Profitability, farmer and farm characteristics: The case of Ghana broiler chicken industry in 2015

by

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A THESIS

submitted in partial fulfillment of the requirements for the degree

MASTER OF SCIENCE

Department of Agricultural Economics
College of Agriculture

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2018

Approved by:

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Abstract

This study assessed the farm and farmer characteristics influencing the profitability of broiler chicken farms in Ghana. It used data obtained from the 2015 census of the poultry industry conducted by USAID-METSS in collaboration with Ghana's Ministry of Food and Agriculture and the Ghana National Association of Poultry Farmers.

Results show that broiler production in Ghana is operated on a small scale basis with an average number of 1,410 birds. Broiler chicken production is profitable in Ghana with national average gross margin/bird of GHS 9.22 and standard deviation of 8.40. Regression analysis was carried out using Ordinary Least Square method to estimate the effect of farm and farmer characteristics on profitability and also explore regional differences. Results shows that farm income and feed were negative and statistically significant such that a farmer with primary income from broiler chicken production had a decrease in gross margin of GHS 1.24 per bird compared to a farmer with other sources of income; a farmer that increases one unit of own feed production will have a decrease in gross margin of GHS 0.06 per bird. Additionally, regional differences exist such that farms situated in Ashanti, Central, and Eastern had higher gross margin per bird of GHS 3.21, GHS 6.10 and GHS 6.26 respectively compared to farms situated in Brong Ahafo Region.

In conclusion, the study shows that both farmer (primary source of income) and farm characteristics (such as regional location and the extent to which feed was prepared on the farm) were important in explaining broiler chicken profitability. Finally, continuous research is recommended to examine the robustness of these factors in explaining profitability.

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Acknowledgements

First, I appreciate God, my maker, the Alpha and Omega for giving me this opportunity, without you where would I be today? I would like to say thank you to my major professor – Dr. Vincent Amanor-Boadu. It has been a privilege working with you. You made me realize that it is never too late to learn, challenged me in my way of thinking and believed in me. To Dr. Kara Ross, thank you for being there, your patience and willingness to answer my questions at all times. To Dr. Alex Shanoyan, thank you for your suggestions, they made a difference. Also, I would like to thank the members of METSS group – Frank Nti, thank you for being there, Agnes Myzece- thank you for your willingness and ease at which you step in to resolve issues, Elizabeth Gutierrez, Bolanle Atilola, Pacem Kotchofa, thanks. To my fellow African students and other graduate students on the fourth floor, thank you for making my stay in graduate school enjoyable.

Finally, to the love of my life, my ever-present husband, thank you so much for motivating me all through this year without you I know I will not be back in school or even dream to achieve the impossible. Thank you so much.

Dedication

This thesis is dedicated to my kids, “The Awesome Four”.

Chapter 1 - Introduction

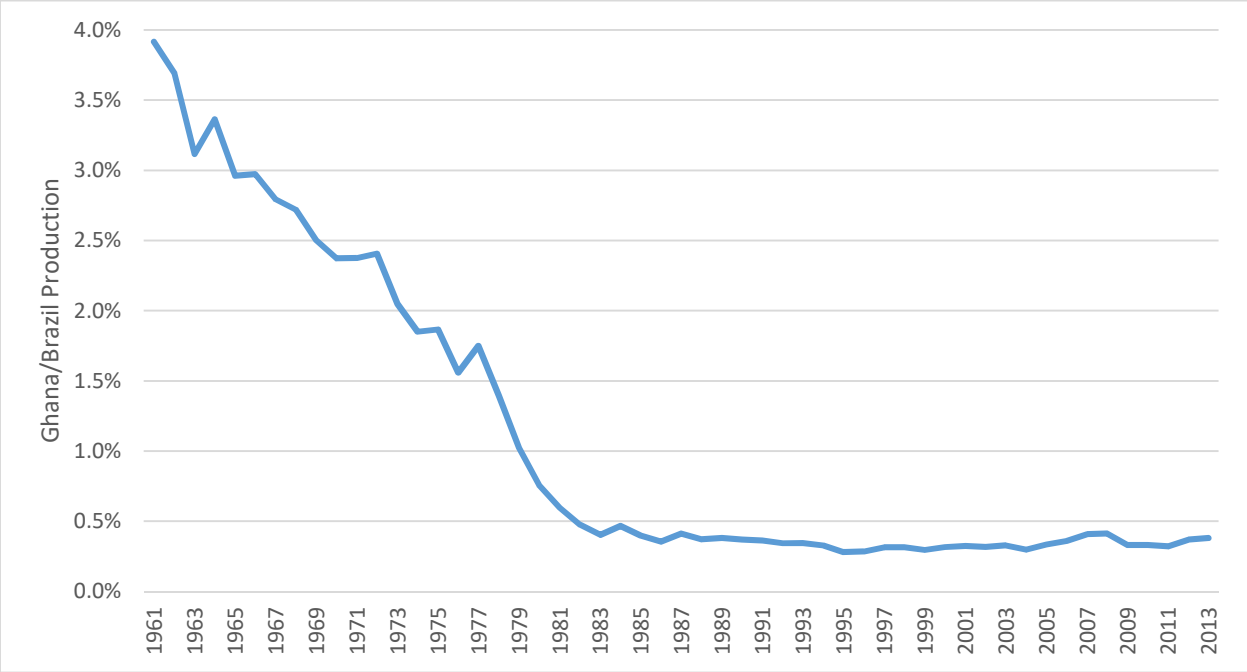
1.1 A Case for Research on Profitability in the Broiler Chicken Industry

Despite being recognized as an important industry, the Ghana livestock industry grew by only 0.6 percent between 2007 and 2014, from 4.7 percent to 5.3 percent. This growth rate has been too low for it to meet domestic consumer demand (Ghana Statistical Service 2015). Domestic broiler chicken production in Ghana only satisfy about 11 percent of total domestic demand (Randan et al. 2011). In fact, Ghana has become a net importer of broiler chicken meat, importing over 140, 000 metric tons (MT) of poultry meat to meet domestic demand as at 2013 (Dziwornu et al. 2014). The Ghana broiler chicken industry has also been described as a dying sector as production has been flat over the last five decades (Figure 1.1), with an average of 0.14 percent per annum presenting a gloomy picture when observed over the long term and through the industry's productivity lens (Kwadzo et al. 2013; Amanor-Boadu et al. 2016).

Figure 1.1 shows the relative production of chicken meat in Ghana and Brazil between 1961 and 2015 using data from FAOSTAT. The figure shows that in 1961, Ghana produced about 4 percent of Brazil's total output. However, by 2015, Ghana's share of Brazil's total output was about 0.4 percent. This would suggest that Brazil's production has been growing at a much higher rate over the decades, approximately the estimated growth rate in Brazil over the five and a half decades was 8.8% per year compared to 3.9% for Ghana. Although Ghana's growth rate increased to an average of 7.8% between 1990 and 2015, it was still not enough to overcome Brazil's 6.8 percent annual growth during the same period. This explains the trend observed in Figure 1.1, the continued decline in Ghana's production relative to Brazil's. It also explains why Brazil is a net

exporter of poultry meat and Ghana is a net importer, a situation that has been increasing rapidly over the past two decades or so.

Figure 1.1 Ghana's Broiler Chicken Meat Output Relative to Brazil's (1961-2013)



Source: FAOStat (www.faostat.org)

The reasons for Brazil's performance may be multidimensional and multifarious. For example, the Brazilian Government initiated a policy to become a leading global agri-food player in the 1980s and made significant investments in the industry in the support of that vision. Of course, the broiler chicken industry in Brazil is not homogenous, productivity has been high enough to support exports. Indeed, about 28 percent of total production in 2015 was exported (Valdes et al. 2015). There is also the issue of profitability. This is related to the infrastructure that supports the industry, from day-old chicks' genetics through the feed processing and distribution cold chains. Available infrastructure has contributed to the expansion of farms to take advantage of the growing demand in both the domestic and international markets. This has been

absent in Ghana. The infrastructure has not developed and the government policy has not been clear, consistent and focused. Yet, these may be conceived of as external factors in the development of an industry. A major factor influencing firm growth is profitability. When incumbents exhibit high profitability, they expand to take advantage of scale economies. Their expansion signals potential investors to consider the industry as credible vehicles and encourages them to invest. These investments lead to growth and expansion, creating the economic rationale for the development of the other infrastructures that contribute to further performance in the industry.

What we have done so far is to use a single highly successful broiler chicken producing country as a benchmark for performance in Ghana. We hypothesize that expansion of the Ghana industry has been declining growth relative to the Brazilian industry because of the low profitability of the Ghana industry. This low profitability is not absolute but relative to chicken egg production for example. This is premised on the observation by Amanor-Boadu et al. (2016) that broiler chicken is not the primary industry for most broiler chicken farmers in Ghana: most of these farmers are egg farmers who produce broiler chicken for supplementary income around festivals, such as Christmas and Easter. Given this situation, the question that arises is how profitable is broiler chicken production. This is the primary motivation for this research. Understanding the profitability of broiler chicken production could provide insights into how it may be supported to grow beyond a supplementary income activity in Ghana into an industry that is addressing the increasing animal protein needs of a population experiencing increasing incomes.

1.2 Broiler Chicken Production in Ghana

Ghana is a West African country with a population of 27.41 million as of 2015. It is bordered by Ivory Coast to the west, Burkina Faso to the north, Togo to the east and the Atlantic

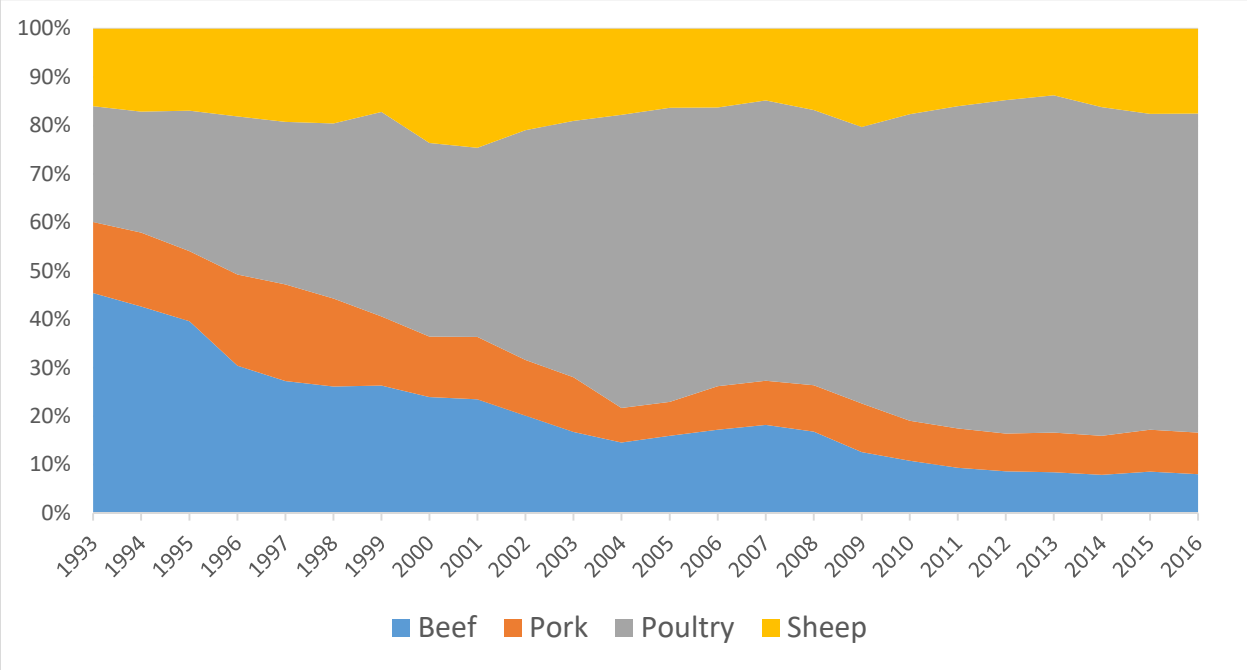
Ocean to the south. Ghana is a lower middle-income country with an estimated GDP of $42.69 billion in 2015, an annual GDP growth rate of 3.57 in 2015 (World Bank 2016). Like most developing countries, agriculture is an important contributor to Ghana's GDP, contributing about 19.5 percent in 2016, in comparison to 24 percent for industry and 56.4% for services. Ghana's major agricultural exports include cocoa, timber, horticultural products, and fish/seafood. Its major mineral exports are petroleum, gold, bauxite, manganese, and diamond (Ghana Ministry of Food and Agriculture 2013).

Ghana has ten administrative Regions: Ashanti; Central; Eastern; Greater Accra; Volta; Western; Brong Ahafo; Northern; Upper East; and Upper West. Based on the last population census carried out in 2010, Ashanti and Greater Accra Region had the largest population of 4.78 million and 4.01 million respectively, while Upper West Region had the lowest population of 0.702 million (GSS, 2012). The share of the population in the northernmost Regions is estimated at 20% (Zereyesus et al. 2015), a distribution that also affects the country's income distribution and ultimately overall economic activity (USAID, 2011).

Post-independence policymakers in 1960 recognized the need to promote modern poultry production in Ghana. Given the prevailing macroeconomic environment then, domestic broiler chicken production accounted for about 95% of total poultry meat consumed within the country (Egyir et al. 2012; Dziwornu et al. 2014). Per capita consumption of poultry meat in Ghana has increased rapidly, especially over the past decade or so when incomes started rising rapidly. Figure 1.2 shows the trend in the per capita consumption of broiler chicken in Ghana in comparison to other meat sources. Per capita consumption increased from under 1 kg in 1993 to nearly 8 kg by the middle of the 2000s. Meanwhile, per capita consumption of beef declined from 1.75 kg to less than 0.8 kg in the same period. While both mutton and pork increased, their rate was not as

impressive as that for chicken, which on average increased at an average of approximately 11.4% per annum. Figure 1.2 shows that poultry (dominantly chicken) accounted for about 24 percent of total per capita meat consumed in Ghana in 1993 and by 2016, its share has grown to nearly 67 percent having peaked at almost 70 percent in 2013. The growth in consumption has been addressed with imports.

Figure 1.2 Distribution of Total Meat Consumed/Person in Ghana



Source: OECD/FAO Agricultural Outlook. (http://stats.oecd.org/viewhtml.aspx?QueryId=71240&vh=0000&vf=0-&l&il=&lang=en#).

1.3 Research questions

We have noted above that profitability is an important incentive for attracting investments into an industry. The lack of expansion of Ghana's broiler chicken industry may suggest that the industry is not as profitable as other segments in the agri-food space to attract investments. The motivating research questions for this research are, therefore, the following:

1. What is the profitability of broiler chicken production in Ghana?
2. What are the critical factors affecting the profitability of broiler chicken production in Ghana?

1.4 Research objectives

The overall objective of this research is to evaluate the factors influencing the profitability of broiler chicken production in Ghana. The specific objectives are as follows:

1. Describe the demographic and socio-economic characteristics of Ghana's broiler chicken farmers;
2. Describe the characteristics of broiler chicken farms in Ghana and assess if there are differences across the different Regions;
3. Measure the profitability of broiler chicken farms in Ghana and determine the extent to which they differ across the Regions;
4. Estimate the effect of farm characteristics, socio-economic and demographic characteristics of farmers on their profitability, and explore the effect of regional location on the relevance of these factors in determining profitability.

Achieving the foregoing objectives could provide insights into how private investors and public policymakers may assess the broiler chicken industry within the context of the changing macroeconomic environment in Ghana. For example, the regional distribution of profitability could point to where broiler chicken farms may be located to enhance their probability of producing profitable outcomes. Describing the characteristics of farms, farmers and their profitability across the regions could also provide insights into gaps in human capacity and other

capabilities in the broiler chicken industry and offer opportunities to improve the industry's attractiveness for investment.

1.5 Thesis outline

Chapter 2 provides a review of the profitability literature. It takes a broad view of the subject and explores it theoretically as well as how it is applied across many industries. Chapter 3 describes the data used for the study, contextualizing it within the location of study and offering a perspective on its advantages and weaknesses. Chapter 3 also presents the foundation of the statistical and econometric models used to address the objectives and answer the research questions. The results, organized around the study's objectives, are presented and discussed in Chapter 4. Chapter 5 presents the summary and conclusions emanating from the study as well as recommendations for future research.

Chapter 2 - Literature Review

Studies geared towards determining the factors that affect profitability are essential to researchers, industry practitioners to help reduce production cost, and income revenue and help policymakers develop more effective policies. This chapter, classified into three sections, focuses on profitability studies conducted in Africa and other regions. The first section looks at the definition of profitability and how it may be measured. The second section examines the factors affecting profitability in various industries and authors. The third section focuses essentially on profitability research in the poultry industry, explaining the methods and factors that are known to affect profitability.

2.1 Profitability Defined

Profitability is used to assess a firm's profit in relation to its size. Size may be measured in various ways e.g. leverage, number of employees or output. It is a measure of efficiency, and as such, it is presented as a ratio or in relative terms and not as an absolute as profit is. There are numerous means of measuring profitability. Such as

- **Net Profit ratio** = (Net profit after sales / Net sales) x 100

The main aim of using this ratio is to evaluate the profitability of the business entity with regards to its primary operations. All non-operating revenues and expenditures are not considered. Here the point of interest is to determine the overall profitability of a business such that a high ratio indicates an efficient management.

- **Gross Profit ratio** = Gross profit / Net sales

  Gross profit = Net sales – Cost of goods sold

  Net sales = Total gross sales – (returns + discounts allowed)

This ratio measures the average gross profit for each dollar sales and should be sufficient to cover all expenses. It tells us the profit generated to cover the fixed operating expense. Additionally, it tells us the extent of which prices of goods can be reduced without necessarily incurring a loss to one's business operation and signifies how efficient a company is in producing its products.

- **Return on Sales** = Net income / Total assets

  Net income = Gross margin – fixed costs

This ratio gives an idea of the profitability of a business in terms of the profit margin of the product. It gives a clear picture of product positioning and its pricing policies. A high ratio tells us that the product has a premium pricing and indicates the supply and demand for the product within the industry.

- **Return on Assets** = Net income / Total assets

This measure provides information on how companies use their assets to generate income. Assets here include cash, physical items of tangible value such as building, equipment, and inventory. It tells us how well a business is utilizing its capital invested in fixed assets to make a profit. The higher the return, the more productive the management of the business at utilizing economic resources.

- **Return on Equity** = Net income / Owner's equity

Shows how the owner's equity is used to generate income. It measures the profitability of the business from its shareholder's perspective. Also tells us how efficient the management of the business is able to utilize resources and reveals the comparative advantage as compared to industry's average. Such that a high ratio signifies a company is efficient at generating shareholder's return which ultimately increases the value of the ownership of the company.

- **Gross Margin** = Total revenue – Total variable cost

  Total revenue = Price of product x Quantity sold

This is the difference between gross revenue and cost of goods which may be defined as a variable cost. It tells us how profitable a business is at selling its products. A higher ratio can be achieved by either buying inventory at a cheaper price or selling products at a higher price.

(Culled from charteredfiancialinstitute.com)

After examining all the profitability measures above which makes reference to fixed cost, fixed assets, revenue and shareholder's equity in its calculation; Gross margin will be used to measure the performance of Ghana broiler industry; largely due to the complexity and inability of obtaining accurate fixed cost, assets and shareholder's equity which include mortgage (when applicable), depreciation and amortization of loan and assets (when applicable). Also, one of the purposes of the study is to estimate the profitability of the industry with regards to the sale of products which can be captured within the confines of this study using gross margin. Finally, in order to eliminate the effect of size (as sample farms vary in size), farm profitability will be compared on a per bird basis. Such that the profitability equation below will be used:

Gross margin/bird = Total Revenue/bird - Total Variable Cost/bird

2.2 Factors affecting profitability

Based on economic theory, a number of socioeconomic factors influence the profitability of a firm. These factors could be described as either firm-specific or industry-specific. Firm-specific factors comprise the objective of the firm (defined as the goal a firm desire to achieve which in most cases is to make profit), managerial decision (decisions concerning operating the firm), efficiency of input (output produced per unit input), relative cost of production (cost incurred

when producing goods), advertising (form of marketing company goods through various medium like print, broadcast, internet or direct), and demand for product. The industry-specific factors are centered around Porter's five forces which are the degree of competition, substitutes, customers, suppliers and potential new entrants. Studies have considered the extent of the impact of industry and firm-specific factors and have concluded that firm-specific factors are dominant. A study conducted by Hirsch et al. (2014) using the European Union food processing firms showed that firm size (classified using Return on Assets into large, micro, medium and small firms) is far more important in determining profitability compared to industry factors. Research conducted on Australian firms listed on the Australian Stock Exchange by Stierwald, (2010) concluded that heterogeneity in profitability is explained by differences observed across firms while industry effects are less important. Using a dataset that ranks companies in the United States and the European Union based on their annual Market Value Added (MVA = Market value of the company – capital invested by shareholders), Hawawini et al. (2003) found that industry effect was dominant for measuring their performance than firm-specific factors.

On the contrary, Darush (2013) showed that firm profitability in Sweden microforms selected from four sectors (healthcare, retail trade, manufacturing, and healthcare) are affected positively by firm size (measured as the firm's value of sales), lagged profitability (past year profitability), growth, and productivity (refers to the total factor productivity i.e. output / labor costs +capital cost), while industry affiliation and firm age (number of years since inception) were negative factors. Research carried out by Zouaghi et al. (2017) looked at the Agri-food sector. They analyzed the effect of the firm, region and industry factors on the profitability of 3,273 Agri-food firms operating in various Spanish district. Results show the dominance of firm-specific effects contributing to 48.8 percent to variance in firm profitability.

While the foregoing tries to determine the effect of firm and industry factors on firm profitability, other factors are also important. For example, Pasiouras et al. (2007) used a balanced dataset from 584 commercial banks in 15 European countries from 1995 – 2001. Their results showed that profitability is not only affected by the bank's specific characteristics but also by the financial market structure and macroeconomic conditions. In all enterprises (small, medium, and large-scale), managerial decisions on investments significantly affect the firm's financial factors that influence profitability in their operations (Popa et al. 2014). Finally, research carried out by Agha (2014) using secondary data collected from a pharmaceutical company shows that proper working capital management can increase the profitability of a firm if the managers minimize inventory turnover, account receivables and decrease creditors turnover.

Economist has debated that the profitability metrics matters in measuring the financial performance of a firm. According to Mishra et al. (1999), they suggested the use of the Farm Financial Standards Task Force (FFSTF) that recommended the use of 16 financial measures for analyzing profitability. They concluded that four financial measures were relevant in calculating farm profitability; which are Net Farm income (gross farm income – production expense); Return on Assets; Return on Equity; and Net Profit margin. However, Petersen et al. (2009) stated that in order to determine the profitability metric, the following questions need to be answered. These questions are: a) What metrics are available? b) What metrics are in place in the industry of interest? c) How can you link metric to strategic actions? d) How does metric relate to customer's value and firm performance?

2.3 *Factors affecting profitability in broiler chicken production*

Broiler chicken farms in Africa are generally small. Their owners may have multiple objectives of operating them instead of only a profit maximization objective. To this end, it is not

enough to evaluate profitability using industry or firm-specific factors. The characteristics of the farmer on production also become important. This section will discuss some of the farm and farmer characteristics identified as having an impact on broiler chicken profitability. The section is organized by farm location, age, experience, educational level, production systems, primary income, farm size, membership in association and feed.

2.3.1 Location of farm

Location of a farm plays an important role in production decision. In the United States, most farms including broiler farms are situated in close proximity to poultry processing plants, feed production plants and labor in order to reduce distribution and transport cost. Artz et al. (2016) studied the impact of firm location and concluded that new companies (poultry and non-poultry) would establish in areas that have an existing array of similar firms in the same industry. These areas are characterized by concentrated suppliers or customers with an established labor force market. According to Tey et al. (2015), a distinct farm typology can be observed across farms in the United States. These are rural (residential) farms, intermediate farms and commercial (large) farms that invest in efficient technology for profit maximization objective. However, a study carried out amongst Pennsylvania and Vermont dairy farmers show no statistical difference between the location of farms in relation to the performance of farms (Winsten et al. 2000). Finally, the issue of rural-urban migration resulted in a labor shortage. This issue was considered by Ofuoku et al. (2016) in their study of broiler production in the Niger Delta area of Nigeria showing a shortage of labor leading to a reduction in profitability.

2.3.2 Farmers age / experience

The age of a farmer may be an indicator of his level of experience and risk-taking preferences in broiler chicken production (Liepzy et al. 2003). Younger farmers take more risks in

production than older farmers. Nehring et al. (2016), however, discovered that older farmers were more profitable, which can likely be due to more practical experience. Bassrir et al. (2006) looked at the goals of Louisiana state dairy and beef producers and concluded that dairy producers are more focused on maximizing profit with age of the farmer having a positive relationship with profitability. They noted that their result was consistent with the analysis made by financial advisors that state that the older the person, the more conservative their decision making compared to the younger ones due to fixed income of the old.

Another study carried out in Europe by Zagata et al. (2015) concluded that younger farmers generate higher value because they manage the larger farms and hire more labor. But a study conducted by Gloy et al. (2002) showed that age has no significant effect on the financial performance of New York dairy farmers. Age and experience can be used interchangeably as farmer's experience plays a positive role, enabling the producer to make better production decisions for increased capacity resulting in increased profitability.

According to Liepzy et al. (2003), the years of experience of a farmer is one of the factors that determine their risk-taking preferences. As producers become more proficient or knowledgeable in poultry production due to increasing experience, the likelihood of a higher incomes and farm success increases. This is supported by studies carried out by Esiobu et al. (2014) and Onubuogu et al. (2014). They found that previous experience in business enable farmers to set relevant time and cost targets. Their result also shows that producers with agribusiness experience can allocate, combine, and utilize resources effectively to identify production and marketing risks. The number of years of experience in broiler production significantly increases profit efficiency as more experienced farmers are highly likely to adopt best farm practices (Tuffour et al. 2014).

2.3.3 Educational level

Educational level describes the level of formal education attained by individual farmers. It can be categorized as none, elementary, secondary, post-secondary, and tertiary level. According to Liepzy et al. (2003), the highly educated farmers are expected to achieve higher profitability as higher education improve a farmer's ability to make better decisions. Adebayo and Adeola, (2005) reported that educational level of producers has a positive and significant effect on production. This relationship between educational level and average production was attributed to the high-need of sound knowledge and efficient management of poultry business to ensure high output and profitability of the farm.

Education also gives insights into the effect of training based on the fact that an educated farmer will be knowledgeable, easy to train for managerial capacity; as a result manage their farm effectively and efficiently to increase profitability (Mishra et al. 2009; Stefanides et al. 1999). However, in other studies, it was found to be insignificant with no effect on farm profitability. This may be due to the complex nature of agriculture that deals with farming techniques and business skills which can be developed on the job with little or no formal education. Notwithstanding it was concluded that further studies need to be carried out in this area (Foltz et al. 2002; Fernandez-Cornejo et al. 2005).

2.3.4 Production Systems

The production system in poultry production can be classified into intensive, semi-intensive and extensive methods. Intensive relates to the confinement of the broilers to a particular space or house entirely with no access to land outside. It is adopted where land is limited or expensive. Semi-intensive system is used when the amount of free space available is limited, but it is necessary to allow broilers some space to run around i.e. not confined entirely to a place. The

extensive system removes any form of confinement and allows birds to roam around outside the farm also referred to as free-range farming (www.agriinfo.in).

In broiler chicken production, the intensive production system is the most commonly used in the developing countries. Research has shown that intensive system gives opportunities for farm expansion and capacity building thereby exploiting economies of scale to enhance profitability and competitiveness (HLPE, 2016). On the other hand, farm production system has been linked to the incidence and spread of disease on the farm. Based on the study carried out by Gocsik et al. (2014), they analyzed the effect of the type of production systems on health cost and its effect on farm profitability in the Netherlands. Their result confirmed that diseases occur on the farm irrespective of the type of production system used but in broiler farms, the effect and likelihood of disease can differ according to production system used. However, veterinary cost represents only a small proportion of variable cost thus its effect is minor in determining farm profitability in relation to feed and day old chick costs.

2.3.5 Primary income

Emaikwu et al. (2011) inferred that broiler chicken production as a primary occupation increases the flock size of farms. They conclude that producers would allocate their best resources in terms of feed, labor, capital, and management practices to increase their scale of operation thereby increasing profitability. Diversification of a farm operation can increase the probability of agricultural success. Farmers practicing mixed farming are less susceptible to income declines if market conditions drive down the price of a single commodity or disease strikes their primary product or producers experience unfavorable weather (Liepzy et al. 2003). It also allows for economies of scale which lowers cost of production and increases the profitability of US limited

resource and small farms (Mishra et al. 1999) while it shows a negative significance in US dairy farmers (McBride at al. 2004).

Diversification can also be viewed by revenue generated from the core and non-core produce; here specialization is achieved leading to higher gross margin in Connecticut dairy farmers (Foltz et al. 2002). This was not evident in the study carried out by Fernandez-Cornejo et al. (2005) on the adoption of Herbicide treated Soybeans in the US. Situations arise when the financial contribution of non-core production, in this case, farmer's efforts are diverted away from their primary agricultural activity (Tey et al. 2015). Over-diversification, however, may not allow one to gain expertise in a particular product production or allow one to achieve economies of scale in such a case the influence of this variable may be unpredictable (Liepzy et al. 2003).

Though diversification on farms might be unpredictable, studies have shown that off-farm employment plays a significant role in Agriculture as it generates additional income or stabilizes income on the farm allowing farmers to continue farming even when not profitable. This was reinforced by an analysis carried out by Goetz et al. (2001) on data obtained from US farmers showing a higher rate of off-farm income helps farmers achieve break-even point (Farms don't make a loss or profit). It is possible to have multiple income sources, for example, more than 50 percent of farmers in the US rely on off-farm income to repay their financial debt and boost their overall income vital to the well-being of their households (Bridgeman, 2011). However, a study by McBride et al. (2002) found this to be insignificant suggesting that off-farm economic activities compete with on-farm economic activities thereby reducing profitability.

2.3.6 Farm size

Nehring et al. (2015) showed farm size as one of the major drivers of farm financial performance in the U.S, others are diversification and broiler housing. These factors affect broiler

chicken production as well as change their competitive trade market advantage. A large broiler chicken flock size (large scale broiler farm) has an increased feed conversion ratio, lower cost-return (cost per bird) and higher profitability in the research conducted by El-Tahawy (2017) on three provinces in Egypt. Farm size usually refers to the number of livestock (in livestock farming) or number of acreages (in crop production). This variable is important as it helps creates economic benefit for large farms in terms of economies of scale (reducing cost per unit of output production) and increased asset base (higher equity intangible assets) to attract financial assistance when applicable (Tey et al. 2015). This result is consistent with research carried out by Winsten et al. 2000; and Jackson-Smith et al. 2004, highlighting cost efficiency, higher rate of capital expansion for greater profits; compared to the study conducted by Dartt et al. (1999), who suggested that larger farms reduce labor efficiency translating to a reduction in profit. This is possible when labor employed to manage the farm is beyond their capacity, leading to a decrease in profitability. Overall, there is a general agreement that scale is a key factor for increased farm profitability (Tey et al. 2015).

2.3.7 Feed

Feed is the single largest cost item in commercial poultry production (Amanor –Boadu et al; Sumberg et al. 2017). Feed still constitutes up to 70 percent of the total production cost of broiler chicken. Grains, which are the major components of feed, coupled with an inadequate workforce, facilities to produce high-quality feed, as well as little to no government oversight of feed production and imports, are also among the biggest challenges in Nigeria's agribusinesses (USDA 2014). The feed share of unit cost in Chinese poultry production varies between 70 and 75 percent, with labor cost accounting for the second-largest proportion of cost at 11 to 15 percent (Xie et al. 2015). Feed has been touted as one of the potential factors that will affect the poultry

sector in China in terms of its supply and price (Gale et al. 2015). It is also important to note that the domestic supply of raw feed materials (corn and soybeans) is inadequate to meet domestic production in many countries in Africa and Asia and importation of feed are necessary to meet domestic demand levels.

Dziwornu (2013) investigated the effect of feed cost in broiler production in Brong Ahafo, Ashanti and Greater Accra Regions in Ghana. Results show that if proper feed management practices are implemented, it will reduce feed cost and maximize the profitability of broiler production. Singh et al. (2010) result were consistent with this but asserted that the number of days that broilers are raised to maturity and for sale also help in reducing feed cost. A typical (minimum) broiler production cycle is 60 days and the more broilers are fed after this date increases feed cost thereby reducing the profitability of the farm. The extra cost is incurred when broiler farmers keep birds beyond the expected required period. Finally, Altahat et al. (2014) in their research found that feed price has the highest negative impact on the profitability of layer hens production in Jordan. As such, there is a need to invest in the procurement of good quality feed to ensure weight gain and optimal feed conversion among the birds. However, feed price varies according to the brand, quantity purchased, transport cost, and market availability.

2.3.8 Membership in Association

Membership in a poultry association could help to increase the production capacity (flock size) of producers in the area. Emaikwu et al. (2011) research suggested that producers could pool together their limited productive resources such as land, feed mills, chicks, brooding, rearing equipment, and finances to produce more output. Farm-Based Association (FBO) are often formed to address market failures and contribution to the accessibility of input. Therefore a farmer that is a member of an association could have a positive effect on farm profitability because the FBO

could provide feed and other inputs at a cheaper rate and provide leverage in selling its products (Emaikwu et al. 2011).

Babatunde et al. (2015) also considered the effect of cooperative membership on the profitability of poultry farmers in Oyo State. Their result shows that cooperative membership has a significant and positive relationship on profitability such that a farmer with membership status in an association will tend to have an increase in income-generating potential than a farmer that is not a member of any farmer's association. Other factors such as government policy, access to extension service, access to credit, theft on the farm, and the prevalence of disease variables are not included in this study.

2.4 Previous Empirical Methods Used

This section focuses on the empirical methods employed to determine the various factors that affect poultry profitability. Using the break-even concept to estimate break-even quantities, net present values, and internal rates of return, Mahama et al. (2013) assessed the profitability of broiler chicken production in Accra-Tema and Kumasi areas. Results from the study show that a farm located in Kumasi is likely to have positive profit than one located in Accra-Tema area.

Anang et al. (2013) used the cost, revenue and profit functions, and data from three-layer farms and three broiler farms to derive total cost, revenue, and profitability of broiler and layer chicken producers in the Brong Ahafo Region of Ghana. One thousand birds per farm were used as the study unit for analysis from day-old chick to maturity stage. The study showed that both broiler and layer production was profitable despite the many constraints facing them. The significant constraints in broiler chicken production were inadequate access to finance, while competition with imported chicken and scarcity or high cost of maize was the constraints in layer production.

A study by Etuah et al. (2013) calculated profitability using gross margin analysis and net returns in broiler chicken production in the Ashanti Region of Ghana. A total of 114 broiler chicken farms were included in the study to examine the factors that influenced profitability. Factors such as an increase in broiler price and farm size were identified to positively improve profitability while high feed cost, lack of access to credit, and competition from cheap poultry imports have a negative effect on the profitability of broiler production. Tuffour et al. (2014) examined the profit efficiency and its determinants in broiler chicken production using the stochastic frontier approach with the application of the Cobb Douglas production function. Results indicated that price of labor significantly reduced profit, but the price of day-old chick increased profit, years of experience in broiler chicken production were found to reduce inefficiency while farms owned by sole proprietors were less economically efficient.

The studies on profitability discussed above highlight the factors affecting poultry production in Ghana. Adebayo et al. (2005) investigated factors that influence poultry profitability in Ejigbo local government area of Osun state, Nigeria. They used frequency distribution and Pearson correlation. Their study revealed that access to finance affected poultry profitability. Amos (2006) considered the factors affecting the profitability of poultry production in Ondo state, Nigeria with a farm budgeting model – the difference between Gross Revenue and Total Cost of Production. Production of layers was affected by feeding and veterinary cost while broilers are affected by the cost of feed and experience of farmers.

Mishra et al. (2012) used the DuPont expansion method (performance measurement decomposing Return on Equity (ROE) into three parts namely, net profit margins, asset turnover ratio, and asset-to-equity ratio) to investigate the impact of demographics, specialization, tenure, vertical integration, farm type, and location on the performance of poultry production and

profitability in US. Their results show that the key factors affecting net profit margins are operator education, farm size, specialization, and level of government payments. Another review was carried out in the USA using the DuPont expansion financial model that considered factors driving US broiler chicken profitability (Nehring et al. 2015). Farm size, diversification, and broiler housing vintage were major drivers of agricultural performance, while region, farmer's age, and off-farm employment are drivers for international competitiveness. Valdesa et al. (2015) in their study pointed out that the industry is characterized by high technology use and productivity such that profitability increases with size.

Chapter 3 - Methods

The model and data used in this study are discussed in this chapter. First, the data, conceptual, and empirical framework is presented in section 3.1, section 3.2 and section 3.3 respectively. Next, variables and their descriptions (section 3.4) are provided. The analyses were conducted using STATA 14.0® statistical software.

3.1 Data

This study used secondary data obtained from the 2015 census of the poultry industry. The census was carried out by Monitoring and Evaluation Technical Support Services (METSS) team between December 2015 and January 2016 with funding from USAID. It revealed that chicken was the dominant species of poultry production with others being guinea fowls, turkeys, and other feather animal species. The total number of poultry farmers interviewed were 4,040 and 1,508 were broiler chicken farmers. The data had information on all the required variables needed to ascertain the profitability of broiler production, farm and farmer characteristics. These include cost incurred by farmers such as feed, medications, the stock of day-old chicks, and other farm consumables that are employed in the rearing of the birds to marketable age. Also included are cost related to the sales and marketing of birds as well as customer service.

3.2 Profitability Equation

The selected profitability measure used for the study is Gross Margin per bird to address the issue of size and allow for comparison across different farm sizes. It is calculated using the equations below:

$$GM_b = R_b - V_b \tag{1}$$

where GM_b is the gross margin per bird, R_b is revenue per bird and V_b is variable cost per bird. Variable cost is defined as the sum of the day-old chick cost, veterinary services and medication, feed and labor. Revenue is the product of the average price received from all channels of production and the number of birds sold by the farm.

3.3 Conceptual framework

Farm profitability is defined as a function of farmer and farm characteristics. This may be presented conceptually as follows, where farm characteristics are represented by a vector X and farmer characteristics are represented by a vector Y:

$$GM_b = X'\beta + Y'\delta + \varepsilon \quad (2)$$

Where β and δ are the estimated coefficients and ε is the regression error term. The farmer and farm characteristics of interest in this research, guided by the literature review, are presented in Table 3.1.

Table 3.1 Description of Variables used for Ordinary Least Square Regression

Variable	Description
Farmer Characteristics	
Farmer Experience	The number of years a farmer has been involved in broiler chicken production.
Primary Income	Binary: 0 if the farm is not primary income and 1 if it is.
Educational Level	Binary: 0 if primary education and 1 if secondary and above
Farm Characteristics	
Location of Farm	Binary: 0 if rural and 1 if urban.
Production System	Method of raising bird, binary, 0 if semi-intensive system and 1 if intensive system.
Feed	Proportion ranging from 0 (commercial feed) to 100 (own feed production).

Membership in Poultry Association	Binary: 0 if no membership and 1 if the farmer is a member of a poultry association.
Farm Size	Binary: 0 if small-scale farm (<2000 birds) and 1 if medium scale (>2000 birds).
Stocking Practice	Source of day-old chicks, the dummy takes one if purchased from local retailers and zero if imported.
Regions	Location of the farm (in one of the 10 regions)*

* The three northernmost regions were organized into a single group due to the few number of farms in those regions.

The explanatory variables used in Equation 6 are selected based on economic theory, published literature, and observations from field data. Table 3.1 provides a description of these variables which include location of farm, farmer's experience, primary income, educational level, production system, feed, membership of poultry association, farm size, stocking price, and regions.

Location of farm describes the locality in which the farm is situated whether in a rural or urban area. This variable can be negative or positive depending on the farm proximity to infrastructure. It is positive if a farm is located close to the urban center because of easy access to infrastructure such as markets, financial services, it can be negative if located in a rural area.

Farmers experience is found to be associated with age of the farmer (Omiti et al. 2009). The experience of a farmer should have a positive impact, as producers become more proficient and knowledgeable with an increase in experience, the more the likelihood of having a successful farm with higher profit/income from the farming operation (Liepzy et al. 2003). The effect of primary income could be positive or negative depending on whether it increases household income and welfare. Educational level is closely related to literacy and training which relates to the ability of the farmer to read and write in English, official Ghanaian language, or in their local Ghanaian language. Educational level is expected to have a positive and significant association with production, (Adebayo and Adeola, 2005) as it is expected that the higher the farmer's education,

the better informed they will be in making informed decisions on the farm that will positively impact the profitability of the farm.

Production system describes the husbandry system employed by the farmers for their broiler chicken production. It is classified as either intensive or semi-intensive production system. Intensive relates to the confinement of the broiler chicken to a space or house entirely with no access to land outside. This system is adopted when land is limited or expensive. Semi-intensive system is used when the amount of free space available is limited, but it is necessary to allow broiler chickens some space to run around, i.e., not confined entirely to a place. Impact of production system on profitability can be positive or negative in its effect depending on the circumstances of the farmer involved (Anang et al. 2013)**.**

Feed is the most significant input in broiler chicken production and represents a considerable proportion of the cost of production (Sumberg et al. 2017). Impact of feed on the profitability of broiler chicken production can be negative or positive depending on the source of the feed. It could be positive if farmer produces own feed and or negative if farmer relies on commercial produced feed. Poultry production in Ghana, however, is exposed to price fluctuations in the purchase of feed ingredients like maize. Membership in poultry Association helps farmers in the a) procurement of farm inputs at discounted price, b) the marketing of their product, c) provide extension services or sector information that helps in the production and marketing of their products, d) access to credit facilities, e) acts as a voice in communicating their needs to the Government and f) timely access to government incentives or the use of new technologies. It is expected that membership in poultry association has a positive impact on profitability.

Farm size is a measure of the total number of birds (flock size) on a farm or the number of poultry housing units available on a farm for production. The number of birds housed on a farm

has a positive impact on profitability. The study shows that the larger the flock size, the higher the expected profit (Emaikwu et al. 2011). Stocking practices described the source of production inputs, especially day-old chicks or point of lay birds, to the farm. Mostly, day-old chicks and point of lay birds are sourced locally within the country, some farmers, however, source their day-old chicks from foreign countries in Europe and America. Stocking practices can negatively or positively affect the profitability of poultry production. Importation of day-old chicks may negatively impact profitability due to exchange rate fluctuations, cost of transportation, and may result in the introduction of new diseases to an area resulting in economic losses to farmers.

Chapter 4 - Results and Discussion

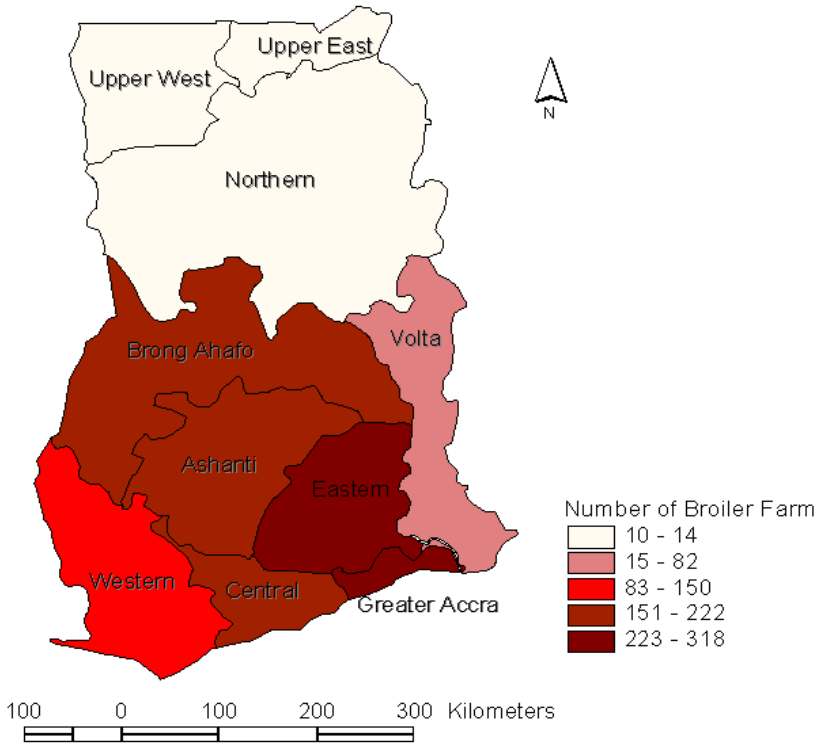
This chapter present and discusses the result of the estimated model. First, descriptive statistics are presented in section 4.1 followed by farm and farmer characteristics in Ghana by Regions in section 4.2. Section 4.3 and 4.4 examines the profitability of broiler chicken farmers and model specification, respectively. Finally, section 4.5 exhibits result from the model estimation.

4.1 Descriptive statistics

4.1.1 Distribution of broiler chicken farms in Ghana

In all, a total of 4,040 farmers were sampled during the nationwide census of commercial poultry farmers, out of which 1,508 were broiler chicken farmers. The result shows that broiler chicken production is concentrated in southern Ghana. Figure 4.1 shows the distribution of broiler chicken farms in Ghana, with farms concentrated in Greater Accra, Eastern, Central, Ashanti, Brong Ahafo, and Western Regions. The Northern, Upper West, and Upper East Regions have a fewer number of broiler chicken farms.

Figure 4.1 Map of Broiler Chicken Production in Ghana during 2015 by Regions.



Note: Plotted by Ekong Olabisi based on data from Ghana Poultry Industry Census 2015

The summary statistics of broiler chicken farms production are presented in Table 4.1. In 2015, national broiler chicken production in Ghana was 2.09 million birds (Table 4.1). The table also shows that Brong Ahafo has the largest broiler farms with average broiler production of 3791 compared to Volta with 549 birds; with standard deviation of 9963 and 1132 respectively. The Northernmost Regions comprising of Northern, Upper East and Upper West, have the fewest number of farms with an average broiler production of 1048 birds. Average production in Ashanti was 1524 with standard deviation of 3277 compared to Eastern with average production of 920 and standard deviation of 1100.

Table 4.1 Summary Statistics of Broiler Chicken Farms in 2015 by Region

Regions	N	Mean	Std. Dev.	Min	Max	Quantity produced in '000
Ashanti	212	1,524	3277	50	32,500	323.2
Brong Ahafo	205	3,792	9963	50	100,000	777.3
Central	222	965	3437	50	50,000	214.3
Eastern	262	920	1,100	50	8,000	240.9
Greater Accra	322	1,006	2601	50	30,000	323.8
Northernmost	35	1,048	2,234	90	6,500	36.6
Volta	76	549	598	50	4,000	41.7
Western	150	895	1133	50	8,000	134.2
Total	1,484	1,410	4,455	50	100,000	2,092.30

* Northernmost Region consists of Northern, Upper East, and Upper West region

4.2 Farm and Farmer characteristics in Ghana by Regions

Table 4.2 represents the characteristics of broiler chicken farms and farmers showing that the majority of broiler chicken farms (87 percent) operating in Ghana during 2015 are classified as small-scale operation. The medium/large scale operations constitute 13 percent. Approximately, 54 percent of broiler chicken farms in Ghana is situated in the urban area, however, in Brong Ahafo Region, where the largest quantity of broiler chicken was produced in 2015, about 68 percent of broiler chicken farms are situated in the rural area. The analysis of data reveals that 80.5 percent of the broiler chicken farms in Ghana are managed by their owners indicating that farm owners are directly involved in the day to day running of their operations and management of their investment. This pattern is consistent across Regions.

Table 4.2 Summary Statistics of Farm and Farmer Characteristics

Variable (continuous)	Number	Mean	Maximum	Minimum	Std Dev
Age	1219	45.18	86	19	12.01
Experience	1219	11.29	55	1	9.24

Variable (Binary)	Number (1219)	Percent
Farm size		
Small	1061	87.0
Medium/Large	158	13.0
Location		
Rural	552	45.4
Urban	667	54.6
Educational Level		
Elementary	367	30.1
Secondary and above	852	69.9
Gender		
Male	1049	86.1
Female	170	16.9
Primary income		
Yes	733	60.2
No	485	39.8
Membership in association		
Yes	501	41.1
No	719	58.9
Production System		
Intensive	1113	91.3
Semi-intensive	106	8.7
Stocking practice		
Local source	610	50.1
Imported	609	49.9
Feed		
Commercial	596	48.8
Own production	523	51.1

Analysis of farmers' characteristics shows that broiler chicken farms in Ghana are mostly (86 percent) owned by male while the remaining 14 percent are owned by women; 69 percent of broiler chicken farmers in Ghana attained at least secondary level of education. Approximately, 60 percent of broiler chicken farmers in Ghana earn their primary income from broiler chicken farming, 39 percent have additional sources of income. The majority (93 percent) of broiler chicken farmers in Ghana own one farm; about 42 percent of broiler chicken farmers are members of farmers' association while 58 percent do not belong to the association. Approximately, 48 percent of broiler chicken farmers in Ghana have less than 10 years of experience operating a broiler chicken farm, while additional 42 percent have between 10 – 25 years of experience. Also, about 51 percent of broiler chicken farmers produce their feed with 49 percent buying commercial feed. Majority of the farms make use of intensive production systems while 50 percent source their day-old chicks from local hatcheries.

The next sets of tables address broiler chicken farms characteristics in Ghana. First, Table 4.3 shows the average price of broiler chicken by regions. The average broiler price in Greater Accra is GHS 36.6 with standard deviation of GHS 3.72 compared to Brong Ahafo with average price of GHS 29.80 per bird and standard deviation of GHS 4.96. For Northernmost Regions (combination of Northern, Upper East, and West Regions) with the lowest number of farms, the average broiler price is GHS 29.20 with standard deviation of GHS 5.86. Also, the Eastern Region has the highest number of farms (246) with an average price of GHS 36.30 and standard deviation of GHS 3.70. Overall the national average gross margin is GHS 35.13 with standard deviation of GHS 4.87.

Table 4.3 Summary Statistics for Average Price of Broiler Chicken by Regions (GHS)

Regions	N	Mean	Std. Dev.	Min	Max
Ashanti	165	34.3	4.93	23.00	40.00
Brong Ahafo	167	29.8	4.96	17.50	40.00
Central	188	36.8	3.87	25.00	43.50
Eastern	246	36.3	3.70	24.40	44.00
Greater Accra	241	36.6	3.72	20.00	40.00
Northernmost	30	29.2	5.86	20.00	39.00
Volta	57	36.7	4.67	25.00	41.50
Western	125	36.3	3.59	25.00	40.00
Total	1219	35.13	4.87	17.50	44.00

Table 4.4 presents the test results for the statistical differences in average price for boiler chicken (per bird) by Regions. The results show that Brong Ahafo is statistically different from other Regions except with Northernmost Region. Ashanti Region is statistically different from all other regions. Central Region is statistically different from other Regions with the exception of Eastern, Greater Accra, Western and Volta Region. Eastern Region is statistically different from other Regions except with Greater Accra, Western and Volta Region.

Table 4.5 shows the cost of labor for Ghana broiler production where the average cost of labor in Brong Ahafo is GHS 1.36 with standard deviation of GHS 0.89. For Northernmost Regions (combination of Northern, Upper East, and West Regions) with the lowest number of farms, the average labor cost is GHS 1.34 with standard deviation of GHS 0.98. Greater Accra Region has an average labor cost of GHS 1.65 with a standard deviation of GHS 1.54. Overall the national average labor cost is GHS 1.63 with standard deviation of GHS 1.36.

Table 4.4 Statistical Differences of Average Price by Regions

Regions	Brong Ahafo	Ashanti	Central	Eastern	Greater Accra	Northern most	Western
Ashanti	8.228***						
	(0.000)						
Central	14.573***	5.067***					
	(0.000)	(0.000)					
Eastern	15.279***	4.812***	-0.889				
	(0.000)	(0.000)	(0.374)				
Greater Accra	15.800***	5.421***	-0.126	0.828			
	(0.000)	(0.000)	(0.899)	(0.407)			
Northernmost	-0.596	-5.030***	-9.041***	-9.246***	-9.541***		
	(0.551)	(0.000)	(0.000)	(0.000)	(0.000)		
Western	12.337***	3.819***	-0.880	-0.141	-0.827	8.440***	
	(0.000)	(0.000)	(0.379)	(0.887)	(0.408)	(0.000)	
Volta	9.180***	3.235**	0.065	0.638	0.150	6.508***	0.668
	(0.000)	(0.001)	(0.947)	(0.523)	(0.880)	(0.000)	0.5048

The probability that Pr>|t| is presented in brackets. *=10%; ** = 5%; *** =1%.

Table 4.5 Summary Statistics for Labor Cost per Bird by Regions (GHS)

Regions	**N**	**Mean**	**Std. Dev.**	**Min**	**Max**
Ashanti	165	2.09	1.70	1.07	8.00
Brong Ahafo	167	1.36	0.89	1.07	7.28
Central	188	1.60	1.32	1.07	7.75
Eastern	246	1.54	1.22	1.07	7.28
Greater Accra	241	1.65	1.54	1.07	7.95
Northernmost	30	1.34	0.98	1.07	6.15
Volta	57	1.54	1.44	1.07	7.28
Western	125	1.65	1.22	1.07	6.87
Total	1219	1.63	1.36	1.07	8.00

Table 4.6 shows the DOC cost with the average cost in Brong Ahafo of GHS 3.66 per bird with standard deviation of GHS 0.67. For Northernmost Regions (combination of Northern, Upper East, and West Regions) with the lowest number of farms, the average DOC cost per bird is GHS 3.35 with standard deviation of GHS 0.86. Also, the Eastern Region has an average DOC cost of GHS 4.63 and standard deviation of GHS 0.75. Overall the national average DOC cost is GHS 4.35 with standard deviation of GHS 0.85.

Table 4.6 Summary Statistics for Day-Old Chicks' Price by Regions (GHS)

Regions	N	Mean	Std. Dev.	Min	Max
Ashanti	158	3.97	0.89	0.40	6.80
Brong Ahafo	165	3.66	0.67	0.40	6.00
Central	179	4.46	0.63	1.50	6.00
Eastern	245	4.63	0.75	2.00	7.00
Greater Accra	221	4.75	0.65	1.50	7.00
Northernmost	22	3.35	0.86	0.40	4.00
Volta	55	4.71	1.15	0.50	8.00
Western	124	4.37	0.75	3.00	6.00
Total	1169	4.35	0.85	0.40	8.00

Feed cost is highlighted in Table 4.7 where the average cost of feed for Brong Ahafo is GHS 19.70 per bird and standard deviation of GHS 5.88. For Northernmost Regions (combination of Northern, Upper East, and West Regions) with the lowest number of farms, the average feed cost per bird is GHS 22.00 with standard deviation of GHS 4.48. Greater Accra Region has an average feed cost of GHS 19.66 with a standard deviation of GHS 6.01. Overall the national average feed cost is GHS 19.59 with standard deviation of GHS 6.00.

Table 4.7 Summary Statistics for Feed Cost per Bird by Regions (GHS)

Regions	N	Mean	Std. Dev.	Min	Max
Ashanti	162	21.10	4.96	9.75	24.00
Brong Ahafo	164	19.70	5.88	9.75	29.81
Central	184	19.29	6.36	9.75	29.88
Eastern	243	18.54	6.25	9.75	28.75
Greater Accra	237	19.66	6.01	10.00	29.61
Northernmost	30	22.00	4.48	9.75	24.00
Volta	56	17.29	6.42	10.00	24.80
Western	124	20.30	5.80	10.00	29.81
Total	1200	19.59	6.00	9.75	29.88

Table 4.8 presents the test results for the statistical differences in feed cost per bird between Regions. The results show that Brong Ahafo is statistically different from other Regions except with Western, Greater Accra, Eastern, and Central Regions. Ashanti Region is statistically different from other Regions except with Northernmost and Western Region. Central Region is statistically different from other Regions with the exception of Eastern, Greater Accra, and Western Region. Eastern Region is statistically different from other Regions except with Greater Accra and Volta Region.

Table 4.9 presents the veterinary cost for broiler chicken production per bird. The average veterinary cost for Brong Ahafo is GHS 1.41 per bird with a standard deviation of GHS 1.73. For Northernmost Regions (combination of Northern, Upper East, and West Regions) with the lowest number of farms, the average veterinary cost per bird is GHS 0.23 and standard deviation of GHS 0.29. Also, Eastern Region has an average cost of GHS 0.63 and standard deviation of GHS 1.14. Overall the national average veterinary cost is GHS 0.81 with standard deviation of GHS 1.33.

Table 4.8 Statistical Difference of Feed Cost Per Bird by Regions

Regions	Brong Ahafo	Ashanti	Central	Eastern	Greater Accra	Northernmost	Western
Ashanti	2.311** (0.021)						
Central	-0.631 (0.528)	-2.923** (0.003)					
Eastern	-1.880 (0.060)	-4.366*** (0.000)	-1.208 (0.227)				
Greater Accra	-0.077 (0.938)	-2.522** (0.012)	0.609 (0.542)	1.989 (0.047)			
Northernmost	2.030** (0.043)	0.927 (0.354)	2.244** (0.025)	2.935** (0.003)	2.063** (0.040)		
Western	0.866 (0.387)	-1.243 (0.214)	1.428 (0.154)	2.618** (0.009)	0.987 (0.324)	-1.494 (0.137)	
Volta	-2.587** (0.010)	-4.573*** (0.000)	-2.051** (0.041)	-1.344 (0.179)	-2.615** (0.009)	-3.572*** (0.000)	-3.123** (0.002)

The probability that Pr>|t| is presented in brackets. *=10%; ** = 5%; *** =1%.

Table 4.9 Summary Statistics for Veterinary Cost per Bird by Regions (GHS)

Regions	**N**	**Mean**	**Std. Dev.**	**Min**	**Max**
Ashanti	162	1.54	1.73	0.01	5.08
Brong Ahafo	164	1.41	1.73	0.01	5.08
Central	184	0.47	0.99	0.00	5.08
Eastern	243	0.63	1.14	0.03	5.08
Greater Accra	237	0.59	0.98	0.01	5.08
Northernmost	30	0.23	0.29	0.04	1.37
Volta	56	0.61	1.15	0.05	4.66
Western	124	0.58	1.09	0.01	5.08
Total	1200	0.81	1.33	0.00	5.08

4.3 Profitability of Broiler chicken farmer in Ghana across regions

This section discusses the gross margin per bird calculated for broiler chicken farmers across Regions in Ghana. Table 4.10 shows the gross margin per bird by Regions for broiler chicken production in Ghana. The average gross margin for Brong Ahafo is GHS 4.10 per bird, with a standard deviation of GHS 7.98. For Northernmost Regions (combination of Northern, Upper East, and West Regions) with the lowest number of farms, the average gross margin is GHS 3.17, with standard deviation of GHS 7.28. Also, Eastern Region has an average gross margin of GHS 11.25 with a standard deviation of GHS 7.56. Overall the national average gross margin is GHS 9.22 with standard deviation of GHS 8.40.

Table 4.10 Summary Statistics for Gross Margin per Bird by Regions (GHS)

Regions	N	Mean	Std. Dev.	Min	Max	Median
Ashanti	165	6.16	8.78	-12.13	35.62	5.82
Brong Ahafo	167	4.10	7.98	-17.09	30.52	3.54
Central	188	11.48	7.66	-5.36	35.42	10.06
Eastern	246	11.25	7.56	-8.18	35.42	9.92
Greater Accra	241	10.70	8.13	-10.79	34.42	9.84
Northernmost	30	3.17	7.28	-5.37	21.51	1.39
Volta	57	13.04	8.24	-5.16	26.37	13.74
Western	125	9.58	7.13	-7.83	34.92	8.95
Total	1219	9.22	8.40	-17.09	35.62	7.90

Table 4.11 presents the test results for the statistical differences in gross margin per bird between Regions. The results show that Brong Ahafo and Ashanti Region are statistically different from other Regions except for Northernmost Region. Central Region is statistically different from other Region with the exception of Eastern, Greater Accra, and Volta Region. Eastern Region is statistically different from other Regions except with Greater Accra and Volta Region.

Table 4.11 Statistical Difference of Gross Margin Per Bird by Regions

Regions	Brong Ahafo	Ashanti	Central	Eastern	Greater Accra	Northernmost	Western
Ashanti	2.239**						
	(0.025)						
Central	8.879***	6.075***					
	(0.000)	(0.000)					
Eastern	9.215***	6.261***	-0.309				
	(0.000)	(0.000)	(0.756)				
Greater Accra	8.118***	5.343***	-1.010	-0.774			
	(0.000)	(0.000)	(0.313)	(0.439)			
Northernmost	-0.592	-1.756	-5.550***	-5.541***	-4.831***		
	(0.553)	(0.080)	(0.000)	(0.000)	(0.000)		
Western	6.068***	3.551***	-2.208**	-2.049**	-1.302	4.398***	
	(0.000)	(0.000)	(0.028)	(0.041)	(0.193)	(0.000)	
Volta	7.238***	5.176***	1.324	1.581	1.948	5.516***	2.888**
	(0.000)	(0.000)	(0.186)	(0.114)	(0.052)	(0.000)	(0.004)

The probability that Pr>|t| is presented in brackets. *=10%; ** = 5%; *** =1%.

4.4 Model specification

This section discusses the various method used in specifying the model. The model fit was tested using link test as well as tests for multicollinearity and heteroskedasticity. Multicollinearity exists in a model when two or more of the independent variables are highly correlated to each other. On the other hand, the presence of heteroskedasticity violates one of the assumptions of the ordinary least square regression that says that the variance of error terms is constant. If multicollinearity and heteroskedasticity are present in a model they produce biased and misleading parameter estimates making the regression coefficients unreliable. Results of these tests are discussed below.

4.4.1 Link test

This test is used to check whether the model is correctly specified. The test regresses the dependent variable on its predicted values (hat) and the square of its predicted values (Hatsq). If the model is not misspecified, then the predicted values will be the only variable that statistically significant. Table 4.12 shows that this is indeed the case, with the t-value for the predicted values estimated at 4.94, indicating a statistical significance at the 1% level, while the hatsq and the intercept are both not statistically significant. Therefore, the model as presented is not misspecified.

Table 4.12 Result for Link Test

Variables	**Coefficients**	**Std. Error**	**t**	**P>|t|**
hat	1.32	0.268	4.94	0.000
hatsq	-0.01	0.015	-1.23	0.217
Cons	-1.06	1.034	-1.03	0.301
Observation = 1219				
R squared =– 0.20				
F (2,1216) = 156				

4.4.2 Multicollinearity and Heteroskedasticity test

Following the test for the overall fit of the model, the correlation among the variables is examined using the Variable Inflation Factor (VIF) test in Table 4.13. The test tells us whether the standard errors are being inflated by any variables. The general rule of thumb is that a value of one shows no correlation among variables, a value above 4 needs to be investigated while a value above 10 shows signs of multicollinearity (Montgomery et al. 1982). Such variable needs to be dropped to correct for multicollinearity in the model. From the result of the test, the mean VIF's values were 1.35 showing that there is no multicollinearity in the model. Furthermore, the Breusch-

Pagan/Cook-Weisberg test for heteroskedasticity was done to determine if the variance of the error term is constant and efficient. Based on the result (0.067), the null hypothesis of constant variance was rejected showing the presence of heteroskedasticity and can be corrected by using a robust regression approach.

Table 4.13 Variable Inflation Factor Results

Variable	**VIF**	**1/VIF**
Location of the farm	1.07	0.935
Experience	1.11	0.900
Primary Income	1.04	0.961
Educational level	1.05	0.955
Production system	1.07	0.930
Feed	1.18	0.845
Association Membership	1.10	0.911
Farm size	1.09	0.916
Stocking practice	1.04	0.965
Regions		
Ashanti	1.77	0.565
Northernmost	1.19	0.837
Central	1.90	0.525
Eastern	2.10	0.475
Greater Accra	2.12	0.470
Volta	1.30	0.770
Western	1.62	0.619
Mean	**1.35**	0.741

4.5 Regression Results

One of the objectives of this study is to estimate the effect of farm characteristics, socio-economic and demographic characteristics of farmers on profitability and explore the effect of regional location. The analysis was carried out using Ordinary Least Square regression with variables such as gross margin/bird (dependent variable), location of farm, regions, farmer's experience, primary income, educational level, feed, membership in poultry association, farm size and stocking practice. It was expected that farm income, educational level, farm size, farmer's experience will have a positive effect on gross margin/bird while feed will have a negative impact on gross margin/bird.

However, the results indicate that holding all other things constant, the gross margin per bird for farms in rural areas is not statistically different from those in urban areas (Table 4.14). Likewise, the gross margin per bird for farms using the intensive production system and those using imported day-old chicks to stock their farms were not statistically different from those using the semi-intensive system and using local day-old chicks. Although it had been expected that education will have a positive effect on the profitability of farms, the results showed that there was no statistically significant difference between the gross margins per bird for farms with educated farmers and those without. The experience of the farmer was expected to have a positive effect on farm profitability. However, the results showed that experience did not have a statistically significant effect on profitability. Larger farms were also expected to exhibit scale economies and present higher profitability than small farms. However, the results indicated that there was no statistically significant difference between farms on the basis of their size. (Table 4.14)

Table 4.14 Regression Results for the Effect of Farm and Farmer Characteristics on Gross Margin/Bird (GHS/bird)

Variables	Coefficient	Robust Standard Error	P>|t|	Significance Level
Farm location (Rural = 0)				
1. Urban	-0.013	0.436	0.976	
Production System (Semi-intensive =0)				
1. Intensive system	0.408	0.821	0.620	
Feed	-0.056	0.005	0.000	***
Stocking practices (Imported =0)				
1. Local purchase	-0.009	0.434	0.983	
Regions (Brong Ahafo = 0)				
Ashanti	3.211	0.863	0.000	***
Northernmost	1.338	1.413	0.344	
Central	6.109	0.826	0.000	***
Eastern	6.263	0.762	0.000	***
Greater Accra	5.090	0.836	0.000	***
Volta	8.933	1.259	0.000	***
Western	4.721	0.885	0.000	***
Educational level (None & Primary =0)				
1. Secondary and above	-0.508	0.478	0.289	
Primary farm income (No = 0)				
1. Yes	-1.242	0.451	0.006	***
Farm size (Small-size = 0)				
1. Medium/Large scale	0.227	0.641	0.723	
Farmer's experience	-0.015	0.024	0.545	
Member of poultry association (No =0)				
1. Yes	-0.812	0.452	0.073	
F(16,1202)				
R-squared: 0.20				
Observation: 1219				

*=10% level of significance; ** = 5% level of significance; *** =1% level of significance

The coefficient for the farmer's primary income source was negative and statistically significant at 1 percent level. It showed that farmers for whom the farms were their primary income source had a gross margin per bird of GHS 1.24 lower than those with other sources of income, ceteris paribus. Type of feed used (whether produced on the farm or purchased) was defined as the proportion of feed that was produced on the farm, i.e., zero implies no on-farm feed production while 100 implies 100 percent on-farm feed production. The results showed that, on average, a unit increase in own feed production decreases gross margin by about GHS 0.06/bird, statistically significant at the 1 percent level. Since feed quality can be difficult to achieve and sustain when produced on-farm (Charo-Karisa et al. 2013), the foregoing results are not surprising. Thus, while farmers might save on feed cost by producing their feed on-farm, they lose in terms of probably using a lot more of it to achieve the same performance, leading to the negative and statistically significant effect of on-farm feed production on profitability. The elasticity of on-farm feed production on farm profitability was estimated at -0.64. That is, one percent increase in the proportion of feed used that is produced on-farm leads to 0.64 percent reduction in farm profitability, holding all other things constant. The proportion of feed produced on the farm has an inelastic effect on farm profitability.

The profitability of farms across the regions was compared to farms located in Brong Ahafo Region. The gross margin of farms located in Ashanti, Central, Eastern, Greater Accra, Volta and Western Region was higher than in the Brong Ahafo Region, and the difference was statistically significant at no less than 1 percent. For example, the average farm in Ashanti Region is expected to have a gross margin of GHS 3.21/bird higher than the average farm in Brong Ahafo, and this difference is statistically significant at the 1 percent level. Likewise, the gross margin of an average

farm in Eastern Region is higher than an average farm in Brong Ahafo by more than GHS 6.23 per bird.

The foregoing results, therefore, show that farmer characteristics were not statistically important in explaining broiler chicken farm profitability in Ghana except farmer's primary source of income. However, farm characteristics, such as regional location and the extent to which feed was prepared on the farm were statistically significant in explaining broiler chicken farm profitability in Ghana.

Chapter 5 - Conclusion and Recommendations

This section is divided into three parts. The first part will summarize the results, the next will provide the conclusions from the result. The final section offers the recommendation for further research

5.1 Summary of results

Broiler chicken was raised in all Regions in Ghana. Brong Ahafo, Greater Accra, Eastern and Western Regions accounted for more than two-thirds of total broiler chicken population in the country. The study found that broiler chicken production in Ghana was profitable, with an average national profitability of GHS 9.22/bird and average price of broiler chicken at GHS 35.13/bird respectively. Labor cost was similar across Regions with the national average cost per bird of GHS 1.63, average DOC cost of GHS 4.35, and average cost of veterinary was GHS 0.81. Feed which constituted the largest proportion of the variable cost had a national average cost of GHS 19.59 per bird.

The regression analyzed the effect of farm and farmer characteristics on farm profitability. The only farmer characteristic determined to influence farm profitability was whether the farm was the farmer's primary income source. The results showed that profitability, where the farm was the primary source of income, was GHS 1.24/bird lower than for those where the farm was not. We assessed feed from the perspective of the proportion of on-farm feed used. Thus, when a farmer did not use any on-farm produced feed but used all commercial feed, this variable was zero. And when they did not use any commercial feed, it was 100. The results showed that a percentage increase in the proportion of on-farm feed decreased profitability by GHS 0.06/bird. There were statistically significant regional effects when they were compared with Brong Ahafo by as much

as GHS 8.93/bird. For example, the profitability of farms in Greater Accra and Ashanti were statistically different from Brong Ahafo's profitability.

5.2 Conclusions

The objective of this study was to describe the farm and farmer characteristics of Ghana broiler farmers, measure the profitability of broiler chicken farms in Ghana, estimate the effect of farm characteristics, socio-economic and demographic characteristics of farmers on their profitability and also explore the effect of regional location. The study results showed that broiler production was mainly operated on a small scale basis and profitable as more than 70 percent of farmers recorded a positive gross margin/bird. Additionally, we conclude that these characteristics -feed, primary source of farm income and regional location were dominant and affected profitability in broiler chicken production. Such that on average, a unit increase in own feed production decreases gross margin while farmers with broiler chicken production as their primary income source had a lower gross margin compared to those with other sources of farm income.

5.3 Recommendation for Further Research

It is recommended that this study be repeated in two to three years to examine the robustness of these factors in explaining profitability. It is also suggested that alternative profitability measures be used to compare the explanatory power of the farm and farmer characteristics. For, it is possible that different profitability measures would be affected differently by these characteristics. The importance of repeating this research over time is to capture the dynamic effect of costs and industry changes on the explanatory variables. This will help policymakers to identify the necessity of changing specific policies in response to their effects on profitability.

The structure of the analytical model was such that the majority of the variables used in this study were binary. Future research could be designed to capture, wherever possible, these variables beyond their dichotomous forms. For instance, farmers' education may be presented in number of formal education so that the nuance of that can be estimated. Likewise, the proportion of farmers' household incomes accounted for by the broiler production activity may replace the binary of asking if the farm was farmers' primary income source. These continuous variables would allow for the proper estimation of profitability responses to changes these characteristics.

References

Adebayo, O., and Adeola, R. (2005) "Socio-economic factors affecting poultry farmer's in Ejigbo local government area of Osun State". *Journal of Human Ecology* 18.1 (2005): 39-41.

Altahat, E., AL-Sharafat, A., and Altarawneh, M. (2012) "Factors Affecting Profitability of Layer Hens Enterprises". *American Journal of Agricultural and Biological Sciences.* 7 (1): 106-113, 2012 ISSN 1557-4989 © 2012 Science Publications.

Amanor-Boadu, V., Nti, F., and Ross, K. (2016) "Structure of Ghana's Chicken industry in 2015" METSS. October 2016.

Amos, T. (2006) "Analysis of backyard poultry production in Ondo State, Nigeria". *International Journal of Poultry Science* 5.3 (2006): 247-250.

Anang, T., Cosmos, Y., and Agbolosu, A. (2013). "Profitability of broiler and layer production in the Brong Ahafo region of Ghana". ARPN *Journal of Agricultural and Biological Science*. Vol. 8, No. 5, May 2013.

Artz, G., Kim, Y., and Orazem, P. (2016). "Does agglomeration matter everywhere? New firm location decisions in rural and urban markets". *Journal of Regional Science*, 56: 72–95. doi:10.1111/jors.12202.

Atuahene, C., Attoh-Kotoku, V., and Mensah, J. (2010). "Poultry production in Ghana: Prospects and challenges" *Ghana Journal of Animal Science*, 5(2010, 2): 93-99.

Babatunde, R., Oladipo, O., and Adekunle, A. (2015). "Determinants and effect of livelihood diversification among small-scale poultry farmers in Oyo State, Nigeria". *Ethiopian Journal of Environmental Studies and Management*. Volume 8. Pg 782 – 792.

Basarir, A., and Gillespie, J. (2006) "Multidimensional goals of beef and dairy producers: An inter-industry comparison. *The Journal of the International Association of Agricultural Economists.* Volume 35, issue 1, July 006. Pages 103-114.

Bell, J. (2009). "Factors limiting production efficiency and profitability from smallholder poultry production". *World's Poultry Science Journal*, Vol. 65, June 2009.

Bucyana, J. (2012). “Poultry and social economic rural development”. BSc dissertation submitted to the National University of Rwanda.

Briggeman, B. (2011). “The Importance of Off-Farm Income to Servicing Farm Debt”. *Econometric Reviews*. 2011.

Charo-Karisa, H., Opiyo, M., Munguti, J., Marijani, E., and Nzayisenga L. (2013) “Cost-benefit analysis and growth effects of pelleted and unpelleted on-farm feed on African catfish (Clarias gariepinus Burchell 1822) in earthen ponds”. *African Journal of Food, Agriculture, Nutrition, and Development.* Volume 13, No 4, 2013.

Dartt, B., Lloyd, J., Radke, B., Black, J., and Kaneene, J. (1999) A comparison of profitability and economic efficiencies between management-intensive grazing and conventionally managed dairies in Michigan. *Journal of Dairy Science.* 82(11):2412–2420.

Darush, Y., (2013) "Profitability determinants among micro firms: evidence from Swedish data", International Journal of Managerial Finance, Vol. 9 Issue: 2, pp.151-160, https:// doi.org/10.1108/17439131311307565.

Dorji, N. and Gyeltshen, T. (2012) “Characterization of family poultry production in Haa and Mongar districts of Bhutan”. Livestock Research for Rural Development 24 (9) 2012.

Dziwornu, K., 2014) “Econometric analysis of factors affecting competitive advantage of broiler agribusinesses in Ghana”. *Journal of Development and Agricultural Economics*, Vol. 6(2), pp. 87-93, February 2014 DOI: 10.5897/JDAE2013.0527 ISSN 2006-9774, 2014 Academic Journals.

Dziwornu, K., and Sarpong, D. (2014). “Application of the stochastic profit frontier model to estimate economic efficiency in small-scale broiler production in the Greater Accra region of Ghana”. *Review of Agricultural and Applied Economics* ISSN 1336-9261, XVII (Number 2, 2014): 10-16 doi: 10.15414/raae.2014.17.02.10-16.

Dziwornu, R. (2014). “Econometric analysis of factors affecting competitive advantage of broiler agribusinesses in Ghana” Journal of Development and Agricultural Economics. Vol. 6(2), pp. 87-93, February 2014.

Eghan, M. (2012). The Effects of Food Price Changes on Household Food Consumption in Ghana,

Unpublished Master of Philosophy Thesis, University of Ghana, Legon, Accra, Ghana.

El-Tahawy, A. (2017). Effect of flock size on the productive and economic efficiency of Ross 308 and Cobb 500 broilers. *European Poultry Science Journal*. 81. 2017, ISSN 1612-9199.

Emaikwu, K., Chikwendu, D., and Sani, A. (2011). **"**Determinants of flock size in broiler production in Kaduna State of Nigeria". *Journal of Agricultural Extension and Rural Development,* Vol. 3(11), pp. 202-211, October 2011 Available online http://academicjournals.org/JAERD ISSN- 2141 -2154 ©2011 Academic Journals.

Esiobu, N., Nwosu, C., and Onubuogu, G. (2014). "Economics of Pineapple Marketing in Owerri Municipal Council Area, Imo State, Nigeria". *International Journal of Applied Research and Technology.* 3(5): 3 – 12.

Etuah, S., Gyiele, K., and Akwasi, O. (2013). "Profitability and Constraints of Broiler Production: Empirical Evidence from Ashanti Region of Ghana". *Journal of Business & Economics*. Vol.5 No.2 (July-December 2013) pp. 228-243.

FAO. 2014. Poultry Sector Ghana. FAO Animal Production and Health Livestock Country Reviews. No. 6. Rome.

FAOSTAT (2015). Statistics Division of the Food and Agriculture Organization of the United Nations. Rome, Italy.

Feed the Future. 2011. Ghana: FY 2011-2015 Multi-Year Strategy. Feed the Future.

Fernandez-Cornejo, J., Hendricks, C., and Mishra, A. (2005) "Technology adoption and off-farm household income: the case of herbicide-tolerant soybeans". *Journal of Agricultural Applied Economics*. 37(3):549–563.

Foltz, J., and Chang, H. (2002) "The adoption and profitability of rbST on Connecticut dairy farms". *American Journal of Agricultural Economics*. 84(4):1021–1032.

Gale, F., Hansen, J., and Jewison, M. (2015). "China's Growing Demand for Agricultural Imports", EIB-136, U.S. Department of Agriculture, Economic Research Service, February. http://www.ers.usda.gov/publications/eib-economic-information-bulletin/eib136.aspx.

Gale, F. and Arnade, C. (2015) "Effects of Rising Feed and Labor Costs on China's Chicken Price". *International Food and Agribusiness Management Association* (IFAMA), Volume 18 Special Issue A, 2015).

Ganesan, P. (2001). "Determinants of profits and profitability of public sector banks in India: A profit function approach". *Journal of Financial Management & Analysis, 14*(1), 27-37.

Gloy, B., Hyde, J., and LaDue, E. (2002). "Dairy Farm Management and Long-Term Farm Financial Performance". *Agricultural and Resource Economics Review.* 31/2 (October 2002).

Gocsik, É., Kortes, H., Oude Lansink, A., and Saatkamp, H. (2014). "Effects of different broiler production systems on health care costs in the Netherlands". *Poultry Science*, Volume 93, Issue 6, 1 June 2014, Pages 1301–1317.

Goetz, S., and Debertin, D. (2001). "Why Farmers Quit: A County-Level Analysis". *American Journal of Agricultural Economics, 83*(4), 1010-1023.

Hawawini, G., Subramanian, V. and Verdin, P. (2003). Is performance driven by industry-or firm-specific factors? A new look at the evidence. *Strategy Management Journal*. 24: 1–16. doi:10.1002/smj.278.

Hirsch, S., Schiefer, J., Gschwandtner, A. and Hartmann, M. (2014). The Determinants of Firm Profitability Differences in EU Food Processing. *Journal of Agricultural Economics*, 65: 703–721. doi:10.1111/1477-9552.12061.

HLPE. 2016. "Sustainable agricultural development for food security and nutrition: what roles for livestock?" A report by the high-level panel of experts on food security and nutrition of the committee on world food security, Rome.

Isika, M., Agiang, E., and Okon, B. (2006). "Dietary Energy and Crude Protein Requirements for Chicks of Nigeria Local Fowl and Crossbreeds". *International Journal of Poultry Science*. 5: 271-274.

Jackson-Smith, D., Trechter, D., Splett, N. (2004). The contribution of financial management training and knowledge to dairy farm financial performance. *Review of Agricultural Economics*. 26(1):132–147.

Johnson, M. (2009). "Why Did the Chicken Cross the Border? An Investigation of Government Responses to Import Surges in Senegal, Cameroon and Ghana". Paper presented at the Annual Meeting of the American Political Science Association, Toronto, Canada.

Kwadzo, G., Dadzie, F., Osei-Asare, Y., and Kuwornu, J. (2013). "Consumer Preference for Broiler Meat in Ghana: A Conjoint Analysis Approach". *International Journal of Marketing Studies* 5(2): 66-73.

Leigh, A. and Gugerty, M. (2010). "Poultry Market in West Africa: Ghana". *Evans School Policy Analysis and Research (EPAR),* May 28, 2010.

Livezey, J., and Foreman, L. (2003). "Factors Contributing to Financially Successful Southern Rice Farms USDA-ERS". Selected paper prepared for presentation at the Southern Agricultural Economics Association Annual Meeting February 1 – 5, 2003 Mobile, Alabama.

Mahama, E., Andah, E., Amegashie, D., and Mensah-Bonsu, A. (2013). "Break-even analysis of broiler production in the Accra-Tema and Kumasi areas." 1st Annual International Interdisciplinary Conference, AIIC 2013, 24-26 April, Azores, Portugal.

McBride, W., El-Osta, H. (2002) Impacts of the adoption of genetically engineered crops on Farm financial performance. *Journal of Agricultural Applied Economics*. 34(1):175–192.

McBride, W., Short, S., and El-Osta, H. (2004). The adoption and impact of bovine somatotropin on US dairy farms. *Review of Agricultural Economics*. 26(4):472–488. doi: 10.1111/j.1467-9353.2004.

Mensah, S., Affedzie-Obresi, S., and Agbekpornu, H. (2013). "Determinants of Consumer Patronage for Ghana Grown Chicken" *International Journal of Science and Research* (IJSR), ISSN (Online): 2319-7064.

Mishra, A., El-Osta, H., and Steele, C. (1999). "Factors Affecting the Profitability of Limited Resource and Other Small Farms". *Agricultural Finance Review*. Vol 59, 1999.

Mishra, A., Wilson, C., and Williams, R. (2009) Factors affecting financial performance of new and beginning farmers. Agricultural Finance Review 69(2):160–179.

Monitoring Evaluation and Technical Support Services (METSS) and Joseph Wise Seyram Klu 2015. Ghana Poultry c Protocol.

Monitoring Evaluation and Technical Support Services (METSS), Kansas State University.

Montgomery, D., and Peck, E. (1982). Introduction to Linear Regression Analysis. John Wiley & Sons.

Nehring, R., Gillespie, J., Harris, J., and K. Erickson. (2014). "What's driving economic and financial success of U.S. cow-calf operations? *"Agricultural Finance Review* 74(3):311-325.

Nehring, R., Gillespie, J., Katchova, A., Hallahan, C., Harris, J. and Erickson, K. (2016) "What's Driving U.S. Broiler Farm Profitability?" *International Food and Agribusiness Management Review.* Volume 18 Special Issue A. 2015.

Nourou, M. (2015) "Can Mastitis 'Contaminate' Poultry? Evidence on the transmission of Volatility between Poultry and Other Commodity Prices". *International Food and Agribusiness Management Review. Volume 18 Special Issue A*, *2015.*

Nwajiuba, C., Nwoke, E. (2000). "Inflation and the Poultry Industry in Nigeria: Implications for profitability". In: Orji, U.I., Mgbere, O.O. (eds) Proceedings of the 5th Annual Conference of the Animal Science Society of Nigeria. Port Harcourt, Nigeria, pp. 206-208.

Ofuoku, A., Okpara, O., and Obakanurhe, O. (2016). "Impact of Rural-Urban Migration on Poultry Production in the Niger Delta Region, Nigeria". *International Journal of Agricultural Science, Research, and Technology in Extension and Education Systems*. Available online at http://ijasrt.iau-shoushtar.ac.ir.

Onubuogu, G., Esiobu N., Nwosu C., and Okereke C. (2014). "Resource use efficiency of smallholder cassava farmers in Owerri Agricultural zone, Imo State, Nigeria'. *Scholarly Journal of Agriculture. Science. Vol*. 7(8), Pg. 142-152.

Osei-Asare, Y. and Eghan, M., (2013), The Effects of Food Price Increases on Urban Household Food Commodities Expenditures in Ghana, *Journal of Economics and Sustainable Development*, 4(6), 70 – 83.

Osei-Asare, Y. and Eghan, M., (2014), "Meat Consumption in Ghana, Evidence from Household Micro-Data". *The Empirical Economics Letters*, 13(2): (February 2014) ISSN 1681 8997.

Palinkas L., Horwitz S., Green C., Wisdom, J., Naihua, D., and Hoagwood, K. (2013). "Purposeful Sampling for Qualitative Data Collection and Analysis in Mixed-Method Implementation Research". *Administration and Policy in Mental Health.* DOI 10.1007/s10488013-0528-y

Pasiourasa, F., and Kosmidoua, K. (2007) "Factors influencing the profitability of domestic and foreign commercial banks in the European Union*" Research in International Business and Finance*, 21 (2007) 222–237.

Petersen, J., McAlister, L., Reibstein, D., Winer, R., Kumar, V., and Atkinson, G. "Choosing the Right Metrics to Maximize Profitability and Shareholder Value". *Journal of Retailing*, Volume 85, Issue 1, 2009, Pages 95-111, ISSN 0022-4359.

Randolph, T., Schelling, D., Grace, C., Nicholson, J., Leroy, D., Cole, M., Demment, A., Omore, J., Zinsstag, J., and Ruel, M. (2007). "Role of livestock in human nutrition and health for poverty reduction in developing countries". *Journal of Animal Science.* 85:2788-2800. doi:10.2527/jas.2007-0467.

Ray, V., and Roy, L. (1991). "The Agriculture Dictionary" (Second Edition). Published by Delmar Publishers Inc. Albany, New York.

Ruchi, J., Yogendra, S., Singh, R., Deshmuk , N., Chikitsa, P., and Vishwavidyalaya, V. (2014). Backyard Poultry Farming—A Tool for Women Empowerment.

Singh, V., Sharma, V., Sidhu, M., and Kingra, H. (210). Broiler Production in Punjab-An Economic Analysis. *Agricultural Economics Research Review*. 23:315-324.

Stefanides, Z., and Tauer L. (1999) "The empirical impact of bovine somatotropin on a group of New York dairy farms". *American Journal of Agricultural Economics.* 81(1):95–102.

Stierwald, A. (2010), "The causes of profit heterogeneity in large Australian firms", Working Paper No. 7/10, Melbourne Institute of Applied Economic and Social Research, University of Melbourne, Melbourne.

Sumberg, J., Awo, M., Fiankor, D., Kwadzo, G., and Thompson, J. (2013) "Ghana's Poultry Sector: Limited Data, Conflicting Narratives, Competing Visions," STEPS Working Paper 56, Brighton: STEPS Centre.

Taha, F., and Hahnb, W. (2015). "Factors Driving South African Poultry and Meat Imports". *International Food and Agribusiness Management Review.* Volume 18 Special Issue A, 2015.

Tey, Y., and Brindal, M. (2015) Factors Influencing Farm Profitability. In: Lighthouse E. (eds) *Sustainable Agriculture Reviews*. Vol 15. Springer.

Tuffour, M., and Boahen, A., (2014). "Profit efficiency in broiler production: Evidence from Greater Accra region of Ghana". *International Journal of Food and Agricultural Economics* (IJFAEC), 1, vol. 2, issue 1, 2014.

UN Comtrade (2015). International Trade Statistics Database accessed at https://comtrade.un.org/

USDA. 2014. Grain and Feed Annual Report. http://gain.fas.usda.gov/Recent%20GAIN%20Publications /Grain%20and%20Feed%20Annual_Lagos_Nigeria_3-13-2014.pdf.

Valdesa, C., Hallahanb, C. and Harveyc, D. (2015). "Brazil's Broiler Industry: Increasing Efficiency and Trade". *The International Food and Agribusiness Management Review* 18(A):263-275 · January 2015.

Weible, D., and Pelikan, J. (2016). "Imported chicken meat in Ghana: A threat for domestic producers and a blessing for consumers?" Presented at the 19th Annual Conference on Global Economic Analysis, "Analytical Foundations for Cooperation in a Multipolar World" Washington, USA, June 15-17, 2016.

Winsten, J., Parsons, L., and Hanson, G. (2000). "A profitability analysis of dairy feeding systems in the Northeast". *Agricultural Resources Economics Review.* 29(2):220–228.

World Poultry. (2013). Feed Prices Stunt Poultry industry growth in Nigeria. http://www.poultryworld.net/Meat/Articles/2013/3/Feed-prices-stunt-poultry-industry-growth-in-Nigeria-1190867W/

Xie, C., and Marchant, M. (2015). "Supplying China's Growing Appetite for Poultry". *International Food and Agribusiness Management Review. Volume 18 Special Issue A, 2015.*

Zagata, L., and Sutherland, L. (2015) Deconstructing the 'young farmer problem in Europe': Towards a research agenda. *Journal of Rural Studies*. Volume 38, 2015, Pages 39-51, ISSN 0743-0167, https://doi.org/10.1016/j.jrurstud.2015.01.003.

Zereyesus, Y. A., K. L. Ross, V. Amanor-Boadu, and T. J. Dalton. "Baseline Feed the Future Indicators for Northern Ghana*, 2012"* Kansas State University, Manhattan, KS, March 2014.

Zouaghi, F., Sanchez-Garcia, M., and Hirsch, S. (2017). "What drives firm profitability? A Multilevel Approach to the Spanish Agri-food sector". *Spanish Journal of Agricultural Research*. Volume 15, Issue 3, e0117, Dec 2017. ISSN 2171-9292.