Competitiveness of broiler production in Nigeria: A policy analysis matrix approach

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ABSTRACT

The Nigeria broiler sector faces a stiff competition from imported frozen chicken over time. However, policies were put in place to improve its competitiveness. In this study, we examined the competitiveness of the Nigeria broiler production using a policy Analysis matrix (PAM). We used both primary (cross-sectional) survey and secondary data source for this study. We found that all of the production systems except the backyard/village system were socially profitable with the large-scale system having a social profit of N7,313,753, the medium scale a profit of N2,709,253.4, small scale a profit of N264,576.8 and the backyard/village with a loss of N81,043.5. These results also showed that the large scale is the most competitive, followed by the medium scale, then the small scale and lastly the backyard/village production scale. The estimated values for NPCO across the systems were greater than 1 and the NPCI was less than 1 for all the production systems. The results of sensitivity analyses showed that an increase in FOB and exchange rate increases the competitiveness of the systems while a decrease in FOB decreases competitiveness.

1. Introduction

Poultry is the most commercialized of the Nigerian livestock production. With an estimated net worth of about N180 billion ($600 million) and approximately 165 million birds, 25% of agriculture contribution to Nigeria’s GDP can be attributed to poultry production (FAO, 2010; Sahel, 2015). Recent estimates show that Nigeria is the largest producer of egg in the continent and fourth largest producer of chicken, producing 650,000 MT of eggs and 290,000 MT of poultry meat per annum (USDA, 2013). Poultry business (especially broiler chicken) has become widely known in Nigeria today owing to the numerous advantages it has over other livestock enterprises. Birds are good at converting grain into protein in the form of meat (Ojo, 2003). The startup capital required for production is low and it has an encouraging turnout rate. According to Ologbon and Ambali (2012), with around 1.3 kg of chicken consumed per head per year, poultry accounts for about 15% of total annual protein intake. The importance of the poultry industry can therefore not be overemphasized in the Nigerian economy.

However, the activities of smugglers have greatly affected the performance of this industry, which exposes it to an ‘unfair’ competition from imported frozen meat, including chicken and turkey (Ahmad, 2018). According to Hassan (2017), Nigeria loses about N700 billion in revenue and 1 million job opportunities annually to smuggling of poultry products, bulk of which are frozen chicken. Okojie (2017) explained that despite government effort at curtailing smuggling, smugglers continued to bring product into the country because of the gap between demand and supply and the relatively cheaper price the smuggled product gets into the country. One major factor that has been identified as responsible for the increased attraction of foreign product to local market is price differential. Sahel (2015) noted that a live chicken costs between $2.5 (N1000) and $3.5 (N1,400) in the foreign market while in the local market it costs between $5 (N2000) and $ 6.5 (N2,600). This price differential has largely been blamed on high cost of production locally caused by high cost of feed. According to Atteh (2004) 75% of cost of production of broiler meat is associated with cost of feed and commercial poultry is well established in the country with substantial infrastructure (poultry houses, feed mills, hatcheries and processing plants) already on ground but most of these assets are idle for reasons associated with high cost of strategic inputs and working capital as well as competition from cheap imports.

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Several efforts have been made at lowering the cost of production, especially cost of feed. According to USDA (2013) the Nigerian Government in 2008 lifted ban on the importation of maize so as to make it available to producers at cheap prices. Meanwhile, studies (Amos, 2006; Ike and Ugwuamba, 2011; Hassan et al., 2011; Ukwuaba and Inoni, 2012) have shown that broiler production has remained profitable in Nigeria, despite high cost of production, because the high cost of production is being met with even higher prices. Inability of producers to achieve cost efficiency in production is suffered by both producers and consumers who are at the receiving end of these high prices. High price of this commodity has made it difficult for locally produced broiler chicken to compete favourably with smuggled product and also made it seem as if Nigeria is at a comparative disadvantage with other producing nations.

Despite heavy commercialization, the Nigerian poultry sector, especially chicken production, has witnessed a stiff ‘competition’ from imported chicken (FAO, 2010; Sahel, 2015). Producers have found it difficult to produce at a price that can match the world price thereby putting a pressure on this sector. For this reason, there was call for the government to intervene and protect local producers from foreign competitors. In 2003, the Nigerian government placed a total ban on importation of all poultry products into the country to encourage domestic production (USDA, 2013). The sector has continued to grow since then; recording large profits but unfortunately price of chicken has remained higher than international prices which have been justified for continuous government protection (Sahel, 2015).

Several studies (Amos, 2006; Ike and Ugwuamba, 2011; Hassan et al., 2011; Ukwuaba and Inoni, 2012) have indicated that chicken production in Nigeria, especially broiler chicken was having high turnover rate though inefficient. Sustained and increasing proofs of profitability have called to question the claim of non-competitiveness in this sector. Yesufu and Ayanwale (2011) in their study of the structure, conduct and profitability of the broiler processing enterprises in Southwestern Nigeria observed that there was a high degree of concentration in the industry implying a monopolist market structure. Competitiveness is not determined only based on market price but on several other indicators which include profitability and comparative advantage (Baker, 2005). Most studies conducted on this subject have focused mainly on profitability (private profitability) and efficiency and none yet on the comparative advantage, social profitability or any other measure of competitiveness as it relates to this sector, a development which has left a gap in knowledge. Therefore, this current study in competitiveness is important in order to determine the level of comparative advantage and government intervention enjoyed by the sector. It is also necessary to examine the current level of profitability so as to determine how much prices can be adjusted to attain competitiveness while maintaining profitability. Hence, this study analyzed the profitability of broiler chicken production in the area; examined the effect of government policy on broiler production industry; and determined the comparative advantage of broiler chicken production.

This study will supply information on the level of competitiveness of broiler chicken producers and help determine whether the protection the industry enjoys from the government is justified. It will also help the government, in case of non-competitiveness, to determine what policy action to take for the industry to achieve competitiveness. At competitive price, locally produced chicken can become more affordable for the people and smuggling of the product into the country will be easily discouraged, while creating an avenue for more firms to enter the industry or for existing ones to increase production. An increased productivity implies that more factors of production, especially labour, can be brought under use creating more employment for the teeming unemployed population.

2. Methodology

2.1. Area of study

Oyo State, Nigeria was the area of study. Oyo State is the 5th largest state in Nigeria by population. It has a total population of about 6 million people with bulk of these people living in the State Capital, Ibadan. Ibadan is the 3rd largest city in Nigeria with a population of over 3 million people. It runs an agrarian economy with a vast majority of the populace taking to farming. There are varieties of agricultural produce in the state. Food crops grown in the area include yam, cassava, cocoyam, maize, rice, cowpea, groundnut etc. Also livestock such as rabbit, poultry, cattle, sheep, goat and pig are reared in the state. The climate is tropical in nature and it is characterized by wet and dry seasons. The temperature ranges between 210C and 340C while the annual rainfall ranges between 1500 mm and 3000 mm. The southwest monsoon wind from the Atlantic Ocean is associated with the wet season, while the northeast trade wind from the Sahara Desert is associated with the dry season. This climatic condition has been found very suitable for poultry production, hence the large concentration of poultry producers in this area.

2.2. Sampling procedure and sample size

A multi-stage sampling procedure was employed for the study area. The first stage involved a purposive selection of two Agricultural Development Zones, Ogbomoso zone and Ibadan/Ibarapa zone, from the four Agricultural Development Zones in Oyo because of the observed large concentration of broiler producers in these zones. The second stage also involved a purposive selection of three local Government Areas (Egbeda, Lagelu and Akinyele LGs) in Ibadan/Ibarapa zones and another three LGAs (Surulere, Ogbomoso North and Ogo Oluwa) from Ogbomosho zones based on the concentration of broiler farmers in these areas. At the third stage, there was a random selection of 60 broiler farmers from each Local Government in view of the relative similarity of the population of broiler producers in the Local Government Areas as reported in the list obtained from the Poultry Association of Nigeria, Oyo state branch, making a total of 360 farms surveyed for the study.

2.3. Data collection

For this investigation, both primary and secondary data were employed. Secondary data was gathered from bulletins and catalogues of institutions such as the Central Bank of Nigeria (CBN), the National Bureau of Statistics (NBS), the United Nations Food and Agriculture Organization (FAO), the Nigerian Poultry Association, and other relevant sources. The primary data was collected by a cross-sectional survey, which included the distribution of a well-structured questionnaire to broiler farmers and processors. The questionnaire was developed based on the components of the variables needed in data analysis. The data collected were coded into excel which are then processed and subjected to data analysis. A combination of analytical software including STATA 14 and SPASS were used for analyzing the data collected.

Furthermore, selected respondents in the study sites were asked for consent to voluntarily participate in the study before the interviews began. Interviews proceeded only when consent was obtained from the respondents. Data were collected by trained enumerators using personal interviews. The questionnaires were used to elicit information such as socioeconomic characteristics, price, output, costs and quantities of inputs including
poultry size, transportation, feeds, drugs and vaccines, water pump, feed trough, water trough, cage, labour costs, marketing costs, processing costs, transport costs etc. Data on exchange rate, tariffs, tax, port charges, loading/unloading costs, level of subsidy, Free on Board (FOB) and Cost, Insurance and Freight (CIF) were obtained through secondary sources.

The study received a formal approval from the postgraduate committee of the department of Agricultural Economics, Obafemi Awolowo University, Ile-Ife. Gate keeper permission was also obtained from the community leaders of the selected communities in the Local Government Areas in Oyo State. The ethical principles of respect for person, anonymity and confidentiality, beneficence and principle of justice were all observed in the course of the study. For instance, data collection was only done after informed consent had been obtained from the respondents. All respondents, irrespective of their ethnicity and creed, were treated fairly and equally throughout the conduct of the study.

3. Analytical techniques

3.1. Policy analysis matrix framework

The policy analysis matrix (PAM) is a computational framework developed by Monke and Pearson (1989) and further developed by Masters and Winter-Nelson (1995) as a result of pricing distortion developments. PAM’s method is based on budget calculation utilizing market pricing and social opportunity costs, and it is used to assess production efficiency, comparative advantage, and the degree of government involvement (policy impact) on commodity production. It is the result of the merger of two accounting identities (Table 1). Profitability is defined in the first identification as the gap between revenues and costs, assessed in private or societal terms. The second identity calculates the difference between observed private values and social values that would prevail if divergence were removed (distorting policies and/or market failures). Private profits are calculated at market prices, while social profits are calculated at social or efficiency prices. When market distortions are absent, the two are fairly interchangeable. If there are market flaws or distortions, however, the two deviate from each other. Their discrepancy serves as a call to action for policymakers.

Private Profits \( D = A - B - C \); 
Social Profits \( H = E - F - G \); 
Output Transfers \( I = A - E \); 
Input Transfers \( J = B - F \); 
Factor Transfers \( K = C - G \); 
Net Transfers \( 1 = D - H \) or \( 1 = I - J - K \)

The data in the PAM framework’s first row give a measure of private profitability, which is defined as the difference between observed income and cost. This encapsulates the agricultural system’s competitiveness in light of current technologicallogies, input prices, output values, and policy transfer. The social profit, which is calculated at shadow pricing, is measured in the second row of the PAM.

The social profit is a measure of efficiency and comparative advantage that takes into account social opportunity costs. A positive social profit suggests that the system is efficient in its use of scarce resources and contributes to national wealth. (Nelson and Panggabean, 1991; Keyser, 2006). A negative social profit demonstrates social inefficiencies and reveals that output at social costs exceeds import costs, implying that the sector cannot thrive without government intervention. The final row of the matrix indicates transfers that occur as a result of market distortions caused by policy. This shows the differences between the first row (measured at private pricing) and the second row (measured at public prices) (measured at social prices). Policy interventions can explain the difference between private and societal expenses, revenues, and profits (Wiendiyati and Raya, 2002; Esmaeili, 2008). The PAM framework can be used to calculate a number of important indicators, such as the nominal protection coefficient (NPC), effective protection coefficient (EPC), domestic cost ratio (DCR), subsidy ratio to producer (SRP), private cost ratio (PCR), and profitability coefficient (PC), which are useful in determining the level of competitiveness between crops or production systems. (See Monke and Pearson, 1989; Masters and Winter-Nelson, 1995 for details on how these indicators are estimated.)

3.1.1. Policy analysis matrix (PAM)

The objectives were captured using the PAM. For the study, the Policy Analysis Matrix was created utilizing farm budget values (sales revenue and input costs) collected from poultry farmers. The research included data on output production, processing, input utilization, market, and farm gate prices. The price data from the field survey was transformed into private prices. Further estimates in the PAM were based on the World reference price and subsidized prices collected from internet sources such as Alibaba’s official website, and were calculated using export parity prices. These were utilized as a starting point for calculating social prices for output and input. The reference price for chicken was set at the FOB Gulf price in the United States. For the product evaluated in the study, the farm-gate was utilized as the location for comparing market and efficiency pricing. The farm-gate was assumed to be located in Ibadan for the sake of this study, and world prices were modified to account for transit costs in order to be comparable to farm-gate pricing.

Secondary data on international input prices and currency rates was collected.

Social prices at the farm gate were calculated by adding transportation costs, port charges, and tariffs to the respective CIF price (calculated by adding ocean freight charges to FOB price) in domestic currency for imported items such as foreign feeds and supplements. The opportunity cost of land is its social pricing. The rental value of land was used as the opportunity cost of land in this study. The analysis also included the use of a

| Table 1. Policy analysis matrix framework. |
|------------------------------------------|
| **Cost** | **Revenue** | **Traded** | **Domestic factor** | **Profit** |
| Private price | A | B | C | D |
| Social price | E | F | G | H |
| Divergence | I | J | K | L |

Developed by Monke and Pearson (1989).
shadow exchange rate (SER), which reflects the foreign currency’s opportunity cost. In the calculation of the import parity price for tradable, the official exchange rate in Nigeria throughout the study period was used as the shadow exchange rate (s). The study employed the approach provided by Yao and Tinprapha to estimate the shadow price for Nigeria (1995). The help of the following formula was suggested for establishing the shadow exchange rate:

\[
SER = \frac{OER}{SCF}
\]

(1)

With

\[
SCF = \frac{M + X}{M(1 + T_M) + X(1 - T_X)}
\]

(2)

Where: 

SER = Shadow Exchange Rate

OER = Official Exchange Rate

SCF = Social Conversion Factor

M = CIF value of imports

X = CIF value of exports

T_M = Import tax rate average

T_X = Export tax rate average

The domestic economy of the country determined the social pricing of domestic components such as capital, labour, and water. The assessment of labour’s shadow wage, the social interest rate for capital, and the opportunity cost of water and land were all considered in the computation of shadow pricing for domestic items. In the case of hired labour and family labour, the current wage rate was utilized to estimate private costs for labour (Gittinger, 1982).

Following Yao and Tinprapha (1995), social values of inputs and outputs were obtained by multiplying the quantities with their respective parity prices. The import and export parity prices are CIF and FOB prices, respectively, at the border. These prices reflect how much a commodity can make as an export or how much it can cost as an import. As a result, they were designated as the social border price.

### 3.1.2. Steps in constructing a policy analysis matrix

i. Collect the mean data per km² of space on birds and of all inputs used (in kilogramme) and labour (in mandays).

ii. Calculate the mean cost in Naira value of all domestic item used, interest and land rent.

iii. Determine the private (market) prices and estimation of social prices for product and inputs.

iv. Tabulate the private and social prices of the product and inputs estimated.

v. Prepare the farm budget from the data obtained.

vi. Extract data from the farm budget to form PAM of total broiler production in the study area.

### 3.1.3. Classifying inputs and outputs

Before determining the private and social prices, the first step was to classify all inputs and outputs into tradables and non-tradables (primary factors). This classification is indispensable, because shadow prices are often determined differently for primary versus tradable.

Primary factors or domestic factors or non-tradables are goods that are not normally traded internationally but supplied locally and these always include land, labour, water and capital. Tradable goods are defined as being traded internationally or potentially could be traded (e.g. feeders, automatic-nipples, cups, cages, feeds, drugs and vaccines).

### 3.1.4. Determination of private price (observed market price)

Broiler output, feeds and other tradable inputs had their private prices determined following the steps indicated in Table 2.

Private prices for locally made tools used for production was also determined by calculating their cost of repairs and depreciation where necessary using a straight line method thus:

\[
D_{ac} = \frac{C - S}{Y}
\]

(3)

Where \(D_{ac}\) = depreciation per year by straight line method.

\(C\) = purchase cost.

\(Y\) = expressed years of usage.

\(S\) = scrap value

Private price of agricultural credits (interest) was determined by computing the average annual interest as thus:

\[
I_t = r[1F - (\sum P_t)]
\]

(4)

Where \(I_t\) = interest payment in period \(t\)

\(P_t\) = principal payment in period \(t\)

\(r\) = rate of interest

\(1F\) = size of the loan
3.1.5. Preparation of farm budgets

Farm budget meant for PAM consists of 3 columns. The first column bears category (accounts). It shows relevant items under revenue, cost and profit accounts. The second bears quantity of the items as contained in the first column while the third main column is divided into two blocks. The first block bears financial representation of the accounts/private values while the second bears the economic representation of the accounts/social values.

Private revenue realised from output and by-product, value of tradable component of inputs, value of non-tradable component of inputs and private profits, which are respectively represented by symbols A, B, C and D in Table 1 was computed from the budget. The social revenues realised from output and by-product, social value of traded component of inputs, social value of non-tradable component of input, social profit, which are represented by symbols E, F, G and H was also computed from the budget. The computation was effected using the following equations:

\[ A = \sum QP \]  
(5)

Where:

\[ A = \text{private revenue realised from output and by-product.} \]
\[ Q = \text{quantity in standard unit} \]
\[ P = \text{price per unit} \]

\[ B = \sum TR(c) \]  
(6)

Where:

\[ B = \text{value of tradable inputs.} \]
\[ TR = \text{percentage of the traded component in decimal term} \]
\[ c = \text{private total cost of inputs.} \]

\[ C = \sum NTR(c) \]  
(7)

Where:

\[ C = \text{value of non-tradable inputs} \]
\[ NTR = \text{percentage of the non-tradable component in decimal term} \]
\[ c = \text{private total cost of inputs.} \]

\[ D = TR - TC \]  
(8)

Where:

\[ D = \text{private profit} \]
\[ TR = \text{total revenue (private)} \]
\[ TC = \text{private total cost} \]

\[ E = \sum QP_s \]  
(9)

Where:

\[ E = \text{social revenue realised from output and by-product} \]
\[ Q = \text{quantity in standard unit} \]
\[ P_s = \text{social price per unit} \]
\[ F = \sum TR_s(C_s) \quad (10) \]

Where:
\[ F = \text{social value of tradable input} \]
\[ TR_s = \text{percentage of the social value of the tradable component expressed in decimal unit}. \]
\[ C_s = \text{social total cost of input per hectare}. \]

\[ G = \sum NTR_n(c) \quad (11) \]

Where:
\[ G = \text{social value of non-tradable inputs} \]
\[ NTR_n = \text{percentage of the social value of non-tradable component expressed in decimal term}. \]
\[ C = \text{social total cost of input per hectare}. \]

\[ H = TR_s - TC_s \quad (12) \]

Where:
\[ H = \text{social profit} \]
\[ TR_s = \text{social value of total revenue} \]
\[ TC_s = \text{social value of the total cost} \]

### 3.1.6. Measure of private profitability

Private profits, Private Benefit-Cost Ratio (PBCR), and Private Cost-benefit Ratio are all examples of private profitability measures in PAM (PCR). These techniques were used to analyze the profitability of broiler production in the area using market prices.

**i. Private profits D**

As seen in Equation (13) below, this is the difference between private revenue (A) and private expense (B + C).

\[ \text{Private Profits } D = A - (B + C) \quad (13) \]

\[ D > 0 = \text{competitiveness}, \quad D = 0 = \text{break even}, \quad D < 0 = \text{non-competitiveness} \]

**ii. Private benefit-cost ratio (PBCR):**

The ratio of private income to private costs is known as the private revenue-to-cost ratio. Equation (14) below is used to express it.

\[ \text{Private Benefit-Cost Ratio (PBCR)} = \frac{A}{(B + C)} \quad (14) \]

\[ \text{PBCR} > 1 = \text{competitiveness}, \quad \text{PBCR} = 1 = \text{break even}, \quad \text{PBCR} < 1 = \text{non-competitiveness} \]

**iii. Private cost-benefit ratio (PCR):**

This is the proportion of domestic factor costs (C) to the value added to private pricing (V) (A - B). Equation (15) below shows how it is defined.

\[ \text{Private Cost-benefit Ratio (PCR)} = \frac{C}{(A - B)} \quad (15) \]

\[ \text{PCR} > 1 = \text{non-competitiveness}, \quad \text{PCR} = 1 = \text{break even and PCR} < 1 = \text{competitiveness}. \]

### 3.1.7. Examination of government policy

The Nominal Protection Coefficient (NPC), Effective Protection Coefficient (EPC), Profitability Coefficient (PC), Net Transfer, and Subsidy Ratio to Producers are all used to evaluate government interventions (SRP).

**i. Nominal protection coefficient (NPC):**

The NPC on tradable outputs, and it has an input and output strategy (NPCO) Equations (16) and (17) define the NPCO and NPCI, respectively.

\[ NPCO = \frac{\text{Output}_\text{marketprice}}{\text{Output}_\text{socialprice}} \quad \text{i.e.} \quad \frac{A}{F} \quad (16) \]

\[ NPCI = \frac{B}{F} \quad (17) \]

NPCO < 1 denotes the presence of a tax (tariff) on output, NPCO > 1 denotes the presence of a subsidy, and NPCO = 1 denotes the absence of intervention (in the absence of market failures), but NPCI 1 denotes subsidy and NPCI > 1 denotes tax.
ii. Effective protection coefficient (EPC):

As shown in Equation (18) below, this is defined as the ratio of value added in private prices to value added in social prices.

\[
EPC = \frac{(Output - Tradable inputs)_{prices}}{(Output - Tradable inputs)_{socialprices}} \text{ i.e. } \frac{(A - B)}{(E - F)}
\]

(EPC < 1 indicates negative effect of policy (tax), EPC > 1 indicates subsidy)

iii. Profitability coefficient (PC):

This is the relationship between private profit (D) and societal profit (S) (H). Equation (19) below shows how it is defined.

\[
PC = \frac{D}{H}
\]

(PC < 1 denotes distorting policy or market failure influencing the system, PC>1 denotes subsidy to the system.

iv. Net transfer (1):

This is calculated as private profit D less social profit H.

\[
\text{Net Transfer (1)} = \frac{D}{H} \text{ or } 1 - (J + K)
\]

1 < 0 shows distorting policy or market failure, 1 > 0 indicates subsidy and 1 = 0 in the absence of market failure signifies no intervention.

v. Subsidy ratio to producer (SRP):

This is the proportion of net policy transfers to societal revenues (1). (E). Equation (21) below shows how to express it.

\[
\text{SRP} = \frac{L}{E}
\]

(SRP > 0 means subsidy and SRP < 0 implies tax.

3.1.8. Measure of comparative advantage

Social Profits (H), Domestic Resource Cost (DRC), Social Cost-Benefit Ratio (SCBR), and Social Benefit-Cost Ratio are indicators of comparative advantage in PAM (SBCR).

i. Social profits (H):

This is the difference between social prices for revenue and social prices for costs.

In Equation (22) below, it is defined.

\[
\text{Social Profits (H)} = E - (F + G)
\]

Positive social profits (H) indicate positive social valuation and thus comparative advantage or efficiency.

ii. Domestic resource cost (DRC):

As shown in Equation (23) below, this is the ratio of domestic resource (G) in social prices to value added (E-F) in social prices.

\[
DRC = \frac{DomesticFactor_{socialprices}}{(Output - Tradableinputs)_{socialprices}} \text{ i.e. } \frac{G}{(E - F)}
\]

(DRC < 1 denotes that generating an additional unit of foreign exchange costs less in domestic resources. As a result, producing such a commodity is less expensive for the country than importing it. This is a sign that a country has a competitive advantage in the production of a particular commodity.

iii. Social benefit-cost ratio (SBCR):

This metric determines how much each unit of investment generates. It’s the ratio of social revenues to social costs, and it’s useful for comparing different systems. Equation (24) below is used to express it.

\[
SBCR = \frac{(Revenue)_{socialprices}}{(Tradables + Domesticfactor)} \text{ i.e. } \frac{E}{(F + G)}
\]

(SBCR>1 denotes an activity is profitable, SBCR = 1 denotes break even and SBCR < 1 shows that an activity isn’t profitable.

3.1.9. Sensitivity analysis

The policy analysis matrix approach has been chastised for its static character, and some argue that the results are unrealistic in a dynamic environment (Nelson and Panggabean, 1991). Because technical coefficients used in constructing enterprise budgets (e.g. output and use of inputs) are often mean values calculated from a range of observed values, and because prices used in calculating social profitability (e.g. shadow and foreign exchange rate) are often estimated prices or project prices makes sensitivity analysis important. To address this issue, the researchers conducted a sensitivity analysis under a variety of assumptions, including tradable input, output, and prices.
4. Review of concepts

4.1. The net social profitability (NSP)

The net social profitability indicates the contribution of each production alternative to the national income, measured in terms of social net returns to land. The NSP of each production is calculated after establishing social prices for goods and services. The NSP represents the most profitable production alternatives in terms of contributing to national income (Issaka, 2002). The enterprise with the largest positive NSP represents the most profitable production alternative in terms of contribution to national income. The NSP indicates relative efficiency in production and provides an empirical measure of profitability. One of the shortcomings of the NSP measure is that it provides no explicit information about the use of tradable (and hence foreign exchange) in production. In addition, the Net Social Profitability is less useful when comparing agricultural technologies, because it is denominated in specific units with a physical numeraire, such as dollars per hectare or per ton of product. This makes it difficult to compare NSP values across different activities (Masters and Winter-Nelson, 1995). Therefore, in addition to NSP it is often helpful to calculate the resource cost ratio for each enterprise.

4.2. The resource cost ratio or social cost benefit

The resource cost ratio (RCR) or social cost benefit (SCB) evaluates the rate of transformation between local resources and value added at world price equivalents. RCR depicts the efficacy of each production alternative in terms of earning (or saving) one unit of foreign exchange using domestic resources. The DRC and RCB are alternative normalizations of the same profit identity. They use the same data and provide the same criterion to determine whether or not an activity is profitable. But they do not necessarily provide the same ranking of any two or more options (Masters and Winter-Nelson, 1995).

\[
\text{RCR} = \frac{\sum W_p F_p}{(P_c T_c - \sum P_i T_i)}
\]

Where

- \(\text{RCR}_c\) = Resource cost for crop \(c\)
- \(W_p\) = Social prices (opportunity costs) of primary factors
- \(F_p\) = primary factors of production (usually per ha)
- \(P_c\) = Social prices (world price equivalents) of crop \(c\)
- \(T_c\) = Quantity produced of crop \(c\) (usually per ha)
- \(P_i\) = Social prices (world price equivalents) of tradable inputs
- \(T_i\) = Quantity used of tradable production inputs (usually per ha)

Comparative advantage in production exists when RCR is less than unity, which means that the cost of producing one dollar’s worth of a product is less than the cost of importing the same product. Both NSP and RCR capture the ability of production alternatives to contribute to national income.

4.3. The nominal protection coefficient (NPC)

The NPC is defined as the ratio of domestic producer price to border price (adjusted for transportation), i.e. the ratio of domestic prices to world prices (Issaka, 2002). A value of NPC greater than one (NPC > 1) indicates a protection on output price.

4.4. The effective protection coefficient (EPC)

It is a ratio of value added at domestic prices to value added at border prices. It is a summary of incentive and disincentive created by government price policy interventions in input and output market. An EPC less than one (EPC < 1) indicate that policy is a potential disincentive to production. An EPC > 1 implies protection on output and tradable inputs (Issaka, 2002).

4.5. Producer subsidy equivalent (PSE)

The producer subsidy equivalent (PSE) is a metric that measures the overall effect of taxes and subsidies on producer prices, input prices, and resource costs. Producers are taxed when (PSE < 0). The consumer subsidy equivalent (CSE) is a measure of how government policies affect the distribution of income between consumers and producers. (Issaka, 2002).

4.6. Direct transfer payment

Direct transfer payments are payments that indicate the transfer of claims to real resources from one person in society to another, rather than the use of real resources. Taxes, direct subsidies, and credit transactions such as loan, receptions and repayments of principal, and interest payments are the most typical transfer payments in agricultural projects. (Gittinger, 1982).

**Tradable goods**: These are goods that are normally traded internationally or potentially could be traded e.g. mineral fertilizers, animal feeds, drugs, vaccines, pesticides and seeds (Issaka, 2002).

**Non-tradable goods**: These are goods that are not available for trade in the international markets and are sourced for domestically in the process of production and these always include land, labour, water and capital (Issaka, 2002).
Table 3. Policy Analysis Matrix for Broiler production systems in Nigeria.

| Production systems          | Number of respondents | Average farm size (Birds) | Cost items          | Production cost (N) |
|-----------------------------|-----------------------|---------------------------|---------------------|---------------------|
|                             |                       |                           | Total revenue (N)   | Tradable input cost (N) | Domestic factor cost (N) | Profit (N) |
| Backyard/ village (< 500 birds) | 36                    | 150                        | Private 300,000     | 94,175.5             | 55,359                 | 150,465.5  |
|                             |                       |                           | Social 146,190      | 97,375.5             | 132,496                | 81,043.5   |
|                             |                       |                           | Diversity 153,810    | (762)                | (77137)                | 81,350      |
| Small scale (501 – 2500 birds) | 171                  | 1385                       | Private 3,776,000    | 1,088,920            | 343,917                | 2,343,163  |
|                             |                       |                           | Social 1,840,044.8   | 1,104,922            | 470,546                | 2,645,678  |
|                             |                       |                           | Diversity 1,935,955.2 | (16,002)            | (126,629)              | 2,078,586  |
| Medium scale (2501 – 10,000 birds) | 117              | 4936                       | Private 11,846,400  | 2,433,730            | 686,998                | 8,726,672  |
|                             |                       |                           | Social 5,772,750.7   | 2,467,246            | 596,251.33             | 2,799,253.4 |
|                             |                       |                           | Diversity 6,073,649.3 | (33,516)            | 89,746.67              | 6,017,418.6 |
| large scale (> 10,000 birds) | 36                    | 14,500                    | Private 30,160,000   | 6,349,170            | 1,269,129               | 22,601,701 |
|                             |                       |                           | Social 14,696,968    | 6,357,265            | 1,025,949.55           | 7,313,753  |
|                             |                       |                           | Diversity 15,463,032 | (8,095)              | 183,179.45             | 15,287,948 |

Table 4. Policy Analysis Matrix for Broiler production systems in Nigeria per kg of Chicken produced.

| Production systems          | Age range of birds (wks) | Average bird weight (kg) | Cost items          | Production cost (N/kg) |
|-----------------------------|--------------------------|--------------------------|---------------------|------------------------|
|                             |                          |                          | Total revenue (N/kg) | Tradable input cost (N/kg) | Domestic factor cost (N/kg) | Profit (N/kg) |
| Backyard/ village (< 500 birds) | 6 – 7                   | 2.5                      | Private 800.00       | 251.13                 | 147.62                 | 401.24       |
|                             |                          |                          | Social 389.84        | 252.63                 | 353.32                 | (216.12)     |
|                             |                          |                          | Diversity 410.16      | (1.50)                 | (205.70)               | 617.36       |
| Small scale (501 – 2500 birds) | 8 – 9                   | 3.4                      | Private 800.00       | 230.70                 | 72.86                  | 496.43       |
|                             |                          |                          | Social 389.84        | 234.09                 | 99.63                  | 56.05        |
|                             |                          |                          | Diversity 410.16      | (3.39)                 | (26.83)                | 440.38       |
| Medium scale (2501 – 10,000 birds) | 8 – 9              | 3.0                      | Private 800.00       | 164.35                 | 46.39                  | 589.32       |
|                             |                          |                          | Social 389.84        | 166.62                 | 40.27                  | 182.96       |
|                             |                          |                          | Diversity 410.16      | (2.26)                 | 6.06                   | 406.36       |
| large scale (> 10,000 birds) | 5 – 6                   | 2.6                      | Private 800.00       | 168.41                 | 32.07                  | 599.51       |
|                             |                          |                          | Social 389.84        | 168.63                 | 27.21                  | 194.00       |
|                             |                          |                          | Diversity 410.16      | (0.21)                 | 4.86                   | 405.52       |

5. Results and discussion

The Nigerian poultry sector, based on the Nigerian Veterinary Services and previous works done by Adene and Oguntade (2006) and Abimiku (2008) can be classified into four in terms of system of production. The backyard/village system with less than 500 birds, the small-scale system having between 500 and 2500 birds, the medium scale system having from above 2500 birds to 10,000 birds and the large-scale system with more than 10,000 birds (FAO, 2008).

The competitiveness of broiler production in Nigeria was analyzed along these four production systems using Policy Analysis Matrix (PAM) approach as in Table 1. The results showed that the large scale is the most competitive, followed by the medium scale, then the small scale and lastly the backyard/village production scale. Tables 3 and 4 illustrate the comparison of the four production systems with regards to private profitability, comparative advantage and government protection.

6. Profitability of the broiler industry

The PAM results as shown in Table 3 revealed that the private profits of the four production systems, the large scale, medium scale, small scale and backyard/village were ₦22,601,701, ₦8,726,672, ₦2,343,163, and ₦150,465.5 respectively. Private profit measures the competitiveness of investment at market prices. The positive prices of these production systems showed that the major players (farmers, processors and marketers) are competitive at the ruling market price. From Table 3, the backyard/village system of broiler production recorded private revenue of ₦300,000 and a social revenue of ₦146,190 which gave a positive divergence of ₦153,810 demonstrating that broiler chicken producers in the backyard/village system benefited from some amount of incentives and as a result were able to compete in the market. The private value of tradable input cost was ₦94,175.5 and the social value was ₦94,737.5 with a divergence of (₦62). The private cost of domestic factor was ₦55,359 and social cost was ₦137,496 to give a divergence of (₦77,137). The private profit recorded for this system was ₦150,465.5 and social profit was (₦81,043.5) to give a divergence of ₦231,509. The small-scale system recorded a private revenue of ₦3,776,000 and a social revenue of ₦1,840,044.8 amounting to a positive divergence of ₦1,935,955.2. The private cost for tradable input was ₦1,088,920 and recorded a social cost of ₦1,104,922 to give a negative divergence of (₦16,022) showing that tradable inputs cost more in the country than in the world market. The domestic factor also had a private cost of ₦343,917 and a social cost of ₦470,546 to give a negative divergence of (₦126,629). The private profit recorded for the small-scale was ₦2,433,730 while the social profit was ₦2,647,546.8 resulting in a positive divergence of ₦2,078,586. The medium scale system recorded a private revenue of ₦11,846,400 and a social revenue of ₦5,772,750.7 to give a positive divergence of ₦6,073,649.3. The private tradable input cost for this system was ₦2,467,246 to give a divergence of (₦33,516). The domestic factor cost had a private value of ₦685,398 and a social value of ₦7,092,253.4 resulting in a positive divergence of ₦6,017,418.6. The large-scale system had a positive revenue of ₦30,160,000 and a social revenue of ₦14,696,968 to give a divergence of ₦15,463,032. The private cost of tradable input was ₦6,349,170 and social cost was ₦6,357,766 giving rise to a divergence of ₦8,095. The domestic factor had a private valuation of ₦22,601,701 and a social valuation of ₦7,313,753 and a divergence of ₦15,287,948.

Meanwhile, Table 4 shows the revenue, costs (tradable input and domestic) and profit of the systems per kg of chicken produced, estimated at both private and social levels. Each of the systems of production had the same private and social revenue of ₦800 and ₦410 respectively. This is
Table 5. Anova test for Profit/kg estimated at both Private and Social values.

| Profit/kg (a) | Backyard/village (N)/kg | Small scale (N)/kg | Medium scale (N)/kg | Large scale (N)/kg | F-value |
|---------------|-------------------------|--------------------|---------------------|--------------------|---------|
| Private value | 401.24                  | 496.43             | 589.32              | 599.51             | 0.948   |
| Social value  | (216.12)                | 56.05              | 182.96              | 194.00             | 38.431† |

* Significant at 1%.

Table 6. Scheffe test for profit/kg estimated at Social values.

| Profit/kg (b) | Backyard/village (N)/kg (a) | Small scale (N)/kg (b) | Medium scale (N)/kg (c) |
|---------------|-----------------------------|------------------------|-------------------------|
| Small scale   | 0.000                       | 0.000                  | 0.000                   |
| Medium scale  | 0.000                       | 0.000                  | 0.000                   |
| Large scale   | 0.000                       | 0.012                  | 0.985                   |

Table 7. Summary of Competitiveness and Policy indicators of Broiler production systems in Nigeria.

| Production systems | Indicators | PP (N) | SP (N) | NPCI | EPC | SRP | PCBR | NPCO | POO |
|--------------------|------------|--------|--------|------|-----|-----|------|------|-----|
| Backyard/ village  | (<= 500 birds) | 150,465.5 | 81,043.5 | 0.994 | 4.000 | 1.584 | 0.498 | 2.052 | -1.857 |
| Small scale       | (501 – 2500 birds) | 2,343,163 | 264,576.8 | 0.986 | 3.655 | 1.129 | 0.379 | 2.052 | 8.856 |
| Medium scale      | (2501 – 10,000 birds) | 8,726,672 | 2,799,253.4 | 0.986 | 2.847 | 1.042 | 0.263 | 2.052 | 3.221 |
| Large scale       | (> 10,000 birds) | 22,601,701 | 7,313,753 | 0.999 | 2.855 | 1.040 | 0.251 | 2.052 | 3.090 |

Table 8. Indicators of Comparative advantage of Broiler production systems.

| Indicators | Production systems |
|------------|--------------------|
| Backyard/village | (<= 500 birds) | 2.575 | 0.640 | 0.180 | 0.123 |
| Small scale   | (501 – 2500 birds) | 0.856 | 0.263 | 0.251 | 0.502 |
| Medium scale  | (2501 – 10,000 birds) | 1.554 | 0.530 | 0.502 |
| Large scale   | (> 10,000 birds) | 1.554 | 0.856 | 0.530 | 0.502 |

largely due to the effect of a strong union (Poultry Association of Nigeria) at fixing prices of poultry products and the identical logistics involved in adjusting the international prices of chicken. The backyard system had a private tradable input cost of N251.13/kg and private domestic cost of N147.62/kg and a private profit of N401.24/kg. The social value recorded are N252.64/kg for the tradable input, N753.32/kg for the domestic factor and a loss of N216.12/kg. The small scale recorded a private tradable input cost of N230.7/kg and domestic factor cost of N72.86/kg and a private profit of N496.43/kg. This system on the other hand recorded a social tradable input cost of N389.84/kg. Social domestic factor cost of N99.69/kg and a social profit of 150,211.70/kg. The medium scale system produced a private tradable input cost of N168.41/kg, a private domestic factor cost of N32.07/kg and a profit of N599.51/kg. It also recorded a social tradable input cost of N168.62/kg, domestic factor cost of N27.21/kg and a social profit of N194/kg.

Table 5 shows an F-value of 0.948 meaning there is no significant difference (p > 0.1) between the private profits per kg of chicken across systems of production and that the difference in overall profits observed across the systems were owed to the scale of production and not necessarily as a result of efficiency in production. This suggests further, that to improve profit scale would have to be improved upon. On the other hand, the F-test result of 38.431 for social profit per kg of chicken showed that there was a significant difference (p < 0.01) between the contribution of the different systems of production to the country’s competitiveness.

7. Government protection policy for the industry

The effects of government policies and changes on the production system were assessed using the following indicators – nominal protection coefficient of inputs and output (NPCI and NPCO), effective protection coefficient (EPC), profitability coefficient (PC) and subsidy to producer ratio (PSR). The estimated values of these indicators are shown on Table 7, the NPCO across the systems were greater than 1 which indicates that an incentive policy had allowed private price of chicken from broiler production within the country is higher than world price. This is so because of the ban placed on importation of poultry product so as to encourage local production. The NPCI was less than 1 for all the production systems which shows that they enjoyed some level of subsidy. The NPCI values revealed that the average market prices of inputs were about 99% of the investment prices. The values of effective protection coefficient (EPC) showed that the backyard/village systems were the most protected from the effects of price distortions from both input and output market and the medium scale system is the least protected. The private cost benefit ratio (PBRC) as shown in Table 7 were 0.498, 0.379, 0.263 and 0.251 for the backyard/village, small scale, medium scale and large scale respectively. The lower PBRC of the large and medium scale production indicates a higher competitiveness, for the large scale it implies that for every N1 of benefit added, it only costs the system about 25 kobo whereas for the backyard/village systems it costs the system about 50 kobo to add a benefit of N1. Hence using this profitability ratio, the large scale will be ranked as the most competitive, followed by the medium scale then by the small scale and lastly the backyard/village system.

8. Comparative advantage of the broiler production systems

The comparative advantage of the production systems was assessed using the social profitability (SP), domestic resource cost (DRC) and social cost benefit ratio (SCBR) indicators. Results shown on Table 8 revealed that all the systems had comparative advantage except the backyard/village.
system which had an above 1 value for both DRC (2.575) and SCBR (1.554). The small-scale system recorded a DRC value of 0.640 and SCBR value of 0.856. Both the DRC and SCBR values were less than 1 showing that it costs less to produce a given value of output in the country than in the international market. The medium scale system also recorded a DRC and SCBR values of 0.18 and 0.53 respectively showing that this system produces at a lesser cost than the small-scale system and in fact as a higher comparative advantage. The large-scale system had a DRC and SCBR of 0.123 and 0.502 respectively which clearly reveals this system of production as the most comparatively advantageous. A less than 1 figure for DRC (0.64, 0.18 and 0.123) for the other systems (small, medium and large scale respectively) was an indication that the cost of domestic resource utilized in production of broiler chicken in Nigeria was less than the contribution of value added at social prices. This is an indication of efficient domestic resource utilization. The SCBR values for these three other systems were also found to be less than 1 which shows production were making revenues exceeding the costs of inputs and domestic factors. The three indicators all showed that large scale system had the highest comparative advantage followed by the medium scale, then the small scale with the backyard/village system at a comparative disadvantage to the society. The result of this study is in tandem with the studies of Kannapiran and Flemming (1999); Akter et al. (2003), Adegbile et al. (2014), Nwigwe et al. (2016), Abdul-Qadir et al. (2018) and Elsedig et al. (2015) who all observed a comparative advantage in different enterprises they studied.

9. Sensitivity analysis of different policy options on the broiler chicken production systems in Nigeria

9.1. Effect of changes in free on board on the systems of production

9.1.1. Backyard/village system

Table 9 shows the effect of decrease and increase in FOB by 20% on the competitiveness of backyard/village system broiler production. The decrease in FOB of 20% caused social loss to increase from (N81,043.5) to (N109,212.5). This indicates a further decrease in social profitability. The DRC decreased from 2.575 (base value) to 5.691, showing that the domestic cost rose from N2.575 to N5.691. The NPCO remained above 1 and increased implying that even with 20% decrease producer will continue to sell product above international market prices. The NPCI remained less than 1 for this system showing that input prices still cost less in the domestic market than in the international market. The EPC value improved considerably from 4 to 8.840 meaning that despite this change producer in this system continues to enjoy favourable government policy. Thus from the foregoing it can be seen that a decrease in FOB decreases the competitiveness of this system. However, when the FOB was increased by 20% for this system, social loss decreased from (N81,043.5) to (N52,922.5). The DRC value decreased from 2.575 (base value) to 1.665 implying that it now costs domestic resources less of what it used before to produce a given level of output. The same thing was recorded for the SCBR value decreasing from 1.554 to 1.304. The NPCO value remained above 1, though less than the base value indicating that producers will still sell their product at higher than international prices but much lesser than the present prices. The NPCI value remained unchanged from the base value meaning the cost of input is likely not to be much affected by an increase of 20% in FOB. The EPC value reduced drastically from what it is in the base year, 4 to 2.587 signifying a less favourable policy as FOB increases.

Despite this, the values of SP, DRC and SCBR generally show that a rise in FOB favours competitiveness and this conforms with the findings of Kassali and Jimoh (2018) which found competitiveness to change in the same direction as FOB this may be due to the policy of protection enjoined by both systems.

9.1.2. Small scale system

The sensitivity analysis for change in FOB for the small scale system as shown on Table 10 revealed that a decrease of 20% decreased the SP from N264,576.8 to (N77,155) while an increase of 20% increased it to N608,253.4. This shows that a decrease in FOB can actually make this system to become non-competitive and increase will make it more competitive. The decrease caused DRC to change from 0.640 to 1.196 leading to a decrease in competitiveness and an increase caused it to change to 0.436 signifying a more competitive situation. Similar change was observed for the SCBR which moved from 0.856 to 1.051 when the FOB decreased and moved to 0.722 when it increased. The EPC value increased considerably
for a reduced FOB and decreased when the FOB increased, this indicates that decreasing the FOB makes policies become favourable and increasing it reverses the situation. The NPCI value obtained for both increase and decrease is less than 1 meaning input prices will always remain cheaper regardless of the direction the FOB moves. The NPCO value meanwhile is above 1 though higher for a decrease in FOB than for a decrease, in both ways implying domestic price is higher than international market price. This result also showed that an increase in FOB for this system favours competitiveness and a decrease harms it. This agrees with the findings of Kassali and Jimoh (2018) which also found competitiveness to change in the same direction as FOB and this may be because both rice and chicken are protected through total ban on importation in Nigeria but disagrees with those of Nwigwe et al. (2016) and Abdul-Qadir et al. (2018) who observed that a higher FOB led to a decrease in competitiveness and a lower FOB led to an increase in competitiveness, the reason for this disagreement may be as a result of differences in the type of input used in production with different tariffs and excise duties.

### 9.1.3. Medium scale system

The sensitivity analyses result for this system on Table 11 did not depart from those of the earlier systems (backyard/village and small scale). Decrease in the FOB caused the SP to reduce from N7,313,753 to N4,497,704 but still competitive and an increase caused it to move to N10,131,804.45 a much competitive level. The DRC and SCB values decreased when the FOB decreased and increased when it was increased, following the pattern of both the backyard and the small scale systems though with much competitive values. The NPCI values increased from the base value for both decrease and increase in FOB but remained above 1 and the NPCO value decreased with a decrease in FOB and increased with an increase in FOB. The EPC increased for a decreased FOB and decreased when it was increased. The SRP also increased with a decrease in FOB and reduced with an increase, this was also the same for the PCO values. Generally, for this system also competitiveness reduced with reduction in FOB and increased with an increase in FOB. This also agrees with the findings of Kassali and Jimoh (2018) which also found competitiveness to change in the same direction as FOB but disagrees with those of Nwigwe et al. (2016) and Abdul-Qadir et al. (2018) that observed that a higher FOB led to a decrease in competitiveness and a lower FOB leads to an increase in competitiveness.

### 9.1.4. Large scale system

Table 12 shows the effect of a change in FOB on the large scale system. The SP reduced from N7,313,753 base value to N4,497,704 when the FOB was reduced and it increased to N10,131,804.45 when it was increased. The DRC value also increased from 0.123 to 0.186 with a decrease in FOB and reduced to 0.092 when the FOB was increased indicating a more competitive situation. The SCB values moved from a base value of 0.502 to 0.621 when the FOB decreased and to 0.422 when it increased. The values of NPCI increased above 1 when the FOB increased implying that domestic input prices will rise above international market price in such situation and NPCI values remain unchanged for 20% increase in FOB. The NPCO were above 1 though it increased when FOB was decreased and reduced when it was increased, it means that for this system, output prices will remain higher than international prices regardless of the direction of change in FOB. The SRP values increased when the FOB was decreased and reduced when it was increased. This result also tallies with the findings of Kassali and Jimoh (2018) which also found competitiveness to change in the same direction as FOB but disagrees with those of Nwigwe et al. (2016) and Abdul-Qadir et al. (2018) that observed that a higher FOB led to a decrease in competitiveness and a lower FOB leads to an increase in competitiveness.

### 9.2. Effect of changes in exchange rate on the systems of production

#### 9.2.1. Backyard/village system

Table 13 shows the effect of increase and decrease in exchange rate by 20% on the competitiveness of the backyard broiler production system. The results show that a decrease in exchange rate of 20% caused social profit (loss) to decrease from (N81,043.5) to (N113,796.1) this indicates a decrease in competitiveness. The DRC increased from 2.575 (base value) to 7.085, showing that the domestic cost rose from N2.575 to N7.085. The NPCO remained above 1 and increased implying that even with 20% decrease producer will continue to sell product above international market prices. The NPCI remained less than 1 for this system when it was increased but slightly above 1 when it reduced showing that input prices will

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Table 11. Sensitivity analysis for change in FOB for medium scale system.

| Indicator | Base value | 20% decrease in FOB | 20% increase in FOB |
|-----------|------------|---------------------|---------------------|
| PP        | N8,726,672 | N8,726,672          | N8,726,672          |
| SP        | N2,709,253.4 | N1,628,965          | N3,841,659          |
| DRC       | 0.180      | 0.268               | 0.134               |
| SCBR      | 0.530      | 0.650               | 0.442               |
| EPC       | 2.847      | 4.230               | 2.121               |
| NPCI      | 0.986      | 1.001               | 0.995               |
| NPCO      | 2.052      | 2.545               | 1.721               |
| SRP       | 1.042      | 1.525               | 0.710               |
| PGO       | 3.221      | 5.357               | 2.272               |

Table 12. Sensitivity analysis for change in FOB for large scale system.

| Indicator | Base value | 20% decrease in FOB | 20% increase in FOB |
|-----------|------------|---------------------|---------------------|
| PP        | N22,601,701 | N22,584,489         | N22,584,489         |
| SP        | N7,313,753 | N4,497,704          | N10,131,804.45     |
| DRC       | 0.123      | 0.186               | 0.092               |
| SCBR      | 0.502      | 0.621               | 0.422               |
| EPC       | 2.855      | 4.308               | 2.132               |
| NPCI      | 0.999      | 1.006               | 0.999               |
| NPCO      | 2.052      | 2.545               | 1.721               |
| SRP       | 1.040      | 1.526               | 0.711               |
| PGO       | 3.090      | 5.229               | 2.229               |
continue to cost less in the domestic market than in the international market as long as exchange rate does not reduce. The EPC value improved considerably from 4 to 11.001 when exchange rate reduced and reduced to 2.878 when it was increased but still above 1 which implies that despite this change, producers in this system continue to enjoy favourable government policy. Thus from the foregoing it can be seen that a decrease in exchange rate decreases the competitiveness of this system. However, when the exchange rate was increased by 20% for this system, social profitability increased (N81,043.5) to (N60,982.3), though still negative meaning loss, it became reduced. The DRC value decreased from 2.575 (base value) to 1.853 implying that it now costs domestic resources less of what it used before to produce a given level of output. The same thing was recorded for the SCBR value decreasing from 1.554 to 1.304. This agrees with the findings of Kannapiran and Flemming (1999) and that increase in exchange rate increases the comparative advantage and hence competitiveness but disagrees with those of Nwigwe et al. (2016) and Abdul-Qadir et al. (2018) that increase in exchange rate decreases comparative advantage and consequently lowers competitiveness this is due to the differences in local policy enjoyed by the different subsectors in the livestock sector.

9.2.2. Small scale system

The sensitivity analysis for change in exchange rate for the small scale system as illustrated on Table 14 showed that a decrease of 20% decreased the SP from N264,576.8 to (N148,150) while an increase of 20% increased it to N608,253.4. The decrease in exchange rate caused DRC to change from 0.640 to 1.460 leading to a decrease in competitiveness and an increase caused it to change to 0.470 signifying a more competitive situation. Similar change was observed for the SCBR which moved from 0.856 to 1.050 when the exchange rate decreased and moved to 0.747 when it increased. The EPC value increased considerably for a reduced exchange rate and decreased when the exchange rate increased, this indicates that decreasing the exchange rate makes policies become favourable and increasing it reverses the situation. The NPCI value obtained for both increase and decrease is less than 1 meaning input prices will always remain cheaper regardless of the direction the exchange rate moves. The NPCO value meanwhile is above 1 though higher for a decrease in exchange rate than for a decrease, in both ways implying domestic price is higher than international market price. This result also showed that an increase in exchange rate for this system favours competitiveness and a decrease harms it. This agrees with the findings of Kannapiran and Flemming (1999) and Osawe and Salman (2016) which also found competitiveness to change in the same direction as exchange rate but disagrees with those of Nwigwe et al. (2016) and Abdul-Qadir et al. (2018) that observed that a higher exchange rate led to a decrease in competitiveness and a lower exchange rate leads to an increase in competitiveness.

9.2.3. Medium scale

As shown on Table 15, a decrease in the exchange rate caused the SP to reduce from N2,709,253.4 to N1,399,591 but still competitive and an increase caused it to move to N3,523,053 a much competitive level. The DRC and SCB values decreased when the exchange rate decreased an increased when it was increased, following the pattern of both the backyard and the small scale systems though with much competitive values. The NPCI values increased from the base value for both decrease and increase in exchange rate but remained above 1 and the NPCO value decreased with a decrease in exchange rate and increased with an increase in exchange rate. The EPC increased for a decreased exchange rate and decreased when it was increased. The SRP values also increased with a decrease in exchange rate and reduced with an increase, this was also the same for the PCO values.

9.2.4. Large scale

Table 16 shows the effect of a change in exchange rate on the large scale system. The SP reduced from N7,313,753 base value to N3,913,273 when the exchange rate was reduced and it increased to N9,347,201 when it was increased. The DRC value also increased from 0.123 to 0.208 with a decrease in exchange rate and reduced to 0.099 when the exchange rate was increased indicating a more competitive situation. The SCB values

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### Table 13. Sensitivity analysis for change in exchange rate for backyard/village system.

| Indicator | Base value | 20% decrease in exchange rate | 20% increase in exchange rate |
|-----------|------------|-------------------------------|-------------------------------|
| PP        | N150,465.5 | N150,465.5                    | N150,465.5                    |
| SP        | (N81,043.5) | (N81,796.1)                   | (N60,982.3)                   |
| DRC       | 2.575      | 7.085                         | 1.853                         |
| SCBR      | 1.554      | 2.015                         | 1.366                         |
| EPC       | 4.000      | 11.001                        | 2.878                         |
| NPCI      | 0.994      | 1.010                         | 0.991                         |
| NPCO      | 2.052      | 2.677                         | 1.801                         |
| SRP       | 1.584      | 2.358                         | 1.270                         |
| PCO       | -1.857     | -1.322                        | -2.467                        |

### Table 14. Sensitivity analysis for change in exchange rate for small scale system.

| Indicator | Base value | 20% decrease in exchange rate | 20% increase in exchange rate |
|-----------|------------|-------------------------------|-------------------------------|
| PP        | N2,343,163 | N2,343,163                    | N2,343,163                    |
| SP        | N264,576.8 | (N148,150)                    | N19,400,182                   |
| DRC       | 0.640      | 1.460                         | 0.470                         |
| SCBR      | 0.856      | 1.050                         | 0.747                         |
| EPC       | 3.655      | 8.335                         | 2.135                         |
| NPCI      | 0.986      | 1.001                         | 0.994                         |
| NPCO      | 2.052      | 2.677                         | 0.180                         |
| SRP       | 1.129      | 1.766                         | -0.814                        |
| PCO       | 8.856      | -15.816                       | 4.419                         |
Table 15. Sensitivity analysis for change in exchange rate for medium scale system.

| Indicator | Base value | 20% decrease in exchange rate | 20% increase in exchange rate |
|-----------|------------|-------------------------------|-------------------------------|
| PP        | N8,726,672 | N8,726,672                    | N8,726,672                    |
| SP        | N2,799,253.4 | N1,399,591                   | N3,523,053                   |
| DRC       | 0.180      | 0.299                         | 0.145                         |
| SCBR      | 0.530      | 0.684                         | 0.464                         |
| EPC       | 2.847      | 4.716                         | 2.285                         |
| NPCI      | 0.986      | 1.001                         | 0.991                         |
| NPCO      | 2.052      | 2.677                         | 1.801                         |
| SRP       | 1.042      | 1.655                         | 0.791                         |
| PCO       | 3.221      | 6.235                         | 2.477                         |

Table 16. Sensitivity analysis for change in exchange rate for large scale system.

| Indicator | Base value | 20% decrease in exchange rate | 20% increase in exchange rate |
|-----------|------------|-------------------------------|-------------------------------|
| PP        | N22,601,701 | N22,584,489                   | N8,726,672                    |
| SP        | N7,313,753 | N3,913,273                    | N9,347,201                    |
| DRC       | 0.123      | 0.208                         | 0.099                         |
| SCBR      | 0.502      | 0.653                         | 0.442                         |
| EPC       | 2.855      | 4.817                         | 2.294                         |
| NPCI      | 0.999      | 1.086                         | 0.999                         |
| NPCO      | 2.052      | 2.677                         | 1.801                         |
| SRP       | 1.040      | 1.657                         | 0.791                         |
| PCO       | 3.090      | 5.771                         | 2.416                         |

Table 17. Effect of Changes in Free on Board (FOB) on the Competitiveness of Broiler Chicken Production systems in Nigeria.

| Measurement criteria | Decrease in F.O.B. by 20% | Increase in F.O.B. by 20% |
|----------------------|---------------------------|---------------------------|
|                      | Backyard/village | Small scale | Medium scale | Large scale | Backyard/village | Small scale | Medium scale | Large scale |
| SP                   | -             | -           | -           | +          | -             | -           | -           | +          |
| DRC                  | +             | +           | +           | +          | +             | -           | -           | -          |
| SCBR                 | +             | +           | +           | +          | -             | -           | -           | -          |
| EPC                  | +             | +           | +           | +          | +             | +           | +           | +          |
| NPCI                 | +             | +           | +           | +          | 0             | +           | +           | 0          |
| NPCO                 | +             | +           | +           | +          | -             | -           | -           | -          |
| SRP                  | +             | +           | +           | +          | -             | -           | -           | -          |
| PCO                  | -             | -           | +           | -          | -             | -           | -           | -          |

Table 18. Effect of Changes in Exchange rate on the Competitiveness of Broiler Chicken Production systems in Nigeria.

| Measurement criteria | Decrease in exchange rate by 20% | Increase in exchange rate by 20% |
|----------------------|-----------------------------------|-----------------------------------|
|                      | Backyard/village | Small scale | Medium scale | Large scale | Backyard/village | Small scale | Medium scale | Large scale |
| SP                   | -             | -           | -           | +          | -             | -           | -           | +          |
| DRC                  | +             | +           | +           | +          | +             | -           | -           | -          |
| SCBR                 | +             | +           | +           | +          | -             | -           | -           | -          |
| EPC                  | +             | +           | +           | +          | -             | -           | -           | -          |
| NPCI                 | +             | +           | +           | +          | +             | +           | +           | +          |
| NPCO                 | +             | +           | +           | +          | 0             | +           | +           | 0          |
| SRP                  | +             | +           | +           | +          | -             | -           | -           | -          |
| PCO                  | +             | +           | +           | +          | -             | -           | -           | -          |

moved from a base value of 0.502 to 0.653 when the exchange rate decreased and to 0.442 when it increased. The values of NPCI increased above 1 when the exchange rate increased implying that domestic input prices will rise above international market price in such situation and NPCI values decreased for 20% increase in exchange rate. The NPCO were above 1 though it increased when exchange rate was decreased and reduced when it was increased, it means that for this system, output prices will remain higher than international prices regardless of the direction of change in exchange rate. The SRP values increased when the exchange rate was decreased and reduced when it was increased. This result also tallies with the findings of Osawe and Salman (2016) which also found competitiveness to change in the same direction as exchange rate but disagrees with those of Nwagwe et al. (2016) and Abdul-Qadir et al. (2018) that observed that a higher exchange rate led to a decrease in competitiveness and a lower exchange rate leads to an increase in competitiveness. Meanwhile, Table 17 and 18 show a summary of the effect of change in FOB and exchange rate on the different indicators for each of the systems of production. The signs are a reflection of how the indicators changed with respect to their base values. Positive sign indicates an increase compared to base value and a negative sign represents a decrease with respect to base value.
10. Discussion

The results of the study showed that the four production system all recorded positive private divergences between the private and social revenue though private cost was below social cost for tradable inputs in all the systems of production resulting in a negative divergence and implying that input cost was a disincentive throughout the systems of production. Meanwhile, positive private and social profits were made throughout the systems except for the case of backyard/village system where a negative social profit was recorded, thereby making it relatively non-competitive. The tradable cost across the systems is very much higher than the domestic cost, averaging about four times high in both private and social valuations. This result is in agreement with the works of Ihe and Ugwumba (2011), Ukwuaba and Inoni (2012), Eze et al. (2012) and Uwalaka (2017) who have earlier found broiler production to be competitive. Furthermore, multiple comparisons test (Scheffe test) carried out as illustrated on Table 6, further revealed that there was a significant difference in the social profits obtained for the backyard system against the remaining three other systems of production, this was the same for the small scale system but the result showed that the social profit obtained for the medium and large scale systems were not significantly different from one another. This result implies that the scale of the system of production has a considerable effect on efficiency meaning efficiency is socially higher for medium and large scale as against the small and the backyard system of production, implying greater effect of those systems on the country’s competitiveness. The incentive effects of all policies as measured by the profitability coefficient (PC) values show that the net policy transfers across all the systems were high to producers except for the case of the backyard/village system where a negative value was obtained and therefore restricting the interpretation. This result corroborates the findings of Osawe and Salman (2016) and Kassali and Jimoh (2018) who also affirmed that farmers generally benefit from government incentives like subsidies and protection. This result of the sensitivity analysis for change in FOB for the small scale system showed that an increase in FOB for this system favours competitiveness and a decrease harms it. This agrees with the findings of Kassali and Jimoh (2018) which also found competitiveness to change in the same direction as FOB and this may be because both rice and chicken are protected through total ban on importation in Nigeria but disagrees with those of Nwigwe et al. (2016) and Abdul-Qadir et al. (2018) who observed that a higher FOB led to a decrease in competitiveness and a lower FOB led to an increase in competitiveness, the reason for this disagreement may be as a result of differences in the type of input used in production with different tariffs and excise duties. Generally, for the medium system also competitiveness reduced with reduction in FOB and increased with an increase in FOB. This also agrees with the findings of Kassali and Jimoh (2018) which also found competitiveness to change in the same direction as FOB but disagrees with those of Nwigwe et al. (2016) and Abdul-Qadir et al. (2018) that observed that a higher FOB led to a decrease in competitiveness and a lower FOB leads to an increase in competitiveness. For the large scale system, output prices will remain higher than international prices regardless of the direction of change in FOB. This result also tallies with the findings of Kassali and Jimoh (2018) which also found competitiveness to change in the same direction as FOB but disagrees with those of Nwigwe et al. (2016) and Abdul-Qadir et al. (2018) that observed that a higher FOB led to a decrease in competitiveness and a lower FOB leads to an increase in competitiveness. This result also showed that an increase in exchange rate for the small scale system favours competitiveness and a decrease harms it. For the medium scale, competitiveness reduced with reduction in exchange rate and increased with an increase in exchange rate. This also agrees with the findings of Osawe and Salman (2016) which also found competitiveness to change in the same direction as exchange rate but disagrees with those of Nwigwe et al. (2016) and Abdul-Qadir et al. (2018) that observed that a higher exchange rate led to a decrease in competitiveness and a lower exchange rate leads to an increase in competitiveness.

11. Conclusion and policy recommendations

The study showed that all the broiler production systems except for the backyard/village system were profitable, they have comparative advantage and benefits from favourable government policies. However, the backyard/village system of production should be assisted to expand their production scale above the current level so as to benefit from economies of scale and achieve economic efficiency. The findings also showed that the DRC and SCBR values were least in the large-scale system of production followed by the medium scale then the small scale. This implies that these systems have potential to compete successfully with imported chicken and go ahead to fill the demand-supply gap in the country. The positive divergence between the private and social revenues and profits revealed that the consumers are being made to pay higher than social price (world price) resulting in higher profits for the producers, while the negative divergence for cost (tradable and domestic) for most of the systems implies that transfers were made from the government as protection in form of ban and subsidy to the producers. The values of the NPCOs and NPCIs also showed that government policies have also helped to keep output prices and input costs at competitive levels. The result of sensitivity analysis revealed that production can still benefit from a number of government policies such as those that increases FOB and exchange rate.

Based on the conclusions drawn from the results, the following recommendations were made to enhance productivity and efficiency in broiler chicken production in Nigeria so as to achieve competitiveness. Higher scale of production should be encouraged among producers to improve the current level of competitiveness in the industry. In view of the competitiveness of the industry, the country should replace the policy of ban with a policy of gradual and moderate taxation. Government, through the central bank should ensure stability in exchange rate to improve competitiveness and overall resource allocation in the industry.

Declarations

Author contribution statement

Rabirou Kassali: Conceived and designed the experiments.
Abisoye Lukman Lasisi: Performed the experiments; Analyzed and interpreted the data.
Kolapo Adetomiwa: Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Data will be made available on request.
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The authors declare no conflict of interest.

Additional information

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Appendix A. Calculating import parity prices for tradable inputs

| Backyard/Village System | Feeders | Drinkers | Water installation | Heat source | Hanging feeders | Chicken |
|-------------------------|---------|----------|--------------------|-------------|----------------|---------|
| Fob                     | $20     | $16.25   | $34.98             | $85.69      | $49            | $371.25 |
| Freight                 | $13     | $13      | $13                | $13         | $13            | $13     |
| Unloading               | $33.00  | $29.25   | $47.98             | $98.69      | $62.00         | $384.25 |
| Insurance               | $33.00  | $29.25   | $47.98             | $98.69      | $62.00         | $384.25 |
| Conversion to local currency (rate) | N361.9 | N361.9 | N361.9 | N361.9 | N361.9 | N361.9 |
| Tariffs                 | 0.02    | 0.02     | 0.05               | 0.05        | 0.05           | 0.1     |
| Subsidies               | N12181.55 | N10797.29 | N18232.16 | N37501.71 | N23509.69 | N152966.1 |
| local port charges      | N12181.55 | N10797.29 | N18232.16 | N37501.71 | N23509.69 | N152966.1 |
| local transport and marketing cost | N500 | N500 | N500 | N500 | N500 | N500 |
| Transport and marketing cost to relevant market | N250 | N250 | N250 | N250 | N250 | N250 |
| Storage cost            | N40     |          |                    |             |                |         |
| Import parity           | N12431.55 | N11047.29 | N18482.16 | N37751.71 | N23809.69 | N153176.1 |

| Small-scale System | Feeders | Drinkers | Water installation | Heat source | Hanging feeders | Chicken |
|--------------------|---------|----------|--------------------|-------------|----------------|---------|
| Fob                | $163.75 | $72.3    | $34.98             | $342.76     | $382           | $3427.875 |
| Freight            | $13     | $13      | $13                | $13         | $13            | $13     |
| Unloading          | $176.75 | $85.50   | $47.98             | $355.76     | $395.00        | $3440.88 |
| Insurance          | $176.75 | $85.50   | $47.98             | $355.76     | $395.00        | $3440.88 |
| Conversion to local currency | N361.9 | N361.9 | N361.9 | N361.9 | N361.9 | N361.9 |
| Tariffs            | 0.02    | 0.02     | 0.05               | 0.05        | 0.05           | 0.1     |
| Subsidies          | N65245.14 | N31561.3 | N18232.16 | N135187 | N150098 | N1369778 |
| local port charges | N65245.14 | N31561.3 | N18232.16 | N135187 | N150098 | N1369778 |
| local transport and marketing cost | N500 | N500 | N500 | N500 | N500 | N500 |
| Transport and marketing cost to relevant market | N250 | N250 | N250 | N250 | N250 | N250 |
| Storage cost       | N40     |          |                    |             |                |         |
| Import parity      | N65495.14 | N31811.3 | N18482.16 | N135437 | N150348 | N1369988 |
References

Abdul-Qadir, M.I., Okoruwa, V.O., Salman, K.K., 2018. Competitiveness of oil palm production systems in Nigeria: a policy analysis matrix approach. Int. J. Hybrid Inf. Technol. 9 (5), 231–250.

Abimiku, J.Y., 2008. An overview of the early impact of highly pathogenic avian influenza (HPAI) H5N1 in Nigeria. Department of Agricultural Economics, University of Agriculture Makurdi, Nigeria.

Adegbile, O., Oni, O., Adeoye, I., 2014. Competitiveness of pineapple production in Osun-State, Nigeria. J. Econ. Sustain. Dev. 5 (2).

Adene, D.F., Ogunmade, A.E., 2006. The structure and importance of commercial and village based poultry in Nigeria. FAO consultancy report. http://www.fao.org/docs/eimo/upload/214331/poultrysector_npa.pdf.

Ahmad, R.W., 2018. 1.3 tonnes of poultry meat smuggling to Nigeria in 2017. Daily trust. Retrieved from https://www.dailytrust.com.ng/.

Akter, S., Jabbar, M.A., Ebui, S.K., 2003. Competitiveness and efficiency in poultry and pig production in Vietnam. International Livestock Research Institute, Nairobi, Kenya. 57(55).

Amos, T.T., 2006. Analysis of backyard poultry production in Ondo State, Nigeria. Int. J. Poultry Sci. 5 (3), 247–250.

Atteh, J.O., 2004. Romancing the chicken 68th Inaugural Lecture, University of Ilorin. Published by Unilorn Press.

Baker, A., 2005. Who wants to globalize? Consumer tastes on labor markets in theory of trade policy beliefs. Am. J. Polit. Sci. 49 (4), 924–938.

Elsegd, E.A.A., Mohd, M.I., Fatimah, M.A., 2015. Assessing the competitiveness and comparative advantage of broiler production in Johor using policy analysis matrix. Int. Food Res. J. 22 (1), 116–121.

Esmaili, A., 2008. Measuring competitiveness of shrimp farming in Southern Iran: using PAM approach. World Appl. Sci. J. 17 (4), 724–729.

Ezeh, C.I., Anyiro, C.O., Chukwu, J.A., 2012. Technical efficiency in poultry broiler production in Imo State capital territory of Abia State, Nigeria. Green Agric. Sci. 2 (1), 001–007.

FAO, 2008. Assessment of Nigeria Poultry Market to Improve Biosecurity. Investment Centre Division. FAO, Rome, Italy.

FAO. 2010. Agribusiness Handbook: Poultry Meat and Eggs. Investment Centre Division. FAO, Rome, Italy.

Gittinger, J.P., 1982. Economic Analysis of Agricultural Projects, 2nd ed. The John Hopkins University Press, Baltimore.

Hassan, A.A., Nwangata, J., Mohammed, A., 2011. Profitability analysis of egg production in Kaduna State, Nigeria. Vet. J. 27 (1), 8–16.

Hassan, T., 2017. PAN: Nigeria may lose N14trn to poultry products smuggling. New Telegraph. Retrieved from https://newtelegraphonline.com/2017/11/.

Ike, P.C., Ugwumba, C.O.A., 2011. Profitability of small scale broiler production in Onitsha north local government area of Anambra State. Int. J. Poultry Sci. 10 (3), 106–109.
Isaka, K., 2002. Innovations in Agricultural Technology Assessment of Constraints and Performance in Benin. Verlag Grauer, Stuttgart.
Kannapiran, C.A., Fleming, E.M., 1999. Competitiveness and comparative advantage of tree crop small holdings in Papua, New Guinea. Agricultural and Resource Economics, University of New England, pp. 99–100.
Kassali, R., Jimoh, O.I., 2018. Competitiveness in rice production in Ogun state, Nigeria: the policy analysis matrix approach. J. Agribusiness Rural Dev. 2 (48), 129–136.
Keyser, J.C., 2006. Description of methodology and presentation of templates for value chain analysis. Part 1: Narrative Text. Background paper for the competitive commercial agriculture in Sub-Saharan Africa (CCAA) Study.
Masters, W.A., Winter-Nelson, A., 1995. Measuring the comparative advantage of agricultural activities: domestic resource costs and the social cost-benefit ratio. Am. J. Agric. Econ. 77 (3), 243–250.
Monke, E.A., Pearson, S.R., 1989. The Policy Analysis Matrix for Agricultural Development. Cornell University Press, Ithaca and London.
Nelson, C.G., Panggabean, M., 1991. The cost of Indonesian sugar policy: a policy analysis matrix approach. Am. J. Agric. Econ. 73 (8), 703–712.
Nwigwe, C., Okoruwa, V., Adenegan, K., Olajide, A., 2016. Competitiveness of beef cattle production systems in Nigeria: a policy analysis approach. J. Agric. Sustain. 9 (2), 175–197.
Ojo, S.O., 2003. Productivity and technical efficiency of poultry egg production in Nigeria. Int. J. Poultry Sci. 2 (6), 459–464.
Okojie, J., 2017. Nigeria’s poultry industry and high rate of smuggling. BUSINESSDAY. Retrieved from https://www.businessdayonline.com/exclusives/analysis-sub/backpage/article/.
Ologhon, O.A.C., Ambali, O.L., 2012. Poultry enterprise combination among small-scale farmers in Ogun State, Nigeria: a technical efficiency approach. J. Agric. Vet. Sci. 2 (4), 7–15.
Onaowe, O.W., Salman, K.K., 2016. Competitiveness of fish farming in Lagos state, Nigeria: an application of policy analysis matrix. J. Agric. Sustain. 9 (1), 58–82.
Sahel, 2015. An assessment of the Nigerian poultry sector. Sahel Capital Partners & Advisory limited, 11.
Ukwuaba, K., Inoni, O.E., 2012. Resource-use efficiency in small scale broiler production in Oshimili North local government area, Delta State. Int. J. Poultry Sci. 11 (8), 700–705.
USDA, 2013. International egg and poultry review – 24 October 2012 - market reports. Retrieved from http://www.thepoultrysite.com/.
Uwalaka, H.E., 2017. Resource-use efficiency in backyard broiler chicken production in Osun state Nigeria. Unpublished M. Sc. thesis. Department of Agricultural Economics, Obafemi Awolowo University, Ile Ife.
Wiendiyati, U.R., Raya, P.U., 2002. The impact of tariff policy and inter-island transport cost on the profitability of soybean production in Ngada regency. NTT Faculty of Agriculture World Bank, 1976. Supplementary annexes to central agricultural development projects. Washington D. C.
Yao, S., Timprapha, C., 1995. Comparative advantage and crop diversification: a policy analysis matrix for the Thai agriculture. A technical report prepared for the Food and Agriculture Organization (FAO) of the United Nations and the Ministry of Agriculture and Cooperatives of the Royal Thailand Government.
Yao, O.A., Ayanwale, A.B., 2011. Structure, conduct and profitability of the broiler processing enterprises in Southwestern Nigeria. J. Agric. Environ. Stud. 2 (2), 1–20.