Profitability and Resource use Efficiency of Guinea Fowl (*Numida meleagris*) Production under Tropical Conditions

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Abstract

Guinea fowl production is a growing poultry enterprise in Nigeria. This paper estimates the profitability and resource use efficiency of guinea fowl production in Osun State. A multistage sampling technique involving purposive and simple random sampling was used in the study. Primary data collected with the aid of a structured questionnaire. Budgetary analysis and Marginal value estimates were carried out to analyze the data. The profitability indicators estimated showed that the net income was *₦18, 573.85 while the gross margin was ₦26, 543.12. These values suggested that returns from guinea fowl production were substantial notwithstanding the high cost of production. A gross return per naira invested in guinea fowl production earned ₦1.08. The overall results showed that guinea fowl production is a profitable enterprise. However, the result showed that number of birds was under-utilized while cost of feed was over-utilized. Potentials to raise profit level are higher if resources are well utilized.

Keywords: Guinea fowl enterprise, budgetary, marginal value, resource use; Nigeria

Introduction

The importance of poultry production to the national economy cannot be over-emphasized as it has become a popular industry for smallholders that have great contribution to the economy (Micro livestock, 1991). Poultry production is unique and offers the quickest returns to investment outlay in livestock enterprises (Ojo, 2002). It has the highest feed conversion rates of 2:1 and produces the cheapest, commonest and best sources of animal protein (Orji et al., 1981).

Poultry production plays a significant role in the economic and social-life of the resource-poor households, contributing to cheap source of animal proteins and cash income (Magothe et al., 2012; Yakubu et al., 2013). When agro ecological issues and the demographics of the human population are considered, village poultry often rank highly in terms of being an existing resource whose productivity can be increased with only a modest input (Copland and Alders, 2009). In sub-Saharan Africa, there are several species of poultry mainly represented by domestic indigenous chicken (*Gallus gallus domesticus*), guinea fowl (*Numida meleagris*), duck (*Cairina sp*.) and turkey (*Meleagris gallopavo*); their distribution varies from one region to the other depending on both the physical and social environment (Yakubu et al., 2012; Yakubu 2013). In Nigeria, special species of poultry abound and they include chickens, guinea fowl, turkeys, ducks, and pigeons.

Guinea fowl (*Numida meleagris)* originated in Africa (Nova Scotia Department of Agriculture and Fisheries archives, 2001; Embury 2001). There are two types of guinea fowl species namely; *Numida ptilorhycha* and *Numida meleagris*. The *Numida ptilorhycha* is indigenous to the deciduous rain forest zone of southern Nigeria while *Numida meleagris* is currently domiciled in the northern part of Nigeria but it is spreading to other smallholder farming areas (Ayorinde, 1987; Obike et al., 2011). This indigenous species makes significant contributions to animal protein through cheap meat and eggs which serve as a buffer to shortages of poultry products (Ocheja et al., 2010). This in turn provides sustenance to the rural populace which is dominated by poor and low income earners. Guinea fowl, an important enterprise in poultry production, is becoming one of the fastest growing sub-sectors in the livestock industry.

Guinea fowl (*Numida meleagris*) is one of the major poultry species consumed in different households in Nigeria. Specialized smallholder poultry farmers employ production techniques and practices. However, not all the techniques are effective. In addition, guinea fowl supply is a challenging task for any sizeable guinea fowl production outfit in Nigeria in that, no farmer should invest in it unless he has a fair knowledge of market outlet and size of demand (Ikani and Dafwang, 2004). Therefore information on effective guinea fowl production is necessary in order to identify opportunities to exploit, promote guinea fowl production and marketing by farmers and enhance income generation, ensure food security and contribute to poverty alleviation of resource poor farmers.

Although guinea fowl is abundant in the wild, they are semi-domesticated in most parts of Nigeria where they co-mingle with the domestic chickens (Haruna, et al., 1993). The over 50 million semi domesticated guinea fowls in Nigeria constitute 25% of the entire poultry population in Nigeria making it a veritable source of animal protein which is socially acceptable (Ikani and Dafwang, 2004). In general, it is believed that guinea fowls are more resistant to most diseases of chicken and has greater capacity to scavenge for grains and insects than chickens (Ayorinde 1999**;** Ikani and Dafwang 2004). Because of these comparative advantages, there is an increase interest in guinea fowl rearing and production in Nigeria.

Guinea fowl production is gaining popularity with households because they are a "watch animals" around homestead (Smith, 2000). In addition, they are kept to control snakes, mice and other pest. Guinea fowl as a meat bird has proven to be a viable and profitable enterprise, thus providing opportunity for commercialization in many parts of the globe. A survey (Nahashon et al., 2006) indicated that interest in guinea fowl as an alternative poultry and specialty bird in the United States appears to be increasing. Turning Guinea fowl production into a profitable enterprise will, impart, require understanding of their growth characteristics and pattern (Aggrey, 2002). The potential for guinea fowl production as an alternative poultry is a promising enterprise (Nahashon, et al., 2006).

In Nigeria, Ikani and Dafwang (2004**)** reported that guinea fowl eggs command premium prices because of their gamey flavor and have better storage ability than chicken eggs, as their eggshell do not crack easily due to their thickness. Guinea fowl eggs are believed to enhance virility and sexual potency. Moreki (2009) reported that guinea fowl meat also commands a premium price. Other advantages of rearing guinea fowl include low production costs, greater capacity to utilize green feeds, control of ticks and other pests and better ability to protect itself against predators (Moreki, 2009). Furthermore, guinea fowl and their eggs are used for scientific research, notably in physiology (Ikani and Dafwang, 2004).

These advantages make guinea fowl suitable to the rural areas where commercial chicken production has failed due mainly to high input costs.

Nwagu and Alawa (1995) reported that guinea fowl production contributed substantially to the supply of animal protein in the form of meat and eggs. Its meat has a higher protein content of approximately 28% compared to 20% for domestic fowl (Ayeni, 1980). In corroboration, Ayorinde (2004) stated that guinea fowl is second to the domestic fowl in terms of number and supply of poultry protein in Nigeria.

The major problem of the poultry production in Nigeria is that of low productivity and inefficiency in resource allocation and utilization (Onyenweaku and Effiong, 2006). The poultry industry in Nigeria is characterized by high production costs, low profit margins, and high feed bills. Olayide (1976) showed that increase in livestock production in Nigeria derives mainly from average expansion rather than higher intensification and productivity of resources. This implies that the present production and supply chain is inadequate (Olaofe, 2004), hence the need to provide present and intending farmer with useful information that will assist and sustain poultry industry in Nigeria. Therefore, this study seeks to provide answers to the following research questions; what are the socio-economic characteristics of guinea fowl farmers in the study areas? What are the costs and returns to guinea fowl production? What is the resource-use efficiency of guinea fowl production in the study areas?

The specific objectives of the study are to examine the socio-economic characteristics of the respondents; determine the costs and returns to guinea fowl production; and analyze resource use efficiency of the enterprise.

Materials and methods

The study was carried out in Osun State, one of the 36 States of Nigeria. The selection of respondent farmers was multi-stage. In the first stage, two Local Government Areas (LGAs) namely Ejigbo and Aiyedaade were purposively selected because of the predominant of guinea fowl farmers in the areas and availability of market for the poultry products. Second stage involved selection of five towns from each Local Government Area and in the third stage seven farmers from each town were randomly selected at each sampling stage, a total of seventy guinea fowl farmers were interviewed. Primary data on socio-economic characteristics of guinea fowl farmers, costs and returns of inputs and output, resource-use efficiency and extension services were collected using well-structured sets of questionnaire.

Data generated were analyzed using budgetary and Marginal value product analyses. The budgetary technique analysis was used to evaluate levels of profitability of the enterprise by estimating the revenue, gross margin and net farm income at the end of the production process. The difference between the two parameters is a measure of net profit or return in poultry production. The following were computed for each category of guinea fowl farmers:

(i) Gross revenue (GR): GR = $P \times Y$, where P = output price and Y = yield,

(ii) Gross Margin (GM): GM = GR-TVC, where GM = Gross Margin, GR = Gross Revenue and TVC = Total Variable Costs

(iii) Net Farm Income (NFl) = GM-Total Fixed Cost (TFC)

(iv) Operating Expense ratio = $\frac{TVC}{GR}$

(v) Net Farm Income ratio = $\frac{NFI}{GM}$

(vi) Return/Naira outlay = $\frac{NFI}{TC}$

Where: TC =TVC+TFC and TC = Total Cost

To determine the resource use efficiency, the Marginal Value Product (MVP_i), the additional income received from using an additional unit of financial input for each resource, was computed and compared with the respective acquisition cost (MFC). The mean estimates (output returns and input costs) of the log-linearized Cobb-Douglas production function were used in the computation of MVPs of each of the resource (input) with its MFC. A statistically significant difference between a resource's MVP and MFC suggests sub optimality in the utilization of that resource.

The MVP of a particular resource was computed thus

MVP = δY/ δX.Py
δY/ δX =MPP
Thus MVP=MPP.Py
Resource-use efficiency = MVP/MFC
Where: y = mean output, δY/ δX derivative of total output (Y_i) ; X_i = factor input
MFC = Marginal Factor Cost, P_y = calculated output's average selling price.
Thus, when Resource-Use Efficiency (RUE) = 1, resources are optimally utilized, When RUE < 1 Resources are over utilized, When RUE > I, resources are underutilized.

Results and discussion

Socio economic characteristics of respondents

Data in Table 1 show that farmers' ages varied between 21 and 70 years. The modal age bracket was between 61 and 70 years which constituted 54.3 percent of the farmers interviewed. At this age, farmers were old and not much physical energy contribution to farming could be expected from them. As expected guinea fowl enterprise is not energy sapping. Majority (81.4%) of the respondents were male indicating that the enterprise is male dominated. This observation was confirmed by the report of Nmadu et al., (2014) that the dominance of males in the poultry business may not be unconnected with the huge sums of money needed to start the business which is often difficult for women to raise in this part of the world but much easier for their male counterparts to obtain. This finding disagrees with Nwanta et al., 2006; Maphosa et al., 2004; Mcainsh et al., 2004 who reported that women have been the major producer of rural poultry in African societies.

Furthermore, the results showed that the majority (71.4%) of the farmers in the area were married as expected given that majority (54.3%) of them were older than 60 years. This conforms to Adeniyi and Oguntunji (2011) who observed that that 75% of the rural poultry farmers were married. This may have positive effect on the availability of family labour. The data revealed that majority (41.4%) of the respondents had a family size of between 6 and 10 persons. This result was corroborated by Adesiyan (2014) who observed that since poultry is labor intensive in nature, it's therefore required a sizeable number of families. This is obtainable in the rural settings where household labor is used for poultry production processes. Large family size could reduce the hired labor cost required in production.

Majority (84.2%) of the respondents was literate and could read and write in both English and Yoruba language. The modal level of education was secondary education (Table 1). The implication of this is that the costs of obtaining new technical and related information by the farmers will be reduced substantially when they can read and understand published materials and simplified farm journals which are increasingly becoming the modern vehicle of disseminating information. The income received by a farmer is important in determining the profitability of the enterprise. Less than a quarter (21 .4%) of the farmers received less than ₦10, 000 (₦ is the naira, Nigerian currency; ₦199 = US$1) income from raising guinea fowl, 6.4% receives between ₦10, 000-30,000 income from guinea fowl production, another 23.0% receives between ₦ 30,000-50,000, 30.6% of the farmers received between ₦ 50,000 and ₦ 70,000 while 18.6% of the farmers receive above ₦ 70,000

Profitability estimates of guinea fowl production

The result showed that an average farmer invested ₦327, 811.38 for the production season (Table 2). This comprises costs of incubator, land, depreciation on building, feed, foundation stock, labor, medication and other necessary items. Cost of feed (₦196, 018.20) constituted the greatest share of the total variable cost. This compares favorably with the findings of Okafor et al., (2006); Onyenweaku and Effiong (2006) that feed is the major important single cost item associated with poultry production due to the increase in cost of poultry feed ingredients such as maize, groundnut cake, soybean meal and scarcity of wheat and corn offal. This shows the importance of feed availability and affordability if poultry production is to be improved. Cost of labor (₦110, 796.48) was next in value of the amount invested in guinea fowl production. Other variable costs were vaccines, foundation stock and medication. The total variable cost was ₦319, 842.11 while total fixed cost was ₦7, 969.24.

It could be seen from Table 2 that the average revenue of ₦346, 385.23 was earned by a guinea fowl farmer during the period. Three profitability indicators were estimated. These were net income, gross margin and gross return per naira invested. The net income was calculated to be ₦18, 573.85 while the gross margin was ₦26, 543.12. These values suggested that returns from guinea fowl production were

substantial notwithstanding the high cost of production. A gross return per naira invested in guinea fowl production earned ₦ l.08. The values obtained for profitability showed that guinea fowl production is a profitable business in Osun State.

Table 1: Socio economic characteristics of respondents

	Frequency (f)	Percentages (%)
Age (Years)		
21-30	2	2.9
31-40	3	4.3
41-50	7	10.0
51-60	20	28.6
61-70	38	54.3
Sex		
Male	57	81.4
Female	13	18.6
Marital status		
Single	9	12.9
Married	50	71.4
Separated	4	5.7
Divorced	0	0.0
Widowed	7	1.0
Household size		
1-5	26	38.6
6-10	30	41.4
11-15	10	14.3
>16	4	5.7
Literacy level		
No formal education	5	7.2
Primary education	11	15.7
Secondary education	29	41.4
Tertiary	19	27.1
Others	6	8.6
Income		
<10,000	14.8	21.4
10,000-30,000	4.5	6.4
30,000-50,000	16.3	23.0
50,000-70,000	21.4	30.6
>70,000	13.0	18.6

There are several functional forms for estimating the physical relationship between input and output. Since the Cobb-Douglas functional form is preferable to other forms if there are three or more independent variables in the model, the Cobb-Douglas production function with four independent variable and three Z variables (Technical inefficiency) was applied in this study. These independent variables were number of bird, cost of feed, amount spent on hired labor and cost of medication while the Z variable were family size, years of formal education and age of the respondent. The estimated coefficient of flock size was found to be positive with a value of 0.3289 and statistically significant at 1 percent level of significance (Table 3). This means one percent increase in flock size brings about 0.328 percent increase in guinea fowl production. This result is in conformity with the findings of Ohajianya et al., (2013); Effiong (2005). With respect to feed input, the coefficient was negative and not significant at the conventional levels. This implies that an increase in feed utilization will reduce output. This was contrary to *a priori* expectation. However, it might be due to excessive usage of feed because cost of feed constituted the greatest share of the total variable cost. Hence the respondents may not mindful of the quantity provided per day.

Table 2: Budgetary analysis to guinea fowl production per season

Items	Mean amount (₦)*
Income from egg production	292,181,56
Income from culled birds	54,203.67
Total Revenue (TR)	346,385.23
Expenditure	
Fixed Costs (FC)	
Incubator	994.22
Halogen lamp	1,554.76
Measuring scales	556.10
Feeding trough	1,265.60
Drinkers	1,835.41
Land charge/rent	1,072.34
Depreciation on building	690.15
Total Fixed Costs (TFC)	7,969.24
Variable Costs (VC)	
Foundation stock	1,306.57
Feed	196,018.20
Medication	4,862.76
Labor	110,796.48
Total Variable Costs (TVC)	319,842.11
Total Cost (TC) = (TFC + TVC)	327,811.38
Profitability indicators	
Net Income (NI = TR-TC)	18,573.85
Gross Margin (GM = TR-TVC)	26,543.12
Gross Return per naira (TR/TC)	1.08

*₦ (Nigerian currency) = 1$ = ₦ 199

Table 3: Maximum likelihood estimates of parameters

Variables	Parameters	Coefficient	t- ratio
Constant	β_0	7.8027	7.9897
Flock size	β_1	0.3289	3.9830*
Cost of feed	β_2	-0.0028	0.0818
Labor input	β_3	-0.0019	-3.0123**
Cost of medication	β_4	-0.0072	-0.0859
Sum of elasticities		0.317	
Inefficiency model			
Family size	δ_1	-0.0897	-2.539*
Education	δ_2	0.0231	0.1911
Age	δ_3	-0.0321	-0.0349
Diagnosis statistics			
Sigma squared($\sigma^2 = \sigma_v^2 + \sigma_\mu^2$)	σ^2	0.9717	2.4051**
Gamma ($\gamma = \sigma_\mu^2/\sigma^2$)	γ	0.9792	0.2492
Log likelihood	λ	-95.36	
Mean efficiency		0.8554	

* and ** indicates significance at 0.01 and 0.05 probability, respectively.

Table 4: Elasticity of productive resources and returns to scale

Inputs	Elasticity
Number of birds	0.3289
Cost of feed	-0.0028
Cost of hired labor	-0.0019
Cost of medication	-0.0072
Returns to scale	0.317

Table 5. Resource use efficiency of guinea fowl

Resource	MPP	Unit price of input (₦)	MVP	MFC(₦)	MVP/MFC	Remark
Number of birds	35.42	64.49	2,284.23	64.49	35.41	Under utilization
Cost of feed	-0.0039	252.86	-0.9861	252.86	-0.0038	Over utilization
Cost of hired labor	-0.00013	4,964.00	-0.6453	4,964.00	-0.0001	Gross inefficiency & over utilization
Cost of medication	-0.0030	844.23	-2.5326	844.23	-0.0029	Over utilization

However, the coefficient of labor and cost of medication are negative. This implies that an increase in labor input, and cost of medication will reduce guinea fowl production by 0.002 and 0.007, respectively. Only labor input is statistically significant at 5 percent. This may due to small flock size holding per individual which led to under utilization of labor and no cost attached to family labor used in the course of production. The statistical non-significance of medication cost probably due to the use of traditional veterinary care using concoctions such as, terramycin antibiotic. The sum of the elasticity coefficients, that is, the return to scale (RTS) which is a measure of total resource productivity was estimated to 0.317 (Table 4). This was less than one but greater than zero. This is indicative of positive decreasing returns to scale, implying that the respondents were producing within the rational zone of production, which is Stage 2. This means that if all the variables are each increased by a unit, the guinea fowl production will increase by 0.317. The nature of the returns to scale obtained in this study compares favourably with a similar study by Oladeebo and Ambe-Lamidi (2007).

The estimated parameters of the inefficiency model in the stochastic frontier models of the respondents showed that the coefficients of age, and family size were negative, while level of education was positive. Over all, it implies that these variables increase or decrease the technical efficiency of the guinea fowl farmers. Those variables with negative coefficients lead to decrease in technical inefficiency or increase the farmers' technical efficiency. The negative signs obtained for variables age, and family size conformed to *a priori* expectation and were similar to the findings of Ojo (2003). This implied that age contributed negatively to inefficiency; that is, the older the farmer, the more efficient he becomes. This may be due to accumulated experiences gathered over time in allocating their resources.

The overall mean technical efficiency which is 0.86 implies that on average guinea fowl farmers observed output is 0.14 less than the maximum output which can be achieved from the existing level of inputs. In addition it is an indication of opportunity for improvement in efficiency which could either increase output or reduce cost of production given the present technology and operating close to the frontier. The observed efficiency (0.86) can be attributed to various factors ranging from technical production constraints, socio-economic and environmental factors**.**

The estimated gamma (γ) coefficient 0.9792 means that about 98 percent of the discrepancies between observed output and the frontier output are due to technical inefficiency. In other words, the shortfall in observed output from the frontier output is primarily due to factors, which are within the control of the respondents in the study area while the remaining was due to random effects. This confirm the presence of one sided error component in the model thus rendering the use of the Ordinary Least squares (OLS) estimating technique inadequate in representing the data. The sigma-square (σ^2) on the other hand was significantly different from zero at 5 percent level, indicating a good fit and the correctness of the specified assumptions of the distribution of the composite error term. The observed significance of σ^2 conforms to Hjalmarson et al., 1996; Sharma, 1999; Rahman, 2003. The log likelihood function was estimated to be 95.36. This value represents the value that maximizes the joint densities in the estimated model.

Resource use efficiency of guinea fowl production

To determine the resource use efficiency, the Marginal Value Product (MVP) of each resource was computed and compared with their respect acquisition cost (Table 5). Given the level of technology and prices of both inputs and outputs, the marginal value productivity is the yard stick for judging the efficiency of resource use. A given resource is optimally allocated when there is no divergence between the MVP and its unit price. Thus, the marginal productivities of individual resource provides a framework for policy decision on resource adjustment and the difference between the MVP and the unit cost indicates the scope of resource adjustment to attain economic optimum. The result shows that for number of birds the ratio of MVP to MFC was greater than one, showing under-utilization, for cost of feed and cost of medication the ratios of MVP to MFC was less than one showing over utilization while for cost of hired labor there was gross inefficiency and over utilization (Table 5).

Conclusions and Recommendations

This study showed that most of the guinea fowl farmers had their age ranged between 21 and 70 years and were educated. Majority of the respondents had their household size ranged between 6-10 members. The stochastic analysis showed that the number of bird, cost of feed, amount spent on hired labor and cost of medication were the major factors in guinea fowl production. The mean efficiency estimates indicated that the guinea fowl farmers in the study area were technically efficient. While the estimates of the returns

to scale obtained indicated positive decreasing returns to scale. Guinea fowl farmers in the study area were not economically efficient in the use of their production resources; it is recommended that special attention should be given to improve the efficiency of guinea fowl farms with large flock size holdings. This could help increase guinea fowl production and reduce under utilization of the birds stocked. These results call for policies aimed at encouraging new entrants to guinea fowl farming and the experienced ones to remains in farming. Micro credit from governmental and non governmental agencies should be made available to rural farmers, for this will go a long way in addressing their inefficiency problems so that positive impact on profitability of the enterprise is enhanced.

The findings of the study revealed that guinea fowl production was profitable. However in order to improve profitability, farmers need to make inputs use more efficient by reducing the level of employment of inputs. However, there is the need to reduce feed and labour costs which formed the major cost components. Some ways of achieving these is for the government to subsidize feed; livestock research centers and State Agricultural Developing Programmes should develop genetically improved breeds of poultry which efficiently convert feed. The results highlight the need for all stakeholders to play active role in ensuring the survival and sustainability of the emerging guinea fowl industry in the State. In view of meeting the increasing demand for protein intake and the yawning gap between demand and supply of guinea fowl in the region, financial leverage should be made available for guinea fowl farming as an alternative poultry. This will make funds to be available to the enterprise.

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