Financial viability of processing broiler chicken into cut parts in Ashanti region of Ghana
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Abstract: This study assessed the financial viability of establishing a 500-bird processing facility to process broiler chicken into cut parts such as thighs, wings, breasts and drumsticks in the Ashanti Region of Ghana. Using data from key informants from Ghana’s poultry industry, the study estimated the net present value (NPV), benefit–cost ratio (BCR), internal rate of return (IRR) and the payback period. At a discount rate of 30%, the NPV, BCR, and IRR were estimated to be GH₵581,537.95 (US$116,307.59), 1.06, 303%, respectively. These figures show that investment in a broiler processing facility with a capacity of 500 birds a day is financially viable. Furthermore, the estimated payback period of 0.44 years (or 5 months 9 days) shows that the initial investment of GH₵78,128.50 (US$15,625.7) is recouped in less than a year, reinforcing the project’s viability. However, sensitivity analyses show that the investment ceases to be viable when either the project cash outflow is increased by 9% or cash inflows reduced by 9%.

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PUBLIC INTEREST STATEMENT
Although the marketing sector of Ghana’s poultry industry has been dominated by cheaper imported poultry products from other countries, there is an opportunity for domestic poultry producers and other investors to favourably compete by supplying exactly what consumers prefer. This opportunity stems from consumers’ preference for domestically produced poultry meat due to its perceived superior quality and safety, the presence of market niche and the increasing demand for convenient poultry products. The desire for convenient meat such as cut parts presents a good investment opportunity. However, a decision to invest one’s limited resources should be informed by sound and detailed analysis. In view of this, the study assessed the financial viability of establishing a 500-bird processing facility to process poultry into cut parts such as thighs, wings, breasts, and drumsticks.
Based on these findings, the study proffers recommendations to help reduce inefficiencies in resource allocation and utilization and enhance project viability.

Subjects: Agricultural Economics; Agriculture and Food; Business & Planning

Keywords: financial viability; processing broiler; net present value; benefit–cost ratio; internal rate of return; payback period

JEL Classification: Q13; Q14

1. Introduction

1.1. Study background and rationale

The global agri-food system continues to witness transformation in the face of the ever-rising population in developing countries. This can be attributed to the changes in the patterns of consumption resulting from an increase in consumers’ disposable income, health consciousness and time constraints. These factors culminate in increased demand for convenient products (Staatz & Hollinger, 2016). Broiler production has the potential to help Ghana, and Africa generally, achieve household protein sufficiency due to its short production cycle (Ministry of Food and Agriculture (MoFA), 2016). In addition, the poultry sector contributes to improvement of rural livelihoods and community development through employment creation and income generation. The poultry sub-sector has contributed about 8.8% to agricultural Gross Domestic Product (GDP) of Ghana in 2012/2013 (MoFA, 2016).

According to Amanor-Boadu et al. (2016), the sector has the potential to employ all actors, provide revenue to the government and be the vehicle to fuel economic development by reducing rural poverty. Moreover, chicken has a nutritive value and provides animal-source protein. When added to staple foods, animal source protein can sufficiently increase nutrient adequacy, thereby contributing to food and nutritional security (Bruyn et al., 2015). Chicken’s popularity in the diets of most developing countries has been due to its lower price, strong consumer perception on safety and health advantages compared to other sources of meat protein (Takyi-Mensah, 2012). All these factors accentuate the importance of local poultry meat production in attaining self-sufficiency and the possibility of stabilizing the local currency with little or no importation.

Meanwhile, the consumption of whole chicken is the point of focus in most households (Food and Agriculture Organization (FAO), 2014) in an era where time has become an important factor in making consumption decisions. Andam and Silver (2016), again confirmed that these changing dynamics in the food systems of developing countries make it necessary for attention to be given to processed and convenient foods. Moreover, the income level of the average Ghanaian household makes it difficult for them to afford whole dressed birds, which is the dominant meat product of the local poultry industry, as part of the household’s regular meal. On the contrary, imported poultry meat is available in different parts, forms and sizes. As a result, Ghanaian consumers have developed an inordinate taste for imported chicken (Takyi-Mensah, 2012), therefore, making Ghana and other developing countries net importers of chicken (Dziwornu & Sarpong, 2014). In view of this, most local poultry farmers have shifted their attention from broiler production to the production of layers (Food and Agriculture Organization (FAO), 2013). As a way of dealing with the dwindling fortunes of the local broiler industry, the government of Ghana and other stakeholders have implemented several initiatives to revamp the poultry sector and increase meat production in the country (Ghana Poultry Project (GPP), 2016). A recent study by Asante-Addo and Weible (2019) reveals that there is a preference for domestically produced chicken to imported chicken. Other studies have been undertaken in the poultry industry and specifically, the broiler sub-sector and have confirmed the profitability of domestic meat production (Asuming-Brempong et al., 2006; Dziwornu, 2014; Etuoh, 2014), availability of organized markets and consumers’ desire for convenience (Adei and Asante, 2012; Woolverton & Frimpong, 2013). There is also the need for market-
oriented approaches to overcome the inefficiencies in poultry meat production (Dziwornu & Sarpong, 2014; Etuah, 2020; Tuffour & Atta Oppong, 2013).

These desirable circumstances create an opportunity for investment in the processing of broiler meats into cut parts. There is however the need for local broiler farmers, processors and other investors to make well-informed decisions based on empirically verifiable evidence. Thus, the uniqueness of this study is seen from the point of making the following contributions to the literature. In the first place, the determination of the initial capital investment for establishing a 500-bird processing facility, the operating costs and associated revenue streams as well as the evaluation of the viability of processing domestic chicken into cut parts will inform investors and policy-makers to make well-considered decisions. The study also analyzes the sensitivity of the proposed enterprise to determine how the enterprise will respond to shocks and eventualities with respect to an increase in costs and a reduction in revenue. Extensive review of literature revealed the paucity of literature on the subject of financial viability of processing poultry into cut parts. Most studies (MoFA, 2016; Etuah et al., 2020; Tuffour and Oppong, 2013) have focused on poultry production and quality/safety related issues with respect to processing. This study will address this literature gap by adding to the body of literature on poultry and investment appraisal studies.

The remainder of the paper is structured as follows. Pertinent literature on investment appraisal processes and the various financial analysis tools used are reviewed. Section 3 deals with methodological and data issues; types and sources of data, data collection methods and analytical methods used. Section 4 also covers analyses of the results, while section 5 discusses the implications of the findings and makes conclusions and recommendations to policy-makers.

1.2. The concept of investment appraisal and investment decisions

The literature on investment appraisal and financial feasibility has been well expounded and interestingly appealing to financial analysts. Financial feasibility refers to the assessment of the financial aspects of a business in terms of its ability to generate enough revenue to cover its investment and operating costs. Similarly, Osei Mensah et al. (2014) indicated that investment appraisal as a cheaper way of guarding against one’s scarce resources. It is normally undertaken in a structured way to ensure and guarantee confident decision-making about a proposal. Information gathered during this phase serves as the basis for preparing a business plan for the business that has been proposed (Thompson, 2002). He again indicates that it is done to ensure the feasibility of the proposed venture before expending resources. Investment appraisal involves considering the outflows and inflows of prospective projects in order to determine how viable the project would be. It considers the start-up capital, operating expenses and revenues, as well as calculating the various cost elements and financial commitment required when dealing with a single project or group of projects.

Anna (2010) considers viability analysis as an activity that should precede the development of a business plan. It shows the sensitivity of the business to changes in the assumptions raised during the analysis relative to the costs and returns (Brockhouse and Wadsworth, 2016; Anna, 2010; Matson, 2000). This is because having an understanding of the assumptions can help in making decisions as to which part of the analysis should be considered in detail to derive the best of the financial feasibility estimates.

However, computer modeling is used in most instances to analyze the instabilities in the prices of the product, changes in maintenance and operating costs among others (Finnerty, 1996). Helfert (2001) states that, in financial feasibility, the task of doing a critical assessment and analysis pays off by providing result-oriented outcomes and returns. The parameters are to be included in financial feasibility analysis as suggested by Hofstrand and Holz-Clause (2009b). This confirms that there is a need for a lot of information during the analysis and estimation to ensure that a more detailed and precise analysis is done. However, the marketability of a product plays an
influential role in determining the financial viability of a project given reasonable assumptions (Finnerty, 1996).

2. Materials and methods

2.1. Study area and data issues

The study is based on gathering relevant information from 13 key informants such as broiler farmers, local broiler processors, wholesalers and retailers of processed chicken meat in the Kumasi Metropolitan Area (KMA) of Ghana collected in February 2019. Both primary and secondary data were used in the study. Primary data obtained from key informants included investment and start-up capital needed, operating expenses gathered from local broiler processors. For chicken meat retailers and wholesalers, the price of a kilogram of processed imported chicken, prices of a processed whole domestic chicken and weight of processed whole domestic chicken were obtained. Major investment costs in this study include land, alternative power source, building, equipment (plucker and cutting knives), storage facility, holding cages, lairage, installation, personal protective equipment, telephone, computers, delivery van, business registration and certification, and office space. Operating cost items include the primary input (broilers), cost of electricity, water and sewage, transportation, packaging, marketing and advertisement, maintenance, taxes, fuel, insurance, labour cost, and cost of institutional supervision. Secondary data on lending rates, prices of some machinery and equipment were obtained from relevant state and non-state institutions.

2.2. Analytical procedure

The Discounted Cash Flow approach was employed to ascertain the financial viability using the Benefit–Cost Ratio (BCR), Net Present Value (NPV) and Internal Rate Return (IRR). This is done using realistic assumptions that have been gathered from all the key informants treated as data sources. A Cost–Benefit Analysis approach is used to match up the costs against the benefits expected of the proposed enterprise. A discount rate of 30% is used as the opportunity cost of capital since the average commercial bank lending rate is 29% as of February 2019. This is used to compute the Discounted Costs and Discounted Benefits of the enterprise on a proposed five-year project lifespan.

The projections made are also subjected to sensitivity analysis to determine how the project responds to an increase in cost and/or a reduction in revenue estimated for the project.

2.2.1. Net Present Value (NPV)

Net Present Value (NPV) is the difference between the present value of all cash inflows and cash outflows associated with an investment project at a given discount rate. It establishes whether the investment project is an acceptable investment, given the return the investor requires from the investment. To calculate NPV, the interest rate used for discounting the cash flows needs to be determined. The decision rule is to accept and invest in all projects with positive NPV, implying that the present value of inflows is greater than the present value of outflows. The implicit assumption underlying NPV is that there is no budget constraint (Campbell & Brown, 2003). However, in instances where there are budget constraints, other decision rules are needed to rank the projects (Campbell & Brown, 2003).

Mathematically, NPV is represented as:

$$NPV = \sum_{t=1}^{n} \frac{Bt}{(1 + r)^t} - \sum_{t=1}^{n} \frac{Ct}{(1 + r)^t}$$

where \(Bt\) and \(Ct\) represent cash inflow and cash outflow per year, respectively; \(t\); \(n\) denotes the total number of years of the investment and \(r\) represents the rate of discount.
2.2.2. Benefit–Cost Ratio (BCR)

The benefit–cost ratio is the quotient of the present value of cash inflows and the present value of cash outflows. It is used more often for public projects. The results are used to compare the benefits of the project to the project costs. For viability, the project benefits should exceed the costs of the project. By definition, the benefits of the project are the favourable outcomes of the project to the business and the costs are the financial commitments made by the firm. The decision rule is to accept a project if BCR is greater than one (1.0). Although NPV and BCR are similar, Gittinger (1984) argues that in situations where the potential investor wishes to know how much profit will be made from a cedi or dollar invested in the project, the latter is preferred.

\[
BCR = \frac{\sum_{t=1}^{n} B_t}{\sum_{t=1}^{n} C_t} = \frac{\text{Present Value of Benefits}}{\text{Present Value of Costs}}
\]

where \( B_t \) and \( C_t \) represent cash inflow and cash outflow per year, respectively, \( t \); \( n \) denote the total number of years of the investment and \( r \) represents the rate of discount.

2.2.3. Internal rate of return

The Internal Rate of Return (IRR) is similar to NPV to the extent that its computation uses the present value of cash inflows and present value of cash outflows. However, the IRR aims at finding the discount rate that makes the present value of cash inflows equals to the present value of cash outflows, thus making NPV zero. Internal Rate of Return (IRR) is a concept based on the return on invested capital in terms of project investment, or as Park (2002) defines it: “IRR is the interest rate charged on the unrecovered project balance of the investment such that, when the project terminates, the unrecovered project balance will be zero”. In other words, the investment has zero NPV at this rate of return, noted as \( i \). Therefore, \( i \) serves as a yardstick interest rate, which makes investors able to accept or reject decision consistent with the NPV analysis. IRR is the same as the \( i \) for simple investments, i.e. investments with only one sign change in cash flow (Park, 2002).

\[
IRR = \text{LDR} + \left(\frac{|\text{HDR} - \text{LDR}|}{\text{NPV}_{\text{LDR}} + \text{NPV}_{\text{HDR}}}\right)\frac{\text{NPV}_{\text{LDR}}}{\text{NPV}_{\text{HDR}}}
\]

Where

- \( \text{NPV} \) is Net Present Value
- \( \text{HDR} \) is Higher discount rate
- \( \text{LDR} \) is Lower discount rate

2.2.4. Payback period

The payback method of project appraisal is a non-discounted method that estimates how long, the number of years, it takes an investment to reap the initial capital invested. In other words, the payback period, the length of time it takes a project to generate cash inflows equal to the investment and pay the investor back. The decision rule is to accept projects with a shorter payback period.

Mathematically, the payback period can be estimated as:

\[
\text{Payback Period} = \frac{\text{Capital Investment} - \text{Cost of Project}}{\text{Annual Cashflow}}
\]
Table 1. Assumptions underlying the investment appraisal

| Item                                      | Assumption         |
|-------------------------------------------|--------------------|
| Increase in price of the cut parts per year | 9 %                |
| Maintenance (% of Housing & Equipment)     | 3 %                |
| Depreciation (% of Housing & Equipment)    | 15 %               |
| Increase in operating cost per year       | 9 %                |
| Average live weight (Full bird)            | 1.5 kg             |
| Percentage of blood in a live bird (Average)| 3%                |
| Dry feather weight (live weight)           | 74 g               |
| Average live weight of broiler chicken     | 2.3 kg             |
| Average % of the dressed chicken weight    | 65%                |
| Quantity of blood in live bird             | 30 g               |
| Average weight of chicken gizzard (per chicken) | 30 g            |
| Estimated life span of the processing equipment | 5 years         |
| Salvage value of fixed assets is added to cash inflow during year five | 67,870.80 |
| Method for depreciation                    | Reducing Balance Method |

2.2.5. Sensitivity analysis
Sensitivity analysis was used to examine the robustness of financial viability estimates to changes in factors that either affect cash inflow or cash outflows or both, and by extension NPV, BCR, IRR and payback. According to Adams et al. (2019), sensitivity analysis assesses what happens to the investor's quest to achieve project objectives if the assumptions underlying the financial viability analysis are either fully or partially violated.

2.2.6. Key assumptions
The data collected from the relevant key informants are used as benchmarks for postulating the underlying assumptions for the financial viability analysis. The assumptions relevant to the analysis are presented in Table 1. Details of operating costs and revenue were subjected to a 9% annual increase as prices are likely to increase due to inflation. The 9% used is the average rate of inflation over the past 3 years. Again, all assets are disposed off in the final year, revealing an increase in the revenue of the final year of the project. The assumptions made include the maintenance, estimated lifespan of the project and depreciation.3

3. Results and discussion

3.1. Analysis of cost of processing broilers in cut parts
The study started the analysis by first estimating the cost (cash outflow of processing broiler into cut parts). Cash outflows consisted of both startup expenditure or investment costs and operating expenses. The investment cost of the proposed venture included all the items that will be needed to establish the 500 bird per day processing facility. This includes some capital equipment and other non-capital cost items. The study included a contingency cost allowance of 3% of the total cost of the investment, which amounts to GH₵2,275.50 (US$ 455.10), to cater for unforeseen circumstances that will add to the investment cost. According to Table 2, the cost of investment for establishing a 500-bird processing facility is estimated at an amount of GH₵ 78,128.50 (US$ 15,625.70). Three cost items constitute about 64% of the total startup cost. These are the cost of land (25.6%), building (25.6%) and standby generator/alternative power source 12.8%. Other key cost items include delivery van (10.2%), storage facility (6.4%) and holding cage (6.4%).
Table 2. Initial investment/start-up cost for operating a 500-bird processing facility

| Items                                      | Amount (GH₵) | Total (GH₵) |
|--------------------------------------------|--------------|-------------|
| Processing Equipment                       |              |             |
| (i) Defeathering (Plucker)                 | 3,000        |             |
| (ii) Cutting knives                         | 100          |             |
| Sub Total (A)                              |              | 3,100       |
| Storage facility                           | 5,000        |             |
| Buildings                                  | 20,000       |             |
| Standby Generator                          | 10,000       |             |
| Delivery van (Cold Van)                    | 8,000        |             |
| Land                                       | 20,000       |             |
| Certification and Business Registration    | 200          |             |
| Sub-Total (B)                              |              | 63,200      |
| Lairage                                    | 1,500        |             |
| Working gears                              | 250          |             |
| Telephone                                  | 300          |             |
| Holding cage (250)                         | 5,000        |             |
| Computer                                   | 1,000        |             |
| Office Space                               | 1,200        |             |
| Installation                               | 300          |             |
| Contingencies (3%) of total investment     | 2,275.50     |             |
| Sub-Total (C)                              |              | 11,825.50   |
| Grand Total (A + B + C)                    |              | 78,128.50   |

US$(footpara)\;\text{amp;#x00A0;}\;=\;\text{GH₵} \;5 \;\text{(Bank \;of \;Ghana, \;2019)}

Table 3 shows the cost items and their respective cost values of operating 500 bird processing facility. The operating cost covers all the items that are needed during the processing of the broilers. It has some cost items being fixed and others being variable. The cost of the raw materials (broilers) is a high-cost item with a unit cost of GH₵ 25.00 (US$ 5.00) and a total of GH₵ 3,300,000 (US$ 660,000) for processing a total of 132,000 birds annually. However, the unit cost of the broiler and all other costs are estimated to increase by 9% every year based on the average rate of inflation. The overall estimated cost of operations is GH₵3,502,004 (US$ 700,400.80).

3.2. Analysis of revenue from processing broilers in cut parts

The revenue estimation for processing broiler chicken stems from the sale of the cut parts, i.e. drumsticks, wings, thighs and breasts together with gizzard, which is a major by-product consumed by the target and potential customers. Other by-products such as the feathers for decorative purposes and the viscera, feet, and head for animal feed for pigs are also minor sources of revenue. The average price of the cut parts was estimated at GH₵ 15.00 (US$ 3.00) with a total number of 19,800 kg of cut parts making an annual sale of GH₵ 2,970,000 (US$ 594,000) for the first year. The gizzard was also estimated at GH₵ 15.00 (US$ 3.00) and a projected quantity of 3,960 kg per year, resulting in a total sale of GH₵ 59,400 (US$ 11,880) for the first year. However, the other by-products were estimated at GH₵ 7.00 (US$ 1.40) and have quantities of 9,768 kg and 92,000 kg for feathers and viscera, respectively. The results are presented in Table 4. The project has a salvage value of GH₵ 67,870.80 (US$ 13,574.18) calculated on the depreciation of the equipment, buildings, storage facility, delivery van, plant, etc. and an appreciation of the land. This is added to the projected revenue for the fifth year.
### 3.3. Income and cost projections

The summary of these projections is presented in Table 5 revealing the flows of the project for the estimated 5 years. The revenue is projected for the lifespan of the project and it is estimated to increase with the basic assumption of a 10% increase in price every year based on historical price changes. The estimated cost and revenue for the first year are GH₵ 3,502,004 and GH₵ 3,732,008, respectively. It is going to be generated after the sale of the actual products (cut parts), gizzard which was found to be consumed by the majority of the respondents, and other by-products such as the feathers, the viscera, and head, feet, blood for animal feed and used litter. Moreover, the cost of the project is also projected and summarized in the table.

### 3.4. Discounted cost-benefit of broiler processing

The inflows and the cash outflows for the proposed venture were discounted, i.e. the projected figures were discounted with a rate of 30% being the prevailing average lending rate of banks during the period.

### Table 3. Estimated cost of operating the 500-bird processing facility (Year 1)

| Item                                      | Unit cost (GH₵) | Quantity | Amount (GH₵) |
|-------------------------------------------|-----------------|----------|--------------|
| Electricity                               | 100             | 11       | 1,100        |
| Supervision from institutions             | 10              | 11       | 110          |
| Water and sewage (L)                      | 0.20            | 132,000  | 26,400       |
| Broiler (raw materials)                   | 25              | 132,000  | 3,300,000    |
| Packaging materials                       | 0.50            | 198,000  | 99,000       |
| Maintenance and other overhead cost       | 3%              | 78,128.50| 2,344        |
| Transportation                            | 0.30            | 132,000  | 39,600       |
| Marketing and advertisement               | 100             | 12       | 1,200        |
| Taxes                                     | 100             | 11       | 1,100        |
| Fuel/oil (L)                              | 4               | 1100     | 4,400        |
| Insurance (per year)                      | 100             | 11       | 1,100        |
| Salaries of employees (per year)          | 400             | 4        | 19,200       |
| Depreciation                              |                 |          | 6,450        |
| **Total**                                 |                 |          | **3,502,004**|

US$(\text{footpara})\text{amp;}\text{#x00A0;}=\text{GH₵ 5 (Bank of Ghana, 2019)}$

### Table 4. Revenue estimates for operating 500-bird processing facility (Year one)

| Item                                      | Unit cost (GH₵) | Quantity (kg) | Amount (GH₵) |
|-------------------------------------------|-----------------|---------------|--------------|
| Sale of cut parts                         | 15              | 19,800        | 2,970,000    |
| Sale of gizzard                           | 15              | 3,960         | 59,400       |
| Sale of by-products (feathers)            | 6               | 9,768         | 58,608       |
| Sale of by-products (viscera, head, feet, blood and used litter) | 7               | 92,000        | 644,000      |
| **TOTAL**                                 |                 |               | **3,732,008**|

US$(\text{footpara})\text{amp;}\text{#x00A0;}=\text{GH₵ 5 (Bank of Ghana, 2019)}$
Table 5. Summary of projected cash inflow and outflows for first five years

| Year | Income (GH₵) | Cost (GH₵) | Net Cashflow (GH₵) |
|------|--------------|------------|-------------------|
| 1    | 3,732,008    | 3,502,004  | 230,004           |
| 2    | 4,067,889    | 3,817,184  | 250,704           |
| 3    | 4,433,999    | 4,160,731  | 273,268           |
| 4    | 4,833,059    | 4,535,197  | 297,862           |
| 5    | 5,335,905    | 4,943,364  | 392,541           |

US$(footpara)amp;#x00A0;GH₵ 5 (Bank of Ghana, 2019)

*The costs and revenue items are subjected to a 9% increase annually for 5 years. Salvage value of 67,870.80 is added to the cash inflow for year 5.

of data collection and analysis. The discounted net cash flows at 30% were GH₵-78,128.50 (US$ -15,625.7), GH₵ 176,926.15 (US$ 35,385.23), GH₵ 148,345.78 (US$ 29,699.16), GH₵ 124,382.23 (US$ 24,876.45), GH₵ 104,289.71 (US$ 20,885.94) and GH₵ 105,722.58 (US$ 24,144.52) for Years 0, 1, 2, 3, 4 and 5, respectively, as shown in Table 6

The estimated Net Present Value (NPV) shows a positive figure of GH₵ 581,537.95 (US$ 116,307.59). Based on the NPV decision rule, which states that all projects with a positive NPV should be accepted, the study concludes that processing domestic broiler chicken with a 500-bird processing capacity per day is financially viable and thus would be accepted. However, since making investment decisions using only the NPV can be misleading, in instances where the money is a problem, there is; therefore, the need to calculate BCR. The study estimated BCR of the project as 1.06 implying that, for every Ghana Cedi invested, there will be a return of GH₵1.06 or US$ 0.21. Relative to finding by Adams et al. (2019) and Wongnaa and Awunyo-Vitor (2013), it can be concluded that the broiler processing venture is financially viable.

From the perspective of the internal rate of return (IRR), the estimated IRR of the project is 303%. This indicates the expected annual rate of return from processing 500 capacity broiler processing firms or the average earning power from the investment (Adams et al., 2019). Since the estimated IRR of 165% is greater than the weighted cost of capital (30%), it can be concluded that the investment is financially viable and worth the investment. This is consistent with the studies of Asante and Kuwornu (2014) and Adams et al. (2019) where estimated IRR of 77% and 23% were found to be higher than their respective cost of capital of 27% and 21%.

The Payback period method is also used to estimate how long it will take for the proposed project to recoup its investment. From the analysis of the payback period, it will take the firm 0.44 years to recoup its investment; meaning that it will take the enterprise 5 months 9 days to recover all monies invested in the business. This indicates that the project has a relatively short payback period compared to the study on mango chip processing by Adams et al. (2019) where the payback period was found to be 1 year 5 months.

3.5. Sensitivity analysis
In analyzing how sensitive the proposed project will be to unforeseen consequences on the final outcome of the project, the following assumptions were used in assessing the financial viability for operating a processing facility that processes 500-bird daily in KMA. The first was to increase the projected operating cost of processing 500-bird daily by 9%, holding all other factors constant. Secondly, projected revenues were also subjected to a 9% reduction.

Table 7 shows the robustness or sensitivity of the proposed investment to a 9% increase in the cost of operations and 9% decrease in projected revenue. The results of the sensitivity analysis show the project to be highly sensitive. The project’s NPV of GH₵ 581,537.95 (US$
Table 6. Discounted cash flows (Amount in GHC) at 30 percent

| Items           | Year 0       | Year 1       | Year 2       | Year 3       | Year 4       | Year 5       | Total        |
|-----------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Cash Inflows    |              |              |              |              |              |              |              |
| Cash Inflows    | 0            | 3,732,008    | 4,067,889    | 4,433,999    | 4,833,059    | 5,335,905    | 22,402,859.01 |
| Cash Outflows   | 78,128.50    | 3,502,004    | 3,817,184    | 4,160,731    | 4,535,197    | 4,943,364    | 21,036,609.00 |
| Net Cash Flows  | (78,128.50)  | 230,004      | 250,704      | 273,268      | 297,862      | 392,541      | 1,366,250.02  |
| Discount Factor | 1            | 0.7692       | 0.5917       | 0.4552       | 0.3501       | 0.2693       |              |
| Discounted Cash Inflows | 0 | 2,870,775.38 | 2,407,034.75 | 2,018,206.06 | 1,692,188.15 | 1,437,114.35 | 10,425,318.70 |
| Discounted Cash Outflows | 78,128.50 | 2,693,849.23 | 2,258,688.97 | 1,893,823.83 | 1,587,898.44 | 1,331,391.77 | 9,843,780.74  |
| Discounted Net Cash Flows | (78,128.50) | 176,926.15 | 148,345.78 | 124,382.23 | 104,289.71 | 105,722.58 | 581,537.95 |
| NPV             | 581,537.95   |              |              |              |              |              |              |
| BCR             | 1.06         |              |              |              |              |              |              |
| IRR             | 303%         |              |              |              |              |              |              |

Payback period = 0.44 years or 5.3 months

US$ (Bank of Ghana, 2019)
Table 7. Sensitivity analysis of processing 500 broilers daily

| Stimulus                      | NPV (GHC)  | BCR | IRR (%) | Payback period                     |
|-------------------------------|------------|-----|---------|-----------------------------------|
| 9% increase operating cost    | ~453,085.84| 0.95| -       | Project will NOT payback within 5 years |
| 9% decrease in revenue        | ~941,717.08| 0.90| -       | Project will NOT payback within 5 years |

116,307.59] reduced to less than zero (GHC ~453,085.84 or US$ ~90,617.168) with a corresponding BCR of 0.95, an IRR indicating that no discount rate can make the present value of cash inflows equal to the present value of cash outflows and a payback period falling outside the estimated life of the project. Thus, the investment should not be undertaken should the operating cost increase by 9%.

Similar to the above stimulus, the investment is also sensitive to a 9% reduction in the projected revenue albeit the rate of change is higher than the increase in cost. The resulting viability indicators are NPV of GHC ~941,717.08 (US$ ~188,343.42), BCR of 0.90, an IRR suggesting that NPV of the project will never be zero and a payback period that lies outside the estimated life of the project. These findings show that the proposed investment should not be undertaken under the circumstance of a 9% reduction in projected revenue.

These results show that although the project is viable, based on the originally projected financial circumstances, the project is highly sensitive to revenue and cost variations.

4. Conclusion and recommendations

The desire for convenient meat such as cut parts presents a good investment opportunity. However, a decision to invest one’s limited resources should be informed by sound and detailed analysis. This study assessed the viability of establishing a 500-bird processing facility to process poultry into cut parts such as thighs, wings, breasts, and drumsticks by estimating the net present value (NPV), benefit–cost ratio (BCR), internal rate of return (IRR) and the payback period.

Using a discount rate of 30%, NPV, BCR, and IRR were estimated to be GHC 581,537.95 (US$ 116,307.59), 1.06, 303%, respectively. These figures show that investment in a broiler processing facility with a capacity of 500 birds a day is financially viable. Furthermore, the estimated payback period of 0.44 years (or 5 months 9 days) shows that the initial investment of GHC-78,128.50 (US$ −15,625.7) is recouped in less than a year, reinforcing the project’s viability. However, sensitivity analysis shows that the investment ceases to be viable if either the project cash outflow is increased by 9% or cash inflows are reduced by 9%.

Based on the findings and conclusions of the study, the following recommendations are made. First, measures should be put in place to reduce inefficiencies in resource allocation and utilization by processing firms to avoid increases in operating costs. Specifically, this may include full utilization of the installed operating capacity to ensure that the projected revenue is realized since the project is very sensitive to the decline in cash inflow. The introduction of subsidy on major feed ingredients by the government will also go a long way to reduce the production cost of both producers and processors. Finally, the present study assumed that the main raw materials (broilers) are sourced from other chain actors. Further studies should estimate and compare the viability of processing firms integrating backward to produce their own raw materials.
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Notes
1. Total capital requirements-seed capital, start-up capital, working capital, contingency capital, equity and credit needs, budget expenses and revenues-estimate expected costs and revenues, the profit margin and net profit expected, etc.
2. Kumasi is the second-largest city in Ghana and the administrative capital of the Ashanti Region. It has a land area of about 214 square kilometers accounting for about 0.9 percent of the region's land area. The population of the Metropolis stands at 730,249 with an annual growth rate of 5.47 percent (Service, 2012). Poultry production is among the key economic activities in the area.
3. The depreciation is the wear and tear of the asset base of the proposed enterprise which affects the value of the asset over time. The depreciation schedule is prepared in connection with the estimated lifespan of the proposed enterprise.

References
Adams, F., Amanawkah, K., Wongnaa, A. C., Honny, E. P., Peters, D. K., Asamoah, B. J., Coffie, B. B., & Yildiz, F. (2019). Financial analysis of small-scale chips processing in Ghana. Cogent Food & Agriculture, 5(1), 1–16. https://doi.org/10.1080/23311932.2019.1679701
Adei, D., & Asante, B. (2012). The challenges and prospects of the poultry industry in Dormaa district. Journal of Science and Technology (Ghana), 32(1), 104–116. https://doi.org/10.4314/just.v32i1.11
Amanor-Bodu, V., Nti, F. K., & Kora, R. (2016). Structure of Ghana’s Industry in 2015. Department of Agricultural Economics, Kansos State University.
Andom, K. S., & Silver, J. (2016). Food processing in Ghana: Trends, constraints, and opportunities. GSSP policy note 11. International Food Policy Research Institute (IFPRI). Accessed 14 October, 2019. [Available at: http://library.ifpri.org/cdm/ref/collection/p15738coll2/id/]
Anna, R. B. (2010). Financial feasibility assessments - Building and using assessment models for financial feasibility analysis of investment projects, Master's thesis, Faculty of Industrial Engineering, Mechanical Engineering and Computer Science, University of Iceland, pp. 70.
Asante, M. K., & Kuwornu, J. K. M. (2016). A comparative analysis of the profitability of pineapple-mango blend and pineapple juice processing in Ghana, APSTRACT. Applied Studies in Agribusiness and Commerce, 8(2–3), 33–42. https://doi.org/10.19041/APSTRACT/2016/2-3/4
Asante-Addo, C., & Weible, D. (2019). Is there hope for domestically produced poultry meat? A choice experiment of consumers in Ghana. Agribusiness: An International Journal, 36(2), 281–298. https://doi.org/10.1002/agr.21626
Asuming-Brempong, S., Osei-Asare, Y. B., & Anim-Samouah, H. (2008). Food and Agriculture Organization (FAO) import surge study: A case study of rice, poultry meat and tomato paste imports to Ghana. FAO.
Bank of Ghana (2019): Daily interbank FX rates. Accra-Ghana. [Available at: https://www.bog.gov.gh/ treasury-and-the-markets/daily-interbank-fx-rates/]. [Accessed 18 December, 2019].
Bruyn, J., Wong, J., Bognal, B., Pengelly, B., & Alders, R. (2013). Family poultry production and food and nutrition security. CAB Reviews, 10(13), 1–9. https://doi.org/10.1079/PAVSNR201510013
Campbell, H. F., & Brown, R. P. C. (2003). Benefit-Cost analysis: Financial and economic appraisal using spreadsheets. University of Cambridge Press.
Dziwornu, K. R. (2014). Econometric analysis of factors affecting competitive advantage of broiler agribusinesses in Ghana. Journal of Development and Agricultural Economics, 6(2), 87–93. https://doi.org/10.5897/JDAE2013.0527
Dziwornu, R. K., & Sarpong, D. B. (2014). Application of the stochastic profit frontier model to estimate economic efficiency in small-Scale broiler production in the greater Accra region of Ghana. Review of Agricultural and Applied Economics, 17(2), 10–16. https://doi.org/10.15414/raae.2014.17.02.10-16
Etuah, S. (2014). Cost efficiency and economies of scale in broiler production in Ghana. A case study of the Ashanti region. Unpublished masters' thesis. Department of Agricultural economics, agribusiness and extension, Kwame Nkrumah University of Science and Technology.
Etuah, S., Ohene-Yankwera, K., Liu, Z., Osei Mensah, J., and Lan, J. (2020). Determinants of cost inefficiency in poultry production: evidence from small-scale broiler farms in the Ashanti Region of Ghana, Tropical Animal Health and Production, 52, 1149 – 1159
Finnerty, J. D. (1998). Project financing: Asset-based financial engineering (1st ed.). John Wiley & Sons.
Food and Agriculture Organization (FAO). (2015). Poultry sector Ghana. FAO animal production and health livestock country reviews (Vol. 6).
Food and Agriculture Organization (FAO). (2014). Poultry sector Ghana. FAO animal production and health livestock country reviews (Vol. 6).
Ghana Poultry Project (GPP). (2016): Baseline report submitted to ACDI/VCO.
Gittinger, J. P. (1984). Economic analysis of agricultural projects. Economic development institute. The World Bank.
Helfert, E. A. (2001). Financial analysis tools and techniques: A guide for managers (1st ed.). McGraw-Hill.
Hofstrand, D., & Holz-Clause, M. (2008). What is a feasibility study? [Available at: http://www.extension.iastate.edu/ogdm/wholefarm/pdf/c5-65.pdf] [Accessed 9 January, 2019]
Matzon, J., (2000): Cooperative feasibility study guide. [online] USA: United States department of agriculture. Rural Business – Cooperative Service. Report 58. [Available at: http://www.rurdev.usda.gov/rbs/pub/sr58.pdf] [Accessed 12 January, 2019]
Ministry of Food and Agriculture (MoFA). (2016). Agriculture in Ghana. Facts and figures (2016) (25th
ed.). Statistics Research and Information Department (SRID).
Park, C. S. (2002). Contemporary engineering economics (3rd ed.). Prentice Hall, Inc.
Service, G. S. (2012): 2010 population and housing census: National analytical report. https://Statsghana.gov.gh/gssmain/fileUpload/pressrelease2010_PHC_National_Analytical_Report.pdf
Staatz, J., & Hollinger, F. (2016): West African food systems and changing consumer demands, West African Papers, No. 04, OECD Publishing. [Available at: http://dx.doi.org/10.1787/b165522b-en] [Accessed 29 May, 2019]
Tokyi-Mensah, R. (2012): Constraints to production, distribution and consumption of locally processed poultry meat in the greater Accra region of Ghana. Unpublished Masters’ thesis. Department of agricultural economics and extension, University of Cape Coast.
Thompson, A. (2002). Understanding the proof of business concept. Murdoch.
Tuffour, M., & Atta Opong, B. (2013). Profit efficiency in broiler production: Evidence from greater Accra region of Ghana. International Journal of Food and Agricultural Economics, 2, 23–32.
Wongnao, A. C., & Awunyo-Vitor, D. (2013). Profitability analysis of cashew production in Wenchi municipality in Ghana. Botswana Journal of Agriculture and Applied Science, 9(1), 19–23.
Woolerton, E. A., & Frimpong, S. (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.