CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE
Faculty of Tropical AgriSciences
Department of Economics and Development

Impact of Microcredit on Agricultural Small and Medium Scale Enterprises: Evidence of Poultry Farming in Dormaa Municipality of Ghana

Master's Thesis

Supervisor:
Dr. RNDr. Tomáš Ratinger

Author:
Sylvester Amoako Agyemang, BA

Prague 2017

Declaration

"I hereby declare that this master's thesis titled **Impact of Microcredit on Agricultural Small and Medium Scale Enterprises: Evidence of Poultry Farming in Dormaa Municipality of Ghana**, is my own research and all the sources has been duly acknowledged through complete referencing".

27th April, 2017

……………………………...

Sylvester Amoako Agyemang, BA

Acknowledgement

First and foremost, my sincere thanks goes God for his blessings, wisdom and gift of life bestowed on me during my entire studies. My gratitude also goes to the Faculty of Tropical AgriSciences of the University of Life Sciences, Prague for the research travel grant and the opportunity offered me to upgrade my academic status.

My heartfelt gratitude again goes to Dr. RNDr. Tomáš Ratinger for his tireless and selfless supervision of this research. I am also grateful to the Chairperson of the Dormaa Poultry Farmers Association (Mr. Dei Kusi) and the entire members for their warm arms support offered during the data collection. I am also grateful to my friends Mr. Alhaji Mumin of Unity Farms, Miss Comfort Obeng Adae, Mr. Adu Enock, Mr. Elvis Oppong Yeboah and Mr. Isaac Kwaku Boateng for their enormous support during the data collection as well as Edward Ameyaw, MPhil for his time and contribution towards the success of this study.

To mother, father, family and friends, thanks for your prayer and support during the challenging times. May the Good Lord shower His Blessings on you all!!

Abstract

Microcredit is assumed to have direct and indirect impact on the production efficiency, output and income of farmers thereby ensuring sustainable food supply. The research therefore studied the impact of microcredit on small and medium scale poultry production using farm level survey data from the Dormaa Municipality of Ghana. The study was conducted on 61 and 39 randomly selected microcredit receiving and non-receiving poultry farmers respectively using questionnaires. Key informant interviews and focus group discussion were also conducted to triangulate the data. Probit model, data envelopment analysis (DEA) along with inefficiency model and the propensity score matching (PSM) technique along with linear regression models were used to analyse the propensity of farmers taking microcredit and its impact on their farm efficiency, output and income. Results from the probit model show that farmers with higher education, experience, large assets base (land and machinery), micro-savings as well as female farmers are more likely to take microcredit whereas large scale and older farmers are less likely to take microcredit. The inefficiency effect model also revealed that microcredit, higher experience, education, capital, and labour helps farmers to efficiently convert inputs into output whilst large farm size increases inefficiency. Microcredit receiving farms on an average were 14% (assuming a variable return to scale) more efficient than non-receiving farms using the PSM. Again, farmers have to cut wasteful expenditure by 15% to be fully efficient. We also compared the output (eggs and birds/chicken) and income of the treated (microcredit farmers) and the control (non-microcredit farmers) groups using the propensity score matching (PSM) technique and linear regression and the results also indicated that microcredit has a positive impact on both eggs and chicken/birds production and farm income. On an average, farmers receiving microcredit produce 8% and 44% (eggs and birds) and earn 28% income more than non-receiving farmers. Sustaining these impacts can increase output, and subsequently make Ghana self-sufficient in eggs and chicken supply and food secured. Expansion of access and timely distribution of soft agricultural credit to smallholder poultry farmers can improve their output and improve food security and should be the policy direction of the Government of Ghana in ending frozen chicken importation.

Keywords: Microfinance, Microcredit, Technical efficiency, Technical Inefficiency, Data Envelopment Analysis, Propensity Score Matching, Self-sufficiency and Ghana.

Table of Content

List of Figures

List of Tables

List of Acronyms

ABD	Agricultural Development Bank
AE	Agro-environment
ASCAs	Accumulating Savings and Credit Associations
ATE	Average Treatment Effect
ATET	Average Treatment Effect on the Treated
BoG	Bank of Ghana
BRAC	Building Resources Across Communities
CCUs	Cooperative Credit Unions
CRS	Constant Return to Scale
DEA	Data Envelopment Analysis
EDIF	Export Development Investment Fund
FAO	Food and Agricultural Organization
FNGOs	Financial Non-Governmental Organisations
GDP	Gross Domestic Product
GHAMFIN	Ghana Microfinance Network
GoG	Government of Ghana
GSS	Ghana Statistical Service
KPK	Khyber Pakhtun Khwa
LFA	Less Favoured Area
MASLOC	Microfinance and Small Loans Centre
MC	Microcredit
MFIs	Microfinance Institutions
MoF	Ministry of Finance
MoFA	Ministry of Finance and Economic Planning
NBFIs	Non-Bank Financial Institutions
PNDCL	Provisional National Defence Council Law
PSM	Propensity Score Matching
ROSCAs	Rotating Savings and Credit Associations
TE	Technical Efficiency
TI	Technical Inefficiency
USDA	United States Department of Agriculture
VRS	Variable Return to Scale
ZTBL	Zarai Taraqiati Bank in Lakki
CRSGIS	Centre for Remote Sensing and Geographic Information Services

1.0 Introduction

Poultry production was identified as a potential source through which the acute shortfall in the supply of animal protein and jobs could be solve in the 1960's and subsequently led to the establishment of the integrated poultry project in Accra (FAO 2014). The industry grew steadily between the 1980's and 1990's into a vibrant sector supplying about 95% of the domestic demand for chicken and eggs (Flake and Ashitey, 2008). The picture in the 2000's has however not been pleasant though the industry remains a vibrant subsector of agriculture which accounted for 20.1% of Ghana's 2016 non-oil GDP and employs 44.7% of its labour force (MoF, 2017). The poultry sector provides 40% of the national animal protein through eggs and chicken supply (FAO, 2014) whilst serving as a 'safety net' to rural livelihood and promoting food security (Embassy of the kingdom of the Netherlands, 2014). It also provides employment opportunities to the rural populace thereby contributing to their income. The sector is however characterised by 95% small and marginal producers (Embassy of the Kingdom of the Netherlands, 2014) with inadequate financial resources thereby unable to apply optimal inputs and new production technologies for higher production. This results in low production and productivity impeding sustainable and sufficient supply of the major source of protein to Ghanaians (chicken). Timely and proper application of inputs like feed, drugs, vaccines, veterinary services, acquisition of quality day-old-chicks, mechanical equipment as well as rationing of feed is vital in poultry production if this menace can be reversed.

Ghana currently imports 73% of the chicken consumed (mainly from EU, USA and Brazil) due to the aforementioned situation which threatens the country's food security (Weible and Pelikan 2016; USDA, 2017). This has forced successive Governments to prioritise accelerating the growth of the poultry industry in their national and economic strategic plans in order to be self-sufficient. Self-sufficiency in poultry production basically means the ability to meet domestic demand with domestic supply by a country. Key to sustainable self-sufficiency and food security is to ensure a sustainable increase in chicken and eggs production to meet the demands of the ordinary Ghanaian. Increasing poultry production also requires a timely supply of farm inputs including credit. Poultry production is cash demanding, however the peasant farmers forming the greatest percentage of the sector lacks the financial resources to meet the demands of the sector. This prompted the establishment of credit-support policies and programmes and the subsequent establishment of the Agricultural Development Bank (ADB) [ADB Act 286] in 1965 by the Government of Ghana to fast-tract the development and modernisation of agriculture and its allied industries (Kusi et al., 2015). Subsequently, the Accelerated Agricultural Growth and Development Strategy (AAGDS), (2001) and the Agriculture Development Fund (Export Development Investment Fund, EDIF), in 2011 were also established to provide affordable credit facilities to farmers, create jobs and rejuvenate the sector to make it attractive to especially the youth, all of which have failed to see the light of the day (Kusi et al., 2015).

Against this background, Ghana opted for a paradigm shift in agricultural and poultry financing (Nuhu et al., 2014) which also coincided with the advent of microcredit under the auspices of microfinance in the late 1980's. Motivated by the successful history of microcredit in developed economies, development economists in least developed and developing economies have promoted microcredit as the "Bible" for rural development through agriculture. The philosophy behind microcredit is to eradicate poverty by stimulating micro-enterprises. This is done by expanding access to credit by rural and micro entrepreneurs who are curbed out of the formal financial market due to limited financial security. MFIs since their inseption in Ghana have grown from strenght to strenght providing credit and other financial services to the poor (Boateng et al., 2015). The assumption was that MFIs can provide these small scale poultry farmers capital to acquire feed, day-old-chicks and other requisite inputs on a timely basis. As such, this will improve their adoption of modernproduction technologies thereby increasing their efficiency and output which will lead to the achievement of self-sufficiency if sustained. Access to agricultural credit by poultry farmers is therefore a crucial factor in realising the full potential of poutry production as a productive and profitable venture.

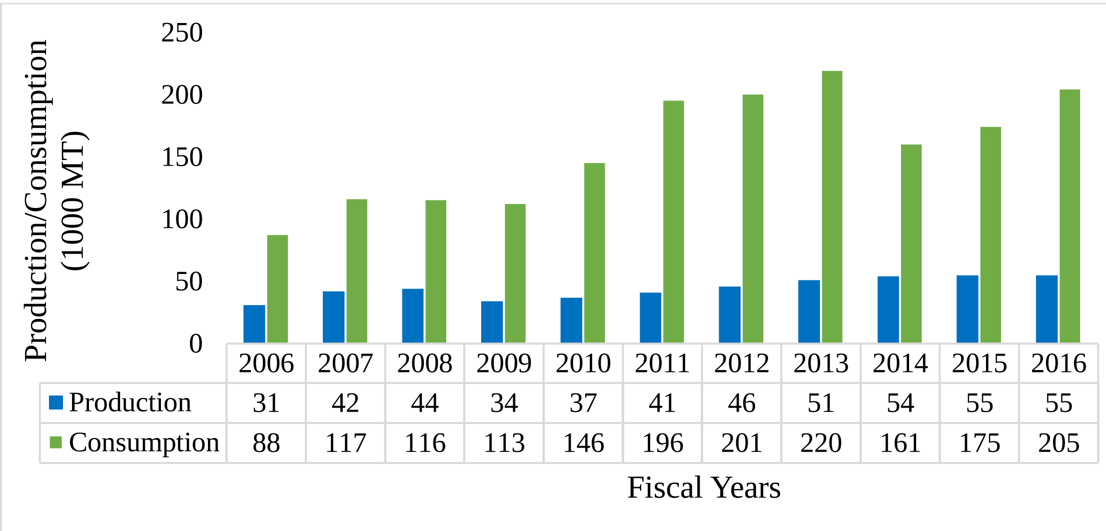
A priori studies have shown that microcredit has a positive impact on farm efficiency performance and as such increases output and income of the farmer to enhance food security (Wadud, 2013). However, Bhutt and Tang (2001) also argued that the growing dependency on microcredit coupled with higher interest charges siphon's the unstable income of the poor. It is on this basis that this research seeks to answer the following questions: Does microcredit positively influence production efficiency which also increases output and income of the poultry farms? And what is its role on Ghana's quest to end the country's dependence on imported chicken? The study will inform GoG on further policy initiatives directed towards agricultural financing (especially poultry farming). It will also guide farmers as to what source they should access credit. It can also help MFIs to extend their services more to the rural farmers and also address issues on interest charges. Finally, it will add to empirical studies since much has not been done in Ghana on the impact of microcredit on the poultry sector especially in the field of farm efficiency.

2.0 Literature Review

2.1 Poultry Production Systems in Ghana

Poultry is kept in wide range of agro-ecological zones and production systems in Ghana. Different production targets under different economic and political regimes has been set, ranging from subsistence farming (high rate of household consumption) to commercial farming. Subsistence farmers keep the birds only for household consumption or for social, religious or cultural reasons selling only when in need of cash (FAO, 2014). The global poultry sector is categorised into a commercial sector dominated by international, developed, country-based and vertically integrated businesses, and a small-scale that makes up to 90% of the total poultry production in developing countries (Hoffmann et al., 2005). This has also been proved in Ghana as statistics show that majority (95%) of poultry farms in the country are small and medium scale enterprises (Embassy of the Kingdom of the Netherlands, 2014). The small scale farms are into broiler birds production whereas medium scale farms produce mainly eggs.

2.2 Production and Consumption Chicken in Ghana



Source: USDA, 2017 fiscal

Figure 1: Production and Consumption of Chicken Meat in Ghana

Estimated per capita consumption of poultry products has been on an increase from 4 kg meat in 2010 to 6.6 kg in 2012 (33% growth rate) (Embassy of the Kingdom of the Netherlands, 2014). This growth has however not been matched with a corresponding increase in production as illustrated in the figure above. The situation has forced the country to import chicken more than it produces. The 2016 fiscal year alone saw the country importing a little over 73% more than what it produced in order to meet the increasing demand in poultry calories by its citizens (USDA, 2017).

2.3 Challenges of the Ghanaian Poultry Sector

The poultry sector (especially in Dormaa) is not as vibrant as it used to be between 2000 to 2005 (Kusi et al., 2015). Several factors challenging the sector have been enumerated among which is the lack of technical know-how and experience in the management of poultry by most Ghanaian farmers (Atuahene et al., 2014). Again, the high level of importation of frozen chicken into the country affects local production. Though consumers prefer the taste of local chicken over imported chicken, consumers in urban areas prefer imported frozen chicken due to their cheap prices and are processed as whole chicken or pre-cut Banson et al., 2015; Weible and Pelikan, 2016;). The cost of production also remains relatively higher due to high cost and scarcity of poultry feed and other production factors. According to Kusi et al. (2015) the high cost of production causes the difference in prices of a fully dressed imported chicken (GH₵ 12 or USD 3.60) and a fully dressed local chicken (GH₵ 15 or USD 4.50). Other factors include sanitation and diseases, death-loses, lack of requisite technology and the absence of processing facilities. Also, high cost of materials, high cost of transport, high cost of energy and erratic power supply as well as unfavourable exchange rates were the factors playing down the competiveness of the poultry sector according to Kusi et al. (2015). The biggest of all these challenges is the lack of the requisite capital for operation (Atuahene et al., 2014). Interest rates remains stubbornly high in Ghana for farmers (Kwakye, 2010). This coupled with poor repayment schedules makes the credit sector unfriendly for poultry farmers to subscribe (Oppong-Anane, 2005; Kusi et al., 2015). Several policies enrolled by previous and current governments to salvage the situation have not resulted in any significant improvements either.

2.4 Capital Requirements in Poultry Production

The initial capital requirements for the establishment of a poultry farm is quite huge. The construction of a brooder house stuffed with the necessary equipment is quite expensive.

Again, the cost of feeding the birds till maturity (whether layers or broilers) requires a lot of capital investment. The scarcity of feed ingredients and additives for poultry (feed meal, soya beans meal, corn, oyster shells, etc.) forces the farmers to acquire them in bulk which reduces their operating capital (Atuahene et al., 2010). This coupled with the frequent emergency cash requirements of the sector makes it relatively cash demanding compared to the other sub-sectors of agriculture. The reluctance of the formal banks to meet the credit needs of the farmers makes it difficult for them to expand production (Atuahene et al., 2010). This constraints the farmers into the informal financial market which also comes at a higher rate (Atuahene et al., 2010) leaving most of the farmers in debt traps and economic hardships. Again, policies enrolled by successive Governments to solve this problem have not seen the light of the day.

2.5 Governmental Initiatives

Several initiatives have been enrolled to champion the course of national self-sufficiency in the production and supply of poultry products over the years. The idea led to the establishment of the Agricultural Development Bank (ADB) [ADB Act 286] in 1965 (Kusi et al., 2015) since the need for credit cannot be overemphasised. The aim, which was to promote the development and modernization of agriculture and its allied industries has fallen flat (Kusi et al., 2015). This has been attributed to poor repayment rate due to the bank's inability to monitor the activities of the farmers (Kusi et al., 2015). ADB today provides loans largely to non-farming businesses with a few of their loan portfolio going to larger commercial farms (Kusi et al., 2015).

The Youth Enterprise Support (YES) under the Youth Employment Agency, the Guinea Fowl Project under the Savanna Accelerated Development Authority (SADA), the Agricultural Development Fund (Export Development Investment Fund – EDIF) and Microfinance and Small Loans Centre (MASLOC) are yet to produce tangible results. The goal of these projects was to provide affordable credit facilities to farmers and to face-lift the poultry industry with favourable interventions such as creation of jobs (especially for the youth) to sustain the industry, make domestic poultry products attractive and cheaper to consumers (Nuhu et al., 2014; Kusi et al., 2015). The failure of such policies (both past and present) caused a paradigm shift in agricultural financing through microcredits by MFIs (Nuhu et al., 2014). The question left unanswered is, what has been the impact of microcredit on the sector since this paradigm shift?

2.6 The Theory of Microfinance and Microcredit

The concepts microfinance and microcredit have been used interchangeably by some writers. It is however worth noting that the two terms are not the same.

Microfinance is the provision of wide range of financial services comprising payments, loans, transfers, insurance, savings and deposits to the poor and unbanked households and their micro-enterprises who hitherto were excluded from the formal financial market (Gutiérrez-Nietoa, et al., 2006; Girabi and Mwakaje, 2013). Microfinance basically means financial services to the poor (Chakravarty and Shahriar, 2010). This definition was echoed by Ghosh (2006) who defined microfinance as broad financial services including savings, insurance and credit directed to eventually benefit the poor or disadvantaged section of the population. Microfinance therefore goes beyond mere borrowing to the poor to include both financial and non-financial services such a training, provision of inputs and capacity building directed to the poor.

Microcredit (MC), also called micro-lending or micro-loan is the provision of small loans to the poor with the intension of helping them to be self-employed. They are monies provided to the poor to improve their living standard by investing in income generating activities (Fernando, 2006; Addae-Korankye, 2012). Schreiner and Colombet (2001) also defined it as “the attempt to improve access to small loans for poor households neglected by banks". From the discussions above it is now clear that whereas microfinance is a range of financial services including microcredit itself, microcredit only takes care of the provision of only smaller loans to the poor. Microcredit is therefore said to operate under the umbrella of microfinance.

Microfinance Institutions (MFIs) are institutions that provide financial services to the poor and their allied enterprises. These institutions were established a priori, to serve the poor and help reduce poverty. They range from for profit, governmental and non-governmental organizations. Examples of MFIs in Ghana include, Cooperative Credit Unions (CCUs), Rural/Village Banks, Savings and Loans Companies, Financial NGOs (FNGOs), Microfinance and Small Loans Centre (MASLOC), Rotating Savings and Credit Associations (ROSCAs), Savings Clubs, etc. The current microfinance sector of

Ghana and other parts of the world are however dominated by profit making MFIs. (Delfiner and Perón, 2007) revealed that the growing trend of competition in the formal financial sector has pushed some banks to resort to the niche financial market (micro-financial market) in order to remain sustainable.

2.7 History of Microfinance

Microfinance has developed into different patterns and paths in various countries and regions. According to Brown (2011), credit and savings groups that have been in operation for centuries include the "susus" of Ghana, "tandas" in Mexico, "chit funds" in India, "arisan" in Indonesia, "cheetu" in Sri Lanka, "tontines" in West Africa, and "pasanaku" in Bolivia, as well as several savings clubs and burial societies found all over the world. He also argue that the formal credit and savings institutions have been in operation, providing customers who were traditionally neglected by commercial banks access to financial services through cooperatives and development finance institutions for decades. Although literature shows the experiment of microfinance in countries like Brazil and Bangladesh dates back several decades, it however started to gain popularity in the 1980s (Ledgerwood, 1999). Commercial Microfinance started with the discovery by Prof. Muhammad Yunus in 1976 that a USD 27 loan can change the lives of 42 poor families in Bangladesh and all the loans were paid back with interest. Yunus formally created the Grameen Bank in 1983 whose method has become the basis for modern microfinancing including group lending, women focused, and good repayment rates (Ledgerwood, 1999). The implication is that microfinance really existed before Yunus's Grameen Bank. It also implies that Yunus rather invented microcredit which has grown into microfinance today.

In the Ghanaian context activities of microfinance were familiar hitherto (MoFEP, 2015). There has been a traditional method of saving and borrowing prior to the inception of MFIs (BoG, 2007). According to BoG (2007), Northern Ghana was the location where the first Credit Union in Africa was established in 1955 by the Canadian Catholic Missionaries, though its impart was not felt in the country and across the continent of Africa. 'Susu', which is one of the microfinance schemes in Ghana also originated in the early 1990s from Nigeria to Ghana. MFIs have gone through 4 phases in Ghana according to the Mistry of Finance and Economic Planning (MoFEP, 2015). First phase according to MoFEP (2015) dealt with the provision of subsidised credit by the Government of Ghana in the 1950's when lack of capital was seen as the only hindrance to poverty elimination. The second phase, which occurred between 1960's and 1970's, was also characterised by the provision of microcredit by NGOs. The third phase which occurred in the 1990s was characterised by the formalisation of MFIs whereas the fourth phase which started in the mid 1990's is characterised with the commercialisation and mainstreaming of MFIs into the Ghanaian financial sector.

2.8 The Current State of Microfinance in Ghana

The microfinance sector in Ghana is largely dominated by commercial MFIs or companies (such as Savings and Loans companies) according to Table 1. They target middle income earners since their priority is to put their assets into profitable investments in order to cover transaction cost and ensure sustainability. Though achieving financial, objective is vital for the continuity of MFIs albeit, MFIs in Ghana are becoming occupied with achieving financial returns thereby reducing their investments in the non-financial services such as training and capacity building offered to their clients. The Credit Unions, popularly known as the Co-operative Credit Unions (CCUs) are the second largest in the MF sector in Ghana. It is owned, financed and controlled by its members with the aim of fulfilling the financial and social needs of its members.

Table 1: List of Licensed MFIs in Ghana

Type of MFI	**Frequency**	**Percent**
Commercial MFIs	429	44
Credit unions	273	28
Rural and community banks	140	14
Lending institutions	64	6
FNGOs	11	1
NBFIs	70	7
Total	**987**	**100**

Source: BoG, 2016

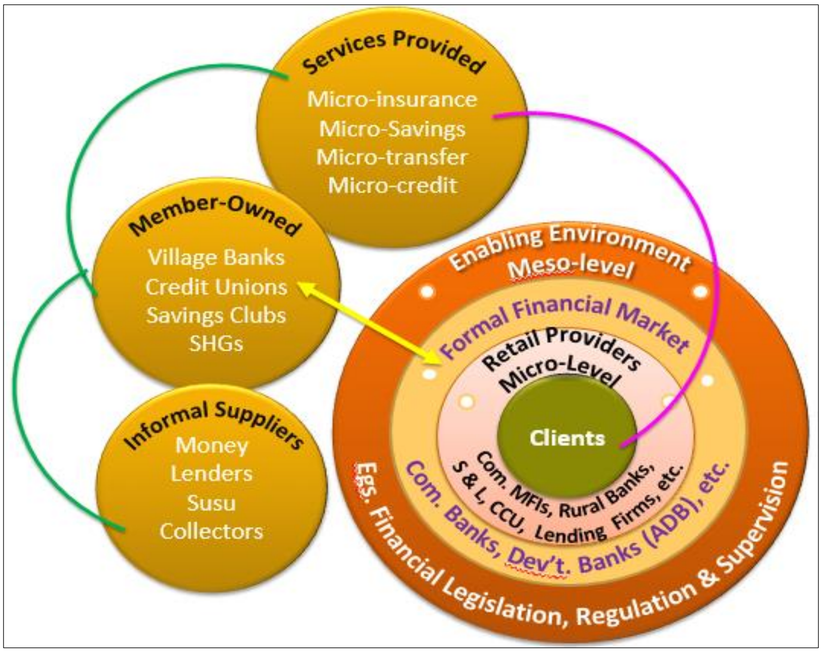
The Rural/Community Banks are the third force in the sector. They are the quasi-commercial banks operating under the Banking Act, 738 of 2007. They are owned by members of the community through equity participation and are licensed to take deposits. The next force in order of numbers licensed are the Lending firms. These are basically institution registered to provide loans but not deposits. Most of these firms are however located in the Urban areas providing financial support to the urban poor rather than the rural poor. Financial Non-Governmental Organisations and Non-Banking Financial Institutions are also another license category provided by the Central Bank.

Though microfinance has been a vital tool for poverty reduction and development, MFIs in Ghana are yet to fully make the impact that other MFIs on the continent (example Uganda, Ethiopia and Kenya) have made (Ayeh, 2012 cited in Diaz-Serrano and Sackey, 2015). MFIs in these countries have developed the appropriate skills and products needed to address the peculiar needs of their clients. For instance, MFIs in Kenya and Uganda have been in the forefront of partnering other players in the field in rolling out mobile banking products for their clients.

2.9 Governance of Microfinance in Ghana

MFIs in Ghana are registered under the umbrella of the Ghana Microfinance Network (GHAMFIN), the body in charge of microfinance operations and regulated by the provisions of the Non-bank Financial Institutions Act, 2008 (Act 774) and the new Banking Act, 2007 [Act 738] (BoG, 2008). The Bank of Ghana based on this Act issues a provisional licence for operation before the issuance of full licence of operation upon the fulfilment of certain basic requirement. For the avoidance of doubt, Rural and Community Banks (RCBs) are under the Banking Act, 2007 (Act 738) while Savings and Loans Companies are regulated under the Non-Bank Financial Institutions (NBFI) Law 1993 [PNDCL 328] (BOG, 2008). All other intermediaries such as CCUs, Susu companies and Susu collectors, money lenders and other financial service providers though are not under the direct supervision of the Bank of Ghana, shall comply with this Act as well (BoG, 2008).

2.10 The Financial Market of the Poor in Ghana



Source: Author's design, 2017 following the ideas of Coetzee, 2012

Figure 2: Illustration of the Microfinance Market, Regulation and Control in Ghana

As indicated in Figure 2, the Ghanaian microfinance sector is made up of four ranges: the formal suppliers (Savings and Loans Companies and Rural and Community Banks); semi-formal suppliers such as Co-operative Credit Unions, Financial Non-governmental Organizations (FNGOs) and Cooperatives; informal suppliers, such as Susu Companies and Collectors, Savings Clubs, Rotating and Accumulating Savings and Accumulated Savings and Credit Associations (ROSCAs and ASCAs); and state microfinance schemes such as the Micro and Small Loans Centre (MASLOC) currently instituted (Diaz-Serrano and Sackey, 2015).

Figure 2 again indicates that the Central Bank supervises directly the activities of the formal microcredit providers (commercial MFIs, Rural Banks and others) who operate as micro financial services providers in the financial service hierarchy. These financial retailors (micro service providers) also have a direct link with some commercial banks who form the formal financial market by saving or taking loans from them. The financial retailors together with the informal and member-owned financial institutions (who are not directly supervised by the central bank) provide microcredits, micro-transfers, payments, micro-insurance, micro-savings and other services mainly to the productive unbanked (usually poor) clients as indicated by the purple arrow in the figure. Some member owned MFIs also operate indirectly under the supervision of some the commercial banks (indicated with the yellow arrow) from whom they borrow and save with. The micro-level financial service providers together with the informal and member-owned institutions form the financial market for especially the poor or low income earners in Ghana. This then brings to bear the factors that propel these poor farmers to participate in credits provided by these sectors?

2.11 Determinants of Access to Microcredit

Women are believed to be more credit worthy and have high repayment rate than their male counterparts (Jazairy et al., 1992 cited in Anang et al., 2015). Previous writers (such as Khalid, 2003; Anang et al., 2015) reported an inverse relationship between gender and access to credit - thus women are more likely to have access to credit than men. The increasing contribution of women in agriculture in Sub-Saharan Africa coupled with their credit worthiness has prompted numerous MFIs to concentrate on reaching out to as many women as possible (Mersland et al., 2009). Contrary to the former, Ololade and Ologunju (2013) and Awunyo-vitor and Al-hassan (2014) in their study “Determinants of Access to Credit among Rural Farmers in Oyo State, Nigeria” and “Drivers of Demand for Formal Financial Services by Farmers in Ghana” found that being a female reduces the probability of having access to credit by 71.3%. They further argued that females are highly disadvantaged in the credit market hence measures should be put in place to salvage this catastrophe.

Also, working capital has been proven by literature as a factor that propels a farmer to opt for microcredit. In their studies, Duy (2012) and Anang et al. (2015) argued that capital endowment is a significant determinant of farmers’ decision to borrow from MFIs. Smallholder farmers are often resource poor. This implies that majority of the core poor farmers are left out of the microcredit market with only the moderate poor been catered for if capital is a positive determinant. Saqib et al. (2016) also used a farmer’s landholding size as a proxy for farm size. Their results however indicated that a farmer’s access to formal and informal agricultural credit increases with an increase in landholdings further argued that lower subsistence farmers have lesser access to credit than medium subsistence farmers. On the contrary, Kausar (2013) and Awunyo-vitor and Al-hassan

(2014) argued that access to microcredit however reduces with increase in farm size since larger farms might borrow from formal banks instead of the smaller loans of MFIs.

Studies shows that age and education are positively related to demand for microcredit (Mpuga, 2004 cited in Bihoctavia, 2013; Magri, 2007) and (Duman, 2009; Messah and Wangi, 2011; Sekyi et al, 2014). Other researches also had different conclusions. To some researchers majority of money lenders advance credit based on trust and not the level of education attained by the client (Crook, 2001; Barslund and Tarp, 2008). Magboul (2016) supported this argument when he found an inverse relationship between individual income and educational level of farmers and their demand for credit. On the relationship between credit and assets, Diagne and Zeller (2001) found that the asset base of a smallholder farmer, especially land, is a positive determinant of access to formal credit. Non-price attributes of microcredit other than interest rate play a crucial role in credit participation. Whereas informal credit is used for consumption, formal credit is used for financing agricultural production and other non-farm entrepreneurial activities (Diagne and Zeller, 2001). Repayment schedules and methods, collateral and application procedure are factors that considerably constraint poor farmers from the formal microcredit market and push them to resort to informal source of credit (Atieno, 2001). In the same study, Atieno (2001) cited in Mabhungu (2011) revealed that information asymmetry on the existence of microcredit is a major reason why farmers of rural Kenya do not seek credit.

Togba (2009) also used two indicators to proxy lack of trust in MFIs and sensitivity of households to higher interest rates were found as contributing factors to the reduction of households' participation in microcredit interventions in Côte d'Ivoire. The study further argued that the length of maturity of the credit positively influences credit participation. Messah and Wangi (2011) also affirmed these when they found that interest charged and collateral inversely influence a farmer's decision to borrow from formal MFIs in Kenya.

Again, Ahmed (2002) noted cost-to-client, including both transaction cost and the price of the loan as crucial determinant of credit demand. The study also included among the transaction cost, non-cash opportunity cost of time value spent on application and repayment of the credit and other cash expenses such as documentation, food and taxes related to acquisition of credit. Financial, economic, socio-cultural, psychological, regulatory and compliance factors of cost-to-client also determine the level of demand for microcredit at the macro (enabling environment), meso (industry context) and micro (service providers) levels (Coetzee, 2012). He again emphasised the need to cut down cost-to-client and cost-to-serve for a wider financial inclusion. Again, the interest rate which is calculated as the administrative cost plus cost of capital plus cost of default (Magboul, 2016) is a major determinant of credit participation. The poor (especially women) are price sensitive than the rich (Karlan and Zinman, 2008). This implies that demand for microcredit by the poor will increase with a decreasing or lower interest rate ceteris paribus (Karlan and Zinman, 2008). On the contrary, (Helms and Reille, 2004) argued that the poor gives much credence to the ongoing concerns on credit than the actual cost of it. This implies that the poor will still increase their demand for microcredit even at higher interest rates if favourable conditions of borrowing and repayment exist.

2.12 Impact of Microcredit on Agriculture

2.12.1 Impact of Microcredit on Farm efficiency

The argument on the role of microcredit in improving agricultural production efficiency continues. Whereas some writers are optimistic about the impact by microcredit (Hakim, 2004; Wadud, 2013), others (Sossou et al., 2014) question the existence and the magnitude of such impact.

Peasant farmers are characterised by lack of credit as they have been cut-out of the traditional financial market. A timely provision of microcredit to these farms therefore contributes to a timely acquisition of fsarm inputs such as seed, fertiliser and irrigation as argued by Wadud (2013). This in turn, helps to increase the use of new production technologies by the farms and subsequently improve the technical efficiency of these farmers. According to Hakim (2004) availability of credit and a timely acquisition of inputs and machinery improves the farmers' ability to effectively use their limited resources to achieve a higher output. He argued in his study, "the relationship between microcredit and agriculture" that small and micro-farmers, are multi-occupational (diverse in investment), productive and efficient with microcredit. This however can be attributed to the soft loans (low interest with flexible repayment) given by some MFIs (especially FNGOs). He therefore concluded that microcredit providers should therefore extend their priorities to cover the poorest of the poor. This raises questions as whether other factors join forces with microcredit to contribute to this improvement. If so, what was the exact contribution of microcredit and what was its magnitude? It is therefore not enough to make a generic conclusion on the effect of a policy on its target group without showing the exact influencing holding other factors constant (Zuberi, 1989). Again, availability of credit and a timely acquisition of inputs and machinery improves the farmers' ability to effectively use their limited resources to achieve a higher output according to

On the contrary, an expansive study on rural/micro credit and farm efficiency was conducted by Sossou et al., (2014) in Benin. Their results however indicated an inverse relations between farm efficiency and the allocation of credit for in-farm activities using the Stochastic Frontier Model to analyse the effect of credit allocation schemes on the technical efficiencies of farms, their study indicated that farms were less efficient for every 1% increase in microcredit provided. They however attributed the inverse impact to the fact that up to 50% of the credit given to farmers were used for off-farm purposes. The study again indicated that doubling the amount of credit given to farmers has no effect on production systems. They however indicated that farmers who use the given credit to purchase quality inputs are likely to improve their technical efficiency. Albeit, they cautioned that credit in itself cannot be mutually exclusive hence should be accompanied by an improved level of farmer's education. The question again is, does this technical efficiency really manifest in production? If yes, to what extend does it affect farm output?

2.12.2 Impact of Microcredit on Farm Output

The effect of a timely provided microcredit goes beyond efficiency performance to improve farm output and subsequently increase farmers' income and living standard (Latif, 2001; Javed et al. 2006). For instance Latif (2001) in a follow-up household survey conducted by a joint venture by the Bangladesh Institute of Development and the World Bank (credit programmes for the poor) found participation in microcredit programmes had statistically significant and quantitatively important influence on the rural farmers' output and income using estimated regression models. Javed et al. (2006) also confirmed the findings of Latif (2001) when they examined the impact of microcredit of on productivity of wheat and sugarcane in Faisalabad, Pakistan. The former established a positive relations between microcredit and crop production and the living standard of farmers in the study area. They attributed this significant influence to the timely provision of financial resources to the farmers which subsequently leads to a timely acquisition of farm inputs and as such, increase output. From their findings, it is evident that microcredit can be a blessing or a curse to the farmer if not provided in time. Poor farmers often need capital to mobilize inputs during the planting period and sometimes the harvesting period to mobilize their output to the market. Credit if given to farmers outside these periods stands the chance of been used on consumables or for household consumption which farmers might find difficult to refund.

Furthermore, a timely flow of credit to farmers increases their demand for inputs and technology and as such, increase farm output (Siddiqi and Baluch, 2009). The elasticity of the amount of credit, number of tractors, irrigation, use of chemical fertilizer and pesticides with respect to explained variables such as agricultural income on per cultivated as well as per cropped acre basis increases according Siddiqi and Baluch (2009) The acquisition of most of these factors can be attributed to credit availability indicating the significance of credit access to the farmer.

Also, contrary to the impact of cash credit on agriculture, Ahmad et al., (2006) analysed the impact of advancing in-kind credit in the form of fertilizer and seed to smallholder farmers in Ethiopia and found that in-kind input credit increases crop output reasonably. The gap their conclusion leaves is, how reasonable is this increase in output? This was however answered in an earlier studies done by Zuberi (1989). He found that 70% of total capital of farmers were used for the purchase of seed and fertilizer. To him, significant increase in agricultural output is attributable to the changes in the quantity and quality of seeds and fertilizers whether acquired by credit or in-kind input form. This implies that credit (whether in-kind or cash) helps to improve both the quantity and quality of inputs used by farmers and subsequently increase output.

Again, Saleem and Farzand (2011) revealed that microcredit has a significant positive impact on agricultural production. In their analysis, a percentage increase in credit disbursement increases agricultural GDP by 1.5%. They therefore argued that credit is vital for agricultural productivity. Albeit, the method of analysis (regression analysis) adopted for the study has been questioned by writers as inappropriate for impact studies (Wadud, 2013). Caliendo and Kopeinig (2008) examined the implementation issues of propensity score matching and regression analysis and described the former as the most effective and efficient approach to impact analysis thereby providing researchers with some guidelines to the use of PSM for evaluation purposes.

Additionally, Girabi and Mwakaje (2013) in their study, impact of microfinance on smallholder farm productivity in Tanzania found out that, microcredit beneficiaries realises higher output compared to the non-beneficiaries. Their study however confirms an earlier one by Fengxia et al., (2010) also argued that credit is not only vital in improving farm output, it also influence positively production and reduce the pattern of structurally unbalance growth of agriculture in Nicaragua. Farm credit is therefore not only a necessity due to the limitations of self-finance, but also by the uncertainty relating to the level of farm inputs and output and the time lag between inputs and output (Rahji and Fakayode, 2009). This situation motivates rural households to balance their budgets during the season when there is small amount of revenue to cover the high expenditures of input purchases and household consumption. The budget balance within the production year can restraint agricultural production given the liquidity constraints faced by rural farmers. Zeller et al. (1998) similarly revealed that participation in an agricultural credit program was able to increase the cropping share for hybrid maize and tobacco, and participation in credit programs had a sizable effect on crop income in Malawi. This symbolises that credit access can have significant impact on agricultural output.

On the contrary, the opposing school of thought (Adebayo, 2008; Nosiru, 2010) argue that the influence of microcredit on agriculture is not always positive as presented by the previous studies. To them providers today are to provide the credit needs of the peasant farmer because of their priority of achieving higher profits and the neglect of their social goals towards the poor. They have turned a blind eye on factors such as high interest rates, poor repayment and collection methods, short or no grace period and poor disbarment and collection modalities (example, provision of commercial loans to farmers) that can limit production and consequently push some farmers out of the field as they seek livelihood opportunities in other sectors. In the long run, overall production in the agriculture sector will fall if these factors persist ceteris paribus.

Credit again has been described as a meek factor of growth of the agricultural sector in Nepal according to Shrestha (1992) cited in Khan et al. (2013). To Zuberi (1989), credit as an independent variable has insignificant impact on production but rather other farm inputs such as chemical fertilizers, high quality seeds, labour and tractors have significant impact on production. Perhaps what the researcher fails to acknowledge was that all inputs mentioned about can be acquire with a timely accessed credit. Khan et al. (2013) affirmed this stand when they analysed the effect of agricultural credit on the income and productivity of beneficiaries and non-beneficiaries using clients of Zarai Taraqiati Bank in Lakki (ZTBL) Marwat, KPK-Pakistan as a case. Their t-test analysis however revealed that agricultural credit has no effect on crop production credit beneficiary farmers. The test revealed that that the output levels of the beneficiary households were significantly less than non-beneficiary households. This implies that the loan advanced by ZTBL had a negative impact on production in the study area.

Furthermore, to Nosiru (2010), microcredit is a means to an end but not an end in itself in agricultural production. In his article "Microcredit and Agricultural Productivity in Ogun State, Nigeria", he argued that microcredit as an exogenous variable has less impact on agricultural productivity compared to its facilitating factors such as irrigation, fertilizers, pesticides, etc.
He however acknowledged that, untimely disbursement, non-judicious use of obtained credits for purposes other than agriculture can be negatively influence production. Again, the extent of the impact of microcredit on productivity is also influenced by the spending and the source of borrowing (Adebayo and Adeola, 2008). In analysing the role of microcredit in agricultural economy and it associated constraints to farmers' investment behaviour in Surulere Local Government area of Nigeria, he revealed that most of the farmers obtain loans from informal sources such as money lenders with high level of interest. Again, his results revealed that famers often use the credit for non-agricultural purposes which might not affect production. The mere provision of microcredit to farmers without appropriate financial and business management skills is like fixing square poles in round holes. MFIs should therefore not relent on their non-economic and training goals which set them apart from other financial institutions moving forward.

2.12.3 Microcredit and Farm Income

Credit availability is a major contributing factor to the rise in income levels of rural peasant farms (Bolarinwa and Fakoya, 2011). Their study revealed in their analyses of impact of farm credit on farmers' socio-economic status that, income levels of credit beneficiaries were high compared to non-beneficiaries. Though the study made a descriptive description of farmers based on the discrepancies in their income (both treated and controlled group), its conclusions were based on the general net income of the farmers and not what is earned out of farming. The question then is, are the credit beneficiaries having a higher income due to microcredit for farming or from other source of household income compared to non-beneficiaries or, is credit the only input of production? Again, their study established a positive correlation between credit and farmers' performance in production operations and recommended an expansion of the credit market for easy access by peasant farmers.

Again, Wadud (2013), in his study, "the impact of microcredit on agricultural farm performance and food security in Bangladesh", argued that microcredit has a positive impact on the average income of farmers. He further argued that on an average, a farmer receiving microcredit earns 9.46% more than those who did not. This also signifies the positive contribution of microcredit on the farm income of farmers. The research also adopted the propensity score matching (PSM) in finding the differences in outcome. To Kiiru (2007), credit beneficiary farming households earn in percentage points of income twice what non-beneficiary counterparts earn. This he found in his study "the impact of microfinance on rural poor households' income and vulnerability to poverty" which sought to conduct a before and after studies on both the controlled and the treated groups in Kenya.

Microcredit has also been proven to have two sides of a coin (negative and positive effect simultaneously) on the incomes of the poor (Nanor, 2008). It is said to increase household income (Nanor, 2008). At the farm level, although numerous studies have proven the hypothesis that microcredit client farmers diversify their investment (Barnes, Gaile, and Kibombo 2001; Barnes, Keogh and Nemarundwe, 2001), only one described the translation of this diversity into higher incomes (Barnes, Gaile, and Kibombo 2001). Furthermore, Ashraf (2010) in a similar studies in Kenya found that microcredit clients' farms performed better in income than those of the control group. This findings were confirmed in an earlier studies by (Gubert and Roubaud, 2005 cited in Rooney et al., 2012) though their findings were statistically not significant. This increase in income described by the aforementioned studies has been described as short-lived (Nanor, 2008).

The researcher further argued that the longer a farmer stays with a credit scheme, the worse their incomes becomes.

In Ghana, microcredit clients gain an increase in income and savings compared to their non-clients counterpart (Effa and Herrings, 2005). In an Ex Post Facto non-equivalent comparison of the impact of microcredit on “with” and “without” microcredit rural women's livelihood, the researchers found that, not only does microcredit improve farm income, it also improve adoption of agricultural innovation at a higher level by farmers. The discussions above then raises questions such as; what is the cost benefit analysis of microcredit participation by poor borrowers? Is participation in microcredit programs by the poor always economically benefiting? Is it justified to invest huge amounts of resources toward microcredit programmes as compared to other poverty alleviation initiatives?

2.12.4 Microcredit and Poverty Reduction among Peasant Farmers

Microcredit has become a crucial poverty alleviation tool over the last two decades globally. It helps the poor to create micro-enterprises and lessen their poverty situation (Khandker and Chowdhury, 1996; Ahsan, 2005). The poor lacks capital (Shastri, 2009). Effective utilization of credits provided by MFIs help the poor, especially, rural women to engage in productive ventures to earn a better living. Several studies have been conducted on microcredit as a poverty alleviation tool, although the existing literature is not clear-cut. Whereas some writers believe that microcredit access has the potential to significantly reduce poverty (Zaman, 1999; Effah and Herrings, 2005; Ahmed et al., 2011), others (Waterfield, 2008; Bateman, 2011; Khanom, 2014) doubt the direction (positive or negative) and magnitude of these impacts and consider microcredit as not “The Bible” for poverty alleviation moving forward.

Microcredit activist believes argue that, farmers earn additional income through capital expansion from microcredit received. This additional income increases the disposable income and improve the consumption pattern and livelihoods of these poor households (Navajas et al., 2000). The acquired credit also helps to provide employment opportunities in the long run, improve food security, access to health care as well as empower the vulnerable section of the population with an improved purchasing power (Ali, 2008).

Again, a recent survey conducted by the Grameen Bank in 2009 on the impact of microcredit on the poverty revealed that, 68% of borrowing families were living above the poverty line while the remaining were moving gradually above the line (Jamadar, 2012). This was evident in an earlier study by Khandker (1998) which indicated that a 10% additional credit from MFIs reduces the probability of falling below the poverty line by 0.3% and 0.2% for males and females respectively. He further argued that, the provision of microcredit by MFIs to rural farmers reduces absolute poverty more than it does to the moderately poor (18% absolute poverty, 8.5% moderate poverty). It is therefore necessary for more attention to be paid to the provision of sustainable credit to peasant farmers.

Furthermore, the impact of microcredit is not limited to only poverty reduction through increase of farms income but also reduction in the level of vulnerability of the poor farmers (Ahmed et al., 2011). Zaman (1999) analysed the relationship between microcredit and poverty reduction and vulnerability by focusing on BRAC, one of the largest microcredit providers in Bangladesh. The study argued that microcredit accounts to vulnerability mitigating factors, whereas impact on income-poverty is a function of borrowing to a stipulated threshold of BDT 10,000.00 (USD 200). According to the writer, to increase the amount of credit given to smallholder farmers on a sustainable bases, is to speed up the process of poverty alleviation and vulnerability mitigation which forms a greater part of the Sustainable Development Goals of the UN.

Yet, the criticisms of microcredit cannot be swept under the carpet. To some researchers, access to credit may not really contribute substantially to poverty reduction (Bateman, 2011; Khanom, 2014) whereas others argue it absolutely influece the poor negatively (Waterfield, 2008; Gokhale, 2009). The poor are risk averse in borrowing and might therefore benefit trivially from microcredit (Scully, 2004; Ciravegna, 2005 cited in Taha, 2012). Secondly, the core poor are often denied the opportunity to join microcredit groups. Credit officers from MFIs might prefer excluding the poor since lending to them is risky (Marr, 2003). They have no or invaluable assets for security hence their practical exclusion from MC by MFIs (Mosley, 2001; Kirkpatrick and Maimbo, 2002). For instance, some MFIs in Ghana require some level of savings with them before been granted a credit. Asking for savings from the core poor seems practically impossible since their incomes cannot afford them even a three daily square meal. This therefore questions the activities of MFIs as to whether they currently serve the poor.

Detaching the poor from local loan interest sharks, often charging higher interest rates, was the aim of microfinance. This was even a claim made by Muhamad Yunus when promoting microfinance to international donors (Khanom, 2014). To some extent, convening some level of social values upon MFIs, rather than loan sharks set up the stage for the poor to be open to the idea of been in debt (Khanom, 2014). Though MFIs charge lower interest rates than rates charged by the informal creditors, they are still seen as imposing high rates on their clients compared to the traditional banks. The excuse in the early days was to cover the high professional cost of providing smaller loans to clients but would fall with competition. The argument however had some point initially, interest rates have not fallen as much as predicted, and in some countries (especially Mexico and Ghana) the rates continue to be high (Khanom, 2014).

In Ghana Franklin (2014) reported that some MFIs charge up to 75% quarterly interest on that loans compared to 20% to 30% annual rates charged by formal banks. This was again the case in Mexico where Annual Percentage Rates (APR) charged by Compartamos raised up to 129% in 2008 (Waterfield, 2008). The fear is that the poorest communities are been drained off a significant financial flows rather than being increased, retained and recycled within the poor to reinforce productive investment as the exit from poverty. Clearly, "killer" interest rates are been charged on microcredit which makes it unsuitable yet for all. Coupled with higher interest rate is the frequent collapse of MFIs in developing countries which also deprives the poor of their micro-savings. This was evident in Ghana in what the researcher term as "*The 2015 Microfinance Crisis*". The country experienced a simultaneous collapse of over 10 microfinance institutions within the same year who had branches nationwide. The poor were made to believe by these MFIs that they will be paid some huge rate of interest (55%) for every two months provided they save with them (BoG, 2015). This led to serious financial crisis especially among farmers in the northern sector of the country out of which billions of Ghana Cedis from the poor were lost. The question therefore is, does microcredit really help?

2.13 The Data Envelopment Analysis Model

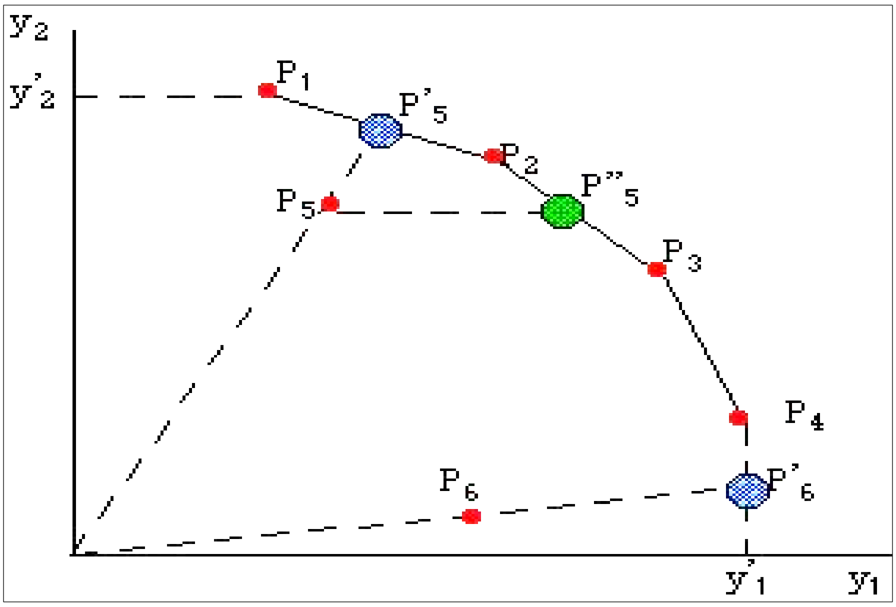
There is a growing concern with the micro-econometric measurement and comparison of the efficiency of units of organisations such as poultry farming and similar cases where there is a relative homogenous set of units (Emrouznejad, 2016).

We often measure efficiency as: $efficiency = \frac{output}{input}$

This estimation is however scant due to the multiplicity of diverse inputs – outputs relationship to diverse resources usage and activities (Emrouznejad, 2016). This problem can be illustrated with this study where a farmer utilises different input combination (feed, chicks, labour, land, drugs, among others) to achieve two output (eggs and birds/chicken). With these inputs and two output, the difficulty of computing the efficiency of the farmers becomes apparent. Diverse patterns of activities are supported by different amount of resources making it difficult for efficiency comparisons (Emrouznejad, 2016). The aforementioned problem led to the formulation of a new approach for measuring relative efficiency combining multiple inputs and outputs known as the Data Envelopment Analysis (DEA) Model (Emrouznejad, 2016).

Following Ali Emrouznejad's DEA (2016), Figure 3 indicates a set of farm units, P_1, P_2,….,P_6 with each farm unit consuming equal amount of a single resource to produce different (y_1 and y_2). A farm unit is said to be efficient if it produces greater volumes of the outputs for a given amount of resource input. Applying the DEA approach to this scenario, farm units P_1, P_2, P_3 and P_4 are efficient and produce an envelope round the entire data set farm units P_5 and P_6 are within this envelope hence inefficient. The lines P_1y_2' and P_4y_1' has been enclosed with the data set by the hypothetical expansion of the data envelope.

P_1 and P_2 are the peer group for farm unit P_5 and a set of targets for P_5 is provided at P_5'. A 'pro rata' increase in the outputs of unit P_5 can obtain these targets. Again, there are other clear possible targets for P_5. For instance, if output level y_2 cannot be increased for P_5 then a target P_5'' can be the set which will rely solely on increasing output y_1. For unit P_6, the 'pro rata' increase provides the target sets P_6'. However P_6' is undoubtedly dominated by P_4 which yields the same amount of output y_1 but more output of y_2. In this regard the 'pro rata' increase needs to be supplemented by a further increase in the output of y_2 to provide an efficient target. Returning to farm unit P_5, the set of targets P_5 can be obtained from a weighted average of the peer units P_1 and P_2. Thus P_5 is said to be a composite unit made up of a weighted average of the peer farm units and this composite unit provides a target for the inefficient unit.



Sources: Emrouznejad, 2016.

Figure 3: The Data Envelope

2.14 Empirical Studies using PSM and DEA

In analysing the impact of microfinance on household consumption in Bangladesh, Islam and Maitra (2008) argued that, programme worthiness and richness criterion certify the use of diverse non-experimental impact evaluation approaches, particularly Instrumental Variable (IV) assessment and Propensity Score Matching (PSM). IV and PSM estimates have been described as average causal effects that are valid for various groups of microfinance clients. The results however shows a non-robust microcredit effect across all groups of deprived household borrowers. This indicates that the core poor clients benefits most. The impact estimates are however lower, or sometimes even negative, for those households marginal to the participation decision. The effect of participation is also stronger for male borrowers. Results held across different specifications and methods, including correction for different sources of selection bias (including the possibility of spill-over effects).

A non-parametric propensity score matching approach was adopted by Pufahl and Weiss (2008) to examine the effects of two types of farm programmes (agro-environment 'AE' programmes and the less favoured area 'LFA' schemes) on the use of input and output of individual farmers in Germany. The estimation showed a significant and positive treatment effect of the LFA scheme for farm sales and the cultivation area. AE schemes participants were found to significantly increase the area under cultivation (in particular grassland), accounting for a decrease in livestock densities. Participation in AE programmes on the other hand decreased the purchase of farm chemicals such as fertilizers and pesticides. Substantial differences were found between individual farms (heterogeneous treatment effects). Farms capable of generating the largest benefits from the programme are most likely to participate.

Again, the most recent study that adopted Propensity Score Matching technique in analysing the impact of microcredit on farm income was done by Wadud (2013) in Bangladesh. His results however revealed that microcredit programme as a whole has a positive impact on average farm income of farmers. His analysis showed that, farmers who are microcredit clients in Bangladesh earn, on an average, 9.46% more than their non-client colleagues which helps the fight against poverty.

In examining efficiency in shrimp farming in rural regions in Bangladesh, Anderson et al. (2008) found that both formal and informal microcredit users are credit constrained. However, the constraints is insignificant for the informal borrowers. The implicit shadow price of working capital is significantly higher in the group that only accesses formal loans than the group that utilises informal loans. The study suggests that, access to credit remains a challenge to small scale farmers even in areas where formal micro-lending has existed for a long time. Informal lending institutions, which remains close ties to the farmers however, remained successful in providing for smallholder farmers who will make the best use of the loans. Thus, higher administrative cost creates a barrier for formal microcredit schemes to provide smallholder farmers with micro-loans though this does not solve the adverse selection in choosing a successful borrower. Formal lenders should however work closely with informal lenders in providing credit to the non-banked. Again, Tung (2010) factors such as education and experience are positively related to the technical efficiency of a shrimp farmer.

To my knowledge, only one study has linked microcredit and farm efficiency, and its resulting improvement in food security. This was done in Bangladesh by Wadud (2013) in which he adopted both Data Envelopment Analysis and Stochastic Frontier Analyses to determine the impact of microcredit, socioeconomic (experience and education) and land fragmentation on farm efficiency. The coefficients of microcredit, experience and education were all negative. This implies that farmers with microcredit, more farm experience and higher level of education are more efficient in their farming activities. The coefficients associated with the CRS TI however exhibited positive signs which were not expected. This he however attributed to the imposition of the constant returns to scale assumption. This shows that, technical inefficiency effect is high among non-microcredit clients as they cannot apply modern equipment and inputs. He however concluded that, microcredit contributes significantly to farm performance which leads to the increase of farm output and output supply. He therefore called for policies that helps timely and adequate distribution of microcredit to farmers as they enhance farm yields and as such, farm revenues and food security through enhancement of the farmers' efficiency.

3.0 Aims of the Study

The goal of this study is to determine the impact of microcredit on poultry production and its subsequent role in Ghana's quest to be sustainably self-sufficient in eggs and chicken supply.

Specifically, the study sought to;

- Determine the propensity of poultry farmers to acquire microcredit
- Examine the role of microcredit in raising poultry production efficiency
- Identify the impact of microcredit on farm output
- Determine the impact of microcredit on the incomes of the poultry farmers in the Dormaa Municipality.

The study sought to focus on achieving its main goal by answering the following research questions and testing the hypotheses at 5% (0.05) alpha level of significance.

1) What are the factors that inform a farmer's decision to acquire microcredit? This will be assessed using the statistical hypothesis;

Hypothesis 1: H_0: There is no significant relationship between a farmer's propensity to take microcredit and his farm land size, working capital, machinery, education, age, farm size, experience, gender and savings status.

2) Does microcredit increase the production efficiencies of client farmers? This will also be assessed using inefficiency effects model to test the statistical hypothesis;

Hypothesis 2: H_0: Microcredit does not have any significant effect on the technical efficiency of a farmer.

3) Does microcredit increases the performance (output and income) of poultry farmers? This will also be assessed using linear regression for the matched observations and tested with the statistical hypothesis;

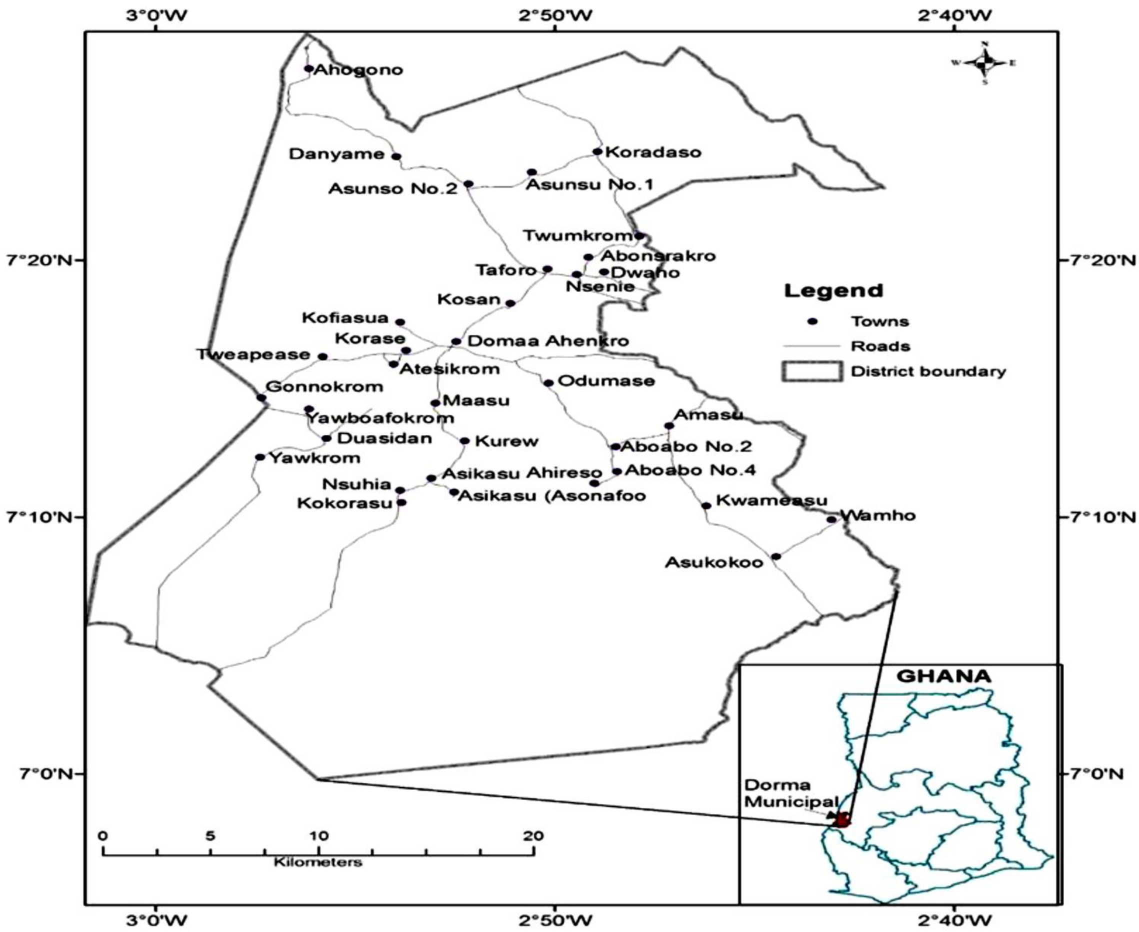
Hypothesis 3: H_0: Microcredit does not have any significant effect on the performance (output and income) of poultry farmers in Dormaa Municipality.

4.0 Methodology

4.1 Introduction

This chapter presents the methodological processes used in achieving the research objectives as well as testing the research hypothesis. The research design includes the sampling and sampling techniques. The chapter presents data collection tools and procedures as well as tools and methods used for analysing the collected data using the appropriate models and forms deemed fit for presentation. The chapter begins with the study area followed by the research design, sampling design, data collection methods, tools and the mode of data analysis and presentation.

4.2 Study Area



Source: CRSGIS cited in Yeboah, 2015

Figure 4: Map of the Dormaa Municipality

The study was conducted in the Dormaa Municipality which is located at the western corner of the Brong Ahafo region of Ghana. It lies on the geographical coordinates 7° 30' 0" North, 3° 30' 0" West with an average elevation between 240 to 300 meters. It shares boundaries with Berekum, Sunyani, Asunafo and Asutifi Municipalities to the North, East, South and Southeast respectively as well as Côte d'Ivoire to the West. The capital of the Municipality is Dormaa Ahenkro which is 80 km from the regional capital, Sunyani. The Municipality is made up of 112,111 inhabitants occupying a land area of 1,210.27 km^2 – density of 92.6 inhabitants/km^2 (GSS, 2014) . The soil is made of the Nzema series which are made of quartz gravels and ironstone and are moderately well-drained. As such, the soil is supportive of both subsistence and industrial food crops, such as cocoa, coffee, oil palm, citrus, cola-nuts, plantain, cassava and maize (GSS, 2014). Covering more than three quarters of the soils of the forest zone are the underlying Birimain formation rocks which contains all the minerals exported from Ghana such as gold, diamond, bauxite and manganese (GSS, 2014). Located within the semi-equatorial climate region, the Municipality has a double maximal rainfall regime with annual average rainfall between 125 cm and 175 cm occurring between May – October. The dry season which occurs between November - February is relatively humid (75% – 80%) while the rainy season is 70% – 72%. Temperature ranges between about 30ºC (in March and April) and about 26.1 ºC in August. The good tropical temperature coupled with the generally good soils and the reliable rainfall makes the area suitable for intensive cropping, tree, livestock and fish production (MoFA, 2011).

The cropping systems are mainly based on cassava, yam, cocoyam, plantain, maize, soybeans, sorghum, groundnuts, and tomatoes, pepper, garden eggs, grown under dryland production with some supplementary drier months. Irrigated crops include pepper, tomatoes, garden eggs and maize grown in the drier months (October – February). Out of the 17,383 agricultural households, 6,333 are engaged in livestock rearing. Out of those engaged in livestock, number 4, 327 (68%) are into poultry farming. Again, chickens alone form 73% of the total livestock population of the Municipality. Majority of these households are however into micro poultry farming producing mainly for consumption with an average of 49 birds per keeper (MoFA, 2011).

The study area is also known in the country for predominant poultry and microfinance activities. It has 211 registered small and medium scale farms as well as 2 large producers

(FAO, 2014). Farmers in the Municipality produces for both the Ghanaian and Ivorian markets as they share boarders with Côte d'Ivoire to the West. Activities of MFIs are predominant in all the 25 rural and urban settlements of the Municipality mainly due to the commercial poultry production in area (Atuahene et al., 2010). They provide farmers and other micro-entrepreneurs with microcredit and other financial services. It is for these reasons that the Municipality was selected for the study as it best suits any study that takes into account poultry production and microfinance activities.

4.3 Research Design

In conformity with the objectives of the study, a comprehensive survey schedule was prepared, which included all the important factors related to the socio-economic characteristics, inputs and outputs as well as microcredit access, awareness and the challenges of 'with credit' and 'without credit' farmers. Though the population of small and medium scale farmers in Dormaa Municipality is not too large (N = 213), the researcher chose the survey research design to complete the study in a reasonable period of time using a manageable representative sample size. Surveying basically means finding facts and collecting data from a population or sample by questioning the respondents about some specific characteristics (Glasow, 2005). Again, survey design is the most efficient approach to gather and obtain data where little is known about the phenomenon under discussion (Leedy, 2014). This method is therefore the most ideal for this study since it entails the collection of data from a representative sample of poultry farmers in Dormaa. The significance of survey design is elaborated in the conclusions of Bogdan and Biklen (2007) that it is good in original data collection and strong in that, it does not influence the decisions of the respondents. This means that the opinions and perceptions of the distinct group are studied through observation and description without any control on them. The results from the defined group can then be generalised to cover the entire population. This is indicative that the research design is relatively cheap and faster in the collection of data from a large population in a short period of time.

4.4 Population and Sampling Technique or Procedure

The target population of the study were small and medium scale poultry farmers within Dormaa Municipality, both "with microcredit" (for at least the last two years) and "without microcredit". The study adopted probability sampling techniques to select a true representation of the study population. In probability sampling each of the members in the population has a non-zero or equal chance of being selected (Cohen and Manion, 2011 cited in Mbangani, 2016). Dormaa Municipality was selected due to its dominance in poultry farming in Ghana. Also, the area is well known in Microfinance activities and is even known as the cradle of some recognised MFIs in the country (for instance Wamfie Rural Bank). A Simple Random Sampling technique was use to select the respondents. The selection was however done using random numbers which were extracted from the poultry farmers association's register obtained from the association's office.

The population for the purpose of this research entailed the total number of poultry farms in the Municipality. The Municipality has 213 registered farms under the Dormaa Poultry Farmers Association (DPFA) as of December 2015. Hanlon and Larget (2011) defines population as, a group of people with collective characteristics that is of interest to the researcher. The farmers in the Dormaa Municipality were therefore ideal since they share common economic, social and environmental background and challenges. It is therefore impracticable if not impossible to study an entire population before making generalisations according to Best and Khan (2013) cited in Mbangani (2016). It would have been therefore been expensive to study the entire population due to the limited time the researcher had to conduct this study.

For the purpose of this study, the total population (N = 213) was further categorised into small scale (50 – 5,000 birds), medium scale (5,000 – 10,000 birds) and large scale (above 10,000 birds) farms according to the commercial farms classifications in Ghana (Kusi et al., 2015). The target population was then narrowed to 153 as some farms fell out of the small and medium scale classification of the farms. This was again narrowed down to the Sample Frame (M = 134) as some of the farms 'with microcredit' did not also meet the criteria of borrowing for at least the last two years. A representative sample (n) was then selected from the sample frame (M) of small and medium scale poultry farms in the Municipality. A sample of 100 minimum respondents was sufficient as calculated with the SurveyMonkey Sample Calculator at 5% margin of error. However, 110 respondents were questioned but reduced to the sample size after screening for purposes of quality data since some respondents failed to answer some vital questions. A sample can therefore be seen as a percentage of the entire population selected for a study from which valid and reliable inference can be made of the population (Hanlon and Larget, 2011). The features should match the population in order to guarantee the drawing of any economical analogy and should also be large enough in order to be representative. The researcher however purposively selected the 6 MFIs whose names were frequently mentioned by the farmers during the questionnaire administration for interviews.

4.5 Sources of Data

Primary and secondary data were collected for the study. Primary data were collected from various small scale poultry farmers, poultry farmers associations and MFIs. Secondary data were also acquired from the Municipal Assembly, farmers association, scientific articles, and other written documents for the literature review and to verify the results of the study.

4.6 Data Collection

The research adopted both quantitative and qualitative data collection techniques. Questionnaires were used to collect primary data from farmers through interviews. Questionnaires are vital in scientific studies as vital information can be gathered with it within a short time frame (Glasow, 2005). The questions were directly administered by the researcher. Peculiar advantage of questionnaire is that it could be filled therefore provides a long-term and verifiable record of the data collected (Leedy, 2014). The research made use of both closed and opened-ended questions. Geer (1991) argue that closed-ended questions are easy and less expensive to code and analyse and are particularly useful when high levels of data specifications are involved. Respondents were given options to choose from and were not allowed the freedom to provide answers that were not relevant to the study. Open-ended questions were also included to allow a certain room of expression by the respondents as Geer (1991) argues that though closed-ended questions might prove easy and less expensive to code and analyse, it proves a weak indicator of public opinion. The tool was divided into five (5) main sections (see Appendix 1). To ensure the validity of the questionnaire, it was first edited and corrected by some student colleagues and the supervisor for the study. It was also tested with 5 poultry farmers and discussed with the farmers association's Chairperson before the actual data collection. Focus Group Discussion (FGD) was held with eight (8) poultry farmers' association executives and key informant interviews were also held with the '2015 National Best Farmer' and four (4) other large scale farmers as well as the six (6) selected MFIs as a means of triangulation to collect the same data and to have an in-depth knowledge on the research topic.

4.7 Methods of Data Analysis and Presentation

The study analysed collected data using Statistical Package for Social Sciences (SPSS) version 20, GAMS and STATA and coded in Excel. Both descriptive and inferential statistics were adopted to examine the 'relationship and causality effects' between dependent and independent variables. Data were however analysed objective by objective.

4.7.1 Conceptual Framework

Given the limited access to financial credit coupled with the numerous challenges associated with the rural credit market, it is purported that some poultry farmers will access credit from MFIs while others will not. The decision by a farmer to take microcredit is however influenced by some factors including price of credit, loan amount, repayment mode, payback period, farm size, size of working capital, farm assets (land and machinery), the age of the farmer, as well as the experience and education of the farmer. Those who access microcredit are expected to have access to modern technology hence make efficient use of inputs (land, labour, chicks and poultry feed) to achieve a maximum level of output (birds and eggs) compared to their non-borrowing counterparts. The higher output is therefore expected to increase farm revenue and consequently increase farm income. This will again inform the farmer's decision to take or not to take microcredit the following farming year. The study therefore conceptualises that a timely and sustainable provision of microcredit and its rational use by small and medium scale farmers can effectively increase their output and income. This if sustained over a period of time, can help Ghana to be sustainably self-sufficient in both chicken and egg production. The Probit model was adopted to analyse the decision to either take or not to take microcredit. The Data Envelopment Analysis (DEA) model was also adopted to calculate the farm specific technical efficiencies (TE) based on the aforementioned inputs and outputs. These efficiency estimates will then be used as a covariate together with other farm-specific factors (education, experience, farm size and microcredit) to determine their impact on farm output (eggs and birds) and income using the propensity score matching. Figure 5 therefore summarises the concept behind the study.

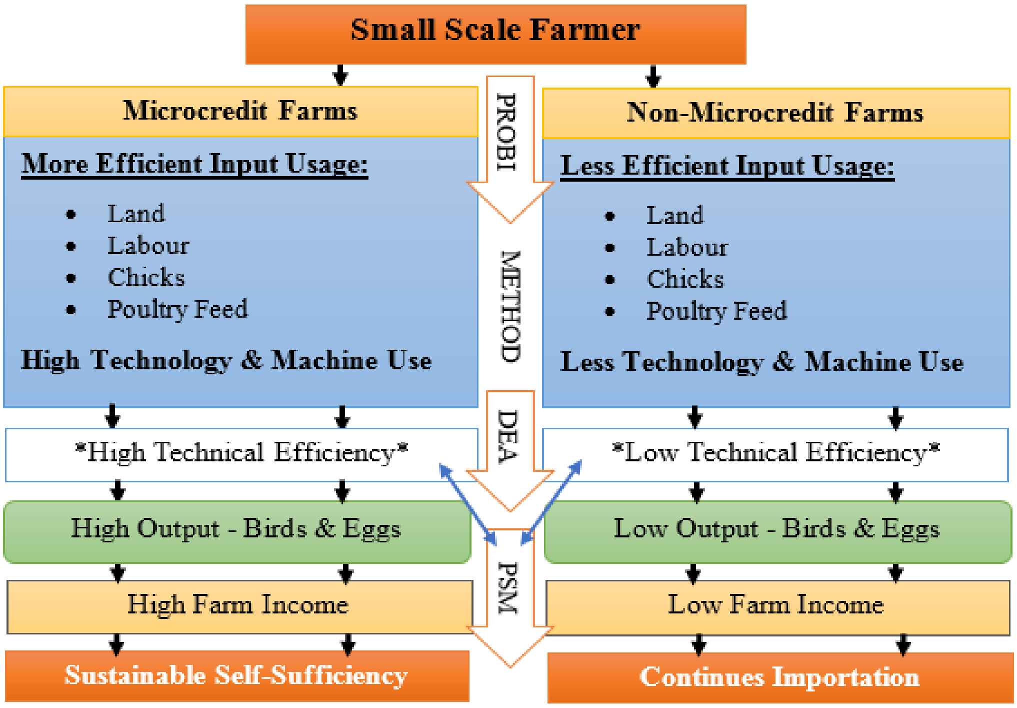


Figure 5: Conceptual Framework Chart for the Study

4.7.2 Descriptive Statistics

Frequencies, cross-tabulations and means along with a T-test of statistics were adopted to analyse the demographic characteristics of the sampled farms and farmers and the results were presented in bar and pie charts, as well as tables. Various data such as farm size, number of employees, inputs, outputs, interest rates credit amount and income among others, were collected and analysed to support the objectives of the study.

4.7.3 Inferential Statistics

The first objective was analysed using Probit model. The second objective was also analysed following the Data Envelope Analysis (DEA) described by Wadud (2013) to determine the technical efficiency (TE) scores which were later used for a linear regression model (inefficiency model) to determine the inefficiency effect of microcredit on the farmers' TEs and the PSM to determine the exact impact of microcredit on the TEs of farmers. The third and fourth objectives – thus, to determine the impact of micro credit on farm output and income were analysed using Propensity Score Matching (PSM) as described by Wadud (2013) in a similar study as well as a linear regression model to test the influence of microcredit and other farm specific factors detailed in the model specification below on farm output and income. Below are therefore detailed specifications of the models adopted in the data analyses.

4.7.4 Model Specification

The Probit Model

The probit model was used in the study to examine the propensity of farmers participating in microcredit programmes. The probit and logit models were ideal since the endogenous variable was binary.

Suppose the dependent variable Z_i is binary with only two outcomes (denoted by 1 = 'with microcredit' and 0 = 'without microcredit'). Taking into account a vector of regressors x_i, assumed to influence Z_i, we assume that the model is specified as:

$\Pr(Z_i = 1/x_i) = \phi(x_i\,'\gamma)$

Where "Pr" is the probability, Z_i is the binary choice variable (access to microcredit), ϕ is the Cumulative Distribution Function (CDF) of the standard normal distribution and $'\gamma$ is a vector of unknown parameters.

Z_i^* can then be specified as:

$Z_i^* = \gamma_0 + \sum_{n=1}^{N} \gamma_n\, x_{ni} + u_i$

That: $Z_i = 1_{if\ Z_i^*>0}$ and $Z_i = 0_{otherwise}$

Where x_i= a vector of explanatory variables is (land, machinery, capital, farm size, education, gender, savings, age and experience);

γ = a vector of unknown parameters and

ui = a random disturbance term. N is the total sample size. The unknown parameters are estimated by the method of maximum likelihood and the magnitude of relations between the dependent and independent variables are explained by marginal effects of the parameters.

Data Envelopment Analysis (DEA) Method

Data Envelopment Analysis (DEA) is a non-parametric mathematical programming approach developed by Charnes, Cooper and Rhodes (1978) cited in Wadud (2013). Their approach which initially assumed constant returns to scale (CRS) was later relaxed to a variable return to scale (VRS) by Banker, Charnes and Copper (1984) cited in Wadud (2013). This model is known as the variable return to scale (VRS) DEA model. The VRS DEA model is different from the CRS DEA model such that it envelops the data more carefully, thereby producing technical efficiency estimates greater than or equal to those from the CRS DEA model. The DEA model assumes monotonicity and convexity of the efficient frontier according to Banker et al. (1984) cited in Wadud (2013).

The model estimates efficiency relative to the Pareto-efficient frontier which estimates best performance (Murthi et al., 1997) cited in Wadud (2013). Again, it can obtain target values based on the best practice units (peers) for each inefficient farm that can serve as a guide for performance improvement. The major deficiency of the DEA is that it is deterministic and assumes a zero value for the stochastic random error component. It therefore assumes all unexplained variations of poultry production to technical inefficiencies which can be biased upwards. Moreover, since it is nonparametric and does not contain random noise or error of measurement, efficiency estimates cannot be subject to statistical test. The DEA frontier assumes that analysis of efficiency can have an input-saving or an output-augmenting interpretation. This model is used here to assess the relative efficiency of homogeneous poultry farms in transforming inputs into outputs.

Assume that the jth farm uses $x_j = \{x_{kj}\}$ of inputs $(k = 1, 2, 3,4)$ {thus, labour, feed, land and chicks) to produce a single output y_j {two outputs for this study; eggs and birds}. The (k×n) input matrix is denoted by X and the (1×n) output vector is represented by number (n) farms where $n = 100$. The technical efficiency can be assessed solving the succeeding linear programming (LP) based on the data Envelopment Analysis (DEA) model:

$$\underset{\varphi^{I,CRS},\omega}{Minimize}\ \varphi_j^{I,CRS}$$

Subject to $-y_j + Y\omega \geq 0;\ \varphi_j^{I,CRS} x_j - X\omega \geq 0\ and\ \omega \geq 0$

The scalar, $\varphi_j^{I,CRS}\ \left(\varphi_j^{I,CRS} \leq 1\right)$ is the technical efficiency score for the j[th] farm. The variable returns to scale (VRS) frontier can be formed by introducing the convexity constraint, $\Omega'\omega = 1$ in (3), where Ω is a $(n \times 1)$ vector of ones.

A degree of scale efficiency can be obtained as$SE_j^I = \left(\varphi_j^{I,CRS} \middle| \varphi_j^{I,VRS}\right)$, where $\varphi_j^{I,VRS}$ is the degree of efficiency under the setup of VRS DEA. Thus $SE = 1$ represents scale efficiency and $SE < 1$ represents scale inefficiency. Scale inefficiency arises as a result of the presence of either decreasing (DRS) or increasing (IRS) returns to scale. A specific farm is therefore efficient when its TE efficiency score is equal to one (1). Thus, that farm is said to be producing a long the frontier. The difference between a specific farm's efficiency score and one (1) is termed as its technical inefficiency (TI) score (that is 1-TE).

The DEA approach was first used to estimate the technical efficiency score for each farm. These scores were used to estimate the farm specific TIs which were further used to build a linear regression (inefficiency effect model) using some farm-specific inefficiency reduction factors, working capital, farm size, number of employees and experience as well as microcredit, to test the second hypothesis and to find their TI effects of the aforementioned factors thereby improving the technical efficiencies of farmers using the model specification;

$$IE_j = \delta_1 x_{1j} + \delta_2 x_{2j} + \delta_3 x_{3j} + \delta_4 x_{4j} + \delta_5 x_{5j} + \delta_6 x_{6j} + \mu_j$$

If $(\delta_1 x_{1j} + \delta_2 x_{2j} + \delta_3 x_{3j} + \delta_4 x_{4j} + \delta_5 x_{5j} + \delta_6 x_{6j}) \geq 0$; inefficiency could be zero or more than zero. Where:

$x_1,\ x_2,\ x_3, \ldots.., x_6$ are the explanatory variables (microcredit, capital, labour, farm size, education, and experience) and

$\delta_1,\ \delta_2,\ \delta_3, \ldots.., \delta_6$ are the parameters of the explanatory variables.

μ_j= stochastic error for the *j-th* farm.

Propensity Score Matching or Logistic Regression

Assessing the impact of microcredit requires one group affected by the intervention and the other group otherwise known as the treated and the control groups respectively. The averages of their outcomes are compared and the difference between the two groups can be described as the impact of the intervention. The method can be described as follows.

Evaluating the mean effect of participation in a programme (treatment) requires making an inference about the outcome that would have been observed for the treated ('treatment group') if they had not been treated. Control and treated groups do not only differ with respect to their participation status but also many other characteristics. Computing the treatment effect as the difference of mean outcomes between the two groups would result to selection bias. PSM has become a popular approach in estimating casual treatment effects and is widely used especially in labour market policy evaluation and analysis (Heckman et al., 1997 and 1998; Dehejia and Wahba, 1999 cited in Wadud, 2013). Problem however arises in micro-econometrics evaluation when computing the difference between the participants' outcome with and without treatment. It is clearly impossible to observe both outcomes for the same individual at the same time. Representing the mean outcome of non-participants as a proxy is not ideal, since participants and non-participants differ even in the absence of treatment. This is what is termed the selection bias problem. The matching approach tries to solve this challenge by finding a large group of non-participants similar to the participants in all relevant pre-treatment characteristics X (capital, farm size, years spent in school, experience and machinery). The differences in outcomes of this carefully selected and thus adequate control group and of participants can be attributed to the intervention (microcredit) with this being done. The underlying identifying assumption is known as *"unconfoundedness, selection on observables or conditional independence"* (Wadud, 2013).

Matching is however no magical invention capable of solving the evaluation problem in any way. It is applicable only if the underlying identifying assumption can be credibly invoked based on the basis of informational richness of the data and a clear understanding of the institutional set-up by which selection into treatment takes place (Blundell et al., 2005 cited in Wadud, 2013). An advantage of matching over standard regression is that it is less demanding with respect to modelling assumptions (Wadud, 2013). Thus, it does not require functional forms assumptions for the outcome equation (it is non-parametric). Again, there is no need for the assumption of constant additive treatment effects across individuals with matching. Individual causal effects are unrestricted instead and individual effect heterogeneity in the population is permitted (Wadud, 2013).

Rosenbaum and Rubin (1983) cited in Wadud (2013) suggested the use of the balancing scores $b(X)$, i.e. functions of the relevant observed covariates X such that the conditional distribution of X given $b(X)$ is independent of assignment into treatment, since conditioning on all important covariates is limited in the case of a high dimensional vector X ('curse of dimensionality'). Propensity Score is one possibility of balancing score, i.e. the probability of been a beneficiary of a programme given observed characteristics X. Matching procedures based on this balancing score are known as Propensity Score Matching (PSM).

Let Y_1 represent the outcome if an individual farmer takes microcredit and Y_0 the outcome if the same individual does not take microcredit. Let $D = \{0, 1\}$ denote the binary indicator of microcredit ($D = 1$ if microcredit, 0 otherwise). For a given farmer $'i'$, the observed farm income and output is given as $Y_i = Y_{0i} + D_i(Y_{1i} - Y_{0i})$. The effect of microcredit can be identified following Heckman et al. (1997) and 1998) and Sianesi (2001) cited in Wadud (2013) as follows:

1) The average treatment effect: $E(Y_1 - Y_0)$ is the mean outcome (output or income) difference between the two groups.
2) The average treatment effect on the treated is given as $E(Y_1 - Y_0/D = 1)$. This parameter is the one receiving peculiar attention in the evaluation literature. It measure the average outcomes (income and output) difference between the incomes and output that the farmers who receive microcredit and the income and output that they would have gotten if they had not received credit.
3) The average treatment effect on the non-treated (control group): $E(Y_1 - Y_0/D = 0)$ is the average income/output difference between the expected output/income that the farmers who does not receive microcredit ($D = 0$) would get if they had $(E\ (Y_1))$ and the real income/output that they earn (Y_0).

The mean impact of treatment on the treated, $ATT = E(Y_1 - Y_0/p = 1) = E[Y_0/p = 1]$ is the evaluation parameter of paramount interest. This answers the question as to the extent to which farms participating in the microcredit benefits compared to what they would have earned or experienced without participating in the programme. Data on $E[(Y_1/p = 1)]$ are available from the programme participants (microcredit participants). The classic problem of evaluators is to find out $E[Y_0/p = 1]$, since data on non-participants enables us to unearth $E[Y_0/p = 0]$ only. This therefore leaves the difference between $E[(Y_1/p = 1)]$ and $E[Y_0/p = 1]$ unobserved for the same farm.

The solution then lies in the advanced solution given by Rubin (1977) cited in Wadud (2013) which states that given a set of observable covariates X (capital, farm size, years spent in school, experience and machinery), potential (non-treatment) outcomes are independent of participation (in microcredit) status (Conditional Independence Assumption - CIA): $Y \perp 0\, S/X$. The mean of the expected outcome is the same for P = 1 and P = 0 after adjusting for observable differences; i.e. $[E(Y_0/P = 1, X) = E(Y_0/P = 0, X)]$. This therefore allows the usage of matched non-participating farms to measure how the group of participating farms would have performed, had they not participated.

Notwithstanding, Caliendo and Kopeinig (2005) spelt out that the propensity score matching is limited since computing its error is not a straight forward approach. The challenge is that estimated variance of the treatment effect should involve the variance as a result of the propensity scores, imputation of the common support and the order in which the treated respondents are matched. The variation added by these estimation steps are beyond the normal sampling variation. For instance in the case of NN matching with one nearest neighbour, treating the matched observation as given will underestimate the standard error (Smith, 2000 cited in Caliendo and Kopeinig, 2005). One way to address this challenge is to use what is termed as “Bootstrapping” suggested by Lechner (2002) cited in Caliendo and Kopeinig (2005). Bootstrapping is a popular method for estimating errors in case biased or unavailable analytical estimates according to Caliendo and Kopeinig (2005). However, Imbens (2004) cited in Caliendo and Kopeinig (2005) that there is little formal evidence or methodological proof that Bootstrapping is the ideal solution to this problem.

Linear Regression Model

The purpose of the linear regression specified below was to again verify the impact of microcredit on farm performance (output and income) estimated with the PSM in order to confirm or reject the null hypotheses of these objectives.

$Y_i = \propto + \delta_1 x_{1i} + \delta_2 x_{2i} + \delta_3 x_{3i} + \delta_4 x_{4i} + \delta_5 x_{5i} + \delta_6 x_{6i} + \delta_7 x_{7i} + \mu_i$

$Y_i =$ farm output (Birds and Eggs) and income of the farmers.

$x_1,\ x_2,\ x_3, \dots \dots, x_7$ are the explanatory variables (microcredit, capital, farm size, education, machinery, experience and technical efficiency),

$\propto =$ Constant; $\delta_1,\ \delta_2,\ \delta_3, \dots \dots, \delta_7$ are the parameters of the explanatory variables.

μ_i= stochastic error term of matched farms.

5.0 Results

5.1 Demographic Characteristics of the Farms and Farmers

Table 2: Demographic Characteristics of Farmers With and Without Microcredit

Features		With Credit (N = 61)	Without Credit (N = 39)	Total (N =100)
		Frequency	Frequency	
	Male	40	37	77
Gender	Female	21	2	23
Age	20 – 29	10	7	17
	30 – 39	29	17	46
	40 – 49	17	10	27
	50 – 59	5	4	9
	60+	0	1	1
	No Formal Education	2	5	7
Level of Education	Basic Education	18	14	32
	Secondary Education	23	15	38
	Post-Secondary/Tertiary	17	5	22
	Personal Savings	29	25	54
	Microcredit	31	-	31
Main source of finance	Friends & Family Loans	-	7	7
	Money Lenders	-	2	2
	Traditional Bank Loans	-	3	3
	Other Sources	1	2	3

Result from Table 2 shows that majority of farmers (77) were male while female farmers constituted 23. Again, among the sampled female farmers 21 received microcredit whilst only 2 did not receive microcredit. On the other hand, 40 of the sampled male farmers were borrowers whilst 37 of them were non-borrowers. Furthermore, the youngest farmer was 24 years while the oldest was 72 years. Moreover, Table 2 shows that 90 of the farmers were between the ages of 20 – 49 whilst only 10 were above 50 years. This indicates that the sector is made of young and energetic labour force. Only a farmer (1) was above the age of 60 years.

The average years of schooling among the respondents was 10 years. The result further indicates that majority of the farmers with microcredit (40) had attained secondary to post-secondary or tertiary education than those without microcredit (20). Only 2 of the farmers with credit had no formal education whilst 18 had basic level of education (grade 1 to 9) out of the sampled farmers with credit (61). On the other hand, the sampled non-microcredit farmers had 5 of them with no formal education and 14 had basic education. Likewise result at the bottom of Table 2 indicates the major source of finance for the farmers. From the table, microcredit was the major source of finance for most of the credit receiving farmers (31) followed by their personal savings (29) and other sources (1). On the contrary, farmers without credit were mainly financed from their personal savings (25) with 7 of them mainly financed by loans from friends and families, 2 by loans from money lenders, 3 by loans from traditional banks and 2 by other sources. The dependence on informal sources by non-borrowing farmers makes their financing source unstainable.

5.1.1 Land Holding Size and Independence from Land Owners

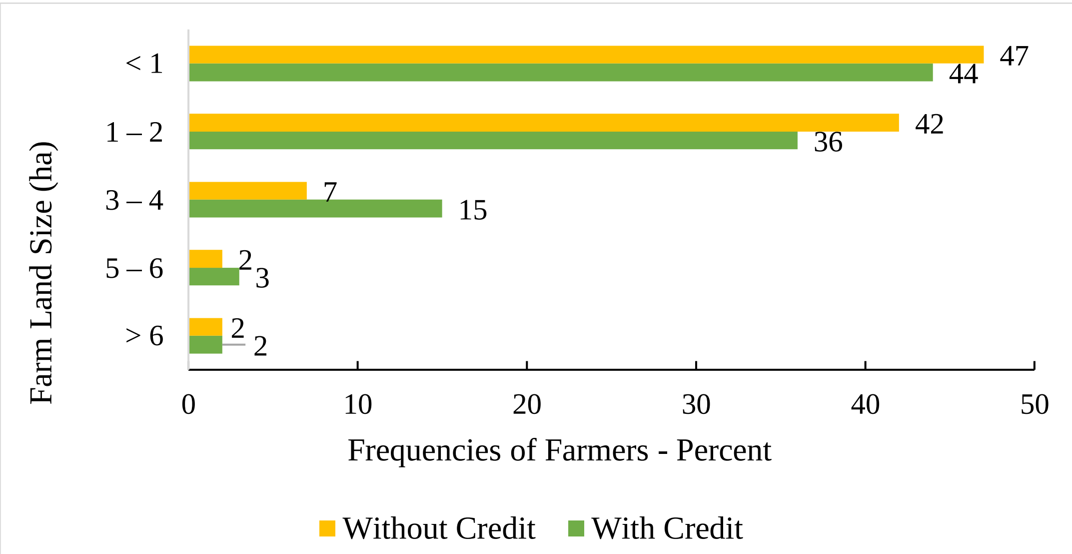


Figure 6: Land Holding Size of Farmers

Result from Figure 6 shows that majority of the farmers without credit (47%) farmed on less than a hectare. Figure 6 again shows that although a higher number of the farmers with credit (56%) cultivated on more than a hectare of land, an increasing number of them

(44%) however farm on lands less than a hectare. On the contrary, a total of 53% of farmers without credit produced on lands more than a hectare. This implies that there is no vast gap between 'with and without' credit farmers with regards to their land sizes. It also implies that lands are relatively not on a higher use in poultry production compared to crop farming.

Again, Figure 7 shows the level of independence of both 'with and without' credit farmers. Generally farmers were highly independent of land owners as majority of them (92%) farmed on their own lands. Only 8% of the farmers depended on other land owners for production subject to periodic rent payments (often annually).

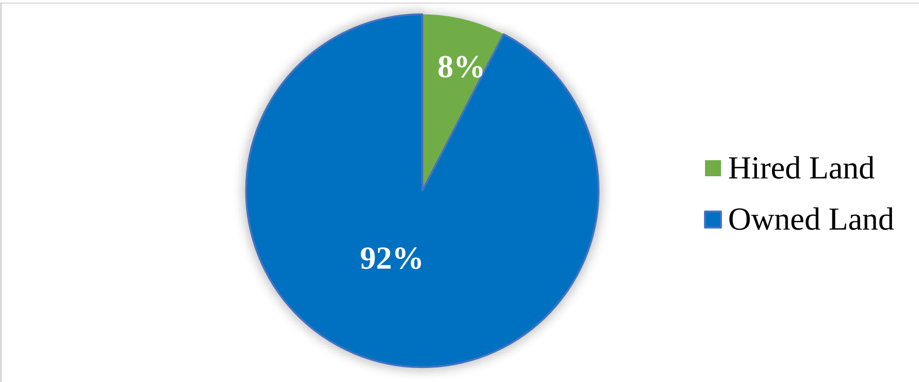


Figure 7: Farmers' Independence from Land Owners

5.1.2 Input – Output Analyses of the Poultry Farms

Result from Table 3 shows the usage of inputs by farmers and the corresponding output achieved. The table indicates that farmers with and without credit utilised approximately equal family and hired labour (2 and 3 respectively) however, both groups made high use of hired labour than family labour. Furthermore, farmers with credit have more assets than those without credit. As indicated in the table, farmers with credit have more poultry farm lands (1.4 ha), machinery (3), farm equipment (344) and building (11) than those without credit (1.1 ha, 2, 226 and 7 respectively). The high use of machinery per farmer among the borrowing farms (118 more than non-borrowers) indicates high adoption of technology which is vital in poultry production.

Table 3: Descriptive Analysis of the Poultry Farm Performance

Variables	With Credit (N=61)	Without Credit (N=39)	Difference
Labour (N)	3.90	3.89	0.01
Family labour (N)	1.80	1.79	0.01
Hired labour (N)	3.33	2.79	0.54
Farm land (ha)	1.40	1.10	0.30*
Machinery (N)	3.00	2.00	1.00***
Equipment (N)	344	226	118.00***
Buildings (N)	11.00	7.00	5.00***
Feed (tons)	296.49	186.30	110.19***
Wages (GH₵)	167.57	185.89	18.32**
Drugs (GH₵)	5,235	3,674.00	1,562.00***
Chicks (N)	7,697	4,334.00	3,363.00***
Farm size (N)	6,405	4,008.00	2,397.00***
Broilers (N)	5,633	1,080.00	4,553.00***
Layers (N)	5,314	3,667.00	1,646.00***
Layer Per capita (crates)	8.16	7.32	0.84**

Note: Alpha (α) level of significance: 0.01=***, 0.05=**, 0.1=*; 2-tail T-test of unequal variance

Again, results in Table 3 shows that farmers with microcredit paid averagely 11% (GH₵ 18.32/USD 4) more wages per month than what was paid by farmers without credit which also shows the indirect effect of microcredit on labour. Likewise, farms with credit used 110.19 tons of feed per annum more than farms without credit while spending GH₵ 1,562 (USD 371) more on drugs. The feeding rate however (0.046 tons or 42 kg/bird/annum) was the same for both groups. The application of better drugs also responded positively in the productivity differences of the two farmer groups. On an average, borrowing farmers produced 4 times (4,553) broiler birds more than their non-borrowing counterparts. Again, layer per capita was also high for farms with credit (8 crates = 240 eggs) than farms without credit (7 crates = 210 eggs) per annum. This implies both with and without credit farmers have to improve their production efficiency in order to meet the global minimum layer per capita (260 eggs) per annum. The farmers with credit were medium scale whereas farmers without credit were small scale based on their average farm sizes (6,405 and 4,008 respectively) against the criteria for poultry farms classification (small scale = 50 – 5,000; medium scale = 5,000 – 10,000; above 10,000 birds = large scale).

5.2 Production Composition and Channel of Distribution of Poultry Products

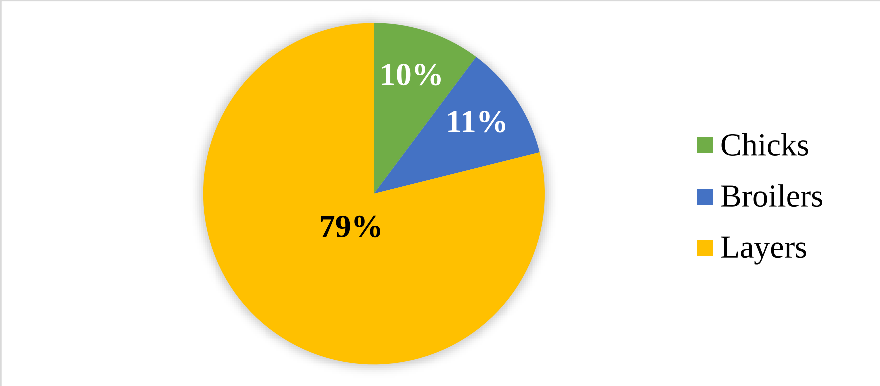


Figure 8: Composition of poultry production

From Figure 8, farmers were mainly into layer birds production (79%). The broiler birds and the chicks also constituted 11% and 10% respectively of the total farm size. This implies farmers focused on eggs production than meat (chicken) production.

Table 4: Source of Revenue and Market for Farmers

	Sources	**Percent**
	Sales – Birds	20
Revenue	Sales – Eggs	80
	Total	**100**
	Sales – Côte d'Ivoire	68
Market	Sales – Local market	32
	Total	**100**

Note: Revenue was measured as cash sales from eggs and birds excluding in-kind revenue

From Table 4 the main source of farm revenue for the respondents was from sales of eggs (80%) which confirms the findings in Figure 8 that 79% of the birds were layers. The remaining 20% of cash revenue was obtained from sales of broiler birds or layers whose laying cycle have ended. Again, a greater proportion (68%) of the birds are sold on the market of the neighbouring country (Côte d'Ivoire). Only 32% of the birds are however sold on the Ghanaian market though the eggs were sold on the local market. A crate of eggs was sold at an average producer price of GH₵ 11. Furthermore, 950 out of every 1,000 birds produced per farm is sold for revenue. The average price per broiler was however higher (GH₵ 24) than the average price of a layer (GH₵ 15) all of which are higher than the average price of imported frozen chicken (GH₵ 12).

5.3 Reasons for Farming

Table 5: Reasons for Entering into Poultry Farming

Reasons	Mean Ranks	Ranks
Income	1.18	1st
Social Status	2.65	2nd
Job Creation	3.51	3rd
Food Security	3.80	4th
Others	3.86	5th

Note: N = 100, Kendall's W =0.508 at $\alpha = 0.05$, Chi-Square (0.05, 4) = 203.39; Asymp. Sig. = .000

Using the Kendall's coefficient of concordance at $\alpha = 0.05$, the farmers' purposes of farming were ranked (with 1 been the highest rank and 5 the least rank) as presented in Table 5 above. According to the farmers their pressing reason for entering into poultry farming was to generate income. Social recognition in society was the second factor whilst job creation, food security and other factors (e.g. family profession and lack of formal employment among others) were also the 2nd, 3rd, 4th and 5th factors respectively that informed their decision to enter into poultry farming.

5.4 Challenges of the Farmers in Poultry Production

Using the Friedman's ranking the challenges faced by the farmers were ranked on a scale of "1 to 9" (with 1 as the highest rank) and the results are presented in Table 6 below. To the farmers, capital inadequacy was their topmost challenge since poultry production is cash demanding whilst access to rural credit is also scare. This was followed by the absence of local market availability, lack of processing and storage facilities, high cost of feed, absence of technology, competition from cheap imports, lack of protective legislative instruments, poor quality of chicks and high energy prices respectively. It is therefore not surprising that 68% of the birds produced are sold in Côte d'Ivoire since the absence of available local market was ranked second.

Table 6: Ranks of the Challenges Faced by Poultry Farmers

Challenges	**Mean Ranks**	**Ranks**
Inadequate Capital	1.68	1st
Lack of market availability	2.84	2nd
Lack of Processing/Storage facilities	3.73	3rd
High feed cost	3.89	4th
Technology	5.02	5th
Competition from Cheap Imports	5.75	6th
Lack Protective Legislative Instruments	6.77	7th
Poor quality chicks	7.45	8th
High energy prices	7.87	9th

Note: Friedman Rank Test at $\alpha = 0.05$, chi^2 value = 486.41; critical (0.005, 8) = 2.733; Asymp. Sig. = .000

5.5 The Microfinance and Microcredit Market of the Farmers

Table 7: Features of Microcredit and other Source of Borrowing of Farmers

Description	**N**	**Mean**	**Std. Deviation**
Years of borrowing (Years)	61	4	2.05
Interest rate/month (%)	61	3	1.09
Interest/annum – MFIs (%)	61	40	13.07
Formal banks' interest/annum (%)	9	30	25.91
MASLOC's interest rate/annum (%)	7	25	0.49
Informal interest (%)	3	51	21.20
Repayment period (months)	61	12	0.00
Actual payback period (months)	61	13	1.90
Access period (days)	61	19	10.30
Lost savings (GH₵)	59	5,371	5086.00
Average credit amount/annum (GH₵)	61	32,790	20517.00

Results in Table 7 illustrate the associated characteristics of borrowing by the respondents. On an average, it takes 19 days for a farmer to receive an applied loan which is quite long for emergencies which often happen in poultry production according to the farmers. Averagely, GH₵ 32,790 (USD 7,761) was borrowed per farmer which is also quite high for the poor farmers. It is however not surprising since borrowing farms had averagely 6,405 birds per farmer (refer to Table 9). The average monthly and annual credit prices (interest rates) for MFIs were also high (3% and 40% respectively) compared to the average market lending rate (30%) charged by traditional banks. Albeit, average interest rates from informal sector (money lenders) remained high (51%) for non-microcredit respondents. Again, it takes MFIs averagely 13 months to amortize loans provided to farmers instead of the 12 months repayment period provided creating a monthly default per farmer. Again, out of the 6 MFIs interviewed, only 1 responded that it provides actual agricultural loans with 5 months grace period. The remaining 5 provided commercial loans in smaller amounts to the farmers with low or no grace period. Also, GH₵ 5,371 (USD 1,186) were the average micro-savings lost per farmer due to the frequent bankruptcies of MFIs over a two year period (2015 – 2016).

5.5.1 Sources and Forms of Borrowing

Table 8: Cross-tabulation of Amount Borrowed and the Source of Borrowing

	Amount Borrowed				
Source of Borrowing	Below GH₵ 10,000	GH₵ 10,000 – GH₵30,000	GH₵ 30,000 – GH₵ 50,000	Above GH₵5 0,000	**Total**
Rural Banks	2	4	6	6	**18**
Savings & Loans	0	6	2	1	**9**
MASLOC	5	2	0	0	**7**
CCU	0	11	10	3	**24**
Money Lenders	0	2	0	1	**3**
Total	**7**	**25**	**18**	**11**	**61**

Table 8 is a cross-tabulation of the source of borrowing and the amount borrowed by the farmers with credit. Results indicates that the major source of borrowing for farmers was the Co-operative Credit Unions (CCU) (24) followed by Rural/Community Banks (18). Again, farmers who took large credits (borrowing above GH₵ 50,000) borrowed from Rural Banks (6) and CCUs (3) which indicates that these two types of MFIs often cater for the middle income farmers. The government initiative (MASLOC) was however the source where smaller credits (below GH₵ 10, 000) were taken by farmers. This is because

MASLOC is obliged to provide micro-loans from GH₵ 1,000 – GH₵ 10,000. However, the minimum and maximum amount borrowed were GH₵5,000 and GH₵ 70,000 respectively.

Again, Figure 9 indicates the major modes of lending by MFIs. The figure indicates that there are only two major approaches used by the MFIs in the study area. Albeit, individual borrowing is predominant (85%) with only 15% of the credits provided in groups.

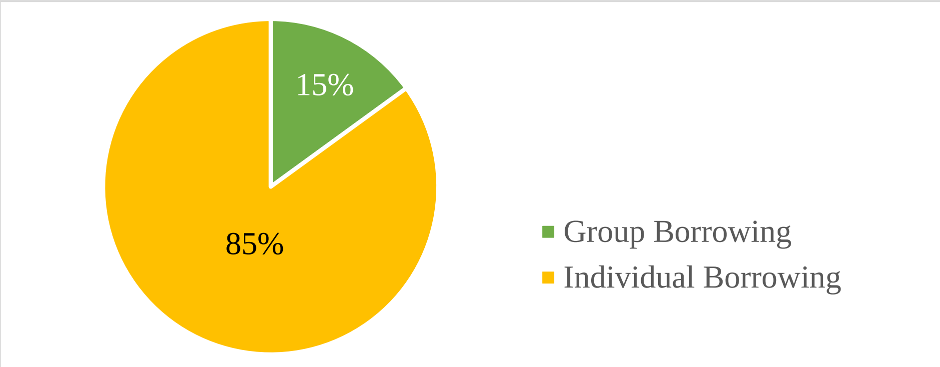


Figure 9: Methods of Borrowing from MFIs

5.5.2 Farmers' Assessment of MFIs Services

On a Likert scale of 1 – 5 (1 = poor), borrowing farmers were asked to assess the credit services provided by the MFIs and the results are illustrated in Figure 10. Results from the figure indicates that farmers were satisfied with services of MFIs since 64% (56% and 8%) rated their services very good to excellent. Only 3% of the farmers rated their services as poor while 21% and 11% rated their services good and fair respectively.

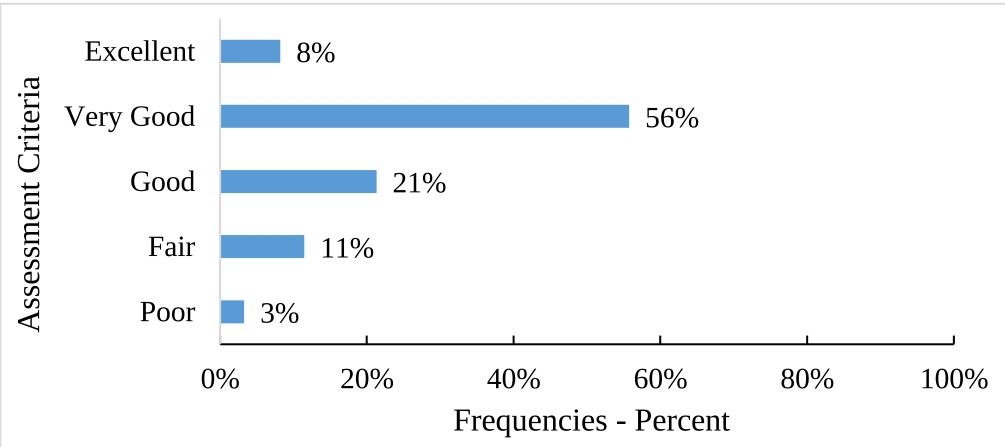


Figure 10: Assessment of Services Provided by MFIs

5.6 Summary Statistics and Description of Variables

Table 9: Summary Statistics and Main Variables Description

Variables	Description	With Credit (N=61)		Without Credit (N=39)	
		Mean	**Std. Dev.**	**Mean**	**Std. Dev.**
Microcredit	Dummy: 1 = with microcredit and 0 otherwise	0.61	-	0.39	-
Gender	Dummy: 1 = male and 0 otherwise	0.66	0.48	0.95	0.22
Savings	Dummy: 1 = Micro-savings and 0 otherwise	0.97	0.13	0.33	0.48
Labour	Man adult equivalence (N)	3.89	1.89	3.88	1.37
Machinery	Number of machinery (N)	3.00	1.54	1.00	1.25
Farm land	Land used for poultry farming (ha)	1.40	2.08	1.10	1.39
Experience	Years spent in poultry farming	10.18	2.82	6.90	2.43
Education	Number of years spent in school	11.36	3.01	8.18	2.43
Age	Age of the farmer (years)	37.05	8.42	37.46	8.68
Feed	Feed consumed by birds per annum (tons)	296.00	162.00	186.00	116
Chicks	Chicks bought per annum (N)	7,697	6170	4,334	2749
Farm size	Current number of birds	6,405	3263	4,008	2892
Output:	Eggs (Crates)	43,337	25281	26,835	16909
	Birds (N)	6,778	8251	2,677	2167
Capital	Size of working capital (GH₵)	79,075	30922	47,029	29534
Revenue	Sum of sales from eggs and birds (GH₵)	560,680	292631	350,834	210931
Expenditure	All variable expenses on revenue per annum (GH₵)	532,381	284479	336,141	204836
Income	Proxy for cash gross margin (GH₵)	28,299	9499	14,694	6954

Note: Expenditure, revenue and income were in cash, no in-kind measurement; N = number

Table 9 presents a summary of all the requisite variables used for the inferential analyses in terms of how they were measured, their means for 'with and without' MC farmers and their standard deviation. The result indicates that 61% of the respondents borrowed from MFIs whereas the 39% were non-borrowers. Again, out of those who took credit, 66% were male whereas 44% were female. Albeit, there was a high rate of borrowing among the female farmers since 95% of the non-borrowing farmers were men. Furthermore, Table 9 shows that out of the borrowing farmers, 98% kept micro-savings with MFIs, perhaps this might be due to the fact that micro-savings are used as collateral alternatives by MFIs in Ghana. Only 33% of the non-borrowing farmers were also saving with MFIs. Again, a farmers with credit had more years in school (approximately 11 years) and with more experienced (10 years) than farmers without credit (8 and 7 years respectively). The sector had active and youthful labour force since the average years of both farmer groups was 37 years. Farmers on an average had 1.4 ha and 1.1 ha (for with and without credit farmers) for the construction of the pens, storages and other important structures. Both farmer groups were however more labour intensive (4 employees per farm for both groups) compared to their capital insensitivity – thus, average machinery 3 and 1 per farmer for with and without credit respectively. Furthermore, farmers with credit had more working capital (GH₵ 79,075/USD 18,805) than farmers without credit (GH₵ 47,029/USD 11,184) in managing their respective average farm sizes of 6,405 and 4,008 birds. Perhaps the high working capital among farmers with credit can be linked to their access to MC. Again, variable expenses per annum was high among 'with' (GH₵ 532,381/USD 126,607) and 'without' (GH₵ 336,141/USD 79,939) credit farms with a greater proportion of it going into cost of feeding. Revenue (GH₵ 560,680/USD 133,337 and GH₵ 350,834/USD 83,433) from both groups, was mainly realised from eggs production (80%) as indicated in Table 4. The average cash income, measured as a proxy of gross margin per farmer also stood at GH₵ 28,299 (USD 6,729) and GH₵ 14,694 (USD 3,494) per farmer per annum. It should also be noted that gender, savings and microcredit were all measured as a dummy, with one (1) been male, keeping micro-savings and farmers with microcredit and zero (0) otherwise.

5.7 Determinants of Farmers' Propensity to take Microcredit

Table 10 illustrates the probit model used in analysing the first objective (farmers' propensity to take MC). Result however shows a high level of significance for the entire model based on its p-value (0.00), which is less than the alpha level of significance (α = 0.05) hence we reject the null hypothesis by concluding that there is a significant relations between a farmer's propensity to take microcredit and the explanatory variables listed in the Table 10. Farm land size, machinery, working capital, education, savings (1 = saving with an MFI) and farm experience were positive determinants of microcredit participation whereas gender (1 = male), farm size and the age of a farmer were inversely related to the propensity of a farmer taking microcredit hence conforming to the 'a priori' expectation of signs. Furthermore, machinery, farm size, education, gender, experience and savings were statistically significant determinants of credit participation whilst farm land, working capital and the age of a farmer were statistically not different from zero at 5% (α = 0.05) level of significance.

Result from Table 10 again shows that the probit model predicts up to 61% of the values and the rest are misclassified. The average predicted probabilities of credit participation was also 39% which is similar to the actual frequency of without microcredit farmers.

Table 10: Probit Model of the Propensity of a Farmer Taking Microcredit

Regressors	Average Marginal Effects	Std. Err.
Farm Land	0.02	0.02
Machinery	0.05**	0.02
Education	0.03***	0.01
Gender*	-0.22**	0.09
Savings*	0.40***	0.14
Age	-0.004	0.004
Experience	0.02**	0.012
Capital	1.710E-06	1.84E-06
Farm Size	-3.63E-05**	1.69E-05
Goodness of fit		**0.61**

Note: (*) dy/dx is for discrete change of dummy variable from 0 to 1; P-value for calculating marginal effects = 0.00, Pseudo R^2 = 0.69**;** Alpha (α) level of significance; 0.01 = ***, 0.05 = **, 0.1 = *

From Table 10, farmers with micro-savings and female farmers are approximately 40 and 22 percentage points respectively more likely to take microcredit than their non-saving and male farmers. Also, for an additional year gained in education and experience by a farmer, individual farms are approximately 3 and 2 percentage points respectively more likely to take microcredit. Furthermore, individual farmers are 5 percentage points more likely to t for an additional machine (technology) acquired. On the contrary, for an additional bird gained, individual farms are 0.004 percentage points less likely to take microcredit. The most influential significant factor by the marginal effects was savings (40 percentage points) whereas the least influential significant factor of borrowing was farm size (0.004 percentage points). Again, farmers with more farm lands and large working capital are more likely to borrow from MFIs whereas older farmers are less likely to borrow from MFIs though these three factors do not have any significant impact on the farmer's decision to borrow. It should also be noted that the entire probit model in its original form was fit based on the Pseudo R^2 in the footnote.

5.7.1 Borrowing Constraints

Table 11: Constraints of Access to Microcredit by Farmers

Challenges	Mean Rank	Ranks
High interest rate	1.62	1st
Short period of credit refund	3.15	2nd
Lack of trust & reliability	3.61	3rd
Poor collection methods	3.66	4th
Bureaucratic application process	4.43	5th
Lack of collateral security	5.76	6th
Information asymmetry	5.78	7th
Kendal's W	**0.468**	

Note: Number of observation = 100; Alpha (α) = 0.05; Chi^2 Statistic = 280.86; Asymp. Sig. = 0.00

Again, according to the farmers, their propensity to take microcredit is not only determined by the aforementioned factors in Table 10 but also by some constraints ranked by the farmers according their magnitude of influence. Result from Table 11 shows that farmers are highly deterred by the high rates of interest charged by MFIs. The next concern of the farmers were the short prepayment period offered them by the MFIs with no or short grace period. Lack of trust was also ranked third because according to the farmers, they are often deceived by the monthly interest rates often presented to them by some MFIs only to pay a high interest amount at the end of the year if these monthly rates are accumulated. They also stated the frequent collapse of MFIs to buttress this point as results in Table 7 indicate that farmers have lost averagely USD 1,186 per farmer over the past two years (2015 – 2016). The farmers also ranked the poor collection methods applied by MFIs in retrieving the credit and the bureaucratic application processes as their 4th and 5th constraints respectively in the microcredit market while lack of collateral security and lack of credit information (information asymmetry) were ranked 6th and 7th. The reason been that farmers borrow either in groups where collateral substitutes (group guarantee) are used or individually where collateral alternatives (such as savings) or their poultry farms are used.

5.8 The Impact of Microcredit on Farmers' Technical Efficiencies

This section presents two models (the technical inefficiency model and the PSM model of the exact impact of MC on farmers' TEs) to interpret the role microcredit plays in achieving maximum output from a given combination of inputs by a farmer.

5.8.1 The Data Envelopment Analysis (DEA) Model

Data Envelopment Analysis (DEA) was employed to calculate the constant returns to scale (CRS) and variable returns to scale (VRS) technical efficiency (TE) estimates using labour, feed, chicks and land as inputs and eggs and birds produced as output. For each farm, the difference between the CRS or VRS estimates and one (1), represents their respective technical inefficiencies (CRS and VRS technical inefficiency). These estimates were regressed on farm specific exogenous variables such as working capital, labour, farm size, education, experience and microcredit to determine their role in reducing technical inefficiencies in farming. Again, the PSM approach as detailed in the methodology was adopted to analyse the exact impact of microcredit on borrowing farms and the results are presented in Table 12 and 13 below.

Table 12: Inefficiency Effects Models

	CRS Technical Inefficiency		VRS Technical Inefficiency	
Regressors	**Coef.**	**Std. Err.**	**Coef.**	**Std. Err.**
Microcredit	-0.02	0.02	-0.02*	0.01
Capital	-2.31E-08	4.51E-07	-8.68E-08*	2.91E-07
Labour	-0.01	0.01	-3.36E-03	3.21E-03
Farm size	3.52E-06	4.51E-06	5.29E-06	2.29E-06
Education	-0.01**	2.71E-03	1.73E-04	1.95E-03
Experience	-8.47E-04	3.02E-03	-3.65E-04	1.95E-03
_Cons	0.14***	0.13	0.27	0.02
Adjusted R^2	**0.13**		**0.09**	
P-value	**0.049**		**0.18**	

Note: Alpha (α) level of significance; 0.01 = ***, 0.05 = **, 0.1 = *

Result from Table 12 indicates the technical inefficiency effects for both with and without microcredit farmers. Results from both models indicate an inverse relationship between microcredit, capital, labour and experience which conform to the a priori expectations of the study. This implies that farmers with microcredit, large working capital, more labour, and high level of experience have less technical inefficiency effects hence more efficient in their operations. On the contrary, the inverse relationship between farm size and TIs (both CRS and VRS) means that technical inefficiency effects are high among larger farms than smaller farms though, this was unexpected. Again, years spent in school (education) positively relates with CRS technical inefficiency. This is perhaps due to the imposition of the constant returns to scale assumption by the CRS technical inefficiency. At 0.05 alpha level of significance, only education was a statistical determinant of TI which implies that technical inefficiency effects are lower for farmers with higher level of education than those with lower level of education. Thus, for an additional year spent in school by a farmer, technical inefficiency effects reduce by 1% for CRS TI. The Adjusted R^2s for the models are however low (0.13 and 0.09 respectively). This can be traced to the low differences in efficiency performance among farmers which reflected in low standard deviation. At 0.05 alpha level, the CRS TI model is statistically significant – thus the p-value (0.049) is less than the alpha level of significance (0.05).

5.9 Propensity Score Matching (PSM) and Microcredit Effect on Farmers' Technical Efficiencies, Output and Incomes

Propensity Score Matching (PSM) technique was deployed to assess the impact of microcredit on the technical efficiency, output and income of the farmers. The model was specified using logistic regression to obtain the propensity scores which were expressed as a function of a set of covariates – thus, working capital, farm size, education, farm experience, labour and machinery. Information of covariates is abstracted as 'x' and technical efficiency, farm income and output as 'y' based on the estimated propensity scores. On the basis of the propensity scores, a participant from the treated group (microcredit receiver) is matched with a participant from the control group (non-microcredit receiver) to hasten causal inference in order to achieve a balance between the treatment and the control groups. Farmers representing matched pairs are ideally identical except the treatment factor (microcredit). The unmatched factors were therefore discarded in the analysis in order to create a level of homogeneity among farms with and without microcredit. The Nearest-neighbour Algorithm was used to identify the matches after the calculation of the propensity scores.

5.9.1 Microcredit Effect on Technical Efficiency

Table13: Propensity Score Matching of Microcredit Effect on Technical Efficiency

Description	CRS Coefficients	Standard Error	VRS Coefficients	Standard Error
Average TE of match treated	0.82	0.03	0.85	0.02
Average TE matched control	0.69	0.02	0.71	0.02
Average Treatment Effect **(ATE)**	**0.13*****	0.17	**0.14*****	0.14
Average impact due to Microcredit **(ATET)**	**0.20*****	0.05	**0.22*****	0.04

Note: Number of observation = 100; control = 39; treated = 61. Alpha (α) level of significance 0.01 = ***, 0.05 = **, 0.1 = *

Table 13 shows the impact of microcredit on the constant return to scale (CRS) and variable return to scale (VRS) technical efficiencies (TEs) of farmers with microcredit using PSM. Result shows that farmers with microcredit are averagely 82% and 85% (CRS and VRS) whereas farmers without microcredit are 69% and 71% (CRS and VRS) technically efficient. However, the combined TEs of the farmers ranges from 22% – 100% with average TEs of 81% and 85% (CRS and VRS respectively). Farms have to reduce wasteful cost by 19% and 15% to be fully efficient. Microcredit therefore has a positive impact on both CRS and VRS TEs of farmers with credit. Two conclusions can however be drawn from the results taking into accounts the impact resulting from the difference between the average TEs of farms with credit (treated) that matched with farms without credit (control). Considering both with and without credit farms, farms with microcredit are averagely 13% or 14% (CRS or VRS) more efficient than farms without credit. Secondly, considering only the treated, microcredit receiving farms are 20% and 22% (CRS and VRS respectively) more efficient than those without microcredit. This boost production and help attain self-sufficiency if sustained. On the basis of the inefficiency and the PSM model in Table 12 and 13, we reject the null hypothesis by concluding that microcredit is a significant determinant of farmers' TEs and can reduce Tis in farming.

5.9.2 Impact of Microcredit on Farm Output

Again, a linear regression model was used to determine the effects of the covariates (microcredit, capital, farm size, machinery, education and experience VRS TE) on a farmer's output (Eggs and Birds) and result is illustrated in Table 14.

Result from Table 14 indicates a better goodness of fit for the first model (0.75) than the second model (0.31). Their Adjusted R^2 s also show that up to 75% and 31% of variations in output (eggs and birds respectively) are associated with corresponding variations in the explanatory variables in the table. The models are also significant since their p-values (0.00 for both models) are less than 0.05 alpha level of significance. On an a priori signs of expectation microcredit, capital, farm size, education, machinery and technical efficiency were positive determinants of output and conformed to predictions. Experience was however positively related with eggs but inversely related with chicken/birds production. Though the inverse relationship between experience and chicken production was not expected albeit, the variable is not statistically significant at 0.05 alpha level.

Table 14: Linear Regression of the Influence of Microcredit on Farm Output

Regressors	Model 1: (Eggs)		Model 2: (Chicken)	
	Coef.	**Std. Err.**	**Coef.**	**Std. Err.**
Microcredit (1)	3.29	2,281	3,138***	1,099
Capital	0.02	0.06	0.01	0.02
Farm Size	3.26***	0.85	0.55**	0.27
Education	520**	247	281***	102
Machinery	3,337***	812	13.89	399
Experience	807**	357	-370*	214
Tech. Efficiency	90,757***	22,259	13,341***	5,147
_Cons	-93,111***	20,920	-13,487***	4,746
Adjusted R^2	**0.75**		**0.31**	
P-value	**0.00**		**0.00**	

Note: Alpha (α) level of significance 0.01 = ***, 0.05 = **, 0.1 = *

The implication of the result in Table 14 based on assumed signs means that microcredit improves the output of its users due to the positive relations. Also, an increase in working capital increases both eggs production and chicken production though the level of impact is insignificant. An increase in farm size by a bird also increases eggs production by approximately 3 crates per farmer per annum whilst increasing chicken production by approximately one bird (0.55). Again, production of eggs increases by 807 crates with an extra level of experience gained by a farmer whilst the inverse is the case for chicken. The difference can however be linked to the fact that experience counts more in the feeding and management of layers for eggs production than broilers for chicken production albeit the difference was not significant. Again, an additional year spent in school by a farmer increases production of eggs and chicken by 520 crates and 218 birds respectively. Machinery, (which also determines the level of technology adoption by a farmer), increases with both eggs and chicken production although it was only a significant factor for eggs production. This implies that an additional machine acquired increases eggs production by 3,337 crates. Technical efficiency was also significant in eggs production only which implies that a percentage increase in the technical efficiency of a farm increases egg production averagely by 90,757 crates and 13,341 birds per farmer per annum. Only working capital was however not significant at 5% alpha level in either models with the remaining variables proving significant in both or one of the models.

Table 15: Propensity Score Matching of Microcredit Effect on Output

Description	Eggs		Birds	
	Coef.	**Std. Err.**	**Coef.**	**Std. Err.**
Average Output of Matched **Treated**	38,338	2405	6,216	775.55
Average Output for the Matched **Control**	35,601	1647	4,310	307.21
Average Between Treated & Control **(ATE)**	**2,737****	7845	**1,906*****	272.25
Average impact due to MC **(ATET)**	**1,673****	23644	**1,440****	2232

Note: total number of observation: eggs = 94, birds = 100; microcredit receivers and non-receivers were 55 and 39 respectively for eggs and 61 and 39 respectively for birds. Alpha (α) level of significance 0.01 = ***, 0.05 = **, 0.1 = *

Result from Table 15 shows that microcredit is an essentially significant positive determinant of birds and eggs production hence we reject the null hypothesis. The positive impact considering both matched 'with and without' microcredit farmers as well as only matched 'with microcredit' farmers implies that on an average farmers 'with microcredit' produced 8% (2,737) crates of eggs and 44% (1,906) birds more than farmers 'without microcredit'. Again, considering only the treated, farmers with microcredit produced 5% (1,673) crates of eggs and of eggs and 33% (1,440) birds more than what they would have produced if they were not receiving microcredit (simulating based on the mean output of the controlled). This is what is termed as ***"Average Treatment Effect on the Treated" (ATET)*** in PSM and that is the exact impact of microcredit on borrowing farmers. It has also received much attention in impact analysis by researchers since normal regression model cannot not estimate this value. It is also worth noting that the impact of credit on bird production was larger than eggs though 79% of total production focused on layers rather than broiler birds or chicken production (refer to Figure 8) . Albeit, farmers with microcredit were able to produce broiler birds four times more than farmers without microcredit as indicated in Table 3. This was attributed to capital availability due to microcredit to the treated group compared to the control group hence the higher impact level of microcredit on birds' production.

5.9.3 Impact of Microcredit on Farm Income

Again, a linear regression model was used to determine the effects of the covariates (microcredit, capital, farm size, machinery, education and experience TE) on a farmer's income. The variable return to scale TE was however used for the PSM analysis and the results are illustrated below.

Table 16: Linear Regression of the Influence of Microcredit on Farm Income

	Model 1: With CRS TE		**Model 2: With VRS TE**	
Regressors	**Coef.**	**Std. Err.**	**Coef.**	**Std. Err.**
Microcredit	3329***	1389	3276**	1278
Capital	0.05	0.03	0.06**	0.03
Farm Size	0.75***	0.31	0.80***	0.29
Education	721***	123	560***	126
Machinery	1610***	425	1258***	1441
Experience	667***	188	754***	172
Tech. Efficiency	4034	4221	22314***	7755
_Cons	-8338***	3725	-25428***	7159
Adjusted R^2	**0.74**		**0.76**	
P-Value	**0.00**		**0.00**	

Note: Alpha (α) level of significance 0.01 = ***, 0.05 = **, 0.1 = *

On an a priori expectation of signs microcredit, capital, farm size, year spent in school, years of experience and TE were positively related with farm income. Again, Table 16 shows that the model is highly significant at 5% level of significance since the p-value (0.00) is lesser than 0.05. The null hypothesis is therefore rejected, implying that all the farm-specific factors (including microcredit) have important impact on farm income. The Adjusted R^2 (0.76) also indicates that up to 76% of variations in income is as a results of the variations in the aforementioned explanatory variables.

The result in Table 16 again shows that upon assumption of a VRS (model 2), an increase in the level of education of a farmer by a year, increases income by GH₵ 560 (USD 132) per annum. Also, a year of experience gained by a farmer increases farm income by GH₵ 754 (USD178) per annum. Also, an additional machine acquired by a farmer increases his or her income by GH₵ 1,258 (USD 297). The highest impacting factor however was technical efficiency. Thus a percentage increase in TE increases farm income by GH₵ 22,314 (USD 5,275) per annum ceteris paribus. Moreover, an increase in farm size by an additional bird only increases farm income by GH₵ 0.80. Using VRS TE estimates however provided higher relationships between farm income and the farm-specific factors than the CRS since the TE scores of the VRS were higher than the CRS. This is perhaps due the assumption of constant return to scale (CRS).

Table 17: Propensity Score Matching of Microcredit Effect on Farm Income

Description	Income	
	Coef.	**Std. Err.**
Average Income of Matched Treated	24,467	1056.24
Average Income of Matched Control	19,168	659.96
Average Impact between Treated and Control **(ATE)**	**5,299****	**826.04**
Average Impact on Treated due to Microcredit **(ATET)**	**6, 271*****	**1781.07**

Note: Number of observation = 100; microcredit receivers and non-receivers were 61 and 39 respectively. Alpha (α) level of significance 0.01 = ***, 0.05 = **, 0.1 = *

Table 17 also shows the impact of microcredit on farm income. Microcredit generally has a positive significant impact on farm income at 5% and 1% (for ATE and ATET respectively) as it had with output. We therefore again reject the null hypothesis by stating that microcredit positively impacts the income of farmers. Two conclusions can also be drawn from the results. First of all, considering only the matched treated group, farms with microcredit earns averagely 34% (GH₵ 6,271/USD 1,482.51) per annum more than what they would have earned if they were not receiving microcredit (simulating based on the average earnings of the matched control). Thus, the exact impact of microcredit on borrowing farmers. Secondly, taking into account both ‘with and without’ microcredit farmers, microcredit receiving farmers earn averagely 28% (GH₵ 5,299/USD 1,252.73) per annum more than their non-receiving counterparts. This can help boost production self-sufficiency and reduce poverty.

6.0 Discussion

The poultry sector is made of young and energetic labour force since both 'with and without' credit farmers were averagely 37 years. This is synonymous with the results of Magboul (2016) that there is high level of independence and economic activeness among people within the ages of 41 – 60 than those less than 20 or above 60 years. The average years spent in school (11) by farmers with credit also implies their higher ability to read, write, digest veterinary information and adoption of technology effectively, an assertion also held by Minde et al., (2008). The higher level of secondary and post-secondary or tertiary education attained by farmers (60%) out-weight's the general level of secondary and tertiary education attained by residents (10%) of the Municipality (GSS, 2014) which is a good indication for the sector. Again, farmers' independence from land owners means a high level of freedom of operation and land usage for the respondents.

Again, the results indicate that the borrowing farmers were medium scale producers (6,405 birds) whereas non-borrowing farmers where small scale producers (4,008 birds) – thus based on the commercial farms classification in Ghana: 50 – 5,000 = small scale; 5,000 – 10,000 birds = medium scale). The sector is also dominated by layer (eggs) production (80%) rather than broiler (meat) production (20%). This implies that medium scale farms in Ghana are into egg production than chicken production. This confirms earlier findings that small scale farms in Ghana are into broiler birds' production whilst medium scale farms are mainly into eggs production (Embassy of the Kingdom of the Netherlands, 2014). The average layer per capita for 'with and without' credit farmers (240 and 210 eggs respectively) is still short of the estimated global layer per capita (260 – 300 eggs) per annum (Poultry Hub, 2017). This implies that the sector is still averagely inefficient compared to the global standards and cannot be competitive if this trend is not reversed. One way to reduce this inefficiency is through a timely provision of MC to the farmers since MC reduces inefficiency (refer to Table 12).

Furthermore, to the farmers, their greatest source of encouragement to embark on poultry farming is the economic benefit (income) arising from it. The Ghanaian poultry sector is highly challenged and still falls short of global competitiveness yet, it is one of the lucrative sub-sectors if not the best under the agricultural sector. "As you can observe, majority of us have our own means of transport (either a car or motor bicycle) due to this business”, these were the exact words of a unanimous farmer during an interview with the researcher. Thus, poultry farming is a lucrative business with high source of economic returns if well managed, an assertion held by Jatto et al. (2012). Also the fame and high level of social status given to poultry farmers in the Municipality encouraged some of these farmers to join the sector. The poultry sector serves as a hub of employment and if audience is given to it the unemployment canker Ghana faces (especially with educated labour) could be reduced – thus supporting the assertion held by Khan and Ravichandran (2015) that the varied allied business of poultry production can develop as rural industry and can create numerous employment avenues. The high source of human food and the nutritive content of eggs and chicken was recognised as the third factor, thus supporting the findings of Khan and Ravichandran (2015) that eggs is not only nutritive but easily digest and can be put to diverse use.

Notwithstanding the benefits influencing the farmers to join, poultry farming has not been an easy playing field either. Concrete plans have not been put in place by successive governments/local government to end the plight of the poultry sector. Poultry farming is associated with staggering expenditure coupled with frequent cash required for the purchase of feed and drugs. The farmers are however deterred from the credit market due to the collateral requirements, bureaucratic application processes and the high rate of interest charged in the credit market in Ghana. It is therefore not surprising that inadequate capital was the topmost challenge of the respondents. This confirms the findings of Oppong-Anane (2005) and Kusi et al. (2015) that scarcity of credit coupled with the unfriendly conditions of the credit market in Ghana makes poultry farming unfriendly to investors. Again, the absence of processing and storage facilities coupled with high cost of feed, lack of required technology, cheap import of frozen chicken and lack of protective legislative instruments continue to increase the plight of poultry farmers in Ghana. High cost of production makes price of chicken (GH₵ 24 and GH₵ 15 for broiler and layer respectively) expensive than a fully dressed imported frozen chicken (GH₵ 12) confirming the findings of Kusi et al. (2015). This coupled with challenges faced by consumers in preparing a live chicken bought from a local producer due to lack of processing facilities force consumers to opt for imported frozen chicken. This then pushes the local producers out of the local market thereby selling to buyers from Côte d'Ivoire at a cheaper price. It is therefore not surprising that 68% of birds produced by the respondents were sold in Côte d'Ivoire. The risk adverse ones are also restricted to only eggs production due to its local market availability and ability to stay longer without proper storage facilities and producing birds only during festive periods (Easter and Christmas) when live birds are of high demand. These findings are also in line with the assertion of Kusi et al. (2015) that prudent legislative instruments should be enacted to protect the local poultry industry if the Government of Ghana so wishes to achieve the self-sufficiency it craves.

The paradigm shift to microcredit in agricultural financing has helped deepened accessibility albeit, some factors have to be addressed in order to make the microcredit market favourable to farmers. Most MFIs in the study area (5) do not offer agricultural loans but rather business loans to the farmers at about 40% per annum. The bureaucratic processes and the collateral requirements further deter the farmers from such loans. This pushes them further to interest sharks (money lenders) who swallow them up with a staggering 51% interest rate per annum (refer to Table 7). Top of it is the non-grace period, short repayment period and the poor collection modalities administered by the MFIs and money lenders during the collection of these credits. This therefore constraints the farmers hence defaulting the usual 12 months repayment period offered them by the MFIs thereby increasing their debt stock. This fully confirms the assertion of Kwakye (2010) that interest rates in Ghana remains stubbornly high and Oppong-Anane (2005) and Kusi et al. (2015) that high interest rates coupled with unachievable repayment schedules make loans unfriendly for poultry farmers to subscribe to credit. Some are forced to borrow from friends and family, take advance payments from customers leading to hedging agreements as well as plough back profit and personal savings which have unfortunately not been helpful.

Likewise, unlike the major reasons for their establishment (to provide smaller loans to the poor), Commercial MFIs in Ghana provide relatively large credits (GH₵ 10,000 – GH₵ 70,000) at relatively high average lending rate (40%) to average income earners. The only hope for the poor farmers for credit is the government initiative (MASLOC) mandated to provide smaller credit at relatively low interest rate, albeit credits provided by this initiative is limited in access. The poor cannot afford larger credits. What they need is some hundreds of Ghana Cedis or dollars as start-up or working capitals for their businesses. This leaves the core poor in the mouths of interest sharks (money lenders).

MFIs are therefore ignoring their core mandate in Ghana. This is synonymous with the assertion that the organisation of MC programmes practically excludes the core poor due to its requirements (Mosley, 2001; Kirkpatrick and Maimbo, 2002). It also confirms the assertion held by anti-microcredit crusaders that the sector cannot be relied on as a poverty reduction strategy (Cain, 2010; Bateman, 2011 and Khanom, 2014). It is therefore clear that microcredit has increased credit accessibility to poultry famers albeit, the poor peasant farmers are left out.

The probability of a poultry farmer taking microcredit is highly influenced by the asset base of the farmer (machinery, and land), farm size, level of education and experience as well as gender and savings status of the farmer. Though MFIs often opt for collateral substitutes in terms of group loans, the onset of individual borrowing into the microcredit market has forced the use of valuable assets from the borrower to protect the loan (collateral security). It is therefore not surprising that the probability of a farmer borrowing increases with an additional machine and land acquired. Land was however not a significant determinant of a farmer's propensity to borrow although it was positively related to borrowing. This can however be linked to the fact that MFIs in the area preferred the use of the poultry farms as a collateral rather than the lands which are highly illiquid. This results confirms the findings of Diagne and Zeller (2001) that the asset base of a smallholder farmer is a positive determinant of borrowing in Malawi. Furthermore, borrowing from an MFI reduces with an increase in farm size. The chances of a poultry farmer borrowing from formal banks at a relatively lower rate increase with an increase in farm size hence the farmer might substitute microcredit for a formal loan from commercial banks. To quote a unanimous large scale farmer during an interview, "imagine my farm taking a credit of GH₵ 800,000 from an MFI, what do you think will happen to such a financial institution? So I stopped taking their services because they cannot meet my demands not because of their services". This highly confirms the findings of Awunyo-vitor and Al-hassan (2014) and Kausar (2013) that access to microcredit however reduces with increase in farm size since larger farms might borrow from formal banks instead of the smaller loans of MFIs. It however contradicts the findings of Saqib et al. (2016) that access to formal and informal agricultural credit by a farmer increases with an increase in farm size. Again, the level of education and experience of a farmer is a positive determinant of the probability of a farmer taking microcredit. Higher level of education commensurate reading and seeking for information about credit terms and conditions. This therefore reduces the level of information asymmetry often occurring between MFIs and their clients. Better knowledge and understanding of the terms and conditions may however prompt a farmer to take microcredit. Also, "experience they say is the best teacher". Experienced farmers have better management knowledge and skills in managing their farms. This might inform them in conducting a cost-benefit analysis of a microcredit facility and if favourable increase their chances of borrowing. These confirm the findings of Magri (2007); Magboul (2016); Saqib et al. (2016) that the level of education and experience of a farmer is positively enhances his or her chances of accessing microcredit. It however contradicts an assertion by Barslund and Tarp (2008) cited in Magboul (2016) that money lenders advance credit based on trust and not the level of education attained by a client. The contradiction between this study and the former is that this study does not concentrates on only the informal credit market (money lenders). The inverse relationship between gender and the propensity to borrow signifies that female farmers are more likely to borrow than their male counterparts. Women are credit-worthy and risk averse than men. MFIs therefore consider female farmers as less risky lending clients with less default rate than men hence giving much credence to their demands (an assertion by the CEO of an MFI during an interview). Poverty credit initiatives such as MASLOC by GoG also gives peculiar attention to women than men since women are considered to be more vulnerable than men. Much audience should therefore be paid to poor women in agriculture if MFIs wants to be sustainable and help fight poverty simultaneously. This is also synonymous to the findings of Anang et al. (2015); Khalid (2003) in a study in Ghana and Tanzania respectively that gender is a significant determinant of access to credit and women are more likely to access credit than men. It however contradicts that of Awunyo-vitor and Al-hassan (2014) that being a female reduces your probability of accessing credit in Ghana . The micro-savings of a farmer is also positively related to his or her credit status. Often MFIs in Ghana use personal savings as a collateral alternative for microcredit hence the positive relationship between the probability of borrowing and savings.

Moreover, the study sought to establish as to whether the decision to take microcredit can influence the best combination of inputs (chicks, feed, labour and land) to achieve a higher output – eggs and birds (technical efficiency). To calculate the TEs the DEA model was used due to its ability to estimate technical efficiencies in a double output situation (for instance eggs and birds). From the technical inefficiency (TI) model (refer to Table 12), inefficiency effects were low for farms with microcredit, more labour, higher level of education, and experience as well as large working capital. This means that microcredit, together with the aforementioned factors contribute to agricultural performance thereby increasing output and this is synonymous with the findings of Hakim (2004); Wadud (2013); Ogolla (2016) that a timely provision of microcredit to peasant farmers contributes to a timely acquisition of inputs and production technologies by the farmers hence, increasing their efficiency. Also, educated and experienced farmers with MC are more likely to operate efficiently. On the contrary, inefficiency effects are lower for smaller farms. The implication is that small scale farmers are more efficient than medium scale farmers. This also means that TIs increases with an expansion of a farm. This was unexpected since the a priori expectation was that medium scale farms can easily afford technology hence will be more efficient than small scale farms. This can however be linked to the inability of the farmers to effectively manage their resources (inputs and outputs) while expansion occurs. This however contradicts the findings of Wadud (2013) that larger scale farmers adopts better technology hence more efficient than small scale farmers.

Furthermore, results from the PSM on the efficiency impact of microcredit proofed that microcredit highly impact the technical efficiencies of its users. From the model (refer to Table 13) a microcredit receiving farmer is 20% and 22% (CRS and VRS TEs respectively) more efficient than what it would have achieved in the absence of the microcredit intervention. This can increase both eggs and chicken production in the poultry sector thereby helping Ghana attain self-sufficiency. This again confirms the findings of Wadud (2013) that microcredit receiving farmers are technically more efficient than non-receiving farmers due to their ability to acquire the required technology with the credit received. Notwithstanding, there is vast room for improvement since the 81% and 85% (CRS and VRS) average TEs o the combined farmer groups implies that farmers have to cut wasteful expenses by 19% and 15% respectively before they can be totally/perfectly efficient

Additionally, the propensity score matching (PSM) technique and linear regression were again adopted to estimate the impact of MC on output. Output here was measured by the number of birds and crates of eggs produced by a farmer. On the basis of this a linear regression was used to establish the relationship between some output improving factors including MC and output. From the results, (refer to Table 14), MC was a significant determinant of bird (chicken) production but insignificant for egg production although it positively relates to both eggs and birds production. This implies that MC has a substantial positive impact on chicken production which is the topmost priority of Ghana. This means that Ghana can reduce frozen chicken importation if much heed is paid to the provision of smaller loans to the small and medium scale poultry farmers. An expansion in farm size by a bird also increases egg production as anticipated. The magnitude of increase (3 crates = 90 pieces) per bird can however help the farmers with MC to be more efficient in production – thus, closing the gap between their current layer per capita (240 eggs) and the global minimum layer per capita (260 eggs) per annum in order to be competitive. Likewise egg production increases with higher farming experience while reducing with chicken production. This is because experience is highly required in feed application for higher yields in egg production than chicken (birds) production. Again, experienced farmers might be more risk adverse and opt for egg production due to the absence of available local market and storage facilities for the meat. Moreover, higher level of education and large farm size contributed to higher eggs and birds production as expected. Additionally, the acquisition of an additional machine increases both eggs and chicken production. This is because high use of machinery means high adoption of technology which can improve the TEs of farmers. It was therefore not surprising that the TE (VRS) of a specific farm was positively related to its output which also implies that farms with MC and for that matter higher efficiencies are more productive and vice versa. This trend if sustained can help achieve self-sufficiency. This also confirms the findings of Ogolla (2016) that technical efficiency level is a vital determinant of total output.

On the exact impact of microcredit on the output of borrowing farmers, the study revealed that farmers with MC produced 8% and 44% (crates of eggs and birds respectively) more than their matched non-borrowing counterparts. Again, a borrowing farmer produced 5% and 33% (crates of eggs and birds respectively) more than what they would have produced if they were not receiving credit. The latter is however the exact impact of microcredit on its users. The higher impact on chicken/birds production can however be linked to the fact that borrowing farmers produced broiler birds quarterly (4 times)per farming season for the Ivorian market instead of the usual production during Christmas and Easter where live birds are of high demand in Ghana due to the capital available to them as a result of MC. This means that microcredit has a higher level of impact on bird production than egg production. The implication is that if appropriate laws are enacted to protect the local poultry industry, processing facilities are provided and the necessary credit support is provided Ghana can achieve the self-sufficiency it craves. This harmonizes with the findings of Siddiqi and Baluch (2009); Ahmed et al. (2011); Saleem and Farzand (2011); Girabi and Mwakaje (2013) and Wadud (2013) that a timely provision of credit to smallholder farmers increases their access to improved inputs and technology thereby increasing their output. It however contradicts that of Adebayo and Adeola (2008); Nosiru (2010) and Khan et al. (2013) that the higher rate of interest charged by MFIs makes microcredit a meek determinant of higher agricultural output.

Again, the same approaches (linear regression and PSM) were adopted in estimating the impact of MC and some farm specific factors (refer to Table 16) on farm income. The study revealed that farmers with large working capital and farm size, high TE and machinery as well as experienced and highly educated owners earn higher incomes than their opposite counterparts ceteris paribus. The highest influencing factor on income like output was TE. These results harmonizes with the findings of Kiiru (2007); Bolarinwa and Fakoya (2011) and Ogolla (2016) that credit has a positive impact on both household and farm income in their respective studies. Albeit, assuming VRS rather produced higher impact on income than CRS. This can however be linked to the assumption of a CRS placed on the combination of variable inputs by the CRS TE. The CRS TE assumes that at any point in time, a combination of production inputs yields a proportionate outcome of that input combination, ceteris paribus. This assumption however does not hold in the poultry sector, especially in egg production as output varies over time. Thus production increases with an increasing proportion in the quantity and quality of feeding but diminishes after a certain point of maturity of the birds.

Also, on the exact impact of MC on the income of borrowers, borrowing farms earned averagely 28% (GH₵ 5,299/USD 1,253) per annum more than their matched non-borrowing counterparts while earning averagely 34% (GH₵ 6271.00/USD 1,483) more than what they would have earned if they were not receiving MC. This again confirms the findings of Wadud (2013) who also used a similar method in analysing the impact of microcredit on farm performance and food security in Bangladesh. His findings state that microcredit receiving farms on an average earns higher than non-receiving farms. This therefore implies that MC has a huge impact on the TE efficiencies of poultry farms, farm output and subsequently farm income.

The decision to take MC by farmers can significantly influence their TEs in the production of eggs and chicken. This will also enhance their output and subsequently increase their income. This process tends to be cyclical if maintained. With the microeconomic notion that savings is percentage of income and that whatever is saved is invested (savings = investment), microcredit receiving farmers are expected to plough back a proportion of their income into farm investment. This will lead to an expansion of these smaller farms and subsequently higher supply of poultry products into the local market. If the expansion and subsequent increase in production and supply are maintained and the necessary policies and infrastructures are provided, Ghana will be sustainably self-sufficient as well as food secured and might cease the importation of frozen chicken which has a serious implications on the trade balance, balance of payment, exchange rate and the general performance of the Ghanaian economy.

The study therefore recommends that appropriate legislative instrument should be enacted to protect an infant industry like the poultry sector in Ghana. Again, appropriate investments should be made towards the construction of poultry processing and storage facilities to reduce the production and post-harvest losses of the farmers. This can also reverse the situation of farmers opting to sell their produce in Côte d'Ivoire rather than the local Ghanaian market. Efforts should also be geared toward providing appropriate veterinary services as well as completing the abandoned poultry laboratory in the study area to support the farmers. Furthermore, strict regulation of MFIs should be ensure in order to reduce the frequent bankruptcies of MFIs which affect the smaller savings of peasant farmers. Also, the Ghana Microfinance Network (GHAMFIN) together with Bank of Ghana should ensure that MFIs do not charge exorbitant rates. MFIs should also consider providing agricultural loans with grace period rather than the usual commercial loans to reduce the burden of the farmers. Commercial banks (especially the Agricultural Development Bank) should also increase access to loans by both small and medium scale farmers. Again, GoG through the MASLOC initiative should expand credit access since it is the borrowing source for peasant farmers. Women should also be targeted more by MFIs if they want to reduce their credit default rates and poverty simultaneously. Lastly, further studies can also be conducted in the marketing and distribution of the poultry products since much has not been done in that area.

Limitations of the Study

The study encountered three major setbacks. First of all, the poor records keeping of farmers made it difficult in accessing quantitative data. Secondly, the respondents were unwilling to produce their actual annual incomes to the researcher since their perception was that it could open doors for them to pay higher taxes. Lastly, it was difficult getting time from the respondents during the morning and afternoon hours as they were often busy with the feeding, eggs collection and distribution. To minimize these constraints, farmers were contacted prior before the questionnaire administration to schedule the appropriate meeting time. Again, the researcher had to calculate with the farmers numerical records of their farms on monthly basis instead of yearly bases to ensure data accuracy which consumed a lot of time in the data collection. Also, we strategically asked for expenditures and the output sold and their respective prices to determine the gross margins of the farmers which were used as proxies for their incomes.

Methodologically, the DEA model due to its non-parametric nature cannot estimate an error noise or error of measurement hence attributing the differences between the TE of a farm unit to its TIs. Again, the complexity surrounding the estimation of the standard error and the statistical test of significance of treatment effect in PSM is a weakness in the specified model used for this study. The researcher tying to minimize these shortcomings adopted different model (the inefficiency and the linear regression) to test the same result which in this study proved similar.

7.0 Conclusion

This study aimed to assess the impact of microcredit on the performance of poultry farming its effect on sustainable self-sufficiency and food security. We employed the Probit Model, Data Envelopment Analysis (DEA), and Propensity Score Matching (PSM) approaches to analyse the propensity of a farmer to take microcredit, the impact of the microcredit taken on production efficiency, farm output, farm income and subsequently sustainable self-sufficiency.

The propensity of a farmer to take microcredit was however highly influenced by their assets base (machinery and land) farm size, years spent in school, experience and age as well as his or her gender and savings status. The study also revealed that whereas farmers with higher savings, years of schooling and experience as well as farmers with more capital, farm land, machinery and female farmers are more likely to take microcredit, older and large scale farmers are less likely to take microcredit. Albeit, there is vast room for improvement since the higher interest charges coupled with short repayment period, lack of trust, poor collection modalities, bureaucratic application processes and information asymmetry constraints farmers from active participation in the microcredit market.

Again, we employed the technical inefficiency (TI) effects model for the output of the DEA model. The role of the TI model was to establish the effect of some farm-specific factors – thus, capital, labour, farm size, years spent in school and experience as well as microcredit on farm efficiency. The results however revealed that microcredit, capital, number of employees, level of education and experience help to reduce inefficiencies in poultry production. Also, the technical efficiencies of the joint farmer groups (treated and control) ranges between 22% – 100% with an average efficiencies of 81% and 85% (CRS and VRS respectively) for all farms. The average efficiencies of farmers with microcredit using the PSM were however 82% and 85% (for CRS and VRS respectively). However, the average efficiencies of farms without microcredit were 69% and 71% (for CRS and VRS respectively). This implies that farmers with microcredit were 13% and 14% more efficient than farmers without credit considering both CRS and VRS. Farmers with microcredit were however able to improve their TEs by 20% and 22% (CRS and VRS respectively) due to the microcredit intervention. This can subsequently improve eggs and chicken supply and subsequently contribute to sustainable self-sufficiency.

Furthermore, results from the Propensity Score Matching technique revealed that microcredit by improving farm efficiency, increases both eggs and birds production by 5% (1,673) and 33% (1,440) respectively and as such farmers with credit produced 8% (2,737) eggs and 44% (1,906) birds more than their non-microcredit receiving counterparts. The study again revealed that through microcredit farmers are able to produce broiler birds frequently for chicken meat than their non-borrowing counterparts. Furthermore, the propensity score matching technique also revealed that microcredit is a significant positive determinant of farm income and that farmers with microcredit on an average earns the dollar equivalence of USD 1,483 (GH₵ 6,271) more due to microcredit intervention while earning 28% (GH₵ 5,299/USD 1,253) more than farmers without microcredit. This additional income would go a long way to reduce poverty in Ghana. The study based on these findings therefore conclude that a synergy of a fair and timely delivery of soft and low-cost credit to small and medium scale poultry farmers could reduce technical inefficiencies in production thereby improving their technical efficiencies. This could enhance eggs and chicken production, increase income and subsequently help Ghana to be sustainably self-sufficient and food secured in eggs and chicken production, supply and consumption.

8.0 References

Addae-Korankye A. 2012. Microfinance: A tool for poverty reduction?. Journal of Business and Retail Management Research 7:138–150.

Adebayo OO, and Adeola RG. 2008. Sources and uses of agricultural credit by small scale farmers in Surulere Local government area of Oyo State. Anthropologist 10:313–314.

Ahmed F, Chamhuri S, Nor Aini HI, Rawshan AB. 2011. Impact of microcredit on poverty alleviation among rural women: A case study of panchagarh District in Bangladesh. 5:7111–7119.

Ahmed H. 2002. Financing Microenterprises: An analytical study of Islamic Microfinance Institutions. Islamic Economic Studies 9:27–64.

Ahsan AHM. 2005. Role of NGO's micro-credit programmes in poverty reduction in Bangladesh: A Study on some selected NGOs. Journal of Social Sciences 3: 1053–1059.

Ali MH. 2008. Evaluation of microcredit operation in Bangladesh: A critical study on Grameen Bank. Pakistan Journal of Social Sciences 5:960–967.

Anang BT, Sipiläinen T, Bäckman S, and Kola J. 2015. Factors influencing smallholder farmers access to agricultural microcredit in Northern Ghana. African Journal of Agricultural Research 10:2460–2469.

Ashraf N, Karlan D, Yin W. 2010. Female Empowerment: impact of a commitment savings product in the Philippines. World Development 38:333–344.

Atuahene CC, Attoh-Kotoku V, Mensah JJ. 2010. Poultry production in Ghana: prospects and challenges. Ghanaian Journal of Animal Science 5: 93–99.

Atuahene CC, Atuahene AJ, Adjei MB, Donkor E. 2014. The perception and preference of consumers for local poultry meat in the Kumasi metropolis of Ghana. Ghana Journal of Agricultural Science 47: 31-38.

Awunyo-vitor D, Ramatu MA. 2014. Drivers of demand for formal financial services by farmers in Ghana. 4:261–268.

Banson EK, Muthusamy G, Kondo E. 2015. The import substituted poultry industry; evidence from Ghana. International Journal of Agriculture and Forestry 5:166–175.

Barnes C, Gary G, Kibombo R. 2001. The impact of three Microfinance programs in Uganda. Available at http://www.mendeley.com/catalog/impact-three-microfinance-programs-uganda/: accessed 2016-09-21.

Barnes C, Keogh E, Nemarundwe N. 2001. Microfinance program clients and impact: An assessment of Zambuko Trust, Zimbabwe 17:298–309.

Barslund M, Tarp F. 2008. Formal and informal rural credit in four provinces of Vietnam. Journal of Development Studies 44: 485-503.

Bateman M. 2011. Microfinance as a development and poverty reduction policy: is it everything it's cracked up to be? Overseas Development Institute (ODI) background notes.

Bhutt N, Tang SY. 2001. Delivering Microfinance in developing countries: Controversies and policy perspectives. Policy Studies Journal 29:319–333.

Bihoctavia T. 2013. Credit Accessibility and Utilisation : The micro and small-scale entrepreneurs' experience in Uganda [MSc]. Wageningen: Wageningen University. 48p.

Boateng GO, Boateng AA, Bampoe HS. 2015. Microfinance and poverty reduction in Ghana: Evidence from policy Beneficiaries. Review of Business and Finance Studies 6:99–108.

BoG. 2007. A note on Microfinance in Ghana. Working paper. Available at https://www.bog.gov.gh/: accessed on 2016-07-25.

BoG. 2008. Banking Acts of Ghana. Aavailable at https://www.bog.gov.gh/banking/banking-acts: accessed 2016-06-17.

BoG. 2015. Press briefing on DKM Microfinance. Available at https://www.bog.gov.gh/: accessed 2017-02-01.

BoG. 2016. Register of lincensed Institutions. Available at https://www.bog.gov.gh/: accessed on 2016-09-13.

Bogdan RC, Biklen SK. 2007. Qualitative research for education: An introductory to theory and methods. 5th Edition. Needham Heights, MA: Allyn and Bacon. 315p.

Bolarinwa KK, Fakoya EO. 2011. Impact of farm credit on farmers socio-economic status in Ogun State, Nigeria. Money 26:67–71.

Brown IAK. 2011. Assessment of credit analysis models in microfinance delivery in Ghana: The case of selected Microfinance Institutions (MFIs) [MBA]. Kumasi: Kwame Nkrumah University of Science and Technology, 83p.

Cain P. 2010. Microfinance meltdown in Bosnia, Al Jazeera Focus, January 4th. Available at http://www.aljazeera.com/focus/2010/01/20101393659573655: accessed 2017-03-13.

Caliendo M, Kopeinig S. 2008. Some practical guidance for the implementation of Propensity Score Matching. Journal of Economic Surveys 22:31–72.

Caliendo M, Kopeinig S. 2005. Some Practical Guidance for the Implementation of Propensity Score Matching. Discussion Paper No. 1588.

Chakravarty S, Shahriar AZ. 2010. Relationship lending in microcredit: Evidence from Bangladesh. Mimeo 1: 1–42.

Coetzee G. 2012. Towards financial inclusion with branchless banking: From Microfinance to financial inclusion in Africa. IDC Conference presentation paper. Sandton: South Africa. 22–23.

Crook J. 2001. The demand for household debt in the USA: Evidence from the 1995 survey of consumer finance. Applied Financial Economics 11:83–91.

Delfiner M, Perón S. 2008. Commercial banks and Microfinance. MPRA. e10229.

Diagne A, Zeller M. 2001. Access to credit and its impact on welfare in Malawi. Research Report 116 International Food Policy Research Institute.

Diaz-Serrano L, Sackey FG. 2015. Is rationing in the Microfinance sector determined by the Microfinance type? Evidence from Ghana. Discussion paper No. 8999.

Duman A. 2009. Access to Credit: Microenterprises in Turkey. Working paper No. 09/05.

Duy VQ. 2012. Determinants of household access to formal credit in the rural rreas of the

Mekong Delta, Vietnam. MPRA Paper 1: e38202.

Effah DA, Herring DR. 2005. Microfinance support to rural women farmers in Ghana: A case study of Ga District of the Greater Accra Region, Ghana. Proceedings of 21st Annual Conference, Sam Antonio, Texas.

Embassy of the Kingdom of the Netherlands. 2014. Analysis Poultry Sector Ghana: An Inquiry of Opportunities and Challenges.

Emrouznejad A. 2016. Data Envelopment Analysis. Available at http://deazone.com/en/resources/tutorial/graphical-representation: accessed 2017-04-10.

FAO. 2014. The Poultry Sector of Ghana. FAO Animal Production and Health Livestock Country Reviews. Available at http://www.fao.org/accessed 2016-06-15

Fernando JL. 2006b. Microcredit and empowerment of women: Visibility without power. In Microfinance: Perils and Prospect. New York: Routledge, p 187-237.

Flake L, Ashitey E. 2008. Ghana's poultry and products Annual Report. USDA Foreign Agriculture Services GAIN Report. Available at https://apps.fas.usda.gov/: accessed 2016-12-04.

Franklin B. 2014. Don't charge high interest rates - Microfinance companies advised, Graphic Online. Available at http://www.graphic.com.gh/business/business-news/don-t-charge-high-interest-rates-microfinance-companies-advised.html: accessed 2017-01-02.

Geer JG. 1991. Do open-ended questions measure "salient" issues?. Public Opin 55: 360–370.

Girabi F, Mwakaje AEG. 2013. Impact of Microfinance on smallholder farm productivity in Tanzania: The case of Iramba District. Asian Economic and Financial Review 3:227–242.

Glasow PA. 2005. Fundamentals of Survey Research Methodology.

Gokhale K. 2009. As Microfinance grows in India, so do its rivals. Wall Street Journal 15:A17.

Gosh J. 2013. Microfinance and the challenge of financial inclusion for development Cambridge Journal of Economics 37: 1203-1219.

Gutiérrez-Nietoa B, Serrano-Cincaa C, Molinero CM. 2006. Microfinance Institutions and Efficiency. Omega 35:131–142.

Hakim MA. 2004. Microcredit and agriculture: How to make it work. Presented at the Asia Pacific Region Microcredit Summit Meeting of Councils (APRMS), Dhaka: Feb. 16-19.

Hanlon B, Larget B. 2011. Sex and older women samples and populations the scientific literature. Statistics Wisconsin University Journal 8:1–6.

Helms B, Reille X. 2004. Interest rate ceilings and Microfinance: The story so far.

Hoffmann D, Mack S, Otte J. 2005. The contribution of poultry to rural development. World's Poultry Science Journal 61: 7-14.

Islam A, Maitra P. 2012. Health shocks and consumption smoothing in rural households: Does microcredit have a role to play? Journal of Development Economics 97:232–243.

Jamadar, Naseer. 2012. Role of Grameen Bank Microcredit programme in poverty reduction. 87–100.

Jatto NA, Maikasuwa MA, Kyiogwom UB, Muhammad I. 2012. Evaluating the factors influencing poultry farmers participation in egg production: A binary logit regression Model. European Scientific Journal 8:125–134.

Javed SM, Hassan S, Adil SA, Ahmad SA, Chattah MWA, Nawaz Z. 2006. Impact assessment of Micro-credit programme of PRSP on crop productivity. Agricultural Economics 43:209–212.

Karlan DS, Zinman J. 2008. Credit elasticities in Less-Developed economies: Implications for Microfinance. American Economic Review 98:1040–1068.

Kausar A. 2013. Factors affect microcredit's demand in Pakistan. International Journal of Academic Research in Accounting, Finance and Management Sciences 3:11–17.

Khalid M. 2003. Access to formal and quasi-formal credit by smallholder farmers and artisanal fishermen: A case of Zanzibar. Dar es Salaam: Research on Poverty Alleviation. 43p.

Khan A, Ravichandran P. 2015. A study on influencing factors to affect the economic status of layer poultry farmers in Namakkal District of Tamilnadu. International Journal of Economics and Management Sciences 4: 1–7.

Khan MN, Khan M, Saqib SA, Saqib A, Murad A, Sobia N. 2013. The effect of Zarai Taraqiati Bank in enhacing farm productivity through agricultural credit - A case study of District Lakki Marwat , KPK-Pakistan. Journal of Agriculture and Forestry Sciences 1: 1–4.

Khandker SR. 1998. Fighting Poverty with Microcredit: Experience in Bangladesh. New York: Oxford University Press. 228p.

Khanom NA. 2014. Rural Micro Credit (RMC) and poverty alleviation : The case of the PKSF in Bangladesh Khanom. 10:115–136.

Kiiru JMM, The impact of Microfinance on rural poor households' income and vulnerability poverty: Case study of Makueni District, Kenya [Dr. agr.]. Bonn: Rheinische Friedrich-Wilhelms-University, Bonn. 127p.

Kirkpatrick C, Maimbo SM. 2002. The implications of the evolving Microfinance agenda for regulatory and supervisory policy. Development Policy Review 20:293–304.

Kusi LY, Agbeblewu S, Anim IK, Nyarku MK. 2015. The challenges and prospects of the commercial poultry industry in Ghana : A synthesis of literature. International Journal of Management Sciences 5:476–489.

Kusi LY, Asabre P, Kosi I, Nyarku MK. 2015. The challenges and prospects of poultry farmers: The case of Dormaa Ahenkro Municipal Area. 2:214–224.

Kwakye J. K. 2010. High interest rates in Ghana, a critical analysis. The Institute of Economic Affairs (IEA), Ghana.

Latif MA. 2001. Microcredit and Savings of Rural Households in Bangladesh. Bangladesh Development Studies 27: 51–71.

Ledgerwood J. 1999. Microfinance Handbook: An Institutional and Financial Perspective. Washinton D. C: The World Bank. 304p.

Leedy PD. 2014. Practical Research: Planning and Design. London: Pearson Education Limited. 381p.

Mabhungu I, Masamha B, Mhazo S, Jaravaza D. 2011. Factors influencing micro and small enterprises ' access to finance since the adoption of multi-currency system in Zimbabwe. Journal of Business 2:217–22.

Magboul A. 2016. Determinants of demand for and supply of credit to small-scale enterprises and performance of formal microcredit markets in Sudan [PhD]. Pretoria: University of Pretoria. 141p

Magri S. 2007. Italian households' debt: The participation to the debt market and the size of the loan'. Empirical Economics 33:401–426.

Marr A. 2003. A challenge to the orthodoxy concerning Microfinance and poverty reduction'. Journal of Microfinance/ESR Review 5:7–42.

Mbangani D. 2016. Development Analysis of Market Parameters for Groundnuts in Mazowe District, Zimbabwe [MSc.]. Prague: Czech University of Life Sciences Prague. 55p.

Mersland R, D'Espallier B, Guérin I. 2009. Women and repayment in Microfinance. Working paper 1:1–37.

Messah OB, Wangi PN. 2011. Factors that influence the demand for credit among small scale investors: A case study of Meru Central District, Kenya. Research Journal of Finance and Accounting, 2: 2222–2847.

Minde M, Madzonga O, Kanthiti G, Phiri K, Pedzisa T. 2008. Constraints, Challenges and Opportunities in Groundnuts Production and Marketing in Malawi. Report No 4, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), 1–53p.

MoF. 2017. The Budget Statement of the Government of Ghana for the 2017 financial year. Available at http://www.mofep.gov.gh/: accessed 2017-03-31.

MoFA. 2011. Agriculture in Ghana: Facts and figures. Accra, Ghana: Statistics, Research, and Information Directorate (2010). Available at http://mofa.gov.gh/: accessed 2016-12-26

MoFEP-Ghana. 2015. General background on global Microfinance trends. Available at http://www.mofep.gov.gh/: accessed 2016-12-22.

Mosley P. 2001. Microfinance and poverty in Bolivia. The Journal of Development Studies 37:101–132.

Nanor MA. 2008. Microfinance and its impact on selected Districts in Eastern Region of Ghana [MPhil]. Kumasi: Kwame Nkrumah University of Technology. 173p.

Navajas S, Schreiner M, Meyer RL, Gonzalez-vega C, Rodriguez-meza J. 2000. Microcredit and the poorest of the poor: Theory and evidence from Bolivia. World Development 28: 333–346.

Nosiru MO. 2010. Microcredits and agricultural productivity in Ogun State, Nigeria. World Journal of Agricultural Sciences 6:290–296.

Nuhu E, Inusah A, Gasu RA, Sano MZ. 2014. Impact analysis of Microfinance on crop production in Ghana. International Journal of Academic Research in Accounting, Finance and Management Sciences 4:109–118.

Ogolla MA. 2016. Factors influencing poultry production among poultry parmers in Eldoret Town, Uasin Gishu County, Kenya [MA]. Nairobi: University of Nairobi. 77p.

Ololade RA, Olagunju FI. 2013. Determinants of access to credit among rural farmers in Oyo State, Nigeria. Global Journal of Science Frontier Research Agriculture and Veterinary Sciences 13: 1–6.

Oppong-Anane K. 2005. Livestock and poultry production in Ghana: Constraints and improvement strategies. Proceedings of the 14th Biennial Conference of GSAP, held 31st August – 3rd September, 2005 in Tamale: 85–89.

Poultry Hub. 2017. Chicken egg (layer) industry. Available at http://www.poultryhub.org/: accessed 2017-03-08

Pufahl A, Weiss CR. 2008. Evaluating the effects of farm programs: Results from propensity score matching. 12th Congress of the European Association of Agricultural Economists-EAAE 2008 1: 1–11.

Rahji M A Y, Fakayode SB. 2009. A Multinomial Logit Analysis of agricultural credit rationing by commercial banks in Nigeria. International Research Journal of Finance and Economics 1: 90–100.

Rooyen VN, Stewart R, Wet DT. 2012. The impact of Microfinance in Sub-Saharan Africa: A systematic review of the evidence. World Development 40: 2249–2262.

Saleem AM, Farzand AJ. 2011. The impact of agricultural credit on agricultural productivity in Dera Ismail Khan (District) Khyber Pakhtonkhawa Pakistan. European Journal of Business and Management 1905:2222–2839.

Saqib SE, Mokbul MA, Sanaullah P. 2016. Landholding size and farmers' access to credit and its utilisation in Pakistan. Development in Practice 26:1060–1071.

Schreiner M, Colombet HH. 2001. From urban to rural: Lessons for Microfinance from Argentina. Development policy Review 19: 339–354.

Scully N. 2004. Microcredit no panacea for poor women. Global Development Research Centre. Available at http://www.gdrc.org/icm/wind/micro.html: accessed 2017-02-09.

Sekyi S, Nkegbe PK, Kunnibe N. 2014. Participation in the credit market by small scale enterprises in Ghana: Evidence from Wa Municipality. African Journal of Business Management 8:292–299.

Shastri KR. 2009. Micro finance and poverty reduction in India (A comparative study with Asian countries). African Journal of Business Management 3:136–140.

Siddiqi MW, Baluch KN. 2009. Institutional credit: A policy tool for enhancement of agricultural income of Pakistan. International Research Journal of Arts & Humanities 37:157–174.

Sossou CH, Noma F, Yabi JA. 2014. Rural credit and farms efficiency : Modelling farmers credit allocation decisions, Evidences from Benin. Economics Research International 2014: 1–8.

Taha SGA. 2012. The effectiveness of Microcredit programmes on alleviating poverty and empowering women in Cairo, Egypt [MSc.]. Cairo: University of Agder. 82p.

Togba EL. 2009. Microfinance, social capital and households access to credit: Evidence from Côte d'Ivoire'. 7th International Conference: GLOBELICS. Available at

Tung PBV. 2010. Technical efficiency of improved extensive shrimp farming in Ca Mau Province, Vietnam [MSc.]. Tromsø: University of Tromsø, Norway. 73p.

USDA. 2017. 2016 Poultry and Products Annual Report. Poultry and Products Annual - Ghana. Available at https://www.usda.gov/: accessed 2017-03-05

Wadud A. 2013. Impact of microcredit on agricultural farm performance and food security in Bangladesh. Working Paper No. 14.

Waterfield C. 2008. Explanation of Compartamos interest rates. Version 1:1–13.

Weible D, Pelikan J. 2016. Imported chicken meat in Ghana: A threat for domestic producers and a blessing for consumers? Available at https://www.gtap.agecon.purdue.edu/: accessed 2017-01-12

Yeboah C. 2015. Internal migration, remittances and welfare impacts: A case study in Dormaa Municipality, Ghana [MA]. Cape Town. University of the Western Cape. 89p.

Zaman H. 1999. Assessing the poverty and vulnerability impact of Micro-Credit in Bangladesh: A Case Study of BRAC. Policy Research Working Paper 2145.

Zeller M, Sharma M. 1998. Rural finance and poverty alleviation. Food Policy Report.

Zuberi HA. 1989. Production function, institutional credit and agricultural development in Pakistan. The Pakistan Development Review 28: 43

Appendices

Appendix 1: Questionnaire for Poultry Farmers

Introductory Remarks
This is an instrument for data collection on microcredit and poultry production in the Dormaa Municipality as part of a survey being conducted to fulfil an academic requirement for a Master's degree. The researcher is **Sylvester Amoako Agyemang** a student of Czech University of Life Sciences pursuing his Masters in International Development and Agricultural Economics under the Faculty of Tropical AgriScience. The main goal of the study is to determine the impact of microcredit on productivity efficiency, output and income and as such its role in poverty reduction and national self-sufficiency in poultry production. Information provided will be distinctly confidential and participation is voluntary. The interview will last for approximately 30 minutes and the respondents are kindly requested to provide honest and authentic answers.

Section 1

Questionnaire Number			
Community			
Enumerator Name			
Respondent's Name			
Date		**Time**	

Section 2: Demographic Characteristics of Farmer

Description	***Answers***
Sex	1 – Male 2 – Female
Age	
Marital Status	1 – Married 2 – Divorced 3 – Separated 4 – Widow/er 5 – Single
Household size	
Literacy	1 – Literate 2 – Illiterate
Number of years spent in school	
Main Income source	1- poultry farming 2- Crop/Vegetable gardening 3- Livestock rearing 4- Fishing 5- Pension 6- Remittance 7- Formal employment 8-Casual employment 9-Business 10- Other (Specify) ……………………………………...
Other source(s) of income	1) ……………………………………………… …….. 2) ……………………………………………… …….. 3) ……………………………………………… ……..

	4) ………………………………………………… ……..

Section 3: Poultry Production

Farm Inputs *(write in figures)*		
Total Land size		
Total land used for farming		
Land used for poultry production	No…………………………	Hired (Rent): Owned:
Value of land used for poultry production		
Total number of employees	No…………………………	Hired labour: Family labour:
Total working capital		GHC………………………………………
Total number of machinery		Hired: Owned:
Please provide a list of all the machineries		1) ………………………….. 2) ………………………….. 3) ………………………….. 4) …………………………… 5) …………………………… 6) ……………………………
Farm Equipment & Buildings		Hired: No…………… GHC………… Owned:

		Modernity	Size
Please provide a list all the equipment & buildings and indicates whether its modernity as well as its size *(Please use the codes provided below)*	1) Buildings ………………	[ ]	[ ]
	2) Feeders…………………	[ ]	[ ]
	3) Drinkers………………..	[ ]	[ ]
	4) Wheelbarrow…………..	[ ]	[ ]
	5) Shovel…………………..	[ ]	[ ]
	6) Water Reservoir………..	[ ]	[ ]
	7) …………………………	[ ]	[ ]
		[ ]	[ ]

Number of day-old chicks (poultry) used per annum:		
How long (years) have you been in poultry farming?		
Total number of birds (currently)	No. ………….	Chicks ……………………………… Broilers …………………………….. Layers ………………………………

Total number of birds produced	No…………………………………
How many birds have you sold for the past one year?	Broilers….. Layers…...
How much is the price of a bird?	Broilers GHC.................................. Layers GHC....................................
Total number of eggs produced per month/year	No………………………………...
Creates of eggs sold for the past one year	No…………………………………
How much is the price of a 'create'?	
Total sales from birds per annum	
Total sales from eggs per annum	
Estimated income per annum	
Why do you **farm** poultry? *Rank in order of importance; 1=Most important*	
Reasons, Rank 1- Source of income [ ] 3- Food security [ ] 5- Others (specify) 2- Social status [ ] 4- Jobs creation [ ] ..……………...	
Modernity Codes 1- New/Modern 2- Old	***Size Codes*** 1- Small 2- Medium 3- Big
Challenges of poultry production? *Rank in order of importance; 1=Most Challenging*	
1- Lack/low level of technology in production [ ] 2- High competition faced from cheap imports [ ] 3- Inadequate capital/credit [ ] 4- High energy prices [ ] 5- High cost of inputs such as feed [ ] 6- Poor quality of day-old birds/chicks [ ] 7- Absence of good government policies and legislative instruments [ ] 8- Absence of available local market [ ] 9- Lack of processing and storage facilities [ ]	

Please try to estimate your expenditure of production for the farming season/year using the following guide

Inputs	Source of input *(Use Codes)*	Quantity	Unit Cost (GHC)	Total Cost (GHC)

Day old chicks/birds				
Poultry feed				
Labour				
Services (Specify)				
Veterinary				
Repairs				
Maintenance				
………………………				
………………………				
Drugs (Specify)				
De-wormer				
Vitamins				
Cocxi				
Newcastle				
Disinfectant				
Glucose				
Energy				
Fuel				
Electricity				
Other Cost				
………………………				
………………………				
………………………				
………………………				
Total				

Where/to whom do you sell your birds and eggs?...

How much do you pay for Hired labour? GHC…………………………..per hour/head

How much do you pay in rent for hired land *(if applicable)?* GHC.................................per year.

Section 4: Microcredit/MF and Poultry Production

Do you take microcredit?	1- Yes 2- No
For Microcredit Clients	
If yes, from what source?	1- Formal a) Rural/Community Banks b) Savings & Loans c) Lending Firms d) Co-Operative Credit Unions e) MASLOC 2- Informal a) Money lenders b) Susu Collectors
For how long?	…………………………..years

Please indicate the amount taken in credit	GHC……………....monthly/quarterly/semi-annually/annually/others (specify)…………..
Please name MFI(s)/credit institution you acquire credit from	1) ……………………………………… 2) ……………………………………… 3) ……………………………………… 4) ………………………………………
Why do you borrow from them?	1- Low interest rate 2- Good services 3- Good terms of repayment due to their application requirements 4 - No security needed 5- The closest MFI 6- Trust them
For what main purpose do you borrow?	1- Farm expansion 2- Working capital 3- Input acquisition
Please indicate the estimated rate of loan used for farm and off-farm purpose(s).	Farm purpose:……………………………percent Off-farm:…………………………………percent
Please how much do you pay in interest (rate) on the credit per month	…………………………………percent
How long is the period of repayment?	………………………………………..(months)
What mode of borrowing do you often use?	1- Group borrowing 2- Individual borrowing
Do you need security before borrowing?	1- Yes 2- No
What do you often use as security?	………………………………………
How long does it take to access a credit?	
How do you assess the services of MFIs based on your experience?	1- Poor 2- Fair 3- Good 4- Very Good 5- Excellent
Main source of finance	1- Personal savings 2- Microcredit 3- Borrowings from friends & family 4- Loans from Money lenders 5- Loans from Traditional banks 6- others (specify)……………………………………
For Non-clients	
Why don't you take microcredit?	1- High interest rate 2- Difficulty in providing security 3- Lost of trust for MFIs 4- Difficulty in access 5- Distance from farm to the closest MFI 6-
What is your main source of finance?	1- Personal savings 2- Loans from friends & family 3- Loans from money lenders 4- Loans from Traditional Banks 5- Others (specify)…………..............
How much do you pay as interest on your source of finance?	…………………………………percent/annum
Have you ever accessed the services of MFIs in the past before?	1- Yes 2- No

If ‘yes’, for how long?	
How do you compare their services (MFIs) to your current source of finance?	
For Clients and Non-clients	
Other services from MFIs apart from credit	1- Micro-savings 2- Micro-insurance 3- Micro-transfer 4- Others (specify)…………………………………
Please indicate if you have ever lost your savings due to the collapse of MFIs before.	1- Yes 2- No
How many times and how much?	No. of times………………………………. Amount lost GHC………………………....

Section 5: Demand Constraint of Microcredit

Please rank the following challenges to your demand for microcredit *Rank in order of Hierarchy (1 = Most Challenging)*
1- Lack of credit security [ ]
2- High interest on credit [ ]
3- Time Wasting (Bureaucratic process of application) [ ]
4- Lack of information on microcredit policy [ ]
5- Poor mode of repayment [ ]
6- Lack of trust and reliability of MFIs [ ]
7- Short period of credit refund [ ]

Appendix 2: Interview Guide for MFIs

Basic Information about the MFI

I. Name of MFI

II. Years of operation

III. Number of clients

1) What are the financial services provided to your clients?
2) Is your organization a credit institution?
3) What are the forms of credit provided by your institution to its clients?
4) Do you have specific credit facilities for farmers?

5) What are the forms of borrowing?
6) How do farmers assess loans from you?
7) Do you have any limit the amount farmers can borrow from you?
8) Do clients need collateral before credits are given to them?
9) How long does it take clients to assess credit?
10) How long does it take to repay back?
11) Are farmers given some grace period before repayment?
12) How is interest rate charged by your institution?
13) What is your rate of interest per month and a year?
14) Are there limitations to the credit offered to the poultry farmers? (lower and upper limits)
15) A brief account on the relations between your institution and poultry farmers?
16) What are your default and repayment rates?
17) Closing remarks

Note: Answers were not restricted to these questions

Appendix 3: Excel Output of the Data Envelopment Analysis using GAMS

dmu	**CRS**	**VRS**	**SCALE**	**u0**	**CRS_TI**	**VRS_TI**
1	0.999986	1	1	0.000	1.35635E-05	0
2	1	1	1	0.000	0	0
3	0.999528	0.999916	0.999817	0.000	0.000472377	8.39E-05
4	0.999788	1	0.999788	-0.532	0.000212425	0
5	0.56187	0.62071	0.905206	0.212	0.438129589	0.37929
6	0.771636	0.780401	0.988769	0.041	0.22836381	0.219599
7	0.052382	0.223542	0.234328	-0.224	0.947617862	0.776458
8	0.737233	0.780097	0.945053	-0.157	0.262767118	0.219903
9	0.78898	0.797641	0.989141	0.013	0.211020405	0.202359
10	0.239166	0.590289	0.405168	-0.489	0.760833988	0.409711
11	0.500947	0.516502	0.969883	0.010	0.499053466	0.483498
12	0.957747	1	0.957747	0.028	0.042252981	0
13	0.434474	1	0.434474	-1.000	0.565525627	0
14	0.648411	0.659544	0.98312	0.012	0.351588983	0.340456
15	1	1	1	4.037	0	0
16	0.86803	0.872169	0.995255	0.009	0.131970355	0.127831
17	0.845989	0.881681	0.959519	-0.073	0.154010608	0.118319
18	0.540686	0.550362	0.982419	0.035	0.459314265	0.449638
19	0.805666	0.854727	0.942599	-0.155	0.194334491	0.145273

20	0.999755	0.999941	0.999981	0.000	0.000245385	5.85E-05
21	0.156491	0.288307	0.542792	-0.288	0.843509109	0.711693
22	0.452003	0.4701	0.961504	-0.099	0.547996884	0.5299
23	0.766369	0.76646	0.999881	-0.036	0.233631389	0.23354
24	0.722245	0.752591	0.959678	0.042	0.277755205	0.247409
25	0.999873	0.999925	0.99997	0.000	0.000127418	7.5E-05
26	0.076776	0.428413	0.179211	-0.416	0.923223632	0.571587
27	0.509587	0.514685	0.990095	0.009	0.490413025	0.485315
28	0.618137	0.694566	0.889962	0.122	0.381863035	0.305434
29	0.999725	0.999743	0.999981	0.000	0.000275411	0.000257
30	0.999848	0.999952	0.999993	0.000	0.000152053	4.81E-05
31	1	1	1	0.000	0	0
32	0.999272	0.999959	0.999959	0.000	0.000728021	4.08E-05
33	0.999092	0.999952	0.999996	0.000	0.000907963	4.84E-05
34	0.999797	0.999939	0.999858	0.000	0.000202845	6.13E-05
35	0.519839	0.616497	0.843214	-0.273	0.480161058	0.383503
36	0.999507	0.999938	0.999971	0.000	0.000493299	6.2E-05
37	0.999991	1	0.999991	0.000	8.87473E-06	0
38	0.999806	0.999888	0.999918	0.000	0.000193642	0.000112
39	0.999141	1	0.999141	0.000	0.000858821	0
40	0.999822	0.999939	0.999997	0.000	0.000177926	6.09E-05
41	1	1	1	-1.000	0	0
42	0.999377	0.999392	0.999985	0.000	0.000622666	0.000608
43	0.999416	0.999947	0.999746	0.000	0.000583532	5.3E-05
44	0.999777	1	0.999788	0.000	0.000222743	0
45	0.999691	0.999967	0.99989	0.000	0.000308736	3.28E-05
46	0.999823	0.999933	0.99994	0.000	0.000177327	6.69E-05
47	0.999724	0.999899	0.999825	0.000	0.000275713	0.000101
48	0.999697	0.999866	0.999831	0.000	0.000302528	0.000134
49	0.999798	0.999978	0.999834	0.000	0.000201614	2.22E-05
50	0.999611	0.999956	0.999999	0.000	0.000388628	4.44E-05
51	1	1	1	0.000	0	0
52	1	1	1	4.240	0	0
53	0.99942	0.999716	0.999703	0.000	0.000580391	0.000284
54	0.999642	0.999875	0.999981	0.000	0.000357635	0.000125
55	0.999935	1	0.999935	-0.001	6.50593E-05	0
56	0.999933	1	0.999933	-0.895	6.6762E-05	0
57	0.99856	0.999181	0.999379	0.002	0.001439854	0.000819
58	0.999964	0.999976	0.999995	0.000	3.62597E-05	2.44E-05
59	1	1	1	0.000	0	0
60	0.999425	0.999514	0.999911	0.000	0.000575474	0.000486
61	1	1	1		0	0
62	0.999972	0.999987	0.999984	0.000	2.8369E-05	1.28E-05
63	1	1	1	-0.480	0	0
64	0.999591	0.999629	0.999962	0.000	0.00040895	0.000371
65	1	1	1	-0.998	0	0
66	0.999816	0.999932	0.999891	0.000	0.000183827	6.8E-05

67	0.999725	0.999786	0.99994	0.000	0.000274553	0.000214
68	0.99978	0.999944	0.99992	0.000	0.0002201	5.65E-05
69	0.999539	0.999689	0.99985	0.000	0.000461397	0.000311
70	0.999911	1	0.999911	-0.416	8.85402E-05	0
71	0.999623	1	0.999918	0.000	0.000377488	0
72	0.999959	0.999976	0.999984	-0.587	4.05895E-05	2.43E-05
73	0.99989	0.999901	0.999989	0.000	0.000110008	9.95E-05
74	1	1	1	0.686	0	0
75	0.999781	0.99997	0.999948	0.000	0.00021865	2.99E-05
76	0.99956	0.999932	0.999974	0.000	0.000440359	6.8E-05
77	0.99985	0.999967	0.999891	0.000	0.0001496	3.29E-05
78	0.999141	1	0.999141	0.000	0.000858821	0
79	0.845989	0.881681	0.959519	-0.073	0.154010608	0.118319
80	0.805666	0.854727	0.942599	-0.155	0.194334491	0.145273
81	0.516779	0.583095	0.886269	-0.210	0.483220752	0.416905
82	0.156491	0.288307	0.542792	-0.288	0.843509109	0.711693
83	0.452003	0.4701	0.961504	-0.099	0.547996884	0.5299
84	0.766369	0.76646	0.999881	-0.036	0.233631389	0.23354
85	0.722245	0.752591	0.959678	0.042	0.277755205	0.247409
86	0.71811	0.875273	0.820442	-0.264	0.281889909	0.124727
87	0.076776	0.428413	0.179211	-0.416	0.923223632	0.571587
88	0.509587	0.514685	0.990095	0.009	0.490413025	0.485315
89	0.618137	0.694566	0.889962	0.122	0.381863035	0.305434
90	0.362267	0.594077	0.609799	-0.360	0.637732575	0.405923
91	0.724012	0.828364	0.874026	-0.305	0.275988352	0.171636
92	0.548067	0.753432	0.727428	-0.361	0.451932599	0.246568
93	0.243731	0.30116	0.809306	-0.104	0.7562695	0.69884
94	0.112678	0.268095	0.42029	-0.234	0.887322482	0.731905
95	0.765066	0.80443	0.951066	0.152	0.234934098	0.19557
96	0.519839	0.616497	0.843214	-0.273	0.480161058	0.383503
97	0.468666	0.496915	0.943152	-0.113	0.531333589	0.503085
98	0.952206	0.974963	0.976659	-0.062	0.04779398	0.025037
99	0.774497	0.797749	0.970853	0.041	0.225502573	0.202251
100	0.392128	0.411812	0.9522	-0.074	0.607872207	0.588188