UNIVERSITY FOR DEVELOPMENT STUDIES

AGRICULTURAL VALUE CHAIN PARTICIPATION AND ITS EFFECTS ON CREDIT ACCESS, LOAN REPAYMENT AND FARMERS' INCOME IN NORTHERN GHANA

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BY

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THESIS SUBMITTED TO THE DEPARTMENT OF AGRICULTURAL AND RESOURCE ECONOMICS, FACULTY OF AGRIBUSINESS AND COMMUNICATION SCIENCES, UNIVERSITY FOR DEVELOPMENT STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF DOCTOR OF PHILOSOPHY DEGREE IN AGRICULTURAL ECONOMICS

APRIL, 2019

DECLARATION

I, the undersigned, hereby declare that this thesis is the result of my own original research work and that no portion of it has previously been submitted for another degree in this university or elsewhere.

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We hereby declare that the preparation and presentation of the thesis was supervised in accordance with the guidelines on supervision of thesis writing laid down by the University for Development Studies

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ABSTRACT

Despite the importance of credit in enhancing productivity and livelihoods, farmers continue to complain about lack of access to adequate credit for agricultural production. The main objective of this study was to examine the effects of agricultural value chain (AVC) participation on credit access, loan repayment and farmers' income in Northern Ghana. Also, the interrelationships between AVC vertical linkage (AVC-VL) and AVC horizontal linkage (AVC-HL) and that of AVC participation and farmers' access to formal and informal credits were assessed. Data processing and analysis were done in STATA version 15 and NLOGIT version 6 using the Heckman Treatment Effect model, Multivariate Probit model with sample selection and Bivariate Probit model respectively. Through a Multi-stage sampling approach, cross-sectional data was collected from 500 farmers by face to face interviews using semi-structured questionnaires. The results revealed that awareness of AVC, extension contact and networking significantly increased farmers' participation in AVC (AVC-VL and AVC-HL). Most interestingly, participation in AVC-VL complements with AVC-HL participation while access to informal credit substitutes for formal credit. The results also revealed that participating in AVC significantly increased farmers' access to bigger size credit, crop income and loan repayment. The study recommends that policies on agricultural financing, farmers' livelihood as well as funds to the sector should be directed through AVC and farmers should be encouraged to participate in it. The study has contributed to empirical literature in that it extended the MVP model with one selection variable (as developed by Greene (2010)) to two selection variables to address unobserved heterogeneity and interrelationships between farmers' access to formal and informal credits and participation in AVC-VL and AVC-HL.

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DEDICATION

This work is dedicated to the following people: My Dad (Mr. Charles Anakwa); Mother (Christiana Addobea); Wife (Rebecca Twumwaa Osei); Children (Paa Joe, Otimo and Addobea); Brothers (Tony and Okai); Sisters (Elizabeth, Joyce, Matilda, Freda, Veronica and Akosua Freda); and my late Uncle Dr. Joe Lartey and his wife Cecilia Morrison both in blessed memory.

TABLE OF CONTENTS

LIST OF TABLES

Table Title Page No.

LIST OF FIGURES

LIST OF ACRONYMS

Acronym	Meaning
ADB	Agricultural Development Bank
ADVANCE	Agricultural Development and Value Chain Enhancement
AVC	Agricultural Value Chain
AVC-HL	Agricultural Value Chain Horizontal Linkage
AVC-VL	Agricultural Value Chain Vertical Linkage
BoG	Bank of Ghana
FBO	Farmer Based Organization
FIs	Financial Institutions
GCAP	Ghana Commercial Agriculture Programme
GDP	Gross Domestic Product
IFAD	International Fund for Agricultural Development
IMR	Inverse Mills Ratio
IWAD	Integrated Water Management and Agriculture Project
MoFA	Ministry of Food and Agriculture
OLS	Ordinary Least Squares
PHC	Population and Housing Census
QRD	Quantitative Research Design
USAID	Unity State Agency for International Development
WB	World Bank
YIA	Youth in Agriculture

CHAPTER ONE

INTRODUCTION

1.0 Research background

In most developing countries, especially those in Africa, Asia and Latin America where most of the world's poor live, agriculture supports the livelihoods of many families and contributes greatly to economic growth and poverty alleviation (Byerlee *et al*., 2009; Dethier and Effenberger, 2012; Blein *et al*., 2013; Golub and Hayat, 2014; Nhemachena *et al*., 2018). Agriculture remains a main source of food security in many developing countries.

In Ghana, agriculture is an important sector to the overall development of the economy, despite the recent oil and gas production and the associated multiplier effects (Institute of Statistical, Social and Economic Research [ISSER], 2017). Agriculture has been noted as the engine of growth and structural transformer of the economy since independence (Tiffin and Irz, 2006; Al-Hassan and Xinshen, 2009). From 2006 to 2016, agriculture accounted for 25.67% of Ghana's gross domestic product (GDP) on the average (Ghana Statistical Service [GSS], 2017), and 29% of foreign exchange earnings in 2016 (ISSER, 2017).

The agricultural sector employs over half (51.5%) of the total labour force, and 90% of the rural active population in Ghana (GSS, 2014; MoFA, 2016). Moreover, the sector provides an indirect source of employment and income for many people (such as input suppliers, aggregators and buyers) involved in providing services and or adding value to agricultural products to and from farmers (Nhemachena *et al*., 2018).

This implies that the sector can be used to spur a strong growth in other sectors such as the agro-processing industry, transport and services due to the interrelationships (Kyere, 2014).

In view of the importance of agriculture, successive governments have made various efforts to boost agricultural productivity and farmers' income through the provision of agricultural credit since credit is important for promoting agricultural growth (see Figure 1) and modernization (Kyere, 2014; Awotide *et al.*, 2015a). From Figure 1, agricultural growth and credit supply are positively correlated.

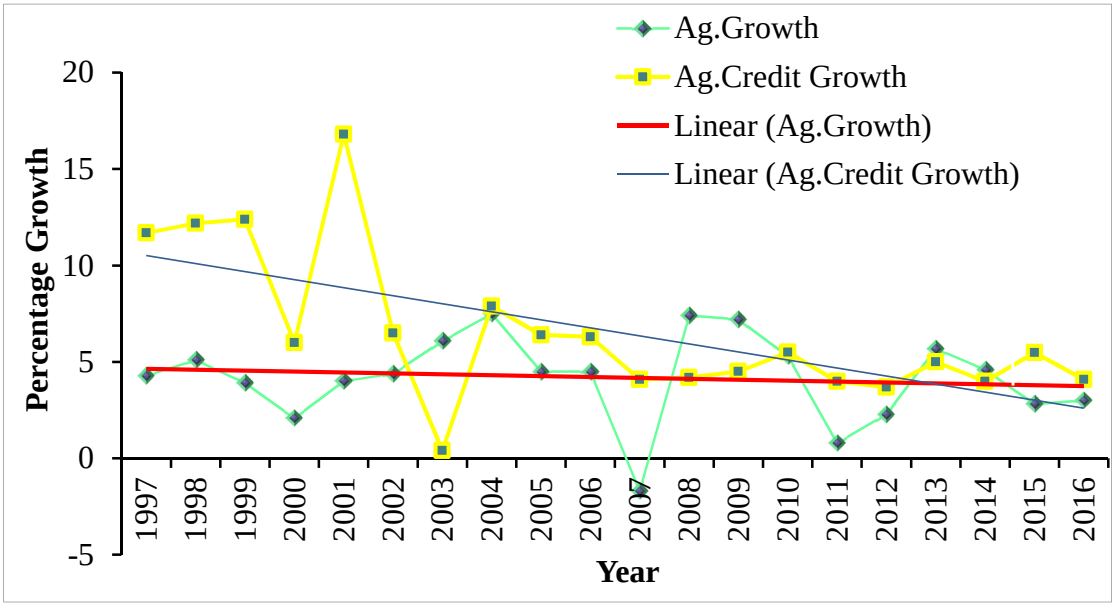


Figure 1. 1: shows a direct relationship between credit growth and agricultural growth
Source: MoFa (2016)

Credit is a key determinant of agricultural productivity and agricultural mechanization because it enables the purchase and use of improved inputs and machineries such as tractors and combined harvesters for production (Kyere, 2014; Awotide *et al.*, 2015a; Narayanan, 2016). In the production process, it can either serve as a main source of

income when farm or non-farm incomes are missing or a supplementary income when farm or non-farm incomes are inadequate. Credit refers to monies, farm inputs and services, including mechanization and labour given to farmers by financial institutions, but with particular agreement on how, where, when (time) and what it is to be disbursed/received and repaid with or without interest (Kosgey, 2013).

1.1 Agricultural financing in Ghana

Since credit has direct effect on agricultural growth, governments through the central bank (Bank of Ghana) took a leading role in the financing of the agricultural sector through the provision of credit. However, in doing so, different financial programmes, instruments and approaches (traditional approach vrs value chain approach) were used counting down from the time of independence.

In fact, with governments' focus on developing and modernizing agriculture in Ghana, the need to set-up a specialized bank to cater for the financial demands of farmers was a priority. Hence, in 1965, the government through the Bank of Ghana (BoG) established the Agricultural Development Bank (ADB) (Awunyo-Vitor, 2012). This led to rapid expansion of agricultural credit and the granting of bigger sized loans to farmers for the purchase of equipment like tractors and combined harvesters as well as modern inputs like improved seeds, fertilizers and other agrochemicals. More importantly, development partners such as the World Bank (WB); Africa Development Bank (A_fDB); among others provided lines of credit to BoG to re-finance the ADB at a concessionary interest rate (subsidized interest rates) under project names such as the Food Crop Development Project, Lowland Rice Project,

and Livestock Development Project among others with the broad aim of increasing farmers' productivity and incomes, and reducing poverty.

In 1976, BoG further introduced the rural banking concept to allow members of the rural communities to: purchase shares; obtained license; as well as open and operate rural banks as an alternative channel for providing financial services at the rural level (Steel and Andah, 2004), when it was realised that the coverage of ADB was limited to the regional and district capitals. Nonetheless, to ensure that farmers and agro-business units obtain credit for agricultural production, BoG introduced the quota system that mandated all RCBs to allocate 50% of their loan portfolio to agricultural production at any point in time. Besides, Commercial Banks were also mandated to allocate 20% of their entire loan portfolio to agriculture too (Awunyo-Vitor, 2012). This further deepened and expanded financial services to majority of the rural people which resulted in an increase in outputs of the farmers.

Furthermore, in the mid-1980s to 1990s, the central bank liberalized the financial market, which paved way for massive expansion of financial services to majority of the rural population through the establishment of the microfinance industry (Awunyo-Vitor, 2012; Kyere, 2014). The above era was noted for the traditional approach.

In the mid-2000s, a new approach of agricultural financing which uses the value chain concept (called the agricultural value chain financing approach (AVCF) started to gain momentum. In this concept, actors are interlinked to each other through market which enables the flow of finance. AVCF emphasizes the role of the private sector in the provision of credit as private entities look for their own credit and use it to finance other members in the chain (internal). Farmers can also obtain credit from outside the

chain, for instance, banks (external). However, the basis for supplying credit by these financial institutions are on end-markets drive, presence of strong linkages and coordination (vertical-backward and forward; and horizontal-FBO (Porter, 1985), greater networking (Anandajayasekeram and Berhanu, 2009), value addition, upgrading, and good governance (Gereffi *et al*., 2001).

1.2 Agricultural value chain and its financing

Agricultural value chain (AVC) consists of several interlinked agents and markets involved in transforming inputs and services into products with attributes that consumers are prepared to purchase (Horton *et al*., 2016) or the full range of activities involved in getting a product or service from conception, through the different phases of production and delivery to the final consumer (Kaplinsky and Morris, 2000). AVC includes a set of actors (e.g., input suppliers, producers, aggregators or traders, processors, exporters and consumers) adding value at one point to satisfy consumers' desires. It is, thus, an alliance, collaboration, coordination, or an integrated approach to bring agricultural actors together by helping to identify solutions to key bottlenecks to boost businesses and food demand (Kaplinsky and Morris, 2008). This is because one actor actively seeks the support of the other in a sustainable manner by increasing his or her efficiency and competitiveness in terms of time and other resources.

AVC builds strong relationships between actors to reach a common goal of satisfying consumer needs and this increases producer profits and buyer satisfactions. It focuses on value addition via innovation in products or processes, marketing and the allocation of incremental value.

The value of a product increases at each point of the process, hence the term value chain (McCormick and Schimitz, 2001). For a farmer, value addition has a particular importance in transforming an unprofitable enterprise into a profitable one. The value chain is about networks, linkages and relationships between and within agents that enable a product to move upstream (i.e. from its inception to final market), and services like credit, information, and inputs to move downstream and upstream (Kula *et al*., 2006; Henriksen *et al*., 2010; Stamm and von Drachenfels, 2011). Thus, for relationships within actors performing similar functions (e.g. farmer-farmer relationship), it is termed horizontal linkage (AVC-HL), a typical example is farmer based organization-FBO while for relationships between actors performing different functions (e.g. farmer -input supplier; farmer- trader; or farmer - processor), it is termed vertical linkage (AVC-VL) (Porter, 1985). In the AVC-VL, when an actor looks backward, he or she connects to input market to source for raw materials (this is termed backward vertical linkage and when an actor looks forward, she connects to output markets to deliver final products (this is termed forward vertical linkage) (Horton *et al*., 2016).

In all cases, these networks, linkages and relationships are strengthened with contractual agreements / arrangements, which enable the flow of funds {known in economic literature as the agricultural value chain financing (AVCF)} to occur. These contractual agreements may be oral or written. AVCF basically describes the financial relationship existing between two or more actors within the value chain (Ardjosoediro and Neven, 2008). It relies on different financial approaches and instruments for agricultural and agribusiness financing (Agarwal *et al*., 2014). Its overall aim is to achieve social and economic goals (Agarwal *et al*., 2014), where actors in the chain

optimize financial investment, resource allocation and business capacity expansion (Miller and Jones, 2010).

Due to this, the AVCF is best adopted against a backdrop of effective and efficient risk management and financial provision in agriculture (Miller and da Silva, 2007). AVCF has been defined as the flow of financial products and services to and among the various actors within the AVC to address or alleviate constraints of production and distribution, and fulfill the needs of those involved in the chain by reducing risk and improving efficiency (Fries, 2007; Miller and Jones, 2010). AVCF is alternative to the traditional financial service delivery and aims at minimizing financial risks and providing opportunities for unleashing capital (Miller and Jones, 2010), mostly because AVCs enable farmers to secure an assured market for their farm produce and this increases their repayment due to lower fungibility. Through the AVCF, farmers can have dual access to credit, thus, internally and externally (Ardjosoediro and Neven, 2008).

The internal or direct financing deals with the flow of funds from within the chain finance whereas the external or indirect financing deals with the flow of financial products and services from outside the chain finance (Miller and Jones, 2010). In the value chain, each actor is a potential lender or a guarantor. For instance, a buyer or contractor can provide a credit directly to farmers and assist or intermediate for farmers to obtain finances from an external source like banks (Casuga *et al.*, 2008). In the direct, there is a potential win -win benefit as farmers acquire inputs, including credit on time for production and buyers also have a stake in farmers' produce after giving out credits (Miller and Jones, 2010). The direct approach is easy to run and

flexible, and so assures financiers within the chain of high repayment since lenders have a stake in the output or in the produce of the farmers (Casuga *et al*., 2008). However, the disadvantage of this approach is that funds supplied within the chain are basically small, and not comprehensive enough to warrant commercial decisions of farmers.

The indirect approach to AVCF on the other hand, is one whereby individuals, businesses or financial institutions outside the chain such as banks finance the chain actors, including producers (Jessop *et al*., 2012). This approach usually involves the provision of large amounts and long-term credits. Also, it is transparent in nature and considerably reduces the risks of exploitation, especially by agricultural-oriented banks through lower interest rates. However, it lacks flexibility in designing credit facilities for farmers because it usually involves stringent credit application procedures.

The AVCF approach has been identified as the most important source of finance in agriculture by financial institutions and governments, especially in developing countries (Jessop *et al*., 2012), as it offers an opportunity to reach out to large numbers of smallholders to reduce costs and risks in financing (Miller and Jones, 2010). The approach comprehensively looks beyond the direct borrower to their linkages in order to best structure financing, according to those in need (Miller and Jones, 2010; A_fDB, 2013).

In the value chain, the actors in a way serve as social collateral for one another. This has the ability to make a significant contribution in convincing formal financial institutions to move away from the traditional approach of demanding collateral as a

loan guarantee (Vorley, 2001). In recent years, the several agricultural programmes being instituted by governments, development partners and private sectors are focused on promoting AVC's of maize, rice and soya in the Northern Ghana. Example of such programmes include Ghana Commercial Agriculture Project (GCAP); Export Development and Agriculture Investment Fund (EDAIF); Youth in Agriculture (YIA); Rural and Agricultural Finance Programme (IFAD-Ghana gov't, 2010-2016); Millennium Development Account Agricultural Credit Programme (MiDA and MoFA); Hunger project, ADVANCE; USAID Fin-gap; Northern Rural Growth Programme; Planting for Food and Jobs (PFJs) among others in Ghana. It is therefore important to examine farmers' decision to participate in AVC and how it affects credit access, crop income and loan repayment.

1.3 Problem statement

Despite numerous efforts by successive governments to increase credit supply to agriculture, many farmers in Ghana continually lack access to adequate credit for agricultural production because most of them do not meet borrowers' criteria by financial institutions (Abdul-Rahman and Donkoh, 2015). Figure 2 shows how credits supplied to agriculture by Financial Institutions remain low as compared to other major sectors.

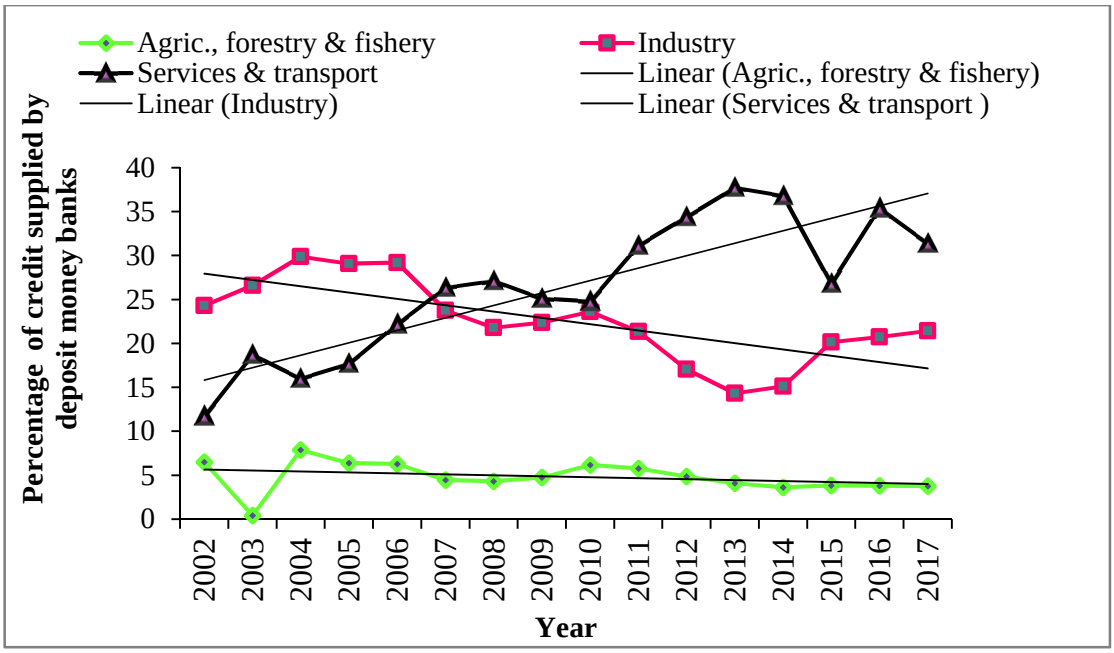


Figure 1. 2: Trend of credit supplied to economic sectors by deposit money banks in Ghana

Source: Bank of Ghana Statistical Bulletin, 2002-2017

As shown in the figure 2, there is a big gap between the supply of credit to the services and industry sectors; compared to that of the agricultural sector. This trend is due to the fact that financing agriculture is very risky, expensive and unprofitable (Awunyo-Vitor, 2012). In Ghana, share of non-performing loans from agriculture remains very high. In an attempt, to recover the loans, financial institutions further increase their operational cost and losses because of the widely dispersed nature of numerous individual farmers (Casuga *et al*., 2008; Awunyo-vitor and Abankwa, 2012; Salami and Arawomo, 2013; Kiplimo, 2015; Mukasa *et al*., 2017). These problems stem from the traditional (segmented) approach of financing individual smallholder farmers independently and without strong market linkages to sell their produce. Due to lack of guaranteed markets, most farmers are unable to sell their farm produce and generate enough income to repay their loans (Awunyo-vitor, 2012). On the other

hand, financial institutions (FIs) require their loans to be repaid in order to reduce the NPLs. In the traditional approach, potential farmers (business units) seeking for credit or financial supports were appraised independently based on their credit worthiness without any coordination; collaboration; or linkage to other actors for assured markets. This approach was ineffective in improving farmers' repayment capacity because it does not make provision for off- taker or output market arrangement to buy farmers' produce. This has turned out to have devastating effects on farmers' image against banks.

In the implementation of past credit programmes, governments focused more on increasing farmers' productivity so enough attention was not given to market access. For instance, performance of most credit programmes was tied to the volume of credit disbursed and how it affects farmers' outputs. Again, the specialized financial institutions (like ADB) were treated as windows of disbursement, neglecting portfolio quality and loan repayments. Also, high government influence in satisfying its supporters with cheap loans (subsidized interest rate) and waiving of debt changed farmers' behaviour about public funds, which weakened their repayment culture and made lending unprofitable to FIs (Jessop *et al*., 2012).

Again, credit supplied by these financial institutions (FI) was based on perceived needs of the farmers rather than assessing the viability of farm businesses; so most farmers borrowed to get cheap credit for other purposes such as consumption (high fungibility) (Jessop *et al*., 2012) which made them unable to repay their loans. In addition, there was lack of due diligence and proper procedures in the loan appraisal process by bank credit officers because of the high government intervention (Kyere,

2014). These resulted in low repayments and high default which affected the profitability of these banks. So till now, financial institutions still perceive agriculture as an unprofitable venture to finance (Awunyo-vitor and Abankwa, 2012); and hence shy away from doing business with poor and small-scale farmers (Wongnaa and Awunyo-Vitor, 2013).

Other factors like bad climatic conditions; low adoption of improved farm practices and technologies including irrigation, and poor road networks (Kyere, 2014) that hindered the achievement of higher productivity and farmer income, also contributed to low loan repayments and defaults. Most critically, the poor road networks discouraged traders and private transport owners from plying these roads since there was no incentive to do so leaving farmers' produce to rot at the farm-gate (Kyere, 2014).

In addition, farmers have internal issues that hinder credit access: e.g. (1) inability to draft business plans and application letters due to low literacy (2) fear/lack of confidence to approach financial institutions (3) low networking/contacts; (4) geographically disadvantages and (5) lack of collateral/guarantor to access credit. As a result, most farmers were left with no option than to access informal credit for agricultural production - which is small and expensive (Casuga *et al*., 2008).

These situations call for a critical investigation into approaches and innovations that have the tendency to increase agricultural credit to the sector whist improving loan repayment. To remedy these problems, the AVC concept has recently been suggested and adopted by some financial institutions due the relative advantages it may have over the traditional approach, such as access to contractual agreement that guarantees

ready input and output markets for the farmer (Mutura *et al*., 2016); high ability to sell produce in bulk and receive reliable incomes for prompt loan repayments; thus, sometimes obtaining ready income after production shorten the repayment period, and reduces the amount of interest charged and paid (Raswants and Khanna, 2010).

In the AVC approach of financing, there is active participation of private investors and financiers in the provision of credit due to the presence of strong linkage, coordination, collaboration, and networking among actors (Casuga *et al*., 2008; Miller and Jones, 2010). Also, the presence of strong governance and group pressure tends to assist in loan repayments. This strengthens their relationship (vertical and horizontal) because of the win-situation (Singh and Asokan, 2005). There is also enjoyment of low transportation cost, (Zakic *et al*., 2014) and social collateral or guarantee (Jessop *et al*., 2012) which reduces the need for physical collateral (Muhammed, 2013). The strong transfer of technology within the chain also increases productivity and income (Miyata *et al*., 2009; Maertens and Swinnen, 2009; Minten *et al*., 2009). Overall, participating in the AVC is a risk sharing strategy which minimizes financial risk of the farmer and the lender and gives high level of comfort in the provision and use of credit (Miller and da Silva, 2007).

Despite these potential benefits of AVC approach, knowledge on farmers' participation in AVC and how this improves their credit access, incomes and loan repayment remain limited, especially in Ghana. Available literature on the extent of farmers' participation in AVC and the interrelationships between AVC-VL and AVC-HL is quite low to the best of the researcher's knowledge. At the moment, there is a huge volume of studies on farmer participation in cooperatives and AVC (Benmehaia

and Brabez, 2017; Awotide *et al*., 2015b; Abdul-Rahman and Donkoh, 2015; Fischer and Qaim, 2012; Asante *et al*., 2011) which did not assess how participation influences credit access, crop income and loan repayment. Similarly, extensive literature on credit constraint, access to credit and loan repayment related their findings mostly to demographic, socio-economic and institutional factors (Akudugu, 2012; Adinya *et al*., 2012; Wongnaa and Awunyo-Vitor, 2013; Anang *et al*., 2015) without analyzing the role that AVC participation plays in credit access, crop income and loan repayment.

In fact, there is a high literature deficiency in the use of quantitative techniques in estimating effects of AVC participation on credit access and loan repayment. For example, Oberholster *et al*. (2015) examined the determinants of perceived success of agricultural value chain financing in South Africa. As part of their objectives, they studied the relationship between perceived success to agricultural value chain financing and certain independent variables such as value chain competitiveness, supporting services, product range, innovation, risk management, sustainable production, institutional environment, strategic partnering and value chain integration. The authors argued that increased levels of value chain competitiveness for instance, give financial service providers with the opportunity to increase financing levels to the agricultural sector. However, they did not determine whether agricultural producers in the chain have access to bigger credit and higher loan repayment. Furthermore, Middelberg (2017) examined how the value chain approach influences farmers' access to finance for mechanization in Zambia through qualitative evidence. But her study failed to address selectivity bias and average treatment between participants and non-participants of the AVC. From the supply-side, Middelburg *et al*.

(2014) also studied credit risk assessment criteria that agricultural financiers consider when evaluating a South African producer's application for farm expansion into Mozambique. However, they did not also include the AVC concept as a variable for improving farmers' credit worthiness. In addition to this, the conceptual link between access to credit, income and loan repayment as well as the constraints to AVC participation, credit access and loan repayment have not yet been revealed, especially in a single study. The foregoing research and knowledge gaps lead to finding answers to the following questions:

i. To what extent do farmers in northern Ghana participate in AVC vertical linkage (AVC-VL) contracts?
ii. What factors influence farmers' participation in AVC (AVC-VL and AVC-HL)?
iii. How does AVC participation influence credit access by farmers?
iv. How does the AVC participation affect farmers' income?
v. What is the effect of AVC participation on loan repayments of farmers? and
vi. What are the constraints of AVC participation, access to credit; and loan repayment from the farmer's perspective?

1.4 Research objectives

The primary objective of the study is to analyze farmers' access to credit, crop income and loan repayments in relation to agricultural value chain participation (AVC) in Northern Ghana.

The specific objectives of the study are to:

1. analyze the extent to which farmers in northern Ghana participate in AVC-VL contracts;
2. examine the factors influencing farmers' participation in AVC (AVC-VL and AVC-HL);
3. determine the effect of AVC participation on credit access by farmers;
4. determine the effect of AVC participation on farmers' income;
5. measure the effect of AVC participation on loan repayments of farmers; and
6. identify and rank the constraints of AVC participation; access to credit; and loan repayment from the perspectives of farmers.

1.5 Research justification and significance

The provision of credit to farmers is important to increase and sustain agricultural production given their low earnings. AVC is increasingly being promoted and facilitated by the government and many organizations including development partners because of its role in agricultural development. The findings of the extent of farmer participation in AVC will provide an insight or indication of how much effort (s) these promoters like USAID- ADVANCE require to ensure an all-inclusive participation to achieve significant growth in the area of agricultural output, improvement in income, poverty reduction, and food security. Hence, the results of the study will be useful to development partners, policy makers, and Non-Governmental Organizations (NGO) who are at the fore front of the value chains concept.

Second, value chain approach is about relationships, networking, flow of information, transfer of technology, value addition and prompt delivery of products within and between actors. The findings of the study will contribute in identifying the factors which need critical attention and consideration in appraising loan requests from farmers involved in value chains of maize, rice and soya. Training of credit officers, relationship managers, credit analysts and other key chain actors on these factors will speed up the loan appraisal and approval processes so as to ensure timely disbursement of credit to meet the needs of chain-members in order to enhance their efforts and commitment in the chain. Thus, a checklist of these factors can be provided for easy referencing.

Third, the findings of the study will guide policy makers, credit and loan administrators, Ministry of Food and Agriculture (MoFA), and management of financial institutions (FIs), in their credit or loan policies and decisions, especially as it affects the poor rural farmers in Northern Ghana. Thus, in designing short and long term credit interventions for farmers, one should be guided by these loan repayment factors to ensure the sustainability of the agricultural interventions and credit support. Thus, the continuous injection of funds into the agricultural sector by FIs, depends on repayment performance of its clients and so factors determining loan repayment will guide FI as to who is likely to repay her loans. This will save the FI from spending additional money chasing clients to recover the loan.

Finally, there is scanty literature on how AVC participation enhances easy access to credits and increases crop income and loan repayments by farmers. Thus, the study

uses quantitative analysis to bridge the gap in knowledge on AVC participation, access to credit, crop income and loan repayment by farmers in Northern Ghana.

1.6 Structure of the Thesis

This study is structured into ten (10) chapters as follows:

Chapter 1 is the introduction which provides the background, problem statement, research questions and its corresponding objectives as well as the justification and significance of the study.

Chapter 2 provides an overview of agricultural value chain and describes and discusses value chain and other related concepts.

Chapter 3 is the literature review of the study, and discusses theories and studies on farmers' participation in AVC, access to credit; loan repayment and farm income.

Chapter 4 contains the research methodology which elaborates on the material and methods employed in the data collection and analysis. It discusses the study area, conceptual and theoretical frameworks, the research design, the sampling technique, sample size determination, survey and data description.

Chapter 5 contains the descriptive report of the sample such as means, standard deviations, frequencies, percentages and statistical tests. The results are summarized in tables and graphs.

Chapter 6 is the empirical findings of the extent and determinants of farmers' participation in agricultural value chains.

Chapter 7 contains the empirical results and discussion of the effect of AVC participation on farmers' access to credit.

Chapter 8 elaborates on the empirical results and discussion of the effect of AVC participation on crop income

Chapter 9 comprises of the empirical results and discussion of the effect of AVC participation on loan repayment.

Chapter 10 provides a summary of the key research findings, concluding remarks, policy implications and recommendations of the study.

1.7 Limitation to the study

Most studies on credit access and loan repayment have focused on the business unit separately. Agricultural value chain is very broad. However, the study was restricted to farmer (and crops) level participation due to financial and time constraint.

CHAPTER TWO

OVERVIEW OF AGRICULTURAL VALUE CHAIN AND FINANCING

2.0 Chapter overview

The literature review section includes an overview of value chain (VC), related concepts to VC, VC in agriculture, ways of linking farmers to VC and an overview of agricultural credit.

2.1 Value chain and related concepts

A value chain (VC) could be defined as a series of actors (firms/agents) who engage in similar or different processes and activities to drive a product or service from production through the different stages of distribution and marketing to final usage or consumption (Kaplinsky and Morris, 2000). VC is also a channel or network through which different or similar actors (firms/agents) take on internal activities to support, produce, market, and distribute a value added product to its final destination (Zakic *et al.*, 2014). It is also a route by which new forms of production practices, technologies, logistics, labour and relationships/firms/actors as well as information and funds are introduced (Trienekens, 2011).

VC basically involves interdependent processes which generate value to meet customers' expectations (thus, taste) and producers' expectations (thus, profit). Thus, it is concerned with how a value added product meets the customer's expectations while unleashing opportunities and minimizing constraints of its institutional

environment for the producer or marketer to explore and obtain the highest possible benefits (Porter, 1990). Each firm (actor/agent) is expected to benefit equitably for taking part in the overall value addition process (Shank and Govindarajan, 1993). This value addition process begins with producers who obtain basic raw materials and services from input suppliers for production and ends in the belly of the final user.

There are varieties of VC depending on a number of characteristics such as the nature of relationships between the actors, location (scope) of operation, market objective (Sturgeon, 2001; Kaplinsky and Morris, 2002) and governance (Gereffi, 1994). The nature of relationship is the horizontal and vertical linkages which bind the actors. Some relationships may be shorter while others may be very long depending on the number of hands that drive the product to its final destination. One actor can be in one or more of these relationships and raw materials and outputs can flow from all sides and it is by way not always uniform. Some VC may be local while others may be global (international) (Rudenko, 2008). Local VC produces goods and services which are confined within a country and for domestic consumers while global VC produces goods and services which are spread over wider areas beyond domestic markets (Riisgaard *et al*., 2010). In terms of its market objective, some VC tend to satisfy product requirements by taking orders from a customer for the supply of products while others fulfill product requirements without an initial consultation with the customer (Feller *et al*., 2006).

Governance in VC refers to the power that one actor or body exerts on the other or the chain. Some VC is largely driven by producers, while others are controlled by buyers, facilitators or by integrated effort (Vorley, 2008). In each of these, the degree of

influence that actors exert on the flow of goods and services, including finances differ (Miller and Jones, 2010). The governance structure gives the VC a formal shape and makes it different from other concepts such as the supply chain. Vorley (2008) expanded VC into four distinct organizational models, namely; producer driven, buyer driven, facilitator driven and an integrated model of VC. Below are brief explanations of these models.

In producer-driven VC, producers drive the chain by forming groups or associations. In this type of value chain, producers rather than buyers decide on what the market needs. The group enables them to have one and amplified voice towards buyers and also to find and penetrate new markets and get a higher price for their commodities due to their strong bargaining power (Musuva, 2015). Most often, the group seeks for external support for their members such as technical advice, guaranteed output markets, provision of ready farm inputs and access to financial services. In buyer-driven VC, processors, wholesalers, exporters and other traditional marketers who buy and sell produce in their raw state or partially cooked play a major role in determining the flow of goods and services, including financing within the chain (Gereffi, 1999).

In terms of product supply and quality, the specifications are supplied by retailers or marketers that order the goods (Gereffi, 1999). In some instances, buyers or traders use finance as a way of facilitating the flow of products of their interest because they are assured of supply and are able to monitor production (Miller and Jones, 2010). Facilitator-driven VC on the other hand, is one that receives support from government and non-governmental bodies to operate and conduct their activities. This type of VC

stems from the notion that small-scale farmers face more production and marketing challenges such as access to credit and ought to be assisted (Musuva, 2015). An integrated VC is one that value chains connect integrated actors and other stakeholders, mostly through formal contracts and other services such extension (Salenque, 2007). This form of VC is largely characterized by end market relationships and external influences and supports (Anandajayasekeram and Berhanu, 2009).

From the literature, there are often overlapping concepts related to the VC concept. Citing Kaplinsky and Morris (2002), VC chain could also be referred to as supply chain, market chain, production chain, distribution chain, supply channel and product channel. Sturgeon (2001) argued that VC can also be interchanged with commodity chain, activities chain, production network, value network and input-output analysis. Other concepts such as the filiere (commodity chain), Subsector approach, Global Commodity Chain (GCC) concept, Net-Chain concept, Inclusive Business Model (IBM) and Global Value Chain (GVC) have also been related to the value chain concept. However, although these terms are often used interchangeably, they represent distinct notions. The VC concept has been developed over time to address the limitations of older concepts, with newer concepts superseding older ones (Makosa, 2015). Below is a brief description of some of the old concepts.

2.1.1 Filiere (commodity chain) concept (1950s)

The filiere concept (FC) is the oldest of the value chain concepts (FAO, 2014). The word filiere means a “thread” in French. FC is used to mean the flow of physical inputs and services in the production of a final product (Humphrey and Schmitz, 2002). FC was initially applied to mostly export crops such as cocoa. FC focuses on optimizing physical product flows and conversion ratios related to the large-scale processing of commodities (FAO, 2014). The prime aim of FC lies in multiplier effects of input-output relations it produces and the efficiency gains which result from economies of scale and lower transaction and transport costs. The difference between FC and VC is that, the former employs a static analysis, reflecting relationships at a one point in time and does not indicate growing or falling commodity or knowledge flows or actors while the latter takes into account both upstream and downstream in trading relationships, customer purchase and the interests of company stakeholders (Humphrey and Schmitz, 2002).

2.1.2 Subsector approach (1970s -1980s)

The subsector approach (SA) incorporates a system perspective for analysis of economic activities within a specific sector. SA is the vertical part of the VC, which deals with the flow of a particular raw commodity through various distinct, competing channels to a range of consumer markets (FAO, 2014). Shaffer (1968) defined the subsector as the vertical set of activities in the production and distribution of a closely related set of commodities. Marion (1986) also defined it as an interdependent array of organizations, resources, laws, and institutions involved in producing, processing and distributing an agricultural commodity. FAO (2014) argued that the SA is a

dynamic system in which the heterogeneity of economic actors and their position in the various channels are recognized.

SA is mostly applied to small enterprise analysis (Haggblade and Gasmer, 1991). SA constitutes a network of firms supplying and transforming raw material and distributing finished goods to a particular consumer market. Originally applied in agriculture, the subsector approach usually starts from a particular agricultural raw material and maps out, quantifies and measures the various competing channels through which the product is transformed into intermediate and final products that are sold into their various markets (Neven, 2014). SA basically underlines the interactions between economic agents, particularly those involved in production and distribution processes. The difference between the SA and VC is that the former emphasizes more vertical relationships or coordination while the latter includes both vertical and horizontal relationships.

2.1.3 Supply chain (1980s)

Supply chain (SC) emerged as an integrative approach for managing the flow of goods from the supplier's supplier to the end user (Cooper *et al*., 1997). SC is interconnected, with end-to-end process control (Nabi and Luthria, 2002). One actor's activity is reliant on another's own. It aims to reduce friction, outages or overstocks, lower transaction costs and improve fulfillment, efficiency and customer requirements (Webb, 2010). SC is a vertical linkage typically managed by firms - normally producers, wholesalers or retailers who aim to reduce costs (Feller *et al*., 2006). It is also used to mean every effort involved in producing and delivering a final product or service to the end user.

In the economic literature, SC is normally interchanged for VC in that both are viewed as extended enterprise with integrated business processes enabling the flows of products and services in one direction and of value as represented by demand and cash flow in the other (Ramsay, 2005). Also both concepts have the same network of actors (Feller *et al*., 2006). Actors in both interact to provide goods and services to consumers and are concerned with the organization of value adding activities while competing in a particular industry (Feller *et al*., 2006; Keyser, 2006). Both increase business performance and productivity through the actors that made up the chain (Feller *et al*., 2006).

Nevertheless, major differences exist, especially in the nature of value flow and governance that occurs between the suppliers and their customers (Keyser, 2006). First the VC concept mainly focuses on customer requirements while the SC focuses on product requirements for the customer. The former also differs from the latter in its unique characteristics such as horizontal coordination (Gereffi *et al*., 2001; Porter, 1985); governance structure; networking; upgrading and geographical spread (Gereffi *et al*., 2001). VC involves satisfying trading relationships, customer needs and the interests of company stakeholders. To promote the VC means to improve arrangement between what the customer wants, what the chain demands, and what is produced and supplied of it while SC management focuses primarily on reducing costs and attaining operational excellence. VC concept is about evolving strategies, enterprise models and numerous efforts at improving business performance (Eskew, 2005).

2.1.4 Porter's VC (1985)

VC is not a recent concept in development processes, having received considerable attention in economic and management literature since it was initially conceptualized by Porter (1985) in his book- entitled "Competitive Advantage: Creating and Sustaining Superior Performance" (1985) (Feller *et al*., 2006). Based on Porter's (1985) conceptualization, a value chain describes all the interlinked processes and activities required to design and deliver a product or service from conception to consumption. According to Porter (1985), firms are expected to identify actual and potential areas of competitive advantage to create value for those who need their services (Feller *et al*., 2006; Rich *et al*., 2009).

Porter sought to examine the contributions of various primary and supportive firm activities to the overall added value of its business (Porter, 1985) arguing that a firm will have competitive advantage over the other when it performs all its important activities in a cost effective manner. The primary activities include in and out-bound logistics; operations, marketing, sales and service which directly appreciate the value of the product. In contrast, the supportive activities include procurement, human resource management, technology development and all infrastructures necessary for the firm to success. Through higher competitiveness, firms are more often able to satisfy customers by fulfilling their request (Wang *et al*., 2011).

Porter (1985) explained that this competitive advantage can be reached only by managing the entire value chain as a whole including all involved functions. Porter (1985) himself noted that competitive advantage arises from optimization and co-ordination in intra-firm linkages. The competitive advantage allows actors in the VC

to identify their ability and to explore for more opportunities. Porter (1985) conceived the VC as the combination of nine generic value added activities operating within the value chain, and as part of a larger stream of activities known as 'value system', which consists of 'suppliers' VC, 'buyers' VC' and 'channel VC'.

Porter (1985) also argued that the "value" of the firm's product is appreciated only if the product moves through the activities. Porter (1985) defined the "value added" as the amount buyers are willing to offer for what a firm provides, which results from diverse activities including bulking, cleaning, grading, and packaging, transporting, storing and processing (Anandajayasekeram and Berhanu, 2009). The application of the Theory of Competitive Advantage in VC, simply advocates for the use of appropriate VC strategies and prudent practices that enhance the financial performance (Porter, 1990). However, Porter's approach to VC has been criticized by Faße *et al*. (2009) due to the fact that, it's analysis is restricted to the firm level without taken into account upstream and downstream activities beyond the firm.

2.1.5 Global commodity chain concept (1994)

The Global commodity chain (GCC) concept was developed by Gereffi and Korzeniewicz (1994). The concept deals with how various firms across the entire chain are coordinated (or strategically linked) in order to be more competitive and add more value. It also emphasized how this coordination is increasingly determined by large global buyers such as retailers and brand marketers (Gereffi and Korzeniewicz 1994). The difference between the GCC and Porter's (1985) approach to the value chain is that the former focuses on inter-firm linkages while emphasizing on governance structure between several actors whereas the latter focuses on intra-firm

linkages of several activities. In addition, the GCC concept highlights that VC is driven by two interrelated elements: the nature of final consumer markets and the process of globalization (Neven, 2014).

2.1.6 Inclusive business model (IBM) (2005)

Inclusive business model (IBM) refers to a set of vertically layered networks of horizontal ties within an industry. Here, the inclusiveness comes from the type of value identification, value creation and value capture but more importantly, from value sharing with smallholders or smaller links in the chain (Sanchez and Ricart, 2010). IBM only addresses a particular challenge at a time and considers the least among the VC actors such as smallholders (Sanchez and Ricart, 2010). IBM is more manageable than the broader and more complex VC concept because it links marginalized producers to a particular actor at a time (Neven, 2014). The author also commented that the concept is more narrowly focused, making the achievement of economies of scale a challenge. The concept is a market-based arrangement that provides opportunity to create livelihoods for the poor through creating value by producing and delivering quality products and services to the end user (Pastakia, 2012).

2.2 The concept of agricultural value chain (AVC)

VC is also sector-specific (agriculture, manufacturing and industry). Agricultural value chain (AVC) in particular is also commodity-specific, with actors of the particular commodity conducting different or similar activities to bring a product from conception (or production) through the different phases of distribution to consumption, with the aim of increasing the value of the final product (Casuga *et al*., 2008).

In the narrow sense, AVC is simply a value added route that crops and animal products pass from the farm-to-plate. It consists of a group of actors that are interlinked or networked in a systemic nature (Gereffi and Korzeniewicz, 1994; Webber and Labaste, 2010). In the broadest sense, AVC is a system of people, organizations and activities needed to create a process and deliver agricultural products from producers to consumers in a form of value addition (Zakic *et al*., 2014). At each stage in the value chain, the product changes hands through the actors, transaction costs are incurred which raise the product price through value addition or creation (Anandajayasekeram and Berhanu, 2009). At the farm level, the value addition results from diverse activities including bulking, cleaning, grading, packaging, transporting, storing and processing.

AVC actors can be categorized into two groups: primary and secondary actors. The primary actors (such as include input suppliers, producers, assemblers/aggregators, traders, wholesalers, processors, retailers, and consumers) are those involved directly in the activities of production-to-consumption whereas the secondary actors such as financial providers, extension and business service providers, bankers, government,

and researchers) are those who conduct indirect services to enable the chain function properly. In fact, the primary actors and secondary actors must co-exist to maximize benefits in the whole value chain.

AVC serves as an entity for analyzing a particular commodity or group of commodities, with emphasis on activities that are linked vertically by market relationships and horizontally by institutional power or group formation. AVC has the potential to create many decent-paying jobs for most poor people and generating higher income in developing countries (Nedelcovych and Shiferaw, 2012; Ferris *et al*., 2014; Zakic *et al*., 2014). AVC is a good avenue for addressing the rapidly changing market requirements, especially with regards to international trade standards (Webber and Labaste, 2010).

AVC enables smallholder farmers adapt to tremendous changes from consumers in relation to quality and safety (Trienekens, 2011). Also, AVC is a special gauge for smallholder farmers to meet and balance buyer demand (Ellram *et al*., 2007) as well as to build and maintain long-term buyer relationships by continuously understanding what consumers want. It also enables them to gain better control over production due to their low capacity to mobilize resources, and access information and credit. AVC increases coordination of activities that are linked vertically by market relationships and horizontally by institutional power or group formation. It is a tool for addressing low the capital injection, low adoption of improved technologies, low innovation and skill development and low profitability in agriculture. Smallholder farmers can benefit from the chain by acquiring greater access to farm inputs, including improved technologies, knowledge on modern farming practices, ready or guaranteed markets

and financial products and services such as credit, insurance and other securities (Mutura *et al*., 2016).

AVC has various features: value added, linkages and coordination, governance, networking and information flow and upgrading. Below is a summary of the features of the AVC.

2.2.1 Value addition

One unique characteristic of VC is the added value to the product which results from activities and processes (such as storage, delivery (transportation), and processing) that increase the quality of the product. At the farm level, value addition occurs when the product is transformed through processing or preservation - cleaning, sorting, grading, transportation and storage. Traditionally, value added along the chain is an indicator of income shares (Gereff *et al*., 2001). So to obtain the best value requires firms to adopt improved technologies for appreciating the quality of the product to satisfy customer needs and values (Feller *et al*., 2006). The value can be generated from Business to Business (B2B) or Business to Consumer (B2C) (Feller *et al*., 2006).

There are three forms of B2B: technical value, organizational value and personal value. Technical value originates from the resource being provided and it occurs in virtually all exchanges. The technical value is intrinsic in nature (Feller *et al*., 2006). Organizational value on the other hand is built upon the context of the exchange, and may be derived from a range of factors such as ethical standards, environmental considerations, prestige, reliability and associations. Finally, personal value is obtained from the personal experiences and relationships involved in the exchange of resources and benefits provided. Technical and organizational values accrue to firms

involved in commercial exchanges whereas personal value accrues to the individual (Feller *et al*., 2006). Also, all activities and producers that do not contribute to meeting the customer needs and expectations are considered as "non-value-added" (Feller *et al*., 2006).

2.2.2 Linkages, relationships and coordination

Vertical and horizontal linkages are important source of information and technical assistance for process upgrading and contracts (USAID, 2006). In the agricultural value chain (AVC), the vertical linkage may be formed by input suppliers, farmers/producers, aggregators (assemblers), wholesalers, processors, retailers, commission agents, cooperatives and commercial investors. Porter (1985) explained the chain coordination as having vertical and horizontal linkages. The vertical linkage refers to the relationship between different actors performing different activities. This type of relationship is mainly through input and product markets. It is the relationship between input dealers and producers, input dealers and traders, producers and traders, producers and processors, producers and exporters as well as producers and consumers.

The input dealer or trader establishes an input or output market relationship with a producer to provide or buy an input or produce from the farmer. Vertical linkage has direct influence on farmers' participation in value chains because it increases and stabilizes farmers' access to markets. So through the formation of strong vertical linkages, farmers are able to gain access to market demand that can absorb their supply. A strong linkage provides a stable income through price and quantity (quality) assurance. USAID (2006) showed that cooperatives constitute an important link

between small scale farmers and specialized markets. Peterson and Wysocki (1997) opined that in vertical linkage, factors such as price; quantity; quality; and terms of exchange can be controlled by joint commitments and investments by the actors in the chain.

In contrast, horizontal linkage refers to relationship among members of the same enterprise or firm performing similar functions. It includes group formation and networking. At the farm level, producers may share information and ideas on market and production technologies to increase their productivity. They normally have similar characteristics and base their relationships on trust. Cooperatives are usually formed in order to have access to inputs and outputs markets at a reduced transaction cost whilst improving their negotiation power (Kherallah and Kirsten, 2002; Bijman, 2007). They form networks which enable them to share information among themselves. The horizontal linkage enables farmers to reduce their transaction costs by aggregating individual buyer and seller power to achieve collective efficiencies (Raswant and Khanna, 2010). Szabó (2002) indicated that the main incentives for forming cooperatives are that traditionally cooperatives enable access and secure markets for the long term. From the literature, (Mutura *et al.*, 2016; Issa and Chrysostome, 2015; Vroegindewey, 2015; Benmehaia and Brabez, 2017) participation in vertical linkage seems to be low compared the horizontal linkage participation.

Figure 2.1 shows the various linkages that exist between farmers and the other value chain actors. At the farmer level, there are two main linkages: vertical and horizontal linkages. The vertical linkages are relationships among different actors. These could

be between an input supplier and a farmer, a farmer and a buyer, a farmer and a processor, among others. These relationships are strengthened by contracts. Contractual arrangements between farmer and input supplier relationship give rise to input market participation while farmer and buyer relationship, farmer and processor relationship as well as farmer and consumer relationship give rise to output market participation. The horizontal linkages are relationship between similar actors such as farmer-to-farmer, processor-to-processor, etc. (see Figure 2.1).

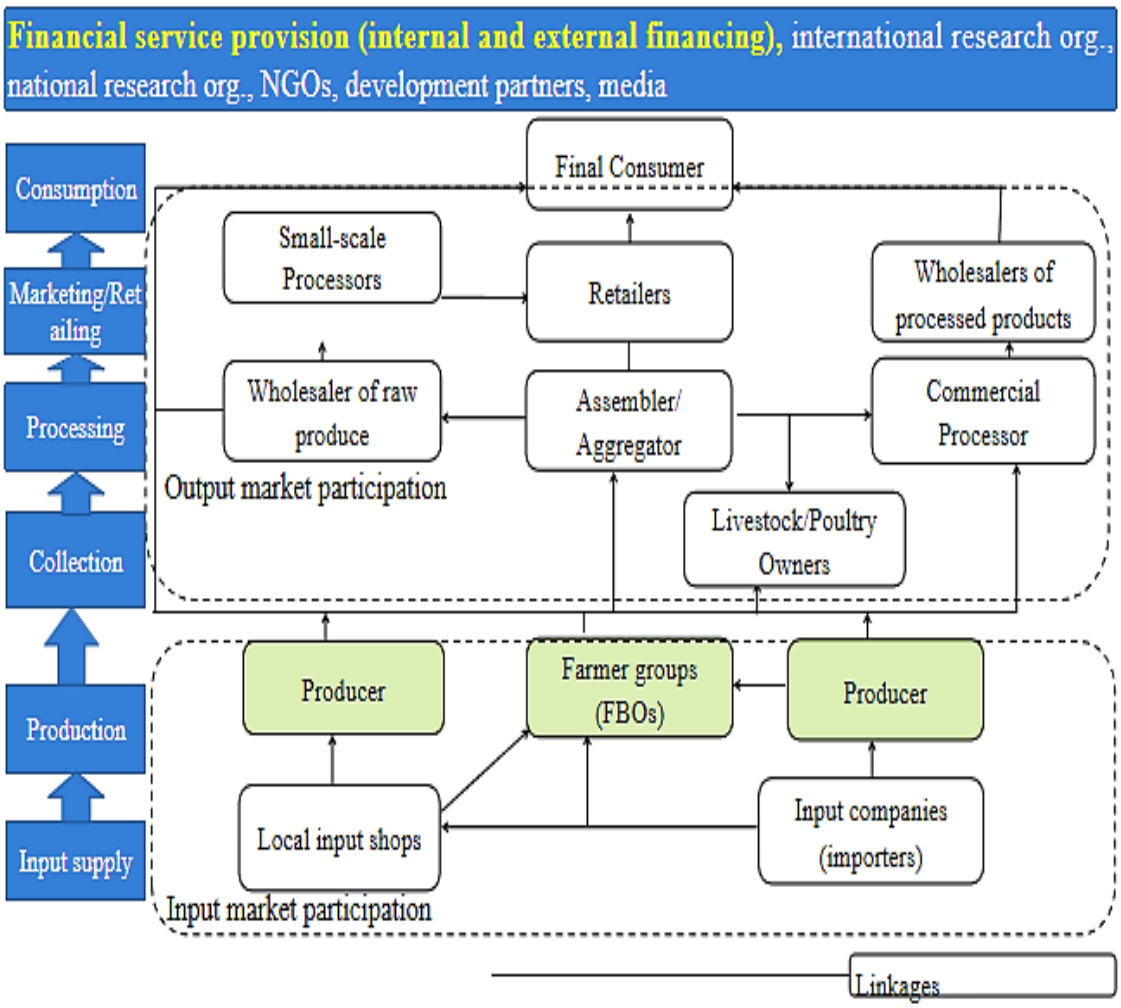


Figure 2. 1: Example of value chain mapping

2.2.3 Governance in value chain

Governance in VC is particularly important for the generation, transfer and diffusion of knowledge leading to innovation, which enables firms to improve their performance (Humphrey and Schmitz, 2002). Governance occurs when some actors within the chain work according to the parameters set by others (Dolan and Humphrey, 2000; Gereffi *et al.*, 2005; Humphrey and Schmitz, 2002; Ponte and Sturgeon, 2014). This form of control is referred to as internal governance.

Governance structure may also extend outside the chain from government agencies, international organizations and NGOs (Kaplinsky, 2000; Nadvi, 2008). Gereffi *et al*. (2005) noted that governance in VC relates to non-market coordination of economic activity within the chain. Governance in VC is the key concept for the top down view. It emanates from the requirement to set product, process, and logistic standards, which then influence upstream or downstream chain actors and results in activities, roles and functions (Humphrey and Schmitz, 2004).

Humphrey and Schmitz (2004) described governance in VC as the process of specifying, communicating and enforcing compliance with key product standards along the VC (Neilson, 2008). Gereffi and Fernandez (2011) explained that governance in the VC refers to the coordination and control mechanisms that different actors or facilitators exert over the activities when asymmetry of power emerges. The governance structure determines the power relations, and how financial, material and human resources flow within the chain. According to McCormick and Schmitz (2001), the power can either emanate from within the chain (internal control) or outside the chain (external control). This gives a formal shape to the VC and makes it different from other concepts. It is also important to understand that value chains can be differentiated based on the governance structure. Gereffi *et al*. (2005) deciphered VC into five categories: modular, market, relational, captive and hierarchy.

In the modular VC, suppliers produce products to meet customers' specifications, which may be more or less detailed Gereffi *et al*. (2005). However, when providing 'services' suppliers maintain full responsibility for competencies surrounding process technology, use generic machinery that limits transaction-specific investments, and

make capital outlays for components and materials on behalf of customers. In the market VC, market linkages do not have to be completely transitory, as is typical of spot markets; they can persist over time, with repeat transactions (Gereffi *et al.*, 2005). Relational VC on the other hand relates to complex relationships between buyers and sellers, which often create mutual dependence and high levels of asset specificity.

According to Gereffi *et al.* (2005), the interactions between actors may be managed through reputation or family and social groups over time. In captive VC, small suppliers are strongly dependent on much larger buyers, while suppliers face significant costs in an attempt to switch between products and are, therefore, 'captive'. Gereffi *et al.* (2005) explained that such networks are frequently characterized by a high degree of monitoring and control by lead firms. Hierarchy VC governance is characterized by vertical integration, and dominated by managerial control, flowing from managers to subordinates.

In the broadest sense, Fromm (2007) categorized the value governance structure into two broad structures: buyer-driven chains and producer-driven chains. Buyer-driven governance is different from producer-driven governance in that the former are normally commanded by big retailers, brand-name companies and merchandisers who are primarily involved in the coordination and outsourcing of labor-intensive production whereas the latter is largely influenced by multinational manufacturers or companies who own capital and technology-intensive industries (Gibbon and Ponte, 2005; Kaplinsky, 2005).

2.2.4 Networking and information flow

Networking is another invisible force that operates within and along the actors of the chain. Networking shows the connection between a farmer or group of farmers with other agents through information seeking or sharing of ideas. Networking is a system of partnerships and alliances that a firm creates to source and delivers its goods and services to its immediate and end customers (Kotler, 2003). A farmer may be networked with farmers or different chain actors such as aggregators, nucleus farmers, marketers, processors, consumers and even government officials, NGOs and traditional leaders in their locality or elsewhere (Kotler, 2003). Apart from the networking, the VC is also comprised of the flow of knowledge and expertise necessary for making the physical input-output structure to function (McCormick and Schmitz, 2001).

2.2.5 Upgrading

According to Gereffi (1999), upgrading is used to mean the ability of the firm to move to more profitable, technology-intensive, capital-intensive and skill-intensive economic niches. Upgrading involves processes by firms to increase skill content of their activities and/or move into market niches which have entry barriers (Humphrey and Schmitz, 2002). It focuses on the strategies the firm uses to maintain or improve their positions in the domestic and global economy. Basically, a firm is said to upgrade when it procures or adds new processes, knowledge and capabilities to improve upon existing products and increase the added value (Ponte *et al*., 2014). The aim of upgrading is to place actors at a more competitive state either by adding value to their products, processes or by acquiring new functional positions (Riisgaard *et al*., 2010; Ponte *et al*., 2014).

In the VC, upgrading can be distinguished into: process, product, functional and inter-chain upgrading (Humphrey and Schmitz, 2002; Kaplinsky and Readman, 2005). Product upgrading occurs when the firm moves into more sophisticated products with increased unit value while process upgrading occurs when inputs are efficiently transformed into outputs through reorganization of productive activities. Functional upgrading on the other hand occurs when the firm acquires new functions that increase the skill content of activities while inter-firm upgrading refers to a situation where a firm applies completeness acquired in one function of the chain for the betterment of different sections or chain. Product upgrading may not necessarily relate to activities that lead to higher value added but also strategies related to the product itself e.g., forward contracts and volume premium (Ponte *et al*., 2014). Process upgrading deals with the improved practices that do not make processes more efficient but allows agricultural firms to maintain and improve their position in value chains in periods of restructuring. Examples of process upgrading include matching strict logistics and lead times, delivering supplies reliably and homogeneously time after time, improving economies of scale; enhancing product qualities and compliance with food safety and sustainability standards.

Upgrading also refers to processes of producers in increasing their farming methods and producing quality products through the acquisition of new knowledge and technologies/innovations, which has direct implications for business performance and competition (Ponte *et al*., 2014). It also facilitates traceability, which has a direct impact on firm's reputation (Roheim *et al*., 2007). Upgrading is necessary for firms to catch up with key competitors and high quality preference from today's consumers (Brewin *et al*., 2009). For producers to increase incomes in the face of

competition, they must consider upgrading as an important dimension of business innovation (Humphrey and Schmitz, 2002).

2.3 Ways of linking farmers to AVC

The AVC itself is about minimizing risks and costs associated with production and marketing activities. Governments and development partners are concerned developing and introducing various intervention models to promote smallholders inclusion in AVC (Birthal *et al*., 2007; Zakic *et al*., 2014). From the literature, producer associations (farmer cooperatives/farmer-based organization) and contract agriculture (out-grower model and contractual arrangements) has major role in linking farmers to value chains.

It must be noted that no model is extremely faultless but each has a particular strength for associating farmers with their colleagues and other actors within the value chain (Fayet and Vermeulen, 2014; Zakic *et al*., 2014). Producer associations (PA) for instance, form the horizontal linkage of the AVC. Producer associations are any association that combines or joins numerous geographically scattered producers together with one faith, whose aim is to connect smallholder farmers to markets (Magnus and Steenhuijsen, 2010). Once producers come together under one umbrella, they are reduced to a single unit and this offers numerous opportunities for participating in AVCs (Zakic *et al*., 2014).

PA aim to amplify the voice and competitiveness of producers toward achieving economies of scale, reduce transaction costs, enhance bargaining power and improve access to market information, farm inputs, including credit (Gonzalez and Nigh, 2005;

Vermeulen *et al*., 2008; Devaux *et al*., 2009; Markelova and Mwangi, 2010; Trienekens, 2011). Thus, it becomes more proactive and efficient for other businesses to deal with producer association than individual smallholder farmers (Fayet and Vermeulen, 2014) because the private sector including buyers and banks can reduce their operational cost by dealing directly with PA (Zakic *et al*., 2014). Through PA, smallholder farmers can have ready access to extension, financial services, capacity building through training, price information and processing, because they enjoy social collateral, and this enhances smallholder farmers' inclusion in AVCs (Vermeulen *et al*., 2008).

Contract farming (CF) on the other hand is one of the business models that promote commercial agriculture (Ton *et al*., 2017). CF has been defined as a production system wherein farm products are bought in advance by firms in exchange for certain services and other benefits (Ton *et al*., 2017). In CF, one party (the producer) agrees to grow a crop (produce) at a pre-agreed market price for procurement by another party, usually a public or private company/corporation. CF is the contractual arrangement between farmers and a company, whether oral or written, specifying one or more conditions of production and or marketing (Roy, 1963). Both the producer (and group of producers) and the other business entity are bound by commercial relationship either by oral/written signed agreement that specifies the terms and conditions of the relationship between the two parties, including, but not limited to, the procurement prices (Sahota, 2013).

As a form of linkage, CF serves as the vertical relationship between actors of the AVC (Sahota, 2013). The relationship can exist between farmers or farmer groups and

individual buyers and companies. These buyers or companies provide the necessary inputs and environment for farmers to produce and later take their share of the products to cater for their investment. In CF, the farmer often receives farm inputs (and technical advice) and is expected to use (part of) the harvested produce to reimburse the contracting firm for the value of the inputs received (Ragasa *et al*., 2018). CF has been accepted against the backdrop that it protects the farmer against the risk of fluctuating crop prices on the commodity spot markets and the difficulties of finding buyers or consumers and increasing the production or supply of their crops (Federgruen *et al*., 2015).

Thus, CF enables farmers to meet ideal levels of market demands by overcoming overproduction or underproduction. CF basically enables farmers to set volume forecasts and quality requirements, predict prices and determine what kind of support can be expected. Another benefit of CF is the access to interest-free credit in the form of inputs that smallholder farmers usually enjoy. CF has also been found to reduce marketing and transaction costs and increase net profits of producers (Birthal *et al*., 2005; Ramaswami *et al*., 2006). In Ghana, CF has been found to significantly increase farmers' skills and knowledge in modern agricultural practices and output (Makafui, 2015).

In the Akwapim South Municipality of the Eastern Region of Ghana, a typical example of contract farming is provided by Blue Skies Company; and Ghana Oil Palm Development Company Limited (GOPDC) Out-grower scheme. In northern Ghana, the most well-known CF schemes are organized mainly for maize such as the Masara N'arziki CF scheme, IWAD CF scheme, Premier Food Limited Out-grower

scheme and the Akate CF scheme (Ragasa *et al*., 2018). There are also several other informal maize CF schemes operating for several years in northern Ghana and led by aggregators or traders (Ragasa *et al*., 2018). Some CF are usually a sale contract where farmers are contracted by commercial buyers or marketing firms to deliver a specified quality and quantity of produce at a specific price at an appointed future time. In this case, the produce are either taken-up by buyers at the farm-gate or transported by the producers to the source of the buyer. In the latter, the transaction cost is usually taken care of in the contract by the two parties. However, they can also improve the access to financial inputs. The CF model is usually used by development partners such as USAID-ADVANCE.

CHAPTER THREE

REVIEW OF THEORETICAL AND EMPIRICAL LITERATURE

3.0 Chapter overview

This section contains discussions of theoretical concepts and empirical studies on AVC participation, access to agricultural credit, farm incomes and loan repayment. The first section identifies and explains the various theories of producer behaviour and decision-making related to the concept of participation/access to credit/loan repayment. The second section is a review of analytical methods employed in the estimation or measurement of producer behaviour and decision-making regarding AVC participation, access to credit, loan repayment and farm income. The third, fourth and fifth sections discuss previous studies on AVC participation, access to credit, farm income and loan repayment. The last section is the conclusion of the chapter.

3.1 The concept of credit

Historically, credit comes from the Latin word Credo which means I Believe, or I Trust or I have Faith. Also, credit is often interchanged with loan (Denkyirah *et al*., 2016). But the former is very broad and includes the latter. In other words, credit is simply a loan (cash credit) or an item/service other than physical money, e.g., farm inputs (fertilizers, improved seeds); mechanization (ploughing, harrowing) and labour (Denkyirah *et al*., 2016). The term credit refers to the "monetary" or financial aspect of capital resource (OlajileL, 1975). This capital resource or source of fund can be

used by farmers in the production process (Awotodunbo, 2008). Murray (1953) defined agricultural credit as an economic study whereby farmers borrow funds from lending agencies at an interest rate for agricultural purposes with the intention to repay within a stipulated time. In this sense, agricultural credit can be considered as a major determinant of accessibility to all other production resources which farmers depend on in times when own income is missing or inadequate.

There are two main credit lines: macro-credit and micro-credit. Macro-credit lines are those raised from different sources within the whole economy. In other words, macro-credit primarily deals with financing agriculture at the aggregate level. This type of agricultural financing usually emanates from government loans and donor funding. Macro-credit also follows basic lending procedure, rules, regulations, monitoring and controlling of different agricultural credit institutions. In contrast, micro-credit lines are usually small loans given to individual farm business units and concerned with the study of how the individual farmer considers various sources of credit, quantum of credit to be borrowed from each source and how he allocates the same among the alternative uses within the farm.

Micro-credit is also concerned with the future use of funds at the farm level. The main difference between macro-credit and micro-credit is that the former deals with the aspects relating to the total credit needs of the agricultural sector, the terms and conditions under which the credit is available and the method of use of total credit for the development of agriculture, while the latter simply refers to the financial management of individual farm business.

Another common classification of agricultural credit is formal, semi-formal and informal credits (Badiru, 2010). Formal credit is a type of credit that is provided by registered companies that are licensed to offer financial services by a central monetary authority such as commercial and development banks. Their main purpose of existence of formal financial institutions is to make profit and for the rural areas, there are Rural Community Banks (RCBs).

More recently, products offered by microfinance institutions have also been classified as formal financial products since the providers are also regulated (Steiner *et al.*, 2009). These financial entities are typically regulated, subject to tax authorities and may provide other specialized or personalized services such as advisory, portfolio management or retirement planning (Steel and Andah, 2004). Such services are quantifiable and their impact in the national economic environment can be measured or monitored. The formal financial institutions are largely based in urban areas and are concentrated with deposit and lending activities.

Semi-formal credit is a type of credit provided by institutions which are registered to provide financial services and are not controlled by a central monetary authority such as NGOs and Credit Union Association (Steel and Andah, 2004). The Credit Union Association (CUA) is similar to ARB Apex Bank; however, it does not have any control over portfolios. There are some credit unions that operate within banks whose tasks are to look for clients and to report back to the bank (Gyamfi, 2012). Finally, informal credits are those provided by financiers who operate outside the regulated monetary system and these include the activities of intermediaries such as relatives and friends, traders, families, community groups, money lenders and NGOs

(Kashuliza *et al*., 1998). In fact, they make the bulk of financial service providers in most developing countries.

Most importantly, it is the largest financial sector in rural areas due to the fact that most rural folks are usually constrained by factors such as lack of education, income level, means of transportation and banking formalities – proof of address and other documents required for formal financial services. The informal financial sector is characterized by familiarities and trust. They operate on no standardization. Their services are typically not regulated or legally recognized and hence assessing their contribution to national development is almost impossible (Steel and Andah, 2004).

From the literature, the decision to access credit is often contingent on the sources of credit for agricultural production. Onumah (2003) reported that most rural borrowers are not attracted to formal financial institutions because they cannot meet the minimum requirements and are perceived as high risk borrowers. Badiru (2010) also asserted that there are many other reasons for lack of patronage of formal credits. First the complex mechanism of commercial banking usually limits small-scale farmers' access to credit (Agnet, 2004). Rahji and Fakayode (2009) also blame the limitation on imperfect and costly information problems encountered in the financial markets; credit rationing policies; and banks' perception of agricultural credit as a highly risky venture.

3.2 Theoretical framework for producer behaviour and decision-making

In economic literature, many theories have been used to explain producer behaviour and decision making. Among these theories are: the traditional theory of utility, Lancaster theory of demand, threshold decision-making theory, rationality theory, bounded rationality theory, prospect theory, inter-temporal theory, delegated monitoring theory, information asymmetry theory, and transaction cost theory (Scholtens and Wensveen, 2003). Nonetheless, the current study concentrates on the theory of satisfaction and threshold decision. This is because; the two theories depend on utility (satisfaction) which is the basis for farmers' decision to commit resources into production.

Farmers' decisions regarding agricultural interventions (AVC participation, credit programmes; and loan repayments) unusually depend on expected utility to be derived and are often self-selecting and voluntary. Farmers have full authority to enter or exit from a project or an intervention. These decisions or behaviours are usually studied with the traditional theory of utility and the threshold decision-making theory proposed by Hill and Kau (1973).

The traditional utility-maximization theory states that economic agents choose an option only if the net utility associated with participation is greater than the utility from alternative sources (Loureiro and Umberger, 2007). According to Hill and Kau (1973), the threshold decision-making theory also states that when a farmer is faced with the decision to adopt or not to adopt an innovation (in this case participate in AVC, access credit or repay loan), he/she has a reactive threshold which is dependent

on a certain set of factors. Below the threshold, no reaction is observed while at the critical threshold value a reaction is stimulated.

3.3 Measuring producer behaviour and impacts of farmers' decision-making

The section identifies and discusses the various econometric approaches that are used in analyzing farmers' participation decision in AVC, credit access, crop income and loan repayment. AVC participation is used to mean farmers participating in vertical and or horizontal linkages of the AVC. The AVC vertical linkage (AVC-VL) participation is used to mean farmers contractual arrangements with VC actors at different levels while the AVC horizontal linkage (AVC-HL) participation is usually used to denote farmers' belonging to agricultural cooperatives groups (Key and Runsten, 1999; Barrett *et al*., 2010; Mutura *et al*., 2016). In other words, the former occurs if a farmer has relationship with the input and/or output markets which is strengthened by contract and governance while the latter happens if the farmer joins a farmer-based organization (FBOs) or an agricultural cooperative. For VC to work efficiently the AVC-VL and AVC-HL must work hand in hand. Group membership can be strengthened by contracts through higher collective marketing, bargaining power and upgrading (Coulter *et al*., 1999; Kherallah and Kirsten, 2002). Linking farmers to VC actors enables them to access ready inputs and produce markets through contracts while belonging to FBOs helps farmers to engage in market arrangements, access ready inputs including credit and have access to production training.

The most commonly used econometric approaches for estimating the determinants of the probability of farmers to participate in AVC (AVC-VL and AVC-HL) include the

Linear Probability model (LPM), Logit model, standard Probit/Logit models, Multinomial probit/logit models and Multivariate probit/logit models (Bivariate Probit/Logit model) (Abdul-Rahman and Donkoh, 2015; Issa and Chrysostome, 2015; Awotide *et al*., 2015b; Mutura *et al*., 2016). In terms of the extent of AVC-VL participation, OLS regression, censored regression (Tobit model) and truncated regression model and Heckman selection models (incidental truncated model) are used (Issa and Chrysostome, 2015).

Access to credit from the borrower-side is used to mean farmers applying and receiving credit (either in-cash or in-kind) from various financial institutions. A farmer is said to have accessed credit only if he/she applies and receives credit from financial institutions (formal and informal). Access to credit can be measured as "binary ". The LPM and standard Probit/Logit models are employed to estimate binary choice outcomes (Mohammed *et al*., 2013; Assogba *et al*., 2017). Also, access to credit can be measured as a multiple choice. In this context, the Multinomial Probit/Logit models, Multivariate (Bivariate) Probit/Logit Models and Ordered Probit/Logit models are used (Awunyo-Vitor and Abankwah, 2012; Mohammed, 2013). In terms of the amount of credit access, OLS regression, censored regression (Tobit model), truncated regression model and incidental truncated regression (Heckman Selection models) are employed (Etonihu *et al*., 2013; Anang *et al*., 2015; Saqib *et al*., 2017).

3.3.1 Discrete choice models

Discrete choice models are basically used to analyze categorical variables. These variables can be binary or more. For a binary choice dependent variable analysis, the Linear Probability model (LPM) and the standard Probit/Logit models are used while for multiple choice (categorical) dependent variable analysis, the Multinomial Probit/Logit models, Multivariate (bivariate) Probit/Logit models and Ordered Probit/Logit models are mainly employed. The LPM is basically an OLS regression on a binary choice variable. Although, the LPM has the advantage of linearity in parameters, easiness and simplicity in its calculation of the explanatory variables over the probit and logit models (Pindyck and Rubinfeld, 1981; Amemiya, 1981), it normally suffers serious defect as its estimated probability values fall outside the zero-one interval and also produces constant marginal effects (Maddala, 1983; Capps and Kramer, 1985).

The standard Probit and Logit models are non-linear model which estimates binary choice variables with standard distribution functions to overcome the defect of the LPM which produces probability values outside zero-one interval (Maddala, 1983; Wooldridge, 2002). The Probit and Logit models produce non-constant marginal effects because they are calculated at different levels of the explanatory variables (Maddala, 1983). In view of this, Probit and Logit models are mostly used when the dependent variable is binary compared to the LPM (Maddala, 1983; Liao, 1994; Gujarati, 2004). However, the Probit and Logit models are similar which makes it very difficult to select one over the other as they all produce almost the same results. From most arguments, the choice of the Logit model over Probit model lies in its simplicity of computation of the logistic distribution. Also, the Logit model may be

preferred to the Probit model because its probability approaches zero (0) at a slower rate as the value of explanatory variable gets smaller and smaller while the probability approaches one (1) at a slower as the value of the explanatory variable gets larger and larger (Gujarati, 2004).

Hosmer and Lemeshew (1989) stressed that the logistic distribution has advantage over the others in the analysis of binary choice outcome variables and that it is extremely flexible and easily to use and results produced can be given meaningful interpretation. The Logit model is powerful, convenient, flexible and usually chosen if the dependent variable is categorical in nature (Maddala, 1983). In modeling binary choice variables using the probit or logit models as specified by Goldberger (1964), Maddala (1983), Gujarati (2004) and Greene (2003), we assume that there is an underlying latent (unobservable) response variable which is linearly related to a deterministic component and an error term.

Multinomial Probit/Logit models are used to analyze categorical dependent variables which are uncorrelated and mutually exclusive. Similarly, Ordered Probit/Logit models are applied to categorical dependent variables which are ordinal and finite. In the case of multiple correlated binary choice dependent variables, the Multivariate Probit/Logit Models are used (Chib and Greenberg, 1998; O'Brien and Dunson, 2004; Xu and Craig, 2010). The Bivariate Probit/Logit models are employed to only two binary choice correlated variables while the Multivariate Probit/Logit models are applied to more than two multiple correlated variables. The Multivariate Probit/Logit models differ from other empirical specifications of the choice problem with multiple outcomes such as the Multinomial Probit/Logit models because the Multivariate

Probit/Logit models do not respect the assumption of the independence of irrelevant alternatives (Chib and Greenberg, 1998). Chib and Greenberg (1998), O'Brien and Dunson (2004) and Obrizan (2010) emphasized the Multivariate Probit/Logit models are suitable when the choice between multiple choice outcomes are associated with a possible simultaneous decision process or one binary response variable is at least correlated with the other. In order to determine that certain decisions are substitutes or compliments, Multivariate Probit/Logit models are appropriate (Awunyo-Vitor and Abankwah, 2012).

3.3.2 Sample selection and treatment effect models

Heckman selection model is the foundation of all other sample selection models. In general, the Heckman selection model has been popularly applied to dependent variables that have some values missing as a result of a non-random sampling or self-selection process. Heckman's 1979 work offers a simple two-step estimator for correcting sample selectivity. The first step consists of a single probit model as the selection equation while the second step consists of a single OLS model as the outcome equation (Heckman, 1979).

Heckman (1979) recognized that estimating a choice problem such as effect of employment on wages by ordinary least squares (OLS) leads to biased inconsistent estimates because there could be observed and unobserved heterogeneity in the outcome variable due to sample selection. Instead, the first equation (also known as the selection equation) is usually modeled with a probit to obtain the inverse Mill's ratio (IMR) which is further included in the substantive (outcome) equation in the second stage as an additional explanatory variable to produce unbiased, consistent and

more efficient parameter estimates (Heckman, 1979). The second equation (outcome equation) describes and quantifies the determinants of a certain continuous variable while testing and correcting for selectivity bias.

Sample selection bias can also occur in a Multivariate (bivariate) Probit/Logit model if the unobserved factors determining the inclusion in the subsample are correlated with the unobservable factors that affect the endogenous variable of interest (Vella, 1998). To account for the incidental truncation due to self-selection, it is important to consider the endogenous variable as part of the disturbance term, by estimating the system of selection equations simultaneously to correct for both correlations in the variance-covariance matrix and the selectivity bias. Greene (2010) proposed Multivariate (bivariate) Probit/Logit models with sample selection. It is basically an extension of the standard Probit model with sample selection. The model first estimates one selection equation using the standard Probit model to obtain the IMR, which is estimated as an additional explanatory variable in the multiple correlated binary variables using the Multivariate (bivariate) Probit/Logit models. However, this model is able to account for unobserved heterogeneity in the sample.

The Treatment effect models on the other hand is important for drawing causal inferences on the impact of intervention on a particular outcome such as the impact of participation in interventions on income (welfare), productivity/efficiency, access to credit, loan repayment, among others. In such cases, the treatment groups are often selected on non-random basis and for that matter the selection decision are likely to be influenced by both unobserved (e.g., managerial skills, motivation, and land quality) and observed heterogeneity that may be correlated to the outcome of interest, and lead

to sample selection bias (Wooldridge, 2002; Antonakis *et al*., 2010; Shiferaw *et al*., 2014). The difference between the Heckman treatment effect model and Heckman selection model is that in the former, the treatment (selection) variable directly enters the outcome equation as an additional explanatory variable. Also, in the Heckman treatment effect model, the observations in the outcome variable are observed for both the treated and control groups.

3.4 Empirical studies on AVC participation

Several analysis have gone into AVC to understand how finances and technology (as in mechanization) affect AVC actors using qualitative analysis (Middelburg, 2017); conditions under which technology transfer within value chains occur (Swinnen and Vandeplas, 2011; Swinnen *et al*., 2015) and factors that promote the success of financial flows through the chain (Oberholster *et al*., 2015). Others have also analyzed the determinants and productivity as well as welfare (income) impacts of AVC participation (Asante *et al*., 2011; Arumugam *et al*., 2011; Musara *et al*., 2011; Adong *et al*., 2012; Fréguin-Gresh *et al*., 2012; Bellemare, 2012; Wainaina *et al*., 2012; Tolno *et al*., 2015; Fakudze and Machethe, 2015; Kolleh, 2016; Kimutai and Chepchumba, 2016; Mutura *et al*., 2016; Warsanga *et al*., 2017). These studies on AVC participation can be distinguished into AVC-VL participation and AVC-HL participation or both. Also, Kissoly *et al.* (2017) have analyzed smallholder participation in various aspects of the AVC such as number of improved input used, number of crop cultivated, average months of storage, engagement in processing, storage for selling, household subsistent share and engagement in collective action using descriptive analysis.

In Kenya, Fischer and Qaim (2012) using the probit model estimated the factors that determine farmer group membership (thus, AVC-HL) of farmers. The study showed that age of farmer, landholding size, value of agricultural equipment and mobile phone ownership seemed to be the significant factors influencing group membership. In the Eastern Region of Ghana, Asante *et al*. (2011) established using the probit model that farm size, farming as a major occupation, access to credit or loan and access to machinery services had a significant effect on farmers' decisions to join farmer based organizations (thus, AVC-HL).

In Nigeria, Awotide *et al*. (2015b) conducted a similar study to find out the determinants of smallholder rice farmers' participation in cooperative organizations (thus, AVC-HL) using the probit model in Nigeria. The study found age of farmer, gender, education, farm size and extension contact tend to be the significant factors affecting the probability of joining cooperatives. Tolno *et al*. (2015) utilized the Heckman selection model to investigate the determinants of group membership (thus, AVC-HL) and its effect on farm income of smallholder potato producers in Guinea and revealed that the age of farmer, gender, educational level, land ownership, extension contact, credit access and off-farm income were significantly related to the probability of joining farmer groups. Benmehaia and Brabez (2017), also examined the factors that affect farmer group (thus, AVC-HL) participation of peasant farmers in Northern Algeria using the probit model and found that age of farmer, education, farm structure, farm size, seasonality and geographical location were significantly related to the likelihood to participate in horizontal linkage by farmers.

The differences between studies by Fischer and Qaim (2012); Asante *et al*. (2011); Awotide *et al*. (2015a); Tolno *et al*. (2015); Benmehaia and Brabez (2017) and that of the current study is that while the current study seeks to analyze the extent and the determinants of farmers' participation in both AVC-VL and AVC-HL, the former only estimates the determinants of AVC-HL participation, so the interrelationships between AVC-VL and AVC-HL are not known.

Mutura *et al*. (2016) analyzed the factors influencing vertical integration (thus, AVC-VL) and horizontal integration (thus, AVC-HL) among smallholder dairy farmers in Lower Central Kenya using the logit model and concluded that factors (such as total fixed investments, enterprise's turnover and volume of output were significantly related to the likelihood to participate in AVC-VL while gender of the household head, age, education, distance from farm-to-markets, size of landholding, milk output were identified as the significant determinants of the likelihood to participate in AVC-HL. However, the interrelationship between AVC-VL and AVC-HL was not determined by the authors.

In Rwanda, Issa and Chrysostome (2015) employed the probit model to examine the factors influencing farmer participation in vertical integration (thus, AVC-VL) and the tobit model to determine the factors influencing the intensity of vertical integration in the coffee industry. The study found that gender of farmer, education level, farm size, off-farm income, credit access and record keeping were the significant determinants of the probability of participation in vertical linkage while off-farm income, credit access, farm size, farming experience, crops cultivated and farm contract agreements were shown to be the significant factors influencing the

intensity of vertical linkage. However, the authors did not correct for selectivity bias in farmer participation in vertical integration (AVC-VL) using Heckman selection model.

In the northern region of Ghana, Abdul-Rahman and Donkoh (2015) examined the determinants of the probability of farmer participation in ACDEP/PAS VC using the probit model. The study revealed that age of farmer, marital status, farm size and the perception that participation enhances one's market access had a significant influence on the probability of farmer participation in ACDEP/PAS value chain. The difference between Abdul-Rahman and Donkoh (2015) and the current study is that the former studies only analyzed the determinants of farmers' participation in AVC while the current study analyzes the extent and determinants of farmer participation in both AVC-VL and identifies the determinants of AVC (as well as AVC-VL and AVC-HL). The current study utilizes the Heckman selection model to estimate the extent of farmer participation in AVC-VL contracts and the bivariate probit model to analyze the determinants and interrelationships between farmer participation in AVC-VL and AVC-HL.

In a study to identify the determinants of vertical integration (thus, AVC-VL) and horizontal integration (thus, AVC-HL) among smallholder dairy farmers using the logit model, Kimutai and Chepchumba (2016) revealed that investment cost, income, volume of milk sold and external source of milk exerted a positive and significant effect on the probability of participating in the vertical linkage of the dairy value chain while education, experience in dairy farming, farm size, monthly turnovers, training and willingness to pay for information were found to be the significant

factors influencing the likelihood of farmers participating in the horizontal linkage of the dairy value chain. However, their study did not encounter potential simultaneity in decisions to participate in vertical and horizontal linkages which this study seeks to analyze using the bivariate probit model, given that farmers may participate in a mix of interventions to deal with a multitude of agricultural production constraints (Barrett *et al*., 2010).

In Tanzania, the study by Sambuo (2014) to examine the factors influencing smallholder farmers' participation in tobacco contract production using the Heckman two-step model showed that farming experience, farmer group and age of the farmers were significant in affecting farmers' participation in contract farming. In India, Narayanan (2010) established that access to irrigation water was a significant factor that increases farmers' participation in gherkin CF. Distance to markets on the other hand has been found to increase the likelihood of participating in CF but in other instances reduce it (Wainaina *et al*., 2012). In northern Ghana, Etwire *et al*. (2013) used the probit model to reveal the determinants of farmers' participation in agricultural interventions (AVC mentorship projects). The study found that education of farmer, access to credit and extension are factors that significantly determine farmers' participation in agricultural interventions. Also, Azumah *et al*. (2016) in a study to determine the factors that influence farmers' decision to participate in contract farming in the Northern Region of Ghana using the treatment effect model revealed that access to extension services and credit positively influenced participation in contract farming whereas farm size and off-farm income negatively influenced participation in contracting.

3.4.1 Factors influencing AVC (AVC-VL and AVC-HL) participation.

This section explores further to compare and contrasts the factors influencing AVC-VL participation and AVC-HL participation from past studies. With regards to socio-demographic factors, age may tend to reduce farmer participation in AVC-VL (CF) than older and more-experienced farmers (Katchova and Miranda, 2004; Musara *et al*., 2011) because younger and less-experienced farmers are more accessible to new interventions and are eager to explore for reliable and assured sources of income to satisfy their needs. Older and more experienced farmers on the other hand tend to appreciate and gauge the importance of agricultural interventions (and innovations), and will devote much effect to explore its activities. In terms of education, highly-educated farmers may participate in AVC-VL (CF) (Arumugam *et al*., 2011; Escobal and Cavero, 2012) because of their ability to process, understand and practice information gained on agricultural inventions than their counterparts. Again, highly-educated individuals tend to have an additional source of income from formal (off-farm) employment to support their farming without engaging in contract farming (Miyata *et al*., 2009; Wainaina *et al*., 2012).

In terms of economic farmers, wealthier farmers may have lower participation in CF (Musara *et al*., 2011) because they have enough income to finance their farming business. Lack of agricultural finance is a major constraint limiting market participation and commercialization and smallholder resource-poor farmers will engage in contract farming to have access to capital inputs. Moreover, wealthier farmers can stock their produce for a longer time in scout for alternative markets where prices or returns are remunerative since they have enough income to spend on their basic needs. Farmers with larger farm size tend to have the opportunity to

increase production or grow more crops to serve the market and will need adequate financing and resources through contracting (Musara *et al*., 2011). Other farm assets such as livestock and machineries can easily been converted into capital inputs without engaging in contract (Fischer and Qaim, 2012).

From the literature, several explanations can be given to explain the mixed results between socio-demographic and economic factors and the likelihood to belong to FBOs (thus, AVC-HL participation). For instance, men may tend to participate more in AVC-VL than female; probably because in Africa, men often tend to decide or engage in the production of staples like maize and rice which are highly produced in the regions (Musyoki *et al*., 2013). Women on the other hand, may tend to have higher likelihood to participate in AVC-HL because they often face more cultural and economic barriers to production than men which drive them to search or participate in agricultural interventions (Othman *et al*., 2009; Ekepu *et al*., 2017) which readily provide production and marketing services without much difficulty.

In terms of age, older farmers who often lack the strength to do hard work will join FBOs to benefit from collective or communal labour to support their agricultural activities (Onumah *et al*., 2007; Fischer and Qaim, 2012; Tolno *et al*., 2015). Younger farmers with their limited experience in farming will belong to FBOs to benefit from greater access to production services. Older farmers sometimes feel complacent and work independently due to their higher experience and will rely less on group activities (Asante *et al*., 2011). With regards to education, highly-educated farmers may require more for doing white colour jobs than to participate in group activities, other things held constant. A household with more active members reflects a greater

amount of family labour for agricultural production and hence leading to lower participation in FBOs (Abdulai and Al-hassan, 2016).

In terms of farm-specific factors, access to more lands may influence farmers to belong to FBOs (Asante *et al*., 2011; Adong *et al*., 2012) in order to acquire more resources, including labour to increase agricultural production (Kimutai and Chepchumba, 2016). Smaller landholders on the other hand tend to have limited income and access to information and market contracts; hence, will rely heavily on group activities for their production and marketing needs.

With regards to institutional factors, farmers who live far away from markets will join FBOs to benefit from mass or collective services such as joint marketing for the sale of produce which reduces transaction cost (Fischer and Qaim, 2012; Adong *et al*., 2012). Also, farmers with extension contacts will join FBOs (Asante *et al*., 2011; Tolno *et al*., 2015; Ekepu *et al*., 2017) because they tend to receive greater information from extension agents (Asante *et al*., 2011). Extension agents regard FBOs as channels to demonstrate improved farming practices to a larger number of farmers at a time. However, the provision of extension services through group demonstration may not reflect individual needs and this could be a limiting factor to membership in FBOs (Adong *et al*., 2012).

Access to credit has also been found to be one of the key reasons why farmers join FBOs (Asante *et al*., 2011) due to the fact that FBOs often appeal and convince financial institutions to consider the social collateral and joint liability that exist among their members to provide them with credit. Again, financial institutions perceive financing through farmer groups or cooperatives as a strategy to reduce

operational cost compared to serving numerous geographically dispersed farmers individually. Communication gadgets like cellphones enhance farmers' knowledge of farmer groups and serves as a source of contact and information sharing with the group (Fischer and Qaim, 2012).

3.5 Empirical studies on credit access

This section compares and contrasts studies that examined the factors affecting farmers' access to credit.

Odu *et al*. (2011) carried out a study to measure the determinants of farmers' access to formal and informal sources of credit using the multinomial logit model in Nigeria. Their results revealed that experience in rice farming, income from rice farm and expenses on fertilizer input were the significant predictors of the probability of accessing formal credit whereas gender of farmer, duration of village residency, experience in rice farming and expenses on fertilizer input were identified as the significant factors influencing the probability of accessing informal credit in the Niger State.

In the Kogi East Senatorial District of Nigeria, Iliyasu *et al*. (2014) examined the factors influencing access to credit by farmers using the probit model. The study showed that age, marital status of farmer, household size, years of farming experience and membership of cooperatives were the significant factors affecting the likelihood of accessing credit.

Chauke *et al*. (2013) using the logit model measured the factors that affect smallholder farmers' access to credit sources in the Capricorn District Municipality of

Limpopo Province, South Africa. The study revealed that the credit needs of the farmer, risk attitudes, distance to financial institutions, perception on loan repayment, perception on lending procedures and total value of assets were the significant factors influencing access to credit.

Furthermore, Etonihu *et al*. (2013) used the stepwise linear regression to study the factors influencing smallholder farmers' access to credit. Their results showed that education of farmer, borrower-lender distance and types of credit source were the significant determinants of smallholder farmers' access to agricultural credit in Nigeria. Saqib *et al.* (2017) used heteroscedasticity corrected and weighted least squares regression with robust standard errors to identify the determinants of farmers' access to agricultural credit in Pakistan and found that education of farmer, household size, farming experience, total landholding, monthly income, and proportion of owned land significantly affect credit access.

In South Africa, Biyase and Fisher (2017) investigated the determinants of poor households' access to formal credit by estimating a Heckman Selection model. The study indicated that age of the household head, race, educational level, gender, employment, geographic location of households were significantly related to the probability of accessing credit. Chandio *et al*. (2017), using the probit model showed that gender of farmer, educational level, household size, farming experience, farm size, income, and availability of collateral to have a positive significant effect on farmers' access to credit in Pakistan.

Also in Benin, Assogba *et al*. (2017) used the logit model to measure the factors that affect farmers' access to credit. The study found that education of the farmer,

membership to farmer association, availability of a guarantor, collateral security and interest rate tended to have a significant influence on farmers' credit access. Asante-Addo *et al*. (2017) analyzed the factors influencing farm households' participation in credit programmes using the probit model and revealed that education of the household head and FBO membership significantly influenced farmers' participation in credit programmes.

Mohammed *et al*. (2013) also analyzed the interplay between social capital and access to credit by FBOs in the Karaga District of Northern Ghana using a logit model. The study found that homogeneity and social capital factors influence access to credit. Owusu (2017), using probit model to analyze the determinants of farmers' access to credit in Afigya-Kwabre District of Ghana revealed that gender of farmer, age, household size, farming experience, education level, farm size, hired labour, extension service and farmer-lender distance were significantly related to access to agricultural credit.

In the Upper West Region of Ghana, Sekyi (2017) studied the determinants of rural households' access to credit and loan amount using the Heckman selection model. From the probit model results, the study found that gender of farmer, age of farmer, type of occupation, credit history of the individual, and household income were statistically significant in influencing the probability of rural households' credit access while gender of farmer, education, marital status, trading, formal sector workers, distance and credit source were the significant factors influencing loan amount as indicated by the OLS regression results.

Awunyo-Vitor and Abankwah (2012) studied the determinants of access to informal and formal credit using the bivariate probit model in the Ashanti and Brong Ahafo Regions of Ghana. The study revealed that gender of farmer, regional location, engagement in other economic activities and the level of agricultural commercialization were significant predictors of farmers' informal credit demand while education of farmer and proximity to financial institutions had a statistical significant effect on formal credit demand.

Mohammed (2013) using the bivariate probit model showed that the demands for formal and informal credit are key substitutes to rice farmers in northern region of Ghana. The study also found that gender of farmer, education, household size, agricultural commercialization and location of farmer were the significant factors influencing the probability of formal credit demand while age of farmer, education, household size, level of agricultural commercialization, engagement in other economic activities and value of assets were the significant factors affecting the probability of informal credit demand.

The difference between Mohammed *et al*. (2013), Chauke *et al*. (2013), Etonihu *et al*. (2013), Sekyi (2017), Biyase and Fisher (2017), Chandio *et al*. (2017), Assogba *et al*. (2017) and Saqib *et al*. (2017) studies and the current study is that the former studies analyze access to credit as binary regression models which otherwise are insufficient in testing for potential simultaneity/interdependencies and selectivity bias in farmers' decisions to access formal and informal credits. Also the difference between the studies by Awunyo-Vitor and Abankwah (2012) and Mohammed (2013) and the current study is that the current study employs the multivariate probit model with

sample selection to test and correct for selectivity bias in loan repayment due to self-selection in farmers' participation in AVC. The standard bivariate probit model only tests for correlation between the error terms of the binary outcomes.

3.5.1 Factors influencing credit access

From the literature, the varying findings have been revealed on the relationship between access to credit and socio-demographic and economic factors (e.g., gender, age, marital status, education, household/family size and farming experience); farm-specific (e.g., landholding, farm size, livestock rearing and irrigation farming) and institutional factors (extension and FBO membership).

Male farmers tend to access credit (Koskey, 2013; Chandio *et al*., 2017) more than female farmers because in traditional societies, household production resources like land that serves as collateral for accessing credit are usually in the control of men (Tefera, 2004). Also, men are more risk-takers than women and thus more likely to undertake activities that offer higher returns if these opportunities require them to bear higher risk (Fletschner *et al*., 2010). In addition, men tend to have higher savings ability due to their engagements in multiple activities which increase their turnovers with financial institutions (Musuva, 2015). Women on the other hand are often perceived to be more earnest and trustworthy in repayment than men and this increases their access to credit.

Age or farming experience may increase access to credit (Koskey, 2013; Iyanda *et al*., 2014; Saqib *et al*., 2017; Chandio *et al*., 2017) because , older and highly-experienced farmers tend to have more networks/connections and information about credit facilities than younger farmers. In contrast, older and highly-experienced farmers tend

to make efficient use of the limited financial resources at their disposal for agricultural production and this may cause them to avoid credit. Also, younger farmers tend to have limited finance and may access credit in their quest to increase productivity and farm incomes due to their inexperiences in farming (Kuwornu *et al*., 2012; Denkyirah *et al*., 2016). Highly-educated farmers tend to access credit (Dzadze *et al*., 2012; Akudugu, 2012; Koskey, 2013; Muhongayirea *et al*., 2013; Etonihu *et al*., 2013; Hananu *et al*., 2015; Saqib *et al*., 2017; Chandio *et al*., 2017) because education has a tendency to increase potential borrowers' knowledge and understanding of credit facilities and their requirements (thus, terms and conditions) (Hananu *et al*., 2015).

Again, education increases ones' confidence in approaching financial institutions since highly-educated individuals exhibit greater aptitudes in presenting a clear plan on how to invest funds and reap sufficient returns to financial institutions. Moreover, highly-educated individuals tend to participate more in financial services due to their possession of salaried or savings accounts from formal employments which are used as securities for accessing credit. In contrast, highly-educated individuals are more likely to obtain additional income from formal employment to finance their farming business without accessing credit. Also, highly-educated individuals tend to have higher ability to read financial market signals like interest rates, which are usually high in developing countries and find it more unprofitable to access credit.

Marriage is a positive factor that increases access to credit (Vuong, 2012) because as a social institution it serves as a source of financial assistance (it is somewhat a financial institution) (Auma and Mensah, 2014). Thus, each spouse is a potential

lender. Furthermore, married couples are more likely to access credit from a spouse's relatives (Jappelli, 1990). In contrast, marriage serves as a credit screening institution where married couples' decisions to access credit may be screened and rejected by the other spouse depending on power and needs differences that exist between husband and wife. Household with more members may require credit for agricultural production (Vuong, 2012; Saqib *et al*., 2017; Chandio *et al*., 2017) because those households are consumption driven – which means that they spend a higher proportion of their disposal income on food products and other consumables. In contrast, households with more active people could obtain financial support from their household members to finance their farming business without accessing credit (Iyanda *et al*., 2014).

Access to household assets such as vehicles, houses, land, livestock among other, are often used as collateral to increase farmers' access to credit from formal financial institutions (Diagne, 1999; Mpuga, 2004; Mohamed and Temu, 2008; Vuong, 2012; Awotide *et al*., 2015a). Banks often utilize collateral to secure credit to reduce non-performing loans (Chandio *et al*., 2017). Moreover, assets like landholding (and farm size) serves as an important factor for increasing agricultural production which most formal financial institutions look out for when supplying credit (Awotide *et al*., 2015a; Saqib *et al*., 2017; Chandio *et al*., 2017). In contrast, households with more assets could easily convert some into cash to finance their production and avoid paying interest on credit (Duflo *et al*., 2008). Also, livestock such as cattle and goats can be sold to finance the farming business rather than accessing credit.

Access to extension services introduces farmers to credit information and facilities which tend to increase their access to credit (Dzadze *et al*., 2012; Muhongayirea *et al*., 2013; Etonihu *et al*., 2013). Also, membership in FBOs tend to expose farmers to credit facilities and information that increase their access (Mohammed *et al*., 2013; Kiplimo *et al*., 2015; Denkyirah *et al*., 2016; Alabi *et al*., 2016). Farmers in FBOs tend to enjoy group lending or social collateral or guarantee which increases their access to credit (Akudugu *et al*., 2009). Hadi and Kamaluddin (2015) explained that financial institutions rely on social collateral to distribute their microfinance loan and assess the ability of the borrowers in the loan repayments. In some instances, FBOs negotiate and mediate with financial institutions on behalf of smallholder farmers to access credit (Bijman, 2007). Moreover, farmers generally join FBOs with the aim of accessing credit (Asante *et al*., 2011; Okwoche *et al*., 2012).

Distance to bank is also an important factor that influence farmers access to credit as lack of physical access to banks caused by long distances and poor roads make credit accessibility in rural areas, especially in developing countries a serious challenge because borrowers incur more cost to reach financial institutions (Osei-Assibey, 2009; Wahiu and Kiritu, 2011).

3.6 Empirical studies on loan repayment

To improve and sustain access to agricultural credit to farmers, loan repayment is very important. This section identifies and contrast empirical studies that examine the factors that affect farmers' decisions concerning loan repayments elsewhere and in Ghana and beyond.

Awunyo-Vitor (2012), using the probit model investigated the factors that influence loan repayment by 374 farmers in five districts of the Brong Ahafo Region of Ghana. The results revealed that farm size, engagement in off-farm income work, loan amount, repayment period and access to training had a significant effect on the likelihood of loan repayment by farmers.

Furthermore, Wongnaa and Awunyo-Vitor (2013) studied the determinants of loan repayment by yam farmers in the Sene district of Ghana. Their results revealed age of farmer, education, experience, profit, supervision and off-farm income to have a positive significant influence on loan repayment performance while gender of farmer and marital status were found to have a negative significant influence on loan repayment by farmers. In Malawi, Chirwa (1997) examined the determinants of loan repayment by farmers using the probit model and revealed that the probability of loan repayment by farmers was significantly impacted by the availability of resources from crop sales and income transfers, the size of the club, the degree of diversification as well as the quality of information.

The difference between studies by Chirwa (1997); Awunyo-Vitor (2012); Wongnaa and Awunyo-Vitor (2013) and the current study is that the former studies measured

loan repayment (or default) as the binary decision of the borrower to payback the total loan accessed when it falls due while the current study measures loan repayment by farmers as the percentage of loan paid over the total amount of credit obtained when it falls due. Thus the dependent variable in this study is continuous which is likely to give better results than the ones whose dependent variable is binary (Maddala, 1983). Also, the current study estimated the effect of AVC participation on loan repayment by farmers as a selectivity bias problem using the Heckman treatment effect model.

Furthermore, Ugbomeh *et al*. (2008) used the OLS multiple regression model to determine the factors that affect loan repayment performance by women in self-help groups in Nigeria. The study found that household heads, household/family size, interest rates on loan, price stability of farm proceeds and commitment of members to self-help groups were the significant factors influencing loan repayment performance. Oladeebo and Oladeebo (2008) analyzed the factors influencing loan repayment of farmers in Ogbomoso Agricultural Zone of Oyo State of Nigeria using the OLS multiple regression model. The study found that age of farmer, education, farming experience and loan size had a statistical significant influence on loan repayment by farmers in Nigeria.

Also in Nigeria, Adinya *et al.* (2012) analyzed the determinants of loan repayment among fish farmers in Nigeria using the OLS multiple regression model. Their results revealed that the volume of credit granted to the fish farmer, as well as his/her fish farming experience, educational level, and income exerted a positive significant influence on loan repayment.

However, the studies by Ugbomeh *et al.* (2008), Oladeebo and Oladeebo (2008) and Adinya *et al.* (2012) differ from the current study in that the current study employed the Heckman treatment effect model to correct for selectivity bias in loan repayment due to self-selection into AVC participation by the farmers, which the OLS estimation approach couldn't address. Also, males produce more farm produce than females due to their farm sizes which may increase their loan repayment (Roslan and Karim, 2009). In contrast, females are perceived to be more earnest and trustworthy which increases their loan repayment. Marriage could exert a positive influence on loan repayment because married individuals are easily located and less likely go into hiding if they default a loan because of their relations (Jappelli, 1990). Moreover, married couples can jointly assist each other in repaying a loan (Jappelli, 1990). Higher education enables borrowers to conduct basic cash flow analysis and make the right decisions to increase production and this increases their loan repayment.

In Ethiopia, Gebeyehu *et al*. (2013) carried out a study to identify the determinants of loan repayment performance of smallholder farmers using a two-limit Tobit regression model. The study found that total landholding, total livestock holding, number of years of experience in agricultural extension services, purpose of borrowing, credit source and expenditure on social festivals had a significant effect on loan repayment.

3.7 Empirical studies on farm (crop) income

Farm income seems to be the most important remuneration for farmers after all days' work. It forms a significant portion of the household's total income since most rural farmers engage in agriculture as their only source of livelihood. It is therefore important to determine the factors that influence farm income in order to find ways to improve their standard of living.

In the Northern Region of Ghana, Azumah *et al*. (2016) analyzed the determinants of contract farming and its effect on farm income using the Heckman treatment effect model. Their results found that access to extension services and credit influenced contract farming participation while farm size and off-farm income negatively affected contract farming participation. Also, farm income of farmers was significantly affected by contract farming participation, land, labour, fertilizers and weedicides.

Similarly, Abdulai and Al-Hassan (2016) carried out a study to examine the effects of contract farming on 340 smallholder soybean farmers' income in the Eastern Corridor of the Northern Region of Ghana using the Heckman selection model. Their results showed that contract participation, age of farmer, education, household size, farm size, cost of ploughing and cost of pesticides were significantly related to soybean income.

Ibekwe *et al*. (2010) studied the factors influencing farm income among the farm households in Nigeria using the OLS regression model. Their results revealed that age

of farmer, education, farm size, and hours spent on farm were the significant variables influencing farm incomes of farmers.

3.8 Conclusion

The literature review captured both qualitative and empirical studies on AVC participation, access to credit, farm income and loan repayment. From the literature, there are different ways of studying AVC participation. Studies have analyzed AVC participation as farmers' membership to FBOs (Horizontal linkage), participation in contract farming (vertical linkage) and both. The results on these studies are mostly mixed and inconsistent. Similarly, the studies on access to credit are those on formal credit sources, informal credit sources and both. Access to credit still seems to be a major problem of smallholder farmers in Northern Ghana (Abdul-Rahman and Donkoh, 2015). However, the effect of AVC participation on access to credit is scanty and not explicit. The few studies only consider one aspect of the AVC (such as vertical linkage or horizontal linkage) at a time. There is also a limited connection between AVC participation, crop income and loan repayment in empirical studies.

CHAPTER FOUR

RESEARCH METHODOLOGY

4.0 **Chapter overview**

This chapter discusses the methods employed in the collection and analysis of the field data in order to achieve the research objectives. The first major section (Section 4.1) provides an introduction to the study area while the second section (Section 4.2) explains the research design, which also elaborates on the sampling techniques and sample size, data and data collection methods as well as the methods of data analysis. The third major section (Section 4.3) of the chapter explains the theoretical framework of the study. The forth section (Section 4.4) discusses the conceptual framework of the study. The final section of this chapter presence the analytical frameworks measuring the extent of AVC-VL contracts (sub-section 4.5.1); determinants of farmers' participation in AVC-VL and AVC-HL (sub-section 4.5.2); effect of AVC participation on access to formal credit and informal credit (sub-section 4.5.3); farmers' crop income (sub-section 4.5.4) and loan repayment (sub-section 4.5.5).

4.1 **Study area**

This study was done in Northern Ghana which is predominantly rural (about 30%) and an agricultural hub (MoFA, 2016). Northern Ghana comprises the Northern region (NR), Upper East region (UER) and Upper West Region (UWR). These regions mainly fall under the savannah zone and have a mono-modal rainfall pattern

which starts from March/April and ends in September/October, with an overall mean rainfall of 150-200 mm per annum (MoFA, 2016). This also means that farmers with no irrigated farms only produce once in a cropping season (Anang *et al*., 2015; Amanor-Boadu *et al*., 2015). The lack of irrigation facilities combined with bad weather and declining soil fertility is a source of food insecurity and poverty among most rural farmers in the area (MoFA, 2010).

Agriculture employs averagely 90% of the active rural population in these regions. The sector's (especially crop) production in these areas is largely done on smaller landholding sizes of less than 2 hectares on the average (MoFA, 2016). The yield levels of major cereals, especially maize and rice fall short of potential yields in the three regions (MoFA, 2016). The farmers are mainly food crop producers, producing mainly maize, rice, soybean, groundnuts, cowpea, guinea corn, beans, sweet potato, millet, sorghum, yam, cassava and most vegetables (MoFA, 2016). Most food crop farms are intercropped by smallholder farmers whiles monocropping is mostly practiced by larger-scale commercial farmers (MoFA, 2016). The main livestock reared in these regions include cattle, sheep and goats as well as swine and poultry.

These three regions put together contain a total of 50 districts; NR has twenty-six (26) districts whilst UER and UWR have thirteen (13) and eleven (11) districts respectively (GSS, 2014). According to the 2010 population and housing census (PHC) in Ghana, the population of the three regions is 4,228,116 (with NR having the highest (2,479,461) followed by UER (1,046,545); and UWR (702,110) respectively). The population in Northern Ghana represents only 17.1% of the total population in Ghana. However, in terms of land mass, these regions account for about 40.91% of

the total land area in the country (MoFA, 2016). NR has the biggest land size (70,384 km^2) among the three followed by UWR (18,476 km^2) and UER (8,842 km^2) (MoFA, 2016).

The NR, with Tamale as its capital shares boundaries with the UER and UWR to the north, Brong Ahafo and the Volta Regions to the south and Republic of Togo to the east and Cote d'Ivoire to the west whereas the UER, with Bolgatanga as its capital is bordered on the north, south, east and west by Burkina Faso, NR, Republic of Togo and the UWR respectively. Also, the UWR, with Wa as its capital is bordered on the north by the republic of Burkina Faso, on the East by UER and on the west by Cote d'Ivoire.

Below is the Map of the Study Area and Research Location.

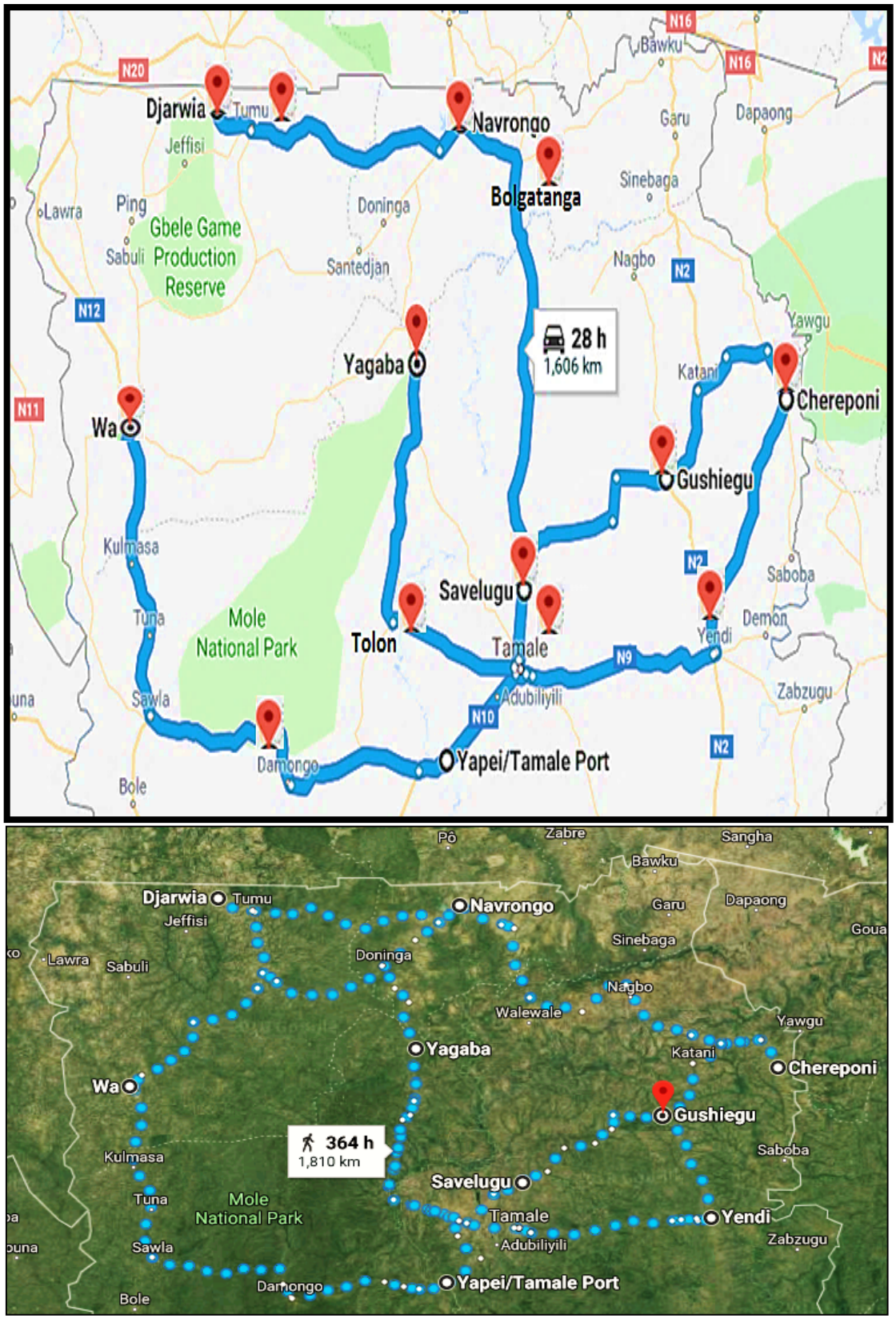


Figure 4. 1: Map of Northern Ghana showing the various Districts sampled for the study.

4.2 Research design

Research design could be defined as the "blue print" or the "conceptual structure" for collecting, measuring and analyzing data (Burns and Grove, 2010; Polit and Beck, 2010). It can be used to mean the researcher's overall frame for answering the research question, testing research hypotheses and/or controlling variance (Kothari, 2004). Research design is the working tool which the researcher employs to collect and analyze data effectively (Dulock, 1993). Research design emphasizes the problem, the location and duration of the study as well as the means by which the questions are addressed. According to Kothari (2004), research design is simply the arrangement of conditions for data collection and analysis in line with the research questions or hypothesis. Research design can be categorized into descriptive, correlational, quasi-experimental or experimental (Dulock, 1993). However, research design has no universal or standard formation but it rather depends on the researcher's overall research aim (Dulock, 1993; Teddlie and Tashakkori, 2003).

In this study, the mixed method of research, which contains both quantitative and qualitative research designs, was adopted. The quantitative research design (QRD) which involves experimental or non-experimental designs (including surveys) (Creswell, 2003; Lund, 2005; Rond and Thiétart, 2007) focuses on establishing cause and effect relationships or testing hypotheses (Creswell, 2003). The qualitative research design was used to generate comprehensive discussions of the reasons for farmers' participation (non-participation) in AVC.

In the current study, methods such as survey, descriptive statistics and econometric models were employed for the collection and analysis of data. A cross-sectional

survey was conducted to obtain primary data through face-to-face interviews using semi-structured questionnaires. The survey was aimed at obtaining sample information, which enabled the researcher to make generalizations about the population of northern Ghana. The descriptive statistics section systematically describes the characteristics of the sample as well as the various constraints to AVC participation, credit access, farmers' crop income and loan repayment. Furthermore, the quantitative section employs econometric models to analyze the determinants of farmer decision and extent of participation in AVC and the effect of AVC participation on farmers' access to credit, crop income and loan repayment respectively.

4.2.1 Sampling technique and sample size

The target populations were maize, rice and soybean farmers in Northern Ghana. The three crops were selected on the basis that their productions are highly promoted through the AVC approach by government, NGOs and developmental partners in the area of late (Amanor-Boadu *et al*., 2015).

The farmers were selected through a multi-stage (three-stage) sampling approach. The first-stage of the sampling process involves clustering of 50 districts in the study areas in four groups (A, B, C and D)[1]. Thus, 13 districts (see figure 4.1) were selected from 3 clusters (A, B, D) in relation to the type of financial institutions that exist in the

[1] Cluster A - consisted of sixteen (16) districts with Commercial Banks (CBs), Microfinance institutions (MFIs) and Rural and Community Banks (RCBs).

Cluster B – comprised of twenty-six (26) with CBs and RCBs only

Cluster C – comprised of four (4) districts with CBs and MFIs only

Cluster D – comprised of four (4) districts with MFIs only

area. Of these, nine (9) were chosen from Cluster A; three (3) from Cluster B and one (1) district from Cluster D. In all, eight (8) out of the 13 districts were in the NR, two (2) in the UER and three (3) in UWR.

In stage 2, communities[2] in each of the 13 selected districts were stratified on the basis of AVC participation. About 2 communities each were randomly chosen from those participating in AVC and those not participating in AVC, summing up to 52 communities. In the third and final stage, the simple random sampling (lottery method) was employed to select ten (10) respondents from each community, amounting to 520 farmers in all. However, 500 questionnaires were completed through face-to-face interviews to obtain the primary data. The remaining 20 questionnaires were incomplete.

The total number of respondents used for the study was estimated using the estimation method given by Bartlett *et al*. (2001) as:

$$n = \frac{N}{1 + N(\alpha)^2} \qquad (4.0)$$

where N is the population size; margin of error (α) of 4.47%. Total number of skilled agric farmers (Northern- 734,854; UE- 312,546; UW- 202,770 with grand total of 1,250,170.00 (GSS,2010).

[2] The study obtained a list showing the communities which participate in AVCs and those who did not from institutions and organizations such as the Agricultural Development and Value Chain Enhancement (ADVANCE) project under USAID, Ghana Commercial Agricultural Project and Northern Rural Growth Program (NRGP) under MoFA, Integrated Water Management and Agricultural Development (IWAD) project under WIENCO and other NGO projects like Association of Church Development Project (ACDEP).

$$n = \frac{1{,}250{,}170}{1 + 1{,}250{,}170\ (4.47\%)^2} = 500.28 = 500$$

4.2.2 Data collection and questionnaire

Data for the study included socio-demographic and economic variables such as gender of farmer, age, education, marital status, resident status, household size, farming experience, off-farm income work, among others. Farm-specific variables were also obtained. These included total landholding size, total farm size, food crops grown including maize, rice and soybeans, other non-crop enterprises, irrigation farming, on-farm technology adoption, crop income, livestock production, access to collateral and ownership of a transport asset.

Other factors of interest were institutional and communication factors (such as extension contact, distance to market among others); AVC participation factors; access to credit and loan repayment. Data were gathered in 2017 from the months of January to March. Five (5) field assistants, including the researcher took part of the data collection. The study employed face-to-face interviews with the help of semi-structured questionnaires to collect the data from the respondents (farmers). The interview time per a respondent lasted for about 45 minutes on the average. The respondents were also at liberty to inquire information from other household members.

4.3 Theoretical framework

The study was guided by the theory of producer behaviour and decision making. In decision making regarding agricultural production, farmers are usually faced with choice between multiple alternatives. The choice of one alternative over the other often rests on the level of utility that the decision maker derives from that particular product. The utility explains the satisfaction that individuals derive from new ideas, technologies and interventions.

The utility theory suggests that a farmer i, as a rational individual, makes production decisions toward AVC participation, access to credit and loan repayment by choosing the alternative that maximize her expected utility (Fernandez-Cornejo *et al.*, 1994; Loureiro and Umberger, 2007) as:

$$MaxU_{i,j} = f\left(X_{i,j}\right) \tag{4.1}$$

where U is the utility which is determined by a set of individual, farm, and institutional factors (X); j can be any linkage (relationship) that farmer i chooses to participate in. The decision variable is unknown to the researcher, and hence, it is treated as a random variable (McFadden, 1974). However, the net (overall) decision to participate in a particular linkage of the AVC, j is stimulated if the expected utility $E\left(U_{i,j}\right)$derived from participating, is greater than the expected utility $E\left(U_{i,k}\right)$derived from participating in k alternative (spot market[3]) as shown in Equation (2).

$$U_i^* = E\left(U_{i,j}\right) \geq E\left(U_{i,k}\right) \tag{4.2}$$

[3] Spot market participation denote the purchase of inputs or sale of produce without contract

where U_i^* is unobserved satisfactions or benefits which the farmer derives from participating in AVC as opposed to not participating. Instead, we can observe the linkage that the farmer participates in as her revealed preference which can be model as a linear relationship of a deterministic component and an unobserved component (also known as the random component) as:

$$U_{i,j} = X'_{i,j}\beta + \varepsilon_{i,j} \tag{4.3}$$

The deterministic component ($X'_{i,j}\beta$) is made up of the observable characteristics (individual, household, farm-specific and institutional variables) associated with the decision maker while the random/stochastic component ($\varepsilon_{i,j}$) is the part of the utility function which is unexplained. β is a vector of unknown parameters to be estimated. We model the random decisions ($U_{i,j}^*$) as the probability of participating in linkage $\Pr(j=1)$. According Verbeek (2004), the probability of choosing alternative j is given by:

$$\begin{aligned}\Pr(j \mid C) &= \Pr\{(V_{ij} + \varepsilon_{ij}) \geq (V_{ik} + \varepsilon_{ik})\} \\ &= \Pr\{(V_{ij} - V_{ik}) \geq (\varepsilon_{ik} - \varepsilon_{ij})\} \\ &\forall j \neq k \in C\end{aligned} \tag{4.4}$$

4.4 Conceptual framework

In many developing countries including Ghana, many smallholder farmers encounter several problems due to uncertainties about production (such as weather) and markets (such as price). Agriculture is therefore, perceived to be a “no go zone”. This has recently become more problematic due to climate change and environmental

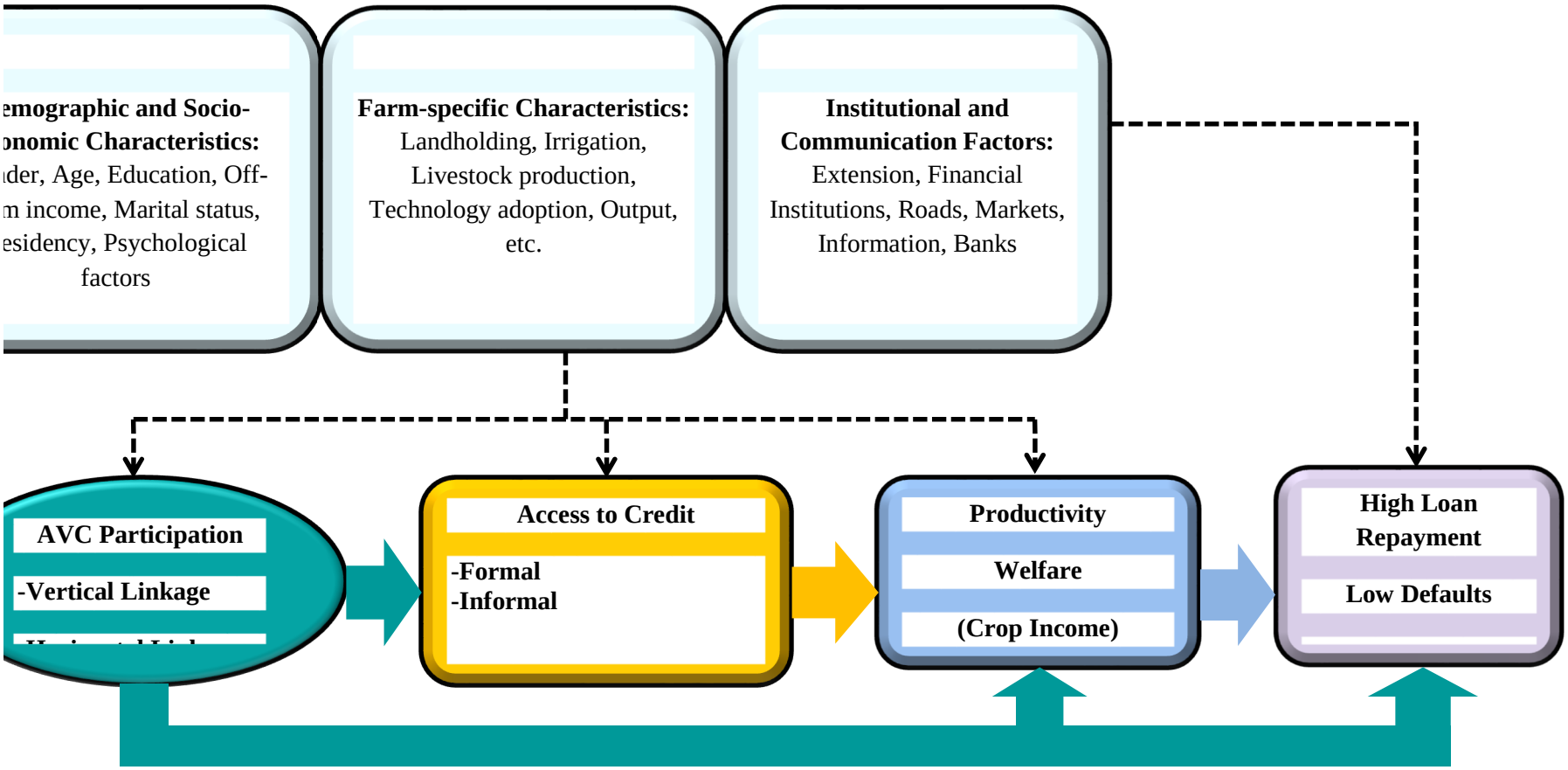
degradation that leads to lower crop output. Moreover, farmers grow products whose market price is often quite unpredictable (Hueth and Ligon, 1999). Farmers are also price takers with little or no control over price. Because of this, farmers often require more coordination as food systems are constantly moving toward greater specialization and competition day after day.

AVC participation on the other hand is an improved form of coordination which allows farmers and intermediaries to share risks. In other words, participating in AVC is supposed to reduce the several risks associated with "spot market" participation (Young and Hobbs, 2002). For example, contract farming focuses on input control, monitoring, quality measurement, and revenue sharing (Wolf *et al*., 2001). Also, AVC participation can improve bargaining power. AVC participation can influence access to credit through contract and social collateral that chain participants rely on (Vorley, 2001). The strong linkages that exist between farmers and the other chain actors have the ability to make a significant contribution in convincing formal financial institutions to sway away from the traditional approach of supplying credit that leads to high operational cost and low profitability.

In terms of loan repayment, participation in AVC can reduce fungibility because credit is usually disbursed and recovered in-kind by market players. Also, there is usually greater pressure from group members to repay loans. Due to guaranteed market availability, AVC participants can also receive reliable (higher) crop income than non-participants. Access to the right amount of credit can also have the tendency of improving the farmers' crop income, which may also affect loan repayment positively. In terms of crop income, contract farming participation stabilizes the

farmer's income by avoiding market instability and lowering market risk, accelerating the development of commercial agriculture, providing greater access to inputs and financing as well as ensuring a guaranteed supply of farm produce. Through contract farming, farmers are not only able to control quality but also minimize risk and hence, increase contractors' capability to expand their farms and increase volume in order to achieve economies of scale.

Farmers differ in characteristics such as socio-demographic and economic characteristics (age, gender, education, income); farm-specific characteristics (assets, landholding, and farm size) as well as institutional factors. While AVC participation is more likely to be influenced by any of these factors, participating in AVC on the other hand could also have positive ramifications on access to credit, crop income, and loan repayment. Furthermore, farmers' crop incomes also tend to affect loan repayment. The conceptual framework illustrated in Figure 4.1 depicts the influences of farmer, farm and institutional factors on participation in AVC. The full horizontal lines (arrows) depict the relationship between dependent variables and the dotted vertical lines (arrows) indicating the relationships between the dependent variables and the independent variables of the study.



F : Conceptual Framework showing the Relationships among the socioeconomic characteristics, AVC participation, access to credit, crop income and loan repayment

Source: Author's own construct, 2018

4.5 Data processing and analysis

The entry, processing and analysis of the field data were done in Stata 15, NLogit 6 and MS Excel 2016. Simple and complex statistics such as descriptive tools frequencies, percentages, means, standard deviations; statistical tests and econometric models were used to analyze the specific objectives of the study. The results from the analyses were presented mainly in tables and graphs for easy presentation and visualization.

4.5.1 Measuring the extent of AVC-VL contracts:

The Heckman selection model

The Heckman selection model (developed by Heckman, 1979) was used to analyze the extent of AVC-VL contracts. This model is used to detect and correct for selectivity bias problem which arises under unobserved heterogeneity in farmers' participation decisions (Winship and Mare, 1992; Sartori, 2003). The Heckman selection model was employed because part of the outcome variable of interest (extent of AVC-VL contracts) are missing values on the basis of non-random sample because the decision to participate in AVC-VL or not was made by the farmer. In other words, farmers who did not participate in AVC-VL self-selected themselves probably because they had no support while others may encounter alternative opportunities that offer higher remunerations. So the outcome variable is only observable when the farmer participates in AVC-VL, which accounts for much of the missing contract data. If we assume that the data were censored (thus, if some observations of the dependent variable were suppressed), then the Tobit model could have been used.

At the same time, if the data were truncated (thus, if some observations of the dependent variable were cut off in the analysis), the truncated regression could have been employed. However, the study did not suppress the missing observations of the dependent variable to a certain threshold or totally truncated them but took into consideration the information on the non-participants by replacing the missing values on the non-participants with zeros. The Heckman selection model corrects for the incidental truncation (Burke, 2009) and also tends to produce non-constant marginal effects for both the selection and substantive equations. In terms of the extent of AVC-VL contract, we encounter missing (unobserved) observations on the dependent variable since some farmers choose not to participate in AVC-VL.

Heckman's (1979) work offers a simple two-step estimator for correcting sample selectivity to produce unbiased and consistent estimators. It first estimates the determinants of AVC-VL participation as a selection equation using the standard Probit model to obtain the lambda (also known as the inverse Mill's ratio (IMR)) which is later included in the OLS model in the extent of AVC-VL contracts (outcome) equation to correct for selectivity bias since the selection hazard is treated as a specification error (Bushway *et al*., 2007). Also, in the second stage, the factors influencing the extent of AVL-VL contracts are determined. The Heckman selection model shows an underlying relationship between the decision and extent of AVC-VL contracts such that:

$$Y_i\left(y_i^* = 1\right) = X_i'\gamma + \varpi_i \qquad (4.5)$$

extent of VL contracts (measured as the sum of the proportion of inputs sourced from contracts in AVC-VL participation and the proportion of output/produce sold on contracts in AVC-VL participation)

is observed only if

$$y_i^* = X_i'\alpha + \varepsilon_i > 0 \quad (4.6)$$

selection (AVC-VL participation) equation

In the first-stage, the determinants of farmer participation in AVC-VL are measured using the standard probit model as:

$$y_i^* = X_i'\alpha + \varepsilon_i \quad (4.7)$$

and,

$$\Pr(y_i = 1) = F(X_i'\alpha) \quad (4.8)$$

where Pr represents the probability of a farmer participating in AVC-VL[4], y_i^* is the unobserved latent variable for AVC-VL participation, y_i is the observed dependent

[4] Note: the proportion of input sourced from contract is computed as the value (amount [in Ghana cedi]) of input bought on contract divided by the value of all inputs bought multiplied by 100. While the proportion of output/produce sold on contract is computed as the value (amount [in Ghana cedi] of produce/output sold on contract divided by the value of all produce/output sold multiplied by 100. Mathematically, the extent of AVC-VL contract was computed as:

variable (which assumes a value of 1 if the farmer participates in AVC-VL; 0 if otherwise) and $F(\bullet)$ is the cumulative distribution function (CDF) of the standard normal distribution; X_i is a vector of exogenous variables that are believed to influence AVC-VL participation (y_i); α is a vector of unknown parameters and ε is the error term.

The second equation (outcome equation) measures the extent of AVC-VL contracts that includes the IMR as an additional explanatory variable for correcting selectivity bias such that:

$$Y_i\left(y_i^* = 1\right) = X_i'\gamma + \kappa\lambda + \varpi_i \qquad (4.9)$$

Y_i is the extent of AVC-VL contracts (measured as the sum of the proportion of inputs sourced from contracts in AVC-VL participation and the proportion of output/produce sold on contracts in AVC-VL participation), γ = unknown parameters to be estimated, X_i is a vector of independent variables hypothesized to be affecting the extent of participation in AVC-VL contracts (these explanatory variables are defined with their measurement in Table 4.5), and ϖ is the error term in the outcome equation. The error term of the selection equation (ε_i) and (ϖ) follow a normal distribution.

$$Extent\_AVC\text{-}VL = \left[\frac{Value\ of\ inputs\ bought\ on\ contract}{Value\ of\ all\ inputs\ bought}\right]\times 100 + \left[\frac{Value\ of\ produce\ sold\ on\ contract}{Value\ of\ all\ produce\ sold}\right]\times 100$$

The expected contract value of AVC-VL participants ($y_i = 1$) is:

$$\begin{aligned} E\left[\mathrm{Y_i}\left(y_i^* = 1\right) | y_i = 1, X_i\right] &= X_i'\gamma + E\left[\varpi_i | y_i = 1, X_i\right] \\ &= X_i'\gamma + \rho\tau\left[\frac{f\left(-\boldsymbol{Z}_i'\boldsymbol{\alpha}\right)}{1-\mathrm{F}\left(-\boldsymbol{Z}_i'\boldsymbol{\alpha}\right)}\right]_i \\ &= X_i'\gamma + \rho\tau\lambda_i \end{aligned} \tag{4.10}$$

where f and F are the standard normal density function and the cumulative normal distribution function respectively, τ is the unknown parameter relating to the lambda (λ) - λ is the inverse Mill's ratio (IMR) estimated in the first selection stage using the probit model. The IMR (also called the selection hazard) name after John P. Mills is the ratio of the probability density function to the cumulative distribution function of a distribution. The $\lambda_i = \left[\frac{f\left(-Z_i'\alpha\right)}{1-\mathrm{F}\left(-Z_i'\alpha\right)}\right]$ can computed using the predicted values ($Z_i'\alpha$) and ϑ, δ and τ by the ordinary least squares (OLS) regression of Y_i on X_i and λ (Greene, 2008).

The empirical model for analyzing the determinants of the probability of AVC-VL participation is given as:

$$y_i = \left| \begin{array}{l} \alpha_0 + \alpha_1 X_{1i} + \alpha_2 X_{2i} + \alpha_3 X_{3i} + \alpha_4 X_{4i} + \alpha_5 X_{5i} + \alpha_6 X_{6i} + \alpha_7 X_{7i} + \\ \alpha_8 X_{8i} + \alpha_9 X_{9i} + \alpha_{10} X_{10i} + \alpha_{11} X_{11i} + \alpha_{12} X_{12i} + \alpha_{13} X_{13i} + \alpha_{14} X_{14i} + \\ \alpha_{15} X_{15i} + \alpha_{16} X_{16i} + \alpha_{17} X_{17i} + \alpha_{18} X_{18i} + \alpha_{19} X_{19i} + \alpha_{20} X_{20i} + \alpha_{21} X_{21i} + \\ \alpha_{22} X_{22i} + \varepsilon_i \end{array} \right| \tag{4.11}$$

and the empirical model for analyzing the extent of AVC-VL contracts is given by:

$$Y_i = \left| \begin{array}{l} \gamma_0 + \gamma_1 X_{1i} + \gamma_2 X_{2i} + \gamma_3 X_{3i} + \gamma_4 X_{4i} + \gamma_5 X_{5i} + \gamma_6 X_{6i} + \gamma_7 X_{7i} + \\ \gamma_8 X_{8i} + \gamma_9 X_{9i} + \gamma_{10} X_{10i} + \gamma_{11} X_{11i} + \gamma_{12} X_{12i} + \gamma_{13} X_{13i} + \quad \gamma_{14} X_{14i} + \\ \gamma_{15} X_{15i} + \gamma_{16} X_{16i} + + \gamma_{17} X_{17i} + \delta \lambda_i + \varpi_i \end{array} \right| \qquad (4.12)$$

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Definition and measurement of variables used in the probit and OLS regression of the Heckman selection model for the
cision and extent of AVC-VL contracts in northern Ghana

Variable	Desc		Measurement	AVC-VL Participation	Extent of AVC-VL Participation
				A priori Expectation	A priori Expectation
X_1	Gen	ıer	Dummy, 1 if respondent is a male, 0 if female	+	+
X_2	Age		Age of the respondent in years	-	-
X_3	Educ	ars	Number of years in formal education	+	+
X_4	Hou		Number of people in the household	+	+
X_5	Tran	ɔment ownership	Dummy, 1 if respondent owns transport equipment, 0 otherwise	-	-
X_6	Live	ıg	Dummy, 1 if respondent rears livestock, 0 otherwise	-	-
X_7	Othe	farming	Number of non-crop enterprises	-	-
X_8	Tota	ng	Total size of cultivated and uncultivated lands in acreage	+	+
X_9	Num	ɔ cultivated	Total number of crops that farmer cultivates	+	+
X_{10}	Enga	irrigation farming	Dummy, 1 if respondent engages in irrigation, 0 otherwise	+	+
X_{11}	Acce	et information	Dummy, 1 if respondent has market information, 0 otherwise	+	+
X_{12}	Dist	rict market	Distance from house to district market in Kilometers	-	-
X_{13}	Avai	storage facility	Dummy, 1 if respondent has a well-structured storage facility, 0 otherwise		-
X_{14}	Cell	ership	Dummy, 1 if respondent has cellphone, 0 otherwise	+	
X_{15}	Timi	:s	Dummy, 1 if respondent obtained inputs on time for previous production, 0 otherwise	-	
X_{16}	Exte	ıct	Dummy, 1 if respondent has extension contact, 0 otherwise	+	+
X_{17}	Past	with contract	Dummy, 1 if respondent has good experience with previous contract, 0 otherwise	+	+
X_{18}	Trus		Dummy, 1 if respondent has high trust in chain actors, 0 otherwise	+	+
X_{19}	% of	ɔroduce held in stock	Percentage of previous produce in store		+
X_{20}	Netv		Dummy, 1 if respondent has strong networks, 0 otherwise	+	
X_{21}	Acce	t information	Dummy, 1 if respondent has access to credit info, 0 otherwise	-	
X_{22}	Nort	n	Dummy, 1 if respondent lives in the Northern Region, 0 otherwise	+	
X_{23}	Upper East Region		Dummy, 1 if respondent lives in the Upper East Region, 0 otherwise	+	
y	AVC-VL participation		Dummy, 1 if respondent participates in the vertical linkage (VL) of the AVC, 0 otherwise		

4.5.2 Estimating the determinants of farmers' participation in AVC (AVC-VL and AVC-HL):

The Bivariate Probit regression model

The Bivariate Probit (BVP) model was employed to analyze the determinants of AVC-vertical linkage (AVC-VL) and AVC-horizontal linkage (AVC-HL) participations. The BVP model assumes that the two dependent variables must all be binary, each dependent variable taking a value of 1 if the farmer participates in the particular linkage of interest and 0 if otherwise. The model was adopted to resolve the correlation between the residuals of the two equations since some farmers chose to participate in accessing input and output market contracts (AVC-VL) and also belong to farmer groups (AVC-HL) at the same time. The general specification of the BVP model arises from the derivation of the latent (unobserved) variable such that:

$$y_{1i}^{*} = W_i'\beta + \varepsilon_{1i} \quad (4.13)$$

$$y_{2i}^{*} = W_i'\Omega + \varepsilon_{2i} \quad (4.14)$$

where y_{1i}^{*} and y_{2i}^{*} are unobserved latent variable representing the propensity of participating in AVC-VL and AVC-HL respectively; instead, we observe only y_{2i} = 1 if $y_{1i}^{*} > 0$ and y_{2i} = 0 if $y_{1i}^{*} \leq 0$; W is a vector of exogenous variables hypothesized to influence participation (these explanatory variables are defined with their measurement in Table 4.2); β and Ω are vectors of unknown parameters to be estimated, ε_{ij} is a normally distributed error term with mean 0 and variance 1. The covariance of the error term is:

$$Cov(\varepsilon_1, \varepsilon_2) = \rho \quad (4.15)$$

and the probability that $y_{ij}=1$, on condition that W_{ij} is given and β, Ω, Σ are unknown, can be written as:

$$\pi\left(y_{ij}=j=1,2 \mid \beta, \Omega, \Sigma\right)=\int_{A1}\int_{A2}\phi\left(z_1, z_2, \rho_{12}\right)\partial z_1 \partial z_2 \tag{4.16}$$

The empirical model for analyzing the factors influencing farmers' participation in AVC-VL is specified as follows:

$$y_{1i}^{*}=\left|\begin{array}{l}\beta_0+\beta_1 W_{1i}+\beta_2 W_{2i}+\beta_3 W_{3i}+\beta_4 W_{4i}+\beta_5 W_{5i}+\beta_6 W_{6i}+\beta_7 W_{7i}+ \\ \beta_8 W_{8i}+\beta_9 W_{9i}+\beta_{10} W_{10i}+\beta_{11} W_{11i}+\beta_{12} W_{12i}+\beta_{13} W_{13i}+\beta_{14} W_{14i}+ \\ \beta_{15} W_{15i}+\beta_{16} W_{16i}+\beta_{17} W_{17i}+\beta_{18} W_{18i}+\beta_{19} W_{19i}+\beta_{20} W_{20i}+\beta_{21} W_{21i}+\varepsilon_{vi}\end{array}\right| \tag{4.17}$$

and the empirical model for analyzing the factors influencing farmers' participation in AVC-HL is specified as follows:

$$y_{2i}^{*}=\left|\begin{array}{l}\Omega_0+\Omega_1 W_{1i}+\Omega_2 W_{2i}+\Omega_3 W_{3i}+\Omega_4 W_{4i}+\Omega_5 W_{5i}+\Omega_6 W_{6i}+ \\ \Omega_7 W_{7i}+\Omega_8 W_{8i}+\Omega_9 W_{9i}+\Omega_{10} W_{10i}+\Omega_{11} W_{11i}+\Omega_{12} X_{12i}+\Omega_{13} W_{13i} \\ +\Omega_{14} W_{14i}+\Omega_{15} W_{15i}+\Omega_{16} W_{16i}+\Omega_{17} W_{17i}+\Omega_{18} W_{18i}+\Omega_{19} W_{19i}+ \\ \Omega_{20} W_{20i}+\Omega_{21} W_{21i}+\varepsilon_{vi}\end{array}\right| \tag{4.18}$$

T Definition and measurement of variables in the bivariate probit (BVP) regression model for analyzing the determinants of A ıd AVC-HL participation

Variable	Des		Measurement	AVC-VL Participation	AVC-HL Participation
				A priori Expectation	A priori Expectation
X_1	Ger	ıner	Dummy, 1 if respondent is a male, 0 if female	+	+
X_2	Age		Age of the respondent in years	-	-
X_3	Edu	ears	Number of years in formal education	+	+
X_4	Hou	e	Number of people in the household	+	+
X_5	Tra	pment ownership	Dummy, 1 if respondent owns transport equipment, 0 otherwise	-	-
X_6	Liv	ing	Dummy, 1 if respondent rears livestock, 0 otherwise	-	-
X_7	Oth	: farming	Number of non-crop enterprises	-	-
X_8	Tot	ing	Total size of cultivated and uncultivated lands in acreage	+	+
X_9	Nu	ıp cultivated	Total number of crops that farmer cultivates	+	+
X_{10}	Eng	ı irrigation farming	Dummy, 1 if respondent engages in irrigation, 0 otherwise	+	+
X_{11}	Acc	ket information	Dummy, 1 if respondent has market information, 0 otherwise	+	
X_{12}	Dis	trict market	Distance from house to district market in Kilometers	-	-
X_{13}	Cel	ıership	Dummy, 1 if respondent has cellphone, 0 otherwise	+	-
X_{14}	Tin	ıts	Dummy, 1 if respondent obtained inputs on time for previous production, 0 otherwise	-	-
X_{15}	Net		Dummy, 1 if respondent has strong networks, 0 otherwise	+	+
X_{16}	Ext	tact	Dummy, 1 if respondent has extension contact, 0 otherwise	+	+
X_{17}	Acc	it information	Dummy, 1 if respondent has access to credit info, 0 otherwise	+	-
X_{18}	Pas	e with contract	Dummy, 1 if respondent has experience with previous contract, 0 otherwise	+	+
X_{19}	Trus		Dummy, 1 if respondent has high trust in chain actors, 0 otherwise	+	+
X_{20}	Northern Region		Dummy, 1 if respondent lives in the Northern Region, 0 otherwise	+	+
X_{21}	Upper East Region		Dummy; 1 if respondent lives in the Upper East Region, 0 otherwise	+	+

4.5.3 Estimating access to formal and informal credits with correction for unobserved hheterogeneity in AVC (AVC-VL and AVC-HL) participation:

The Multivariate Probit model with sample selection

Prior to estimating the direct effect of AVC participation on credit amount (using the Heckman treatment effect model), the study analyzed farmers' access to formal and informal credits in relation to AVC participation using the Multivariate Probit (MVP) model with sample selection developed by Greene (2010). This model is an extension of the standard Probit model with sample selection (Heckprob), which is used to analyze a system of two or more binary choice correlated outcome variables, where part of the outcome variable for each equation is missing or unobserved due to self-selection or non-random sample (Marra and Radice, 2017). Thus, it is only used to correct for unobserved heterogeneity and correlations between the error terms of the two equations (Yen, 2005) but unable to measure the direct effect (average treatment) regarding farmers' participation in AVC.

The sample selectivity bias arises from the fact that certain unobserved factors determining decision to participate in AVC could correlate with the error terms in the outcome equations of interest (Vella, 1998). According to Greene (2010), failure to address both the interrelationships between the participation decisions and the sample selection bias problem will make the estimates inefficient. The MVP model with sample selection model involves a two-step estimation, which estimates one selection equation and multiple correlated binary choice outcome equations (Marra and Radice, 2017). In the case of the current study, the estimation of the effect of AVC participation on access to credit was done twice using MVP model with sample selection.

The first case estimates one selection equation (involving AVC participation) to obtain the inverse Mill's ratio, which was later included in two outcome equations (involving formal credit access and informal credit access) as an additional regressor. The second case estimates two selection equations (involving AVC-VL and AVC-HL participations), to obtain their IMRs, which were later included in the two outcome equations involving formal credit access and informal credit access. In the first case, the selection equation is still AVC participation (same as the Heckman selection model), which is given:

$$y_i^* = X_i'\alpha + \varepsilon_i \quad (4.19)$$

where; y_i^* is the unobserved latent continuous variable, denoting propensity to participate in AVC, y_i is the observed dependent variable, which denotes AVC participation; 1 if the farmer participates in AVC; 0 otherwise; α is a vector of unknown parameters, which measures the relationship between AVC participation and the set of independent variables, X is a vector of independent variables; ε_i is an error/disturbance term and the outcome equations are:

$$A_i^* = Z_i'\theta + \xi_i \quad (4.20)$$

where, i denote the decision maker; j stands for the sources of credit; A_{ij}^* are unobserved latent continuous variables, which indicates the propensity to access credit, A_{ij} are observed binary dependent variables for access to credit, 1 if the farmer accesses credit; 0 otherwise; θ is a vector of unknown parameters to be estimated in the access to credit models, Z_i is vector of explanatory variables; ξ is a two-sided

error term. Due to the correlation between ξ and ε, and the incidental truncation, the inverse Mills ratio (λ) from the Bivariate Probit model enters as a regressor in the access to credit equations as:

$$\begin{aligned} E[A_i = 1, Z_i] &= E[y_i / \varepsilon_i > -Z_i'\theta] = Z_i'\theta + E\left[\frac{\xi_i}{\varepsilon_i} > -S_i'\gamma\right] \\ &= W_i'\theta + \sigma\left[\frac{f(-Z_i'\alpha)}{1-\mathrm{F}(-Z_i'\alpha)}\right] \\ &= Z_i'\phi + \sigma\lambda \end{aligned} \tag{4.21}$$

and the outcome equation can be rewritten as:

$$A_i = Z_i'\theta + \Theta\lambda + \xi_i \tag{4.22}$$

For identification sake, X_i must contain at least one exogenous covariate that does not overlap with Z_i. The empirical model for analyzing the determinants of access to formal and informal credits in the first case is stated as:

$$A_{i,j} = \begin{vmatrix} \theta_{o,j} + \theta_{1,j}Z_{1i,j} + \theta_{2,j}Z_{2i,j} + \theta_3 Z_{3i,j} + \theta_4 Z_{4i,j} + \theta_5 Z_{5i,j} + \theta_6 Z_{6i,j} + \theta_7 Z_{7i,j} + \\ \theta_8 Z_{8i,j} + \theta_9 Z_{9i,j} + \theta_{10} Z_{10i,j} + \theta_{11} Z_{11i,j} + \theta_{12} Z_{12i,j} + \theta_{13} Z_{13i,j} + \theta_{14} Z_{14i,j} + \theta_{15} Z_{15i,j} \\ + \theta_{16} Z_{16i,j} + \theta_{17} Z_{17i,j} + \theta_{18} Z_{18i,j} + \theta_{19} Z_{19i,j} + \theta_{20} Z_{20i,j} + \theta_{21} Z_{21i,j} + \sigma\lambda + \xi_{i,j} \end{vmatrix} \tag{4.23}$$

where $A_{i,j}$ are two binary variables, access to formal and informal credits respectively; θ is vector of unknown parameters to be estimated; Z is vector of explanatory variables (these explanatory variables are defined with their measurement in Table 4.3); λ is the IMR from the probit model, σ is a unknown parameter relating to the IMR and $\xi_{i,j}$ is a vector of error terms.

In the second case, the IMRs of AVC-VL and AVC-HL participation variables enter the access to credit models such that Equation (4.22) becomes:

$$A_{i,j} = \begin{vmatrix} \theta_{o,j} + \theta_{1,j}Z_{1i,j} + \theta_{2,j}Z_{2i,j} + \theta_3 Z_{3i,j} + \theta_4 Z_{4i,j} + \theta_5 Z_{5i,j} + \theta_6 Z_{6i,j} + \theta_7 Z_{7i,j} + \\ \theta_8 Z_{8i,j} + \theta_9 Z_{9i,j} + \theta_{10} Z_{10i,j} + \theta_{11} Z_{11i,j} + \theta_{12} Z_{12i,j} + \theta_{13} Z_{13i,j} + \theta_{14} Z_{14i,j} + \theta_{15} Z_{15i,j} + \\ \theta_{16} Z_{16i,j} + \theta_{17} Z_{17i,j} + \theta_{18} Z_{18i,j} + \theta_{19} Z_{19i,j} + \theta_{20} Z_{20i,j} + \theta_{21} Z_{21i,j} + \hbar_1 \lambda_1 + \hbar_2 \lambda_2 + \xi_{i,j} \end{vmatrix} \quad (4.24)$$

where $\hbar_1$ is the coefficient relating to the IMR (λ_1) of farmer participation in AVC-VL and $\hbar_2$ is the coefficient relating to the IMR (λ_2) of farmer participation in AVC-HL.

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Definition and measurement of variables in the multivariate probit (MVP) model with sample selection for access to informal credit

V	Description	Measurement	a *priori* expectation
	Gender of farmer	Dummy, 1 if respondent is a male, 0 if female	+
	Age of farmer	Age of the respondent in years	-
	Education of farmer	Number of years in formal education	+
	Resident status of farmer	Dummy, 1 if respondent is a native, 0 otherwise	+
	Household size	Number of people in the household	+
	Other forms of farming	Number of non-crop enterprises	-
	Total landholding	Total size of cultivated and uncultivated lands in acreage	+
	Number of crops cultivated	Total number of crops that farmer cultivates	+
	rrigation farming	Dummy, 1 if respondent engages in irrigation, 0 otherwise	+
	Possession of collateral	Dummy, 1 if respondent has physical collateral, 0 otherwise	+
	Bank account holder	Dummy, 1 if respondent has a bank account, 0 otherwise	+
	Credit experience	Number of years in credit accessibility	+
	Distance to lending institution	Distance from house to bank	-
	Savings culture	Dummy, 1 if respondent performs monthly savings, 0 otherwise	+
	Default problems	Dummy, 1 if respondent fear to default and being chased to repay, 0 otherwise	-
	Lack of confidence	Dummy, 1 if respondent lacks confidence to approach a financial institution, 0 otherwise	+
	Extension contact	Dummy, 1 if respondent has extension contact, 0 otherwise	+
	Networking	Dummy, 1 if respondent has strong networks, 0 otherwise	+
	Availability of guarantor	Dummy, 1 if respondent has access to a guarantor, 0 otherwise	+
	Record keeping	Dummy, 1 if respondent keeps records, 0 otherwise	+
Z_{21}	Access to credit info.	Dummy, 1 if respondent access to credit information, 0 otherwise	+

4.5.4 Estimating the effect of AVC participation on credit amount:

The Heckman treatment effect model

As stated above, the Heckman treatment effect model was employed typically to analyze the effect of AVC participation on credit amount. The first equation analyzes the determinants of AVC participation using the standard Probit model while the second step estimates the direct effect of AVC participation on credit amount in addition to other factors.

This can be represented as:

$$CA_i = \left| \begin{array}{l} \kappa_0 + \kappa_1 R_{1i} + \kappa_2 R_{2i} + \kappa_3 R_{3i} + \kappa_4 R_{4i} + \kappa_5 R_{5i} + \kappa_6 R_{6i} + \kappa_7 R_{7i} + \\ \kappa_8 R_{8i} + \kappa_9 R_{9i} + \kappa_{10} R_{10i} + \kappa_{11} R_{11i} + \kappa_{12} R_{12i} + \kappa_{13} R_{13i} + \kappa_{14} R_{14i} + \\ \delta(\mathrm{F}_i y_i) + \sigma\lambda_i + v_i \end{array} \right| \quad (4.25)$$

where CA_i = credit amount (in GH₵); R = vector of explanatory variables (these explanatory variables are defined with their measurement in Table 4.4); κ is a vector of unknown parameters to be estimated; λ = inverse Mills ratio (IMR) from the probit (selection) equation, σ = unknown parameter relating to the IMR and v = vector of error term. δ = the unknown parameter relating to the treatment variable (AVC participation);

T Definition and measurement of variables in the Heckman treatment effect model for determining the effect of AVC p on on credit amount

V al	cription	Measurement	a *priori* expectation
	der of farmer	Dummy, 1 if respondent is a male, 0 if female	+
	of farmer	Age of the respondent in years	-
	cation	Number of years in formal education	+
	dholding	Total size of cultivated and uncultivated lands in acreage	+
	ps cultivated	Total number of crops that farmer cultivates	+
	er forms of farming (including livestock rearing)	Number of non-crop enterprises	-
	agement in irrigation farming	Dummy, 1 if respondent engages in irrigation, 0 otherwise	+
	idency status	Dummy, 1 if respondent is a native, 0 otherwise	+
	ance to lending institutions	Distance from house to bank	-
	ilability of guarantor	Dummy, 1 if respondent has access to a guarantor, 0 otherwise	+
	ing culture	Dummy, 1 if respondent performs monthly savings, 0 otherwise	+
	session of collateral	Dummy, 1 if respondent has physical collateral, 0 otherwise	+
	rest rate	% of money charged on the principal amount taken	-
	dicted values for AVC participation		

4.5.5 Estimating the effect of AVC participation on crop income

The Heckman treatment effect model

The Heckman treatment effect model was employed to analyze the effect of AVC participation on crop income. This model has been applied to programme/intervention evaluations (e.g., contract farming) on outcome such as crop income (Azumah *et al.*, 2016). The model was employed because it controls for unobserved heterogeneity (selectivity bias) and measures the direct effect of AVC participation on crop income (Maddala, 1983).

The Heckman treatment effect model is an extended form of the Heckman two-step selection model, which follows a simple two-step estimation procedure (Maddala, 1983). The first equation estimates a standard Probit model to obtain the linear predictions of the AVC participation variable, which are later used to calculate an inverse Mills ratio (IMR).

In the second step, both predicted values of the AVC participation variable and the IMR are then included in the outcome (crop income) equation as additional explanatory variables to achieve unbiased and consistent estimates of the parameters (Maddala, 1983). First, we specify the outcome equation for crop income as:

$$\eta = C_i'\vartheta + \delta y_i + v_i \; ; \tag{4.26}$$

where η = crop income (in Ghana cedis, (GH₵)), C_i = vector of exogenous variables that are expected to influence crop income (these explanatory variables are defined with their measurement in Table 4.5); y_i = AVC participation which takes the value 1 if a farmer is an AVC participant and 0 if otherwise; v = a two sided error term with

$N(0,\sigma_v^2)$ and ϑ = vector of unknown parameters relating to the explanatory variables; δ = the unknown parameter relating to the treatment variable (AVC participation); λ = inverse Mills ratio (IMR) from the probit (selection) equation, σ = unknown parameter relating to the IMR.

In fact, the inclusion of AVC participation variable directly into the crop income equation may produce biased and inconsistent estimators since y_i is endogenous (Maddala, 1983). Hence, a selection equation of y_i is first estimated using the binary probit model in order to calculate the linear predictions of the AVC participation variable and IMR, which is further added to the crop income equation to control the unobserved factors that correlate with both the decision to participate in AVC and crop income. Thus, v_i and ε_i are correlated and jointly distributed so $\rho \neq 0$, the OLS estimates (ϑ and δ) will be biased and inconsistent as compared to the Heckman treatment effect model.

The joint distribution of the error terms is as follows:

$$\begin{bmatrix} v_i \\ \varepsilon_i \end{bmatrix} \sim N\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix} \begin{bmatrix} 1 & \rho \\ \rho & \sigma^2 \end{bmatrix} \right) \tag{4.27}$$

and the expected output of AVC participants ($y_i = 1$) is:

$$\begin{aligned} E[\eta_i | y_i = 1, \boldsymbol{C_i}, \boldsymbol{Z_i}] &= C_i'\vartheta + \delta(1) + E[v_i | y_i = 1, \boldsymbol{C_i}, \boldsymbol{Z_i}] \\ &= C_i'\vartheta + \delta + \rho\tau \left[\frac{f(-\boldsymbol{Z_i'\alpha})}{1 - F(-\boldsymbol{Z_i'\alpha})} \right]_i \\ &= C_i'\vartheta + \delta + \rho\tau\lambda_i \end{aligned} \tag{4.28}$$

where ρ is the correlation coefficient measuring joint relationship between v_i and ε_i; τ is the unknown parameter relating to the IMR (λ_i). According to Maddala (1983) cited in Azuma *et al.* (2016), the outcome equation with the predicted values of AVC participation and the IMR can be represented as:

$$CI_i = \beta'(\mathrm{F}_i X_i) + \delta(\mathrm{F}_i y_i) + \sigma\lambda_i + v_i \tag{4.29}$$

where $\mathrm{F}_i \equiv \mathrm{F}(X_i'\alpha)$

The empirical model for the crop income can be specified as follows:

$$\eta_i = \left| \begin{array}{l} \vartheta_0 + \vartheta_1 C_{1i} + \vartheta_2 C_{2i} + \vartheta_3 C_{3i} + C_4 Z_{4i} + \vartheta_5 C_{5i} + \vartheta_6 C_{6i} + \vartheta_7 C_{7i} + \\ \quad \vartheta_8 C_{8i} + \vartheta_9 C_{9i} + \vartheta_{10} C_{10i} + \vartheta_{11} C_{11i} + \vartheta_{12} C_{12i} + \vartheta_{13} C_{13i} + \vartheta_{14} C_{14i} + \\ \quad \vartheta_{15} C_{15i} + \delta(\mathrm{F}_i y_i) + \sigma\lambda_i + v_i \end{array} \right| \tag{4.30}$$

Definition and measurement of variables used in the second stage of the Heckman treatment effect model for crop

Description	Measurement	A priori Expectation
Gender of farmer	Dummy, 1 if respondent is a male, 0 if female	+
Age in years	Age of the respondent in years	-
Education	Number of years in formal education	+
Household size	Number of people in the household	+
Livestock production	Dummy, 1 if respondent rears livestock, 0 otherwise	+
Other forms of farming	Number of non-crop enterprises	+
Farm size	Total size of cultivated and uncultivated lands in acreage	+
Number of crops cultivated	Total number of crops that farmer cultivates	+
Irrigation farming	Dummy, 1 if respondent engages in irrigation, 0 otherwise	+
Adoption of improved farm technologies	Number of technologies adopted by the farmer	+
Access to credit	Dummy, 1 if respondent obtains credit, 0 otherwise	+
Extension contacts	Dummy, 1 if respondent has extension contact, 0 otherwise	+
Access to market information	Dummy, 1 if respondent has access to market information, 0 otherwise	+
Distance to market	Distance from house to market	-
Predicted values for AVC participation		

4.5.6 Measuring the effect of AVC participation on loan repayment:

The Heckman treatment effect model

Similarly, the Heckman treatment effect model was used to analyze the effect of AVC participation on loan repayment. The first equation analyzes the determinants of AVC participation using the standard Probit model while the second step estimates the determinants of loan repayment in addition to predicted values of the AVC participation variable and the IMR to achieve unbiased and consistent estimates of the parameters.

This can be represented as:

$$\ell_i = \left| \begin{array}{l} \psi_0 + \psi_1 Q_{1i} + \psi_2 Q_{2i} + \psi_3 Q_{3i} + \psi_4 Q_{4i} + \psi_5 Q_{5i} + \psi_6 Q_{6i} + \psi_7 Q_{7i} + \\ \psi_8 Q_{8i} + \psi_9 Q_{9i} + \psi_{10} Q_{10i} + \psi_{11} Q_{11i} + \psi_{12} Q_{12i} + \psi_{13} Q_{13i} + \psi_{14} Q_{14i} + \\ \psi_{15} Q_{15i} + \psi_{16} Q_{16i} + \delta(\mathrm{F}_i y_i) + \sigma\lambda_i + \varpi_i \end{array} \right| \quad (4.31)$$

where ℓ_i = dependent variable (loan repayment); Q = vector of explanatory variables hypothesized to influenced loan repayment (these explanatory variables are defined with their measurement in Table 4.6); ψ = unknown parameters relating to the explanatory variables; δ = the unknown parameter relating to the treatment variable (AVC participation); λ = inverse Mills ratio (IMR) from the probit (selection) equation, σ = unknown parameter relating to the IMR; ϖ = vector of error term.

T

Definition and measurement of variables used in the Heckman treatment effect model for loan repayment

V	Description	Measurement	A priori Expectation
	Gender o farmer	Dummy, 1 if respondent is a male, 0 if female	-
	Age in years	Age of the respondent in years	+
	Education in years	Number of years in formal education	+
	Other forms of farming	Number of non-crop enterprises	+
	Number of crops cultivated	Total number of crops that farmer cultivates	+
	rrigation farming	Dummy, 1 if respondent engages in irrigation farming, 0 otherwise	+
	Crop income	Total revenue from crop farms in Ghana Cedis	+
	Amount of credit	Total number of credit obtained in Ghana Cedis	+
	Average interest rate	% of money charged on the principal amount taken	-
	Possession of collateral	Dummy, 1 if respondent has tangible collateral, 0 otherwise	+
	Formal source of credit	Dummy, 1 if respondent obtains formal credit, 0 otherwise	+
	nformal source of credit	Dummy, 1 if respondent obtains informal credit, 0 otherwise	+
	Default problems	Dummy, 1 if respondent fear to default and being chased to repay, 0 otherwise	+
	Availability of guarantor	Dummy, 1 if respondent has access to guarantor, 0 otherwise	+
	Mobile money usage	Dummy, 1 if respondent has mobile money account, 0 if female	+
	Predict values of AVC participation		

CHAPTER FIVE

DESCRIPTIVE RESULTS AND SAMPLE DESCRIPTION

5.0 Chapter overview

The primary goal of this chapter is to summarize and discuss the characteristics of the farmers, AVC participation, access to credit, crop income and loan repayment. The first section (Section 5.1) elaborated on farmers' location characteristics on regional basis while Section 5.2 and 5.3 discussed the continuous and dummy variables included in the study.

5.1 Description of farmers' locations and regional characteristics

Farmers were sampled from NR, UER and UWR of Ghana. The study showed that 68.0% of the farmers interviewed were from the NR, 18.4% from the UER and 13.6% from the UWR (Figure 5.1). It must be emphasized that farmers in the NR and UER have the advantage of increasing crop production all-year round due to the presence of more large-scale irrigation facilities such as the Tono Rice Irrigation Project under ICOUR (in the UER), Golinga Irrigation Project, Botanga Irrigation Project, the IWAD Irrigation Project (in the NR) among others which offer a large area of irrigation water and land for rice production.

The IWAD project for instance also offers irrigation services and sponsorship for agribusinesses and smallholder farmers to participate in AVC in the Mamprugu Moaduri District of the NR. This is expected to increase farmers' participation in AVC and or access to credit in the NR and UER compared to those in the Upper West

Regions. Also, farmers in the NR in particular, have more advantage in increasing vertical linkage participation. This is because the NR is centrally or strategically located and has Tamale (the capital of NR) as one of the major business hubs which attract businessmen and women from all over the country and beyond.

Besides, large marketing companies like the Savannah Marketing Companies, Premium Foods Ltd and a greater number of commercial buyers and aggregators from Kumasi and Accra come to the region to mobilize and buy farm produce mostly due to its proximity than in the UER and UWR. Currently, the biggest rice processing plant in the whole of West Africa (Avnash Industries Limited) is located in Nyankpala in the Tolon District of the NR, close to Tamale which purchases rice from farmers for processing. Also, the Savannah Agricultural and Trading Company (SATCO) in the Cheriponi District purchases rice produce from farmers for processing.

Additionally, development partners (e.g., USAID) and NGOs (e.g., ACDEP, PAS, among others) keen in providing agricultural support services to farmers with the aim of increasing food production and markets through a value chain approach are more functional and have their headquarters in Northern Region (especially in Tamale) compared to the UER and UWR. This means that farmers in the NR may tend to receive the greatest assistance from donors and NGOs to increase their participation in AVC and or access credit. Higher access to agricultural interventions is important to stimulate smallholder farmers' participation in AVC (Abdul-Rahman and Donkoh, 2015).

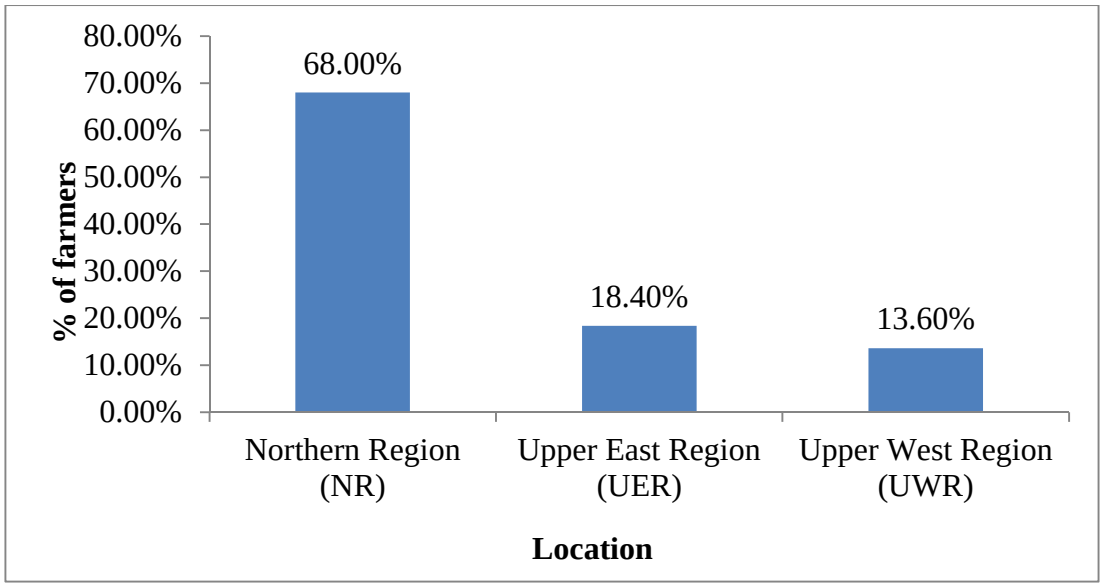

Figure 5. 1: Distribution of farmers by location
Source: Estimations from Author's Data, 2017

5.2 Description of continuous variables

The results of the continuous variables included in this study are captured in Table 5.1. Averagely, the sample was in the middle age bracket (42.7 years) and the less-educated (3.4 years). The farmers were cultivating approximately 2 (1.95) crops from the following crops; maize, rice, soybeans, millet, sorghum, groundnuts, beans, yam, cassava, vegetables, and guinea corn on an average farm size of 10.29 acres (4.17 hectares). The results also revealed that farmers adopted averagely 3 improved technologies on their farms. These technologies include: fertilizers, pesticides, improved seeds, tractor for ploughing and harrowing, planters, combined harvesters, shellers and other farm management practices such as row planting for agricultural production. The farmers were also engaged in other forms of farming apart from the food crops listed above (these were perennial crop production, aquaculture,

beekeeping and forest tree production). On the whole, the mean landholding was 22.30 acres (8.99 hectares).

The mean household size was fairly large (10.16 people per household), and this could be a potential source of family labour for increasing crop production by most farmers in the study area. Farmers with more household members could increase their participation in AVC since they can delegate some households and external duties to other members so as to have ample time to participate, especially in FBOs (Etwire *et al.*, 2013).

The mean farming experience was also high (17.49 years) which meant that farmers had great knowledge and skills in crop production and to increase productivity. The results also showed that the farmers travelled fairly longer distances (8.47 kilometers) to access credit facilities (financial institutions) than markets (and 6.39 kilometers). The mean experience in accessing credit for agricultural production was approximately 2 years.

Table 5. 1: Summary statistics of continuous variables included in the study

Variables	Freq.	Mean	SD	Min (Max)
Age (in years)	500	42.67	13.22	18 (82)
Education (in years)	500	3.54	4.63	0 (16)
Household size	500	10.16	6.42	1 (38)
Farming experience (in years)	500	17.49	12.04	1 (65)
Farm size (in acres)	500	10.29	28.53	0.5 (400)
Landholding (in acres)	500	22.17	39.51	1 (500)
Number of crops grown	500	1.93	0.94	1 (6)
Improved technology adoption	500	3.03	1.12	1 (8)
Other forms of farming	500	0.06	0.59	0 (2)
Credit experience	500	1.8	3.10	
Distance to nearest bank	500	8.47	6.40	1 (36)
Distance to district market	500	6.39	6.66	0.1 (53)

Source: Estimations from Author's Data, 2017

5.3 Description of dummy variables

Table 5.2 also shows the results of the dummy variables included in this study. The sample consisted of more male farmers (63%) than female farmers (37%). The male dominance in the cultivation of maize, rice and soybeans could possibly be due to their greater access to resource and strength to cultivate these resource-demanding and rigorous labour requiring crops than women. Most often, women owe very little farms for maize, rice and soybean in order to provide labour on the man's farm which usually happens to be the household's farms.

About 95% of the farmers were natives (or indigenes) of their respective communities, which confirms the fact that agriculture is principally an indigenous activity for many rural people in northern Ghana and elsewhere. Being a true member of a community improve networking since natives are more likely to have more relations in their communities than foreigners. Natives may have higher access to credit because lenders or investors providing credit or contracts to farmers in remote areas may consider natives for the assurance that it is very hard for them to abscond or run away from their communities when they default due to their greater relations and properties compared to foreigners.

The results showed that a limited number of farmers (25.0%) engaged in irrigation farming). About 35% of farmers were engaged in the rearing of livestock such as cattle, sheep and goats for food, social prestige and income to support food crop production.

Also, about 52% of the farmers had their own transport equipment, including donkeys - with cart, tricycles, motorbikes, tractors with trailer and Lorries (trucks) for their agricultural activities. Furthermore, about 54% had strong network or connection with social groups such as value chain actors, government workers, chiefs, and other important personalities.

Farmers with contact with extension agents were 56%. Extension agents were the main source of information about farming practices, credits and markets. Nearly 70% obtained inputs on time (early) for crop production in the previous season. Most (91%) farmers interviewed had access to market information, which could be attributed to the high usage of cellphone (79%). Although most farmers (89%) were

aware of lending institutions around them, very few had access to credit information (15%); bank accounts (21%); guarantors (43%) and collateral (46%) or engaged in personal savings (27%) and financial record keeping (22%). Over half (55%) of the farmers had high trust in AVC actors and about 74% had ever succeeded in previous contracts. The vast majority of them (76%) were aware of the existence of AVC in their area.

Table 5. 2: Summary statistics of dummy variables included in the study

Variables	Sub-level	Freq.	Percentage	Code
Sex	Male	315	63	1
	Female	185	37	0
Resident status	Natives	475	95	1
	Migrants	25	5	0
Irrigation farming	Irrigators	115	23	1
	Non-irrigators	385	77	0
Livestock production	Yes	175	35	1
	No	325	65	0
Ownership of transport asset	Yes	260	52	1
	No	240	48	0
Networking	Strong	270	54	1
	Weak	230	46	0
Extension contact	Access	280	56	1
	No access	220	44	0
Awareness of lending institutions	Yes	445	89	1
	No	55	11	0
Ownership of cellphone	Yes	395	79	1
	No	105	21	0
Mobile money usage	Subscriber	105	21	1
	Non-subscriber	355	71	0
Access to market information	Yes	455	91	1
	No	45	9	0
Access to credit information	Yes	75	15	1
	No	425	85	0
Time of farm input accessibility	Early	350	70	1
	Late	150	30	0
Record keeping	Yes	110	22	1
	No	390	78	0
Availability of guarantor	Yes	215	43	1
	No	285	57	0
Availability of collateral	Yes	230	46	1
	No	270	54	0
Personal saving, at most a month	Yes	135	27	1
	No	365	73	0
Past experience with other contracts	Yes	370	74	1
	No	130	26	0
Trust in AVC actors	High	275	55	1
	Low	225	45	0
Awareness of AVC	Yes	380	76	1
	No	120	24	0

Source: Estimations from Author's Data, 2017

5.4 The target crops

Three crops were selected for the study. These were maize, rice and soybean (Figure 5.2). From the results, maize was the most dominant, cultivated by 88.9% of the farmers, followed by rice (49.6%) and soybeans (44.4%). However, 28.2%, 4.6% and 5% cultivated maize, rice and soybean only respectively. About 22.8% grew maize and rice only, 17.2 percent grew maize and soybeans only and 1.8% cultivated rice and soybeans while 20.4% cultivated all the three (3) crops. Amanor-Boadu *et al*. (2015) noted that maize, rice and soybeans are important AVC crops because they possess high market potentials in the northern regions. Maize for instance is central to household food security and income generation while rice has also become an important staple and not just an occasional food as we knew previously (Amanor-Boadu *et al*., 2015). Also, soybeans production is more and more emerging in northern Ghana as an important cash crop, which most farmers find it appropriate for soil fertilization. According to Amanor-Boadu *et al*. (2015), soybean is attracting a new role as a nutritive food recipe compared to rice and maize in northern Ghana.

u= 500

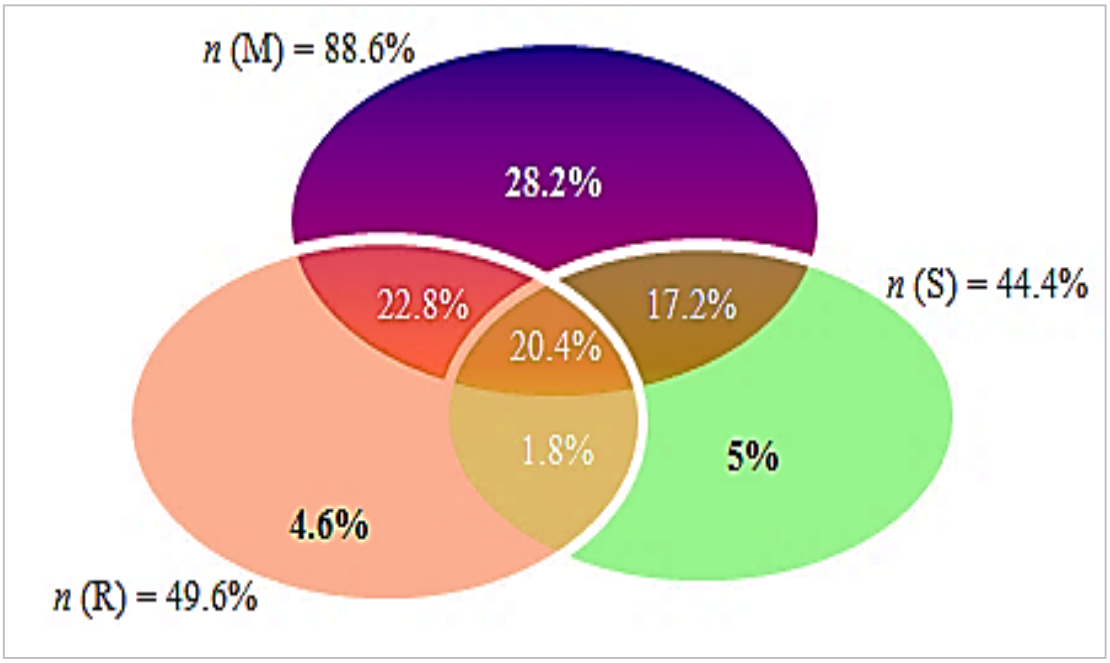

Figure 5. 2: Types of crops selected for the study
Note: M, R and S represent maize, rice and soybean producers, n = number of farmers

Source: Estimations from Author's Data, 2017

CHAPTER SIX

FARMERS' DECISIONS AND EXTENT OF AVC PARTICIPATION

6.0 Chapter overview

In many developing countries including Ghana, farmers need greater integration to overcome imperfect information and challenges associated with long distances of production areas to markets and become highly competitive. This chapter discusses farmers' decisions and extent of participation in AVC with focus on AVC-VL and AVC-HL.

6.1 Describing farmers' source of awareness of avc

The results of AVC in Table 6.1 revealed that about 76% of the farmers interviewed were aware of AVCs from different organizations and individuals such as FBOs (27.6%), NGOs (27.2%) and MoFA (20.8%), nucleus farmers (9.8%), lead agribusiness firms (9.6%), markers/buyers (2.2%), input suppliers (2%) and aggregators/assemblers (0.8%). It was inferred from the study that farmer groups, public institutions and NGOs play a significant role in creating awareness and disseminating information about AVC.

6.2 Description of farmers' decisions and source of AVC participation

AVC participation was grouped into vertical linkage (VL) participation and horizontal linkage (HL) participation. AVC-VL participation, also called the farmer-to-buyer relationship, occurs when farmers are linked to different actors like input suppliers or buyers and aggregators through contracts while AVC-HL participation, also known as the farmer-to-farmer relationship occurs when farmers are connected to each other through group formation. Table 6.1 showed that out of the 500 farmers, 54% were participants of AVC-VL whereas 56% were participants of AVC-HL. The AVC-VL participation occurred in a form of contract arrangements. From the study, three different types of contracts were identified as the source of AVC-VL participation such as forward contract, out-grower contract and contract farming. The forward contract was one where the farmers were contracted by commercial buyers or marketing firms to deliver a specified volume and quality of produce at a given price at an appointed time with their own resources while the contract farming was the type of arrangement where the farmers produced exclusively for buyers, after receiving the necessary inputs and support. In terms of the outgrower contract, the farmers were registered and assisted by a nucleus farmer with production and marketing services in return for portions of their farm produce equivalent to the services rendered. Furthermore, the results in Table 6.1 revealed that about 66% of the farmers participated in AVC-VL through the assistance of FBOs while 34% through farmers' own initiatives as reported.

6.3 Description of governing bodies within the AVC

Table 6.1 also showed that the most dominant form of governance in the AVC was by lead firms such as IWAD, Masara N'arziki Farmers Association, Premier Food Limited and marketers (61.0%) followed by producer organizations (20.6%) and facilitators such as USAID ADVANCE, ACDEP among others (18.8%). Governance in AVC shows the kind and volume of support provided by the party and the quality of services rendered. Lead firms play increasing role in supervising or assisting farmers to build strong agricultural value chains through contract agriculture. Whereas IWAD provided access to irrigation facilities and inputs, Masara N'arziki Farmers Association provided input package (fertilizer and agrochemicals) to farmers for agricultural production in agreement for the exchange of farmers' produce and market.

IWAD in particular, acquired vast lands from the neighbouring communities and redistributed it to smallholder farmers (outgrowers) with input support for production. These organizations were involved in the supervision of input usage and the provision of technical advice to farmers to increase productivity. Their governance was evident in their ability to provide farm inputs, including credit to farmers and determine quantity and quality specification on the produce. The facilitators mainly aid and intermediate on behalf of the farmers in accessing inputs, credit and markets. Producer organizations were also involved in providing production and marketing support to farmers. They also facilitate negotiations and mediate on behalf of smallholder farmers to acquire support.

Facilitators and producer organizations develop partnerships and strengthen networks between AVC actors. They take decisions and implement practical solutions to build stronger relationships by organizing inputs, output markets and credits for farmers at the community, district and regional level. They also gathered market and credit information for farmers, ensured timely delivery of inputs and produce, quality standards and provided feedbacks. They have laws and regulations that guide the activities of farmers in the group.

Table 6. 1: Summary statistics of AVC participation characteristics

Variables	Labels	Freq.	%
Awareness of AVC	Yes	380	76.0
	No	120	24.0
Source of Awareness	Ministry of Food and Agriculture	79	20.8
	Non-Governmental Organizations	103	27.2
	Farmer-based organizations	105	27.6
	Input Suppliers	8	2.0
	Marketers/Buyers	8	2.2
	Nucleus farmers	37	9.8
	Aggregators	3	0.8
	Lead agribusiness firms	36	9.6
AVC-VL participation	AVC-VL participants	151	53.6
	AVC-VL non-participants	131	46.4
AVC-HL participation	AVC-HL participants	158	56.0
	AVC-HL non-participants	124	44.0
Source of AVC-VL participation	FBOs	186	66.0
	Farmer own initiative	96	34.0
AVC governing bodies	Lead firm	172	61.0
	Facilitator led	51	18.0
	Producer led	59	21.0

Note: VL and HL denote vertical linkage and horizontal linkage.

Source: Estimations from Author's Data, 2017

6.4 Description of value addition activities

The study collected information on value addition activities of farmers. The results as captured in Table 6.2 shows that farmers performed several activities to improve or upgrade the value of their produce such as cleaning, sorting, bagging, storage, processing, transporting by vehicle, shelling and threshing for maize, rice and soybean. The results found that maize farmers were highly involved in value adding activities such as shelling, cleaning, bagging, storage and transportation of produce to market centers whereas rice and soybean farmers were more involved in value adding activities such as transportation than cleaning, bagging and storage. These activities improve the quality and value of grains and to avoid early deterioration. In general, more maize is kept in stock by farmers for food security reasons as compared to rice and soybeans in northern Ghana. Among the cereals produced and consumed in the Northern regions as elsewhere in Ghana, maize is ranked first before rice (MoFA, 2016). The fact is that majority of the meals such as porridge and "Tuozaafi" consumed in northern Ghana are maize products.

Table 6. 2: Summary statistics of value adding activities by farmers

Activity	sub-level	1. Maize (*n* = 445)	2. Rice (*n* = 248)	3. Soybean (*n* = 222)
Cleaning	Yes	41.8	16.4	16.2
	No	58.2	83.6	83.8
Sorting	Yes	2.0	0.0	1.4
	No	98.0	100.0	98.6
Bagging	Yes	55.6	20.8	21.0
	No	44.4	79.2	79.0
Storage	Yes	53.4	20.8	21.0
	No	46.4	79.2	79.0
Processing	Yes	1.0	0.8	0.0
	No	99.0	99.2	100.0
Transport from farm to market	Yes	53.4	70.0	67.4
	No	46.6	30.0	32.6
Shelling	Yes	42.4	0.0	0.0
	No	57.6	100.0	100.0
Threshing	Yes	0.0	18.6	0.0
	No	100.0	81.4	100.0

Source: Estimations from Author's Data, 2017

6.5 Reasons for participation and non-participation in AVC

The reasons for participating in AVC or not were grouped into motivating factors and non-motivating factors. From Table 6.3, most AVC participants showed (strong) agreements that they participated in AVC for the benefits of gaining or accessing farm inputs, loans, tractor services, training, technology information, market information, accessing reliable output markets, transportation services, strong networks and strong bargaining power to expand their farms. Participating in AVC and in particular, farmer groups enables farmers to increase their financial and human capitals through

greater awareness (knowledge) of financial services and farming practices (Hellin *et al*., 2009; Bernard and Spielman, 2009; Markelova *et al*., 2009). Through farmer groups, financial institutions, especially those with fewer staff to monitor disbursement and recovery of the credit/loan prefer to disburse credit to farmers who are in linkages or groups to reduce their transaction costs and to enhance loan repayment (Musara *et al*., 2011).

Also, farmer groups attract more extension services because their members can easily be located and assisted with improved farming practices to increase agricultural productivity (Etwire *et al*., 2013). Alternatively, the non-participants who were aware of AVC also cited that lack of access; unfair selection of members by chain actors including lead firms; and high external influence are reasons for non-participation. Other factors are high cheating (exploitation) by chain actors, lack of trust in actors and fear of contract as well as lack of interest and time are the reasons preventing farmers from participating in AVC. The study argues that the greatest challenge for not participating in AVC was the fact that most non-participants are not in contacts with AVC actors due to their remote locations.

T **Distribution of factors motivating or demotivating farmers' participation in AVC**

Motivating f		Freq.	SA (%)	A (%)	CT (%)	D (%)	SD (%)
To have easy	farm inputs		52.94	41.18	0.00	3.68	2.21
To have easy	mechanization (tractor services)		52.94	44.49	0.00	1.47	1.10
To have easy	credit (in-cash or in-kind loan)		34.19	37.13	9.56	9.93	9.19
To have easy	access to reliable output market		31.99	41.91	2.21	12.50	11.40
To be able to	y farm size		30.88	41.18	5.15	18.75	4.04
To enjoy easy	d cost-effective transport through group membership		25.00	38.24	5.15	22.79	8.82
To enjoy stro	ing power through group membership		24.26	48.90	2.21	14.71	9.93
To acquire m	ks through group membership		48.90	40.81	1.47	7.35	1.47
To have more	extension services through group membership		45.59	47.06	0.37	4.78	2.21
To have more	market information through group membership		25.74	56.25	3.31	12.50	2.21
To have more	production technology information through group membership		32.72	61.40	2.21	1.47	2.21
To have more	training on improved farming methods through group membership		50.00	45.96	1.47	1.84	0.74
Demotivatin							
I have no acc	in my community		39.91	11.40	1.32	27.19	20.18
I have no trus	actors		3.51	3.95	54.39	13.6	24.56
There is unfa	into the chain by actors		10.96	6.14	59.21	9.65	14.04
I don't like hi	l influence		9.65	2.63	65.35	9.65	12.72
I have no inte	ticipating in AVC		6.58	3.95	21.05	23.68	44.74
There is a lot	g (exploitation) by actors		2.19	7.46	56.14	6.14	28.07
I don't have t	participate in AVC		5.26	1.75	33.33	24.12	35.53
I am afraid of	in general		6.17	9.69	15.42	32.16	36.56

SD- Strongly Disagree, D-Disagree, CT- Cannot Tell, A- Agree, SA- Strongly Agree

Source: Estimations from Author's Data, 2017

6.6 Comparing dummy variables with AVC participation

The variables used in the Heckman selection model and the bivariate probit model are captured under Table 6.4. From the results, more males participated in AVC-VL (56.8%) than females (48.1%). The χ^2 test (3.56) showed a statistically significant difference (at 5% level) between AVC-VL participation and gender. On the other hand, the proportion (54.6%) of males who participated in AVC-HL was less than that of females who participated in AVC-HL (58.4%). However, the χ^2 test (0.67) between AVC-HL participation and gender was not statistically significant.

Furthermore, farmers with transport equipment who participated in AVC-VL (53.1%) were slightly less than those with no transport equipment who participated in AVC-VL (54.2%). However, the χ^2 test (0.67) showed that there was no significant difference in transport equipment ownership between AVC-VL participants and non-participants. On the other hand, 64.5% of farmers with transport equipment participated in AVC-HL while 46.6% of farmers with no transport equipment participated in AVC-HL. The χ^2 test (16.15) showed that the difference between AVC-VL participation and transport equipment was statistically significant at 1% level. Access to transport equipment is expected to reduce farmers' transportation burdens and improve access to markets.

About 49.72% of farmers who rear livestock participated in AVC-VL compared to those who do not rear livestock (55.8%). The χ^2 test (1.71) showed no statistically significant difference between AVC-VL participation and livestock rearing. On the other hand, 72.5% of farmers who rear livestock participated in AVC-HL compared to the share (46.7%) of who do not rear livestock. The χ^2 test (30.88) showed that AVC-

HL participants who owned livestock differ significantly (at 1% level) from AVC-HL participants who had no livestock.

Irrigated farmers who participated in AVC-VL were higher (56.8%) than non-irrigated farmers who participated in AVC-VL (43.9%). The χ^2 test (6.17) showed a statistically significant difference (at 5% level) between AVC-VL participation and engagement in irrigation farming. In contrast, the proportion (51.7%) of irrigated farmers who participated in AVC-HL was lower than non-irrigated farmers who participated in AVC-HL (69.1%). The χ^2 test (11.37) showed that the difference between AVC-HL participation and engagement in irrigation farming was also statistically significant at 1% level.

The χ^2 test (47.56) showed that the percentage (67.9%) of farmers with strong networking who participated in AVC-VL was significantly (at 1% level) higher than the proportion (37.1%) of farmers with weak networking who participated in AVC-VL. Similarly, the χ^2 test (312.93) revealed that the share (92.54%) of farmers with strong networking who participated in AVC-HL was significantly higher than the proportion (13.78%) of those with weak networking who participated in AVC-HL.

About 60.2% of farmers with extension contacts participated in AVC-VL while the proportion of those with no extension contact who participated in AVC-VL was 47.3%. The χ^2 test (11.11) difference in AVC-VL participation and extension contact was statistically significant at 1% level. Also, the proportion of farmers with extension contacts who participated in AVC-HL was higher (72.8%) than the proportion with no extension contacts (34.8%) who participated in AVC-HL. The χ^2

test (71.96) showed a statistically significant difference (at 5% level) between AVC-VL participation and extension contact.

Cellphone owners who participated in AVC-VL (52.3%) were less than non-cellphone owners who participated in AVC-VL (53.9%). The χ^2 test (0.09) showed no statistically significant difference between AVC-VL participation and cellphone ownership. On the other hand, cellphone owners who participated in AVC-HL (65.4%) were more than the portion of non-cellphone owners who participated in AVC-HL (53.4%). The difference between AVC-HL participation and ownership of cellphone was statistically significant at 5% level based on the χ^2 test (4.90). Farmers who own cellphones tend to have greater access to production and marketing information.

The proportion (54.4%) of farmers with access to market information who participated in AVC-VL was higher than the proportion of farmers without access to market information who participated in AVC-VL (45.5%). The χ^2 test (1.29) showed no statistically significant difference between AVC-VL participation and access to market information. About 53.1% of farmers with access to market information participated in AVC-HL while 86.36 percent of farmers with no access to market information participated in AVC-HL. A statistically significant difference (at 1% level) was revealed between AVC-HL participation and access to credit information based on the χ^2 test (18.05).

The comparison of AVC-VL participation and access to credit information showed that the share (50.7%) of farmers with access to credit information who participated in AVC-VL was lower than the proportion of farmers with no access to credit

information who participated in AVC-VL (54.1%). The χ^2 test (0.32) showed no statistically significant difference between AVC-VL participation and access to credit information. Alternatively, percentage of farmers with access to credit information who participated in AVC-HL (75.3%) was significantly (at 1% level) higher than the percentage (52.5%) of farmers with no access to credit information who participated in AVC-HL. The χ^2 test (13.79) showed a statistically significant (at 1% level) difference between AVC-HL participation and access to credit information.

The χ^2 test (171.26) revealed that the portion of farmers with high trust in AVC actors who participated in AVC-VL were significantly (at 1% level) higher (80.0%) than the proportion of farmers with low trust in AVC actors (21.3%). Also, about 61.8% of the farmers with high trust in AVC participated in AVC-HL while 48.9% of the farmers with low trust in AVC participated in AVC-HL. The χ^2 test (8.40) showed that participants with high trust in chain actors differ significantly (at 1% level) from participants with low trust in chain actors.

The percentage (53.5%) of farmers with previous contract experiences who participated in AVC-VL was statistically equal to the percentage (53.8%) of farmers with no previous contract experiences who participated in AVC-VL. The χ^2 test (0.00) showed no significant difference between AVC-VL participation and previous experience with contract. Similarly, about 56.5% of farmers with previous contract experiences participated in AVC-HL while 54.6% of farmers with no previous contract experiences participated in AVC-HL. The χ^2 test (0.15) indicated no significant difference between AVC-HL participation and previous experience with contract.

About 65.9% of the farmers who accessed inputs on time for production in the previous season participated in AVC-VL while 50.4% of those who did not access inputs on time for production in the previous season participated in AVC-VL. However, χ^2 value (2.17) which showed the difference in AVC-VL participation and timing of inputs was not statistically significant. Alternatively, the χ^2 test (1.03) indicated that the percentage (53.7%) of the farmers who accessed inputs on time for production in the previous season participated in AVC-HL was less than the percentage (58.2%) of farmers who did not access inputs on time for production in the previous season participated in AVC-HL. However, the difference was not significant.

T Chi-square test analysis of dummy variables used in the bivariate probit (BVP) model

V		Sub-level	AVC-VL Participation (%) Part (Non-part)	χ^2	AVC-HL Participation (%) Part (Non-part)	χ^2
G		Males	56.83 (43.17)	3.56[c]	54.60 (45.40)	0.67
		Female	48.11 (51.89)		58.38 (41.42)	
N	g	Strong	67.91 (32.09)	47.56[a]	92.54(7.46)	312.93[a]
		Weak	37.07 (62.93)		13.79 (86.21)	
E	contact	Access	60.22 (38.78)	11.11[a]	72.76 (27.24)	71.96[a]
		No access	45.25 (54.75)		34.84 (65.16)	
T	equipment	Own	53.05 (46.95)	0.67	64.50 (35.50)	16.15[a]
		Do not own	54.20 (45.80)		46.64 (53.36)	
I	farming	Irrigators	56.76 (43.24)	6.17[b]	51.72 (48.28)	11.37[a]
		Non-irrigators	43.90 (56.10)		69.11 (30.89)	
C	ownership	Yes	52.34 (47.66)	0.09	65.42 (34.58)	4.90[b]
		No	53.94 (46.06)		53.44 (46.56)	
M	ormation	Access	54.39 (45.61)	1.29	53.07 (46.93)	18.05[a]
		No access	45.45 (54.55)		86.36 (13.64)	
C	rmation	Access	50.65 (49.39)	0.32	75.32 (24.68)	13.79[a]
		No access	54.14 (45.86)		52.48 (47.52)	
L	roduction	Yes	49.72 (50.28)	1.71	72.38 (27.62)	30.88[a]
		No	55.80 (44.20)		46.71 (53 (2.9)	
T	tors	High	80.00 (20.00)	171.2	61.82 (38.18)	8.40[a]
		Low	21.33 (78.67)	6[a]	48.89 (51.11)	
P	ence with contract	Yes	53.53 (46.47)	0.00	56.52 (43.48)	0.15
		No	53.79 (46.21)		54.55 (45.45)	
T	nputs	Early	65.97 (43.03)	2.17	53.69 (46.31)	1.03
		Delay	50.39 (49.61)		58.20 (41.80)	
R	ummies	Northern Region	62.35 (37.65)		56.47 (43.53)	
		Upper East Region	29.35 (70.65)	35.51[a]	60.87 (39.13)	3.12
		Upper West Region	42.65 (57.35)		47.06 (52 (94)	

Source: Estimations from Author's Field Data, 2017

6.6 Comparing continuous variables with AVC participation

Also, the results in Table 6.5 showed that AVC-VL participants were older (43.38 years) than AVC-VL non-participants (41.51 years) on the average. The $t-test$ (1.58) indicated a statistically significant (at 10% level) difference between the mean age of AVC-VL participants and non-participants. Similarly, the $t-test$ (1.17) showed no statistical significant difference between the mean age of AVC-HL participants (43.13 years) and non-participants (41.74 years).

On the average, no statistical significant difference was found between AVC-VL participants' education (3.60 years) and that of the AVC-VL non-participants (3.46) based on the $t-test$ (0.35). On the other hand, the mean education of AVC-HL participants (3.37 years) was slightly lower than the mean education of non-participants (3.75 years). Nonetheless, the $t-test$ (0.90) showed no statistical significant difference between the mean education of AVC-HL participants and that of non-participants. AVC-VL participants had higher household size (10.62 people) than AVC-VL non-participants (9.63 people) on average. The $t-test$ (1.74) indicated a statistical significant difference (at 5% level) between the mean household size of AVC-VL participants and mean household size of non-participants. In other words, AVC-VL participants had a significantly larger household size (approximately 1 person more) than their counterparts. Similarly, the $t-test$ (2.60) showed a statistical significant (at 1% level) difference between the mean household size of AVC-HL participants (10.82 people) and the mean household size of non-participants (9.32 people).

The mean total landholding (18.31 acres or 7.4 ha) of AVC-VL participants was significantly (at 1% level) lower than the mean total landholding of AVC-VL non-participants (26.91 acres or 10.89 ha) based on the $t-test$ (-2.44). On the other hand, the $t-test$ (0.64) revealed no statistical significant difference between the mean total landholding of AVC-HL participants (21.29 acres or 8.62 ha) and that of the non-participants (23.58 acres or 9.55 ha). On the average, AVC-VL participants and non-participants cultivated approximately equal numbers of crops (1.91) and (2.00) respectively. In other words, the $t-test$ (1.21) revealed no statistically significant difference between the mean number of crops cultivated by AVC-VL participants and non-participants. Furthermore, the $t-test$ (0.37) revealed that both AVC-HL participants (1.97) and non-participants (1.94) were cultivating similarly numbers of crops on the average.

Both AVC-VL participants and non-participants were engaged in other forms of farming (e.g., cash crop and aquaculture and apiculture) but there was no significant difference between them based on the $t-test$ (0.47). A significant difference ($t-test$ = 1.60) was recorded between AVC-HL participation and other forms of farming at 10 percent level. Thus, both AVC-HL participants and non-participants were engaged in approximately one (thus, 1.15 and 1.07) other farming activities apart from crop and livestock production. The $t-test$ (0.20) showed that both AVC-VL participants and non-participants traveled approximately the same distance (6.34 kilometers) and (6.45 kilometers) to access a district bank respectively. Similarly, the $t-test$ (1.14) revealed that both AVC-HL participants (6.69 kilometers) and non-participants (6.01 kilometers) travelled the same distance to access a district bank.

Table 6. 5: T-test analysis of continuous variables used in the bivariate probit (BVP) model

	AVC-VL Participation		AVC-HL Participation	
Variable	Part (Non-part)	χ^2	Part (Non-part)	χ^2
Age in years	43.38 (41.51)	1.58[c]	43.13 (41.74)	1.17
Education in years	3.60 (3.46)	0.35	3.37 (3.75)	0.9
Household size	10.62 (9.63)	1.74[b]	10.82 (9.32)	2.60[a]
Total landholding	18.31 (26.91)	-2.44[a]	21.29 (23.58)	0.64
Crop cultivated	1.91 (2.00)	1.21	1.97 (1.94)	0.37
Other forms of farming	1.10 (1.13)	0.47	1.15 (1.07)	1.60[c]
Distance to district bank	6.34 (6.45)	0.2	6.69 (6.01)	1.14

Source: Estimations from Author's Field Data, 2017

6.7 Determinants of extent of AVC -VL contracts

Heckman selection model results

This section presents and discusses the OLS estimates (second-stage) of the Heckman selection model showing the determinants of extent of AVC-VL contracts as shown in Table 6.6. The determinants of AVC-VL participation from the probit model in the first stage of the Heckman selection model are discussed together with AVC-HL participation and AVC participation in the next section (see Table 6.5). The results showed the presence of selectivity bias in AVC-VL contract data, which has been corrected to achieve consistent and unbiased estimates (thus, the lambda proved to be significant). This implied that there were certain unobserved factors affecting both the decision and extent to participate in AVC-VL. From the results, past experience with contracts, number of crops cultivated, other forms of farming, livestock rearing, engagement in irrigation farming, percentage of previous produce held in stock and

availability of storage facility were the significant factors influencing the extent of AVC-VL contracts.

In particular, farmers with past experience with contract engaged in bigger contracts (7.5%) as compared with those with no experience with past contracts. This means that farmers' engagement in contract is dependent on familiarity with buyers or contracting firms (Interis *et al*., 2016).

Also, the results showed that engaging in other forms of farming enterprises (like beekeeping; aquaculture and tree crop production) reduces AVC-VL contracts (6.8%); probably because farmers who engaged in more farming enterprises have the opportunity to earn enough income which could be used to finance crop production without engaging in more contracts.

Alternatively, the higher the number of crop cultivated, the higher farmers engage in bigger AVC-VL contracts. An additional crop cultivated by the farmer increases the proportion of AVC-VL contracts by 3.7%. This is because cultivating more crops demand more inputs which farmers can acquire through contracts.

Moreover, livestock rearing increases the extent of AVC-VL contracts, which meant that farmers with livestock had bigger contracts (10.5%) as compared to those who do not rear livestock. This is because farmers with livestock tend to sell or exchanged some of the animals for cash or inputs to finance their crop production without engaging in more contracts (Berdegué *et al*., 2007; Milczarek-Andrzejewska *et al*., 2008; Fischer and Qaim, 2012). However, the result proved otherwise and suggests that they even engage in more AVC-VL contracts.

Engagement in irrigation farming was also found to reduce AVC-VL contracts. This meant that irrigated farmers engaged less in contract (17.6%); possibly because such farmers are better able to reduce the risk of crop failure, which increases their chances of generating more income from one season to finance crop production in the other season without engaging in contracts.

Percentage of previous produce held in stock was positive, which indicated that farmers who had more produce in stock from the previous season had bigger contracts (7.6%) as compared to those who had less produce in stock from the previous season. Farmers with more produce in stock from the previous season engaged in bigger contracts in order to avoid adding more produce to what is already in stock and to prevent postharvest losses.

Availability of storage facility on the other hand was found to reduce AVC-VL contracts, meaning that farmers with well-structured storage facilities engaged in smaller contracts (9.2%) as compared to those who do not have well-structured storage facilities. This is because having adequate and secured storage facility serves as an effective way of holding farm produce in stock and this tends to reduce the extent of AVC-VL contracts by farmers in order to search for alternatives markets where prices are higher.

Table 6. 6: Heckman selection model (OLS) results for the extent of AVC-VL contracts by farmers in northern Ghana

Variable	Coef. (Std. Err.)	z-stat	p-value
Gender of farmer	0.027 (0.040)	0.67	0.506
Age in years	0.022 (0.016)	1.44	0.151
Education	0.049 (0.049)	1.00	0.320
Household size	-0.023 (0.035)	-0.67	0.504
Extension contact	0.005 (0.041)	0.12	0.902
Transport asset ownership	0.028 (0.047)	0.59	0.553
Past experience with contracts	0.075 [c] (0.043)	1.74	0.083
Landholding	-0.005 (0.004)	-1.31	0.191
Number of crops cultivated	0.037 [c] (0.022)	1.67	0.095
Other forms of farming	-0.068 [b] (0.027)	-2.51	0.012
Livestock rearing	0.105 [b] (0.051)	2.04	0.042
Engagement in irrigation farming	-0.176 [a] (0.061)	-2.86	0.004
Distance to district market	0.020 (0.033)	0.61	0.540
Access to market information	0.033 (0.084)	0.40	0.689
Trust in AVC actors	-0.031 (0.051)	-0.61	0.539
% of previous produce held in stock	0.076 [b] (0.038)	-1.99	0.047
Availability of well-structured storage facilities	0.092 [b] (0.050)	-1.84	0.066
Membership in FBO	-0.008 (0.044)	-0.19	0.850
Constant	0.159 (0.164)	0.97	0.332
Lambda	-0.098 (0.048)		

Number of obs. = 500; Wald chi-square (11) = 43.29; Prob > chi-square = 0.0004; Wald test of indep. eqns. (rho = 0): chi2(1) = 4.67; Prob > chi2 = 0.0307

Superscripts: ([a]), ([b]) and ([c]) represent significance levels at 1%, 5% and 10% respectively.

Source: Estimations from Author's Data, 2017.

6.8 Determinants of AVC (AVC-VL and AVC-HL) participation in Northern Ghana

Standard Probit and Bivariate Probit model results

Table 6.7 presents the results of the factors influencing AVC participation, which was analyzed with the standard Probit model as well as the bivariate probit model results of the factors influencing farmers' participation in AVC vertical linkage (AVC-VL) and AVC horizontal linkage (AVC-HL).

From the bivariate probit model, a likelihood ratio (LR) test of correlation was performed; and it indicated that the BVP model was correctly specified as compared to mounting two separate probit models. This result means that the likelihood of a farmer to participate in AVC-VL is not independent of the probability of participating in AVC-HL. Furthermore, the correlation coefficient (0.536) revealed that AVC-VL participation and AVC-HL participation are complementary, which meant that farmers tend to participate more in AVC-VL through AVC-HL participation. From a farmer's perspective, farmer groups tend to attract buyers to engage in contract with farmers because it saves time and cost. Also AVC-HL participants tend participate in AVC-VL because when they are in a group or cooperative, they do not need to provide or present individual information and physical collateral to access credit or engage in contract with the actors in the AVC-VL because of the joint liability between them.

From the results, ownership of transport equipment, networking, extension contact, access to marketing information, trust in chain actors and resident's location (Northern region (NR)) were significant and positively related to the probability of

AVC-VL participation while livestock rearing and total landholding were negatively related to the probability of AVC-VL participation. On the other hand AVC-HL participation was positively influenced by cellphone ownership, networking, extension contact, access to credit information and resident's location (NR) but negatively affected by timing of inputs and access to marketing information.

In addition to this, the probit regression results (in the 1st-stage) of the multivariate probit model with sample selection revealed that gender of farmer; landholding; awareness of AVC; networking, extension contact, access to marketing information; trust in chain actors; resident's location (NR and Upper East region (UER)) and distance to district market significantly influenced farmers' participation in AVC in general.

With resident's location, farmers living in NR and UER had higher likelihoods (38.9% and 15.1%) to participate in AVC as compared to those living in the Upper West region (UWR). Furthermore, farmers living in NR were generally more likely (30.7% and 27.8 %) to participate in AVC-VL and AVC-HL respectively. In Ghana, NR and UER tend to have adequate farming infrastructures and huge markets which tend to increase farmers' participation in AVC compared to those in UWR.

Furthermore, the results revealed that, farmers with access to marketing information were less likely (9.4% and 26.6%) to participate in AVC and AVC-HL respectively but more likely (23.7%) to participate in AVC-VL. Farmers with access to marketing information tend to participate in AVC-VL because they can easily contact value chain actors for business opportunities as revealed by Kiwanuka and Machethe (2016). Alternatively, participating in group activities is a chance for farmers without

access to marketing information to have adequate market opportunities (Fischer and Qaim, 2012; Nandi *et al*., 2017).

Increasing networking further tend to increase the likelihood to participate in AVC as well as AVC-VL and AVC-HL by 42.2%; 45.2% and 83.7% respectively. This could be due to the fact that farmers with strong networks have greater connections or access to information about value chain actors as compared to those with weak networks. In most remote areas, social groups serve as primary points of contact by businesses in reaching or locating specific farmers to engage in contract and other business opportunities (Mohammed *et al*., 2013).

Additionally, farmers with extension contacts were more likely (19.9%; 12.1% and 23.9%) to participate in AVC, AVC-VL and AVC-HL respectively. In most cases, extension agents tend to mobilize and connect value chain actors to smallholder farmers when they contact them for contract and other business arrangements (Abokyi, 2013). In mobilizing farmers, the extension agents explain to them the importance of membership in farmers groups when delivering their service, which increases their engagement in collective actions (Asante *et al*., 2011; Rwelamira, 2015). These findings agree with Azumah *et al*. (2016); Asante *et al*. (2011) and Awotide *et al*. (2015b).

From the results, being aware of AVC increases the likelihood of farmers to participate in AVC by 43.9%, ceteris paribus. This is not surprising because farmers who are aware of AVC participated in it because such farmers tend to have adequate information about the merits of AVC, which tend to increase their participation in AVC.

Also, distance to district market on the other hand reduces the likelihood to participate in AVC by 5.3%. Ideally, we expect that the further away a farmer is from the district market, the higher the likelihood to participate in AVC, in order to reduce transaction cost (Masamha *et al*., 2018). However, the result did not prove so but justifies that, farmers who lived further away from district markets were more likely to participate in AVC.

Similarly, farmers with access to credit information were more likely (21.1%) to participate in AVC-HL but not in AVC and AVC-VL. Credit information tends to increase farmers knowledge of credit packages, which they could easily obtain by participating in group activities.

Timing of inputs had a negative correlation with the probability of participate in AVC-HL, which meant farmers who did not receive inputs on time for the previous season were more likely (12.1%) to participate in AVC-HL as compared to those who received inputs on time. FBOs usually provide ready services to their members because they tend to have stronger power to bargain and convince businesses to supply inputs to their members on time for production.

With gender, female farmers were more likely (5.7%) to participate in AVC. In general, participating in AVC enables farmers to overcome several market failures by offering them with reliable quality inputs including credit, technical extension advice and price guarantees through contracts (Barrett *et al*., 2010), which are often limited to women, so they will participate more than men.

Also, smaller landholders were more likely (0.6% and 1.6%) to participate in AVC and AVC-VL respectively as compared to those with larger landholding. In most remote areas, smallholder farmers often lack access to ready inputs to grow a wide range of crops on large scales or commercial basis; hence, will participate in AVC to acquire inputs and other services from contractors or VC actors. Smallholder farmers are also unlikely to take the risk of exploring market opportunities as they wait for better market price but participate in AVC to obtain ready income. This finding is consistent with Kiwanuka and Machethe (2016) who also found a negative relationship between landholding size and farmers' participation in vertical integration in Zambian.

In terms of the AVC-VL participation model, transport equipment owners had higher likelihood (10.9%) to participate in AVC-VL. The study expected that owing transport equipment will reduce farmer participation in AVC because it gives farmers the chance to deliver their goods to remunerative markets. However, the results prove otherwise. The result agrees with Kokeyo (2013) and Chaturuka (2014) who found a positive correlation between ownership of transport equipment and the probability of participating in contract.

Livestock rearing reduces the likelihood to participate in AVC-VL by 22.8%. The fact is that farmers with livestock such as cattle, sheep and goats could sell some of these animals to finance their farming business rather than to participate in contract. In some cases, farmers engage in barter trade by exchanging their livestock with farm inputs, which tend to minimize the inherent risk in agricultural production.

In terms of the AVC-HL participation model, cellphone owners had higher probability (13.6%) to participate in AVC-HL as compared to those who do not own cellphones. The result agrees with Fischer and Qaim (2012) who found a positive link between cellphone ownership and membership in agricultural cooperatives, because having a cellphone serves as a source of information about farmer groups and medium for conducting group activities and sharing of ideas. For instance, at the group level, cellphones are used for communicating to group members, or reaching out to potential members so farmers who own cellphones will have a higher probability of belonging to FBOs.

It was also revealed that farmers with high trust in chain actors had higher likelihood (65.4%) to participate in AVC and AVC-VL respectively as compared to those with low trust in chain actors. Trust is an important factor that must prevail between the two parties before a contract is unified and accepted. The result is consistent with Rugema *et al*. (2018) who revealed a positive significant correlation between trust and farmers' participation in rice VC.

T **Maximum likelihood estimation (MLE) results for farmers' participation in AVC; AVC-VL and AVC-HL, in northern Ghana**

Variable	Bivariate probit model results								Binary probit model results			
	1. AVC-VL Participation				2. AVC-HL Participation				3. AVC participation			
	Coeff. (Std. Err.)	z-stat	p-value	ME	Coef. (Std. Err.)	z-stat	p-value	ME	Coef. (Std. Err.)	z-stat	p-value	ME
Gender	0.066 (0.156)	0.42	0.675	0.261	-0.216 (0.190)	-1.14	0.256	-0.066	-0.371[c] (0.211)	-1.82	0.069	-0.057[c]
Age in years	0.024 (0.058)	0.41	0.68	0.009	-0.029 (0.073)	-0.40	0.689	-0.009	0.024 (0.078)	0.45	0.655	0.004
Education in years	0.125 (0.170)	0.74	0.462	0.050	-0.126 (0.223)	-0.57	0.571	-0.039	0.153 (0.229)	0.41	0.684	0.025
Household size	0.076 (0.126)	0.61	0.542	0.030	0.137 (0.160)	0.85	0.393	0.042	0.109 (0.167)	0.63	0.529	0.018
Cellphone ownershi	-0.161 (0.179)	-0.90	0.36	-0.064	0.445[b] (0.227)	1.96	0.05	0.136[b]	0.261 (0.246)	1.21	0.255	0.038
Transport equipmen p	0.274[c] (0.162)	1.70	0.09	0.109[c]	0.372[c] (0.201)	1.85	0.065	0.113[c]	0.150 (0.230)	0.77	0.44	0.025
Livestock rearing	-0.574[a] (0.178)	-3.23	0.001	-0.228[a]	0.089 (0.216)	0.41	0.681	0.027	-0.135 (0.242)	-0.69	0.488	-0.023
Other forms of farm	-0.008 (0.139)	-0.06	0.952	-0.003	0.002 (0.170)	0.01	0.991	0.001	0.036 (0.197)	0.11	0.909	0.006
Landholding	-0.041[c] (0.024)	-1.70	0.089	-0.016[c]	-0.022 (0.020)	-1.10	0.273	-0.007	-0.039[c] (0.023)	-3.17	0.002	-0.006[c]
Number of crops cu	-0.107 (0.081)	-1.33	0.185	-0.043	-0.113 (0.098)	-1.15	0.248	-0.035	-0.129 (0.108)	-0.57	0.567	-0.021
Engagement in irrig ng	0.272 (0.179)	1.52	0.128	0.108	-0.152 (0.223)	-0.68	0.495	-0.046	-0.090 (0.264)	0.25	0.799	-0.014
Timing of inputs	0.145 (0.144)	1.01	0.314	0.058	-0.396[b] (0.183)	-2.16	0.031	-0.121[b]	-0.031 (0.194)	-0.83	0.406	-0.005
Networking	1.136[a] (0.175)	6.51	0.000	0.452[a]	2.745[a] (0.210)	13.6	0.000	0.837[a]	2.177[a] (0.264)	8.14	0.000	0.422[a]
Extension contact	0.304[c] (0.157)	1.94	0.052	0.121[c]	0.783[a] (0.182)	4.30	0.000	0.239[a]	1.092[a] (0.200)	5.17	0.000	0.199[a]
Access to market in	0.597[b] (0.278)	2.15	0.032	0.237[b]	-0.871[b] (0.409)	-2.13	0.033	-0.266[b]	-1.010[b] (0.508)	-2.60	0.009	-0.094[b]
Access to credit inf	0.217 (0.235)	0.92	0.356	0.086	0.691[b] (0.304)	2.28	0.023	0.211[b]	-0.052 (0.357)	-0.75	0.453	-0.009
Past experience witl	-0.210 (0.169)	-1.24	0.213	-0.083	0.032 (0.207)	0.15	0.878	0.010	-0.320 (0.225)	-1.32	0.188	-0.047
Distance to district	-0.052 (0.125)	-0.42	0.677	-0.021	-0.033 (0.136)	-0.25	0.806	-0.010	-0.326[b] (0.152)	-2.55	0.011	-0.053[b]
Trust in AVC actors	1.646[a] (0.149)	11.1	0.000	0.654[a]	0.180 (0.190)	0.94	0.346	0.055	1.242[a] (0.208)	5.51	0.000	0.227[a]
Northern Region	0.772[a] (0.234)	3.30	0.001	0.307[a]	0.913[a] (0.283)	3.22	0.001	0.278[a]	1.671[a] (0.323)	5.44	0.000	0.389[a]
Upper East Region	-0.040 (0.268)	-0.15	0.881	-0.016	0.516 (0.315)	1.64	0.085	0.157	1.741[a] (0.383)	5.17	0.000	0.151[a]
Awareness of AVC		-	-			-	-		1.693[a] (0.242)	7.35	0.000	0.439[a]
Constant	-2.611 (0.552)	0.42	0.675		-1.214 (0.705)				-2.225 (0.803)			
Rho	0.536 (0.113)											

Note: Upper West Region was used as the reference category in the location dummy. Number of obs. = 500; Wald chi-square (42) = 360.58; Prob > chi-square = 0.0000; LR test of rho = 0: chi-square (1) = 16.759; Prob > chi-square = 0.0000 – SE and ME denote standard errors and marginal effects respectively. **Superscripts:** ([a]), ([b]) and ([c]) represent significance levels at 1%, 5% and 10% respectively.
Source: Estimations from Author's Data, 2017.

6.9 Constraints to AVC participation

The study observed several constraints of farmers toward AVC participation; namely: smaller landholding, limited access to extension services, production technology, inputs, lack of encouragement from stakeholders, poor road networks and lack of irrigation facilities (Table 6.8). The response to the constraints were elicited using 1-5 points Likert scale. Smaller means (averages) indicate the least pressing constraint while larger means indicate the most pressing constraint. From the results, the AVC participants cited smaller landholding (mean = 2.24) as the least important constraint that limits their participation in AVC while the most important constraint was lack of irrigation facilities (mean = 3.70). The study further compared the constraints to AVC participation with gender. From the results, there were significant differences between limited access to inputs and poor road network access between male and female farmers. In terms of location, farmers in NR, UER and UWR identified similar constraints to AVC participation.

Table 6. 8: Mean analysis of farmers' constraints to AVC participation

		Gender	Location		
Constraints	All farmers	Male (Female)	NR	UER	UWR
Smaller landholding	2.24	2.22 (2.25)	2.25	2.22	2.22
Limited access to extension services	2.27	2.26 (2.29)	2.36	1.85	2.00
Limited access to production technology	2.30	2.2 (2.34)	2.33	1.67	2.19
Limited access to inputs	2.57	2.42 (2.6)[c]	2.55	2.15	2.42
Lack of encouragement from stakeholders	2.73	2.71 (2.76)	2.77	2.41	2.70
Poor road network	3.49	3.78 (3.53) [c]	3.70	3.22	4.15
Lack of irrigation facilities	3.70	3.43 (3.63)	3.58	2.89	3.41

1 = Strongly disagree; 2 = Disagree, 3 =Neutral 4= Agree 5= Strongly agree;
Source: Author's estimations from field data, 2018

CHAPTER SEVEN

RESULTS OF THE EFFECT OF AVC PARTICIPATION ON AGRICULTURAL CREDIT ACCESSIBILITY

7.0 Chapter overview

This chapter presents and discusses the results of the effects of AVC participation on access to credit.

7.1 Description of farmers' access, source and amount of credit

The study results revealed that majority (74.9%) of the farmers interviewed accessed credits in the study area. Of these credits, 71.8% were accessed from informal lenders (which were mainly agricultural source (AVC actors) and non-agricultural source) although they were smaller in size (GH₵739.54) as compared to the mean loan amount (GH₵8,745.65) of those (28.2%) who obtained their credits from formal lenders. For the formal credit, about 48.4% accessed theirs from commercial banks and got bigger loan amount (GH₵8,650.8) on the average followed those (38.7%) who obtained theirs from rural and community banks (GH₵4,800.0) and those (12.9%) who obtained theirs from microfinance institutions got the smallest loan amount (GH₵ 2,881.8). Among the AVC actors, 26.1% of the borrowers accessed theirs from commercial agribusiness firms and got a loan amount of GH₵590.8 on the average followed by nucleus farmers (25.5%); traders/marketers (15.8%); input suppliers (13.9%); NGOs (13.3%); aggregators (4.2%); and colleague farmers (1.2%) who got a loan amount of GH₵1,765.0; GH₵827.8; GH₵1,437.2; GH₵155.0; GH₵748.8; and GH₵873.3 respectively. Among the non-agricultural source, most

(62.8%) of them obtained theirs from friends and got a smaller loan amount (GH₵350.0) as compared to 35.7% and 15% who obtained theirs from relatives (GH₵855.0) and money lenders (GH₵712.8).

Table 7. 1: Summary statistics of farmers' access and source of agricultural credit

Characteristics	Freq.	Percentage	Mean credit amount (GH₵)
Credit application status (n = 500)			
Applied	438	87.6	
Did not	62	12.4	
Credit access status (n = 93)			
Applied and received	328	74.9	
Applied and denied	110	25.1	
Major source of credit access			
Formal	93	28.5	5,121.90
AVC actors	165	50.4	788.23
Informal lenders	128	39.1	690.85
Formal source (n = 93)			
Commercial banks	45	48.4	8, 650.8
Rural and community banks	36	38.7	4, 800.0
Microfinance institutions	12	12.9	2,881.80
AVC actors (n = 165)			
Input suppliers	23	13.9	1,437.20
Farmers	2	1.2	873.3
Aggregators	7	4.2	748.8
Traders/marketers	26	15.8	827.8
Nucleus farmers	42	25.5	1,765.00
Cooperate agribusiness firms	43	26.1	590.8
NGOs	22	13.3	155
Informal lenders (n = 129)			
Friends	80	62.8	350
Relatives	46	35.7	855
Money lenders	2	1.5	712.8

Source: Estimations from Author's Data, 2017

7.2 Description of the types of credit

In Table 7.2 also, three types of credits (thus, cash/loan; inputs and mechanization services) accessed by farmers from the various financial institutions are presented. From the results, most (100.0%; 66.7%) credits obtained from commercial banks and microfinance institutions (MFIs) were in the form of cash. However, most (72.2%) credits obtained from rural and community banks (RCBs) were in a form of inputs. With regards to the informal agricultural source, most (71.4%) credits obtained from input suppliers were in the form of inputs. Also, about 71.4% of all the credits obtained from aggregators were in the form of inputs. However, all (100%) the credits obtained from colleague farmers were in the form of cash. About 73.8% of the credits obtained from nucleus farmers were in the form of mechanization services. Alternatively, most (92.3%, 58.1% and 40.9%) credits obtained from marketers/traders, commercial agribusiness firms and NGOs were in the form of inputs. Lastly, most (92.6%; 80.4% and 100%) credits obtained from friends; relatives and money lenders were in the form of cash.

Table 7. 2: Frequency/percentage distribution of the types of credit obtained by farmers from the different financial institutions

	Type of credit			
	Cash credit	**Input credit**	**Mechanization credit**	**All**
Sources	Freq. (%)	Freq. (%)	Freq. (%)	Freq.
Formal (n = 93)				
Commercial banks	45 (100.0)	0 (0.0)	0 (0.0)	45
Rural and community banks	10 (27.8)	26 (72.2)	0 (0.0)	36
Microfinance institutions	8 (66.7)	4 (33.33)	0 (0.0)	12
AVC (n = 165)				
Input suppliers	0 (0.0)	21 (91.3)	2 (8.7)	23
Aggregators	1 (14.3)	5 (71.4)	1 (14.3)	7
Colleague farmers	2 (100.0)	0 (0.0)	0 (0.0)	2
Nucleus farmers	0 (0.0)	11 (26.2)	31 (73.8)	42
Marketers/traders	2 (7.7)	24 (92.3)	0 (0.0)	26
Commercial agribusiness	3 (7.0)	25 (58.1)	15 (34.9)	43
NGOs	5 (22.7)	9 (40.9)	8 (36.4)	22
Informal (n =129)				
Friends	75 (92.6)	4 (4.9)	2 (2.5)	81
Relatives	37 (80.4)	9 (19.6)	0 (0.0)	46
Moneylenders	2 (100.0)	0 (0.0)	0 (0.0)	2

Source: Estimations from Author's Data, 2017

7.3 Determinants of access to formal and informal credits with correction for unobserved heterogeneity with AVC participation

Multivariate Probit model with sample selection results

One of the major interests of the study was to estimate the average treatment (amount of credit) for two groups (thus, AVC participants and non-participants). However, there was no model for estimating the effect of AVC participation on formal and informal credits (especially using their amount as the dependent variables). The study could only estimate a multivariate probit (MVP) model with sample selection developed by Green (2010) to correct for potential selectivity bias in farmers' access

to formal and informal credits in relation to AVC participation (see table 7.3). In doing this, the MVP model with sample selection estimation was done twice. The first case estimated one selection equation (involving AVC participation) and two binary correlated outcome equations (involving formal credit access and informal credit access) while the second case estimated two selection equations (involving AVC-VL participation and AVC-HL participation) and two binary correlated outcome equations (also involving formal credit access and informal credit access).

In both cases, the results proved the presence and elimination of selectivity bias at 10% significance level. This means that certain unobserved factors which influence farmers' access to formal and informal credits may correlate significantly with those of AVC participation. In addition, the results also suggested that access to formal credit is a substitute for informal credit by farmers. However, the average treatments in formal and informal credits between AVC participants and non-participants are not directly observed. Meanwhile, the significant factors influencing farmers' access to formal and informal credits are discussed below:

Age of farmer reduces the likelihood of access to formal credit by 0.6% (see model 1 in table 7.3). From the perspective of formal financial providers, younger farmers are more energetic to produce more in order to repay their loans, and this increases their access. Financial institutions also tend to perceive older farmers with the fear that they may not live long enough to pay back their loan, and this reduces their access (Kuwornu *et al*., 2012).

Also from model 1, farmers who are natives had higher likelihood (10.7%) to access informal credit but less likely (16.9%) to access formal credit. From logic, one would

imagine that financial institutions providing credit to farmers in remote areas may consider natives rather than migrants for the assurance that it is very hard for them to abscond or run away from their communities when they default due to their greater relations and properties compared to non-natives. However, the result proved otherwise. Natives on the other hand tended to have access to informal credit because relations (including family members and friends) often help them with loans for production in times of need.

Furthermore, the likelihood to access formal and informal credits was negatively correlated with the number of crops cultivated as well as engagement in irrigation farming. Thus, any additional crop that the farmer cultivates reduces the probability of accessing formal and informal credits by 8.0 and 10.0% respectively while farmers who engaged in irrigation farming were about 0.2% less likely to access informal credit (see model 1 in table 7.3). Under normal circumstance, one would imagine that cultivating more crops require greater capital investment which is not often met by own income; nevertheless, cultivating more crops can be a way of enterprise diversification to reduce risk associated with crop failure and increase farmers' income to support agricultural production.

Farmers with strong networks with social groups were more likely to access informal credit by 16.2% than those with weak networks. Networking helps farmers to acquire information about informal financial lenders, which increases their access (Mohammed *et al*., 2013).

In addition to this, farmers with extension contacts were more likely (1.7%) to access formal credit as compared to those without extension contacts. This is because

extension agents often help to link credit for farmers from formal financial institutions.

Availability of guarantor had a significant and higher effect (8.5%) on the likelihood of formal credit access but not informal credit access (see model 1). Guarantors tend to use their personal securities to pledge a loan on behalf of the farmers (Assogba *et al.*, 2017).

Access to bank account also increased the likelihood of farmers' access to formal credit by 56.9% but decreased the likelihood of informal credit access by 53.9% (see model 1 in table 7.3). Possessing a bank account gives financial institutions the opportunity to evaluate the account turnover (an indication of level of business) of the potential borrower, which increases their access only if the account is not dormant.

Furthermore, from model 2 in table 7.3, farmers who are more experienced in credit accessibility were more likely to access formal credit due to the lasting relationship that they develop with financial institutions. However, those with access to credit information were less likely to access formal credit probably because if information about interest rate, collateral requirement, repayment type, repayment schedule, duration of the loan by banks are known, it puts fear and discourages farmers from accessing formal credit.

Also, confidence to approach a bank tended to increase the likelihood of farmers' access to formal credit by 9.2%. Having confidence to approach a bank reduces fears associated with providing adequate business plans and financial statements, and paying some processing and other application charges to access credit.

T **Determinants of access to formal and informal credits and interrelationships with AVC (AVC-VL and AVC-HL) participation**

Model 1: One Selection Equation

V		1. Formal credit				2. Informal credit			
		Coef. (Std. Err.)	z-stat	p-value	ME	Coef. (Std. Err.)	z-stat	p-value	ME
G	rmer	0.245 (0.232)	1.06	0.564	0.009	-0.113 (0.170)	-0.66	0.674	-0.028
A	er	-0.025[a] (0.008)	-3.13	0.000	-0.006 [a]	-0.001 (0.006)	-0.17	0.942	-0.006
E	farmer	-0.025 (0.026)	-0.96	0.202	-0.005	-0.004 (0.019)	-0.21	0.997	-0.004
R	us of farmer	-0.969[c] (0.505)	-1.92	0.070	-0.169 [c]	0.795 [c] (0.441)	1.80	0.080	0.107 [c]
H	ize	-0.009 (0.018)	-0.50	0.987	-0.002	-0.011 (0.014)	-0.79	0.405	-0.002
O	of farming (including livestock rearing)	0.103 (0.212)	0.49	0.625	0.041	0.169 (0.138)	1.22	0.123	0.057
L		0.004 (0.004)	1.00	0.139	0.001	-0.006 (0.004)	-1.50	0.684	-0.001
N	rops cultivated	-0.236 [c] (0.139)	-1.70	0.074	-0.080 [c]	-0.160 [c] (0.095)	-1.68	0.060	-0.100 [c]
E	in irrigation farming	-0.159 (0.236)	-0.67	0.715	-0.012	-0.333 [c] (0.193)	-1.73	0.062	-0.002 [c]
P	f collateral	0.044 (0.227)	0.19	0.918	0.013	0.062 (0.155)	0.40	0.823	0.017
P	f bank account	2.515 [a] (0.649)	3.88	0.000	0.569 [a]	-0.355 [b] (0.166)	-2.14	0.043	-0.539 [b]
C	ience	0.034 (0.033)	1.03	0.221	0.062	-0.017 (0.025)	-0.68	0.608	0.006
D	ank	0.019 (0.016)	1.19	0.123	0.004	-0.010 (0.012)	-0.83	0.612	-0.003
S	ure	-0.343 (0.254)	-1.35	0.413	-0.08	-0.003 (0.169)	-0.02	0.996	-0.079
A	ards default problems	0.325 (0.227)	1.43	0.157	0.073	-0.058 (0.169)	-0.34	0.941	-0.068
C	o approach a bank	-0.416 [c] (0.238)	-1.75	0.088	-0.092 [c]	0.103 (0.162)	0.64	0.494	0.084
E	ntact	0.590 [b] (0.259)	2.28	0.036	0.017 [b]	-0.226 (0.187)	-1.21	0.136	-0.133
N		-0.268 (0.222)	-1.21	0.654	-0.113	0.634 [a] (0.158)	4.01	0.000	0.162 [a]
A	of guarantor	0.399 [c] (0.242)	1.65	0.085	0.085 [c]	-0.159 (0.172)	-0.92	0.528	-0.074
R	ing	0.364 (0.287)	1.27	0.414	0.108	0.145 (0.198)	0.73	0.355	0.126
A	edit information	0.405 (0.287)	1.41	0.140	0.062	-0.038 (0.238)	-0.16	0.997	-0.037
λ	ication	-0.966 [a] (0.033)	-29.27	0.000		0.557 [a] (0.126)	4.42	0.000	
rh	and Informal)	-0.322 [b] (0.143)	2.25	0.047					

N fit statistics from the first case are as follows: Number of observation = 438; Log likelihood function = -822.917. Superscripts: (a), (b) a sent significance levels at 1%, 5% and 10% respectively.

Source: Estimations from Author's Data, 2017

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Cont

Variable		**Model 2:** Two Selection Equations							
		1. Formal credit				2. Informal credit			
		Coef. (Std. Err.)	**z-stat**	**p-value**	**Marginal Effect**	**Coef. (Std. Err.)**	**z-stat**	**p-value**	**Marginal Effect**
Gender of fa		0.121 (0.255)	0.47	0.906	0.036	0.107 (0.141)	0.76	0.221	0.004
Age of farme		-0.020 [c] (0.011)	-1.82	0.813	-0.001	-0.009 (0.005)	-1.80	0.779	-0.001
Education of		0.027 (0.026)	1.04	0.372	0.001	0.019 (0.014)	1.36	0.392	0.005
Resident stat	er	-0.668 (0.537)	-1.24	0.334	-0.277	0.970 [a] (0.303)	3.20	0.000	0.618
Household si		0.009 (0.019)	0.47	0.870	0.005	-0.009 (0.011)	-0.82	0.752	-0.001
Other forms	(including livestock rearing)	-0.209 (0.298)	-0.70	0.593	-0.007	0.045 (0.133)	0.34	0.086	0.009
Landholding		0.008 [c] (0.004)	2.00	0.055	0.002	-0.008 (0.012)	-0.67	0.516	-0.001
Number of c	ated	-0.110 (0.141)	-0.78	0.582	-0.008	-0.080 (0.073)	-1.10	0.773	-0.002
Engagement	n farming	-0.508 [b] (0.258)	-1.97	0.022	-0.109	-0.235 (0.157)	-1.50	0.372	-0.019
Possession o		0.158 (0.244)	0.65	0.608	0.052	-0.075 (0.131)	-0.57	0.613	-0.002
Possession o	ount	0.009 (1.446)	0.01	0.968	0.001	-0.326 [b] (0.135)	-2.41	0.035	-0.179
Credit experi		0.064 [c] (0.037)	1.73	0.054	0.003	-0.013 (0.021)	-0.62	0.853	-0.001
Distance to b		0.019 (0.018)	1.06	0.884	0.001	-0.015 (0.010)	-1.50	0.967	-0.002
Savings cultu		-0.323 (0.271)	-1.19	0.707	-0.076	0.119 (0.146)	0.82	0.668	0.076
Attitude tow	t problems	0.580 [b] (0.247)	2.35	0.038	0.011	0.095 (0.138)	0.69	0.837	0.004
Confidence t	a bank	-0.426 [c] (0.244)	-1.75	0.086	-0.078	0.222 [c] (0.131)	1.69	0.069	0.180
Extension co		0.445 (0.296)	1.50	0.115	0.217	-0.151 (0.155)	-0.97	0.745	-0.022
Networking		-1.334 [b] (0.662)	-2.02	0.025	-0.202	0.447 (0.2931)	1.53	0.135	0.278
Availability	or	0.787 [a] (0.277)	2.84	0.000	0.126	-0.472 [a] (0.153)	-3.08	0.000	-0.382
Record keep		0.442 (0.284)	1.56	0.207	0.114	-0.190 (0.157)	-1.21	0.492	-0.056
Access to cre		-1.048 [a] (0.341)	-3.07	0.003	-0.695	0.181 (0.192)	0.94	0.693	0.018
λ_AVC-VL	on	-0.234 [b] (0.010)	-23.40	0.024		0.197 [a] (0.052)	3.79	0.000	
λ_AVC-HL	on	1.051 [a] (0.410)	2.56	0.008		-0.407 [a] (0.171)	-2.38	0.000	
rho (Formal	al)	-0.435 [a] (0.128)	-3.40	0.000					

Note: Model fit statistics from the first case are as follows: Number of observation = 438; Log likelihood function = -457.194. Superscripts: (a), (b) and (c) represent significance levels at 1%, 5% and 10% respectively.
Source: Estimations from Author's Data, 2017

7.4 Effect of AVC participation on credit amount

Heckman treatment effect model results

In this section, the effect of AVC participation on credit amount by farmers in Northern Ghana was estimated. The coefficients tell us the amount of credit a farmer obtains for a unit change in a particular variable, when others are held constant.

The results in Table 7.4 proved the presence and elimination of selectivity bias at 10% significance level. Most importantly, the results revealed that participating in AVC increases farmers' credit amount by GH₵7,222.16. As highlighted earlier, farmers in AVC have the opportunity to access credit within and outside the chain through the assistance of other actors, and this increases the amount of credit obtained. Additionally, social collateral (Jessop *et al.*, 2012) and contracting (Raswants and Khanna, 2010) which exist through AVC participation are able to make significant contributions in convincing financial institutions in providing farmers with bigger loans.

In addition to the AVC participation variable, residency status was another significant factor, which increases farmers' credit amount. Thus, being a native increased credit amount by GH₵2,557.55. From logic, financial institutions, especially banks providing credit to farmers in remote areas may consider natives rather than migrants for the assurance that it is very hard for them to abscond or run away from their communities when they default due to their greater relations and properties compared to non-natives. Their family members and friends also help them with loans for production in times of need, making their amount bigger than their non-native counterparts.

Furthermore, other forms of farming (including livestock rearing) tended to decrease credit amount. A unit increase in other forms of farming reduces farmers' credit amount by GH₵1,370.07. Under normal circumstance, engaging in other forms of farming (including livestock rearing, aquaculture, beekeeping and tree crop production) is a way of enterprise diversification to reduce risk associated with crop failure and increase farmers' income to support agricultural production, without accessing bigger credit.

Also, farmers who engaged in irrigation farming obtained higher credit amount (GH₵2,099.68); because such farmers require adequate credit in order to produce and sell more output all year round.

Additionally, landholding was a positive significant factor influencing credit amount. A unit increase in landholding increases farmers' credit amount by GH₵90.43. Land serves as collateral, which most banks often utilize to secure their credit (Saqib *et al.*, 2017). Also, larger landholders have the capacity to expand and grow more crops and commercialize, which often requires more credit support, which farmers are not often able to meet with their own income.

Furthermore, farmers with regular savings (at least once a month) had bigger credit amount (GH₵2,763.81) as compared to those who do not save. Much savings increases the account turnover (an indication of level of business) of the potential borrower and enhances the chances of obtaining bigger loans.

In addition to this, farmers with physical collateral obtained bigger credit (GH₵3,052.52) as compared to those with no collateral. Collateral is the last resort

and a fallback for financial institutions to recover their non-performing loans. Normally, the size of the loan granted depends on the level of business or financial needs of the farmer but possession of collateral enhances ones chances of obtaining bigger size loans considering the value of the assets.

Lastly, a marginal increase in distance to nearby bank reduced farmers' credit amount by GH₵179.328. Shorter distances increase physical contact between lenders and their borrowers, which enables them to monitor and recover loan easier. This increases profitability of credit by financial insutitions if they grant bigger loans (Osei-Assibey, 2009; Wahiu and Kiritu, 2011).

Table 7. 4: Determinants (including AVC participation) of credit amount

Variable	Coef. (Std. Err.)	z-stat	p-value
AVC participation	7222.163[a] (2638.573)	2.74	0.006
Gender of farmer	-327.417 (1617.041)	-0.20	0.840
Age of farmer	167.941 (492.634)	0.34	0.733
Education	797.978 (1351.631)	0.59	0.555
Landholding	90.426[a] (29.865)	3.03	0.002
Number of crops cultivated	1300.380 (955.786)	1.36	0.174
Other forms of farming (including livestock rearing)	-1370.070[c] (721.850)	-1.90	0.058
Engagement in irrigation farming	2099.679[c] (1181.909)	1.78	0.076
Residency status	2557.545[b] (1224.103)	2.09	0.037
Distance to lending institutions	-179.328[b] (82.41273)	-2.18	0.030
Availability of guarantor	343.183 (1994.569)	0.17	0.863
Saving culture	2763.806[b] (1262.533)	2.19	0.029
Possession of collateral	3052.519[b] (1486.192)	2.05	0.040
Interest rate	-64.2242 (460.0215)	-0.14	0.889
Constant	-9998.580[a] (3766.638)	-2.65	0.008
Rho	-0.207[c] (0.091)		
Lambda	-3110.856[c] (1922.371)		

Note: Number of observations (438); Wald Chi^2 (14) = 28.31; P>Chi^2 (0.0130); Wald test of indep. eqns. (rho = 0): chi^2 (1) = 4.94; Prob>chi^2 = 0.0263.
Superscripts: ([a]), ([b]) and ([c]) represent significance levels at 1%, 5% and 10% respectively.
Source: Estimations from Author's Data collected in 2017.

7.5 Constraints to credit access

From Table 7.5, farmers also cited lack of financial institutions in their area; high transaction cost; lack of confidence to approach financial institutions; fear of default and being chased to repay; lack of off-farm activities to regular income; fear of losing collateral used to secure loan; proof address and identification; lack of access to market; lack of collateral as constraints they face in accessing credit. The results revealed lack of financial institutions in their area as their least important constraint (mean = 1.82) to accessing credit. From the study, the majority of farmers live in rural areas though, but they were nearer to financial institutions, especially banks. On the other hand, the farmers reported that lack of collateral is their most pressing constraint to accessing credit (mean = 3.58).

Table 7. 5: Mean analysis of farmers' constraints to credit access

		Gender	Location		
Constraints	All farmers	Male (Female)	NR	UER	UWR
Lack of Financial Institutions	1.82	1.77 (1.85)	1.73	1.96	2.13
High transaction cost	3.16	3.09 (3.21)	3.14	3.12	3.39
Lack of confidence to approach financial institutions	2.87	2.84 (2.93)	2.88	2.78	2.94
Fear of default and being chased to repay	2.90	2.92 (2.86)	2.86	3.11	2.79
Lack of off-farm activities to regular income	2.98	2.89 (3.11)	2.93	3.14	3.00
Fear of losing collateral used to secure loan	3.22	3.22 (3.22)	3.15	3.37	3.34
Proof address and identification	3.39	3.40 (3.35)	3.4	3.40	3.28
Lack of access to guaranteed market	3.54	3.23 (3.42)	3.32	3.51	3.19
Lack of Collateral	3.58	3.52 (3.69)	3.55	3.67	3.63

1 = Strongly disagree; 2 = Disagree, 3 =Neutral 4= Agree 5= Strongly agree;
Source: Author's estimations from field data, 2018

CHAPTER EIGHT

RESULTS OF THE EFFECT OF AVC PARTICIPATION ON CROP INCOME

8.0 Chapter overview

This chapter contains the results of the explanatory variables used in the Heckman treatment effect model. The first section (Section 8.1) summarizes and discusses the effect of AVC participation on crop income whilst the second section (Section 8.2) presents the results of the empirical determinants (and effect of AVC participation on crop income of farmers).

8.1 Description of variables used to explain crop income

This section discusses the results of all the variables used in the Heckman treatment effect model. Crop income of farmer was measured as the value of maize, rice and soybean harvested (thus, total quantity harvested [in 100 kg per bag] times unit price) in Ghana Cedis (GH₵) in the 2016/2017 cropping season.

The results in Table 8.1 revealed that on the average, the farmers earned GH₵6,560.2 as income from maize, rice and soybeans farms in the 2016/2017 season. This can be a major source of livelihood for majority of the farmers who do not engage in non-farm employment. These monies can also serve as a major assurance for the repayment of loan by farmers who accessed credit for agricultural production. A higher crop income could indicate a higher probability of repaying loans by credit borrowers, all other things been equal.

The results further showed that male farmers earned slightly higher income (GH₵6,835.3) as compared to female farmers (GH₵6,091.7). However, the t – test (-0.294) did not reveal any significant difference between the two. Also, farmers who obtained credit for agricultural production earned an average crop income of (GH₵7,431.5), which was not statistically different from the mean crop income of non-credit borrowers (GH₵4,898.6) based on t – test (-0.988).

Farmers who received extension services earned an average income of GH₵7,453.7 while those without access to extension services earned a mean crop income of GH₵5,432.2. However, the t – test (-0.824) showed no statistical significant difference between the crop income of farmers who received extension services and those who did not.

Furthermore, the t – test (0.758) showed no statistical significant difference between the mean crop income of irrigated farmers and non-irrigated farmers. But this time round, farmers with no irrigated farm had a higher crop income (GH₵8,176.7) as compared to those who engaged in irrigation farming (GH₵6,032.8). Also, farmers with access to market information had an average crop income of GH₵6,853.9 while those without access to market information had a mean crop income of GH₵3,516. 8. However, the t – test (-0.776) showed no statistical significant difference between the crop income of farmers who had accessed to market information and those who did not.

In the case of livestock rearing, farmers who kept livestock had a smaller crop income (GH₵3,931.3) as compared to those who did not keep livestock (GH₵8,051.8). The t – test (1.628) showed that there was a statistically significant difference between

the crop income of farmers who kept livestock and those who did not at 10% level. The study finally did not record any statistical significant difference between the mean crop income of AVC participants and non-participants based on the t – test (-0.338). However, AVC participants earned slightly higher crop income (GH₵6,822.1) than non-participants (GH₵5,912.7).

Table 8. 1: T-test analysis showing the differences between crop income and explanatory variables used in the Heckman treatment effect model

Variable	Sub-level	Mean (GH₵)	t-stat
Gender	Female	6091.700	-0.294
	Male	6835.336	
Access to credit	No access	4898.616	-0.988
	Access	7431.504	
Extension contact	No	5432.170	-0.824
	Yes	7453.713	
Engagement in irrigation farming	No	8176.670	0.758
	Yes	6032.798	
Access to marketing information	No	3516.782	-0.776
	Yes	6853.853	
Livestock rearing	Not engaged	8051.818	1.628[c]
	Engaged	3931.301	
AVC participation	Non-participants	5912.670	-0.338
	Participants	6822.109	
Total crop income	All	6560.191	

Note: Superscripts ([a]), ([b]) and ([c]) represent significance levels at 1%, 5% and 10% respectively.

Source: Estimations from Author's Data, 2017.

8.2 Effect of AVC participation on crop income

Heckman treatment effect model results

The Heckman treatment effect model was estimated to quantify the effect of AVC participation on crop income of farmers and to produce unbiased, consistent and efficient estimates for the explanatory variables after controlling for selectivity bias. Table 8.2 captures the results of the second-stage of the Heckman treatment effect model, which measures the determinants (including AVC participation) of crop income). It is important to note that the explanatory variables and dependent variable were not logged.

From the results, the IMR/lambda was statistically significant at 10% level, indicating the presence of selectivity bias, which has been eliminated. It also suggests that the estimates produced from the Heckman treatment effect model are unbiased and consistent because they have been treated. The parameter 'rho' which indicates the correlation between the error terms was also significant at 1% level, further confirming the presence of selectivity bias.

Most importantly, AVC participation had a positive and significant (at 10% level) effect on crop income, which implied that farmers who participated in AVC obtained higher crop income (GH₵4,971.7) as compared to the non-participants. The result is not consistent with Abdulai and Al-Hassan (2016) but agrees with Azumah *et al*. (2016), who found that contract participants obtain higher crop incomes because they are more likely to be supported with resources and technologies (on credit) that enhances productivity. As observed earlier (Table 7.2), AVC actors mostly provide

input and mechanization credits to farmers through contracts for production, which they payback with their produce.

The results further revealed that household size, other forms of farming (including livestock rearing), farm size, adoption of improved farm technologies, extension contact and distance to district market had a significant effect on crop income of farmers.

In particular, household size increased crop income of farmers. Thus, for any additional member added to the farmer's household, crop income would increase by GH₵1,593.9 other things held constant. The result corroborates with Abdulai and Al-Hassan (2016) who revealed a positive correlation between crop income and household size. Farmers with more active household members on the farm tend to have more labour at a reduced cost for increasing productivity and generating more incomes (Abdulai and Al-Hassan, 2016).

Other forms of farming (excluding livestock rearing) also had a positive significant influence on crop income at 5% level. In other words, farmers who engaged in more farm enterprises obtained bigger crop income (GH₵2,966.9), because such farmers tend to channel income from the other farming businesses to increase food crop income.

Farm size was also found to increase crop income at 1% significance level. Thus, an increase in farm size by 1 acre leads to an increase of GH₵723.8 in crop income. This is not surprising because farmers with larger farm sizes produced more and are expected to earn higher crop incomes (Arumugam *et al*., 2011).

Adoption of improved farm technologies on the other hand, exerted a negative significant effect on crop income at 10% level, which implied that adopting an additional technology leads to a reduction (of GH₵1,129.7) in crop income. The result does not meet a priori expectation and is not in tandem with Sambuo (2014) who found a positive significant correlation between fertilizer use and income in Ethiopia.

Also, extension contact was significant at 10% level and negatively related to crop income of farmers. The negative effect implied that farmers who did not receive extension services earned higher crop incomes (GH₵2,414.1) as compared to those without extension contact. Extension agents provide technical advice to farmers on how to increase productivity and achieve higher income. However, the result tended out to prove otherwise.

Lastly, distance to district market was also significant at 5% and negatively correlated with crop income, which implied that an increase in distance to district market by 1 kilometer reduces farmers' crop income by GH₵2,036.8 holding other factors constant.

Table 8. 2: Heckman treatment effect model results showing the effect AVC participation on crop incomes in northern Ghana

Variable	Coef. (Std. Err.)	z	p-value
AVC participation	**4,971.747 c (2798.404)**	**1.78**	**0.076**
Gender of farmer	721.874 (1411.250)	0.51	0.609
Age in years	-374.847 (397.915)	-0.94	0.346
Education in years	1214.522 (1630.053)	0.75	0.456
Household size	**1593.877 c (843.429)**	**1.89**	**0.059**
Livestock rearing	-2607.715 (1794.117)	1.45	0.146
Other forms of farming	**2966.940 b (1277.171)**	**2.32**	**0.020**
Farm size	**723.796 a (177.190)**	**4.08**	**0.000**
Cost of labour	-13.255 (437.329)	-0.03	0.976
Cost of fertilizer	-1.067 (5.122)	-0.21	0.835
Cost of agrochemicals	-0.818 (8.327)	-0.10	0.922
Cost of seed	-5.807 (4.814)	-1.21	0.228
Number of crops cultivated	-407.026 (1103.045)	-0.37	0.712
Irrigation farming	-3339.920 (2098.827)	-1.59	0.112
Adoption of improved farm technologies	**-1145.094 c (621.345)**	**-1.84**	**0.065**
Access to credit	1288.919 (1981.617)	0.65	0.515
Extension contacts	**-2414.081 c 1428.246)**	**-1.69**	**0.091**
Access to market information	1936.734 (1320.942)	1.47	0.143
Distance to district market	**-2036.796 b (947.466)**	**-2.15**	**0.032**
Constant	-187.507 (7144.548)	-0.03	0.979
rho	**-0.153 c (0.086)**	**-**	**-**
lambda	**-2715.296 c (1775.347)**	**-**	**-**

Note: Number of obs. = 500; Wald chi-square (15) = 41.53; Prob > chi-square = 0.0020; Wald test of independent equations (rho = 0): chi-square (1) = 3.08; Prob > chi2 = 0.0793– se denotes standard errors. **Superscripts:** ([a]), ([b]) and ([c]) represent significance levels at 1%, 5% and 10% respectively.

Source: Estimations from Author's Data, 2017.

CHAPTER NINE

RESULTS OF THE EFFECT OF AVC PARTICIPATION ON LOAN REPAYMENT

9.0 Chapter overview

The chapter begins with the summary and discussions of the explanatory variables used to explain loan repayment in the Heckman treatment effect model as captured in section 9.1. This is followed by the result and discussion of empirical determinants and effect of AVC participation on loan repayment as captured in section 9.2 in Northern Ghana. Section 9.3 also discussed the constraints to loan repayment.

9.1 Description of variables used to explain loan repayment

Loan repayment is an important factor in the credit market. It tends to establish confidentiality and good relationships as well as continuity of service between the lender and the borrower. This is because the borrower wants to have timely and cost-effective credit in times of need while the lender always wants his monies to go and come back to increase and sustain the business. In fact, non-performing loans in a form of poor loan repayment and high defaults are believed to be a major cause of the collapse of many banks in Ghana of late.

From the result, the average loan repayment offered by farmers who obtained credit was 38.1%. The result is not consistent with Ojiako *et al*. (2012) who found that the average repayment rate to be 69%. Furthermore, male farmers had lower mean repayment (36.8%) than female farmers (40.4%). However, the $t-test$ (1.267)

showed that there was no statistical significant difference between the mean loan repayment of male farmers and female farmers. The $t-test$ (-1.054) also showed no statistical significant difference between the mean loan repayment of irrigated farmers (38.9%) and non-irrigated farmers (35.4%). Also, mobile money subscribers had higher mean repayment (38.2%) than non-subscribers (37.9%). However, the $t-test$ (0.082) also showed no statistical significant difference between mean loan repayments of the two categories.

Moreover, the $t-test$ (3.122) showed a significant difference between the mean loan repayment of farmers with access to guarantors and that of those who did not have access to collateral. The result indicates that farmers who had access to guarantors had a significantly higher loan repayment (42.8%) than those without access to guarantors (34.3%), which coincide with those who accessed informal credit. Similarly, the result indicates that farmers who had access to collateral for accessing credit had a higher loan repayment (39.6%) than those without access to collateral (37.2%).

On the other hand, the $t-test$ (0.843) showed no statistical significant difference between the mean loan repayment of farmers who have access to collateral and that of those who do not have access to collateral. The mean loan repayment capacity of borrowers who fear the problems associated with loan was 40.8% while the mean repayment of borrowers who do not fear the problems associated with loan was 35.9%. The $t-test$ (1.765) revealed that the difference between the mean loan repayment of borrowers who do fear the problems associated with loan and those who do not fear the problems associated with loan was statistically significant. Also, farmers who obtained informal credit had a mean loan repayment of 38.9% compared

to those who obtained formal credit (36.1%). However, the $t-test$ (0.944) showed no statistical significant difference between the mean loan repayment of farmers with access to formal credit and those who accessed informal credit.

Table 9. 1: T-test analysis showing the differences between loan repayment and explanatory variables used in the Heckman treatment effect model

Variable	Sub-level	**Mean**	**t-stat**
Loan repayment (%)	-	0.381	-
Gender (%)	Female	0.404	1.267
	Male	0.368	
Engagement in irrigation farming (%)	Irrigators	0.389	-1.054
	Non-Irrigator	0.354	
Mobile money usage (%)	Subscriber	0.382	0.082
	Non-Subscriber	0.379	
Availability of guarantor (%)	Access	0.428	3.122[a]
	No Access	0.343	
Possession of collateral (%)	Access	0.396	0.843
	No Access	0.372	
Attitude toward default problems	Yes	0.408	1.765[c]
	No	0.359	
Source of credit (%)	Informal	0.389	0.944
	Formal	0.361	

Superscripts: ([a]), ([b]) and ([c]) represent significance levels at 1%, 5% and 10% respectively.

Source: Estimations from Author's Data, 2017.

9.2 Effect of AVC participation on loan repayment

Heckman treatment effect model results

To estimate the effect of AVC participation on loan repayment, the Heckman treatment effect model was also used. Table 9.2 consists of the OLS result (coefficients) in the second-stage of the Heckman treatment effect model. From the result, the IMR/lambda was significant at 1% level, indicating that selectivity bias was present and has been corrected. The parameter 'rho' was also significant, further indicating that some unobserved factors in the AVC participation equation correlate with the error term of the loan repayment equation.

Furthermore, AVC participation had a positive significant effect on loan repayment at 1% level, which meant that farmers who participated in AVC had higher loan repayment (13.0%) than those who did not participate in AVC. This could be attributed to the fact that participating in AVC tends to give farmers the opportunity to secure incomes through guarantee sales.

Also, value addition and upgrading within the chain also tend to help farmers obtain higher incomes to repay loans, although these incomes are not significantly different from that of non-participants. In the value chain approach, farmers tend to have higher repayment because of the presence of strong governance and group pressure that force them to repay. Sometimes, credit is given and recovered in-kind so farmers do not feel it very much when paying their loans. A good example is the case where buyers take charge of the produce and sell to deduct part of the income to repay the loan on behalf of the farmers.

Also, the presence of strong linkages and guaranteed output markets to sell produce are important factors to minimize the poor loan repayment and high defaults (Awunyo-vitor and Abankwa, 2012; Haile, 2012). AVC participation in a form of engaging in group activities reduces transaction costs associated with travelling longer distances to repay loans because farmers often have the chance to aggregate their monies and repay to the financial institution through one channel. Table 9.2 further revealed gender of farmer, number of crops cultivated, availability of guarantor and mobile money usage had a significant influence on loan repayment of farmers.

In specifics, gender was significant at 10% level and negatively correlated with loan repayment, implying that female farmers had higher repayment (5.0%) than their male counterparts. This is not surprising because, females have been noted to be more honest (or trustworthy) and will repay their loans to maintain their relationships and integrity with financial institutions. Again, most women are also softhearted and quite fearful and for that matter, will repay their loans to prevent being chased by financial institutions and to escape troubles associated with loan litigations when they default, other things held constant.

Number of crops cultivated was also found to be statistically significant at 5% level and positive. The positive effect shows that loan repayment increases by 3.5% when farmers produce one additional crop. This suggests that cultivating more crops reduces the risk of crop failures, which gives farmers the opportunity to generate more income to repay their loans.

Mobile money usage also exerted a positive significant influence on loan repayment at 5% level. This indicates that farmers who subscribe to the mobile money had

higher loan repayment (8.4%); probably because mobile money usage tends to reduce transaction cost associated with travelling to longer credit facilities to repay their loans.

Availability of a guarantor had a positive influence on loan repayment at 10% significance level. This meant that having a guarantor for accessing credit was associated with high loan repayment. In other words, farmers who have access to guarantor for accessing credit had a higher loan repayment (5.0%) than those who do not have. This could be due to the fact that guarantors insisted on farmers to repay their loan because of the legal commitment they have put themselves into with the financial institutions. Also, farmers will tend to repay their loans to maintain the good relationships they have with the guarantors so as to have easy access to credit in the future. Guarantors offer assistance to potential borrowers based on trust and this trust is more or less a social capital for most rural farmers in Northern Ghana.

Table 9. 2: Heckman treatment effect model results showing the effect of AVC participation on loan repayment by farmers in northern Ghana

Variable	Coef. (Std. Err.)	z	p-value
AVC participation	**0.130 a (0.043)**	**3.02**	**0.003**
Gender of farmer	**-0.050c (0.027)**	**-1.85**	**0.065**
Age in years	-0.002 (0.010)	-0.24	0.812
Education in years	-0.023 (0.032)	-0.71	0.476
Other forms of farming (including livestock rearing)	0.028 (0.024)	1.17	0.241
Number of crops cultivated	**0.035 b (0.016)**	**2.24**	**0.025**
Eng. in irrigation farming	0.013 (0.032)	0.4	0.686
Crop income in Ghana Cedis	0.003 (0.016)	0.2	0.845
Amount of credit in Ghana Cedis	**0.003 a (0.001)**	**4.64**	**0**
Average interest rate	0.006 0.009)	0.71	0.475
Possession of collateral	0.031 (0.025)	1.24	0.216
Formal credit source	0.034 (0.034)	0.99	0.322
Informal credit source	0.048 (0.033)	1.45	0.146
Fear of default problems	-0.024 (0.028)	-0.86	0.392
Availability of guarantor	**0.050 c (0.030)**	**1.7**	**0.089**
Mobile money usage	**0.084 b (0.033)**	**2.55**	**0.011**
Constant	0.099 (0.078)	1.28	0.201
rho	**0.524a (0.148)**	**-**	**-**
lambda	**0.121 b (0.036)**	**-**	**-**

Note: Number of obs. = 324; Wald chi-square (17) = 70.30; Prob > chi-square = 0.0000; Wald test of independent equations (rho = 0): chi-square (1) = 8.17 Prob > chi2 = 0.0043– se denotes standard errors. **Superscripts:** ([a]), ([b]) and ([c]) represent significance levels at 1%, 5% and 10% respectively.

Source: Estimations from Author's Data, 2017.

9.3 Constraints to loan repayment

The constraints that farmers face in repaying their loans were also elicited and ranked. These were low incomes; unforeseen circumstances; late acquisition of inputs; lack of guaranteed market; high interest on loans; fire outbreaks; low productivity; unfavourable weather and high post-harvest losses. The results in Table 10.1 also showed that farmers cited high post-harvest losses, low productivity and unfavourable weather as their most pressing constraints to loan repayment (mean = 4.11) and unforeseen circumstances as their least important constraint (mean = 2.71) to loan repayment.

Table 9. 3: Mean analysis of farmers' constraints to loan repayment

		Gender	Location		
Constraints	All farmers	Male (Female)	NR	UER	UWR
Low incomes	3.94	3.92 (3.96)	3.87	4.11	4.04
Unforeseen circumstances	2.71	2.71 (2.72)	2.65	2.95	2.69
Late acquisition of inputs	3.29	3.35 (3.18)	3.28	3.33	3.25
Lack of guaranteed market	3.34	3.29 (3.42)	2.82	2.30	3.41
High interest on loans	3.77	3.80 (3.73)	3.72	3.90	3.89
Fire outbreaks	3.82	3.82 (3.82)	3.80	3.92	3.78
Low productivity	4.14	4.16 (4.11)	4.12	4.12	4.28
Unfavourable weather	4.14	4.22 (4.02)	4.11	4.21	4.22
High post-harvest losses	4.15	4.18 (4.09)	4.10	4.20	4.3

1 = Strongly disagree; 2 = Disagree, 3 =Neutral 4= Agree 5= Strongly agree;
Source: Author's estimations from field data, 2017

CHAPTER TEN

SUMMARY, CONCLUSIONS AND POLICY RECOMMENDATIONS

10.0 Chapter overview

This chapter contains the summary of the study, including key findings based on which the conclusions and policy recommendations are drawn. The chapter also provides suggestions for future research. Specifically, the first section (Section 11.1) elaborates on the summary of research while the second section (Section 11.2) captures the conclusions. Furthermore, the third, fourth and five sections (Sections 11.3; 11.4 and 11.5) capture the policy recommendations, contribution of the study and suggestions for future research respectively.

10.1 Summary of key findings

The need to achieve higher agricultural growth will continue to attract support from the government and development partners because it is inextricably linked to economic growth and poverty alleviation. Critically, to achieve higher agricultural growth largely depends on the provision of agricultural credit which can only be sustained when farmers have access to reliable input and output markets that produce and stimulate higher farm incomes and loan repayment. A cross-sectional study was conducted aimed at achieving six (6) research objectives as outlined in chapter six (6) to ten (10).

In Chapter 6, the results of the first and second objectives (1 and 2) examining the extent of AVC-VL contracts as well as the determinants of farmers' participation in

AVC; AVC-VL and AVC-HL were presented and discussed. To measure the extent of VL contracts, the Heckman selection model was employed. The OLS regression results (in the 2nd-stage) of Heckman selection model revealed that past experience with contracts, number of crops cultivated, other forms of farming, livestock rearing, engagement in irrigation farming, percentage of previous produce held in stock and availability of storage facility significantly influenced the extent of AVC-VL contracts.

Also, using the BVP model, the study found that ownership of transport equipment, networking, extension contact, access to marketing information, trust in chain actors and regional location (Northern) were significant and positively related to the probability of AVC-VL participation while livestock rearing and total landholding were negatively related to the probability of AVC-VL participation. On the other hand AVC-HL participation was positively influenced by cellphone ownership, networking, extension contact, access to credit information and resident's location (Northern region (NR)) but negatively affected by timing of inputs and access to marketing information. The findings also indicated that the decisions by farmers to participate in AVC-VL and AVC-HL are complementary.

In addition to this, the probit regression results (in the 1st-stage) of the multivariate probit model with sample selection revealed that gender of farmer; landholding; awareness of AVC; networking, extension contact, access to marketing information; trust in chain actors; resident's location (NR and UER) and distance to district market significantly influenced farmers' participation in AVC in general.

In Chapter 7, the third objective of measuring farmers' access to formal and informal credits in relation to AVC participation was empirically determined using the multivariate probit (MVP) model with sample selection. In achieving this, the estimation was done in two ways.

The first case estimated one selection equation (involving AVC participation in a joint manner) and two binary correlated outcome equations (involving formal credit access and informal credit access) while the second case also analyzed two selection equations (involving AVC-VL participation and AVC-HL participation) and two binary correlated outcome equations (also involving formal credit access and informal credit access). In both cases, the results proved that selectivity bias exists in farmers' access to formal and informal credits when we take into account AVC participation. This justified that the significant variables identified below were consistently and efficiently estimated.

With regards to the other determinants of formal credit access, the study revealed age of farmer, resident status and number of crops cultivated to have a negative effect on the probability of formal credit access. At the same time, confidence to approach a bank, access to a bank account, extension contact and guarantor were found to influence formal credit access positively. On the other hand, the study found number of crops cultivated, engagement in irrigation farming and access to a bank account to have a negative correlation with informal credit access while resident status of farmer and networking had a positive significant influence on informal credit access.

In measuring the effect of AVC participation on credit access (thus, amount of credit obtained), the Heckman treatment effect model was employed. The findings revealed

that AVC participation was significant and positively correlated with credit amount. In addition to the AVC participation variable, residency status; landholding; other forms of farming; engagement in irrigation farming; savings culture; availability of collateral and distance to nearby bank had a significant influence on credit amount.

In Chapter 8, the fourth objective of examining the effect of AVC participation on crop incomes was estimated and discussed. In doing this, the Heckman treatment effect model was used. The result showed that participating in AVC has a positive and significant influence on crop income. Also, household size, engaging in other forms of farming, total farm size, adoption of improved farm technologies, extension contact and distance to district market were the other significant factors influencing crop income of farmers.

The fifth objective which estimated the effect of AVC participation on loan repayment of farmers was explained under Chapter nine (9). Most importantly, AVC participation exerted a positive influence on loan repayment of farmers based on the results of the Heckman treatment effect model. Also, gender of the farmer, number of crop cultivated, availability of guarantor, mobile money usage and amount of credit obtained were found to be the other significant predictors of loan repayment of farmers.

The last and sixth objective identified and discussed the constraints to AVC participation, access to credit and loan repayment by farmers as captured under Chapter 10. From the results, the most important constraints to AVC participation, access to agricultural credit and loan repayment by farmers were lack of irrigation

facilities to farm all-year round, lack of collateral to access bigger loans and low productivity respectively.

10.2 Conclusions

The primary aim of the study was to assess how farmers' access to credit, crop income and loan repayment could be enhanced through agricultural value chain participation (AVC) in northern Ghana. The AVC concept had two main components: thus, vertical linkage (AVC-VL) and horizontal linkage (AVC-HL). Farmers' participation in AVC-VL was strengthened with contractual arrangements while farmers' participation in AVC-HL was enhanced through collective actions. Awareness creation and access to cellphones, extension services and social groups were important for increasing farmers' participation in AVC (AVC-VL and AVC-HL). The AVC concept was embraced by smallholder farmers and female farmers in the study area. These kinds of farmers usually encounter more constraints to higher income. Most importantly, AVC participants had direct positive contribution credit, farmers' crop income and loan repayment. However, in terms of participation in AVC-VL and AVC-HL and access to formal and informal credit, farmers substituted formal credit for informal credit even though AVC-VL and AVC-HL were complements. In conclusion, AVC can be used to overcome major problems in the credit market and agricultural sector.

10.3 Policy implications and recommendations

Agricultural value chain is the best intervention to help address farmers' production and marketing needs in northern Ghana. The study realizes that smallholder farmers are females are key players in AVC participation in Northern Ghana. Accordingly, upcoming and existing policies should be strengthened by governments, development partners, NGOs and other stakeholders for promoting AVC participation should principally target and strengthen small-scale farming through contracts and group membership in Northern Ghana.

The study offers important evidence that, farmers in Northern Ghana are increasingly participating in AVC as a key strategy to access bigger loans, improves their crop incomes and increase their loan repayment. Given that awareness creation increases farmers' participation in AVC, the government, development partners, NGOs, and other stakeholders should actively create awareness on the benefits of AVC (such as greater access to credit, higher crop income and loan repayment) in northern Ghana in an persuasive manner to make the intervention attractive to farmers. In the remote areas, awareness should be intensified through social groups (social networking) and extension agents as they also have increasing effect on AVC participation. Agriculture Extension Agents (AEA) under the Ministry of Food and Agriculture (MoFA) should be resourced, motivated and trained through refresher courses in value chain concepts and benefits so that they can disseminate such details to farmers.

Furthermore, the study strongly recommends that in order for farmers to have access to credit, financial institutions, development partners and other stakeholders should strictly channel credit supports through AVC and encourage farmers to participate as

it improves their crop incomes and loan repayment. Moreover, since cellphone ownership are vital in AVC participation, it is recommended that MoFA collates and creates data base with the contact numbers of all farmers in the zone so that AVC actors could contact them through their phones in voice and text mails and messages to increase their participation in AVC. In addition, institutions like ESOKO should be contracted to provide daily update of market information to all farmers to enhance their participation in AVC.

The provision of credit to larger landholders and irrigated farmers could help improve agricultural commercialization, so it is recommended that, farmers engage in irrigation farming in order to access bigger loans. Savings is also suggested to be persuaded by farmers to enable them access bigger loans. Again, formal financial providers should identify, liaise and resource the informal financial players such as value chain actors (nucleus farmers, aggregators, processors) to supply credit to farmers (especially AVC participants) as they substitute formal credit for informal credit.

10.4 Contribution of the study

This study offers important contribution to the debate on access to credit, crop income and loan repayment by considering the role of AVC participation by farmers in Northern Ghana. The study has contributed to empirical literature in that it extended the MVP model with one selection variable (as developed by Greene (2010)) to two selection variables to address unobserved heterogeneity and interrelationships between farmers' access to formal and informal credits and participation in AVC-VL and AVC-HL. Interestingly, the study has contributed to the development of

agriculture in Northern Ghana since the findings can be used to improve credit programmes and agricultural interventions aimed at improving smallholder production and livelihoods.

10.5 Suggestion for further research

The study was limited to farm level chain actors (farmers) but not input suppliers and marketers/buyers, who also supply considerable credits to farmers for production. The author suggests that future studies should look at the complete chain by studying how the other chain actors (such as input supplies, aggregators/ marketers, processors and exporters) access credit because they also finance the production units (farmers). The study also recommends that a model that is able to estimate a system of continuous correlated variables and multiple selection equations should be developed to estimate the effect of AVC-VL participation and AVC-HL participation on formal and informal credit amounts.

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APPENDICES

UNIVERSITY FOR DEVELOPMENT STUDIES, TAMALE, GHANA

FARMER SURVEY QUESTIONNAIRE

AGRICULTURAL VALUE CHAIN PARTICIPATION, CREDIT ACCESS AND LOAN REPAYMENT BY FARMERS IN NORTHERN GHANA

Introduction

Hello, my name is _____ and I am an enumerator collecting data on behalf of a PhD student on a study examining Agricultural Value Chain and Its Effects on Credit Access and Loan Repayment of Farmers in Ghana. This study is part of the requirement for a Doctor of Philosophy Degree in Agricultural Economics of Agricultural and Resource Economics Department. All information in this questionnaire will be treated strictly confidential and will be used for scientific purposes only. Your participation is voluntary but I would be glad if you could allow 20-30 minutes of your time to complete this questionnaire.

SECTION A: Study Area- Northern Ghana

1. Location Characteristics

Region: _____ Date of Interview: _____

District: _____ Interview starting time: _____

Name of community: _____ Interview ending time:

Name of Interviewer: _____ Household No. (#): _____

Questionnaire ID_____

SECTION B: Farmer Socio-Demographic and Economic Characteristics

2. Farmer Characteristics

Table 1

Status of respondent in household **Code 1**	Sex **Code 2**	Age of farmer (years)	Years of formal education	Highest level of education **Code 3**	Household size (HH)	# of HH members above 18yrs	Resident status **Code 4**	Marital status **code 5**

Code 1: Household head -1, Husband/Wife -2, Child -3

Code 2: Male -1, Female -2

Code 3 No formal -1, Non-formal -2, Primary-3, Secondary -4, Tertiary -5

Code 4: Native-1, Migrant- 2, Relative -4, Others (specify)-5

Code 5: Married-1, Single - 2

SECTION C: Farm Characteristics - Crop Production

3. How long have you been farming? Years.....
4. What is the size of your total land holding (in terms of acres)?.....(acres)
5. Please, indicate the type of crop cultivated in the 2015/16 season and provide information on the farm size, quantities harvested, stored or consumed and sold as well as the price, in the Table 2 below:

Table 2

Crop type	**Farm size (acres)**	**Quantity harvested (maxi-bag)**	**Quantity Stored / consumed (Maxi-bag)**	**Quantity sold (Maxi bag)**	**Unit price (GHS)**	**Total income (GHS)**
Maize						
Rice						
Soybean						

6. Did you undertake any crop insurance for any of your crops last season? Yes [ ] b. No [ ]
7. If yes, for which crops ……and by which organization .....
8. If no, why? **a**. Lack of awareness of crop insurance [ ] **b**. No interest in the insurance [ ]

c. Too expensive [ ] d. Lack of availability [ ] **e.** Lack of payout of affected members [ ] **f.** Unfriendly nature of the managers of crop insurance scheme[ ] **g.** Unnecessary [ ]

9. **Labour Employment: Please indicate the labour cost last farming season for the following activities.**

Table 3

		Family labour		**Hired labour**			
	Farm Activity / acre	# of people employed	Cost per worker (GH₵)	# of people employed	Cost per worker (GH₵)	Total cost of labour (GH₵)	Comment
1.1	Land preparation* (e.g. Ploughing, land clearing, spraying)						
1.2	Planting / Sowing						
1.3	Weed control 1& 2						
1.4	Fertilizer application						
1.5	Harvesting						
1.6	Threshing						
1.7	Transportation						

* If tractor, provide total cost of land preparation

10. Do you readily get labour for these activities during the peak of the season? Yes [ ] No [ ]

SECTION D: CREDIT ACCESS AND REPAYMENT- CASH (LOAN); AGRO-INPUTS; AND MECHANIZATION SERVICES

11. Did you apply for credit from any financial institution, organization or person for your business in the 2015/16 season? Yes [ ] No [ ]

12. If yes, what type of credit ? (multiple responses applicable)
    a. Cash credit (loan) [ ] b. Input credit [ ] c. Mechanization credit [ ]

(If cash credit, fill Tables in 4 & 5; if input credit skip to Q15 & 16 and fill Table 6; and mechanization skip to Q18 fill Table 7)

13. A. If cash credit fill Table 4 and 5 below:

Table 4

Source of credit*	**Amount applied (GHS)**	**Date or month of application**	**Amount Received (GHS)**	**Month of disbursement**	**Collateral used Code 1**	**Interest rate (%)**	**Processing fee (%)**	**Tenure (period) (months)**	**No. of installments payment**

*Provide name of the financial institution ..... **Code 1**

Building property -1
Fixed deposit - 2
Treasury bill -3
Personal guarantor -4
Warehouse receipt - 5
Group guarantee - 6
Good record keeping -7

14. Loan repayment information

Table 5

	Loan installment repayment		Date of payment	Source of payment	Comment
	Amount Due(GHS)	**Amount Paid (GHS)**			
1st					
2nd					
3rd					
4th					
5th					
6th					
7th					
8th					
9th					
10th					
11th					
12th					

Input credit

15. **If input credit, what is the source of the input credit?**

a. Input dealers [ ] e. Consumers [ ]
b. Nucleus farmer [ ] f. Bank [ ] specify_____
c. Aggregators [ ] g. MFI [ ] specify_____
d. Processors [ ] h. NGO [ ] specify _____
d. Marketers (e.g. Wholesalers/Retailers) [ ] i. Informal sector [ ] specify __

16. **What kind of input (s) was accessed?** a. Chemical Fertilizer [ ] b. Sulphate of ammonia [ ]c. seed [ ] d. Weedicides [ ] e. Pesticides [ ] f. Organic fertilizer [ ]

1' : credit fill the Table 6 below:

I (Agro s)	**Quantity of input accessed** (Bags or Litres)			**Market price / unit (GHS)** (at time of production)			**Quantity of produce paid (Bags) (**after harvest **)**			**Current Market price per produce paid (GHS)** (after harvest)			**Interest rate (%)** (To be computed by researcher)	**Month of sale** **Code 1**
	Maize	**Rice**	**Soya**	**Maize**	**Rice**	**Soya**	**Maize**	**Rice**	**Soya**	**Maize**	**Rice**	**Soya**		
1. Chemical 15-15-15 N bag)														
2. Organic fe (Bags or tra														
3. Sulphate c a (50 kg ba														
4. Seed (kg)														
5. Weedicide														
6. Pesticide (														

: January -1, February – 2, ….., December -12

18. If mechanization fill the Table 7 below:

Table 7

Type of Service	**Total activity performed**	**Unit cost / activity (GHS)**	**Quantity of produce or cash paid /activity (bags)**		**Current selling price (GHS)**	**Interest Rate**	**Comment**
1. Tractor			Produce (bags) (after harvest)	Cash(GHS)			
Ploughing (acre)							
Harrowing (acre)							
Planting (acre)							
Threshing (bag)							
2. Combined Harvester							
Harvesting (acre) or (bag)							

19. From whom did you secure or obtain the mechanization credit?

a. Input dealers [ ] e. Consumers [ ]

b. Nucleus farmer [ ] f. Bank [ ] specify_____

c. Aggregators [ ] g. MFI [ ] specify_____

d. Processors [ ] h. NGO [ ] specify _____

d. Marketers(e.g.Wholesalers/Retailers) [ ] i. Informal sector [ ]specify _____

Institutional Agreement

20. How long have you been in this relationship? (in months or years)_____
21. What determines the type of credit you access? (multiple response allowed)

a. Cost effectiveness [ ] d. Convenience [ ] g. flexibility of loan terms [ ]
b. Timeliness [ ] e. Availability [ ]
c. Urgency of need [ ] f. Reliability [ ]

22. What is the institutional agreement behind the use of these credit modes?
Table 8

	Cash Credit (Loan)	**Tick**	**Input credit**	**Tick**	**Mechanization**	**Tick**
1.	Formal Application		Registration of farmers		Registration of farmers	
2.	Collateral		Acreages under consideration		Acreages under consideration [ ]	
3.	Interest rate*(%)		Guarantor		Guarantor	
4	Duration** (months)		Mode of payment		Mode of payment	
5	Repayment schedule		Time of payment		Time of payment	

*Indicate interest rate:_____% **State duration: _____month

SECTION E: VERTICAL COORDINATION - Input

23. Did you get access to inputs at the right time during the last cropping season?
a. Yes [ ] b. No [ ]
24. Did you already have arrangement / collaboration with the input dealer(s) to supply or buy agro-chemicals (inputs) for your production in the 2015/16 season?
a. Yes [ ] b. No [ ]
25. If yes, how long have you been dealing with the input dealer/ supplier? Years.....
26. What kind of input (s) did you access from the input dealer(s) last season?
a. Seed [ ] b. fertilizer[ ] c. Weedicide[ ] d.Pesticide[ ] e. Other [ ] specify

Provide information on the inputs used for your cultivated crops and cost in the Table 9 below:

Table 9

Crop Type	**Quantity Used**					**Unit cost (GHS)**					**Total cost**
	Seeds (Kg)	**Chemical Fertilizer (50kg Bag)**	**Organic Fertilizer / trailer**	**Weedicide (Litres)**	**Pesticide (Litres)**	**Seeds**	**Chemical Fertilizer**	**Organic fertilizer**	**Weedicide**	**Pesticide**	(To be completed by the Researcher)
Maize											
Rice											
Soya											

27. What kind of seed did you use for your 2015/16 production? **a**. Hybrid seed from input shops [ ]
b. improved but own seed from previous season [ ] **c**. Local seeds [ ]

SECTION F: VERTICAL COORDINATION - Marketing

28. Do you have any arrangement or collaboration for marketing your produce? a. Yes [ ] No [ ]

29. Who made the arrangement for you? a.self[ ] b. aggregator [ ]c. Input dealer [ ] d. Service provider [ ] e. MoFA [ ] f. NGO [ ] g. Dev't partner [ ]

30. Who were the main buyers of your produce for the 2015/16 production season? Use the Table 15 below to answer Q 29.

Table 10

Crop Code 1	**Source of buyer Code 1**	**Quantity sold (bags)**	**Unit Price (GHS)**	**Total Revenue** (to be computed by the researcher)
Maize				
Rice				
Soya				

Code 1: Input dealer-1; Aggregator-2; Processor -3; Wholesaler - 4; Retailer -5 Consumer -6; Tractor service provider-7

31. Where do you normally market your produce? a.Farm gate only[ ] b.Market place c. Futures market (arranged market) [ ] d. Spot market only [ ]

32. If spot market, do you look out for someone to buy your produce? a.Yes[ ]b.No[ ]
33. Is there any form of networking between and within yourselves for marketing your produce? a. Yes [ ] b. No [ ]
34. If yes, how is it done? a. Negotiation and aggregation of produce of members for one buyer [ ] b. Individual members negotiate and sell their produce to different buyers independently [ ]
    c.One buyer negotiates and buys from different producers differently [ ]

SECTION G: HORIZONTAL COORDINATION - Membership to FBO or Group

35. Do you belong to any farmer based organization (FBO)? a. Yes [ ] b. No [ ]
    If yes, give name .....

36. If yes, do you meet regularly to share ideas or information?
    a. Yes [ ] b. No [ ]

37. Can anybody become a member of the group? a. Yes [ ] b. No [ ]

38. Does your group help you to get access to inputs and market?

    a. Yes [ ] b. No [ ]

39. Does your group operate a bank account? a. Yes [ ] b. No [ ]

40. Does your group have access to extension services? a. Yes [ ] b. No [ ]

41. What is the number of extension contacts per month? a. once b. Twice c. Thrice d. Four and more

SECTION H: Awareness and Participation in Agricultural Value Chain (AVC)

42. Please, answer the question 42 using the Table 11 below.

Table 11

Are you aware of any AVC **(Code 1)**	If yes, indicate which AVC you know of **(Code 2)**	Source of information on AVC **(Code 3)**	Are you currently participating in any of the AVC specified? **(Code 4)**	If yes, which AVC do you participate in? (**Code 2)**

Code 1: Yes-1, No- 2

Code 2: Maize value chain-1, Rice value chain- 2, Soya value chain- 3, Other- 4

Code 3 Public institution (e.g. MoFA) -1, NGO - 2, Colleague farmer / FBO -3, Input dealer - 4, Marketer - 5, Mass media (e.g. TV., Radio etc.) - 6, Devt Partner e.g. (ADVANCE, USAid-FinGAP) -7

Code 4 Participant - 1, Non- participant-2

If **VC participant**, then answer Q 43 - 51, if **non-participant** then answer Q52 & 57

PARTICIPANT of AVC

43. How did you participate in the AVC? **a**. As a member of a primary AVC group [ ]
b. As a member of a secondary AVC group [ ] **c**. As an individual [ ]

44. This section of the survey deals with the **rationale for participating in a value chain**.

Kindly indicate the extent to which you agree or disagree with the following statements about your participation in value chain. Please rank each statement using the statements below from 1-5 scale. Only one response is required per statement.

1 = Strongly disagree; 2 = Disagree, 3 =Neutral (can't tell) 4= Agree 5= Strongly agree

Table 12

	Rationale for participating in AVC is to have:	**1**	**2**	**3**	**4**	**5**
1	Easy access to farm inputs					
2	Easy access to tractor service					
3	Easy access to capital (cash credit- loan)					
4	Easy access to reliable market for my produce					
5	Increase in farm size					
6	Easy access to transport					
7	Easy access to storage facilities					
8	Strong bargaining power over sale of produce					
9	Strong social networking among members					
10	Advice from agric extension agent					
11	Easy access to market information					
12	Easy access to increase prices					
13	Easy access to technical production information					
14	Perceive increase in net income of farmers					
15	Reduction in Transactional cost					
16	Access to training on proper agronomic practices					

45. This question deals with **Role of** A**gricultural Value Chain (AVC)** in helping in access to credit. Kindly, indicate by ticking Yes or No to the following statements about the role of AVC in helping your access to credit. Yes= 1 and No =2. Only one response is required per statement.

Table 13

	Statement- Can you say:	Yes - 1	No -2
1	Belonging to AVC group (group collateral) helped you to have access to cash credit(loan)		
2	Belonging to AVC group (group collateral) helped you to have access to input credit (agro inputs)		
3	Belonging to AVC group (group collateral) helped you to have access to mechanization services		
4	Participating in AVC provided guaranteed prices and sales (market) for my produce.		
5	Participating in AVC enlightened and equipped me to obtain the needed information that facilitated my easy access to credit.		
6	Group executives of AVC are able to use their influence to access credit for the group as a whole.		
	Social networking among the members and farmer groups, FI enable them have access to credit.		
7	The governing bodies or promoters of AVC (like NGO, ADVANC, NRGP, ADRA etc) linked me to FI to enable me or the group to have access to credit.		
8	Signing of MOU or contract with an off-taker (vertical linkage / market) enable me or my group to have access to credit		
9	Adding value to my produces enabled me to have access to credit		
10	Business Advisory Services provider under AVC of USAid-FinGap facilitated my loan application to enable me have access to credit		
11	Marching grant component of the AVC under NRGP enable me have access to credit		
12	Capacity building or training on the use of credit under AVC enable me have access to credit		

46. This question deals with **Role of** A**gricultural Value Chain (AVC) in facilitating Loan or Credit Repayment.** Kindly, indicate by ticking Yes or No to the following statements about the role of AVC in facilitating your loan or credit repayment. Yes= 1 and No =2
Only one response is required per statement.

Table 14

	Statement	Yes=1	No=2
1	Participating in AVC helped you to increase and or stabilize you income and this enabled me to repay my loan or credit as scheduled.		
2	Participating in AVC increased my crop productivity and this enabled me repay my loan or credit as scheduled.		
3	Participating in AVC facilitated me to use improved technologies that made me increase my yield, and this enabled me to repay my loan as scheduled.		
4	Participating in AVC provided guaranteed prices and sales (market) to enable me repay my loan as scheduled		
5	Group pressure from AVC members made me repay my loans or credit as scheduled		
6	Buyers or aggregators who buy my produce pay directly into my account which is deducted for loan repayment		
7	Proper monitoring from the Nucleus farmer enabled me repay me loan or credit without default		
8	Governance body of AVC e.g NGO, NRGP, ADRA influenced me to repay all me loan on time		

SECTION I: GOVERNANCE STRUCTURE OF THE VALUE CHAIN

47. Are you aware of the governance structure of the value chain you participate in? a. Yes [ ] b. No [ ]

48. If yes to 42, fill the Table 15 below:

Table 15

	Level	**Tick which of them you are aware of**	**Mode of election of members** 1= internal 2= external	**Mode of operation Code 1**	**Main Function Code 2**
1	Group Executives (Primary FBO)				
2	Unit Committee (Secondary FBO)				
3	NGO, NRGP, ADVANCE USAid-FinGap, ADRA etc,				
4	District executive				
5	Regional Executive				

Code 1

Organize inputs for VC actors at the community level -1
Organize market for VC actors at the community level -2
Organize markets for VC actors at the district level -3
Organize market for VC actors at the regional level -
Organize market for VC actors at global level -5

Code 2

Links AVC actors to input dealers - 1
Link AVC actors to markets - 2
Gather market information for VC actors-3
Facilitate VC group formation- 4
Ensures that VC laws are enforced- 5
Ensures quality standards are observed- 6
Ensures timely delivery of produce- 7

49. Who oversees your activities or the operations of the value chain at your level?

a. Elected AVC group executives[ ] b. Elected value chain committee members[ ]
c. Government [ ] d. NGOs [ ] e. Aggregator [ ] f. Nucleus out-grower [ ]
g. Others (specify)_____

SECTION J: ACTIVITIES OF VALUE ADDITION

50. Do you add value to your produce before sale? Yes [ ] No [ ]

Use the Table16 below to answer subsequent questions

Table 16

Crop type	**What activities do you perform after harvest (Code 1)**	**Do you store your produce after harvest? 1= Yes 2= No**	**Do you transport your produce from farm to house? 1=Yes, 2=No**	**Do you process your produce? 1=Yes, 2=No**	**Reasons for value addition Code 2**	**Reasons for not adding value Code 3**
Maize						
Rice						
Soya						

Code 1: **Code 2** **Code 3**

cleaning- 1 Parboiling-4 Avoid post harvest losses-1 No price differentiation-1

sorting- 2 Threshing - 5 Price differentiation-2 Lack of storage -2

grading - 3 packaging/ bagging- 6 Lack of funds-3

parboiling- 4 Storage - 7

51. How often do you add value to your produce before sale?

a. Always [ ] b. Sometimes [ ] c. Once [ ]

NON - PARTICIPANT OF AVC

52. This section of the survey deals with the **rationale for non - participation in a value chain.**

Kindly indicate the extent to which you agree or disagree with the following statements about the rationale for non- participating in value chain. Please rank each statement using the statements below from 1-5 scale. Only one response is required per statement.

1 = Strongly disagree; 2 = Disagree, 3 =Neutral (can't tell) 4= Agree 5= Strongly agree

Table 17

	Rationale for non-participating in AVC	1	2	3	4	5
1	No AVC group in my community					
2	Lack of trust, confidence among for the members					
3	Members select among themselves					
4	Group formation done by external body eg. MoFA, AGRA, ADVANCE, NRGP					
5	Lack of opportunity to participate in VC					
6	Not interested in the AVC groupings					
7	Cheating by aggregator who purchase produce					
8	Partiality of the leaders of VC groups					
9	Time constraint					
10	Being a migrant					
11	Fear of defaulting under the VC approach					

SECTION K: ACCESS TO FORMAL FINANCIAL SERVICE

53. Do you know of any formal financial institution around you? a. Yes [ ] b. No [ ]
54. If yes, what is the name of the financial institution? _____
55. What is the distance from your house to the nearest bank or financial institution?_____Km
56. Do you operate a bank account(s) with any bank or financial institution? a. Yes [ ] b. No [ ]

If Yes to Q56, then answer Q 57 - 61 below; If No, skip to Q62 - 65

57. If yes, which financial institution (s)? a. Commercial bank_____
    b. Micro-Financial_____ c. Rural bank_____
58. What type of account(s) do you operate with the financial institution? Kindly tick the type of product or service you are current enjoying from the institution. Tick from Table 18 as many as applicable.

Table 18

	Product / Service	Tick where applicable	Frequency of use within the last 3 years	Reason / motive for use **(code 1)**
1	Current account			
2	Savings account			
3	Salary account			
4	Term loan / overdraft			
5	Personal loan			
6	Commercial loan			
7	Agricultural loan			
8	Fixed deposit			
9	ATM service			
10	e-banking service			
11	Internet banking service			
12	SMS alert			
13	Mobile banking service			
14	Mobile money transfer			

Code 1 : To access loan or overdraft - 1; To earn interest - 2; To save my money-3

59. How long have you been with the financial institution? Years_____

60. Why don't you operate a bank account(s) with any bank or financial institution?
a. Time consuming[ ]b. Have no interest[ ] c. Long queues at the banking halls[ ]
e. High transaction cost [ ] f. Proof of address [ ]g. Minimum deposit requirement [ ]

61. In what form do you make saving(s)? a. Stock of farm produce [ ]
b. Purchase of building materials [ ] c. Keep money in the house [ ]
d. keep money with friends [ ] d. keep it in the form of livestock [ ]

SECTION L: INFORMAL FINANCIAL SERVICE ACCESS

62. Did you obtain support from the informal financial sector for your farm business last season(2015/16)?
a. Yes [ ] b. No [ ]; If yes, please indicate the source in Table 19

Table 19

	Source of informal financial service	Tick where applicable	Frequency of usage Within last 3 years Code 1	Purpose (code 2)
1	Money lender			
2	Susu			
3	Credit union			
4	Friends			
5	Relatives			
6				

Code 2: Once - 1; Twice -2; Trice or more - 3
Code 1: Farming -1; consumption-2; funeral -3; off-farm -4

63. Do you prefer seeking financial assistance from the informal sector? a. Yes [ ] b. No [ ]
64. If yes, why? a. Easy to obtain [ ] b. Quick to obtain [ ] c. Readily available [ ]
d. No collateral needed [ ] e. No processing fee [ ], (Multiple responses allowed)
65. If no, why? a. Very high interest rates [ ] b. Small nature of loan amounts provided
c. Unreliability of funds [ ] d. Unavailability of the funds [ ]

SECTION M: Infrastructure- Road, Transportation, Electricity, Telecommunication facilities

66. How far is the source of market from your house in km? _____
67. Do you transport your farm produce to market outlets? a. Yes [ ] b. No [ ]
68. If yes, what mode of transport do you use?
a. By foot [ ] b. Bicycle [ ] c. Motor bike [ ] d. Motor king (Tricycle) [ ]
e. Tractor [ ] e. Vehicle (e.g KIA Truck) [ ]

Indicate the cost of transportation where applicable in Table 20

Table 20

	Mode of transport	**Average Cost of transportation / 2015/16 season (GHS)**
1		
2		
3		

69. Do you have access to first-class good roads? a. Yes [ ] b. No [ ]
70. Do you have access to electricity? a. Yes [ ] b. No [ ]
71. Do you have access to irrigation site e.g Dam, wells ? a. Yes [ ] b. No [ ]
72. Do you have access to communication channel or mobile phone? a. Yes [ ] b. No [ ]

SECTION N: Technology transfer- Improved Technology, Communication and Mobile Technology, and extension services

73. This Section of the survey deals with use of technology, communication and extension services.

Kindly indicate utilization by ticking usage and the extent of accessibility / availability by using

the 1-3 scale below in Table 21

1 = Lack of Access; 2 = Irregular Access; 3 = Readily Available

Table 21

	Technology Transfer	**Usage (Tick)**	**1**	**2**	**3**
A	**Production Technology**				
1	Improved variety of seeds				
2	Chemical fertilizers				
3	Weedicides				
4	Pesticides				
5	Irrigation				
B	**Mechanization**				
6	Tractors				
7	Combined harvesters				
8	Planters				
9	Dibblers				
C	**Electronic communication**				
10	Access to mobile phone				
11	Access to price / market information				
12	Access to weather information				
13	Access to SMS message from account by FI				
14	Access to mobile banking services				
15	Access to mobile money transfer services				
D	**Access to extension service (contact)**				
16	Increase in number of extension visits				
16	Access to information(weather, pricing, marketing)				
17	Access to credit or loans information				
18	Access to training on proper agronomic practices				
19	Access to crop insurance information				
20	Access to proper record keeping information				

SECTION P: Other Economic Activities

74. Are you involved in any other economic activities to earn income in addition to maize, rice or soya production? Yes [ ] b. No [ ]

75. If yes, please indicate by ticking the specific economic activities you are involved in and provide the contribution of the that activity to your total income in Table 22 below:

Table 22

	Activity type	Tick	Contribution to total income
1	**Livestock production** (Cattle, sheep, goat, rabbits, pigs, etc)		
2	**Poultry/ Birds production** (Guinea fowl, layers, etc)		
3	**Perennial cash crops** (eg. mango, cashew, shea, etc)		
4	**Food crops** (eg. groundnut, sorghum, millet, cassava etc)		
5	**Vegetable production** (cabbage, tomatoes, onions, etc)		
6	**Aquaculture** (eg. red fish, tilapia, etc)		
7	**Off-farm activities** (eg salary or wage earner, charcoal burning, craftsmanship, petty trading		
8	**Hunting of wildlife / bush meat** (grass-cutter etc)		

76. How much do you spend on food items a week? GH₵_____

77. Do your receive remittance? Yes [ ] No [ ]

78. If yes, on average, how much remittance did you receive in 2015? GHS_____

SECTION O: Constraints to Value Chain Participation; constraint to financial services participation; and constraint to loan repayment.

79. This section of the survey deals with **constraints to value chain participation.** Kindly indicate the extent to which you agree or disagree with the following statements about your participation in value chain. Please rank each statement using the statement below from 1-5 scale. Only one response is required per statement in Table 24.

1 = Strongly disagree; 2 = Disagree, 3 =Neutral 4= Agree 5= Strongly agree
Table 24

A. Constraint to Value chain participation	**1**	**2**	**3**	**4**	**5**
High transaction costs					
Lack of market for produce					
Lack of access to inputs					
Lack of production technology					
Lack of extension visits					
Lack of farm lands for expansion					
Lack of irrigation facilities					
Lack of good roads					
Lack of adequate warehouse for storage					
Lack of encouragement for participation					

80. This section of the survey deals with **constraints to financial services participation**. Kindly indicate the extent to which you agree or disagree with the following statements about constraints to financial services participation. Please rank each statement using the statement below from 1-5 scale. Only one response is required per statement.

1 = Strongly disagree; 2 = Disagree, 3 =Neutral 4= Agree 5= Strongly agree
Table 25

B. Constraints to Financial Services Participation	**1**	**2**	**3**	**4**	**5**
Lack of Financial Institution in the area					
Lack of collateral as security for loans					
High transaction costs					
Proof of address and identification					
Lack of timely release of loans / credit for farming purposes					
Lack of awareness of the financial products and service					
Lack of access to electricity					
Low incomes of farm households					
Lack of credit information					
Lack of self-confidence to approach a financial Institution					
Fear of losing collateral used to secure loan					
Fear of default and being chased to repay loan					
Lack of off-farm activities to generate regular income					

81. This section of the survey deals with **constraints to loan repayment**. Kindly indicate the extent to which you agree or disagree with the following statements about the constraints to loan repayment. Please rank each statement using the statement below from 1-5 scale. Only one response is required per statement. **1 = Strongly disagree; 2 = Disagree, 3 =Neutral 4= Agree 5= Strongly agree**

Table 26

C. Constraints to loan repayment	**1**	**2**	**3**	**4**	**5**
Lack of market for produce					
High post harvest losses					
Low yield/productivity					
High interest rate					
Late acquisition or release of inputs; mechanization service or late disbursement of funds (loans).					
Unproductive use of credit eg. for funeral, marriage					
Unfavorable weather condition (e.g., drought, low rainfall)					
Lack of monitoring and hence, diversion of funds					
Out-break of bushfire on farm					

Appendix I: Estimation Outputs of the Heckman selection model for the extent of AVC-VL contracts

```
Iteration 0:   log pseudolikelihood =   -265.968
Iteration 1:   log pseudolikelihood = -265.67504
Iteration 2:   log pseudolikelihood = -265.67371
Iteration 3:   log pseudolikelihood = -265.67371

Heckman selection model                         Number of obs     =        500
(regression model with sample selection)              Selected    =        268
                                                      Nonselected =        232

                                                Wald chi2(18)     =      43.24
Log pseudolikelihood = -265.6737                Prob > chi2       =     0.0007
```

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
extnt						
sex	.0268174	.0402872	0.67	0.506	-.0521441	.1057788
ageyrs	.0223222	.0155265	1.44	0.151	-.0081092	.0527537
edu	.0485316	.0487647	1.00	0.320	-.0470455	.1441086
hhsze	-.0232574	.0348314	-0.67	0.504	-.0915256	.0450108
ext_cont	.0050648	.0410247	0.12	0.902	-.0753422	.0854717
trnsset	.027883	.0470277	0.59	0.553	-.0642896	.1200556
pexp_ctrt	.0748234	.0430922	1.74	0.083	-.0096358	.1592825
lndsze	-.0054508	.0041642	-1.31	0.191	-.0136125	.0027109
no_crops	.0370796	.0222349	1.67	0.095	-.0065001	.0806592
noother	-.0679585	.0270994	-2.51	0.012	-.1210723	-.0148446
lvsk_prd	.1046605	.0513909	2.04	0.042	.0039361	.2053849
irr_frmg	-.1756743	.0614597	-2.86	0.004	-.2961332	-.0552155
dist	.0202015	.0329828	0.61	0.540	-.0444435	.0848466
mkt_info	.0334947	.0836376	0.40	0.689	-.1304319	.1974213
trust	-.0312355	.0508349	-0.61	0.539	-.13087	.0683991
stckng	.0759016	.0381329	1.99	0.047	.0011624	.1506408
stor_facilities	-.0923689	.0501978	-1.84	0.066	-.1907548	.0060171
horizontal_int	-.0083811	.0443462	-0.19	0.850	-.095298	.0785357
_cons	.1590727	.1638978	0.97	0.332	-.1621611	.4803065

vertical_int						
sex	.0536487	.152671	0.35	0.725	-.2455809	.3528783
ageyrs	.0287411	.0609754	0.47	0.637	-.0907684	.1482507
acc_cphe	-.2034511	.1809186	-1.12	0.261	-.558045	.1511429
edu	.1269391	.1582505	0.80	0.422	-.1832262	.4371044
hhsze	.0826994	.1252525	0.66	0.509	-.1627909	.3281897
noother	.013234	.1538547	0.09	0.931	-.2883156	.3147836
lndsze	-.0474501	.0196778	-2.41	0.016	-.0860179	-.0088823
no_crops	-.1060936	.0782798	-1.36	0.175	-.2595192	.047332
irr_frmg	.2599045	.165818	1.57	0.117	-.0650928	.5849018
delay_access	.0918264	.1447486	0.63	0.526	-.1918756	.3755284
trust	1.653012	.144845	11.41	0.000	1.369121	1.936903
trnsset	.3042364	.1537721	1.98	0.048	.0028485	.6056242
netwking	1.111183	.1693014	6.56	0.000	.7793582	1.443008
ext_cont	.2901724	.1509829	1.92	0.055	-.0057487	.5860935
mkt_info	.6355366	.2629979	2.42	0.016	.1200702	1.151003
cred_info	.3244245	.2093486	1.55	0.121	-.0858911	.7347401
pexp_ctrt	-.1956732	.1718623	-1.14	0.255	-.5325171	.1411708
dist	-.0484813	.1078604	-0.45	0.653	-.2598837	.1629212
lvsk_prd	-.5816077	.1645631	-3.53	0.000	-.9041454	-.25907
northern	.7073859	.2202103	3.21	0.001	.2757816	1.13899
upper_east	-.1608359	.2704087	-0.59	0.552	-.6908272	.3691555
_cons	-2.597664	.5916785	-4.39	0.000	-3.757333	-1.437995
/athrho	-.3392767	.1569852	-2.16	0.031	-.646962	-.0315914
/lnsigma	-1.171542	.0624572	-18.76	0.000	-1.293956	-1.049128
rho	-.3268315	.1402162			-.5696213	-.0315809
sigma	.3098886	.0193548			.2741839	.3502429
lambda	-.1012814	.0464222			-.1922672	-.0102956

Wald test of indep. eqns. (rho = 0): chi2(1) = 4.67 Prob > chi2 = 0.0307

Appendix II: Estimation Outputs of the Bivariate probit for the determinants of AVC-VL participation and AVC-HL participation

```
Iteration 0:   log likelihood = -331.33606
Iteration 1:   log likelihood = -323.10635
Iteration 2:   log likelihood = -322.95653
Iteration 3:   log likelihood = -322.95635
Iteration 4:   log likelihood = -322.95635

Bivariate probit regression                     Number of obs     =        500
                                                Wald chi2(42)     =     360.58
Log likelihood = -322.95635                     Prob > chi2       =     0.0000
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
vertical_int						
sex	.0656818	.1564789	0.42	0.675	-.2410112	.3723748
ageyrs	.0237588	.0576278	0.41	0.680	-.0891897	.1367073
edu	.1252016	.1703075	0.74	0.462	-.2085951	.4589982
hhsze	.0764948	.1255023	0.61	0.542	-.1694853	.3224749
acc_cphe	-.1613217	.1792357	-0.90	0.368	-.5126172	.1899738
trnsset	.2742173	.1615576	1.70	0.090	-.0424299	.5908645
lvsk_prd	-.5743831	.1777565	-3.23	0.001	-.9227794	-.2259868
noother	-.0083662	.1390366	-0.06	0.952	-.280873	.2641406
lndsze	-.040935	.0240571	-1.70	0.089	-.0880861	.0062161
no_crops	-.1072468	.0808914	-1.33	0.185	-.2657911	.0512975
irr_frmg	.2718809	.1785139	1.52	0.128	-.078	.6217617
delay_access	.1446453	.1437801	1.01	0.314	-.1371585	.4264491
netwking	1.136422	.1745339	6.51	0.000	.7943422	1.478503
ext_cont	.3039958	.1567414	1.94	0.052	-.0032116	.6112032
mkt_info	.5965942	.2779277	2.15	0.032	.051866	1.141323
cred_info	.2166832	.2345322	0.92	0.356	-.2429914	.6763579
pexp_ctrt	-.2098374	.1686456	-1.24	0.213	-.5403768	.120702
trust	1.645709	.1486677	11.07	0.000	1.354326	1.937093
dist	-.05225	.1253457	-0.42	0.677	-.297923	.1934229
northern	.7717108	.2339606	3.30	0.001	.3131565	1.230265
upper_east	-.0399614	.2678775	-0.15	0.881	-.5649916	.4850688
_cons	-2.610535	.5516512	-4.73	0.000	-3.691752	-1.529319

horizontal_int						
sex	-.2158838	.1900713	-1.14	0.256	-.5884167	.1566491
ageyrs	-.0293411	.0733626	-0.40	0.689	-.1731292	.114447
edu	-.1263874	.2229582	-0.57	0.571	-.5633774	.3106026
hhsze	.1370722	.1604549	0.85	0.393	-.1774136	.451558
acc_cphe	.4451787	.2270473	1.96	0.050	.0001742	.8901833
trnsset	.3722757	.2013761	1.85	0.065	-.0224142	.7669656
lvsk_prd	.0888046	.2162909	0.41	0.681	-.3351178	.512727
noother	.001969	.1698713	0.01	0.991	-.3309726	.3349107
lndsze	-.0223087	.020361	-1.10	0.273	-.0622155	.0175981
no_crops	-.1134192	.0982529	-1.15	0.248	-.3059914	.079153
irr_frmg	-.1519789	.2228413	-0.68	0.495	-.5887398	.2847819
delay_access	-.3962166	.1831672	-2.16	0.031	-.7552177	-.0372154
netwking	2.745232	.210146	13.06	0.000	2.333353	3.15711
ext_cont	.7831919	.182118	4.30	0.000	.4262471	1.140137
mkt_info	-.8709647	.4085919	-2.13	0.033	-1.67179	-.0701393
cred_info	.6913145	.3036942	2.28	0.023	.0960848	1.286544
pexp_ctrt	.0317287	.2069974	0.15	0.878	-.3739786	.4374361
trust	.1796416	.1904959	0.94	0.346	-.1937235	.5530067
dist	-.0334768	.1364544	-0.25	0.806	-.3009225	.233969
northern	.9129928	.2833514	3.22	0.001	.3576343	1.468351
upper_east	.5155885	.315093	1.64	0.102	-.1019824	1.133159
_cons	-1.213929	.705134	-1.72	0.085	-2.595967	.1681079
/athrho	.5987201	.1591791	3.76	0.000	.2867347	.9107055
rho	.5361382	.113424			.2791267	.7214707

LR test of rho=0: chi2(1) = 16.7594 Prob > chi2 = 0.0000

Appendix III: Estimation Outputs of the Heckman treatment effect model for the effect of AVC participation on credit amount

```
Iteration 0:   log pseudolikelihood = -4931.0094
Iteration 1:   log pseudolikelihood = -4930.9486
Iteration 2:   log pseudolikelihood = -4930.9486

Linear regression with endogenous treatment     Number of obs     =        438
Estimator: maximum likelihood                   Wald chi2(14)     =      28.31
Log pseudolikelihood = -4930.9486               Prob > chi2       =     0.0130
```

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
AMT						
sex	-327.4169	1617.041	-0.20	0.840	-3496.759	2841.925
ageyrs	167.9414	492.6395	0.34	0.733	-797.6143	1133.497
lndhldg	90.426	29.86508	3.03	0.002	31.89153	148.9605
edu	797.9781	1351.631	0.59	0.555	-1851.169	3447.125
noother	-1370.074	721.8497	-1.90	0.058	-2784.873	44.72584
no_crops	1300.38	955.7857	1.36	0.174	-572.9259	3173.685
irr_frmg	2099.679	1181.909	1.78	0.076	-216.8204	4416.179
svg_cul	2763.806	1262.533	2.19	0.029	289.286	5238.326
dist_bank	-179.3283	82.41273	-2.18	0.030	-340.8543	-17.80231
acc_coll_01	3052.519	1486.192	2.05	0.040	139.6367	5965.4
int_rate	-64.22424	460.0215	-0.14	0.889	-965.8498	837.4013
guarantor	343.1827	1994.569	0.17	0.863	-3566.101	4252.466
res_stat	2557.545	1224.103	2.09	0.037	158.3473	4956.742
1.avpart	7222.163	2638.573	2.74	0.006	2050.655	12393.67
_cons	-9998.577	3766.638	-2.65	0.008	-17381.05	-2616.102

Appendix IV: Estimation Outputs of the Heckman treatment effect model for the effect of AVC participation on crop income

```
Iteration 0:   log pseudolikelihood = -5720.0405
Iteration 1:   log pseudolikelihood = -5719.8812
Iteration 2:   log pseudolikelihood = -5719.8809

Linear regression with endogenous treatment     Number of obs     =        500
Estimator: maximum likelihood                   Wald chi2(19)     =      41.53
Log pseudolikelihood = -5719.8809               Prob > chi2       =     0.0020
```

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
tot_income						
sex	721.8739	1411.25	0.51	0.609	-2044.125	3487.873
ageyrs	-374.8471	397.915	-0.94	0.346	-1154.746	405.0521
hhsze	1593.877	843.429	1.89	0.059	-59.21383	3246.967
frm_size	723.7964	177.19	4.08	0.000	376.5103	1071.082
edu	1214.522	1630.053	0.75	0.456	-1980.322	4409.367
noother	2966.94	1277.171	2.32	0.020	463.7298	5470.149
no_crops	-407.026	1103.045	-0.37	0.712	-2568.954	1754.902
labcost	-13.25517	437.329	-0.03	0.976	-870.4042	843.8939
cost_fert	-1.067144	5.122162	-0.21	0.835	-11.1064	8.972108
cost_seed	-5.807175	4.813578	-1.21	0.228	-15.24162	3.627264
cost_agroc	-.8182395	8.326634	-0.10	0.922	-17.13814	15.50166
irr_frmg	-3339.92	2098.827	-1.59	0.112	-7453.546	773.7061
credit_obtained	1288.919	1981.617	0.65	0.515	-2594.979	5172.816
dist	-2036.796	947.466	-2.15	0.032	-3893.796	-179.7971
mkt_info	1936.734	1320.942	1.47	0.143	-652.2641	4525.733
ext_cont	-2414.081	1428.246	-1.69	0.091	-5213.392	385.2299
tech_ado	-1145.094	621.3453	-1.84	0.065	-2362.908	72.72059
lvsk_prd	-2607.715	1794.117	-1.45	0.146	-6124.119	908.6891
1.avpart	4971.747	2798.404	1.78	0.076	-513.0248	10456.52
_cons	-187.5073	7144.548	-0.03	0.979	-14190.56	13815.55

avpart						
sex	-.3752602	.2062972	-1.82	0.069	-.7795952	.0290749
ageyrs	.0231001	.0772469	0.30	0.765	-.128301	.1745013
acc_cphe	.2477238	.2460744	1.01	0.314	-.2345731	.7300207
edu	.1723528	.2107822	0.82	0.414	-.2407727	.5854783
hhsze	.1121217	.1783046	0.63	0.529	-.237349	.4615924
noother	.0644065	.1402071	0.46	0.646	-.2103944	.3392074
lndsze	-.0354684	.0174141	-2.04	0.042	-.0695994	-.0013374
no_crops	-.1422437	.1074971	-1.32	0.186	-.3529343	.0684468
irr_frmg	-.1066705	.2523932	-0.42	0.673	-.6013522	.3880111
delay_access	-.0177705	.1847287	-0.10	0.923	-.379832	.3442911
trust	1.236188	.2084321	5.93	0.000	.8276683	1.644707
trnsset	.1684882	.2183371	0.77	0.440	-.2594447	.5964211
awareness_AVC	1.697401	.212205	8.00	0.000	1.281487	2.113315
netwking	2.169281	.2549586	8.51	0.000	1.669571	2.668991
ext_cont	1.086569	.1978151	5.49	0.000	.6988582	1.474279
mkt_info	-1.058433	.4457438	-2.37	0.018	-1.932075	-.1847913
cred_info	-.134347	.2674206	-0.50	0.615	-.6584817	.3897877
pexp_ctrt	-.3305877	.1952867	-1.69	0.090	-.7133426	.0521672
dist	-.3406924	.1254869	-2.71	0.007	-.5866421	-.0947426
lvsk_prd	-.1358583	.238189	-0.57	0.568	-.6027002	.3309837
northern	1.670707	.3032778	5.51	0.000	1.076293	2.26512
upper_east	1.693578	.3410634	4.97	0.000	1.025106	2.36205
_cons	-2.159289	.77446	-2.79	0.005	-3.677202	-.6413749
/athrho	-.1537103	.0876012	-1.75	0.079	-.3254054	.0179848
/lnsigma	9.787174	.1537882	63.64	0.000	9.485755	10.08859
rho	-.1525111	.0855636			-.3143863	.0179829
sigma	17803.92	2738.033			13170.77	24066.92
lambda	-2715.296	1775.347			-6194.911	764.3202

Wald test of indep. eqns. (rho = 0): chi2(1) = 3.08 Prob > chi2 = 0.0793

Appendix V: Estimation Outputs of the Heckman treatment effect model for the effect of AVC participation on loan repayment

```
Iteration 0:   log pseudolikelihood = -54.129554
Iteration 1:   log pseudolikelihood =  -52.95818
Iteration 2:   log pseudolikelihood = -52.897684
Iteration 3:   log pseudolikelihood = -52.897452
Iteration 4:   log pseudolikelihood = -52.897452

Linear regression with endogenous treatment     Number of obs     =        324
Estimator: maximum likelihood                   Wald chi2(16)     =      70.30
Log pseudolikelihood = -52.897452               Prob > chi2       =     0.0000
```

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
LOAN_REP						
sex	-.0500459	.0270907	-1.85	0.065	-.1031428	.003051
ageyrs	-.0024855	.0104344	-0.24	0.812	-.0229366	.0179655
edu	-.0226376	.0317418	-0.71	0.476	-.0848505	.0395752
noother	.0276474	.0235591	1.17	0.241	-.0185275	.0738224
no_crops	.0350858	.0156869	2.24	0.025	.0043401	.0658315
irr_frmg	.0127879	.031605	0.40	0.686	-.0491567	.0747325
inc	.0031216	.0159918	0.20	0.845	-.0282217	.0344649
at_crt	.0030252	.0006519	4.64	0.000	.0017474	.0043029
int_rate	.0063114	.0088324	0.71	0.475	-.0109998	.0236226
acc_coll_01	.0314066	.0254018	1.24	0.216	-.0183799	.0811932
fear_default	-.0241933	.0282879	-0.86	0.392	-.0796366	.03125
guarantor	.0504694	.0296592	1.70	0.089	-.0076615	.1086003
for_source	.0338235	.0341269	0.99	0.322	-.0330639	.1007109
inf_source	.0477063	.0328145	1.45	0.146	-.0166089	.1120215
mb_money	.0839641	.0329506	2.55	0.011	.0193822	.148546
1.avpart	.1295072	.0428887	3.02	0.003	.045447	.2135674
_cons	.0994338	.077684	1.28	0.201	-.052824	.2516916

avpart						
sex	-.2982134	.2433284	-1.23	0.220	-.7751283	.1787016
ageyrs	.1668038	.0852607	1.96	0.050	-.0003042	.3339118
acc_cphe	-.0486843	.2842725	-0.17	0.864	-.6058482	.5084795
edu	.4131024	.2577534	1.60	0.109	-.092085	.9182898
hhsze	-.0799681	.2056448	-0.39	0.697	-.4830244	.3230883
noother	.1172899	.1926398	0.61	0.543	-.2602771	.4948569
lndsze	-.0684283	.0199891	-3.42	0.001	-.1076062	-.0292504
no_crops	-.2674991	.1487884	-1.80	0.072	-.5591191	.0241209
irr_frmg	-.1795755	.3315821	-0.54	0.588	-.8294644	.4703134
delay_access	-.2787909	.2263761	-1.23	0.218	-.7224799	.1648981
trust	.9569423	.2247375	4.26	0.000	.5164648	1.39742
trnsset	-.0351582	.243128	-0.14	0.885	-.5116803	.4413639
awareness_AVC	1.534324	.2311975	6.64	0.000	1.081185	1.987462
netwking	2.162686	.2752849	7.86	0.000	1.623138	2.702235
ext_cont	.7560254	.2165007	3.49	0.000	.3316918	1.180359
mkt_info	-.7869809	.5833221	-1.35	0.177	-1.930271	.3563093
cred_info	-.2480164	.3560713	-0.70	0.486	-.9459034	.4498706
pexp_ctrt	.3959577	.2160013	1.83	0.067	-.027397	.8193124
dist	-.2430495	.1510879	-1.61	0.108	-.5391764	.0530774
lvsk_prd	-.1926058	.2581568	-0.75	0.456	-.6985838	.3133722
northern	.8042282	.3229119	2.49	0.013	.1713325	1.437124
upper_east	1.066527	.3672805	2.90	0.004	.34667	1.786383
_cons	-1.886372	.9071392	-2.08	0.038	-3.664332	-.1084115
/athrho	.5818649	.2036182	2.86	0.004	.1827805	.9809492
/lnsigma	-1.467544	.0416836	-35.21	0.000	-1.549242	-1.385845
rho	.5240195	.1477054			.1807719	.7534765
sigma	.230491	.0096077			.2124089	.2501123
lambda	.1207818	.0362687			.0496964	.1918671

Wald test of indep. eqns. (rho = 0): chi2(1) = 8.17 Prob > chi2 = 0.0043