International Food and Agribusiness Management Review
Volume 25, Issue 4, 2022; DOI: 10.22434/IFAMR2021.0142

10 November 2021 / Accepted: 3 March 2022

Broiler production systems in Ghana: economics and the impact of frozen chicken imports

RESEARCH ARTICLE

Craig Chibanda[ⓘa], Mohamad Isam Almadani[b], Petra Thobe[c] and Christine Wieck[d]

[a]Researcher, [b]Researcher, [c]Senior Researcher, Thünen Institute of Farm Economics, Bundesallee 63, 38116 Braunschweig, Germany

[d]Professor, Institute of Agricultural Policy and Markets, University of Hohenheim, Schwerzstr. 46, 70593 Stuttgart, Germany

Abstract

Chicken meat consumption in Ghana has significantly increased in the last two decades. However, production has stagnated, and domestic producers are struggling to satisfy the local market. Consequently, Ghana is dependent on chicken imports. The imports have attracted criticism as they are believed to be negatively affecting producers. This paper uses typical farms to analyze broiler production systems in Ghana and the impact of chicken imports. The typical farms represent the most common broiler production systems in the most important producing regions (Accra, Kumasi, and Dormaa). Large-scale integrated, medium-scale, and small-scale production systems were identified as the most common broiler production systems. The study demonstrates that feed and day-old chick costs are the most significant production cost items. The study also shows that broiler production is profitable for all systems when only considering cash-costs. Medium-scale farms located in Dormaa are unprofitable in the medium and long-term, when depreciation and opportunity costs are reflected, respectively. Cost comparisons show that imports make it difficult for broiler producers to market their chickens in the local market throughout the whole year. Therefore, broiler production in Ghana is seasonal. Furthermore, small-scale producers are the most negatively affected by the competition from the imports.

Keywords: broilers, chickens, imports, production systems
JEL code: F61, Q12, Q18

ⓘCorresponding author: craig.chibanda@thuenen.de

1. Introduction

Rapid population growth, urbanization and improved incomes have led to increased demand for poultry meat, particularly chicken meat, in many African countries (Mottet and Tempio, 2017). In the case of Ghana, Figure 1 shows that poultry meat consumption has significantly increased in the last two decades. However, local production has stagnated over the same period. The stagnation in production has resulted in local production failing to meet the strong demand for chicken meat (Andam *et al.*, 2017b). Figure 1 also shows that there has been a sharp increase in the quantity of poultry meat products imported by Ghana in the last two decades. The country imports an estimated 79% of the total chicken meat supply (Zamani *et al.*, 2020). It is one of the major importers of frozen chickens in the sub-Saharan Africa region, and most of the imports originate from the European Union (EU), the United States of America (USA) and Brazil (Matthews and Soldi, 2019).

The significant importation of frozen chickens has attracted criticism from the civil society, producers and other actors in the poultry sector (Ayisi and Adu, 2016). Much of the criticism is focused on the fact that imports are more affordable than locally produced chickens (Andam *et al.*, 2019; FAO, 2014). Therefore, the imports are believed to be pushing the local producers out of business as the producers cannot compete with them (Al-Hassan *et al.*, 2014). Low-cost frozen chicken imports have also been controversial in other African countries. For example, in 2002, the Nigerian government banned poultry meat imports in order to protect the domestic poultry sector (Heise *et al.*, 2015). In 2005, Cameroon imposed a strict import quota which drastically lowed poultry meat imports. In the same year, Senegal also imposed poultry trade protectionist measures (Johnson, 2011).

In Ghana, the ongoing debate regarding the impact of frozen chicken imports on the poultry industry often singles out broiler producers as the biggest losers, while consumers are often touted as the biggest winners (Johnson, 2011; Kornher and Von Braun, 2020). To our best knowledge, most of the existing literature regarding the impact of poultry imports to Ghana focuses on consumer preference for domestic and imported meat (Asante-Addo and Weible, 2020; Mensah *et al.*, 2020; Woolverton and Frimpong, 2013). However, there is limited evidence of how imports affect different broiler production systems (Sumberg *et al.*, 2013). Therefore, there is limited research that links production systems, farm performance and the implications of imports.

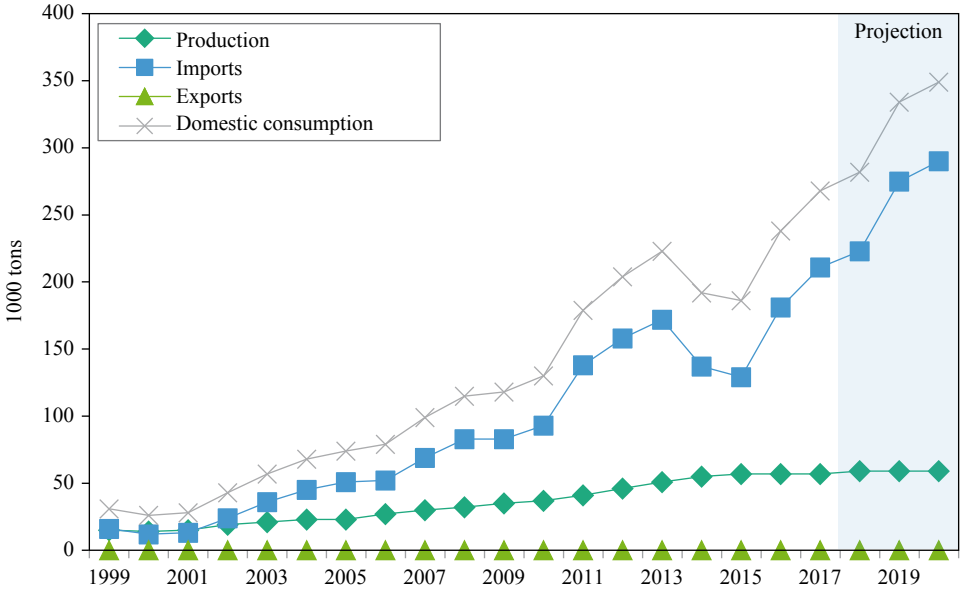

Figure 1. Development of poultry meat balance in Ghana from 1999 to 2019 (in 1000 metric tons). The graph presents the USDA projection (Zamani *et al.*, 2021).

In this context, this study aims to investigate the performance of broiler production systems in Ghana and analyze how they are affected by frozen chicken imports. Two steps were undertaken to achieve this. Firstly, measuring and comparing the performance of typical broiler production systems in Ghana. Second, providing insights into the implications of low-priced frozen chicken imports on local broiler production.

2. Materials and methods

2.1 Typical farm approach

The research was conducted within the framework of the typical farm approach. Chibanda *et al.* (2020) define the approach as a method for developing empirically grounded farm data sets through the use of expert interviews, focus groups and farm observations. The approach has been applied in numerous published research on beef (Chará *et al.*, 2019; Siqueira and Duru, 2016), pig (Kress and Verhaagh, 2019), fish (Lasner *et al.*, 2017, 2020) and dairy (Alqaisi *et al.*, 2014; Hagemann *et al.*, 2011; Ndambi and Hemme, 2009; Ndambi *et al.*, 2008) production systems. However, to the best of our knowledge, it has not yet been applied in any published research on poultry production systems. Therefore, this paper also provides insights on how the approach can be applied in poultry production economics. The application of the typical farm approach in poultry farm economic analysis is slightly comparable to the methodology used by Van Horne (2018, 2020). Van Horne uses data from farms that are considered to be representative of other farms. The approach was applied as stipulated by the agri benchmark standard operational procedure (SOP), which is outlined by Chibanda *et al.* (2020). The six steps of the SOP that were applied are described below.

- *Step 1: Identifying the most significant regions and prevailing production systems*

The most significant regions in terms of broiler production (highest total population of chickens per region) and prevailing production systems were identified through a two-step process. First, an in-depth literature review was conducted to identify the prevailing broiler production systems in Ghana. Second, key-value chain actors were consulted, during a multi-stakeholder workshop held in Accra on 6 September 2019, to discuss the main characteristics of the production systems that were identified through the literature review. The workshop was attended by 44 participants who included producers, policymakers, researchers, and processors. Three broiler production systems in three different regions were identified and confirmed. The large-scale integrated production system in the Ashanti Region, medium scale system in Brong-Ahafo region and small-scale commercial system in the Greater Accra region.

- *Step 2: Selection of farms within the prevailing production systems*

Due to the lack of detailed regional information and statistics on farms, local experts (veterinary and extension officers) were consulted to identify farms with characteristics that represent the typical broiler production systems. Three farms were selected to represent the three broiler production systems, and these farms were used as the foundation for constructing typical farms.

- *Step 3: Farm visits and interviews*

The three farms selected in Step 2 were visited, and semi-structured interviews with producers were conducted in March 2020. A standard questionnaire was used to collect detailed farm data including the whole farm level and the broiler production data.

- *Step 4: Focus groups*

According to Bryman (2016), a focus group is a qualitative data collection method that entails data collection from a small group of people through an open discussion. Focus groups can also be used to construct typical farms (Chibanda *et al.*, 2020; Lasner *et al.*, 2020). They served two primary purposes in our study. First, they

were used to construct typical farms. Second, they were used to gain an understanding of each production system's particularities and the impact of chicken imports on the production systems. To develop typical farms, focus group participants reviewed the individual farm data (collected in Step 3) in each production system. Each focus group was comprised of ten participants who included five producers, two local researchers and three local experts (extension/veterinary officers). They discussed each farm figure (e.g. number of cycles per year, mortalities) until they reached a consensus that each figure reflected the typical situation within a production system and region. Consequently, the typical farms that were developed are 'synthetic' farms representing the most common farm type within the production systems and regions. A total of three focus groups were held, one for each of the identified production systems.

■ *Step 5: Data analysis*

The technology impact policy impact calculations (TIPI-CAL) model was used to analyze the collected typical farm data. TIPI-CAL is a production and accounting model used for farm economic analysis as it allows a detailed examination of farm-level variables (Chibanda *et al.*, 2020; Kress and Verhaagh, 2019). TIPI-CAL enables the calculation of physical and economic parameters at both whole farm and broiler enterprise levels. It provides detailed information on activity levels, performance and productivity of selected farms such as the feed conversion ratio (FCR) and broiler farm economy index (BFEI). FCR is a measure of the amount of feed used per kilogram of meat produced. While BFEI is a single indicator that combines multiple indicators (FCR, livability, live weight and slaughter age) to highlight the global efficiency of a broiler farm (Singh *et al.*, 2017). The European broiler index (EBI) is another important indicator that can also be used to assess the overall efficiency of a broiler farm (Kryeziu *et al.*, 2018). However, the EBI was not calculated in this study because it produces results that are comparable to those obtained using the BFEI. Of which the BFEI was used because it is more widely used in broiler farm economic calculations in developing countries. The BFEI was calculated using the following formula:

$$\text{BFEI} = \frac{\text{Average live weight (kg)} \times \text{\% livability}}{\text{FCR} \times \text{growing period (days)}}$$

Whereby;

$$\text{FCR} = \frac{\text{Cumulative feed intake (kg)}}{\text{Total weight gain (kg)}}$$

Using TIPI-CAL, the data that was collected on the whole farm level was broken down into the farm enterprises such as crop, feed production (in the case of integrated farms) and broiler production in order to perform a unit cost analysis (per kilogram chicken produced). Some costs were easily collected on a per bird or cycle basis. Other costs were available and collected on the whole farm level and were subsequently allocated to the enterprises analyzed. These costs included the costs of machines and buildings, labor (hired and family labor), land (rented and own) and overhead costs. Costs used for all enterprises on the farm were allocated by the share of the respective enterprise in total farm revenues. Cost items that belong to one enterprise and are used only for that production, were allocated 100% directly to that enterprise. Regarding total returns of the broiler production, TIPI-CAL considered meat prices and manure prices.

In the result database obtained through TIPI-CAL, costs were represented either per kg live weight or carcass weight of chicken meat produced. Moreover, the filter options in the TIPI-CAL model result database allows for aggregations of the costs in two different ways; (1) cash and non-cash costs; and (2) factor and non-factor costs into two categories that include cash costs and non-cash costs. Langrell *et al.* (2012) explain that production costs can be classified according to several dimensions. Of which, the classification of the production costs into cash and non-cash costs is based on the monetary flow dimension. Langrell *et al.* (2012) also explain that, for cash costs, monetary payments for production inputs are incurred at the instance they are used in the production operations (e.g. cash payments for chicks, feed, medicine and veterinary services, and similar items). However, non-cash costs do not affect short-term capital, either because the payment is not realized (opportunity cost of own inputs) or the payment is spread out over time even though it occurred all at once.

Non-cash costs are composed of depreciation and opportunity costs. Of which, depreciation costs account for the decreasing value of farm assets (e.g. buildings and machinery) and opportunity costs represent the cost of a foregone alternative, for example, the opportunity cost of family labor on a broiler farm is a paid off-farm (Langrell *et al.*, 2012). Regarding the factor and non-factor costs, Menghi *et al.* (2011) indicate that factor costs cover land costs (cash cost of rented land plus opportunity cost of own land), labor costs (cash cost of contract labor plus opportunity cost of family labor), and capital costs (interest paid on liabilities as cash cost of capital plus interest on own capital as opportunity cost of capital and). While non-factor costs are composed of all other costs (including depreciation) such as purchased feed and day-old chicks, machinery (maintenance, contractor), fuel, energy, lubricants, water, buildings (maintenance), veterinary services and medicines, insurance and taxes.

The TIPI-CAL model calculates the opportunity cost based on calculated costs for family labor, rent on land and interest on own capital.[1] The depreciation is calculated by the model as linear depreciation on machinery and buildings over their economic utilization period, based on replacement values. Generally, cash costs can be represented by variable costs, that change with the production level and non-cash costs can be related to fixed costs, which are independent from the production level.

Basing on the cash and non-cash costs, the TIPI-CAL model calculated profitability figures as a production unit base within three breakdowns; short-term, mid-term and long-term profitability. The short-term[2] profitability of producing one kg of meat was calculated by deducting cash costs from total returns (meat prices, manure prices and potential subsidies). This means it does not provide information related to depreciation and opportunity costs. On the other hand, medium-term[3] profitability reflects both cash and depreciation costs. While a farm can be long-term[4] profitable when returns cover total costs; cash, depreciation and opportunity costs.

The qualitative data collected through focus groups was analyzed in order to gain more insights regarding broiler production and the implications of frozen chicken imports on the farm level. The focus group discussions were recorded and transcribed verbatim. The data was then analyzed through the formulation of theory through coding.

■ *Step 6: Data validation*

Preliminary results from the farm economic analysis were sent back to local experts for validation. The validation process entailed the experts cross-checking the results and reaching a consensus that the results reflect the reality of a typical farm within a specific production system and region.

2.2 Limitations of the typical farm approach

The main limitation of the approach is that it only represents specific farm types in particular regions of a country. This means that the farm data acquired through the approach cannot represent the variety of farms in an entire country (Langrell *et al.*, 2012). Furthermore, the approach is dependent on focus groups which present some limitations; for example, focus group participants may exaggerate their answers (Krueger and Casey, 2014). This implies that the quality of the data collected through focus groups depends on how honest participants are during the discussions. In our study, the limitations associated with focus groups were addressed through careful selection of participants and good facilitation skills of the discussions by the researchers. Extension officers nominated the producers who participated in the focus groups from their respective regions. This was done because extension officers work closely with producers and have in-depth

[1] Opportunity cost of land = own land × regional land rents; opportunity cost of labor = family working hours × wage for qualified local labor; opportunity cost of labor = non-land equity × long-term government bonds interest rate.
[2] Short term profitability = total returns – cash costs.
[3] Medium term profitability = total returns – cash costs – depreciation costs.
[4] Long term profitability = total returns – cash costs – depreciation costs – opportunity costs.

knowledge of farms' characteristics in their region. Furthermore, data validation with local experts also ensured that the focus groups' data is reliable.

2.3 Data collection and analysis of retail prices of chicken products

The researchers also collected retail prices of imported and local chicken meat from five supermarkets in Accra in July 2020. The prices were collected over a week. This was done to have a snapshot of the broiler meat retail market prices. The imported chicken meat available during the period of data collection was from Brazil and Ukraine. The researchers collected the prices of frozen whole dressed chickens and frozen chicken parts (wings and thighs). For whole dressed chickens and chicken parts, prices were collected for three local brands, two brands from Brazil and one brand from Ukraine. The average prices of local and imported chicken meat were then compared.

3. Results and discussion

3.1 Typical broiler production systems

The key characteristics of typical broiler production systems in Ghana are summarized in Table 1. Amanor-Boadu *et al.* (2016) estimate that about 86.7% of the broiler farms in Ghana are small-scale, 8.6% are medium-scale and 4.8% are large-scale farms. Furthermore, they explain that, in 2015, small and medium-scale farms accounted for an estimated 32.6 and 17.0% of the total local market supply of broiler meat, respectively. While large farms contributed about 50.4% of the local broiler meat supply.

3.2 Characteristics of the typical broiler farms

Table 2 presents the characteristics of the three typical broiler farms that were constructed to represent the typical broiler production systems. The typical farms were named according to the country code and the number of birds they produce in a year (GH_3600, GH_12100 and GH_27000).

GH_3600 represents a typical small-scale broiler farm that can be found in peri-urban areas in the Greater Accra region. GH_12100 represents a medium-scale typical broiler farm that can be found in the border town of Dormaa (at the border with Ivory Coast). The farm markets live birds to poultry traders that come from Ivory Coast. Focus group participants indicated that the exporting of chickens from Dormaa to the Ivory Coast is largely informal (little border formalities) due to the close social and economic links in the region. GH_27000 represents a large-scale integrated broiler located in Kumasi. GH_27000 often markets slaughtered birds to retailers and restaurants. Although GH_27000 typically sells slaughtered birds, FAO (2014) explains that most of the locally produced chickens are sold as live birds. FAO (2014) further explains

Table 1. General characteristics of typical broiler production systems in Ghana. Compiled from Amanor-Boadu *et al.* (2016), FAO (2014) and the multi-stakeholder dialogue.

	Small-scale commercial	**Medium scale commercial**	**Large-scale integrated**
Farm size (birds sold/year)	<5,000	5,000-20,000	>20,000
Biosecurity measures	Low to moderate	Moderate	Moderate to high
Feed sourcing	Commercial feed-mills		Own feed-mills
Day old chicks (DOCs)	Often imported	Often imported	Own hatchery
Marketing	Live birds sold in local communities, live markets and to small restaurants	Live birds sold in live markets or to traders. Rarely, the birds are slaughtered and sold to fast food shops and restaurants	Birds are slaughtered on the farm and marketed to retailers and restaurants

Table 2. Characteristics of the typical broiler farms.

Farm name	GH_3600	GH_12100	GH_27000
Production system	Small scale	Medium scale	Large scale integrated
Farm location	Greater Accra	Dormaa	Kumasi
Farm size (birds sold/year)	3,613	12,086	27,000
Genotype	Ross 308[1]	Cobb 500	Cobb 500
Origin of day-old chicks	Imported from Europe (usually from the Netherlands and Belgium)	Imported from Ivory Coast	Own hatchery
Type of labor	Family labor; 1,680 hrs./yr. Casual labor; 1,440 h/yr.	Family labor; 1,152 hrs./yr. Permanent labor; 6,720 h/yr.	Permanent labor; 26,136 h/yr.
Farm ownership	Privately owned farm	Rented coops	Privately owned farm

[1] Typical small-scale farms use the Ross 308 breed because it is the breed that is commonly reared in the Netherlands and Belgium and is the only breed available for export.

that most of the slaughter houses are operating at far below capacity and poorly equipped. It is important to note that, although GH_27000 is considered as a large-scale farm in Ghana, the farm rears a far lower number of birds in comparison to typical broiler farms in exporting countries. For example, typical broiler farms in Brazil can produce more than 220,000 birds/year, in Germany more than 300,000 birds/year, and in Thailand more than 350,000 birds/year (Menghi *et al.*, 2011).

3.3 Performance indicators

- *Livability*

Tandoğan and Çiçek (2016) define livability as the total number of birds alive at the end of a production cycle relative to the number of chicks at the beginning of the cycle. The livability rates on broiler farms in some key exporting countries such as Brazil, Germany and Thailand are 97.00, 95.80 and 95.00% respectively (Menghi *et al.* 2011). Table 3 shows that GH_3600 has the highest livability of 97.12%, then followed by GH_12100 (95.92%) and GH_27000 (90.00%). The comparison of livability shows that locally hatched day old chicks (DOCs) have the lowest livability (highest mortalities) as compared to imported DOCs. These findings are supported by Yeboah *et al.* (2019), whose study concludes that locally hatched DOCs in Ghana have higher mortality rates. Furthermore, FAO (2014) explains that the use of locally hatched DOCs which are often of low quality is one of the leading causes of low livability among Ghanaian poultry producers. The low quality of locally hatched DOCs is mostly attributed to poor breeder flock management and poor hatchery management (i.e. incubation practices, vaccinations and other post-hatch management practices) (Yeboah *et al.*, 2019).

Table 3. Technical efficiency indicators and other production performance indicators.

	GH_3600	GH_12100	GH_27000
Livability (%)	97.12	95.92	90.00
Feeding period (days)	63.00	45.50	42.00
Selling live-weight (kg)	3.00	2.20	2.00
Number of cycles per year	3.72	3.00	3.00
Feed conversion ratios (FCR)	2.43	2.08	2.33
Broiler farm economy index (BFEI)	1.90	2.01	2.03

FAO (2014) and RVO (2020) explain that the root cause of poor hatchery management in Ghana is the absence of the monitoring and regulation of hatchery operations as there is no hatchery policy or laws governing the operations of hatcheries.

■ *Feeding period*

According to Smith (2001), fast-growing broiler genotypes that are commercially reared in the tropics often achieve an ideal selling live weight of around 2 to 2.5 kg in a feeding period of 35 to 42 days. Typical conventional broiler farms in some broiler meat exporting countries like Brazil, Germany and Thailand have average feeding periods of 42 days, 37 days and 40 days respectively (Menghi *et al.*, 2011). Table 3 shows that GH_12100 rears its broilers in 45.5 days and GH_27000 in 42 days. These feeding periods can be considered to be reasonable. However, GH_3600 rears its broilers for 63 days. This is far beyond the expected range in commercial conventional broiler production. Focus group participants explained that small-scale farms, like GH_3600, rear their broilers for an extended period because they often face challenges with marketing their live birds due to market competition from more affordable and conveniently available frozen chicken imports.

■ *Production cycles*

Table 3 shows that the Ghanaian typical broiler farms have around 3.0 production cycles per year. In contrast, typical broiler farms in Brazil, Germany and Thailand have 8.0, 7.5 and 6.0 production cycles per year respectively (Menghi *et al.*, 2011). The findings suggest that none of the typical farms in Ghana is maximizing their asset utilization as Amanor-Boadu *et al.* (2016) indicate that broiler producers in Ghana who maximize their asset utilization can run up to 6.5 production cycles per year. Focus group participants explained that most broiler producers have 3.0 production cycles per year because their production mainly targets festive holidays.

■ *Feed conversion ratio and broiler farm economy index*

According to Aning (2006), the lower the FCR value the more technically efficient the production. Table 3 shows that GH_12100 is the most efficient farm in terms of feed use, and GH_3600 is the least efficient. The recommended FCR value for the Ross 308 breed after a feeding period of 63 days is 2.02 (Aviagen, 2019) and for the Cobb 500 breed after feeding periods of 45.5 days and 42 days are 1.75 and 1.68 respectively (Cobb, 2015). Typical broiler farms in some broiler meat exporting countries like Brazil, Germany, the USA, and Thailand have FCRs values of 1.79, 1.58, 1.83, and 1.65 respectively (Van Horne, 2018). Therefore, Ghanaian farms are less efficient in terms of feed use than these countries. A BFEI value of less than 1.30 indicates overall poor management and performance of a broiler farm, while a BFEI value of 2.00 and above indicates efficient farm management (Singh *et al.*, 2017). GH_3600 has a BFEI value that is lower than 2. While GH_12100 and GH_27000 have BFEI values that are more than 2.

3.4 Economic results

■ *Costs of production*

Figure 2 shows that GH_27000 has the highest total production costs, followed by GH_3600 and GH_12100. Furthermore, for all farms, the highest cost items are feed and DOCs. Focus group participants attributed the high costs of feed to the high prices of locally produced and imported feed ingredients. This is supported by Martey *et al.* (2020) who demonstrate that, although not higher than international prices, local soya prices are also high. In addition, Andam *et al.* (2017a) explains that poultry feed is expensive in Ghana because the country is also dependent on expensive imports of maize and soy which are the two primary poultry feed ingredients. Currently, Ghana has a 5% import tariff rate on feed products (Zamani *et al.*, 2021). The main feed ingredients used by all three typical farms include maize (57-60%), soy meal (20-24%), wheat

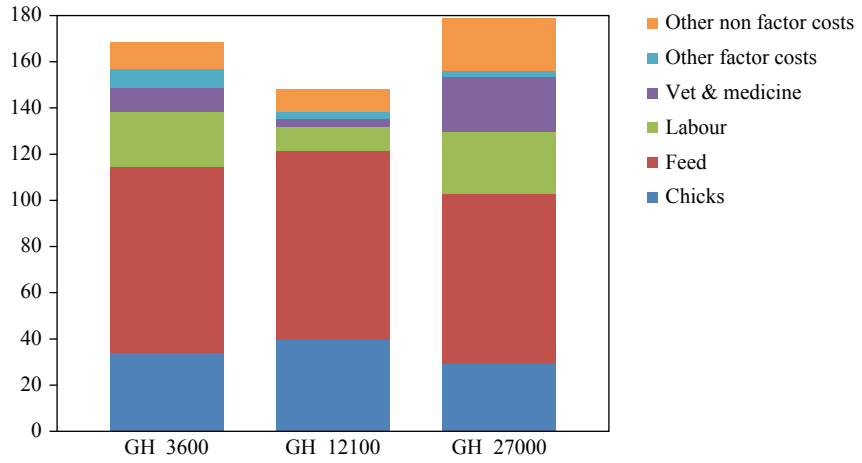

Figure 2. Production costs of the typical broiler farms (EUR/100 kg live weight).

bran (7-12%), fishmeal (2-5%) and oyster shells (1-2%). Furthermore, the previous analysis of FCR shows that all three typical farms are inefficient in terms of feed use. Consequently, feed use inefficiency results in increased feed costs as more feed is used per kilogram of meat produced.

GH_3600 and GH_12100, which import DOCs, have the highest costs of DOCs compared to GH_27000, which uses locally hatched chicks. GH_3600 uses DOCs imported from the Netherlands at 0.98 EUR/chick. GH_12100 uses DOCs imported from Ivory Coast at 0.75 EUR/chick. GH_27000 uses locally hatched DOCs which cost 0.58 EUR/chick. Focus group participants explained that, although imported DOCs are more expensive, most producers prefer to rear them because the locally hatched DOCs are generally of low quality and often lead to high mortalities and poor growth.

GH_27000 has the highest 'other non-factor' costs. These costs include fuel, energy, water, insurance and taxes. These cost items are much higher for GH_27000 because it spends much more on fuel, energy and water. Furthermore, GH_27000 is the only farm that pays for some form of insurance.

■ *Returns and profitability*

Table 4 shows that GH_27000 has the highest selling price and returns per 100 kg of live weight. It is also the only farm with manure returns. Focus group participants explained that, unlike layer production, broiler production is characterized by the production of very few chicken litter due to the short cycle. However, large farms like GH_27000 can accumulate a large amount of chicken litter due to the high number of birds. GH_12100 has considerably lower selling price and returns compared to other farms. This can be attributed to the fact that the farm markets its live chickens to traders from Ivory Coast who purchase the chickens at a much lower price compared to the Ghanaian market.

Table 4. Comparison of returns of the typical broiler farms (EUR /100 kg live weight).

Indicators	**Typical farms**		
	GH_3600	**GH_12100**	**GH_27000**
Broiler price	2.22	1.37	2.68
Broiler returns	222.48	137.66	268.31
Manure returns	0	0	0.13
Total returns	222.48	137.66	268.44

Figure 3 shows that all three farms are profitable in the short-term. This means that deducting cash costs (costs of production) from total returns, gives a positive for all farms. Figure 3 shows that GH_27000 is the most profitable typical farm. GH_12100 is the least profitable farm as it is not profitable in the medium and long term. For a farm to be profitable in the medium-term, its total returns must be able to cover the cash costs and depreciation. While the total returns from farms that are profitable in the long term are able to cover the cash cost, depreciation and opportunity costs. Although GH_3600 and GH_27000 have higher cash costs of production in comparison to GH_12100, this is offset by higher selling prices which enable them to generate medium- and long-term profits. GH_12100 is unprofitable in the medium and long-term because it markets live chickens to traders from Ivory Coast at a significantly low selling price.

3.5 Comparison of prices of imported and local chicken meat in Accra (Ghana)

Figure 4 shows that, in 2020, imports from Brazil and Ukraine, especially chicken cuts pieces (thighs and wings) were cheaper than the locally produced chicken meat. The findings of the snapshot are consistent with the results obtained from a market research conducted by Andam *et al.* (2019). In their study, the prices of imported whole dressed chickens and chicken parts were consistently lower than those of locally produced chickens and chicken parts. The findings are also in line with the consumer studies conducted by Asante-Addo and Weible (2020) that conclude that urban consumers in Ghana consume more frozen chicken imports than local production because the imported chicken meat is more affordable and conveniently available in cut pieces that make preparation faster.

GH_27000 is the only farm with the capacity (i.e. slaughtering facilities, marketing arrangements) to sell chickens to supermarkets. Figure 5 shows that such a farm would be unprofitable if it sold slaughtered birds at a similar price to imported whole birds.

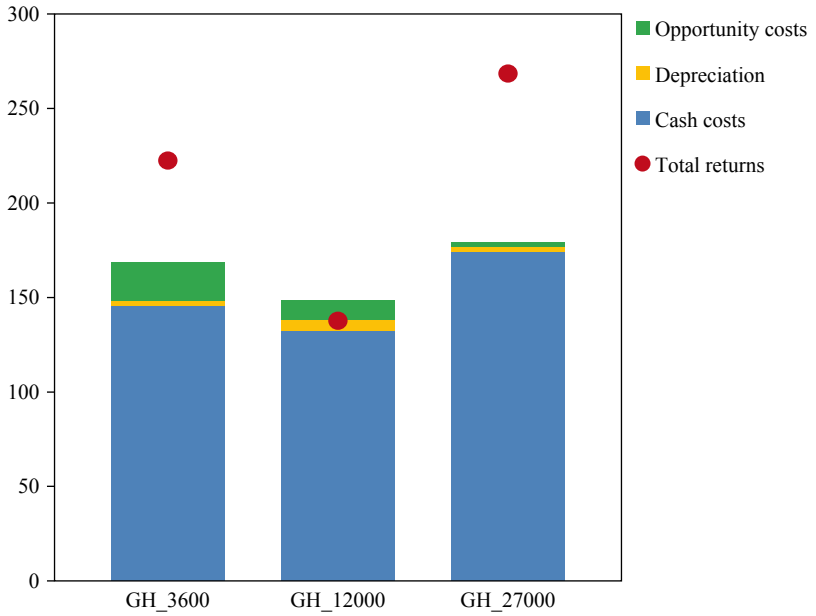

Figure 3. Profitability of the typical broiler farms (EUR/100 kg live weight).

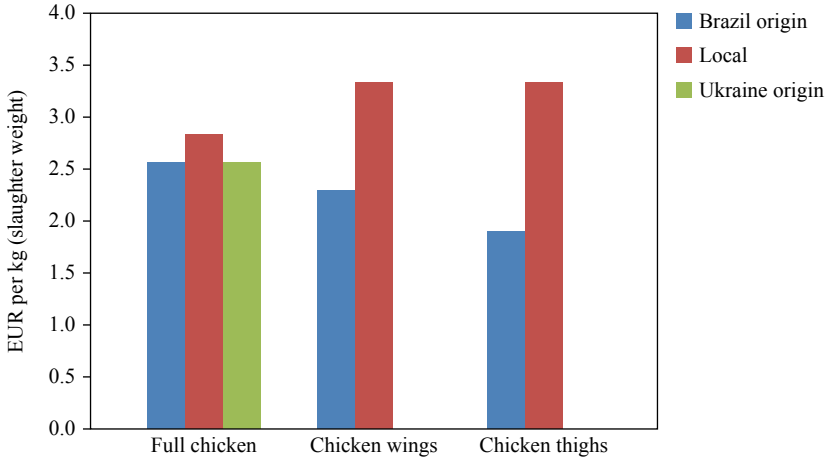

Figure 4. A snapshot of prices of frozen imported and local chicken meat in Accra (EUR/kg slaughter weight). Note: the prices were collected in five supermarkets in Accra in July 2020 and are used as indicative prices.

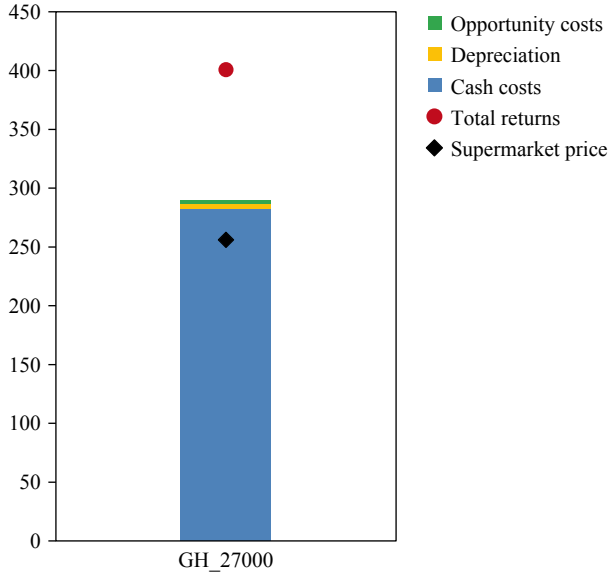

Figure 5. Total costs and returns vs returns based on supermarket prices (EUR/100 kg carcass weight).

3.6 Implications of frozen chicken imports on broiler production

Although the competition from low-priced frozen chicken imports has implications on the entire value poultry chain, these are not discussed because the scope of this study does not go beyond the farm level. The results of the farm economic analysis suggest that the competition from low-priced frozen chicken imports has three direct implications on broiler production in Ghana.

Firstly, broiler production in Ghana can be considered to be seasonal because all the typical broiler farms only run about 3 production cycles per year instead of 6,5 cycles which are expected in conventional broiler farms in Ghana. Focus group participants explained that typical farms can often only market their birds during festive holidays (Christmas, Easter and Eid Al-Fitr) which are characterized by an increased demand for local chickens. Amanor-Boadu *et al.* (2016) confirm that broiler production in Ghana is seasonal as producers often produce only for the festive holidays which are characterized by increased demand for live chickens and consequently better price conditions compared to out of the festive seasons.

Secondly, our results show that small-scale broiler producers located in Accra are the most negatively affected by the competition from the low-priced imports. The competition from the imports has resulted in extended feeding periods for the small-scale producers because they often fail to secure a market for their chickens after the normal feeding period. Focus group discussions revealed that the producers cannot sell all their chickens during the expected time frame because their live chickens cannot compete with more affordable and conveniently available frozen chicken imports. 'After six weeks of rearing, if the market is okay, it takes about two weeks to sell our chickens, but often the market is bad, and it takes about three weeks,' indicated one of the producers during the focus group discussion held in Accra. Unlike in many poultry meat exporting countries, contract farming is not widespread in the Ghanaian broiler value chain. Okantah *et al.* (2005) explain that small-scale producers in Ghana tend to face more significant marketing challenges than medium and large-scale producers because they often do not have contractual arrangements or informal links with buyers. Consequently, the long feeding periods have resulted in the small-scale farms being the least technically efficient farm-type in terms of FCR and BFEI.

Thirdly, our findings show that the price competition from frozen chicken imports push producers in Dormaa to sell live birds to poultry traders from Ivory Coast at a lower selling price. Focus group participants explained that even though the selling price is low, producers in Dormaa prefer to sell their chickens to traders from Ivory Coast because they cannot secure a reliable market in Ghana. 'It is close to impossible to sell all my chickens at this price in the local market if I produce more than 500 birds per cycle,' said a producer during the focus group in Dormaa. Adei and Asante (2012) highlight that Ivory Coast is a better market for the producers in Dormaa because of the high sale volumes. They further explain that restaurants in Ghana usually place orders of a few birds at a time, while traders from Ivory Coast purchase truckloads of birds in one transaction. The traders are able to negotiate a low price because of the large volumes they purchase. The analysis of profitability (Figure 3) shows that although producers in Dormaa have a market for their chickens through informal agreements with the Ivorian traders, the low selling prices make broiler production in the region unsustainable in the medium and long term. Unprofitability in the medium term suggests that the producer will be unable to reinvest into the farm as he/she cannot afford to account for the depreciation, while unprofitability in the long term implies that there is a significantly high opportunity cost which means the producer can most likely earn a higher income from other activities or sectors. These results support the findings made by Adei and Asante (2012) that indicate that broiler producers in Dormaa are reducing their production or increasingly switching to layer production which is more profitable and has no competition from imports. Therefore, if the status quo is maintained, more and more producers in Dormaa will be forced to either reduce or abandon broiler production in the long run. These results are of significant importance because Dormaa is one of most important broiler production regions in Ghana.

4. Conclusion and recommendations

The study identified large-scale integrated, medium-scale, and small-scale commercial production systems as the most common broiler production systems in Ghana. The study also established that all broiler production systems in Ghana are characterized by high production costs, of which, feed and DOCs costs are the most important cost items. Despite the relatively high costs of production, broiler production is profitable for all typical production systems in the short-term.

The farm economic analysis revealed that small-scale broiler farms are the least technically efficient system in terms of FCR and BFEI. The inefficiency of small-scale farms is attributed to their significantly longer feeding periods. Of which, a careful analysis of the impact of frozen chicken imports on local broiler production suggests that the long feeding periods are due to the market competition from low-cost imports. The analysis also reveals that the use of poor-quality DOCs, particularly by large-scale farms, is another driver of farm inefficiency. The analysis further suggests that the competition from low-cost chicken imports has generally made broiler production seasonal in Ghana as producers can only market their chickens during festive seasons at a favorable price when there is an increased local demand.

Based on the farm economic analysis, we recommend the implementation of policies that aim to reduce the costs of broiler production in Ghana so that locally produced chicken meat can compete with frozen chicken imports in terms of prices. More specifically, these policies could aim to reduce the costs of primary feed ingredients (maize and soya) and improve the quality of locally produced DOCs. The costs of feed could be reduced by supporting maize and soya producers to boost local production. More concretely, policies that aim to support local maize and soya production may: (1) promote and support the use of improved seeds to boost productivity; (2) facilitate the increase of the area of land under irrigation to ensure year-round production of maize; and (3) promote and support post-harvest handling practices to enhance the quality of locally produced feed ingredients (Andam *et al.*, 2017a). Furthermore, policy makers may also consider removing the 5% import tariff on feed products which may slightly lower the prices of imported feed ingredients. The quality of locally produced DOCs may be improved by rigorous monitoring and regulation of hatchery operations. The implications of good quality DOCs are the reduction in the use of expensive DOCs imported from Europe and an improvement in farm performance (reduced mortalities). It is important to note that the Ghanaian chicken meat value chain also faces a wide range of challenges such as inadequately equipped slaughtering facilities, limited access to credit, diseases, limited extension and veterinary services and poorly developed cold chains (Kareem and Wieck 2021; Zamani *et al.*, 2021). Therefore, the competitiveness of locally produced chicken meat will also depend on how these other off-farm challenges are overcome.

Although this study provides important insights into a contentious issue in Ghana, it only focuses on producers. However, it is to assume that the impacts of frozen chicken imports have a much broader economic impact, for example on value chain development, the rural farm and non-farm economy and job creation in particular. Hence, future research may focus on how other key actors (hatcheries, slaughterhouses, retailers) in the poultry meat value chain and the rural economy are affected.

Acknowledgements

The project is supported by funds of the German Ministry of Food and Agriculture (BMEL) based on a decision of the Parliament of the Federal Republic of Germany.

References

Adei, D. and B.K. Asante. 2012. The challenges and prospects of the poultry industry in Dormaa District. *Journal of Science and Technology* 32(1): 104-116. https://doi.org/10.4314/just.v32i1.11

Al-Hassan, R.M., N. Larvoe and A.A. Adaku. 2014. Hedonic price analysis of dressed chicken in Ghana. *International Journal of Business and Social Science* 5(12): 215-223.

Alqaisi, O., T. Hemme, U. Latacz-Lohmann and A. Susenbeth. 2014. Evaluation of food industry by-products as feed in semi-arid dairy farming systems: the case of Jordan. *Sustainability Science* 9(3): 361-377. https://doi.org/10.1007/s11625-013-0240-6

Amanor-Boadu, V., F.K. Nti and K. Ross. 2016. *Structure of Ghana's chicken industry in 2015*. Department of Agricultural Economics, Kansas State University, Manhattan, KS, USA.

Andam, K., S. Gupta, M.E. Johnson, D.S. Kufoalor and C. Ragasa. 2017a. *A chicken and maize situation: the poultry feed sector in Ghana*. International Food Policy Research Institute, Washington, DC, USA.

Andam, K.S., C. Arndt and F. Hartley. 2017b. *Eggs before chickens? Assessing Africa's livestock revolution with an example from Ghana*. International Food Policy Research Institute, Washington, DC, USA.

Andam, K.S., C. Ragasa, S. Asante and S. Amewu. 2019. *Can local products compete against imports in West Africa? Supply-and demand-side perspectives on chicken*, *rice*, *and tilapia in Accra*, *Ghana.* International Food Policy Research Institute, Washington, DC, USA.

Aning, K.G. 2006. *The structure and importance of the commercial and village based poultry in Ghana. Poultry Review Report prepared for FAO.* Food and Agriculture Organization of the United Nations, Rome, Italy.

Asante-Addo, C. and D. Weible. 2020. Is there hope for domestically produced poultry meat? A choice experiment of consumers in Ghana. *Agribusiness* 36(2): 281-298. https://doi.org/10.1002/agr.21626

Aviagen. 2019. *Ross 308/ Ross 308 FF broiler: performance objectives*. Aviagen, Newbridge, UK. Available at: http://en.aviagen.com/tech-center/download/1339/Ross308-308FF-BroilerPO2019-EN.pdf

Ayisi, N.D. and K.J. Adu. 2016. Challenges and future prospects for broiler meat consumption in Ghana. *Imperial Journal of Interdisciplinary Research* 2(8): 648-654.

Bryman, A. 2016. *Social research methods*. Oxford University Press, London, UK.

Chará, J., E. Reyes, P. Peri, J. Otte, E. Arce and F. Schneider. 2019. *Silvopastoral systems and their contribution to improved resource use and sustainable development goals: evidence from Latin America*. FAO, CIPAV and Agri Benchmark, Cali, Colombia, 60 pp.

Chibanda, C., K. Agethen, C. Deblitz, Y. Zimmer, M.I. Almadani, H. Garming, C. Rohlmann, J. Schütte, P. Thobe, M. Verhaagh, L. Behrendt, D.T. Staub and T. Lasner. 2020. The typical farm approach and its application by the Agri Benchmark Network. *Agriculture* 10(12): 646. https://doi.org/10.3390/agriculture10120646

Cobb. 2015. *Cobb500 broiler performance and nutrition supplement*. Available at: http://sedima.com/wp-content/uploads/2017/07/Cobb-Performance-July-2015.pdf.

Food and Agriculture Organisation (FAO). 2014. *Poultry sector Ghana. FAO animal production and health livestock country reviews*. Food and Agriculture Organization of the United Nations, Rome, Italy.

Hagemann, M., T. Hemme, A. Ndambi, O. Alqaisi and Mst. N. Sultana. 2011. Benchmarking of greenhouse gas emissions of bovine milk production systems for 38 countries. *Animal Feed Science and Technology* 166-167: 46-58. https://doi.org/10.1016/j.anifeedsci.2011.04.002

Heise, H., A. Crisan and L. Theuvsen. 2015. The poultry market in Nigeria: market structures and potential for investment in the market. *International Food and Agribusiness Management Review* 18: 197-222.

Johnson, M.C. 2011. Lobbying for trade barriers: a comparison of poultry producers' success in Cameroon, Senegal and Ghana. *The Journal of Modern African Studies* 49(4): 575-599. https://doi.org/10.1017/S0022278X11000486

Kareem, O.I. and C. Wieck. 2021. *Mapping agricultural trade within the ECOWAS: structure and flow of agricultural products*, *barriers to trade*, *financing gaps and policy options*. Agricultural Economics Working Paper Series 32. Institute for Agricultural Policy and Markets, University of Hohenheim, Stuttgart, Germany.

Kornher, L. and J. Von Braun. 2020. *EU common agricultural policy impacts on trade with Africa and African agricultural development*. ZEF – Discussion Papers on Development, Policy No. 294. Center for Development Research, Bonn, Germany.

Kress, K. and M. Verhaagh. 2019. The economic impact of German pig carcass pricing systems and risk scenarios for boar taint on the profitability of pork production with immunocastrates and boars. *Agriculture* 9(9): 204. https://doi.org/10.3390/agriculture9090204

Krueger, R.A. and M.A. Casey. 2014. *Focus groups: a practical guide for applied research*. Sage Publications, Thousand Oaks, CA, USA.

Kryeziu, A.J., N. Mestani, S. Berisha and M.A. Kamberi. 2018. The European performance indicators of broiler chickens as influenced by stocking density and sex. *Agronomy Research Journal* 16(2): 483-491. https://doi.org/10.15159/AR.18.040

Langrell, S., P. Ciaian, S. Gomez y. Paloma, D.L. Cunningham, J.-F. Garnier, F. Isermeyer and A.K. Mishra. 2012. Methodologies and comparisons of production costs – a global overview. In: S. Langrell, P. Ciaian and S. Gomez y Paloma (eds.) *Sustainability and production costs in the global farming sector: comparative analysis and methodologies*. Publications Office of the European Union, Luxembourg.

Lasner, T., A. Brinker, R. Nielsen and F. Rad. 2017. Establishing a benchmarking for fish farming – profitability, productivity and energy efficiency of German, Danish and Turkish rainbow trout grow-out systems. *Aquaculture Research* 48(6): 3134-3148. https://doi.org/10.1111/are.13144

Lasner, T., A. Mytlewski, M. Nourry, M. Rakowski, and M. Oberle. 2020. Carp land: economics of fish farms and the impact of region-marketing in the Aischgrund (DEU) and Barycz Valley (POL). *Aquaculture* 519: 734731. https://doi.org/10.1016/j.aquaculture.2019.734731

Martey, E., N. Gatti and P. Goldsmith. 2020. Assessing the performance of regional soybean prices in Ghana. *International Food and Agribusiness Management Review* 23: 267-281.

Matthews, A. and R. Soldi. 2019. *Evaluation of the impact of the current CAP on the agriculture of developing countries*. European Union and the Committee of the Regions, Brussels, Belgium. https://data.europa.eu/doi/10.2863/81237

Menghi, A., K. De Roest, A. Porcelluzzi, C. Deblitz, Z. Von Davier, B. Wildegger, T. De Witte, K. Strohm, H. Garming, W. Dirksmeyer, Y. Zimmer, D. Bölling, G. Van Huylenbroek, and E. Mettepenningen. 2011. *Assessing farmers' cost of compliance with EU legislation in the fields of environment*, *animal welfare and food safety*. European Commission Directorate-General for Agriculture and Rural Development. Report No. AGRI-2011-EVAL-08. EC, Brussels, Belgium.

Mensah, J.O., S. Etuah, E.F. Musah, F. Botchwey, L.O. Adjei, K. Owusu, J.O. Mensah, S. Etuah, E.F. Musah, F. Botchwey, L.O. Adjei and K. Owusu. 2020. Consumers' preferences and willingness to pay for domestic chicken cut parts in Ghana: evidence from the Kumasi metropolis. *Journal of Agribusiness in Developing and Emerging Economies* 12(1): 126-141. https://doi.org/10.1108/JADEE-05-2020-0105

Mottet, A. and G. Tempio. 2017. Global poultry production: current state and future outlook and challenges. *World's Poultry Science Journal* 73(2): 245-256. https://doi.org/10.1017/S0043933917000071

Ndambi, O.A. and T. Hemme. 2009. An economic comparison of typical dairy farming systems in South Africa, Morocco, Uganda and Cameroon. *Tropical Animal Health and Production* 41(6): 979-994. https://doi.org/10.1007/s11250-008-9288-1

Ndambi, O.A., O. Garcia, D. Balikowa, D. Kiconco, T. Hemme and U. Latacz-Lohmann. 2008. Milk production systems in Central Uganda: a farm economic analysis. *Tropical Animal Health and Production* 40(4): 269-279. https://doi.org/10.1007/s11250-007-9091-4

Netherlands Enterprise Agency (RVO). 2020. *Analysis poultry sector Ghana 2019. An update on the opportunities and challenges*. Netherlands Enterprise Agency, The Hague, the Netherlands.

Okantah, S.A., P.A. Aboe, K. Boa-Amponsem, P.T. Dorward and M.J. Bryant (eds.) 2005. Small-scale poultry production in peri-urban areas in Ghana. In: T. Smith, S.H. Godfrey, P.J. Buttery, E. Ssewannyana and E. Owen (eds.) *Small stock in development. Proceedings of a workshop on enhancing the contribution of small livestock to the livelihoods of resource-poor communities*. Hotel Brovad, Masaka, Uganda, 15-19 November 2004. Natural Resources International Ltd., Aylesford, Kent, UK.

Singh, V.P., S. Kumar and H.S. Chauhan. 2017. Effect of dietary supplementation of Ashwagandha (Withania somnifera), Selenium and their combination on production performance of broiler chicks. *Trends in Biosciences* 10(19): 3597-3602.

Siqueira, Tiago T.S. and M. Duru. 2016. Economics and environmental performance issues of a typical Amazonian beef farm: a case study. *Journal of Cleaner Production* 112: 2485-2494. https://doi.org/10.1016/j.jclepro.2015.10.032

Smith, A.J. 2001. *Poultry; the tropical agriculturalist*. Macmillan Publishing Company, New York, NY, USA.

Sumberg, J., M. Awo, D.D. Fiankor, G.T. Kwadzo and J. Thompson. 2013. *Ghana's poultry sector: limited data*, *conflicting narratives*, *competing visions*. Brighton, UK.

Tandoğan, M. and H. Çiçek. 2016. Technical performance and cost analysis of broiler production in Turkey. *Revista Brasileira de Ciência Avícola* 18(1): 169-174. https://doi.org/10.1590/18069061-2015-0017

Van Horne, P.L.M. 2018. *Competitiveness of the EU poultry meat sector*, *base year 2017; international comparison of production costs.* Wageningen Economic Research, Report 2018-116. Wageningen UR, Wageningen, the Netherlands.

Van Horne, P.L.M. 2020. *Economics of broiler production systems in the Netherlands. Economic aspects within the Greenwell sustainability assessment model*. Wageningen Economic Research, Report 2020-027. Wageningen UR, Wageningen, the Netherlands.

Woolverton, A.E. and S. Frimpong. 2013. Consumer demand for domestic and imported broiler meat in urban Ghana. Bringing non-price effects into the equation. *British Journal of Marketing Studies* 1(3): 16-31.

Yeboah, P.P., L.A. Konadu, J.A. Hamidu, E.A. Poku, D. Wakpal, P.Y. Kudaya, A. Dey and S.M. Siddiq. 2019. Comparative analysis of hatcheries contribution to poor development of day-old chicks based on biological and immunological performance. *Veterinary World* 12: 1849-1857. https://doi.org/10.14202/vetworld.2019.1849-1857

Zamani, O., J. Pelikan and J. Schott. 2020. *EU exports of livestock products to West Africa: an analysis of dairy and poultry trade data*. Thünen Working Paper No. 162. Braunschweig, Germany.

Zamani, O., C. Chibanda and J. Pelikan. 2021. Investigating alternative poultry trade policies in the context of African countries. Evidence from Ghana. International Association of Agricultural Economists, 2021 Virtual Conference. August 17-31, 2021. https://doi.org/10.22004/ag.econ.315173