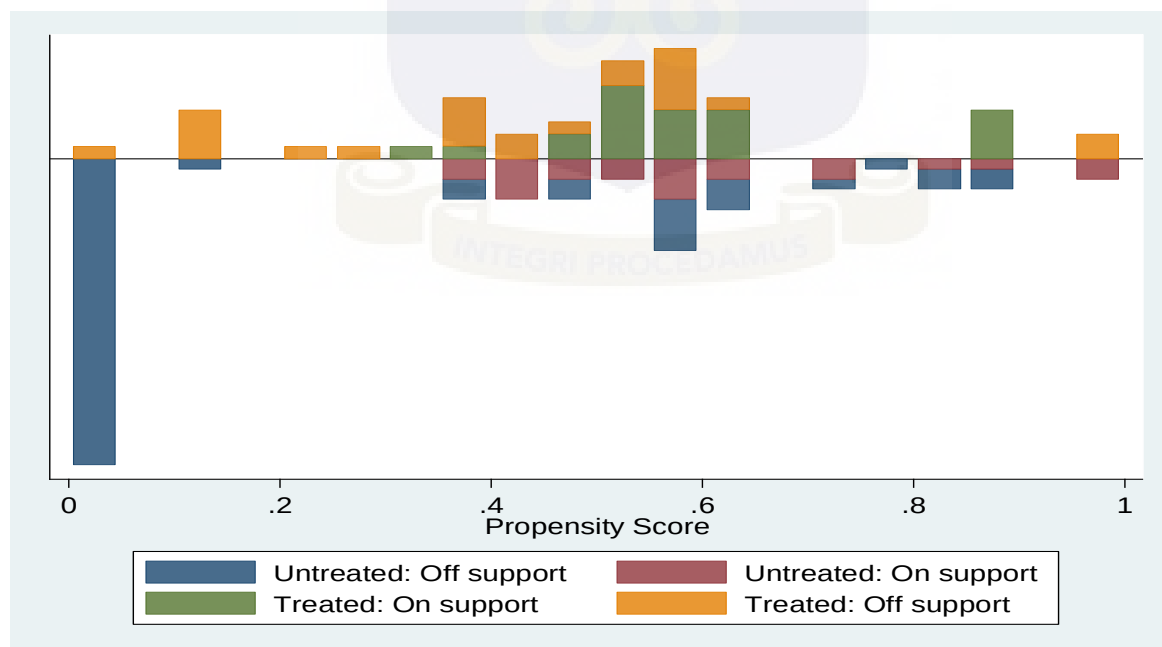
Source: Author's Computation, Field Survey, 2017

Before Matching for Return on Investment



Source: Author's Computation, Field Survey, 2017

After Matching for Return on Investment



Source: Author's Computation, Field Survey, 2017

Appendix VI: Questionnaires Administered

MPHIL-RESEARCH PROJECT

**IMPACT OF NUCLEUS FARMER-OUTGROWER SCHEMES ON INPUT USE AND
PROFITABILITY AMONG SMALLHOLDER FARMERS IN NORTHERN REGION**

QUESTIONNAIRE FOR SMALLHOLDER FARMERS

Administrative District.....

Name of Community.....

Questionnaire Number []

Name of Interviewer:

Date of Interview/...../...../...../

Certified by..... (sign only after questionnaire is complete)

George A. Akuriba
University of Ghana, Legon
MPhil Agribusiness
January, 2017

A. DEMOGRAPHIC AND SOCIOECONOMIC CHARACTERISTICS OF FARMERS

A1. Name of farmer.....

A2. Gender 1=Male 2=Female

A3. What is your age (in years)?

A4. What is your religion? 1= Christian 2=Muslim 3= Traditionalist 4= Other
(specify).....

A5. What is your marital status? 1= Married 2= Single 3=Divorced

A6. What is your highest level of education attained? 1= Primary 2 = JHS
3=SHS/Technical 4=Tertiary 5=NoneA7. What is your major occupation? 1= Farming 2=Trading 3=Salary worker 4=Tradesman
5=Artisan 6=Other (specify).....A8. What is your minor occupation? 1= Farming 2=Trading 3=Salary worker 4=Tradesman
5=Artisan 6=Other (specify).....

A9. How many years have you been involved in maize farming.....

A10. What is the size of your household and how many are available for farm work regularly?

No	Category of Household Members	Number of People	Number available for farm work	
			< 2days/ week	>2days/ week
A10a	Male adults (eighteen years and above)			
A10b	Female adults (eighteen years and above)			
A10c	Children between 6 years and above			
A10d	Children under 6 years			
A10e	Total number of people			

A11. Number of dependents.....

A12. What is your total agricultural landholding for 2016?

Details of Respondent's landholding in 2016 (Last one year)

No	Land type and rental rates	Land size (Ha)
A12a	Total land size owned for agricultural purposes	
A12b	Total land size inherited from family	
A12c	Total land size obtained from friends	
A12d	Total land size rented from others	
A12e	Total cultivated land size	

A13. Do you save toward your farm investment for the next cropping year? 0=No, 1=Yes

A14. Do you have insurance to protect your farm investment? 0=No, 1=Yes

A15. Are you a member of a Farmer Based Organization (FBO)? 0=No, 1=Yes

A16. If No, why? **(Multiple responses allowed)** 1= Not interested, 2= No available FBO to join, 3= Strict requirement by FBOs, 4= Other (Specify).....

A17. If Yes, name of the FBO.....

A18. How long have you been with the FBO (years)?

A19. What does the FBO do? **(Multiple responses allowed)** 1=Provision of farm inputs to members 2=Provision of extension services to members 3=Marketing of members' produce 4=Provision of credit facility to members 5= Provision of credit linkages to members 6=Enhancing members welfare 7=Other (Specify).....

Extension contact:

Have you received extension services in the past 2 years? 0=No, 1=Yes	If No, why? 1= No need 2= Extension services not available 3= Extension services not affordable 4= Other (Specify)	If Yes, from which institution/scheme? 1= Government 2= NGO 3=FBO 4=Outgrower scheme 5= Other (Specify)	When was the last time you received the service (year)	How many times did they visit you last year (2016)	How will you appreciate the efficacy of their services? 1=Very effective 2=Effective 3=Not very effective 4=Not effective
A20	A21	A22	A23	A24	A25

(NB: Multiple responses allowed for A22 and most important reason for A21)

Access and use of external credit

Have you applied for loan or borrow money from family and friends in the past 2 years? 0=No 1=Yes	If No, why? 1= No need for credit 2= Loan facility not available 3= Lack of collateral 4= Long bureaucratic processes involved 5= High interest charges on credit 6=No one to assist me to apply for the loan 7= Other (Specify)	If Yes, where did you apply/borrowed from? 1= Formal finance institution 2= Informal finance institution 3=Micro finance institution 4=NGO, 5=FBO 6=Outgrower scheme 7=family and friends 8= Other (Specify)	When did you apply? (year)	Did you use the money for farming? 0=No 1=Yes	How much did you receive?	Did you receive the money on time? 0=No 1=Yes
A26	A27	A28	A29	A30	A31	A32

(NB: Multiple responses allowed for A28 and most important reason for A27)

A33. What did you use the money for? **(Multiple response allowed)** 1=purchase inputs 2=pay for mechanized services 3= pay for labour 4=pay for land, 5= Other (specify).....

B. TERMS OF ENGAGEMENT WITH NUCLEUS FARMERS**I. General information on outgrower schemes**

B1. Are you a member of a nucleus farmer-outgrower scheme? 0=No, 1=Yes

If no skip to section C

B2. If Yes, who is your nucleus farmer?

B3. How many years have you been on the scheme?

B4. What is the nature of the contract scheme? 1= Resource providing contract, 2=Production management contract, 3= market specification contract

B5. Is the contract formal or informal? 1=Formal, 2=Informal

II. Elements (terms) in the contract scheme in which you engaged

What are the elements of the contract terms? Circle as many as applied in cases where responses are not mutually exclusive

B6. Which inputs are supplied under the contract? **(Multiple responses allowed).** 0=None, 1=Seed, 2= Fertilizer, 3= Agrochemicals, 4= Other (specify).....

B7. Which mechanized services are supplied under the contract? **(Multiple responses allowed)**.
0=None, 1= Land preparation, 2= Sowing, 3=Agrochemical application, 4=Shelling,
5=Threshing, 6=Harvesting, 7= Other (specify)

B8. At what point do you determine the prices of inputs given under the contract? 1= Prefixed in contract 2=Negotiated at time of sales 3= Other (specify).....

B9. At what time do you pay for the inputs given under the contract? 1= Cash and carry, 2= Immediately after harvest, 3= Later after harvest (> 3 months)

B10. What is the mode of payment for inputs? **(Multiple responses allowed)**. 1=Cash, 2= Kind (Produce), 3= Other (specify).....

B11. Does the contract provide other cash credit facilities to farmers? 1= 0=No, 1=Yes

B12. Does the contract provide technical assistance (advice and training on maize production) to outgrowers? 0=No, 1=Yes

B13. If yes, how often do you receive the assistance in a year? 1= Very often 2=Often 3=Not very often, 4= not often

B14. What is the amount of produce sold under the contract? 1= No specified amount 2= All produce 3= Any amount to cover credit, 4= Other (specify)

B15. Are there quality standards requirements stated in the contract? 0=No, 1=Yes

B16. Does the contract provide insurance cover to outgrowers against their farm investment? 0=No, 1=Yes

B17. Does the contract provide warehouse services to outgrowers? 0=No, 1=Yes

B18. What are the specific roles performed by outgrowers under the contract? **(Multiple responses allowed)**. 1= Provision of land, 2= provision of labour for sowing, weed control, harvesting, etc, 3= Monitoring including pest and disease control, 4= Storage of produce, 5=Other1 (specify) 6=Other2 (specify)

III. Conflict between Parties

What are the nature of conflict, frequency of their occurrences and methods of resolution of conflicts between outgrowers and nucleus farmers?

No	Nature of Conflict	How often does it occur?	Conflict resolution method
B19	Dispute over untimely delivery of inputs		
B20	Dispute over non-delivery of inputs and other services specified in contract		
B21	Dispute over late payment of produce sold under contract		
B22	Dispute over interference in outgrowers' farming activities		
B23	Other1 (specify)		
B24	Other2 (specify)		

Codes for frequency of conflict occurrence:

1= Very often, 2=Often, 3=Not very often, 4= not often

Codes for Conflict resolution methods (Multiple responses allowed).

1=Legal actions 2=Internal resolution by parties themselves 3=External interventions by scheme facilitators 4= Unresolved

C. ACCESS TO INPUTS (AVAILABILITY AND ABILITY TO ACQUIRE)

Indicate whether you have access to these inputs and mechanized services, sources and rate your access as well. Indicate 1 for access and 0 otherwise. Also tick to rate your access. Find codes for sources below the table.

No	Inputs and mechanized services	Access 0=No 1=Yes	Sources if you have access	How will you rate your access to the inputs and mechanized services?				
				Bad (1)	Poor (2)	Satisfactory (3)	Good (4)	Very good (5)
	Inputs:							
C1	Improved seeds							
C2	Fertilizer							
C3	Agrochemicals							
C4	Hired Labour							
	Mechanized Services:							
C5	Land preparation (use of tractor)							

	services)							
C6	Sowing (use of planters)							
C7	Harvesting services							
C8	Shelling services							
C9	Threshing services							

Codes for sources if full or limited access (Multiple responses allowed). 1= Contract scheme, 2=Market/ Private Tractor Operators, 3=Government/MOFA, 4= FBO, 5=NGO, 6=Other (specify).....

Timeliness of Inputs Received/Acquired

No	Item	Timeliness of Inputs Received/Acquired		Reasons if Not Timely
		Timely (Yes)	Not Timely (No)	
	Inputs:			
C10	Seeds			
C11	Fertilizer			
C12	Agrochemicals			
C13	Hired Labour			
	Mechanized Services:			
C14	Land preparation (use of tractor services)			
C15	Sowing (use of planters)			
C16	Harvesting services			
C17	Shelling services			
C18	Threshing services			

Codes for reasons if not timely (Multiple responses allowed). 1= Late release of input/Services by contractors, 2=Inadequate funds to purchase inputs/Services, 3=Inputs/Services unavailable at the market, 4= Transportation challenges, 5= Other (specify).....

C19. Can you access additional inputs through the scheme but with different terms?(1)Yes (2) No

C20. What are the terms of payment if yes? 1= Cash and carry, 2= Pay immediately after harvest, 3= Pay later after harvest (> 3 months)

C21. Do you use other inputs other than what is provided under the scheme? (1) Yes (2) No

C22. If Yes, state the inputs **(Multiple responses allowed)**. 1= Seed, 2=Fertilizer, 3=Agrochemicals, 4= Others (specify)

**D. COSTS AND RETURNS OF A HECTARE OF MAIZE CROP CULTIVATED
(2016 CROPPING YEAR)**

D1. What is the farm size for your maize crop?

D2. What is the farm size under the scheme?

I. COST

Material Input costs for a Hectare of Maize Cultivated (GH¢)

Particular	Unit	Qty	Price/unit	Total Value	Qty given under scheme
D3. a. Improved Seed					
b. Local variety					
D4. Organic fertilizer or manure					
D5. Inorganic fertilizer					
1. Urea					
2. Ammonia					
3. NPK 15-15-15					
D6. Chemicals (Weedicides)					
a. Non-selective Weedicides					
b. Selective Weedicides					
Other Chemicals					
.....					
D7. Packaging Materials (Sacks)					
D8. Other costs.....					
D9. Total material cost (Sub-total)					

NB: Kindly add the unit of seed when inputting the quantity. E.g kg, sachet, etc. If in sachet, write the size of the sachet here

Labour cost for the Hectare of Maize Cultivated

Particulars	No of Labour Days								Wage rate for hired labour (GH¢)		Labour Cost If work is done on contract (GH¢)
	Number of Family Labour				Number of Hired Labour						
	# people	# Days	# M	# F	# people	# Days	# M	# F	M	F	
D10. Land preparation											
D11. Sowing											
D12. Fertilizer application											
D13. Chemical application											
D14. Weeding 1. 1 st weeding 2. 2 nd weeding											
D15. Harvesting											
D16. On–Farm transportation											
D17. Any other costs (eg. Shelling, Cleaning packaging, etc)											
D18. Sub total											

NB: If work is done on contract, kindly input the total amount charged for that particular activity in the labour cost column. Also note: M=Male, F=Female and # = number of

Cost of Mechanized Services (If Any)

No	Particular	Amount (GH¢)
D19	Land preparation	
D20	Sowing	
D21	Fertilizer application	

D22	Chemical application	
D23	Harvesting	
D24	Threshing	
D25	Shelling	
D26	Sub total	

II. RETURNS

D27. Total quantity harvested from the area planted to maize.....

Returns from sale of maize

No	Timing of sales	Sell to: 1=Under contract 2=Outside contract	Quantity sold (kg)	Amount per unit (GH¢)	Total Amount (GH¢)
D28	First sales				
D29	Second sales				
D30	Third sales				
D31	Fourth sales				
D32	Total				

NB: If the amount is given for the total quantity sold, kindly ignore the amount per unit column

D33. In general, how satisfied are you about your production (inputs and outputs)?

1. Very satisfied 2. Moderately satisfied 3. Neither satisfied nor unsatisfied
4. Moderately unsatisfied 5. Very unsatisfied

E. ASSET OWNERSHIP

Assets Owned by Farmers as at December 2016

No	Asset	Number	Value (GH¢)
	Productive Assets: Farm tools		
E1	Tractor		
E2	Hoe		
E3	Cutlass		
E4	Spray machine (knapsack)		
	Productive Assets: Animals		
E5	Cattle		
E6	Sheep		
E7	Goat		

E8	Chicken		
E9	Guinea fowl		
E10	Sub total		
	Non-Productive Assets:		
E11	Car		
E12	Motor bike		
E13	Bicycle		
E14	TV		
E15	Radio		
E16	Mobile Phone		
E17	Sub total		
E18	Total		



MPHIL-RESEARCH PROJECT

**IMPACT OF NUCLEUS FARMER-OUTGROWER SCHEMES ON INPUT USE AND
PROFITABILITY AMONG SMALLHOLDER FARMERS IN NORTHERN REGION**

QUESTIONNAIRE FOR NUCLEUS FARMERS

Administrative District.....

Name of Community.....

Name of Interviewer:

Date of Interview/...../...../...../

Certified by..... (sign only after questionnaire is complete)

George A. Akuriba
University of Ghana, Legon
MPhil Agribusiness
January, 2017

A. DEMOGRAPHIC AND SOCIOECONOMIC CHARACTERISTICS OF NUCLEUS FARMERS

A1. Name of nucleus farmer.....

A2. Gender (1) Male (2) Female

A3. Age (in years).....

A4. What is your religion? 1= Christian 2= Muslim 3= Traditionalist 4= Other (specify)
.....

A5. What is your marital status? 1= Married 2= Single 3= Divorce

A6. What is your highest level of education attained? 1= Primary 2= JHS
3= SHS/Technical 4= Tertiary 5= None

A7. What is your major occupation? 1= Farming 2= Trading 3= Salary worker 4= Tradesman
5= Artisan 6= Other (specify).....

A8. What is your minor occupation? 1= Farming 2= Trading 3= Salary worker 4= Tradesman
5= Artisan 6= Other (specify).....

A9. How many years have you been involved in maize farming.....

B. TERMS OF ENGAGEMENT

I. General information on outgrower schemes

B1. Are you a nucleus farmer under a nucleus farmer-outgrower scheme? 0=No, 1=Yes

B2. If Yes, with who do you engage in the outgrower scheme with? 1=ADVANCE, 2=NRG,
3=GCAP 4=other (specify)

B3. When was the contract started? (year)

B4. How many outgrowers do you have?

B5. What is the nature of the contract scheme? 1= Resource providing contract, 2= Production
management contract, 3= market specification contract

B6. Is the contract formal or informal? 1= Formal, 2= Informal

B7. How many years have you been operating as a nucleus farmer?

B8. What is the area of maize farm supported by the scheme?

II. Elements (terms) in the contract scheme in which you engaged

What are the elements of the contract terms? Circle as many as applied in cases where responses are not mutually exclusive

B9. Which inputs are supplied under the contract? **(Multiple responses allowed)**. 0=None, 1=Seed, 2= Fertilizer, 3= Agrochemicals, 4= Other (specify).....

B10. Which mechanized services are supplied under the contract? **(Multiple responses allowed)**. 0=None, 1= Land preparation, 2= Sowing, 3=Agrochemical application, 4=Shelling, 5=Threshing, 6=Harvesting, 7= Other (specify)

B11. At what point do you determine the prices of inputs given under the contract? 1= Prefixed in contract 2=Negotiated at time of sales 3= Other (specify).....

B12. Who determine the prices of inputs given under the contract? 1= Contractors 2= Farmers 3= Both contractors and farmers

B13. At what point do you determine the prices of produce sold under the contract? 1= Prefixed in contract 2=Negotiated at time of sales 3= Other (specify).....

B14. Who determine the prices of produce sold under the contract? 1= Contractors 2= Farmers 3= Both contractors and farmers

B15. Who deliver inputs to farmers? 1= Contractors 2=Farmers 3=Both contractors and farmers

B16. At what time do outgrowers pay for the inputs given under the contract? 1= Cash and carry, 2= Immediately after harvest, 3= Later after harvest (> 3 months)

B17. What is the mode of payment for inputs? **(Multiple responses allowed)**. 1=Cash, 2= Kind (Produce), 3= Other (specify).....

B18. Does the contract provide other cash credit facilities to farmers? 1= 0=No, 1=Yes

B19. Does the contract provide technical assistance (advice and training on maize production) to outgrowers? 0=No, 1=Yes

B20. If yes, how often do you give the assistance to outgrowers in a year? 1= Very often 2=Often 3=Not very often 4= not often

B21. What is the amount of produce otgrowers sold under the contract? 1= No specified amount 2= All produce, 3= Any amount to cover credit, 4= Other (specify)

B22. Are there quality standards requirements stated in the contract? 0=No, 1=Yes

B23. Does the contract provide insurance cover to outgrowers against their farm investment?
0=No, 1=Yes

B24. Does the contract provide warehouse services to outgrowers? 0=No, 1=Yes

B25. Maximum area of maize farm supported to outgrowers under the contract (in hectares).....

