# Structure of Ghana's Chicken Industry in 2015

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# Structure of Ghana's Chicken Industry in 2015

## Introduction

Chicken consumption in Ghana has been increasing over the past several decades and so has production. Domestic chicken meat supply increased from about 4,808 metric tonnes in 1961 to nearly 47,384 metric tonnes by 2013, increasing at an average rate of about 3.6 percent per annum over the period.[1] As elegant as this might seem on its own, production has not kept pace with consumption, leading to a rapid increase in the importation of processed chicken products. For example, between 1991 and 2015, the volume of fresh, chilled and frozen chicken product imports into Ghana grew at an average annual rate of 15.2 percent per annum.[2] Using FAOStat data, the import penetration ratio, defined as total imports divided by total domestic production, was estimated to increase from about 100 percent in 1991 (i.e., Ghana was importing as much as it was producing) to 438.5 percent. That is, by 2013 Ghana was importing about 4.4 tonnes of fresh, chilled and frozen chicken products for every metric tonne it produced.

Ghana's chicken meat situation is actually worse when looked at over the long term and through the industry's productivity lens. Productivity in the poultry industry is measured as meat per carcass weight. Average productivity in Ghana's chicken industry has been virtually flat over the past five decades, averaging about 0.14 percent per annum. More seriously, when productivity over time is indexed to 1961, i.e., 1961 = 100, then Figure 1 shows that the productivity in recent years has fallen below 100 percent, averaging about 92.8 percent between 2009 and 2013. We also assess Ghana's productivity trend against Brazil's, which like Ghana was a largely domestic producer in the 1960s. Over the fast five decades, Brazil has emerged as a major chicken meat exporter, exporting more than 4 million metric tonnes in 2015, more than a million metric tonnes than the U.S. and almost 3 million metric tonnes more than EU-27 (USDA, 2016).[3] In 1961, Ghana's chicken industry's productivity was about 80 percent of Brazil's. Figure 1, however, shows that Ghana's productivity has been declining against Brazils over the past several decades. By 2013, Ghana's chicken productivity was 32.1 percent of Brazil's, a decline of nearly 60 percent since 1961.

The high import penetration ratio seems to support a belief that developing and implementing policies that would support growth in Ghana's chicken production would be beneficial to the industry's stakeholders. For example, it could create opportunities for income enhancement among chicken producers whose production begin to replace some of the imports. Additionally, it could create opportunities upstream in the grain and oilseed supply chains, extending income enhancement outside the poultry industry. Furthermore, it may be expected to produce downstream benefits through expansion in primary and secondary poultry processing, the development of a packaging industry and

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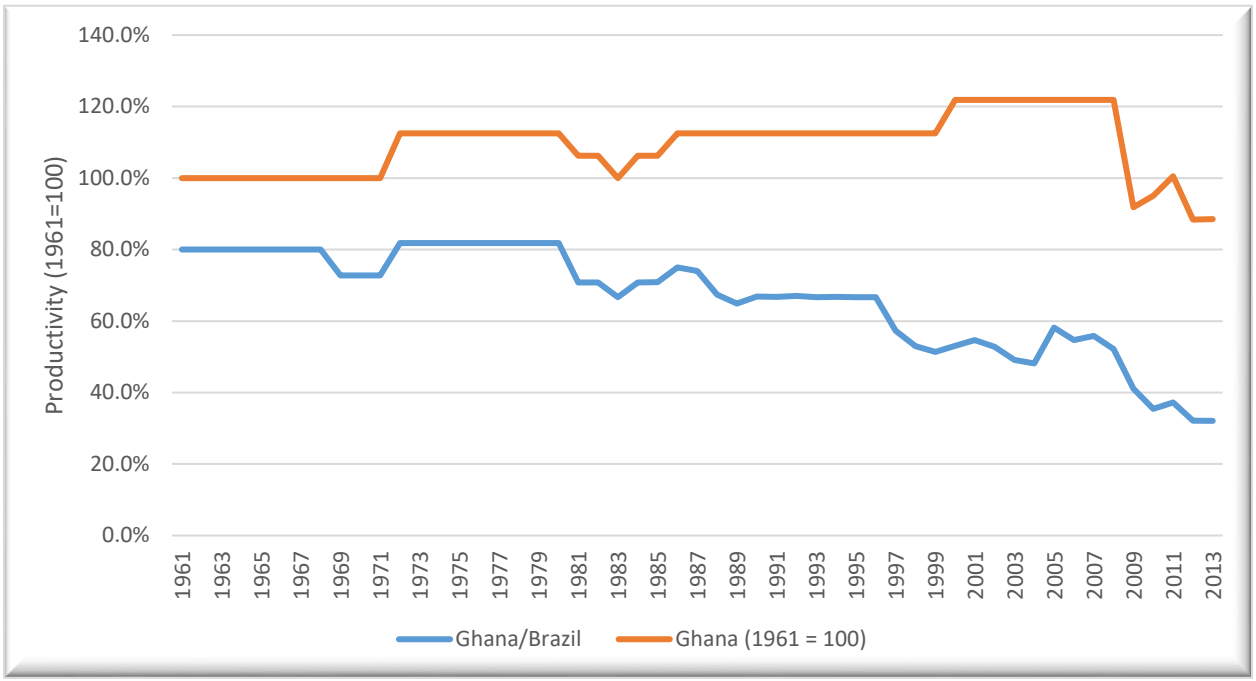
1 Food and Agriculture Organization of the UN. FAOStat. Data query results page: http://faostat3.fao.org/download/Q/QL/E. Queried July 5, 2016.

2 UN COMTRADE. Data query results page: http://comtrade.un.org/db/ce/ceSnapshot.aspx?px=HS-&gt=ss&r=288&rg=1&cc=0207, queried July 5, 2016.

3 U.S. Department of Agriculture. Livestock and Poultry: World Markets and Trade. Foreign Agricultural Service, 2016. Available at http://apps.fas.usda.gov/psdonline/circulars/livestock_poultry.pdf.

overall improvements in cold chain systems. These benefits may be expected to spill over into other food industries as scale and scope benefits offer incentives for all these firms to expand their investments.

*Figure 1: Chicken Productivity in Ghana and Brazil (1961-2013) 1961 = 100*




Developed from FAOStat data (www.faostat.org).

## Research Problem and Objectives

With increasing demand for and consumption of chicken meat in Ghana, there seems to be an opportunity to leverage chicken production as a vehicle to reduce poverty, increase incomes and enhance nutrition among Ghanaians. To what extent, though, does the prevailing industry structure limit or enhance the industry's leverage potential given that demand expansions are essentially being filled by imported ready-to-eat products? Understanding the industry's structure and its performance may provide insights into the possible policies and strategies that could overcome prevailing challenges to the industry's ability to support the poverty reduction, income expansion and nutrition improvement objective. The research question above unites the Economic Growth Office of U.S. Agency for International Development – Ghana, the Ghana Ministry of Food and Agriculture (MOFA), the Ghana National Association of Poultry Farmers (GNAPF) and the U.S. Department of Agriculture, all of whom have direct interest in the potential insights emanating from the study.

The study's overall objective, therefore, is to describe the structure and performance of Ghana's chicken industry to provide insights into how the industry may be leveraged to contribute to income expansion, poverty reduction and nutrition improvement. In achieving these broader objectives, the solutions would contribute to enhancing and sustaining the competitiveness of the chicken industry. Based on the overall objective, the study's specific objectives are:

1. Estimate the numbers and size distribution of chicken farms by region;
2. Evaluate the economic performance of chicken farms by size and region; and

3. Use the results from the structure and performance analysis to provoke focused conversations about sustainable and economically viable policy alternatives that support the stakeholders in Ghana's chicken industry.

## Methods

To address the research questions and achieve the above objectives, we undertook a comprehensive primary survey of the Ghana poultry industry using a structured electronic questionnaire developed using Qualtrics® survey software. The survey instrument was executed with the help of enumerators using the Qualtrics® Offline App ran in Android tablets. The enumerators were all Ministry of Food and Agriculture (MOFA) staff, working as agricultural extension agents or in the regional or district offices. The survey was conducted between December 2015 and January 2016 and covered the whole country. The information collected covered all poultry species - chicken, guinea fowls, turkeys and other feather animal species. We also collected information on producer demographics, production systems, inputs, production and production capacity by species.

We used a snowball sampling approach to identify and interview respondents to this survey. We started with collecting information about farms, farm locations and farmers and/or farm managers from national and regional poultry associations and from Ministry of Food and Agriculture staff working in the regions and the districts. We also surveyed a select group of Ministry of Food and Agriculture district staff for information about poultry farms in their districts. We augmented our initial list with the results from this survey. Finally, we used Google Maps to identify farms and confirm the completeness of our list. From here, enumerators visited each listed farm and, upon completing their interviews, asked respondents about farms they know about in their localities, adding those that were not already listed. This snowball approach enabled this research to identify *virtually* all known poultry farms and interview about 90 percent of these identified farmers. A few large farms chose not to be interviewed and there were some non-responses. However, the locations of non-participating non-responsive farms are now known and documented for any future research on the industry.

The study also identified and recorded the locations of farms that were not currently in operation but had built facilities. Although the state of these buildings were not assessed, they point to the potential availability of reinvestment in poultry production if farmers should choose to do so given a favorable market environment. This study, therefore, conducted a census of poultry farms and not farm animals. The expectation is that this information would provide insights into the industry's structure and its effect on performance, which would direct further research into developing long-term viable strategies that support the industry's profitability and competitiveness.

The study's focus was on commercial farms, and so they were separated from the data prior to analyses. Commercial farms are defined by two indicators: (i) Farmers' primary production intent; and (ii) The minimum number of birds produced per year. Commercial farmers' primary intent is to sell the output from the farm for profit. As such, they undertake investments that support their intent – husbandry, housing, feeding, veterinary services, selling decision, etc. Commercial poultry farms' physical and operating structures, therefore, often differ from that of non-commercial farms, also referred to as "backyard" or "village" poultry farms, which offer minimal feeding and husbandry, allowing birds to roam and fend for themselves. The commercial intent was weighted a lot higher than number of birds, allowing

us to define commercial broiler farms as those with a minimum 50 birds per year and commercial egg farms as those with a minimum of 15 layers, producing a minimum of 60 eggs per week. The driver for inclusion is whether the farm produces and sells its broilers in batches within specific cycles or sell eggs on a regular basis. The data are analyzed using statistical and econometric tools. The results are reported in ways that make them accessible to a typical policymaker and industry stakeholder.

## Outline

We have divided the document into two main sections reporting on the two principal outputs of the chicken industry: meat and eggs. The first covers broilers, produced for their meat over relatively short durations. The second covers layers, kept for the production of eggs and over relatively longer periods. For each segment, we first describe its size, structure and distribution across the country and then its economic performance. We use gross margin as an indicator of economic performance. Prior to discussing the structure and economic performance of the principal output segments, we provide an overview of respondents' demographics and farm characteristics to contextualize observed structural and performance outcomes. A penultimate section presents policy options for addressing the principal challenges emerging from the study. The final section summarizes the findings from the research.

# The Chicken Industry in the Context of Ghana's Poultry Sector

## Overview of the Chicken Industry

Ghana's poultry sector encompassed chicken, guinea fowls, turkeys, ducks, geese, ostriches and quail. However, chicken is synonymous with poultry in Ghana because it is the sector's dominant industry.[4] Of the 4,040 poultry farms surveyed, 96.3 percent (3,889 farms), produced chicken-related products – broilers, layers, growers/pullets and cockerels. Guinea fowls were produced by about 5.2 percent of survey farms while 4.5 percent produced turkeys and 1.8 percent produced ducks. About 2.6 percent of farms producing chicken also produced guinea fowls compared to about 4.1 percent also producing turkeys and approximately 1.5 percent also producing duck. Overall, 9.5 percent of chicken farms had another species on the farm. On the contrary, 87.3 percent of turkey farms, 78.4 percent of duck farms and 46.9 percent of guinea fowl farms produced chicken. The multi-species production may be seen as leveraging production resources to diversify revenue and minimize risks.

The leveraging of resources, revenue diversification and risk minimization is most evident in chicken production itself, where 38.8 percent of chicken farms (1,508) produced broilers and 74.3 percent (2,889) produced eggs. Approximately 52.4 percent of broiler chicken farms also had layer chickens, but only 27.4 percent of layer chicken farms had broiler chickens. Of the 1,508 broiler chicken-producing farms, about 98.7 percent (1,488) qualified as commercial farms, i.e., produced a minimum of 50 birds per annum. All 2,889 egg-producing farms qualified as commercial under the definition of commercial egg farms used in this study.

## Farm and Decision-Maker Characteristics

Given the nature of the chicken industry's products and resource needs, the Ghanaian context, poultry farms are perceived to be located in urban areas. Based on the survey data, though, it was estimated that about 58.1 percent of the chicken farms, by their owners' classification, are located in rural areas. This was statistically different at the 1 percent ($t = 10.87$) from a hypothesis that 50.0 percent of farms are located in rural areas and the remainder in urban areas. This would suggest that the majority of poultry farms endure the infrastructural challenges facing rural communities, possibly affecting their transaction costs associated to market access, electricity, pipe borne water, transportation costs for feed, etc.

We identified two types of chicken farm managers: Owner managers; and employed managers. About three-quarters of chicken farms are managed by an owner while the remaining 24.5 percent are managed by employed managers. The farm was the primary source of income for 63.4 percent of respondents, implying that for about a third of respondents, the farm was not their primary source of income. The farm was the primary source of income for only 60.9 percent of owners and 71.1 percent of employed managers.

We define professional managers as those whose management activities are the primary source of their incomes. When the activity is not the actor's primary income source, it is plausible to expect that it will command its place with respect to time and effort investment in accordance to its income contribution. This has implications for the level and types of investments (time, money, commitment, etc.) managers

[4] The number of geese, ostrich and quail farms were too few to preserve their anonymity. They are, therefore, not included in any of the analyses in this document as independent industries.

make into the business. In general, the size of the business tends to be small when the business is not the primary income source. Additionally, when size is small, transaction costs related to entry-exit decisions tend to be low, contributing to low entry and exit costs. When managers know they can exit the business without significant transaction costs, they tend not to make the depth of investments required unless such investments are portable to other activities. Share of income emanating from may explain production levels by its effect on participation volatility, which is a direct effect of entry-exit decision resulting from the business' economic performance. The increased uncertainty may have adverse effects on downstream investment in processing and related activities. We return to this later.

Decision-making in Ghana's poultry industry is dominated by males, with only 12.7 percent of owners and managers being female. The proportion of employed female managers was 8.9 percent compared to proportion of about 14.0 percent for female owners. About 81.7 percent of respondents indicated being married. About 59.0 percent of female respondents indicated the farm being their primary income source, compared to 64.1 percent of male respondents. The difference was statistically significant the 5 percent level ($|t| = 2.15$; $P > |t| = 0.031$). When only employed managers are considered, the proportion of male managers for whom the farm is their primary income source was 72.8 percent compared to 54.1 percent for females. The difference was statistically significant at the 1 percent level ($|t| = 3.32$; $P > |t| = 0.000$). This has implications for professional female manager development in Ghana's chicken industry.

People enter poultry farming at different times in their lives in Ghana. This is a function of the role the industry plays in the economic lives of its participants. Respondents' average age was 44.5 years, with a standard deviation of 12.2 years and a median of 44 years. The average age of owners was about 46.8 years, with a standard deviation of 11.2 years and a median of 46 years, compared to 37.3 years for hired managers, with a standard deviation of 12.1 years and a median of 35 years. The difference in the average of managers and owners was determined to be statistically significant at the 1 percent level ($|t| = 21.30$). Average age of female hired managers was 40.5 years compared to 36.9 years for male hired managers, and the difference between them is statistically significant at the 1 percent level ($|t|$ 2.71; $P > |t| = 0.007$).

The overall average experience of respondents in poultry farming was about 10 years, with a standard deviation of 8.7 years and a median of seven years. However, the average experience for owners was about 10.7 years, with a standard deviation of nine years and a median of eight years. This compares with the average experience of hired managers was about 7.8 years, a standard deviation of 7.6 years and a median of five years. The difference between average experience of managers and owners was also statistically significant at the 1 percent level ($t = 9.72$). There was no statistically significant difference between the experience of males and females whether they were hired or owners.

The level of education in the industry is higher than in the general population, with only 3.5 percent of managers and owner/managers indicated having no education compared. About 34.6 percent of the managers and owner/managers indicated having at least secondary education while another 31.0 percent indicated having post-secondary educational attainment. An interesting observation is that the proportion of owners with post-secondary education was 35.5 percent, compared to 20.8 percent of managers with post-secondary education. Contrarily, the proportion of owners with secondary education or less was 64.5 percent compared to 79.2 percent for hired managers. The difference was statistically significant at the 1 percent level, suggesting that owners tend to hire people with lower education levels to manage their poultry farms.

Approximately 92.5 percent of them operated a single farm. The remaining 7.5 percent operated more than one farm and the preference for hired managers increased with increasing number of farms. For example, while owners managed 64.2 percent and hired managers managed 35.8 percent of two-farm operations, the distributions were 48.4 percent and 51.6 percent and 18.2 percent and 81.8 percent for three-farm and four-farm operations respectively.

## Production Systems

## Production Inputs

Poultry farms in Ghana have two principal sources of feed: On-farm production; and Commercial. On-farm production involves the procurement of feed ingredients and mixing them in the right proportions to produce the required feed for use on the farm. Commercial feed, on the other hand, is often purchased as complete feed, instead of as ingredients, and used without further processing. About 57.1 percent of chicken farms produced all or some of their own feed while 42.9 did not produce any feed. On average, chicken farms producing on-farm feed produced about 82.0 percent of their feed needs, with a standard deviation of 23.4 percent and a median of 92 percent.

We noted earlier that transaction costs, such as access to feed, may be higher for poultry farms located in rural areas. If access to feed are perceived to be higher, then these poultry farms would be more likely to produce their own feed *if* they believe such an initiative would contribute to cost control. The results show that 63.5 percent of rural compared to 48.3 percent of urban chicken farms produce some or all of their feed requirements on-farm. Rural farms produce about 82.8 percent of their feed requirements produced on-farm while their urban counterparts produce about 80.5 percent. The difference between the proportions is statistically significant at the 5 percent level ($|t| = 2.14$; $P > |t| = 0.032$). Hired-manager managed farms produce about 3.4 percent more of feed requirements than owner-managed farms; this was statistically significant at the 1 percent level ($|t| = 3.13$; $P > |t| = 0.003$).

Three classes of employees are defined in the study: adult male; adult female; and children. In each class, a farm might have paid and/or unpaid employees who work full time or part time. About 79.9 percent of broiler farms compared to 86.6 percent of chicken egg farms had employees. On average, chicken farms employed three full-time adult males and about 2.6 adult females. About 33.9 percent of chicken farms with male employees had only one adult male employee and 79.6 percent of farms with female employees having one adult female employee. Eighty-two chicken farms indicated having children (under 18 years) full time employees but only 25 farms had full time children employees who are paid. Like the farms with adult employees, the majority (about 82.7 percent) of these farms with children employees had no more than two of them.

## Production Systems

The primary stocking method used is day-old chicks, with 99.0 percent for broiler chickens and 100 percent for chicken layers. In contrast, about 85.8 percent and 87.6 percent of broiler and layer guinea fowl farms used day-old chicks as their primary stocking unit. The foregoing implies that access to affordable, healthy and productive day-old chicks is extremely important in the sustainability and growth of the chicken industry. While 58.5 percent of chicken farms depended on local suppliers for their day-old chicks, 34.6 percent depended on local importers. Less than 2 percent of farms produce their own day-old chicks while the remaining 4.9 percent imported their own day-chicks.

While about 36.5 percent of all broiler chicken farms produce year-round, nearly 61 percent of them are seasonal producers while 2.5 percent only produce on special orders. In contrast, about 79.6 percent of all guinea fowl farms produced year-round compared to 18.8 percent that were seasonal and only 1.7 percent producing only on special orders.

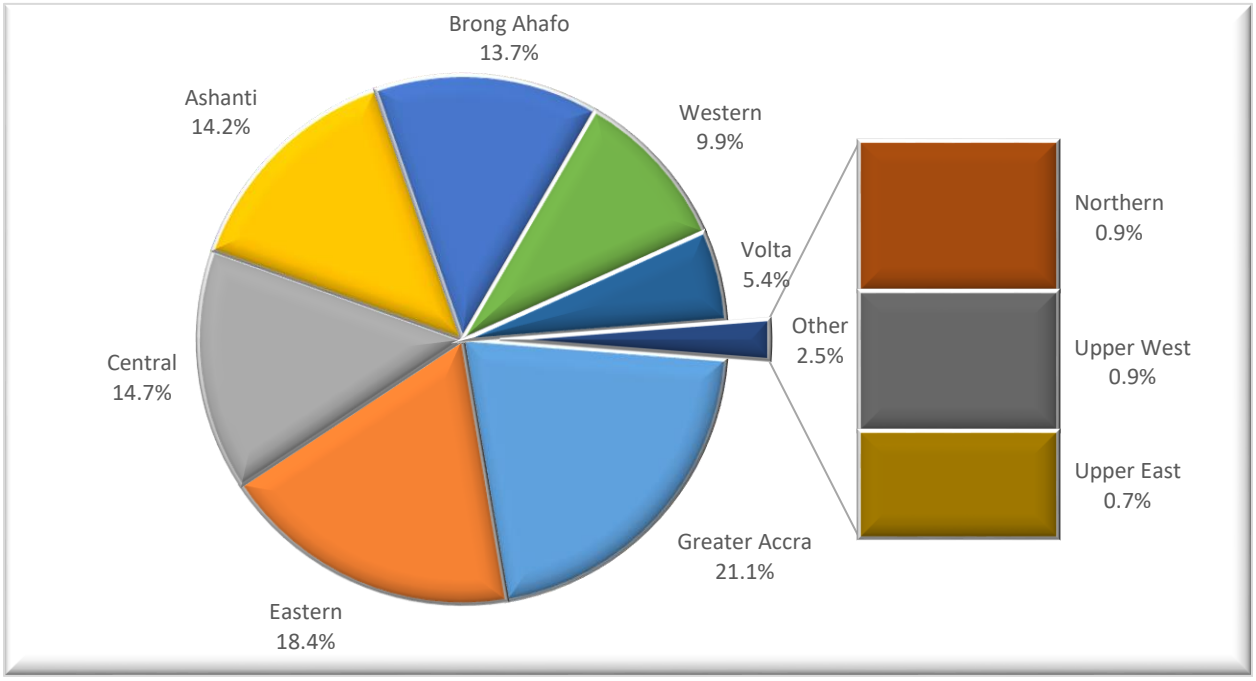
We turn our attention now to the situation and performance of the two segments in the chicken segment: broiler chickens and chicken egg segments. We first provide the number of farms and their size distributions by region. We then assess the economic performance of these farms with the view to providing the baseline information for assessing the competitiveness of broiler chicken and chicken egg production in Ghana vis-à-vis the primary competitors in the country. The ensuing information, therefore, is mainly resource for further research into the critical challenge of crafting the appropriate strategy for enhancing and sustaining the industry's competitiveness.

# Structure of the Broiler Chicken Segment

## Distribution of Broiler Production

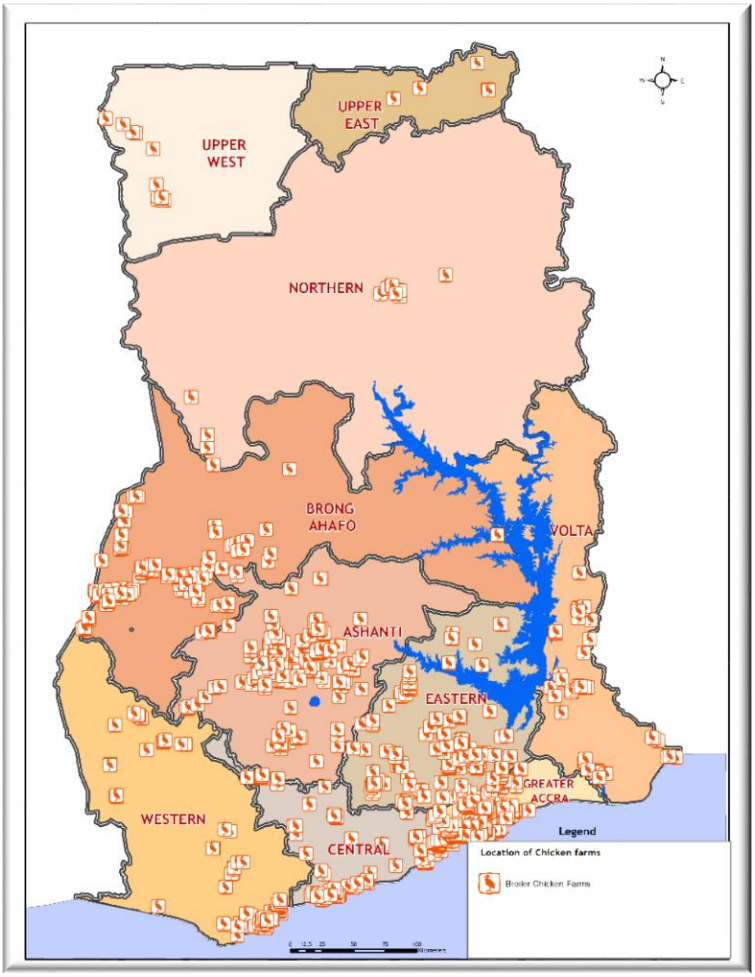
The number of commercial broiler chicken farms in Ghana was estimated at 1,508 in 2015. Figure 2 shows that Greater Accra Region accounted for the majority (21.1 percent) of Ghana's broiler farms, followed by Eastern Region with 18.4 percent and Central Region with 14.7 percent. The figure shows that the farms are concentrated in the southern regions of the country, with the three northernmost regions accounting for only 2.5 percent of broiler farms. The locations of broiler chicken farms are presented in Figure 3.

*Figure 2: Distribution of Broiler Chicken Farms in Ghana by Regions (N = 1,508)*




Broiler production is a batch process, with farmers bringing in a batch of day-old chicks, feeding them to market weight and selling them off. Given that broiler chickens are typically ready for market in as few as six weeks, farms can have numerous production cycles in a year given their market orientation. Farms seeking to maximize their asset utilization would have more cycles than those for whom the production is done for supplemental income reasons. A farm seeking to maximize asset utilization will grow birds efficiently, dispose of them quickly and maximize the number of production cycles per year. If we assume that birds reach market weight between six and seven weeks and we allow one week for cleaning and disinfection before restocking, then an average of 6.5 production cycles per year is possible. The results show that the average number of broiler production cycles was 2.5, with a standard deviation of 1.7 and a median of 2.0. About 31.3 percent of farms indicated producing broilers only once per annum and another 31.1 percent produced twice per year. The results show that about 91.3 percent of farms have fewer than five cycles per annum. The foregoing confirms the narrative that broiler producers generally target their production to the two major Christian holidays in the country – Christmas and Easter – suggesting that income supplementation may be the production motivation for a majority of these farms.

*Figure 3: Locations of Broiler Chicken Farms in Ghana by Region (2015)*




Map produced with field data by Jennifer Asiedu-Dartey, USAID-METSS, 2016.

We assumed that the product of their output at the time of the survey (if they were in production) or a prior period (if they were not in production) and the number of production cycles provides a good estimate of their total 2015 production. Based on this, the average annual broiler chicken output was 1,410 birds per farm, with a standard deviation of 4,455 and a median of 500 birds per farm for the year. Given that production quantity at any time is based on farmers' expectation about the broiler market at the end of production, we asked farmers about their production capacity given their available production facilities. The average broiler chicken production capacity was 2,953, with a standard deviation of 8,694 and a median of 1,000 birds per farm.

Aning (2006) organized poultry farms in Ghana into three size classes: Small, with less than 5,000 birds; Medium, with 5,000 to 9,999 birds; and Large, with 10,000 or more birds.[5] A scan of the production data suggested a recalibration of farm sizes to allow for effective statistical analysis. We used the following definition for size: Small (under 2,000 birds); Medium (2,000 to 5,000 birds); and Large (More than 5,000

[5] Aning, K. Poultry industry review: The structure and importance of commercial and village based poultry in Ghana, Rome: FAO. 2006.

birds). Based on projected annual production assumptions, 86.7 percent of broiler chicken farms are small, 8.6 percent are medium-size and 4.8 percent are large-size farms.

The average production cycles per annum varied by farm size. It was approximately 2.3 times for small farms, 3.8 for medium farms and about 4.0 times for large farms.[6] The difference between small farms' average number of production cycles was statistically different from those of medium and large-size farms at the 1 percent level. However, there was no statistical difference between the average production cycles for medium and large farms.

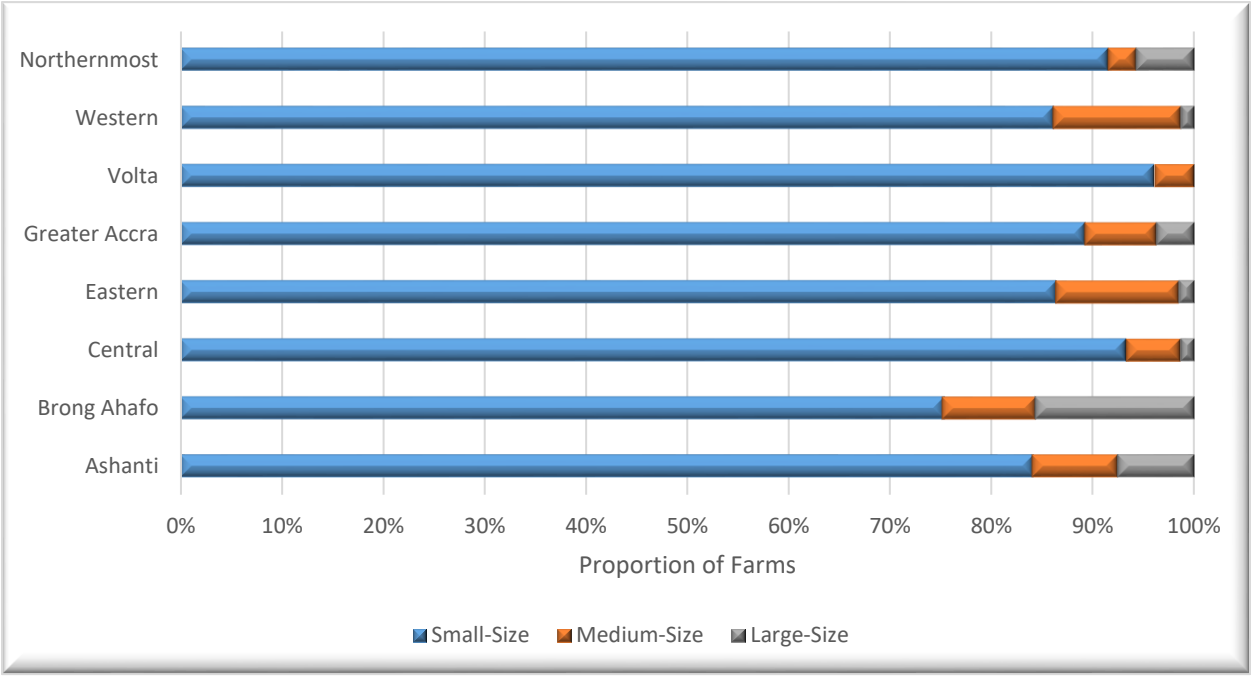
Also, a larger proportion of females and owners manage small farms. For example, while 92.1 percent of females and 85.8 percent of males managed small farms, only 2.8 percent and 5.1 percent managed large farms, respectively. For owners, while 89.2 percent of owners and 76.1 percent of hired managers managed small farms, 3.5 percent and 10.0 percent managed large farms respectively. While a larger proportion of all farms were found in urban areas, a much larger proportion of rural farms were large compared to urban farms – i.e., approximately 7.0 percent versus about 3.0 percent.

The distribution of farms by size and regions is presented in Figure 4, and it shows that with 75.1 percent, Brong Ahafo Region has the lowest proportion small farms while both Northern Region and Upper East Region have only small farms.[7] Brong Ahafo also has the largest proportion of large farms (15.6 percent) with Ashanti Region in second place with 7.5 percent of its farms being large. Both Eastern Region and Western Region have more than 12 percent of their farms being medium with Brong Ahafo posting 9.3 percent and Ashanti posting 8.5 percent of their farms in the medium category.

[6] Farms with 10,000 or more bird output per year averaged 4.4 cycles with a standard deviation of 0.5.

[7] Given the small number of broiler chicken farms in the three northernmost regions, we have chosen to merge their numbers to provide increased anonymity to the respondents.

*Figure 4: Distribution of Broiler Chicken Farms by Size and Region*




## Broiler Chicken Farm Size Distribution

Table 1 shows that average production on small farms was about 530 birds, with a standard deviation of 412 birds compared to an average output of 2,807 on medium-size farms and almost 15,000 on large farms with standard deviations of 982 birds and 14,658. The medians for the three sizes were respectively 400 birds, 2,400 birds and 9,000 birds respectively. It is observed that small farms produce less than 20 percent of the output of medium-size farms, who produce about 18.9 percent of the average output of large farms. Obviously, the variability in the number of birds on farms is large, as presented by the standard deviation statistic. The coefficient of variation, measured as the ratio of standard deviation to the average, provides a means to compare different variables' variability relative to the average. It can be inferred from Table 1 that the coefficient of variation increases between the annual output and the production capacity of the farm. However, medium-size farms have the least variability among them for both the estimated annual output and potential production capacity.

Based on Table 1, it is observed that small farms are producing about 36.2 percent of their capacity, medium-size farms about half their capacity and large farms about 56.8 percent of their capacity. Overall, current annual production is only 47.2 percent of installed capacity of available facilities. This means that, holding all things constant, broiler chicken production can be doubled without any new investment in production facilities if factors causing the holdback from producing at full capacity are identified and addressed.

Total current output was approximately 2.1 million birds. However, the potential output is estimated at 4.4 million without changing production cycles or building new poultry houses. If all farms with less than six cycles per year increased their production cycles to six, then the total broiler output could increase to 3.3 million birds, an increase of about 57.1 percent. This would be a significant improvement in asset utilization by these farms.

*Table 1: Summary Statistics of Broiler Farms by Size (Projected Annual Production and Production Capacity)*

| Size | Variable | Number of Farms* | Average | Std. Dev. | Median | Total Output |
|---|---|---|---|---|---|---|
| Small-Size | Annual | 1,286 | 530 | 412 | 400 | 682,202 |
| | Capacity | 1,268 | 1,465 | 2,023 | 1,000 | 1,858,099 |
| Medium-Size | Annual | 127 | 2,807 | 982 | 2,400 | 356,500 |
| | Capacity | 124 | 5,655 | 4,162 | 5,000 | 701,250 |
| Large-Size | Annual | 71 | 14,841 | 14,658 | 9,000 | 1,053,692 |
| | Capacity | 69 | 26,118 | 30,638 | 15,000 | 1,802,112 |
| Total | Annual | 1,484 | 1,410 | 4,455 | 500 | 2,092,394 |
| | Capacity | 1,461 | 2,985 | 8,754 | 1,000 | 4,361,461 |

* The difference between the number of farms in the estimated annual and the capacity is a result of non-response of some farmers to their production capacity.

We can estimate from Table 1 that while small farms accounted for 86.7 percent of farms, their share of total output in 2015 was only 32.6 percent. Medium-size farms' output share in 2015 was 17.0 percent despite their farm share being about 8.6 percent and large farms accounted for 50.4 percent of total output in 2015 while they accounted for 4.8 percent of farms. If farms produced at their installed capacity, small farms' share would increase to 42.6 percent while the share of medium-size and large farms' share decline to 16.1 percent and 41.3 percent respectively. This would suggest that the principal opportunity in the broiler chicken segment is with small farms who are currently nowhere near maximizing their asset utilization rate. Not only will improving asset utilization enhance farm performance, it will also improve the structure in the industry, allowing small farms to control a larger share of total production.

The summary statistics of annual broiler chicken production by region are presented in Table 2. The three northernmost regions (Northern, Upper East and Upper West), each presenting fewer than 30 broiler chicken farms, have been aggregated into a single group (Northernmost) for analytical purposes. The table shows that the largest broiler farms are in Brong Ahafo, where the average broiler chicken farm produced about 3,792 birds in 2015 compared to 549 birds in Volta Region. The standard deviations in those two regions were respectively 9,963 and 598. Average production in 2015 in Ashanti was 1,525 compared to 920 in Eastern, with standard deviations of 3,277 and 1,100 respectively. The median production in Brong Ahafo was 738 birds and 500 in the majority of the other regions, including Western, Central and Eastern. Greater Accra's median production was the lowest, at 300 birds per farm. Total production across the regions was about 2.1 million birds in 2015.

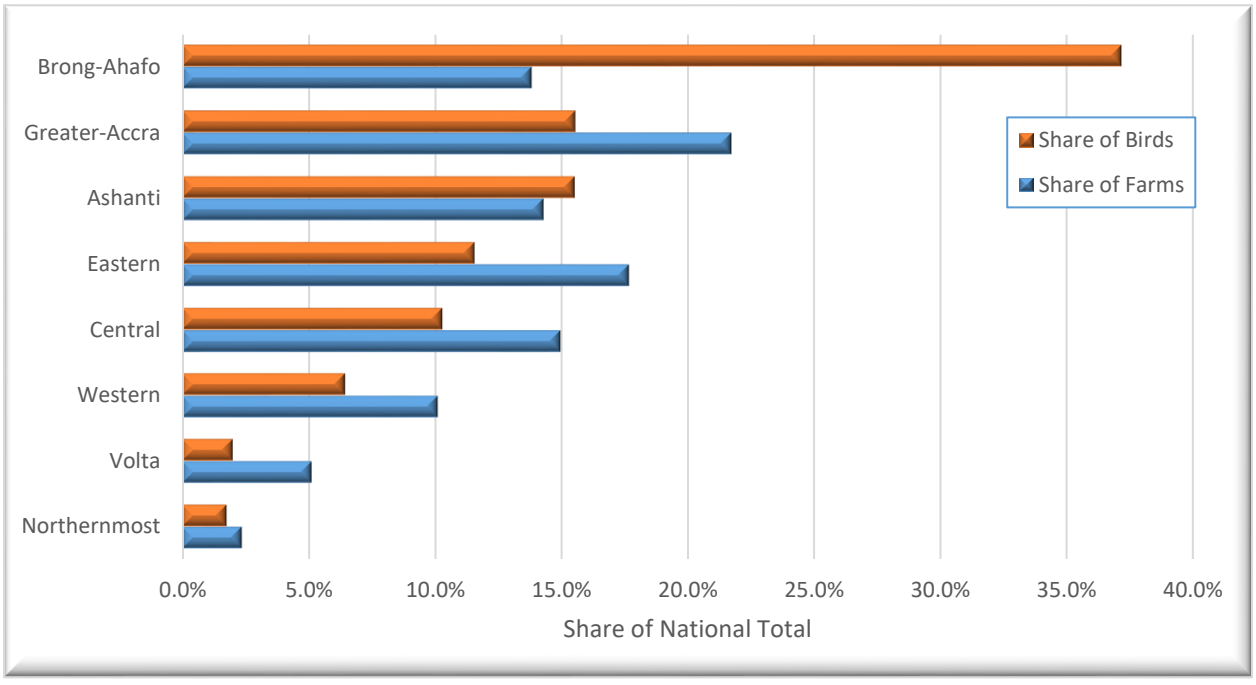
Figure 5 shows that while Brong Ahafo accounted for 13.8 percent of all broiler chicken farms, its share of broiler chicken production in 2015 was about 37.2 percent, i.e., nearly 2.7 times its share of farm numbers. While Ashanti's share of farms was 14.3 percent and its share of birds was about 15.5 percent, the remaining regions all had a larger proportion of farms compared to their share of broiler chicken production. Indeed, while Volta Region had 10.1 percent of farms, its share of national broiler chicken output in 2015 was only about 2.0 percent. Likewise, while Greater Accra accounted for 21.7 percent of farms, its share of birds was only 15.5 percent, the same share accounted for by Ashanti. Thus, the larger

farms are located in Brong Ahafo, Greater Accra and Ashanti Region. These three regions accounted for 84.5 percent of large farms and 47.2 percent of medium size farms. They also, together, accounted for about 68.1 percent of total output in 2015. The foregoing indicates the concentration of broiler chicken production in Ghana.

*Table 2: Summary Statistics of Commercial Broiler Chicken Production by Region*

| Region | N | Mean | Std. Dev. | Median | Total |
|---|---|---|---|---|---|
| Ashanti | 212 | 1,525 | 3,277 | 500 | 323,288 |
| Brong Ahafo | 205 | 3,792 | 9,963 | 738 | 777,346 |
| Central | 222 | 965 | 3,437 | 500 | 214,328 |
| Eastern | 262 | 920 | 1,100 | 500 | 240,962 |
| Greater Accra | 322 | 1,006 | 2,601 | 300 | 323,826 |
| Northernmost Regions | 35 | 1,048 | 2,234 | 500 | 36,691 |
| Volta | 76 | 549 | 598 | 400 | 41,736 |
| Western | 150 | 895 | 1,133 | 500 | 134,217 |
| Total | 1,484 | 1,410 | 4,455 | 500 | 2,092,394 |

*Figure 5: Distribution of Broiler Chicken Farms and Broiler Chicken Output in 2015 by Region*



## Broiler Chicken Production Systems

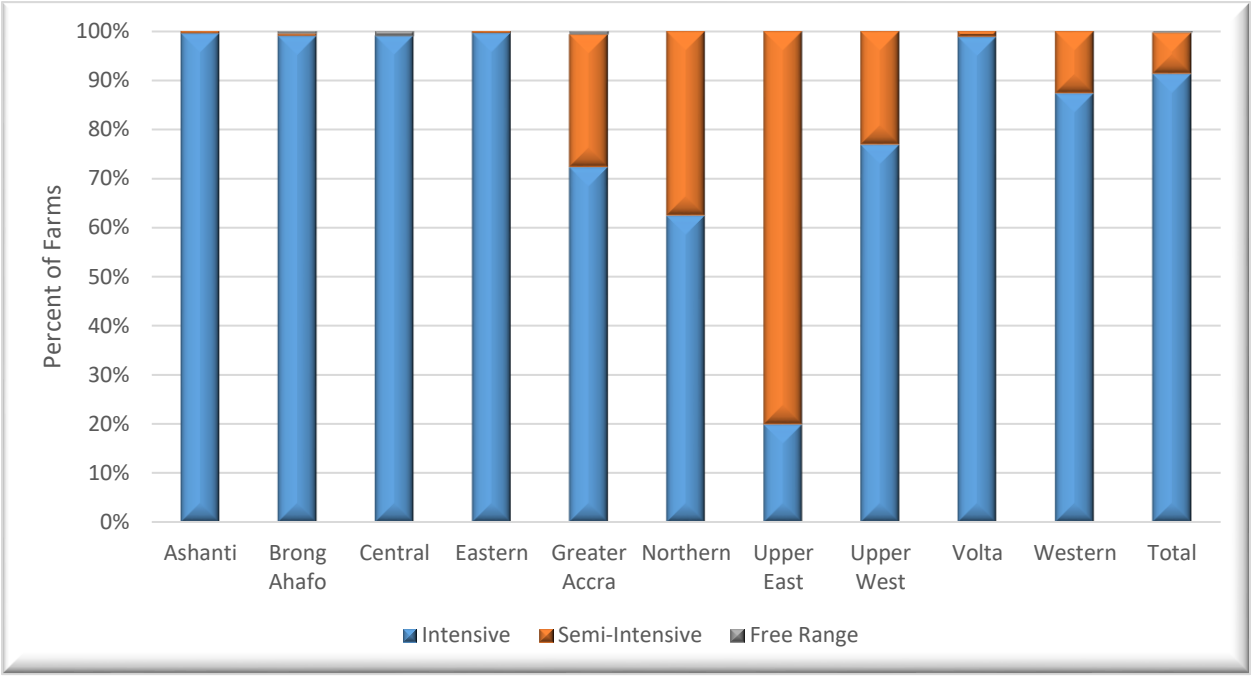
We identified three types of production systems for broiler chicken production in Ghana: Intensive; Semi-intensive; and Free range. Under intensive production, the birds are confined to poultry houses, which protects them from the elements and from predators, while providing them with all their needs – feed, water, medications, etc. Under free range production, the birds are not confined, and thus, roam but within confined areas. Free range birds are usually confined in sheds at night to protect them from predators and in inclement weather. The UK Government stipulates that birds must be kept outside in open-air runs for at least half of their life for the production system to qualify as free range. There are other stipulations, such as stocking density, that qualify the production system. Semi-intensive production system involves a combination of intensive and free range, with birds being allowed to forage outside of the bird houses to supplement provided feed.

Intensive production is the production system of choice in commercial broiler chicken production in Ghana. Figure 6 show that farms in Upper East Region were the most likely to use the semi-intensive production system for broiler production. What is interesting is the free range system is not a major production system in any region.

The dominant barn type is deep litter, with 96.1 percent of broiler farms using it. The deep litter barn type exhibits lower capital costs but relatively higher labor costs while the intensive production system has higher capital costs and lower labor and land costs in comparison to free range, for example. From a biosafety perspective, the intensive production system can prevent exposure to external pathogens and predators but could also increase the spread of any disease if infection occurs.

It is also important to note that consumer perceptions about animal welfare in developed countries are changing in favor of less intensive production and cage-free systems. How quickly these trends will emerge among Ghanaian consumers remains to be seen. However, in an increasingly open global trade environment, is there an opportunity for Ghana's poultry industry to explore export opportunities leveraging its "endowed" competitive advantage in labor and land to consider alternative production system? We return to this later when assessing alternative policies to enhance the industry's structure and performance.

*Figure 6: Broiler Chicken Production Systems by Region (N = 1,484)*



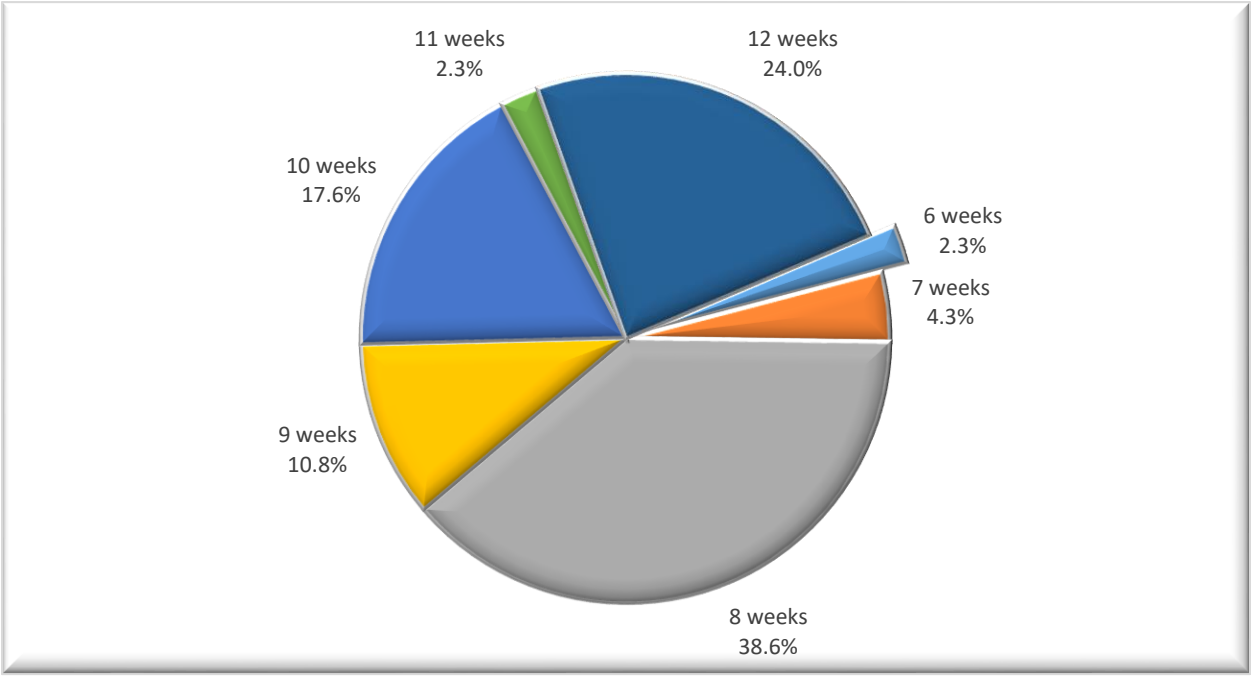

## Broiler Chicken Age at Sale

The production system, breed, the stocking intensity and other husbandry processes, including feeding and nutritional quality, have direct effect on bird growth rate and feed conversion performance. As noted, broiler chicken producers to look to get their birds to market weight of about two kilograms dressed weight in about six weeks. However, Figure 7 shows that only about 2.3 percent of farms sold birds at an average age of six weeks and a total of about 45.2 percent sold birds aged less than nine weeks. The remainder was sold at nine weeks or older. Indeed, about nearly a quarter of farms sold their birds at an average age of 12 weeks. The mean across all reporting farms was about 9.4 weeks, with a standard deviation of 1.7 weeks and a median of nine weeks. These estimates were based on 1,407 farms that provided useful data.

The average age of birds at sale for small farms was about 9.6 weeks, with a standard deviation of 1.7 weeks. The average age of broiler chickens at sale for medium and large farms was respectively 8.7 weeks and 7.9 weeks, with standard deviations of 1.6 weeks for both. The differences between small farms on the one hand and medium ($|t| = 5.37$; $P > |t| = 0.000$) and large farms ($|t| = 8.00$; $P > |t| = 0.000$) on the other were both statistically significant at the 1 percent level. The difference between medium and large farms was also statistically significant at the 1 percent level ($|t| = 3.25$; $P > |t| = 0.001$).

Brong Ahafo Region's average age of birds at sale was the lowest at 8.6 weeks, with a standard deviation of 1.8 weeks, while Volta Region had the highest at 10.3 weeks, with a standard deviation of about 1.9 weeks. The median age of birds at sale in Brong Ahafo was eight weeks compared to 10 weeks in Ashanti and 11 weeks in Volta. Ashanti Region's average age of birds at sale of approximately 10.0 weeks differed statistically from those of Brong Ahafo, Central and Eastern. There was no statistical difference between the average age at sale for farms managed by owners or hired managers, males or females and rural or urban locations.

*Figure 7: Distribution of Broiler Chicken Farms by Average Age of Birds When Sold (N = 1,407)*




## Summary of Broiler Chicken Segment Structure

The story told by the data may be summed as follows:

- More than 86.6 percent of Ghana's broiler chicken industry are small farms, with an annual production in 2015 of less than 2,000 birds.
- About 43 percent of small farms, compared to about 20 percent of large farms, are managed by people for whom the farm is not their primary income source.
- The average number of production cycles for all broiler chicken in Ghana was 2.4 per year and about 4.0 for large farms, compared to six or more cycles per annum for farms focused on maximizing asset utilization.
- The average production for small farms was about 530 birds per year, compared with about 2,800 and 14,840 for medium and large farms, respectively. We may compare this to a *typical* broiler farm in Mississippi producing about 100,000 birds per **cycle**.
- On average, broiler chicken farms could double their 2015 output without any new investment in infrastructure, such as buildings.
- Brong Ahafo and Ashanti each accounted for only about 14 percent of broiler chicken farms compared to 18 percent and 22 percent in Eastern Region and Greater Accra. For distribution of total broiler chicken produced, Brong Ahafo accounted for 37 percent compared to 15 percent each for Ashanti and Greater Accra and only 12 percent for Eastern Region.

# Economic Performance of Broiler Chicken Producers

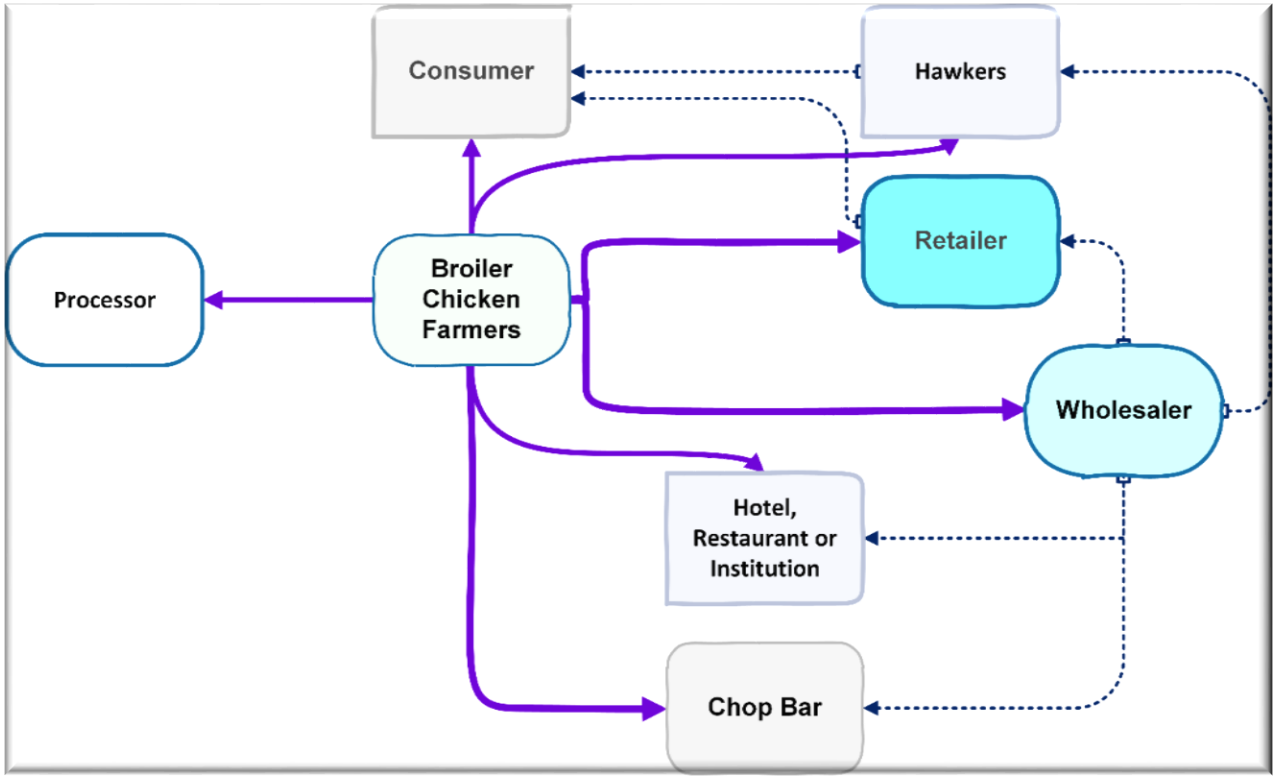
## Broiler Chicken Marketing Channels

Broiler chicken farms in Ghana may sell their birds through seven possible channels: direct-to-consumer; wholesalers; retailers; hawkers; chop bars; hotels, restaurants and institutions (HRI); and processors (Figure 8). Channel selection are defined by a number of factors, including location and size of the farm. Farms proximate to consumers are likely to choose the direct-to-consumer channel. Often, consumers living close enough to poultry farms would choose to purchase their broilers at the farm gate because of a believe that on-farm products are superior to off-farm products in both quality and price. Most farmers also like selling directly to consumers because they tend to get higher prices because they do not pay for the services provided by wholesalers and other downstream buyers ("middlemen") who incur the necessary transaction and other risks to move the product through the downstream supply chain to the consumer. Small farms tend to use the direct-to-consumer channel also because their total cost of holding stock is usually small enough for them not to consider it in the estimation of their prices. Thus, in selling in small quantities directly to consumers, they fail to account for the feed, risk of loss, time and other transaction costs they incur. Yet, these costs do affect economic performance if appropriately addressed.

Wholesalers offer the lowest unit transaction costs for poultry farmers because they purchase large volumes of products in each transaction. In the case of live broiler chickens, they reduce farmers' total production costs because birds have to be fed and cared for as long as they remain on the farm. Because disease exposure and loss is real and uncertain every day on a poultry farm, wholesalers also remove this risk when they purchase large volumes of broiler chickens and take them off the farm. They also incur the transportation costs associated with moving products from farms, which are often in rural areas without very good roads and transportation infrastructure, to urban areas where markets are. As a result, they extract discounts reflected in the whole-farm price compared to farms receive when they sell directly to consumers. Like wholesalers, retailers, hawkers and HRI may also buy in volume from farmers, hold stock, assume mortality and loss risks and feed the birds until they are sold or used. However, the nature of their business is such that they typically do not buy as much as wholesalers do.

Consumption cost for live birds prior to cooking includes the purchase cost, slaughter, dressing, evisceration, cutting and cleaning. None of these exists for the consumption cost for fresh, chilled or frozen ready-to-cook (RTC) broiler chicken, unless it is a whole bird, then there is cutting and washing costs. While the former may command a lower price than the latter, consumers experiencing increasing incomes and time constraints begin to discriminate between total cost of consumption and time. Price alone becomes inadequate in determining consumption. Time, for some people, become a lot more critical in the consumption decision. Live birds, then, become a specialty product, consumed for celebrations, such as Christmas and Easter, and not as part of everyday meals. Live birds, then, are an imperfect substitute for RTC broiler chicken products. This specialty status allows farmers to extract a premium for live birds and still dispose of their birds during festive seasons. We will return to this later in our private and public policy recommendations section.

*Figure 8: Distribution Channels for Live Broiler Chickens in Ghana*




## Distribution of Channel Utilization

Overall, about 69.9 percent of broiler chicken farms indicated using the direct-to-consumer channel to sell their birds compared to 10.0 percent using HRI and 12.7 percent using chop bars. While 27.3 percent indicated using the wholesale channel and 25.9 percent indicated using hawkers, only 12.7 percent indicated using the chop bars channel. About 1.8 percent indicated selling to processors.

Table 3 shows that about 46.8 percent of broiler chicken farms in Brong Ahafo used the direct-to-consumer channel, the proportions in Eastern, Western, Greater Accra and Ashanti was 89.3 percent, 77.3 percent, 69.3 percent and 60.8 percent, respectively. The wholesale channel was used most intensely by farms in Brong Ahafo (53.2 percent) and in the Northernmost regions (54.3 percent) and least intensely in Western (7.3 percent) and Volta (13.2 percent). Table 4 shows that 71.4 percent of small farms and 45.1 percent of large farms used the direct-to-consumer channel. Contrarily, while nearly 39.4 percent of large farms used the wholesaler channel, only 25.8 percent of small farms used it. More medium-size farms used the HRI channel (22.8 percent) and the retailer channel (19.7 percent) than the other two groups. Although only a few farms indicated using the processor channel, about 9.9 percent of large farms selected this channel compared to 1.3 percent of small and 1.6 percent of medium-size farms.

*Table 3: Percentage of Broiler Chicken Farms in each Region Using the Different Distribution Channels*

| Region | Direct-to-Consumers | Wholesaler | Retailers | Hawkers | Chop bars | HRI | Processor |
|---|---|---|---|---|---|---|---|
| Ashanti | 60.8% | 37.7% | 16.5% | 30.2% | 5.7% | 7.1% | 0.0% |
| Brong Ahafo | 46.8% | 53.2% | 12.2% | 17.6% | 23.4% | 5.9% | 5.9% |
| Central | 77.0% | 19.4% | 2.7% | 35.1% | 10.4% | 13.1% | 0.5% |
| Eastern | 89.3% | 30.2% | 17.9% | 33.6% | 25.2% | 14.5% | 0.4% |
| Greater Accra | 69.3% | 19.6% | 16.8% | 17.1% | 1.6% | 5.9% | 2.8% |
| Northernmost Regions | 74.3% | 54.3% | 5.7% | 5.7% | 42.9% | 25.7% | 8.6% |
| Volta | 72.4% | 13.2% | 1.3% | 3.9% | 7.9% | 9.2% | 0.0% |
| Western | 77.3% | 7.3% | 11.3% | 40.0% | 7.3% | 9.3% | 0.0% |
| Total | 70.8% | 27.9% | 12.6% | 26.0% | 12.5% | 9.6% | 1.8% |

*Table 4: Proportion of Broiler Chicken Farms in Each Size Group Using the Different Channels*

| Size | Direct-to-Consumers | Wholesaler | Retailers | Hawkers | Chop bars | HRI | Processor |
|---|---|---|---|---|---|---|---|
| Small | 71.4% | 25.8% | 11.7% | 24.9% | 12.0% | 8.2% | 1.3% |
| Medium | 69.3% | 35.4% | 19.7% | 34.6% | 16.5% | 22.8% | 1.6% |
| Large | 45.1% | 39.4% | 14.1% | 28.2% | 18.3% | 18.3% | 9.9% |
| Total | 69.9% | 27.3% | 12.5% | 25.9% | 12.7% | 10.0% | 1.8% |

## Broiler Chicken Revenue

Revenue is defined as the product of price and quantity sold. It is assumed that total estimated production from the farm is sold.[8] Based on the foregoing, revenue, $R_i$, accruing on Farm $i$, was estimated as follows:

$$R_i = \sum_{j=1}^{7} \rho_{ij} P_{ij} q_i \quad (1)$$

[8] Although farmers may consume some of their production and give some away as gifts, the assumption of sale of total production is valid in the sense that the utility of consuming or gifting cannot be lower than the utility from selling.

where $\rho_{ij}$ is the proportion of Farm *i* production going through channel *j*, where *j* is each of the seven channels described in this study; $P_{ij}$ is the price the farm receives in channel *j* and $q_i$ is the number of birds produced by the farm. This approach also allows for the determination of the prices farmers received in the different channels. Then, using farmers' responses to the proportion of their total production sold through each channel, we estimate their revenues.

### Analysis of Prices and Quantities

Recall that the principal product sold by broiler chicken farmers in Ghana is live birds. These birds are essentially sold by numbers, and not by weight. Table 5 shows that the average direct-to-consumer price was GHS 36.94 per bird, with a standard deviation of GHS 5.47 and a median of GHS 35.00. The average price broiler farms received selling to wholesalers and/or aggregators was GHS 32.31, with a standard deviation of GHS 7.21 and a median of GHS 35.00. This shows that the implied discount wholesalers and/or aggregators extracted from farmers relative to selling directly to consumers was about 12.5 percent.[9] The average price for the chop bar channel was GHS 33.79 and for the HRI channel was GHS 34.43. Hawkers paid a slightly higher price than wholesalers and/or aggregators.

*Table 5: Summary Statistics on Distribution Channel Prices (GHS/Bird)*

| Channels | N | Mean | Std. Dev. | Median |
|---|---|---|---|---|
| Direct-to-Consumers | 1,051 | 36.94 | 4.92 | 40.00 |
| Wholesaler | 413 | 32.31 | 5.47 | 35.00 |
| Retailers | 185 | 34.05 | 4.34 | 35.00 |
| Hawkers | 388 | 34.10 | 4.28 | 35.00 |
| Chop bars | 188 | 33.79 | 5.58 | 35.00 |
| HRI | 145 | 34.43 | 4.20 | 35.00 |
| Processor* | 26 | 29.42^ | 4.71^ | 27.50^ |

* Number of respondents is fewer than 30 and hence estimated statistics lack of confidence in statistical validity.

Figure 9 shows the average price of broiler chicken by distribution channel and farm size. Across all distribution channels, it is found that the average price was inversely related to the scale of the broiler chicken farm. For example, while small farms received an average of GHS 37.24 per bird in the direct-to-consumer channel, large farms' average price was GHS 36.94 while medium-size farms' average price was GHS 33.50. In the wholesaler channel, the average price received by small farms was GHS 32.68 compared with GHS 32.02 and GHS 28.11 for medium-size and large farms. The relatively higher volume large farms offer may explain their relatively lower prices across the channels. Additionally, it is important to recognize that small wholesalers buy often buy from small farms and hence do not present the savings that large wholesalers buying from large farms present. Also, small farms are able to hold off selling at a

[9] While direct-to-consumer price is often used as the reference for prices paid by wholesalers and/or aggregators, it fails to recognize that wholesalers and/or aggregators do not generally sell directly to consumers but to other intermediaries who pay less than the consumer price.

relatively lower total cost than larger farms, a situation confirmed by the average of two-week longer sell-by age of birds from smaller farms compared to the other farms. Across all channels, the average price for small farms was GHS 35.11 per bird, with a standard deviation of GHS 4.69, medium-size farms received an average price of GHS 33.17 per bird with a standard deviation of GHS 4.70, and large farms received an average price of GHS 30.72 per bird with a standard deviation of GHS 5.85. The overall average across all channels was GHS 35.11, with a standard deviation of GHS 4.87 and a median of GHS 36.00.

Table 6 shows that with the exception of the HRI price, the average price across all distribution channels in Ashanti were higher than in Brong Ahafo and Greater Accra's average prices across all channels were higher than Ashanti's. The difference between direct-to-consumer prices in Brong Ahafo and Ashanti was statistically significant at the 1 percent level ($|t| = 6.89$; $Pr > |t| = 0.000$). Likewise, the difference between the average wholesale prices in Brong Ahafo and Greater Accra was statistically significant ($|t| = 13.98$; $Pr > |t| = 0.000$). Indeed, average channel prices in Brong Ahafo were only higher than those in the northernmost regions, but the differences were not statistically significant. For example, the difference between Brong Ahafo and the northernmost regions in direct-to-consumer channel was GHS 0.28 per bird, with a $|t| = 0.785$ and $Pr > |t| = 0.607$. The lower prices in Brong Ahafo may be explained by the fact that the majority of country's large broiler chicken farms are in Brong Ahafo, implying they probably deal with larger buyers across all channels.

*Figure 9: Average Price of Broiler Chicken by Distribution Channel and Farm Size*

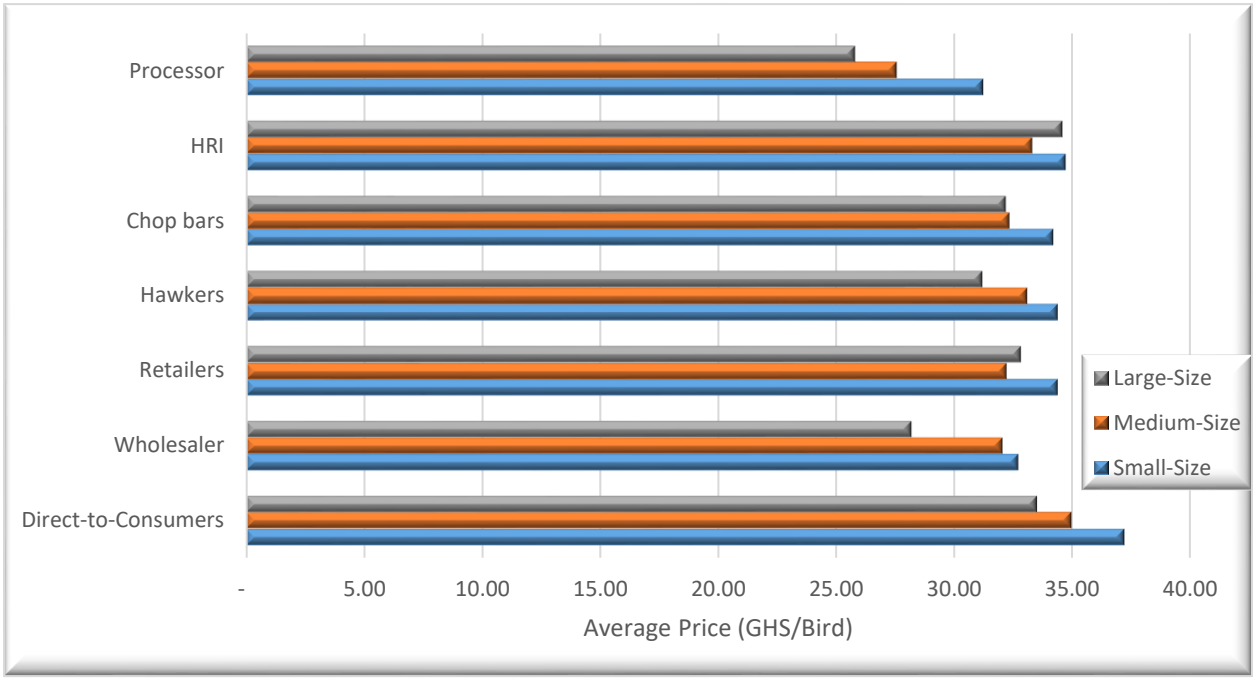



*Table 6: Average Distribution Channel Price of Broiler Chicken by Region*

| Region | Direct-to-Consumers | Wholesaler | Retailers | Hawkers | Chop bars | HRI | Processor* |
|---|---|---|---|---|---|---|---|
| Ashanti | 36.13 | 32.19 | 33.66 | 32.69 | 32.92 | 34.20 | . |
| Brong-Ahafo | 30.85 | 28.48 | 30.92 | 31.06 | 30.52 | 34.55 | 26.25 |
| Central | 38.06 | 35.35 | 32.83 | 35.71 | 36.57 | 33.79 | 35.00 |
| Eastern | 37.88 | 34.72 | 34.77 | 34.17 | 35.35 | 35.11 | 35.00 |
| Greater-Accra | 38.17 | 34.24 | 35.81 | 34.67 | 35.00 | 35.24 | 33.89 |
| Northernmost | 30.58 | 27.16 | 32.50 | 28.33 | 30.53 | 30.50 | 25.00 |
| Volta | 37.32 | 36.00 | 35.00 | 35.00 | 37.50 | 36.43 | . |
| Western | 38.17 | 35.91 | 32.71 | 34.95 | 36.36 | 34.64 | . |
| Total | 36.94 | 32.31 | 34.05 | 34.10 | 33.79 | 34.43 | 29.42 |

* Number of respondents is fewer than 30 and hence estimated statistics lack of confidence in statistical validity.

We also observe that while Western Region's direct-to-consumer price was the same as Greater Accra's, its average prices in the retail and wholesale channels were 9.5 percent lower and 4.7 percent higher respectively. On the other hand, Volta Region's average prices were between 11.3 percent (hawker channel) and 20.9 percent (wholesale channel) higher than Brong Ahafo's. The average wholesale channel

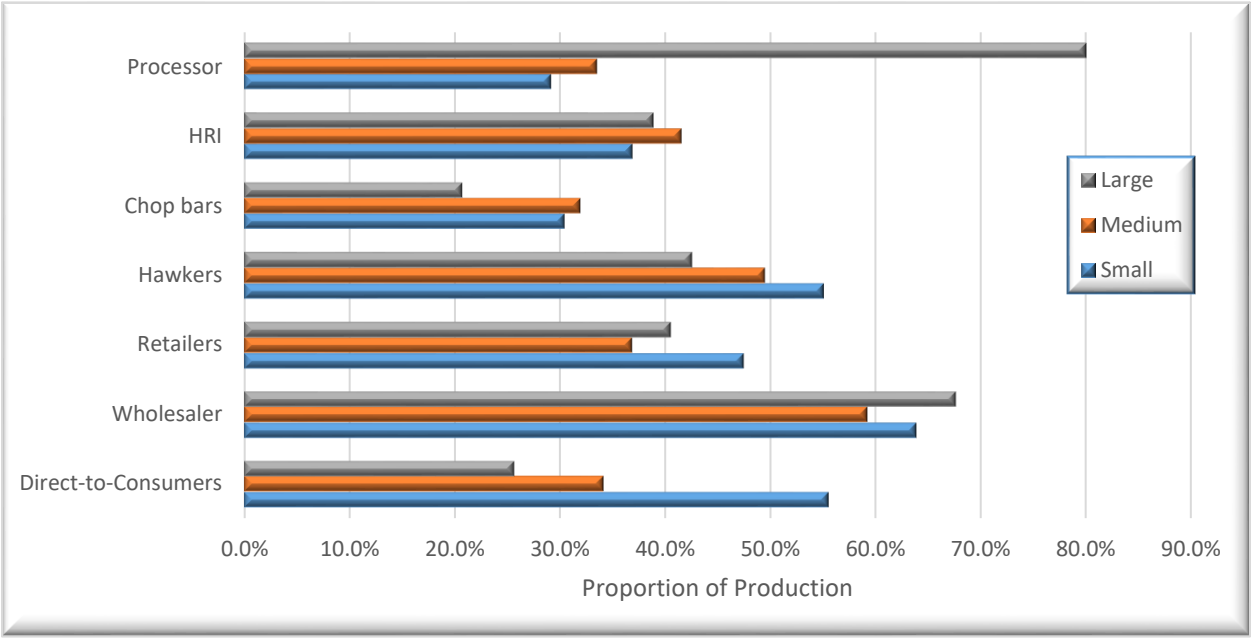
price in Easter Region was about 7.3 percent higher than Ashanti Region's but its direct-to-consumer channel average price was only 4.6 percent higher.

The average share of farm production going through the different channels is presented in Figure 10. The figure shows that, on average, farms selling through the direct-to-consumer channel sell about 52.8 percent of their production through the channel compared to 64.0 percent for those selling through the wholesaler channel. The standard deviations for these were 35.5 percent and 27.8 percent respectively. Farms using the hawker channel sell an average of 53.7 percent of their production through that channel while those using the chop bar channel sell an average of 30.2 percent of their total production.

The average share of small farm output sold through the direct-to-consumer channel (55.4 percent) was similar to the share sold through the hawker channel (55.0 percent) even though a smaller proportion of small farms used the latter. Their respective standard deviations were 35.4 percent and 29.2 percent. On the other hand, the average share of small farm output sold through the wholesale channel was 63.8 percent, compared to 36.8 percent of total output sold through the HRI channel. The standard deviations were 27.9 percent and 28.8 percent. For large farms, the average output share going direct to consumers was 25.6 percent compared to 67.5 percent going through the wholesale channel, with standard deviations of 29.9 percent and 31.1 percent. This contrasts with 34.1 percent and 59.2 percent respectively for medium-size farms, with standard deviations of 27.8 percent and 26.0 percent. Despite these averages, it is estimated that the median proportion sold through the direct-to-consumer channel for small and large farms was 50 percent and 12.5 percent respectively. It was 30 percent for medium-size farms. On the other hand, the median proportion sold through wholesale channel was 70 percent for large farms and 60 percent for small and medium-size farms.

It is noted that while 33.1 percent of small farms using the direct-to-consumer channel sold all their output through that channel, only 9.1 percent and 9.4 percent of medium and large farms sold 100 percent of their output through the direct-to-consumer channel. On the other hand, while 22.1 percent, 15.6 percent and 32.1 percent of small, medium and large farms using the wholesale channel sold all their output through that channel. Also while 15.4 percent of large farms sold 100 percent of their output through the HRI channel, only 7.5 percent and 6.9 percent of small and medium-size farms sold 100 percent through that channel.

*Figure 10: Average Proportion of Production Sold through the Different Distribution Channels and their Coefficient of Variations*




* Number of respondents is fewer than 30 and hence estimated statistics lack of confidence in statistical validity.

The average and total number of birds sold through the different channels by farm size is presented in Table 7. The table reveals that while very few firms use the processor channel, on average large farms sell more through the processor channel than any other channel. As indicated earlier, wholesale channel procures the largest number of birds on average for all farm sizes, with the exception of the few processors that are supplied by large farms. Even though a large proportion of small farms used the direct-to-consumer channel, the average number of birds sold through that channel was the fourth highest, after the average number of birds sold through the retail channel. On average, farms sold 387 birds per farm through the direct-to-consumer channel compared with 1,267 birds per farm through the wholesale channel in 2015. The average number of birds sold through the retail channels was 837, more than 216 percent the average number going through the direct-to-consumer channel and about 18 percent more than the number going through the hawker channel. This confirms that, on average, the wholesale channel remains the most important channel for most farms. This is true for all regions except Volta Region, where the average number of birds going through the direct-to-consumer channel was about 376 compared to 233 birds through the wholesale channel.

Table 7 also shows the total number of broiler chickens sold through each channel. About 401,320 birds were sold through the direct-to-consumer channel compared to 513,208 through the wholesale channel. While about 56.6 percent of birds going through the direct-to-consumer channel were from small farms, 59.4 percent of birds going through the wholesale channel were from large farms. It is also observed that 53.3 percent of birds sold through the HRI channel were from large farms. However, what is very interesting is that although only 8.1 percent of broilers went through the processor channel, 96.6 percent of them were from large farms. This seems to suggests that large farms are able to provide the required certainty of supply necessary for broiler chicken processing to thrive.

*Table 7: Average and Total Number of Broiler Chickens Sold through Alternative Channels by Farm Size*

| Farm Size | Direct-to-Consumers | Wholesaler | Retailers | Hawkers | Chop bars | HRI | Processor |
|---|---|---|---|---|---|---|---|
| *Average Number of Broiler Chickens Sold* | | | | | | | |
| Small | 248 | 390 | 265 | 329 | 202 | 233 | 152 |
| Medium | 896 | 1,752 | 1,085 | 1,451 | 882 | 1,019 | 1,023 |
| Large | 2,976 | 10,888 | 8,839 | 5,103 | 3,585 | 4,757 | 19,029 |
| Total | 387 | 1,267 | 837 | 706 | 512 | 784 | 5,301 |
| *Total Number of Broiler Chickens Sold* | | | | | | | |
| Small | 227,223 | 129,498 | 40,079 | 105,197 | 31,052 | 24,713 | 2579 |
| Medium | 78,865 | 78,855 | 27,135 | 63,830 | 18,530 | 29,540 | 2,045 |
| Large | 95,230 | 304,855 | 88,394 | 102,059 | 46,609 | 61,844 | 133,200 |
| Total | 401,318 | 513,208 | 155,608 | 271,086 | 96,191 | 116,097 | 137,824 |

* Number of respondents is fewer than 30 and hence estimated statistics lack of confidence in statistical validity.

### Summary Analysis of Broiler Chicken Revenue

Based on price and quantity estimates above, the total revenue generated by the broiler industry for 2015 was estimated at approximately GHS 53.6 million (Table 8). The average revenue per chicken broiler farm in 2015 was GHS 36,621, with a standard deviation of GHS 118,590 and a median of GHS 13,280. Despite having the lowest price among the channels, the highest total revenue emanates from the wholesaler channel because it accounts for the highest volume of birds. The average revenue per farm in the wholesale channel was more than 2.6 times the average revenue per farm in the direct-to-consumer channel. These two channels together account for 55.5 percent, equivalent to more than GHS 29.7 million. The median revenue in the wholesale channel is GHS 12,600 compared to GHS 7,000 in the direct-to-consumer channel.

*Table 8: Summary Statistics of Broiler Chicken Sales Revenue by Channel*

| Channels | N | Average | Std. Dev. | Median | Total |
|---|---|---|---|---|---|
| Direct-to-Consumers | 1,035 | 14,137 | 30,517 | 7,000 | 14,632,104 |
| Wholesaler | 404 | 37,358 | 97,576 | 12,600 | 15,092,808 |
| Retailers | 183 | 25,629 | 86,629 | 9,100 | 4,690,029 |
| Hawkers | 384 | 22,690 | 50,214 | 9,800 | 8,713,040 |
| Chop bars | 187 | 15,732 | 37,436 | 5,250 | 2,941,827 |
| HRI | 145 | 27,592 | 82,116 | 8,000 | 4,000,894 |
| Processor* | 26 | 136,001 | 318,705 | 5,688 | 3,536,014 |
| Total | 1,463 | 36,621 | 118,590 | 13,280 | 53,576,211 |

* Number of respondents is fewer than 30 and hence estimated statistics lack of confidence in statistical validity.

Figure 11 shows the distribution of total broiler chicken sales revenue by channel and farm size. It shows that while direct-to-consumer channel accounted for 43.4 percent of small farms' broiler chicken sales revenue, it accounted for only 14.1 percent of large farms'. While the processor channel presented negligible contribution to sales revenues of the small and medium-size farms, it contributed as much revenue to large farms as did the direct-to-consumer channel. This is important in assessing the location and utilization of the processor channel in the industry and provides instruction in how this channels may be nurtured to make a bigger impact on the industry's overall competitiveness.

By size, small farms accounted for about 35.6 percent to total revenue of the broiler chicken segment while large farms accounted for 45.2 percent. The remaining 18.4 percent was generated by medium-size farms. Figure 12, showing the distribution of revenues by region, indicates that Brong Ahafo generated 29.3 percent of total broiler chicken revenues, followed by Greater Accra with 17.6 percent. Eastern and Ashanti generated 15.0 percent and 15.8 percent each while the three northernmost regions together generated 2 percent. Thus, Greater Accra's share of total revenue was higher than its share of birds while Brong Ahafo's was the opposite. This means the lower bird price in Brong Ahafo was low enough to affect the distribution of total revenue.

*Figure 11: Distribution of Total Broiler Chicken Revenue by Channel and Farm Size*

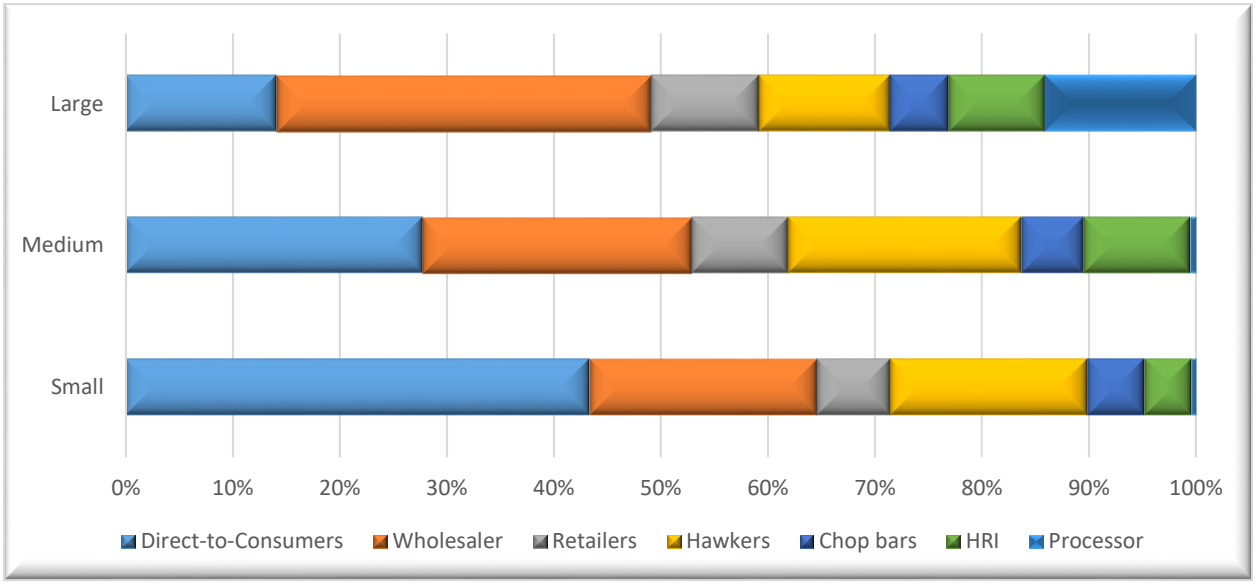
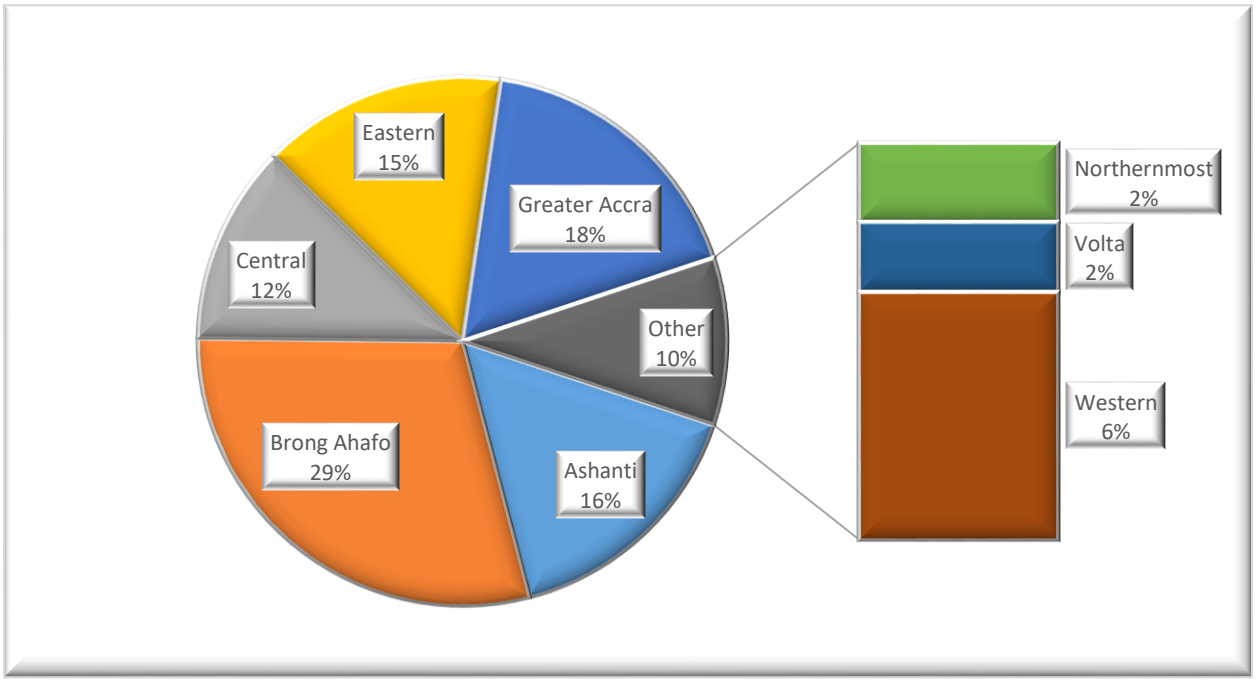



*Figure 12: Distribution of Total Broiler Chicken Revenue by Region*




## Broiler Chicken Variable Cost of Production

Four variable cost items are recognized: feed, labor, veterinary services and day-old-chicks. In the absence of diligent recordkeeping, collecting these data is based solely on recall and can be very difficult and potentially inaccurate. Therefore, the survey questions designed to collect cost-related information were structured to minimize the risk of error and improve recall accuracy. We did this by asking the same question in different ways at least three times to allow for verification and authentication of accuracy. While this made the survey longer than it would otherwise have been, its value was higher than the time

cost incurred. For example, poultry farmers often can easily recall the quantity of feed they purchased and its cost, but are not very good at remembering feed price. This is especially true when the feed is purchased over several weeks from different locations in different sizes and at different prices. However, they often have no difficulty recalling the price of their day-old chicks because they purchase them once at a time and from a single location. Given this scenario, we asked for the price of day-old chicks but used different questions to get to the cost of feed.

We asked farmers to provide information on the types of diseases they saw on their farms and how much it cost them in veterinary services, drug and medication expenses as well as special equipment to treat or prevent or manage the disease. The treatment and related cost estimates for all diseases were summed to get the total cost of veterinary medical costs for the year.[10]

There were 18 classes of labor based on whether they were remuneration, sex/age and duration of work. Labor may be paid or unpaid under remuneration; adult males, adult females and children under 15 years under sex/age; and full-time, part-time or seasonal under duration of work. We used the paid wage rate in each sex/age and duration of work class as a proxy for the wage rate for unpaid labor in that class. We estimated total labor cost for each labor class using respondents' estimates of the number of people and the number of weeks worked by each labor class and the class' average wage rate. Because labor on poultry farms is used for all species on the farm, the total labor cost for broiler chickens was estimated as the product of the average labor cost per bird on the farm and the number of broiler chickens on the farm. About 79.9 percent of broiler chicken farms indicated having employees (including themselves) on their farms. About 88.7 percent of the 1,508 broiler chicken farms had full-time workers, compared to 23.5 percent with part-time workers and 12.1 percent with seasonal workers.

Farmers may use domestic or imported day-old chicks. Imported day-old chicks may be imported by the farmer or purchased from an importer. Domestic day-old chicks may be produced by the farmer or purchased from local suppliers. About 3.3 percent and 2.1 percent of farms imported or produced their own day-old chicks while 54.8 percent procured their day-olds from local suppliers and 39.8 percent used local importers. We used the average of local suppliers' price as a proxy for day-old chicks produced by the farm and the average price of all four sources served as the price of day-old chicks.

The final variable cost category is feed. Farms produced their own feed and/or purchased commercial feed. About 51.9 percent of broiler chicken farms produced some or all of their own feed, with 32.4 percent of them producing 100 percent of required feed on farm. However, only about 16.3 percent of broiler chicken farms producing on-farm feed produced 50 percent or less of their total feed requirements. Feed retail stores served about 46.0 percent of broiler chicken farms' commercial feed needs compared to 10.4 percent by farmer-based organizations and 8.2 percent and 8.9 percent respectively by small and large commercial feed mills. We used the average feed price per kilogram of purchased feed as a proxy for on-farm feed to estimate the total cost of feed used by the farm.

Average total feed cost was estimated at GHS 19.68 with a standard deviation of GHS 5.93. It averaged GHS 14.60 with a standard deviation of GHS 3.04 for large farms and GHS 16.80 with a standard deviation of GHS 3.47 for medium-size farms. For small farms, average total feed cost was GHS 20.26 with a standard deviation of GHS 6.03.

[10] Diseases on chicken farms in Ghana are covered in a different report.

Total variable cost per bird on farm *i*, $VC_i$, producing broiler chickens was, thus, defined as follows:

$$VC_i = L_i + V_i + D_i + F_i \quad (2)$$

where L is total labor costs, V is veterinary medical costs, D is the cost of day old chicks and F is feed costs. As indicated above, total labor cost is defined as follows:

$$L_i = \sum_{j=1}^{3} w_{ijks}(n_{ijks}t_{ijks}) \quad (3)$$

where $w_{ijk}$ is the wage rate paid by farm *i* to labor type, *j* = {male adult, female adult child} and labor class, *k* = {paid, unpaid} and labor structure, *s* = {part time, full time, seasonal}, and *n* and *t* are respectively the number of workers and the duration worked. The wage rate was in months and the time worked was in weeks. Dividing the wage rate by four transformed it into cedis per week and multiplying by the total time worked yielded the total wage bill. Dividing this by the number of birds on the farm and multiplying through by the proportion of boiler chickens produced its share of the wage bill.

Table 9 shows that the estimated total variable cost was GHS 24.91, with a standard deviation of GHS 8.48 and a median of GHS 28.80. The difference in total variable costs between small and medium-size farms was GHS 4.21, with a t = 10.29 and Pr > t = 0.000, causing us to reject the hypothesis that the two are equal. The same is true for the difference between medium-size farms and large farms, with a difference in total variable cost of GHS 2.81 (t = 4.19; Pr > t = 0.000). The difference in feed costs between small and medium-size farms and between medium and large farms were both statistically significant at the 1 percent level.

*Table 9: Summary Statistics of Variable Cost Components for Broiler Chicken by Farm Size (GHS/Bird)*

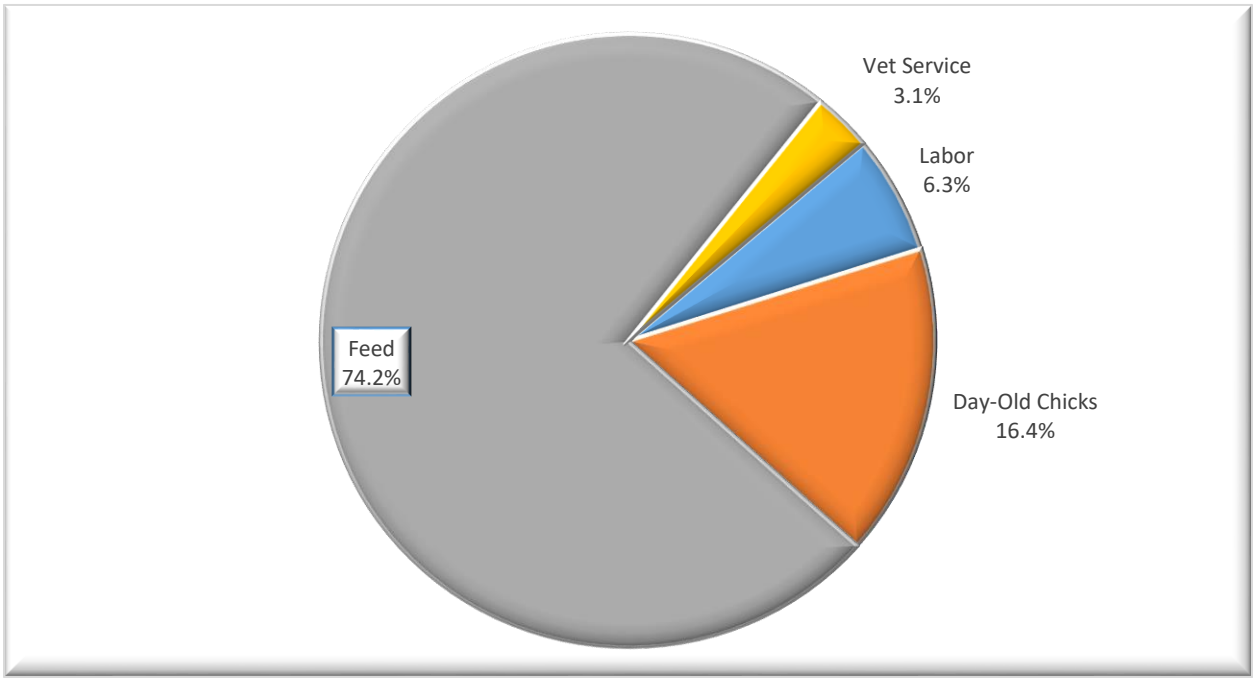
| Category | Labor | Day-Old Chicks | Feed | Vet Service | Variable Cost |
|---|---|---|---|---|---|
| *Small* | | | | | |
| Average | 1.69 | 4.39 | 20.26 | 0.89 | 27.07 |
| Std. Dev. | 1.41 | 0.82 | 6.03 | 1.38 | 6.80 |
| Median | 1.08 | 4.50 | 24.00 | 0.27 | 29.58 |
| *Medium* | | | | | |
| Average | 1.51 | 4.29 | 16.80 | 0.34 | 22.94 |
| Std. Dev. | 1.08 | 0.88 | 3.48 | 0.76 | 3.94 |
| Median | 1.08 | 4.45 | 19.57 | 0.10 | 24.24 |
| *Large* | | | | | |
| Average | 1.49 | 3.89 | 14.60 | 0.47 | 20.10 |
| Std. Dev. | 1.35 | 0.95 | 3.04 | 1.21 | 4.32 |
| Median | 1.08 | 4.00 | 16.34 | 0.08 | 20.96 |

| *Total* | | | | | |
|---|---|---|---|---|---|
| Average | 1.64 | 4.36 | 19.78 | 0.82 | 24.91 |
| Std. Dev. | 1.38 | 0.84 | 5.91 | 1.34 | 8.48 |
| Median | 1.08 | 4.50 | 24.00 | 0.21 | 28.80 |

Veterinary medical costs averaged GHS 0.82, with a standard deviation of GHS 1.34 and a median of GHS 0.21. The difference between the veterinary medical cost for small and medium-size farms was significantly different from zero but the difference between medium and large farms' veterinary medical costs was not. The difference between day-old chicks' cost on large and medium-size farms was statistically significant at the 1 percent ($t = 2.79$; $Pr > t = 0.005$) but there was no statistically significant difference between small and medium-size farms' day-old chicks' price. Finally, there was no statistically significant difference between the labor cost per bird on small and medium-size farms and between medium-size and large farms.

The distribution of the variable cost by its components, presented in Figure 13, shows that veterinary service costs account for only 3.1 percent of total variable costs compared to day-old chicks at more than 16.4 percent. Feed cost share of total variable cost averaged approximately 74.9 percent, with an estimated standard deviation of 10.1 percent. This is higher than the industry narrative that feed accounts for about 60 percent of total variable costs. It is important to note that this may be just unique for 2015 since the data covered only that year. That notwithstanding, we do not think it would be any much lower given the numerous studies that show farmers identify feed costs as the principal a major challenge to their operations.

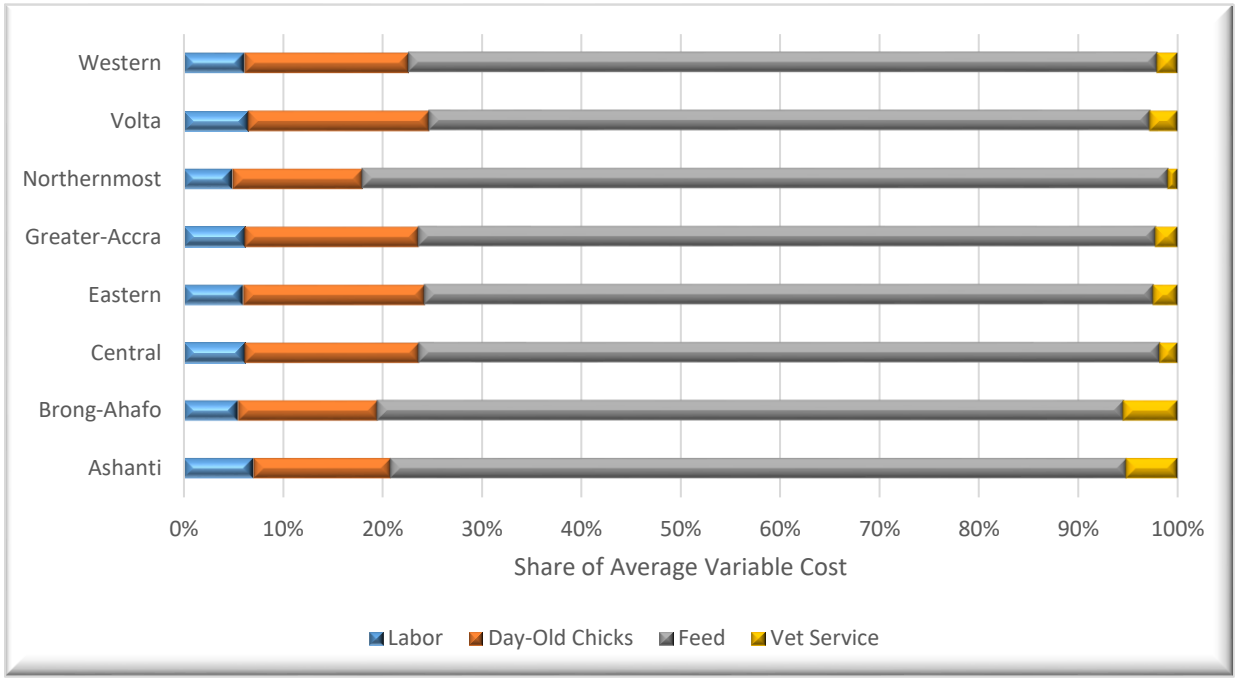
*Figure 13: Distribution of Total Variable Cost of Producing Broiler Chicken Among Its Components for 2015.*



At GHS 27.52 per bird, the average variable cost of producing broiler chicken was highest in Ashanti Region, and lowest in the northernmost regions, at GHS 22.98. Eastern Region average variable cost was GHS 23.64 per bird compared to Greater Accra's at GHS 25.36. Brong Ahafo's average variable cost came in at GHS 24.44 per bird while Western Region was GHS 25.32. Finally, Volta returned an average variable cost per bird of GHS 23.07, the lowest after the northernmost regions'.

The share of day-old chicks in variable cost was highest in Volta, at 20 percent, and lowest in Ashanti at 14.5 percent. However, the share of veterinary medical costs in Ashanti was about 5.5 percent, it was about 5.9 percent in Brong Ahafo and 3.1 percent in Volta. The remaining regions all posted a veterinary medical cost share below 3.0 percent. It could be the health situation in the regions different significantly in 2015 to produce the foregoing results. The distribution of the variable cost components differed across the regions. Figure 14 shows that feed cost accounted for about 92.9 percent of variable costs in the northernmost regions, compared to 77.5 percent in Ashanti, the lowest. Labor costs share in Ashanti were the highest, accounting for 7.3 percent of variable costs while Brong Ahafo's labor cost share were the lowest at 5.8 percent of variable cost.

*Figure 14: Distribution of Broiler Chicken Average Variable Cost Among its Components by Region*




## Broiler Chicken Gross Margin

Gross margin per bird is defined as revenue per bird less variable costs per bird. The gross revenue per bird is essentially the average price received. Given that farms sold their birds through various channels, the weighted average of prices received across the channels, $P_{wi}$, was used to represent the average price. It is defined as follows:

$$P_{wi} = \sum_{j=1}^{7} \rho_{ij} P_{ij} \qquad (4)$$

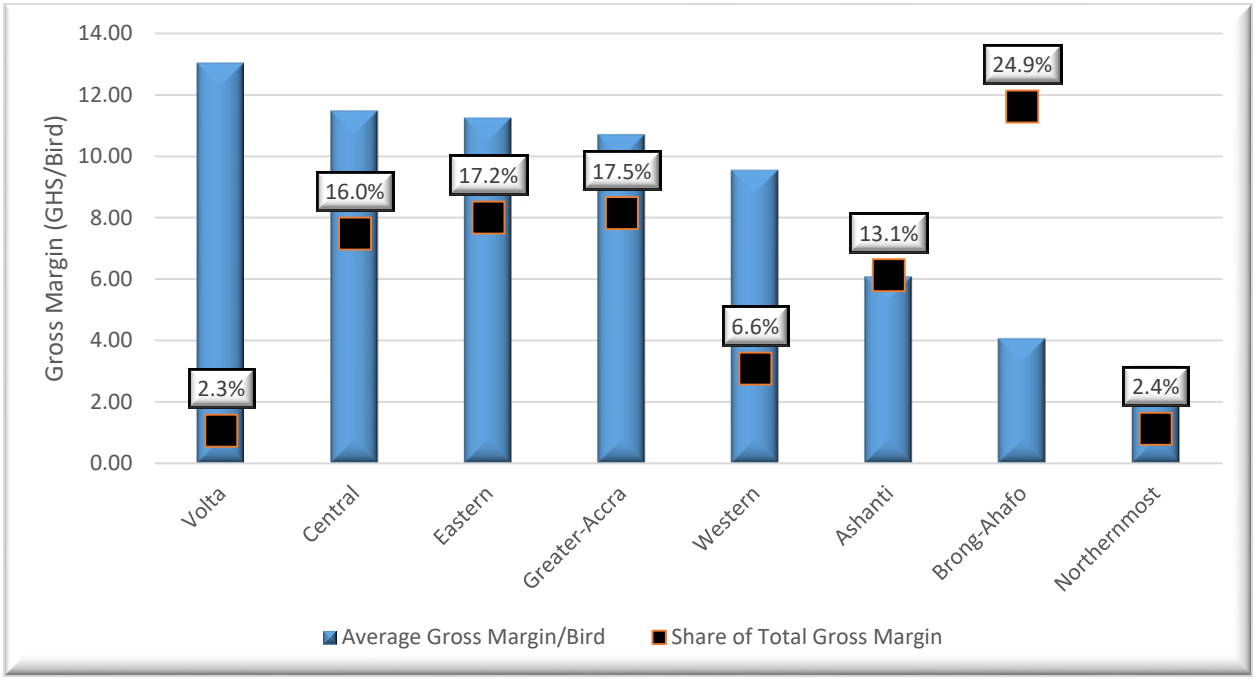
The average gross margin per broiler chicken for all broiler chicken farms was estimated at GHS 8.87, with a standard deviation of GHS 8.00 and a median of GHS 8.72. By farm size, the average gross margin for small farms was GHS 8.64, compared to GHS 10.34 for medium-size farms and GHS 10.49 for large farms (Table 10). While the average gross margin differed statistically between small and medium-size farms, there was no difference between medium-size and large farms. It is interesting to note that while 14.5 percent of small farms posted negative gross margins, only 6.5 percent of medium-size farms and 3.8 percent of large farms posted negative gross margins. This would suggest that despite selling their birds at lower prices, large farms have size advantages that manifest in their gross margin estimates.

*Table 10: Summary Statistics of Gross Margin by Size of Operation (GHS/Bird)*

| Farm Size | N | Average | Std. Dev | Median |
|---|---|---|---|---|
| Small | 1,049 | 8.64 | 8.16 | 8.42 |
| Medium | 107 | 10.34 | 6.79 | 10.72 |
| Large | 53 | 10.49 | 6.57 | 10.59 |
| Total | 1,209 | 8.87 | 8.00 | 8.72 |

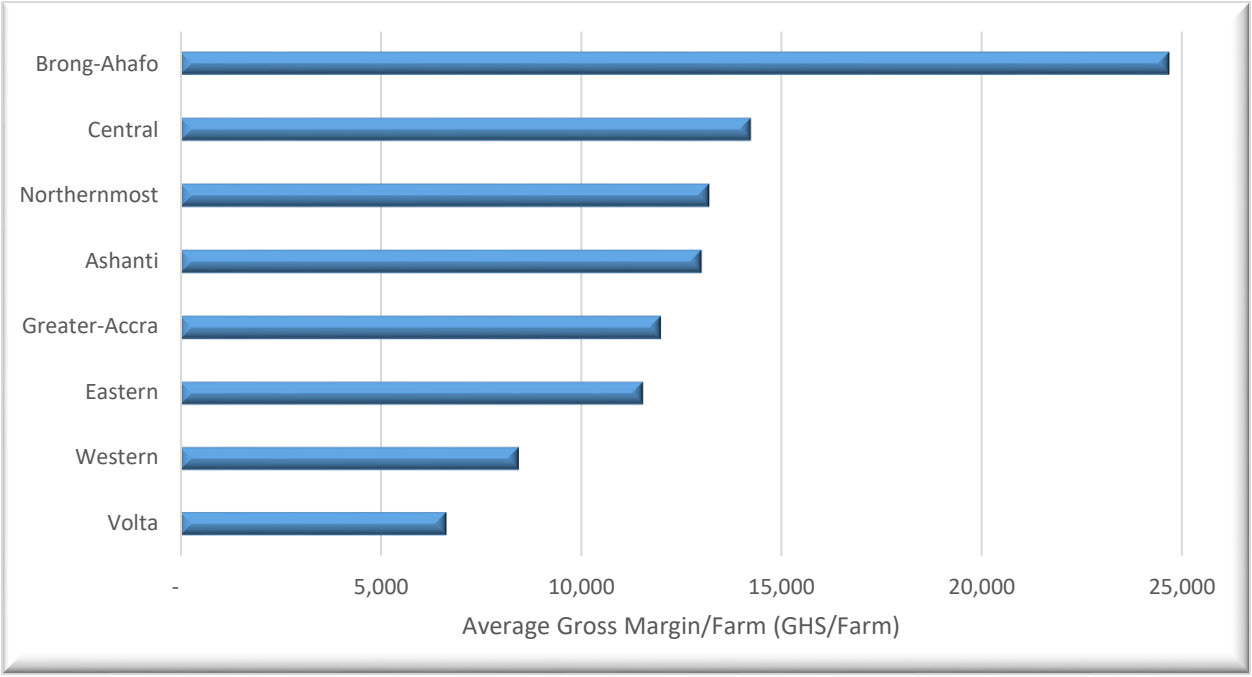
Figure 15 shows that despite having the highest average gross margin per bird of GHS 13.04 (standard deviation = GHS 8.24), Volta Region's share of total gross margin in Ghana's broiler chicken segment was the lowest, at about 2.3 percent. On the contrary, while Brong Ahafo had the second lowest average gross margin per bird of GHS 4.09 and standard deviation of GHS 7.96 per bird, it had almost a quarter of the segment's total gross margin. This result provides some information on how an increase in the professional operations of poultry farms may be a worthwhile focus of policymakers in enhancing the sector's contribution to poverty reduction and income enhancement. We return to this again later.

*Figure 15: Average Gross Margin per Broiler Chicken and Share of Total Gross Margin by Region*




The industry's total gross margin in 2015 was estimated at about GHS 16.4 million, with an average total gross margin per farm of about GHS 13,535, with a standard deviation of GHS 52,238. Figure 16 shows the ranking of the regions by their average gross margin per farm in 2015. Brong Ahafo has the highest average gross margin per farm, at GHS 24,685, with a standard deviation of GHS 99,396. The average gross margin per farm in Greater Accra at GHS 12,011 in Greater Accra (standard deviation of GHS 35,098), was only 48.7 percent of Brong Ahafo's while Ashanti Region's, at GHS 13,025, with standard deviation of GHS 38,448, was about 52.8 percent of Brong Ahafo Region's. Central Region was the closest to Brong Ahafo in terms of average gross margin per farm, at GHS 14,252, with a standard deviation of GHS 72,202. We notice that despite the high average gross margin per bird, the size of farms in Volta Region causes it have the lowest average total gross margin per farm – GHS 6,649 and a standard deviation of GHS 8,328 – and only about 26.9 percent of the average gross margin per farm in Brong Ahafo.

*Figure 16: Average Broiler Chicken Gross Margin per Farm by Region*




## Summary on Broiler Chicken Segment Performance

We started the assessment of the economic performance of the broiler chicken segment by assessing the channels farmers use in distributing their products. We identified seven channels: direct-to-consumer; wholesale; retail; hawkers; chop bars; hotels, restaurants and institutions; and processors. The channel of choice for most farms is the direct-to-consumer channel and our analysis showed that it also produced the highest average price. We argued that the direct-to-consumer channel's price, averaging about GHS 36.94 per bird, exceeded all other channels' prices, and the difference reflect the lower level of service involved in using it from the point of view of the supply chain. We pointed out that the assumption of risks by wholesalers, for example, explain the GHS 4.60 difference on average between wholesale price and direct-to-consumer price. Thus, this difference may be perceived as a risk premium paid by broiler chicken farmers using the wholesale channel to transfer loss and husbandry risks to wholesalers. Based on this, we estimated that while nearly 70 percent of broiler chicken farms used the direct-to-consumer channel to sell birds, only about 27 percent indicated using the wholesale channel. This means that a larger proportion of broiler chicken farmers in Ghana choose to self-insure these husbandry and loss risks instead of transfer them. Farms in Brong Ahafo Region were the least likely to use the direct-to-consumer channel, where only approximately 47 percent indicated using it, compared to almost 90 percent of farms in Eastern Region and about 70 percent in Greater Accra. On average, the price realized by large farms in all channels was lower than that realized by small farms. This, we argue, may be a result of the total cost of assuming husbandry and loss risks, and hence a higher willingness of large farms to transfer these risks to wholesalers and others downstream in their supply chains and pay the risk avoidance premium.

The average revenue per farm from the direct-to-consumer channel was estimated at GHS 14,137, was the lowest among all the channels. This means that despite presenting a higher price, broiler chicken farms in Ghana do the bulk of their sales through alternative channels. The benefits of enhancing the operations of these downstream supply chain actors in the broiler chicken segment cannot be

overemphasized. For example, although the number of processors was too low to have confidence in the estimated statistics for that channel, the results showed that the average revenue per farm using the processor channel was significantly higher than for even the wholesale channel. The results also showed that large broiler chicken farms were the only ones that were using the processor channel, with about 14.1 percent of their total sales revenue generated in that channel, comparable to the share of their revenue generated in the direct-to-consumer channel and less than the share from the chop-bar channel.

We identified four principal components of variable costs for broiler chicken farms: feed; veterinary services; day-old chicks; and labor. On average, feed costs accounted for almost three-quarters of total variable costs on broiler chicken farms in Ghana. Farm size did not a statistically significant influence on the of feed cost share of total variable cost. On the other hand, farm size did influence veterinary services cost. For example, small farms spent an average of about GHS 0.55 and GHS 0.42 per bird on veterinary services per year more than medium-size and large farms. These differences were both statistically significant at the 1 percent level.

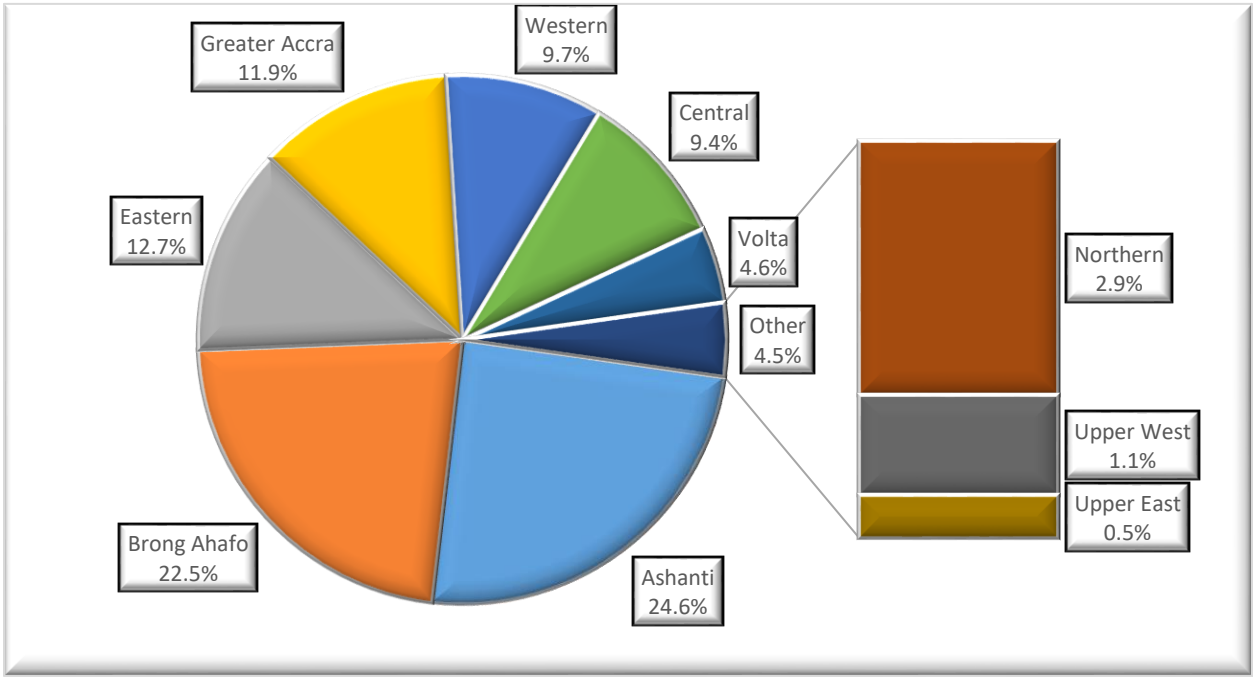
The difference between price and variable cost per bird is gross margin. The average gross margin was about GHS 8.87 per bird nationally. However, small farms averaged about GHS 8.64, compared to medium-size and large farms average of GHS 10.34 and GHS 10.49. While the average gross margin for small farms differed in a statistically significant way from those of medium and large farms, there was no statistical difference between medium-size and large farms. Interestingly, we found a negative correlation between the average gross margin per bird and the share of total gross margin by region. While Volta Region had the highest average gross margin per bird – about GHS 13.04 per bird – its share of the total gross margin was only 2.3 percent. This is in contrast with Brong Ahafo, whose average gross margin per bird was only GHS 4.01 and its share of total gross margin was almost 25 percent. Brong Ahafo's average total gross margin per farm was also the highest in the country, about GHS 25,000, compared to under GHS 7,000 for Volta Region. The foregoing offers some policy directions we shall return to later.

# Structure of the Chicken Egg Segment

## Distribution of Chicken Egg Production

There were 2,889 commercial layer chicken farms in Ghana in 2015 and they were distributed as shown in Figure 17. Nearly a quarter of the farms were in Ashanti Region and about another 22.5 percent in Brong Ahafo Region. As found in broiler chicken, the least number of layer chicken farms was found in the three northernmost regions, which together accounted for only 4.5 percent of all layer chicken farms. The locations of these farms are presented in Figure 18.

*Figure 17: Distribution of Chicken Egg Farms in Ghana by Region (2015)*

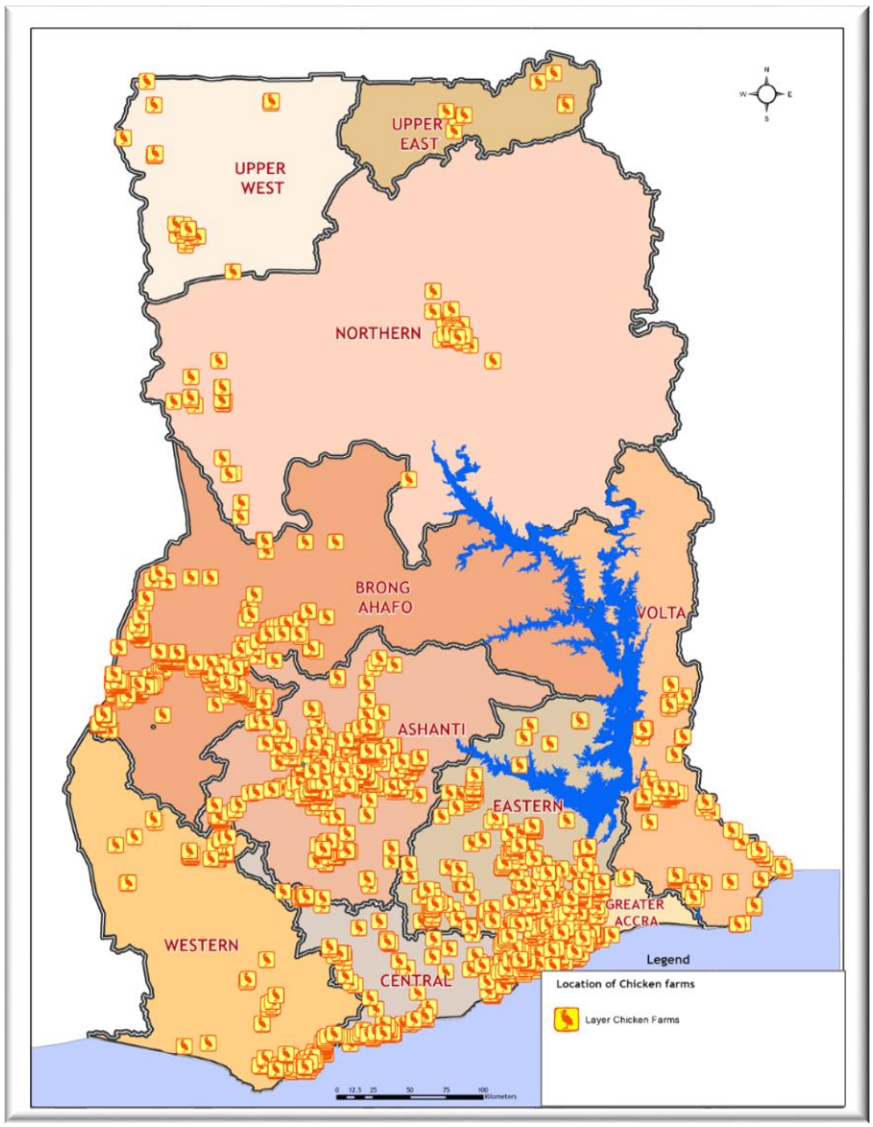



Unlike broiler chickens which are produced for their meat over a short time period, layer chickens are kept for their eggs, and over a much longer period. The survey data showed that the production cycle among chicken egg producers averaged about 77.9 weeks, with a standard deviation of about 21.7 weeks. The minimum production cycle reported was 52 weeks and the longest 130 weeks. Layer chickens begin producing at about 20 to 24 weeks of age and can produce continuously for about 52 to 60 weeks, depending on breed and husbandry. After this period, egg production and shell quality begin to decline and egg size begin to increase. About 33.2 percent of farms in the survey kept their birds in lay for less than 52 weeks, 36.1 percent kept them for between 52 weeks and 78 weeks while 28.9 percent kept their hens for between 78 and 103 weeks. Only 43 farms, or 1.9 percent, indicated keeping their birds in lay for more than 130 weeks.

The egg production cycle has been determined to peak very early after birds come into lay and decline steadily thereafter. Thus, to estimate annual egg output in Ghana, it is necessary to know not only the number of layer chickens on the farm and their age but how long they have been in lay and their laying performance profile. Figure 19 shows that at the end of 2015, only about 11.7 percent of layer chicken

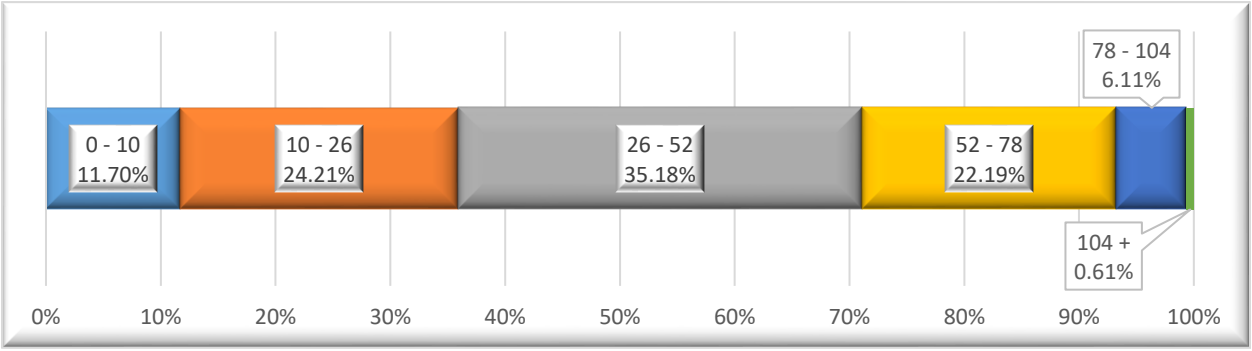
farms had flocks in their pre-peak period. Another 24.2 percent had birds in lay for between 10 and 26 weeks while 35.2 percent have been in lay for between 26 and 52 weeks.

*Figure 18: Location of Layer Chicken Farms in Ghana by Region (2015)*




Map produced with field data by Jennifer Asiedu-Dartey, USAID-METSS, 2016.

*Figure 19: Distribution of Farms by How Long Birds Have Been in Lay (in Weeks)*



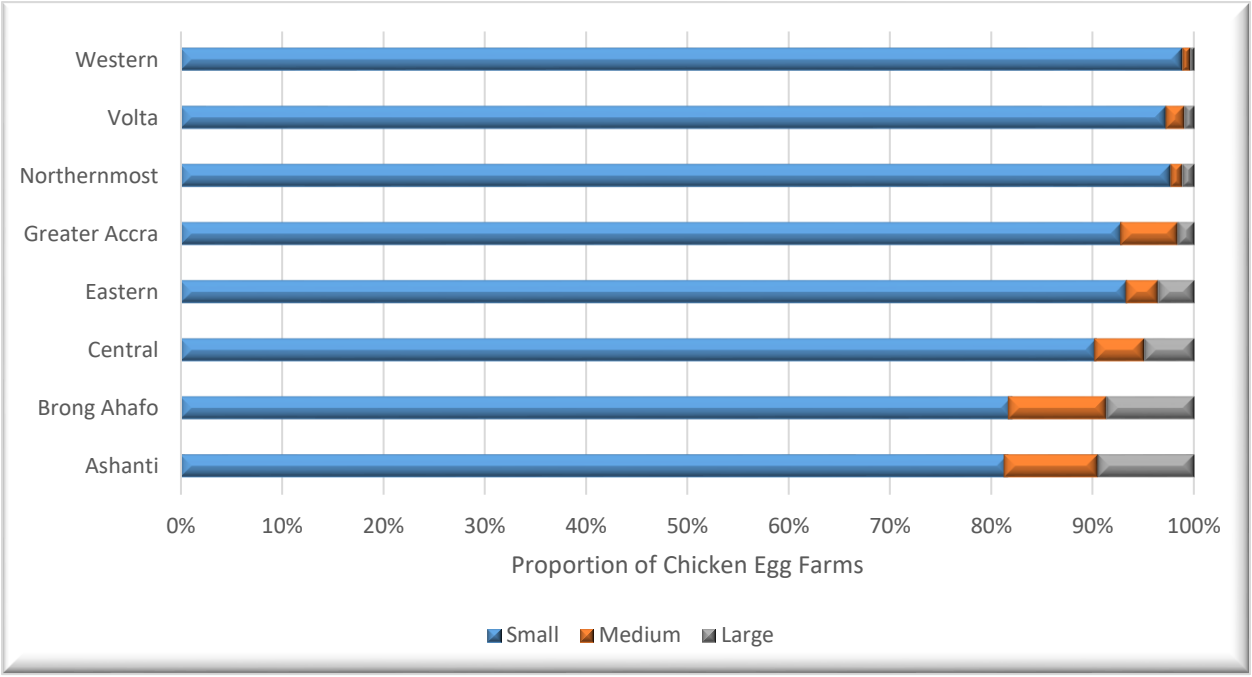

We set commercial chicken egg farms as those with 15 or more birds. Based on this, the number of farms of interest for this project declined from 2,889 to 2,404. These farms had a minimum of 15 layers to a maximum of 34,400 layers in 2015. Using Aning's (2011) size definition, 88.1 percent of chicken egg farms were small-size, about 6.3 percent were medium-size and the remaining 5.6 percent were large-size farms.[11] The average number of birds on small farms was about 1,184, with a standard deviation of 1,034 and a median of 900 birds. For medium-size birds, the average number of birds was 6,554, with a standard deviation of 1,439 and a median of 6,000 birds. And for large-size farms, the average number of birds was 29,624, with a standard deviation of 42,097 and a median of 16,000 birds. Across all farms, the average number of birds was about 3,121, with a standard deviation of 11,982 and a median of 1,000 birds. At the time of conducting the study, we show that the total number of laying chickens in the country was about 7.5 million and 53.4 percent of them were on large while small and medium-size farms accounted for 33.4 percent and 13.2 percent respectively.

While about 95.7 percent and 1.7 percent of females managed small and large chicken egg farms, the proportions for male managers were 87.0 percent and 6.2 percent. About 81. 2 percent of females managing egg farms were owners compared to 70.4 percent of males. This means about 8.3 percent of hired managers on egg farms were females compared to about 91.7 percent being male. Overall, 63.0 percent of egg farms are located in rural areas, compared to the 45.3 percent of broiler farms that were located in rural areas. About 62.1 percent of small egg farms were in rural areas compared to 70.1 percent of medium-size and 68.2 percent of large farms.

The distribution of egg farms by size and region is presented in Figure 20, and it shows that Ashanti Region and Brong Ahafo have the lowest proportion of small chicken egg farms while Western Region has the highest proportion. The largest proportion of large farms are in Ashanti Region, with 9.4 percent of farms, followed by Brong Ahafo Region, with 8.6 percent of farms.

[11] We did not change Aning's (2006) definition for layers because there were enough observations in each of the size categories.

*Figure 20: Distribution of Chicken Egg Farms by Size and Region*

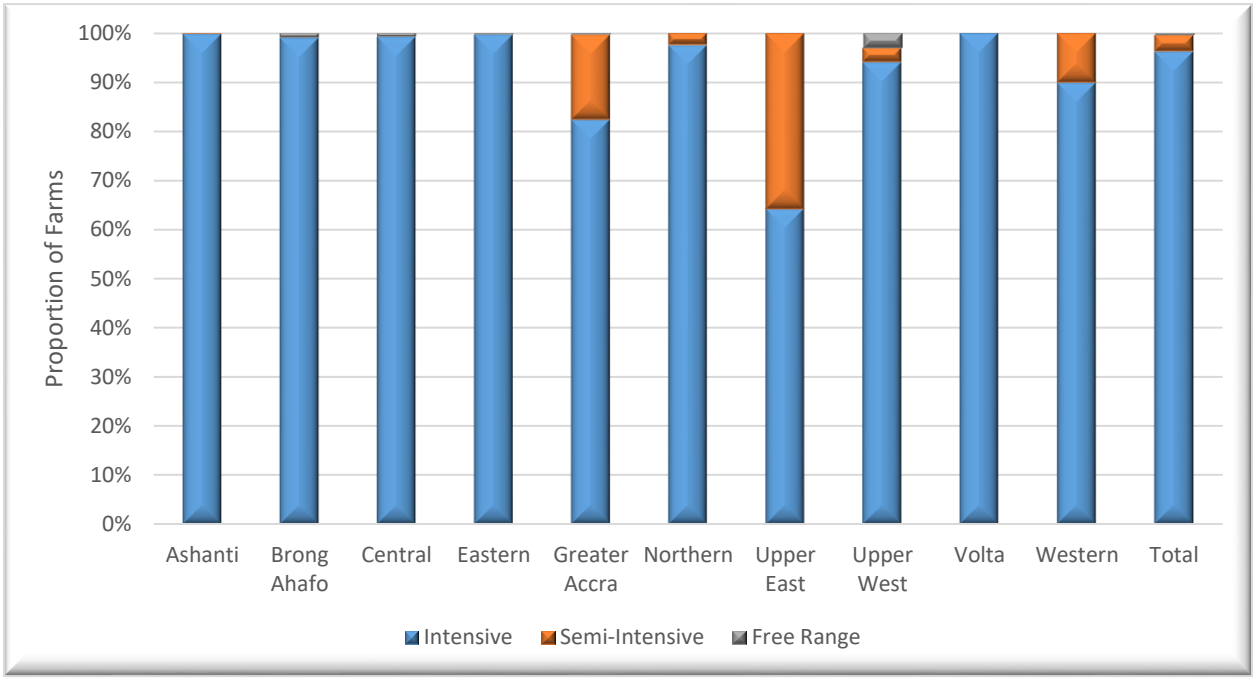



## Chicken Egg Production System and Output

We identified three types of production systems for broiler chicken production in Ghana: Intensive; Semi-intensive; and Free range. Under intensive production, the birds are confined to poultry houses, which protects them from the elements and from predators, while providing them with all their needs – feed, water, medications, etc. Under free range production, the birds are not confined, and thus, roam but within confined areas. Free range birds are usually confined in sheds at night to protect them from predators and in inclement weather. The UK Government stipulates that birds must be kept outside in open-air runs for at least half of their life for the production system to qualify as free range. There are other stipulations, such as stocking density, that qualify the production system. Semi-intensive production system involves a combination of intensive and free range, with birds being allowed to forage outside of the bird houses to supplement provided feed.

Intensive production is the production system of choice in commercial broiler chicken production in Ghana. Figure 21 show that farms in Upper East Region were the most likely to use the semi-intensive production system for broiler production. What is interesting is the free range system is not a major production system in any region. However, about 3 percent of farms in Upper West indicated using free range in their chicken egg production.

*Figure 21: Layer Chicken Production Systems by Region*




While the intensive production is dominant in the industry, the results also show that the dominant barn type is deep litter, with 96.1 percent of broiler farms and 97.5 percent of chicken egg farms using it. The deep litter barn type exhibits lower capital costs but relatively higher labor costs while the intensive production system has higher capital costs and lower labor and land costs in comparison to free range, for example. From a biosafety perspective, the intensive production system can prevent exposure to external pathogens and predators but could also increase the spread of any disease if infection occurs. It is also important to note that consumer perceptions about animal welfare in developed countries are changing in favor of less intensive production and cage-free systems. How quickly these trends will emerge among Ghanaian consumers remains to be seen. However, in an increasingly open global trade environment, is there an opportunity for Ghana's poultry industry to explore export opportunities leveraging its "endowed" competitive advantage in labor and land to consider alternative production system? We return to this later when assessing alternative policies to enhance the industry's structure and performance.

Recall that more than a third of the chicken layers in this study were in the first half of the first year of their production. Recognizing that laying performance is a function of how long the birds have been laying, as well as other factors, it is quite daunting to assess annual production from a national chicken layer population without some clear assumptions. In order to ensure transparency, the assumptions driving the calculation of total eggs are here presented.

It is very difficult to project the future, even for professionals who do such projections for a living. We understood the challenge it presented to respondents when we asked them to project their farms' total egg production based on their knowledge about history and current conditions. As a result of this difficulty, it was not at all surprising to find some significant implausible numbers when we worked their responses backwards to estimate, for example, their laying percentage.

Because of the foregoing and the difficulty of finding an effective approach to extract some value from their responses, we chose to pursue the second-best solution. All estimated laying percentage below 55% or above 79% were replaced by the average laying percent estimated by excluding those outside the specified boundaries. The estimated average laying percent under the foregoing condition was 66.45 percent. This was comparable to the Netherlands Enterprise Agency (RVO.nl) (2014) study which indicated that the laying chicken in Ghana laid an average of 250 eggs per bird per year, an estimate that translates into a laying percent of about 68.5 percent.[12] The upper cut-off was based on a 2012 study published in *World Poultry*, and updated in 2013, which indicated that it is possible to get 280 eggs per bird per year in Ghana – a laying percentage of 76.7 percent.[13] In doing this, it is recognized that the risk of overestimating production is likely to exceed the risk of underestimating it since reported management challenges suggest that poultry operators do not perform at their utmost best because they do not use appropriate feed and other modern husbandry techniques that produce the highest performance.[14]

Given the effect of age on laying percentage, it was necessary to adjust the current laying performance by the age of the flock in order to estimate the annual production on the farm from the beginning to the end of 2015. This effort required that the estimation of the number of crates of eggs, $E_i$, farms could be expected to produce in 2015 will be determined by the age of the birds in December of 2015, when the data were collected.[15] If the flock age was such that the difference between the flock age and 52 weeks was 18 or more, then it implied the flock would have a full year of egg production, *ceteris paribus*. However, if the difference is less than 18, then it means that the particular flock would not have a full year of egg production. The number of weeks of production based on the flock age at the beginning of the year, *A*, is used to adjust the number of eggs it will produce in the year. The adjustment is expressed in the following equation, thus:

$$E_i = \begin{cases} If\ \ A_i - 52 \geq 18 : (365 n_i \rho_i) / 30 \\ If\ \ 0 < A_i - 52 < 18 : [365 n_i \rho_i (7.25 + 0.25 m_i)] / 30 \\ If\ \ A_i - 52 \leq 0 : 0 \end{cases}, \quad (5)$$

where $n_i$ is the number of birds in the flock, $\rho_i$ is the laying percentage assumed for the farm and $m_i$ is the difference between the flock age and 52 weeks.

Based on the foregoing assumptions and useable observations from the survey, the summary statistics on egg production for 2015 is presented in Table 11. Total projected egg output is about 36.5 million crates, with an average of 16,694 crates per farm and a standard deviation of 78,286 crates. The median is 4,498 crates per farm in 2015. Of the estimated total output, large-size egg producing farms included in the

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12 Rijksdienst voor Ondernemend Nederland. *Analysis Poultry industry Ghana: An Inquiry of Opportunities and Challenges*, 2014.

13 Bal, Ad. Ghana is Balancing on the Table Egg Market. *World Poultry*, Feb. 6, 2012. Available at http://www.worldpoultry.net/Layers/Eggs/2012/2/Ghana-is-balancing-on-the-table-egg-market-WP009959W/.

14 Opoku-Mensah, S. "Performance and Efficiency Measures of Layer Production Enterprises in the Ashanti Region of Ghana," *International Journal of Innovation and Applied Studies*, 14(2016): 1105-1115.

15 The crate, which is 30 individual eggs, is the standard unit of measurement on egg farms in Ghana.

study accounted for about 54.9 percent while small-size farms accounted for 32.0 percent. The remaining 13.2 percent of total output was produced by medium-size farms. While the average output on small-size farms was 6,091 crates per year, it was almost 158,000 crates per year on the large-size farms, which was about 4.6 times the average production on medium-size farms. The median output on medium-size farms was 81,760 crates, about nine times the median production on small-size farms and about a 39.1 percent of large-size farms' median output.

*Table 11: Summary Statistics on Projected Egg Production for 2015 by Size of Operation (Crates)*

| Size of Farm | N | Sum | Mean | Std. Dev. | Median |
|---|---|---|---|---|---|
| Small | 1,915 | 11,665,157 | 6,091 | 6,809 | 3,537 |
| Medium | 143 | 4,800,899 | 33,573 | 16,632 | 32,004 |
| Large | 127 | 20,011,046 | 157,567 | 288,410 | 81,760 |
| Total | 2,185 | 36,477,102 | 16,694 | 78,286 | 4,498 |

The summary statistics of egg production by region is presented in Table 12 shows that the average output per farm in Ashanti Region was 25,235 crates, with a standard deviation of 80,270 crates and a median of 6,712 crates. Total output was about 14.5 million crates. In contrast, the average output in Volta Region was about 4,342 crates per farm, with a standard deviation of 8,715 crates and a median of 1,780 crates. The average output per farm in Brong Ahafo of 27,544 crates was about 9.2 percentage points higher than in Ashanti, with standard deviation of 137,455 and a median of 8,085.

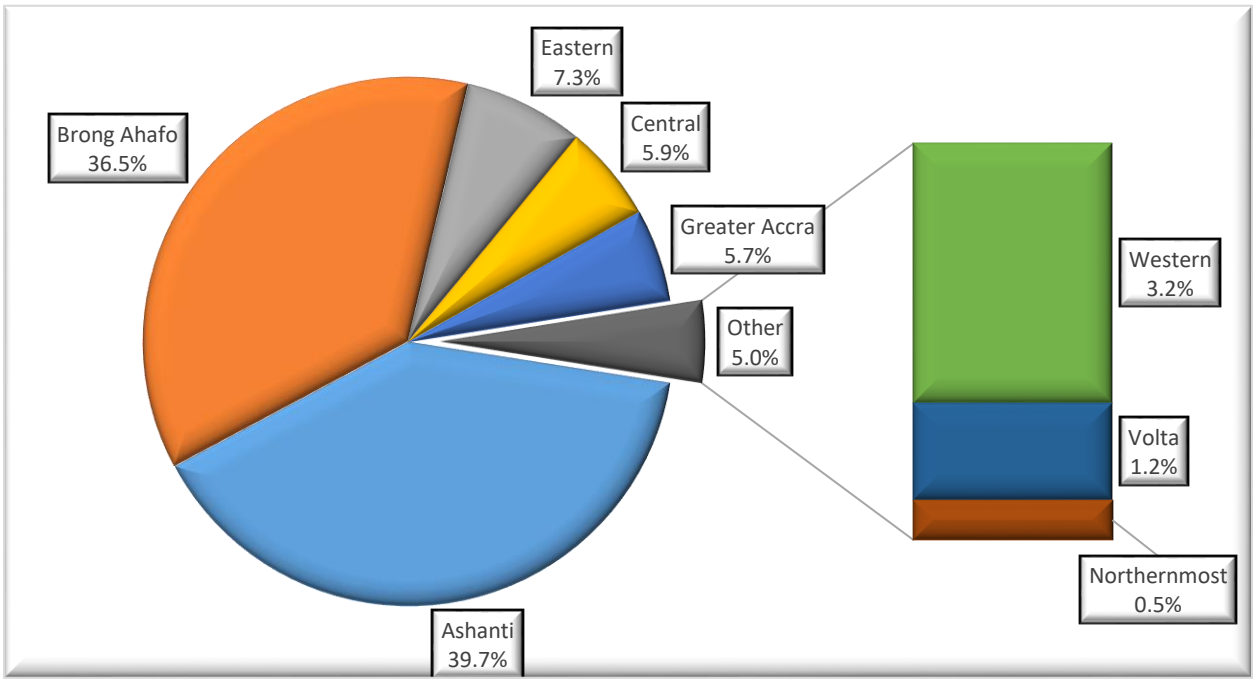
*Table 12: Summary Statistics for Project Eggs Production in 2015 by Region (Crates)*

| Regions | Farms | Average | Std. Dev. | Median | Total Output |
|---|---|---|---|---|---|
| Ashanti | 574 | 25,235 | 80,270 | 6,712 | 14,484,667 |
| Brong-Ahafo | 483 | 27,544 | 137,455 | 8,085 | 13,303,705 |
| Central | 194 | 11,061 | 22,594 | 3,962 | 2,145,800 |
| Eastern | 273 | 9,770 | 21,601 | 3,234 | 2,667,223 |
| Greater-Accra | 237 | 8,710 | 24,747 | 2,695 | 2,064,350 |
| Northernmost | 78 | 2,357 | 2,869 | 1,581 | 183,842 |
| Volta | 102 | 4,342 | 8,715 | 1,780 | 442,885 |
| Western | 244 | 4,855 | 6,110 | 2,998 | 1,184,631 |
| Total | 2185 | 16,694 | 78,286 | 4,498 | 36,477,102 |

The distribution by region (Figure 22) shows that Ashanti Region, which had 26.5 percent of farms, accounted for almost 39.7 percent of total eggs output in the country while Brong Ahafo, with 22.3 percent of farms, accounted for 36.5 percent of total production. The remaining regions all produced a

lower share of total output than their share of farms. For example, Volta Region's share of egg output was 4.4 percent even though its share of farms was 5.1 percent.

*Figure 22: Distribution of Estimated Total Egg Output Across the Regions (2015)*




## Summary of Chicken Egg Segment Structure

The foregoing on the chicken egg segment of the Ghana poultry industry may summarized as follows:

- There are 2,889 chicken eggs farms in Ghana, with more than 47 percent of them located in two regions – Ashanti and Brong Ahafo. The three northernmost regions of Northern Region, Upper East and Upper West – together accounted only 4.5 percent of chicken egg farms.
- Small farms accounted for about 87.6 percent of chicken eggs farms in Ghana but large farms accounted for about 55 percent of total egg output in 2015.
- While 81.4 percent chicken egg farms managed by women were owners, only about 70 percent of chicken egg farms managed by men was by owners.
- Only 3.5 percent of large chicken egg farms compared to 13.6 percent of small chicken egg farms were managed by women.
- While about 62.2 percent small and 68.1 percent of large chicken egg farms were in rural areas, nearly 71 percent of medium-size chicken egg farms were in rural areas.
- Average egg output per farm was about 16,700 crates per year in 2015. However, the average for small farms was just about 6,100 crates. The average egg output on large farms was almost 158,000 crates per year.
- Ghana's chicken egg production is concentrated in Ashanti and Brong Ahafo, with those two regions accounting for more than 76 percent of total egg output in 2015.

# Economic Performance of Chicken Egg Segment

## Chicken Egg Marketing Channels

As seen with broiler chickens, chicken egg farmers in Ghana use alternative channels to sell their eggs: direct-to-consumer; wholesale; retail; hawkers; chop bars; and HRI. Like broiler chickens, processing is currently not a viable outlet for eggs in Ghana. This implies that, as noted earlier, almost all eggs produced in Ghana are table eggs. In general, wholesalers and hawkers and some consumers would purchase their eggs on the farm, reducing the logistics costs that would have been incurred by the farmer had the eggs been transported to market. However, these savings are not all accreted at the farm but may be shared with buyers depending on size and the nature of the relationship.

Wholesalers often sell to hawkers and retailers at relatively small margins. Hawkers would often add value by cooking the eggs and selling them in roadside shops or kiosks or on their heads in traffic in cities and on highways. Therefore, hawkers in the eggs segment may compete with snack food vendors. Wholesalers and aggregators may also sell to retailers in small retail stores in urban areas. The most important service that wholesalers provide is move relatively large volumes of highly perishable eggs from farms, relieving farmers of the risks associated with spoilage. The absence of on-farm climate-controlled storage facilities increase the value of this service.

The dominant channels for chicken egg farms are direct-to-consumer and wholesale. About 59.2 percent of chicken egg farms used the direct-to-consumer channel while 60.5 percent indicated using the wholesale channel. Another 29.6 percent and 38.8 percent used the retail and hawkers' channel. HRI and chop bar channels were used by about 5.2 and 5.0 percent of chicken egg farms respectively. Table 13 shows that more than 81.1 percent of large farms (those with more than 10,000 layers) indicated using the wholesale channel. On the other hand, less than a third of these large farms used the direct-to-consumer channel. Contrarily, 62.9 percent of small chicken egg farms indicated using direct-to-consumer channels. However, chop bars and HRI are minor channels for chicken egg farms in Ghana, with less than 10 percent of both large and small farms indicating using the channel.

*Table 13: Proportion of Farms Using the Different Channels to Distribute Eggs by Farm Size*

| Size Category | Direct to Consumers | Wholesaler | Retailers | Hawkers | Chop bars | HRI |
|---|---|---|---|---|---|---|
| Small | 62.9% | 57.7% | 29.0% | 40.0% | 4.8% | 4.8% |
| Medium | 35.7% | 81.1% | 32.9% | 32.9% | 6.3% | 10.5% |
| Large | 29.9% | 81.1% | 33.9% | 26.8% | 7.9% | 6.3% |
| Total | 59.2% | 60.5% | 29.6% | 38.8% | 5.0% | 5.2% |

## Chicken Egg Revenues

As with broiler chickens, chicken egg farm revenue is defined as the product of price per crate and number of crates sold under the assumption that all farm egg output is sold. Egg revenue, $R_i$, accruing on Farm $i$, was estimated as follows:

$$R_i = \sum_{j=1}^{7} \rho_{ij} P_{ij} q_i \quad (6)$$

where $\rho_{ij}$ is the proportion of Farm *i* egg output going through each distribution channel *j*; $P_{ij}$ is the price per crate the farm receives in channel *j* and $q_i$ is the number of crates of eggs produced by the farm.

### Analysis of Egg Output and Prices

Table 14 presents the summary statistics of the volumes sold through each of the seven channels. The average volume sold through the direct-to-consumer channel was about 2,045 crates per farm compared to nearly 19,000 crates per farm through the wholesale channel. The standard deviations are respectively 6,778 and 96,104 crates. Overall, despite the relatively large proportion of chicken egg farms using the direct-to-consumer channel, only about 6.6 percent of the approximately 36.5 million crates of eggs produced in Ghana in 2015 went through that channel. Nearly 23.6 million crates of eggs (64.7 percent of total output) went through the wholesale channel, with an average of about 18,946 crates per farm. The standard deviation for the wholesale channel was 96,104 crates and its median was less than 4,600 crates per farm. About 366,422 crates or 1.0 percent of total egg output went through the HRI channel, with an average of 3,557 crates per farm and a standard deviation of 6,564 crates and a median of about 1,369 crates per farm. The volume going through chop bars was about 258,302 crates (about for 0.7 percent of total egg output), with an average and standard deviation of 2,414 crates per farm and 5,290 crates per farm. The average volume going the direct-to-consumer channel was the lowest among the channels, being only about 10.8 percent of the average volume per farm going through wholesale and less than a third of the average volume going through either retail or hawker channels.

*Table 14: Summary Statistics of Volume (Crates) Distributed through Alternative Distribution Channels*

| Channel | N | Total Channel | Mean | Std. Dev. | Median | Channel Share of Total |
|---|---|---|---|---|---|---|
| Direct to Consumers | 1,171 | 2,394,285 | 2,045 | 6,778 | 639 | 6.6% |
| Wholesaler | 1,245 | 23,588,363 | 18,946 | 96,104 | 4,539 | 64.7% |
| Retailers | 595 | 4,129,179 | 6,940 | 24,253 | 1,824 | 11.3% |
| Hawkers | 768 | 5,558,707 | 7,238 | 25,330 | 2,347 | 15.2% |
| Chop bars | 107 | 258,302 | 2,414 | 5,290 | 1,037 | 0.7% |
| HRI | 103 | 366,422 | 3,557 | 6,564 | 1,369 | 1.0% |
| Processor | 25 | 169,608 | 6,784 | 20,156 | 425 | 0.5% |
| Total | 2,185 | 36,464,867 | 47,925 | 184,475 | 12,180 | 100.0% |

Table 15 presents the summary statistics for egg prices by the marketing channels.[16] The average price across all channels ranged from GHS 13.20 for chop bars to GHS 13.90 per crate for direct-to-consumer channels. The difference between wholesale and direct-to-consumer price was GHS 0.60 per crate. This difference was statistically significant at the 1 percent level (t = 13.34 P > |t|= 0.000). On the other hand, the GHS 0.072 per crate difference between wholesale and retail and the GHS 0.04 per crate difference between wholesale and hawkers were not statistically significant at the 5 percent level [(t = 1.75; P > |t|= 0.081) and (t = 1.081; P >|t| = 0.277)]. Thus, statistically speaking, the price farmers get selling through the wholesale channel was no different from the price they get selling to retailers and hawkers.

*Table 15: Summary Statistics for Egg Prices by Marketing Channel (GHS/Crate)*

| Channels | N | Average | Std. Dev. | Median |
|---|---|---|---|---|
| Direct-to-Consumers | 1,359 | 13.90 | 1.57 | 14.00 |
| Wholesaler | 1,375 | 13.30 | 0.58 | 13.00 |
| Retailers | 677 | 13.23 | 1.28 | 13.00 |
| Hawkers | 886 | 13.25 | 1.33 | 13.00 |
| Chop bars | 115 | 13.20 | 1.74 | 13.00 |
| HRI | 124 | 13.49 | 1.01 | 13.07 |
| Total | 2,396 | 13.35 | 1.03 | 13.00 |

The summary statistics of prices by channel and farm size are presented in Table 16. The difference between the average price received by small-size farms and medium-size farms in the direct-consumer channel was GHS 0.41 and it was statistically different from zero at the 5 percent level (t = 2.13; P > t = 0.034). The difference between the average price received by small farms and large farms in the direct-consumer channel was GHS 0.74 and it was statistically different from zero at the 1 percent level (t = 3.37; P > t = 0.001). On the other hand, the GHS 0.09 per crate difference in the prices received by small and large farms and GHS 0.08 per crate difference in the prices received by small and medium-size farmers in the wholesale channel were both not statistically significant at the 5 percent level [(t = 1.72; P > t = 0.086) and (t = 1.89; P > t = 0.059)]. The foregoing would seem to suggest that, on average, the transaction between wholesalers and egg farms is size neutral. Indeed, it is possible that the transaction costs incurred by the wholesaler in dealing with small farms may be higher than those incurred in dealing with large farms because the former tends to smaller volumes of product while incurring similar time and effort investment to complete purchase transactions.

*Table 16: Summary Statistics of Prices Across Distribution Channels (GHS/Crate)*

| Statistics | Direct-to-Consumers | Wholesaler | Retailers | Hawkers | Chop bars | HRI |
|---|---|---|---|---|---|---|

[16] Revenue from spent hens have not been included because we wanted to focus solely on egg revenue as the primary product. Also, it is difficult to include spent hen sales when birds are still in production.

| | | | | | | |
|---|---|---|---|---|---|---|
| *Small-size* | | | | | | |
| Number of Farms | 1,211 | 1,108 | 557 | 767 | 88 | 91 |
| Average Price | 13.94 | 13.31 | 13.25 | 13.29 | 13.40 | 13.56 |
| Std. Dev. | 1.56 | 0.60 | 1.30 | 1.37 | 1.63 | 1.03 |
| Median | 14.00 | 13.00 | 13.00 | 13.00 | 13.75 | 13.50 |
| *Medium-size* | | | | | | |
| Number of Farms | 51 | 116 | 47 | 47 | ^ | ^ |
| Average Price | 13.53 | 13.22 | 13.08 | 12.98 | 11.89 | 13.38 |
| Std. Dev. | 1.33 | 0.44 | 1.33 | 0.91 | 2.85 | 0.97 |
| Median | 13.00 | 13.00 | 13.00 | 13.00 | 13.00 | 13.07 |
| *Large-size* | | | | | | |
| Number of Farms | 38 | 103 | 44 | 35 | ^ | ^ |
| Average Price | 13.20 | 13.22 | 12.85 | 12.94 | 13.00 | 13.17 |
| Std. Dev. | 1.32 | 0.47 | 1.11 | 0.98 | 1.17 | 1.00 |
| Median | 13.00 | 13.00 | 13.00 | 13.00 | 13.00 | 13.00 |

^ Number too few to produce confidence in the statistical validity of estimates.

Theory would suggest that intensity of competition resulting from a higher number of farms in a particular geographic area would have a downward pressure on price. That wholesale prices had a relatively low coefficient of variation across the regions may be explained by the level of competition among farms than farms. Also, the larger wholesalers often travel across regions to procure their products. As such, they tend to have more market information and share information a lot more effectively than farmers because of their higher levels of interactions in the marketplace. It is important to note, however, that their information sharing efforts are informal and often unintentional. Wholesalers, thus, have an asymmetric advantage in knowledge about the market and the competitive pressure they engender in their search for eggs explain the lower variability in prices around the country.

The foregoing is supported by the average egg prices by region and channel. Table 17 shows that Volta Region posted the highest price in all channels with the exception of direct-to-consumer and HRI channels. Brong Ahafo and Ashanti had the lowest prices across all channels with the exception of chop bar channel, where Greater Accra posted the lowest channel. Given the effective information sharing among wholesalers described above, it is unsurprising that the difference between the highest average wholesale price in Volta Region was only 5.6 percent higher than in the lowest wholesale price Ashanti Region. On the other hand, the differences between the highest and the lowest price regions in the other channels were much higher, ranging from about 12.6 percent for the retail channel to 20.5 percent for the chop bar market.

*Table 17: Average Price of Eggs by Distribution Channel and Region (GHS/Crate)*

| Regions | Direct-to-Consumers | Wholesaler | Retailers | Hawkers | Chop bars | HRI |
|---|---|---|---|---|---|---|
| Ashanti | 12.92 | 13.13 | 12.74 | 12.73 | 13.27 | 12.96 |
| Brong Ahafo | 13.08 | 13.15 | 12.65 | 12.50 | 11.86 | 12.35 |
| Central | 14.34 | 13.52 | 13.24 | 13.80 | 13.68 | 13.42 |
| Eastern | 13.86 | 13.37 | 13.53 | 13.41 | 13.29 | 13.67 |
| Greater Accra | 14.54 | 13.58 | 13.61 | 13.61 | 12.00 | 13.95 |
| Northernmost | 14.09 | 13.65 | 13.54 | 13.93 | 14.00 | 13.72 |
| Volta | 14.36 | 13.86 | 14.25 | 14.31 | 14.29 | 13.63 |
| Western | 14.74 | 13.35 | 13.49 | 13.77 | 13.86 | 13.86 |
| Total | 13.90 | 13.30 | 13.23 | 13.25 | 13.20 | 13.49 |

### Chicken Egg Farm Revenue

The summary statistics for chicken egg revenue by channel, presented in Table 18, shows that total revenue from egg sales in 2015 was over GHS 478 million, with an average of GHS 219,610, a standard deviation of GHS 1.02 million and a median of GHS 59,123. The estimates were based on 2,178 farms (equivalent to 75.4 percent of chicken egg farms) across the country who produced and sold eggs in 2015. T About 1,169 farms generated some revenue selling through the direct-to-consumer channel compared to 1,244 who generated revenue through wholesale channel. The average revenue in the direct-to-consumer channel was approximately GHS 27,475 per farm in 2015, with a standard deviation of GHS 86,605 and a median of GHS 9,096. The total revenue generated in the direct-t-consumer channel was abut GHS 32.2 million. The wholesale channel's revenue average GHS 248,998 with a standard deviation of more than GHS 1.2 million and a median of GHS 59,123. Both retail and hawkers' channels posted higher revenues than the direct-to-consumer channel but the rest of the channels had relatively small total revenues, despite their average revenues being higher than that of the direct-to-consumer channel.

*Table 18: Summary Statistics of Total Revenues Generated by Channel in 2015 (GHS)*

| Channel | N | Total | Mean | Std. Dev. | Median |
|---|---|---|---|---|---|
| Direct to Consumers | 1,169 | 32,118,228 | 27,475 | 86,605 | 9,096 |
| Wholesaler | 1,244 | 309,753,397 | 248,998 | 1,251,084 | 59,123 |
| Retailers | 594 | 53,660,369 | 90,337 | 320,844 | 24,225 |
| Hawkers | 768 | 73,173,232 | 95,278 | 343,654 | 30,647 |
| Chop bars | 106 | 3,391,079 | 31,991 | 71,461 | 13,358 |
| HRI | 103 | 4,937,120 | 47,933 | 86,897 | 18,980 |
| Processor | 24 | 1,276,566 | 53,190 | 173,618 | 5,802 |
| Total | 2,178 | 478,309,990 | 219,610 | 1,021,832 | 59,123 |

Total chicken egg farm revenue accruing to small farms across all channels was GHS 155.2 million, compared to about GHS 63.3 million for medium-size farms and GHS 256.0 million for large farms. Thus, small farms accounted for 32.4 percent of total segment revenue while large farms' share was 54.3 percent. The remainder went to medium-size farms. The average revenue for small-size farms was GHS 81,326 compared to GHS 2.06 million for large-size farms. The standard deviations were respectively GHS 90,988 and GHS 3.77 million. Their medians were GHS 48,006 and GHS 1.08 million. The contribution of medium-size farms to revenue was about GHS 63.12 million, with a mean of GHS 441,427 and a standard deviation of GHS 221,000. The median for this group was actually close to its average – about GHS 440,398. Across discussed earlier, Figure 23 shows that the share of wholesale channel was largest among the three farm sizes. However, the wholesale channel share for large farms is larger than the other two farm sizes and the share of direct-to-consumer channel share of total chicken egg revenue was larger than the other two sizes. Likewise, there is a size effect on the distribution of revenue share from the hawkers' channel, with small farms generating a larger share of their revenues from that channel than medium-size farms whose share was higher than large farms.

*Figure 23: Distribution of Chicken Egg Segment Revenue Across Distribution Channels by Farm Size*

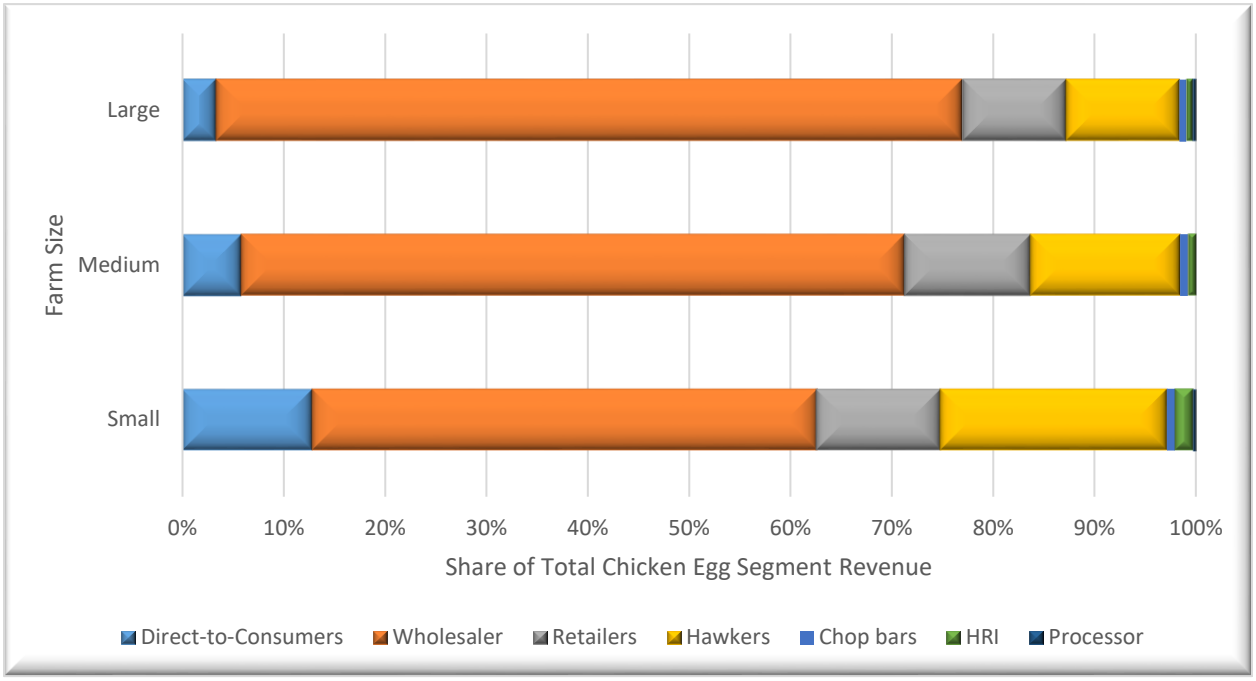


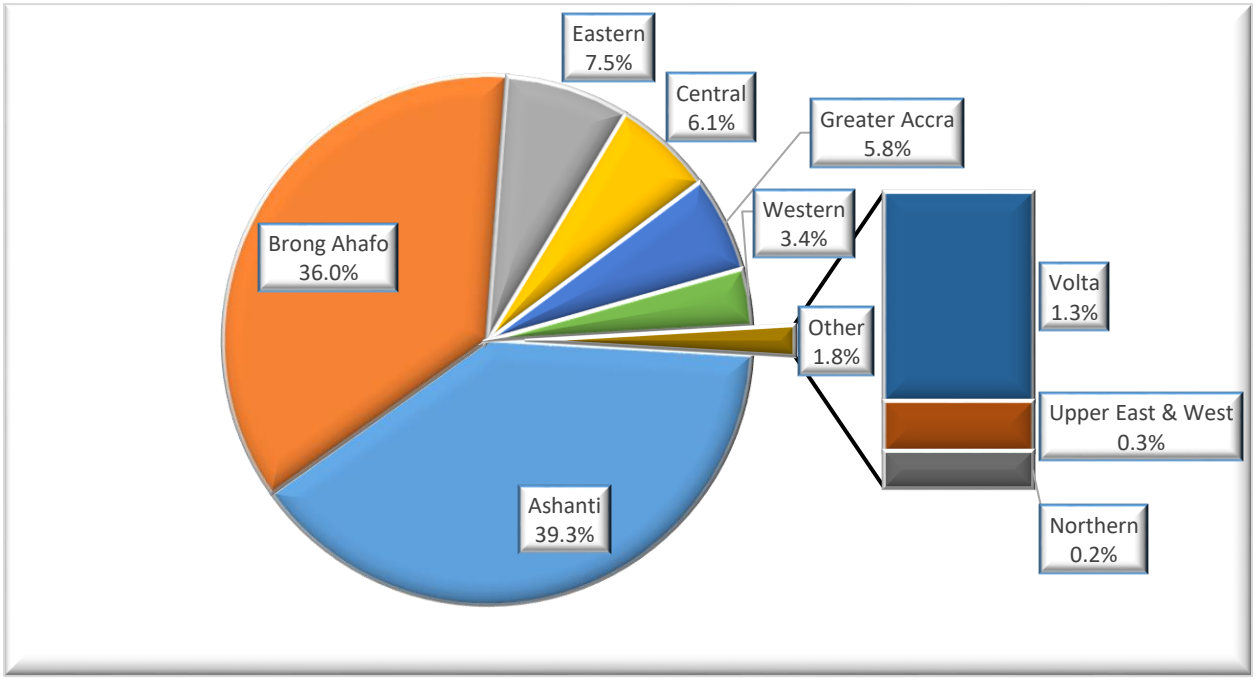

Table 19 presents the summary statistics of chicken egg segment revenue by region. The total revenue from egg sales in Ashanti was about GHS 187.8 million, with an average total revenue per farm of GHS 328,865, a standard deviation of GHS 1.05 million and a median of GHS 87,148. Ashanti's average was lower than Brong Ahafo's by about 8.7 percent even though the former's total chicken eggs revenue was 9.0 percent higher. The median egg revenue in Brong Ahafo of GHS 105,107 exceeded that of Ashanti by 20.6 percent. Although the average revenue in Central Region was 12.3 percent higher than in Eastern Region, the total revenue in Eastern was 23.0 percent higher. In terms of total revenue and average revenue from egg sales, Greater Accra ranked fifth, with its total revenue and average revenue about 10.1 percent and 23.0 lower than that of Eastern Region. The regions' summary statistics are presented in

*Table 19: Summary Statistics of Chicken Egg Enterprise Annual Revenue for 2015 by Region (GHS)*

| Region | N | Total Revenue | Average Revenue | Std. Deviation | Median |
|---|---|---|---|---|---|
| Ashanti | 571 | 187,782,149 | 328,865 | 1,052,298 | 87,148 |
| Brong Ahafo | 482 | 172,294,535 | 357,458 | 1,789,864 | 105,107 |
| Central | 194 | 29,164,914 | 150,335 | 306,738 | 48,915 |
| Eastern | 272 | 35,877,905 | 131,904 | 291,752 | 42,447 |
| Greater Accra | 236 | 27,971,101 | 118,522 | 319,720 | 37,647 |
| Northern | 42 | 1,076,243 | 25,625 | 28,857 | 18,344 |
| Upper East & West | 36 | 1,477,879 | 41,052 | 49,913 | 25,784 |
| Volta | 101 | 6,167,928 | 61,069 | 120,804 | 25,270 |
| Western | 244 | 16,497,337 | 67,612 | 86,937 | 41,788 |

The distribution of egg revenue among the regions is presented in Figure 24. Ashanti's share of 39.3 percent was higher than its 26.4 percent share of number of farms while Western's share of 3.4 percent was lower than its 10.6 percent share of number of farms. Brong Ahafo contributed 36.0 percent of estimated national egg revenue in 2015 but had only 22.3 percent of egg producing farms in 2015. These differences in contributions, having established a negligible difference in prices, can then be attributed to production and productivity. Ashanti's share of the number of laying chickens was 41.8 percent while Brong Ahafo's was 34.4 percent. Greater Accra's was 5.2 percent and its share of revenue was 5.8 percent while Eastern Region's was 7.5 percent was equal to its share of revenue. However, none of these matters since the sold product is eggs and performance must be evaluated in terms of the sold product.

*Figure 24: Distribution of Total Egg Revenue in 2015 by Region (GHS)*




## Chicken Egg Variable Production Cost

As with broiler chickens, four different items are used in the estimation of variable costs: day old chicks; labor; feed and veterinary services. The questions were the same for chicken egg producers as they were for broiler chicken producers. However, the unit of analysis was cost per crate instead of per bird. Chicken egg farms not producing eggs in 2015 were not included in these analyses since they would have not revenues to balance their costs.

The summary statistics of the components of variable costs on a per crate basis are presented in Table 20. Feed cost, as expected, is the highest in variable costs, averaging about GHS 11.05 per crate and a standard deviation of GHS 0.73 and a median of GHS 10.41. It accounted for about 92.3 percent of total variable cost, on average, with a standard deviation of 8.4 percent and a median of 95.4 percent. Average labor cost was GHS 1.15 per crate, with a standard deviation of GHS 1.07 and a median of GHS 0.78 per crate. Labor share of total variable cost averaged approximately 8.6 percent, with a standard deviation of 7.2 percent and a median of 6.5 percent. Veterinary services accounted for about 1.7 percent, averaging GHS 0.23 per crate, with a standard deviation of GHS 0.68 per crate and a median of GHS 0.03. Total variable cost per crate averaged GHS 12.08, with a standard deviation of GHS 1.48 and a median of GHS 11.83 per crate.

*Table 20: Summary Statistics of Variable Cost of Egg Producing Farms (GHS/Crate)*

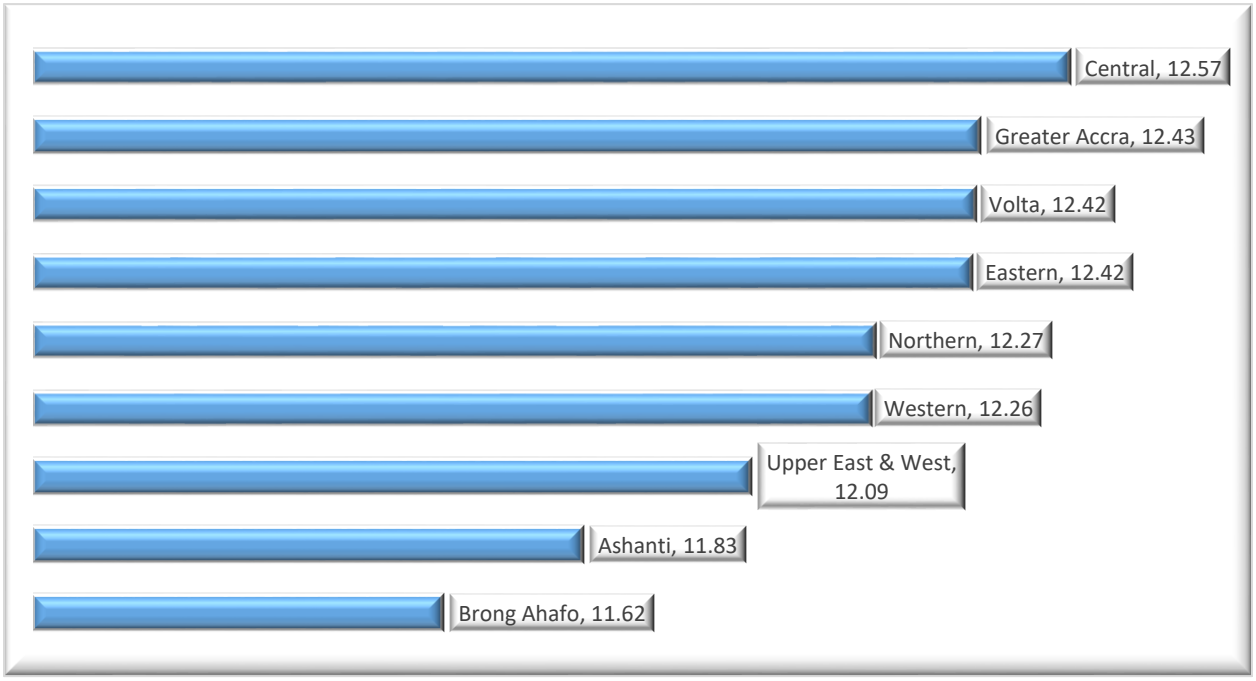
| Variable | N | Mean | Std. Dev. | Median |
|---|---|---|---|---|
| Day-Old Chicks | 2,109 | 0.00 | 0.01 | 0.00 |
| Vet Services | 2,185 | 0.23 | 0.68 | 0.03 |

| | | | | |
|---|---|---|---|---|
| Labor | 1,512 | 1.15 | 1.07 | 0.78 |
| Feed | 2,185 | 11.05 | 0.73 | 10.41 |
| Variable Cost | 2,185 | 12.08 | 1.48 | 11.83 |

The average variable cost for small-size farms was GHS 12.17 per crate, with a standard deviation of GHS 1.51 and a median of GHS 11.95. This was higher than the average variable cost for medium-size farms of GHS 11.44 per crate and GHS 11.32 per crate for large-size with respective standard deviations of GHS 1.22 and GHS 0.93 per crate. While the difference between the average variable cost for medium- and large-size farms of GHS 0.12 was not statistically significant ($t = 0.89$; $P > t = 0.373$), the difference of GHS 0.85 per crate between the small- and large-size farms' average variable cost was statistically significant at the 1 percent level ($t = 9.54$; $P > t = 0.000$) as was the difference between small- and medium-size farms' average variables costs of GHS 0.73 per crate ($t = 6.81$; $P > t = 0.000$).

Figure 25 presents the average variable cost by regions with statistically viable egg production. It shows that Central Region had the highest variable cost in the country while Brong Ahafo had the lowest with Ashanti about GHS 0.21/crate behind Brong Ahafo. The difference in the variable costs in Brong Ahafo and Ashanti was statistically significant at the 5 percent level ($t = 2.37$; $P > |t| = 0.018$). The average variable cost for Greater Accra was GHS 12.43 per crate with a standard deviation of GHS 1.58 and a median of GHS 12.07. The difference between Eastern and Central's variable costs was GHS 0.15 per crate, which was not statistically significant ($t = -1.13$; $P > |t| = 0.257$).

*Figure 25 : Average Variable Cost of Egg Production by Region (GHS/Crate)*




## Layer Chicken Gross Margin

The gross margin per crate ranged from negative GHS 7.46 to positive GHS 8.96. The average gross margin per crate was GHS 1.30, with a standard deviation of GHS 1.76, with a median of GHS 1.54. About 82.1 percent of farms presented positive gross margin, presenting an average gross margin of GHS 1.91 per crate, with a standard deviation of GHS 1.15 and a median of GHS 1.87 per crate. Of the farms presenting a positive gross margin, 86.0 percent were small-size farms, a slightly lower proportion than the proportion of small farms in the data. However, this translated to only 72.6 percent of all small farms. In this sense, the odds of a small chicken egg farm producing a positive gross margin was about 2.7 times the odds of such a farm not producing a positive gross margin. The proportion of medium-size farms posting a positive gross margin was 88.1 percent, resulting in the odds of such farms producing a positive gross margin instead of a negative gross margin being about 7.4. The odds of a large farm producing a positive gross margin instead of a negative gross margin was 6.5. Thus, size does increase a farm's odds of posting a positive gross margin.

Table 1 shows the summary statistics of the gross margin by farm size. It shows that the average gross margin for small farms was GHS 1.24 per crate per farm, with a standard deviation of GHS 1.79 and a median of GHS 1.42. The average gross margin for medium and large farms was GHS 1.73 and GHS 1.76 respectively. Their standard deviations were GHS 1.49 and GHS 1.20 while their median were GHS 2.01 and GHS 2.04 respectively. The difference of GHS 0.52 per crate between small and large farms' average gross margins was statistically significant at the 1 percent level ($t = 4.49$; $P > t = 0.000$). Similarly, the difference of GHS 0.49 per crate between small and medium-size farms' average gross margins was statistically significant at the 1 percent level ($t = 3.70$; $P > t = 0.000$). However, the difference between large and medium-size farms' average gross margins was approximately GHS 0.03 per crate, and it was not statistically significant ($t = 1.25$; $P > t = 0.212$).

*Table 21: Summary Statistics of Gross Margin of Chicken Egg Production in 2015 (GHS/Crate)*

| Farm Size | Average | Std. Dev. | Median |
|---|---|---|---|
| Small | 1.24 | 1.80 | 1.42 |
| Medium | 1.73 | 1.49 | 2.01 |
| Large | 1.73 | 1.26 | 2.04 |
| Total | 1.30 | 1.76 | 1.54 |

The average gross margin per crate of eggs across the regions is presented in Figure 26 and it shows there are differences that differ from the differences seen in revenue and variable costs. For example, Ashanti Region and Brong Ahafo Region did not have the highest gross margin per crate of eggs despite showing in Table 20 that these regions were the lowest variable cost regions in chicken egg production in the country. It shows that Volta Region posted the highest gross margin per crate of eggs, averaging about GHS 1.74 while Central Region presented the lowest, averaging about GHS 1.09.

Although gross margin per unit of product provides an indication of efficiency, gross margin per farm is a more useful indicator from a financial performance perspective because that is what the business can bank. For this reason, we present the average total gross margin per egg farm in Table 22. It shows that the average total gross margin per farm was GHS 31,657, with a standard deviation of GHS 195,182. The large standard deviation explains the median being only GHS 5,421. It also helps to cement the fact that a large majority of chicken egg farms are small. This is emphasized when we look at the summary gross margin per farm by size. The average gross margin per farm was GHS 9,941, compared to about GHS 66,422 and GHS 321,045 for medium and large farms respectively. The median gross margins per farm provide a clearer indication of the distribution of gross margin per farm. For example, the median for small farms was about a 40 percent of the average gross margin for small farms, it was about half for large farms and almost 86.0 percent for medium farms. The coefficient of variation – which describes the spread in gross margin relative to the average – was largest for large farms and smallest for small farms. Medium farms presented the lowest coefficient of variation relative. Although large farms accounted for only 5.6 percent of all chicken egg farms, their share of the GHS 68.9 million total gross margin was about 58.7 percent, compared to 27.5 percent for small farms and 13.8 percent for medium-size farms. The distribution of total gross margin across regions, presented in Figure 26, shows that Brong Ahafo Region accounted for almost 40 percent of total gross margin in the chicken egg segment in 2015, followed closely by Ashanti Region, which accounted for 37.5 percent. Thus, even though the per unit performance of these two regions was inferior to that of Volta, their shares of the total were much higher about 30 times that of Volta's at 1.3 percent. Hence, what this total gross margin distribution analysis shows not only the effect of size but also opportunity from a policy consideration perspective.

*Figure 26: Average Gross Margin per Crate by Region (GHS/Crate)*

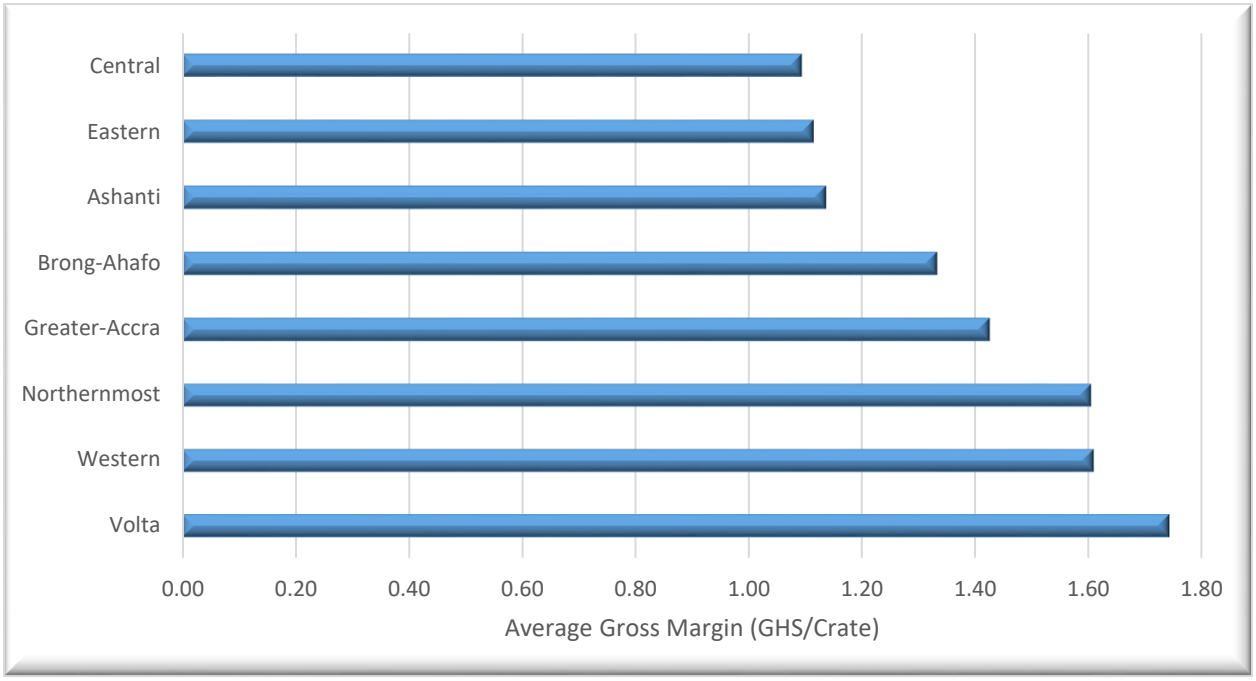
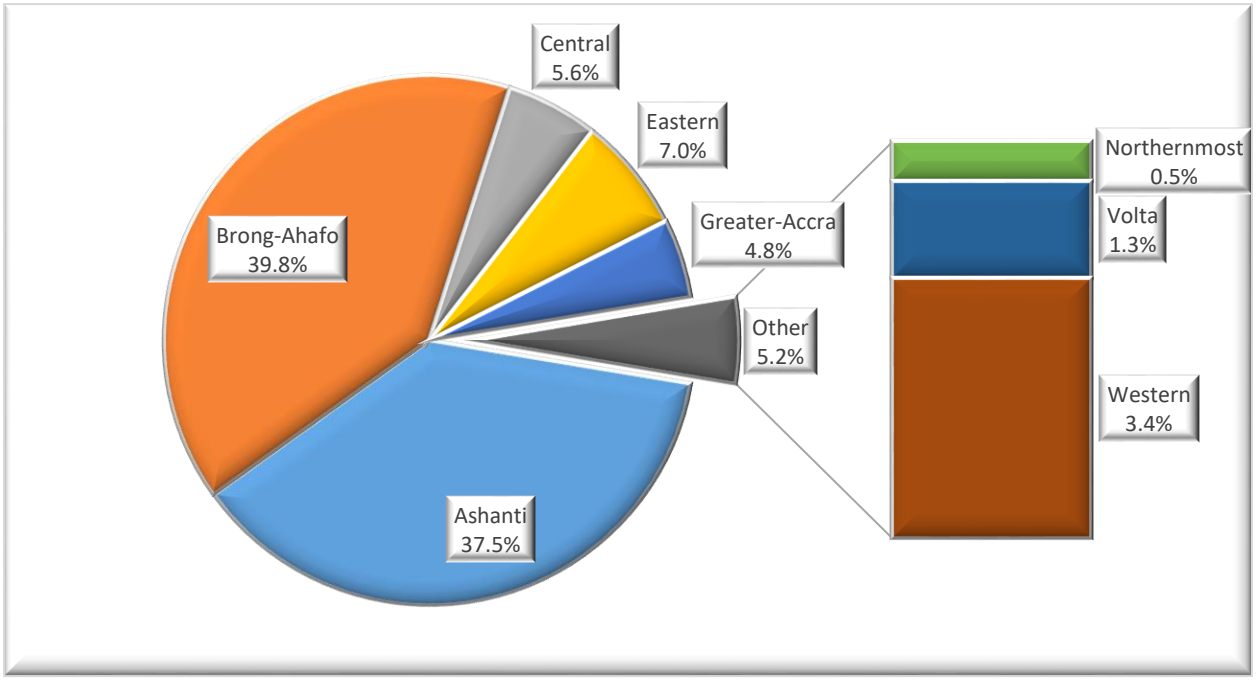



*Table 22: Summary Statistics of Total Gross Margin by Farm Size*

| Farm Size | Average | Std. Dev. | Median |
|---|---|---|---|
| Small | 9,941 | 17,117 | 3,989 |
| Medium | 66,422 | 55,898 | 57,035 |
| Large | 321,045 | 749,772 | 153,671 |
| Total | 31,657 | 195,182 | 5,421 |

*Table 23: Distribution of Total Chicken Egg Segment Gross Margin by Region*




## Summary on Chicken Egg Segment Performance

The chicken egg segment, like the broiler chicken segment, used the same seven channels to distribute its output. The channels of choice for most farms are the direct-to-consumer and wholesaler channels. Our analysis showed that the direct-to-consumer channel produced the highest average price of about GHS 13.90 per crate. Nearly 60.0 percent of chicken egg farms used the direct-to-consumer channel to sell eggs, while about 61.0 percent indicated using the wholesale channel.

On average, the price realized by large farms in all channels was lower than that realized by small farms. This, we argue, may be a result of the total cost of assuming husbandry and loss risks, and hence a higher willingness of large farms to transfer these risks to wholesalers and others downstream in their supply chains and pay the risk avoidance premium.

The average revenue per farm from the direct-to-consumer channel estimated at GHS 27,475 was the lowest among all the channels. This means that despite presenting a higher price, chicken egg farms do not sell much of their output directly to consumers. This is realistic since consumer purchases of eggs will be too atomistic to ensure the preservation of product quality.

Like broiler chickens, we defined four variable cost components for chicken egg farms – feed; veterinary services; day-old chicks; and labor – and feed costs accounted for almost 92 percent of total variable costs. Farm size influenced average variable cost. For example, the difference in average variable cost between small farms on one hand and medium and large farms on the other hand were both statistically significant at the 1 percent level. Central Region had the highest average variable cost in the country while Brong Ahafo had the lowest.

The difference between price and variable cost per crate is gross margin. The average gross margin was about GHS 1.30 per crate. However, small farms averaged about GHS 1.24, compared to medium-size and large farms average of GHS 1.73 each. The average gross margin for small farms differed statistically from those of medium and large farms. We found a negative relationship between the average gross margin per crate and the share of total gross margin by region. While Volta Region had the highest average gross margin per crate – about GHS 1.74 per crate – its share of the total gross margin was only 1.3 percent. This is in contrast with Brong Ahafo, whose average gross margin per crate was GHS 1.33 and its share of total gross margin was almost 40 percent.

## Transforming Ghana's Chicken Industry: Some Policy Options

The structure of the chicken industry in Ghana reveals two major observations from this study. First, the broiler chicken market is nearly exclusively a live bird market. And second, the growth in chicken consumption has almost exclusively been in the processed product market. The growth in processed chicken products has resulted from Ghanaian consumers' increasing demand for convenient products. This means that consumers, by default, do not and cannot afford to purchase live birds as frequently as they consume chicken.[17] The near-focus of the domestic industry on live birds while demand is being driven by processed products creates opportunities for imports that present what may be termed "false competitive disadvantage" for the domestic industry. "False competitive disadvantage" because the broiler chicken market is essentially a dichotomized market: live market, supplied exclusively by domestic producers; and processed chicken products (fresh, frozen, chilled or frozen whole or cutup).[18]

The performance of the broiler chicken industry suggests that there is a vibrant market for live birds. Thus, despite their demand for convenience, Ghanaian consumers seem to have time around festivals – Christmas, Easter, etc. – to purchase live birds for celebration. Poultry farmers recognize this and produce specifically to meet these demand spikes. This explains the roughly two production cycles seen on most broiler chicken farms in Ghana. When it comes to their non-holiday chicken consumption, however, Ghanaian consumers seem to signal their time constraints, choosing instead to consume ready-to-cook products, which are processed, more convenient and, hence, attractive.

The foregoing market segmentation and the resulting production strategy of domestic producers challenges the narrative that processed products and domestic products are in competition. Subscribing to this narrative may prevent appreciation of the fact that imports and local production serve the market at different times (time segmentation) and with different products (product differentiation). There is, however, an opportunity for broiler chicken producers to expand their market share of the total domestic chicken meat market, however, this extension will not be in the form of live birds given the forces driving chicken products' demand in Ghana.

If the segmentation profile described above is accepted, then it will look as if Ghana's broiler chicken industry has ceded the year-round, growing fresh, chilled and frozen chicken meat market to imports and specialized on live bird production to meet intermittent festival needs. Controlling imports under the prevailing business strategy of the industry – which we believe was not designed by emerged due to processing resource constraints – will not enhance farmers' economic performance and wellbeing. Indeed, policies controlling imports would only increase domestic prices of processed chicken products, which cannot benefit live bird producers but only harm consumers. However, appreciating the reality of the marketplace could help policymakers and the industry discover alternative strategies and policies that can achieve the desired objective of improving farmers' wellbeing.

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17 Current market conditions suggest a focus of policy options on broiler chickens segment.

18 See Donkor, J., A. Sarpong, C. Kankam-Kwarteng and F.A. Duah. "Consumer Choice Analysis of Imported and Locally Produced Chicken Products: Evidence from Ghana," *European Journal of Business and Management* 5(2013): 74-84. Also, Kwadzo, G., F. Dadzie, Y. Osei-Asare, and J.K.M. Kuwornu. "Consumer Preference for Broiler Meat in Ghana: A Conjoint Analysis Approach," *International Journal of Marketing Studies*, 5(2013): 66-73.

We observed in the structural analysis that the processor channel was all but absent in Ghana's chicken industry. We argued that processing has the ability to move large volumes of birds, and is the only channel that does not bear the loss risks or incur the feeding and watering costs associated with live birds. The causes of the lack of processing as a credible and competitive channel in the broiler chicken industry are both structural and infrastructural. The structural factors include the atomistic nature of production in the country. For example, the study shows that nearly 86 percent of broiler chicken farms in the country are small, producing less than 2,000 birds on average per annum. This production level is not nearly enough to keep any processor in production for any duration, much less offer them a competitive advantage in what is essentially a global market. An argument may be that if a processor emerged, production would increase. Unfortunately, the fact that most of these farms seem to be producing broiler chickens to supplement incomes increases the risks any investor in a processing facility would face. What if farmers are unwilling or unable to make the required capital and time commitment necessary for producing year-round? Additionally, because small production present low exit and shut-down costs, processors may be vulnerable to changes in input market conditions that cause these small farms to shut down production. Poultry processing depends on availability of dependable infrastructure: roads, electricity, potable water and effective cold chain systems. This may explain why large farms accounted for 96.6 percent of broiler chicken and 96.2 percent of broiler chicken sales going through the processor channel.

Against this backdrop, policymakers may consider a number of market-oriented solution or a second-best option to support the industry. A second-best option assumes that there is an inherent market failure and the most effective way to address the failure's effects is for the government to intervene with policies and programs that force behavior alteration to achieve desired objectives. Unlike a second-best solution that invariably requires government budgetary outlay, market-oriented solutions often achieve behavioral alterations by facilitating market-driven incentives. The government's role in a market-oriented solution involves facilitating an operating environment that enables industry stakeholders to independently make choices that achieve their business objectives while contributing to overall social welfare. We present what we consider the most feasible examples of these two policy options for consideration in addressing the observed conditions in the broiler chicken market in Ghana. They are: a subsidy as a second-best solution; and a Blue Ocean strategy as a market-oriented solution.

### Feed Subsidy Approach to Improved Production

We noted various studies that showed that feed cost was a major constraint on chicken production in Ghana. This study shows that with feed costs accounting for more than 70 percent of total variable costs – higher than the industry narrative of 60 percent – it is plausible to accept that feed costs are a problem for poultry farmers. Suppose, then, that it is assumed that addressing the feed cost problem would enable farmers to expand production, which would increase domestic output and lead to a reduction in chicken meat imports, *all things remaining unchanged*. It is important to note that this assumption does not recognize the current dichotomized market for chicken products in Ghana described above, i.e., live birds for domestic producers and processed chicken meat products for imports. Furthermore, it is important that policymakers pay attention to the caveat – *all things remaining unchanged* – because of the unintended potential feedback effects market interventions often have on market participants' decisions and performance.

In production agriculture, subsidies have been used by public policymakers to help farmers overcome input cost constraints. The direct effect of these subsidies is to reduce the effective cost of the input in

question and increase its use to potentially shift output of the desired agricultural product. Thus, subsidies have been used for crop production inputs, such as fertilizer and agrochemicals, in agricultural product marketing, and in agricultural insurance. With specific reference to the case in point, the government may apply a subsidy of a certain value on maize – the principal ingredient that most affects feed prices – or apply a subsidy to formulated commercial feed. Either of these approaches would reduce the price of feed by a proportion or the full amount of the subsidy, depending on other related costs to procuring the maize input or the commercial feed.

Suppose the government chooses to target the subsidy to maize, which is also a staple food in Ghana. This could present arbitrage opportunities for enterprising subsidy recipients who perceive a higher net return from selling their subsidized maize in the food market than using it in feed production. The policy, therefore, must be designed to minimize the risk of selling subsidized maize for feed into the unsubsidized maize for food market if the subsidy is going to achieve its desired objective.

Because the majority (57 percent) of broiler chicken farmers produce on average 82 percent of their feed on-farm, targeting the subsidy to commercial feed may not contribute much to the stated objective of using reductions in feed cost to motivate increases broiler chicken production. If the subsidy causes current on-farm feed producers to switch to commercial feed, then without a significant increase in commercial feed output, the increased demand will cause commercial feed prices to rise. An increase in commercial feed production could cause the inputs prices, especially maize's, to rise. Given the dual role of maize in the Ghanaian market, this would lead to an increase in consumers' food bill, defeating the policy's purpose, and leaving farmers and consumers worse off than before the policy.

In addition to the foregoing risks presented by a subsidy policy, another risk worthy of consideration is subsidy's effect on farmers' production objectives. We have argued that the size and frequency of production suggests that income supplementation is the primary motivation for the majority of broiler chicken farmers. If this is true, then any increase in income beyond a certain level may have two potential outcomes: (1) Lead to a change in production objective from income supplementation to profit maximization; or (2) Result in a backward bending supply curve because the desired income supplementation level is achieved at a lower production level. Given that the subsidy's purpose is to increase domestic output to reduce imports, a backward bending supply curve will be an unintended consequence.

The first potential outcome results from a recognition that expanding production could lead to higher net benefits. Farmers recognizing this will, thus, make the requisite investments and increase their production output, contributing to the achievement of the policy's purpose. The positive feedback of increased profits lead to further investments in production, further contributing to the achievement of the policy's objective. The reality in Ghana is that small producers dominate the broiler chicken segment. For example, about 47 percent of broiler chicken farms produce less than 500 birds per year and about 71 percent producing less than 1,000 birds per year. If the subsidy causes costs to decline enough for them to achieve their income supplementation objective without output expansion, then it is plausible to expect farmers will reduce production and divert their resources into higher valued activities that were foregone because of the prior income constraint. This explains the risk of backward bending supply effect of the subsidy on farms is not motivated by profits but by income supplementation.

How may the subsidy be implemented to increase the probability of its success while reducing the potential counter effects among supplementary income-driven producers? How would the subsidy be

paid for in order for it to be cost neutral to the treasury? These are the challenges policymakers must wrestle with when considering a feed subsidy policy to enhance broiler chicken production in Ghana.

Large broiler chicken producers may provide the best response to a feed subsidy given that they are driven by profits and have high asset specificity and high reduction costs. The subsidy reduces their production costs, allowing them to expand production to take advantage of scale economies. These profit-driven farms may be the best hope for a feed subsidy policy achieving its intended objective. However, if the policy targets only large producers, it would be seen as discriminatory, and given the large proportion of small farmers in the industry, create untenable political situation for policymakers. To overcome the discriminatory perception and achieve the policy's objective, the feed subsidy policy may be designed to take effect *ex post* production or structured for beneficiaries to self-select.

Here is a way to design the feed subsidy policy to increase the probability of producing the desired result. The policy may be based on, say, the 90$^{th}$ percentile lowest feed cost per bird up to six weeks. This should motivate farmers small and large to maximize the subsidy's benefits by minimizing their feed costs and selling birds at around six weeks. This would cause them to use the best formulated feed that produces the highest gain rates at the lowest cost. The feed subsidy designed this way would, in effect, motivate an enhancement of the professionalization of farmers. Eligibility for the subsidy may also be limited to farms registered as business entities, who agree to year-round production using specified husbandry methods designed to achieve specific health and output standards. These eligibility criteria would weed out farms uninterested in professional production and help alter the structure of Ghana's broiler chicken industry.

The suggested feed subsidy's constraints and eligibility criteria should encourage investments in processing as year-round production increases input supply, reduces risks of lack of inputs and reduces overall poultry processing costs. In fact, the emergence of processing to prevent live bird glut through the traditional marketing channels is critical for the sustainability of feed subsidy success. Without processing to remove increased output from the market, prices are bound to fall, leading to exits and a reduction in output, and a defeat of the policy.

### A Blue Ocean Strategy Approach

Import substitution policies advocate the replacement of foreign imports with domestic production. They can be useful when countries are experiencing foreign exchange difficulties or see a pathway to building a globally competitive domestic industry. However, they have been used mostly for nationalistic more than economic reasons, forming the industrialization policy cornerstone in many developing countries. Unfortunately, by focusing on import substitution, policymakers often overlook opportunities for export development for products for which they command real competitive advantage. This caused Ghana, for example, to focus its industrial development program after independence on replacing imports instead of enhancing exports.[19]

Import substitution policies assume homogeneity of products without acknowledging incumbents' inherent market power and consumers' demand options. As a result, industrialization programs focusing on import substitution have either failed to produce their desired results or succeeded marginally but

[19] Steel, W.F. "Import Substitution and Excess Capacity in Ghana," *Oxford Economic Papers*, 24(1972): 212-240.

with a negative net benefit to taxpayers. Because they always involve import controls, they have always created a negative consumer welfare effect which is often not compensated for by producer welfare gains.

Import substitution policies are favored by local industries which see imports as competitors and, as such, lobby governments for such policies. Unfortunately, without clearly understanding their primary sources of competitive advantage, such policies often fail to provide the insulation that local industries assumed they will receive from them. A case in point is the current rapid increase in chicken meat products in to Ghana and the government's attempt to control such imports through the imposition of import tariffs at the behest of industry stakeholders. These policies assume that domestic producers will fill the gap generated by the reduction in imports. What if the domestic product is not a good substitute for the import, as is the case in the chicken market in Ghana? For example, in the case of chicken, the consumer market is seeking ready-to-cook products offered by importers while the domestic suppliers are offering live birds. The expectation that the domestic industry can catch up to the exporting industries with such a policy often present false hopes to local producers and increase costs for consumers when the traded products are not good substitutes.

We argue that if Ghana attempts to compete head-to-head in chicken products with its current exporters, it would experience significant costs without achieving much in return. Consumers will continue to demand conveniently packaged chicken meat products as their time constraints increase with their increasing incomes. How, then, can the Ghana poultry industry define a sustainable future for itself?

To answer this question, we argue that the industry should rethink its value proposition to its market, define its strategy canvas and frame its value curve against its global competitors and organize to make the competition irrelevant. Given that the current "competitors" are all high volume low cost suppliers, Ghana has to develop a value curve that radically differs from this but has embedded high enough value for it to count to particular market segments. And it is imperative that it looks at this from a global market perspective. This is the essence of blue ocean strategies. Blue ocean strategies seek to make the competition irrelevant.[20]

In presenting a blue ocean strategic perspective, we are supposing that policymakers seek for the broiler chicken industry to be globally competitive in its presentation of a uniquely Ghanaian product. To initiate this strategy, the stakeholders first have to suspend their ideas about what they are currently doing and explore what they can do to address existing gaps in chicken consumers' demand profiles. What are the significant and/or idiosyncratic product attributes that specific consumers want which they are not getting from suppliers? How can the Ghanaian industry reposition itself to supply products with these attributes via value innovation?

Poultry meat is traditionally sold on price because, as they say, chicken is chicken. However, it is possible for discerning consumers to present different attributes that are valued. To different extents, different consumers may consider eating quality, convenience, stability, wholesomeness and nutritive value as important quality attributes of their chicken.[21] Some might also consider production systems – bird

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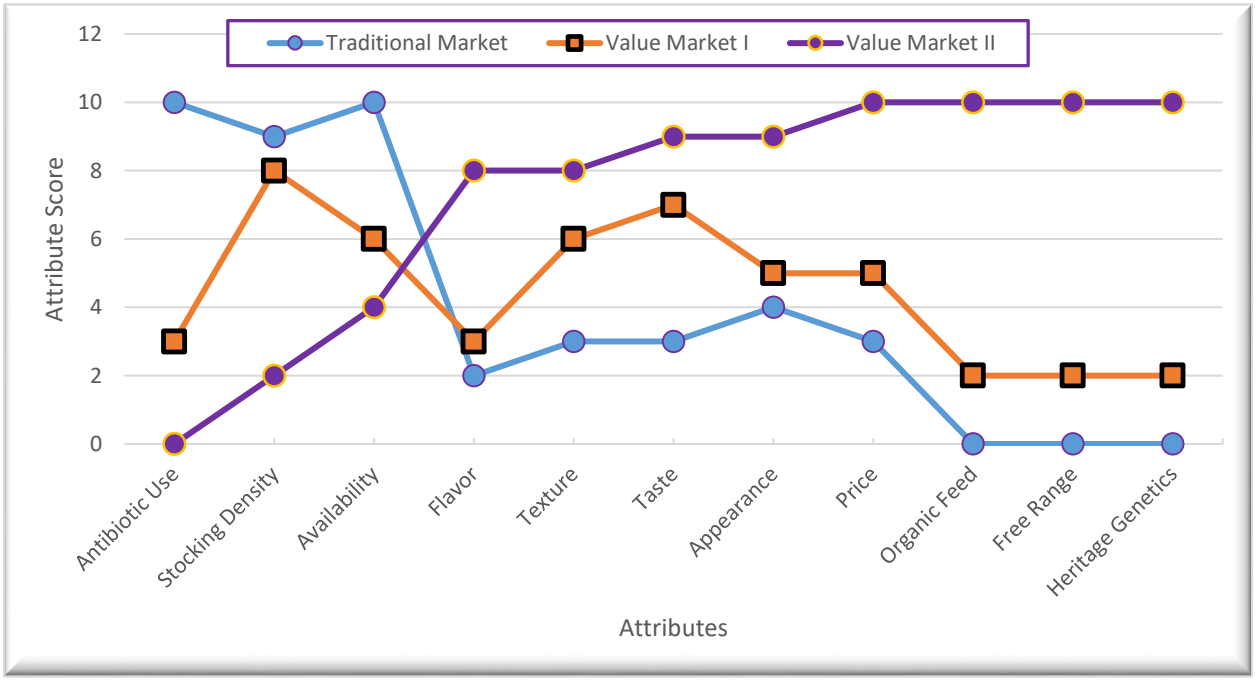
[20] Kim, W.C. and R. Mauborgne. *Blue Ocean Strategy: How to Create Uncontested Market Space and Make the Competition Irrelevant*, Harvard Business School Press, 2015.

[21] Erdtsieck, B. Quality requirements in the modern poultry industry. In *Processing of Poultry,* G. C. Mead (ed.) New York: Elsevier Applied Science, 1989, pp. 1-30.

density, free range versus pens – for animal welfare reasons, the use of antibiotics and other medications, feed type, etc. The value specific consumers place on these attributes may help famers develop specific supply chains organized to produce value innovations that specific customers in identified market segments will be satisfied with.

Figure 27 shows hypothetical value curves for three alternative markets: Traditional Market; Value Market I; and Value Market II. The traditional market is the current domestic market – homogenous product and production systems, free entry/exit by farmers and price-driven. Value Market I is a segmentation of the market that seeks some level of differentiation from the traditional market in specific production attributes. It increases the entry cost, and hence the exit cost that farmers face and presents other valuation methods besides price. Value Market II segregates itself completely from the Traditional Market and Value Market I, presenting a different value curve profile. It focuses on addressing the needs of a unique segment of consumers who value flavor excellence, texture, taste, husbandry methods and genetics. For doing these, it is able to extract a much higher price from the market than the other two markets. The profile suggests that Value Market II consumers may be classified as ethical consumers because of their little about price and strong orientation towards ethical production attributes.[22] Assessing the different markets this way allows various producers and their supply chains to determine the market they are most effective at servicing and would like to service. Those seeking to be extremely unique would consider Value Market II while those seeking to be marginally different from the Traditional Market will consider Value Market I. The costs and rewards associated with the markets determine their attractiveness.

*Figure 27: Value Curves for Alternative Markets*




[22] Amanor-Boadu, V. and C. Schnitz. "Consumers and the Evolution of New Markets: The Case of the Ethical Foods," Southern Agricultural Economics Association, Dallas, TX, February 2-6, 2008, 2008.

Thus, blue ocean strategies are proactive rather than defensive approaches to market development and growth. They challenge organizations to identify customer dissatisfactions and market opportunities and then figure out how to use new combinations of existing resources or completely new resources to address identified problems and seize identified opportunities. The first step in this new direction is, as we noted earlier, rethinking the difference between their product and all other poultry products in every market, including imports into Ghana.[23] This allows them to extricate themselves from the competitive market, recognizing, for example, that they will never match the scale economies of the one "*average*" poultry farm in Mississippi that produces 100,000 birds about every couple of months.

Before negative voices emerge that such a differentiated market for Ghana's poultry industry is impossible, let us illustrate a Ghanaian company employing blue ocean strategy in a global market and winning in what may be considered a very thin margin competitive commodity. Blue Skies (http://www.blueskies.com/) is a fresh fruit processor, founded in 1997 by Anthony Pile, a British entrepreneur, whose value proposition to its highly discriminating customers is *ready-to-eat hand-cut fresh fruit*. This value proposition allows it to separate itself from its very large, low cost competitors, and thus avoid competing with them. It allows it to select its customers by working with those who share its value of providing employment for more than 1,500 in Ghana people and ensuring farmers get a decent price for their produce. The company exports more than 90 percent of its daily output to Europe, meeting its 36-hour farm-to-store value proposition. Blue Skies has successfully engaged ethical consumers who share in its corporate value of natural freshness, "family" among its diverse workers and respect for each other, the environment and the communities in which they operate.

Most fruit farmers in Blue Skies' supply chain did not have a secure market prior to being engaged by Blue Skies. They produced for the seasonal fruit market, characterized by seasonality in supply, implying supply glut and low prices, spoilage and income uncertainty. Indeed, like poultry farmers, fruit farmers holding out for better prices in the absence of climate-controlled storage often experience quality deterioration and losses. Processors, such a Blue Skies, arrest freshness and, in so doing, extend shelf life. They also offer convenience by undertaking some or all of the pre-consumption activities consumers do – slaughtering or peeling, dressing and cutting, etc. For farmers, processors purchase large volumes of raw product, taking them out of the traditional channels. Processors are, indeed, the only marketing channel that is able to effectively prevent spoilage of the raw agricultural products.

To successfully implement a blue ocean strategy, the chicken industry would need to facilitate and nurture processing. This facilitation begins with improving production standards and organizing producers to more effectively participate in new structures supporting the strategy. It needs to invite producers to subscribe to these standards to secure the confidence of its downstream partners to make the requisite value innovation investments needed to support the industry's value proposition. To implement this, they need to define product quality at every stage along the supply chain, developing protocols to help current and future participants to comply with meeting these quality standards. It may demand redefining the appropriate genetics and husbandry methods that produce chicken meat perceived by consumers to taste different, or it may present a production system that is aligned with the values of a particular ethical consumer segment. In either case, it is important for the approach to be difficult to replicate so that the

[23] Since the chicken meat market in Ghana is global, it will be myopic for the Ghana industry to limit itself to its domestic market since it is sharing that market with the rest of the world.

presented value is not eroded through imitation. The foregoing may require new public and private investments in research and development, supply chain development and local and international market development. Because it is a bold and radical view of how things can be, it definitely requires a brave mindset and single-minded commitment to a new industry vision and a different structure.

# Summary and Conclusion

The purpose of this study was to describe the structure and performance of Ghana's chicken industry. We were interested in farm sizes, their distribution across the country and their effect on economic performance. We looked at the two principal segments in the chicken industry: broiler chickens and chicken eggs. The study aimed to provide current research-based information for policymaking to enhance the industry's overall performance. The study used primary data collected between December 2015 and February 2016 months across all 10 regions of Ghana. The survey covered all poultry farms, first using membership data available at poultry associations, then drawing on the local knowledge of Ministry of Food and Agriculture staff in the districts, and finally using the snowball approach to identify others that had not been identified by the previous methods.

Although concerns about the poultry industry in Ghana are principally around the broiler chicken segment, we organized this study to explore the structure and performance of both the broiler chicken and chicken egg segments of the chicken industry. We argued that rapid increase in processed chicken meat imports over the past two decades or so has caused concerns about competition in the poultry industry, suggesting that this import growth may be attributable to increasing economic wellbeing of Ghanaians, which causes an increase in demand for animal protein. Additionally, consumers' increasing economic wellbeing engenders a demand for convenience in foods and food ingredients to address time constraints. We showed that domestic production of chicken meat has not kept up with this demand, evidenced by the rapid growth rate in the industry's import penetration ratio.

## Summary

### Decision-Makers and their Farms

- The average age of managers was about 45 years and their average experience in chicken farming was about 10 years.
- About 66 percent of managers in the chicken industry had secondary or post-secondary education. And only about 13 percent of managers in Ghana's commercial chicken industry were female.
- Day-old chicks and deep-litter flooring are the preferred stocking and housing methods on both broiler and egg farms.
- More than 57 percent of chicken farms produce some or all of their feed, with an average proportion of feed needs produced estimated at about 82 percent. At the same time, about 60 percent of chicken farms purchase at least some commercial feed.
- Broiler farms produce about two-and-a-half cycles per annum on average while layers farms keep their birds for an average of 78 weeks.

### Farms, Output and Performance

- Defining small broiler chicken farms as those with less than 2,000 birds output per year, we found that about 87 percent of the about 1,500 commercial broiler chicken farms were small. For chicken egg farms, small farms were those with less than 5,000 birds, and about 88 percent of the nearly 2,900 chicken egg farms were small.
- Four regions – Greater Accra, Eastern, Ashanti and Brong Ahafo – accounted for more than two-thirds of all broiler chicken farms. Ashanti and Brong Ahafo together account for about half of chicken egg farms.

- Average output on small broiler chicken farms was about 530 birds per annum. Average output on small chicken egg farms was about 6,100 crates per year.
- Average revenue on small broiler chicken farms was about GHS 18,500, compared with GHS 91,500 and GHS 408,000 for medium and large size broiler chicken farms. For eggs, the average revenue was GHS 81,354 for small farms, about GHS 443,000 for medium farms and more than GHS 2 million for large farms.
- Average total variable cost was about GHS 24.91 per bird on broiler chicken farms and about GHS 12.08 per crate of eggs on chicken egg farms. Feed cost accounted for approximately 75 percent of variable cost for broiler chicken farms and 92 percent for chicken egg farms.
- Gross margin averaged about GHS 4,872 for small broiler chicken farms compared to GHS 28,194 and GHS 155,393 for medium and large broiler chicken farms respectively. For chicken egg farms, the average gross margin per farm was respectively GHS 9,941, GHS 66,422 and GHS 321,045 for small, medium and large farms. The gross margins produced at the different size levels illustrate the potential professional commitment the farmers can make to the enterprise.
- The majority of industry's output goes through the direct-to-consumer and wholesale channels. The absence of a significant processor channel is telling.

### Looking Forward – Conversation Starters

- There are two distinct poultry product markets in Ghana: live bird market, controlled by the domestic industry; and processed meat market, dominated by imports. Therefore, the domestic poultry market is not in direct competition with imported products because they are completely different products.
- Given feed cost's high proportion in total variable cost, the absence of a processor channel and the current segmentation of markets, two conversation starters are presented for consideration: a feed subsidy program with stringent participant eligibility criteria; and a blue ocean strategy for exploring innovative solutions to enhancing the poultry industry's global competitiveness.
- We argued that the pursuit of either or both policies would demand a development and nurturing of a processor channel to help address the industry's current marketing channel limitations, which probably influence production cycles and selling age of birds.

## Conclusions

There is concern that chicken meat imports are adversely affecting domestic production and the ability of local producers to grow and address consumer demand. However, our analyses show that the atomicity of broiler chicken production and the virtual lack of a processor channel may be the main explanatory variables of the current situation in Ghana's poultry industry. Nearly half of broiler chicken producers produce less than 500 birds per annum while 87 percent produce less than 2,000 birds per year. Since the total time investment in this level of production is relatively low, we concluded that these farms were essentially for supplementary incomes. A similar distribution was found to exist in chicken egg production.

The atomistic structure of the chicken industry as well as infrastructural challenges, we argued, are impediments to the development of an effective processor channel, limiting the domestic broiler chicken segment to a seasonal live bird market. However, the chicken meat consumption trends suggest that the industry's future rests in the ready-to-cook market and not the live bird market. This is evidenced by the rapid increase in imports of chicken meat products over the past two decades even as consumer incomes

increased. We argued that the increasing incomes and the increasing need for convenience act together to support the demand for processed food products, including chicken meat.

Both the government and the industry have been searching for a solution to the rapid growth in imports. We argue that the problem facing the industry is not competition from imports but the structural and infrastructural conditions defining the industry. Without a significant processor channel, farms are limited to using live bird marketing channels, and without significant production, viable processor channels cannot emerge. The absence of processing may also explain why more than half of broiler chicken sold in 2015 was nine weeks or older! The effect of this on farm performance is obvious. These conditions have generated a situation where the domestic industry controls the seasonal live bird market and imports control the year-round ready-to-cook market.

The results showed that feed costs accounted for about three-quarters of total variable cost of production of broiler chicken in 2015. Also, the analyses revealed that the domestic broiler chicken segment and imports seem to occupy different markets and are, therefore, not competitors. This recognition engenders a mindset to develop viable and sustainable strategies for enhancing the industry's performance.

We presented two policy options for discussion based on the foregoing results and observations, both underscored by a deliberate effort to develop and nurture chicken processor channel in Ghana. The policy options were: a feed subsidy; and the facilitation of a blue ocean strategy. We argued that without the development and nurturing of a viable and expansive processor channel accessible by a larger proportion of broiler chicken farms, these policies will fail to help the industry and may end up adversely affecting producers. We suggested that both policy options must be designed and implemented to enhance professionalism in the industry – a commitment to the production of high quality products that can be uniquely placed in specific markets to extract premiums.

The feed subsidy option was presented as a way to reduce production costs while increasing output. We presented several challenges with such a policy and suggested solutions to ensure its effectiveness in achieving its objectives. One of such solutions involved the development of eligibility criteria for receiving the feed subsidy that ensured enhancement in production standards and output levels. The blue ocean strategy, unlike the subsidy policy, does not intervene in the market but facilitates the emergence of a new business model in the industry. It begins with a recognition that the Ghanaian industry cannot win a head-to-head competition with current incumbents in the poultry meat industry. However, it can redefine itself as producing a uniquely different product from the competition's, segment the global market and offer this product to that market in a way that is impossible for the incumbents to copy. We pointed out that while this will be the most sustainable and viable solution, it will require a deliberate but urgent investment in the poultry industry's supply chain, from genetics through processing to marketing and promotion. It would the government to maintain a commitment to liberal international trade policies since the strategy is by default structured to leverage the global marketplace to enhance sales volumes.

This research has revealed the structure of Ghana's chicken industry and its effect on performance and its contribution to the prevailing conditions in the poultry meat market in Ghana. As a result of exploring size and marketing channels, we have been able to conclude that the industry is currently not in direct competition with imports and policies to control imports would only harm consumers without helping the industry. Based on the analyses, we proposed two policy options for discussion and exploration. However, we argued that these policy conversations must be underscored by a deliberate effort to develop and

nurture a viable and accessible processor channel to absorb any output increases resulting from the implementation of output expanding policies and programs.