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Optimum Productivity of Labor and Cost Analysis of Chicken Production in Kaduna State, Nigeria

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Abstract

Chicken production was a source of labor employment as revealed by the study. The optimum productivity of labor employed in chicken production differs between chicken production categories, the optimum productivity of labor in broiler production was1431 birds per labor per farm/year, pullet was 1080 per labor and 1599 layer per labor. The Average Total Cost (ATC) and Marginal Cost (MC) in chicken production decline as chicken output increases; the study also reveals that economies of scale existed in chicken production in the study area. MC, MR relationship revealed a profit maximizing position of chicken producers in the study area. The study recommends that optimum productivity of labor should be adhered to by the chicken producers in order to minimize cost and maximize profit.

Keywords: *Chicken production, Cost, Optimum productivity, Revenue and Profit*

Introduction

Chicken production in Nigeria was considered as one of the important sub sector due to its relevance in providing employment for the job seekers, creating business opportunities for entrepreneurship and a major source of protein from meat and egg which was considered to be one of the most nutritious food intake and acceptable by the major religions in the country (Ohajianya *et al*, 2014). Apart from generating quick economic return to

the producers, the subsector provides direct jobs opportunities to the greater number of Nigerian populace and it also generate substantial income to those working under the sector (Afolabi *et al*, 2013) and (Abiola, 2007). Sahel (2015) described the Nigerian poultry industry as one of the largest in Africa because of the huge capital that involved which was estimated to the tune of ₦80 billion ($600 million), the industry products comprises 165 million birds that produced 650,000 metric ton (MT) of eggs as the largest in Africa and 290,000 MT of poultry meat as the second largest, after South Africa.

Chicken subsector in Kaduna state provides employment opportunities to over 50 percent of the people mostly at subsistence level (Tabari and Abuga, 2017). Commercial chicken production was categorized in to small, medium and large scale enterprises in Kaduna state, but the majority of the chicken producers fall within the category of small and medium scale producers. This subsector has an advantage over other livestock sector in providing income and greater employment opportunities to the good number of people in Kaduna state (Emaikwu *et al*, 2012).

Labor is an important factor input in chicken production, its employment varied according to farm operations, the optimal productivity of labor determined by the chicken output produced in a given farm. The optimal productivity function of labor employed in chicken production was analyzed in general and later analyzed separately by the category of chicken production such as broiler production, pullet production and layer production. The analysis was based on physical product analysis of chicken production and labor employed per farm. Other parameters used are Marginal Cost (MC) and Marginal Revenue (MR) analysis.

Problem Statement

Chicken production in Nigeria in general and Kaduna state in particular with numerous challenges ranging from inefficiency in production, low profitability, marketing, government policy, infrastructures decay, high cost of feed and other input used in the process of chicken production. Other problems includes poor breed, low eggs and poor weight as a result of diseases and pest, poor quality feeds and inefficiency of management, lack of capital, risk and uncertainty of the business that arises from price fluctuations, unexpected depreciation of investment, unstable supply of quality feeds, others includes optimum productivity of labor to be employed in chicken production, cost analysis and

inability to of the chicken producers to maximizes profit and minimizes cost. These and many more challenges have affected the productivity, efficiency and profitability of the business despite the growth in the demand for chicken output. This could be the reason why the subsector contribution to GDP over the years remains at 10% (Achoja 2012) and (Heise *et al,* 2015)

Objective of the Study

1. To determine the optimum productivity function of labor in chicken production
2. To determine the marginal cost (MC) and marginal revenue (MR) of chicken production.

Methodology

Study area description: The research was conducted in Kaduna State as one of the 36 state in Nigeria. It has 23 local governments with population 8 million (Kaduna state 2015). The state covers an area of about 48,473.2 kilometres and occupies the central portion of northern Nigeria and lies between latitude 90 and 140 north of the equator. The state extends from tropical grassland (savannah) in the south to Sudan savannah in the north. The savannah region covers the southern part with vegetation and tall trees. The Sudan savannah covers the northern part with veldt grass and short tress. The state has arable land of about 4.5 million hectares and only 2.02 million hectares are in actual cultivation. More than 70 percent of the work force earns their livelihood from the production of food crops, cash crops and livestock (Kaduna State 2010). Commercial poultry production is receiving wider popularity and acceptability by day as a result of the growing demand for poultry meat and egg (KADP 2013). The research considered 9 local government areas where commercial poultry producers concentrated, 3 local governments from zone one (northern zone) which comprises Zaria, Sabon gari and Lere local governments. Four local government from zone two (central zone) which comprises Kaduna North, Kaduna South, Igabi and Chukun. The two local governments from zone three (southern zone) were Kachia and Sanga respectively.

Source of data collection: This study was cross sectional survey that gathered information from farm records, questionnaire and supplementary interview administered to the commercial chicken producers in Kaduna state, which also served as primary sources of data. The used of publications, documents, journals, library materials and sources of secondary data.

Sample procedure: A stratified random sampling procedure was applied. Where by chicken producers were divided into areas and randomly selected based on years of chicken production experience (minimum of 10 years) and

must be commercial chicken producers and based in Kaduna state from the selected 9 local government areas that covered by the study and the respondents' rate of the questionnaire was 71% as indicated in table 1.0

Table1.0 Response Rates of the Distributed Questionnaires

Response Rate	Frequency	Percentage (%)
Response	166	71
Non Response	84	29
Total	**250**	**100**

Sources: Primary Data, 2015

The farm location for the chicken production activities is indicated in table 1.1 above that the majority of the chicken producers whose questionnaires were returned were from Kaduna North and Kaduna South, followed by Igabi and Zaria local government respectively. The choice of these local governments was due to the concentration of people and chicken farms, nearness to market and availability of resources in these local government areas as confirmed by the (KADP 2007).

Table 1.1 Returned Questionnaires by Chicken Farms

Local Governments	Frequency	Percentage	Cumulative Percentage
Chukun	14	8.4	8.4
Igabi	21	12.7	21.1
Kachia	16	9.6	30.7
K/ North	25	15.1	45.8
K/ South	24	14.5	60.2
Lere	18	10.8	71.1
Sabongari	15	9.0	80.1
Sanga	14	8.4	88.6
Zaria	19	11.4	100.0
Total	166	100.0	

Sources: Primary Data, 2015

Table 1.2 indicated the types of chicken production in the study area, where broiler production farms constitutes 33.1%, pullet farms 4.2% and layer farms 62.7%

Table 1.2 Type of Chicken Production

Poultry Production		Frequency	Percent	Cumulative Percent
	Broiler	55	33.1	33.1
	Pullet	7	4.2	37.3
	Layer	104	62.7	100.0
	Total	166	100.0	

Sources: Primary Data, 2015

Method of Data Analysis

This study determined the optimum productivity function of labor employment in chicken production which was analyzed based on the chicken output and number of labor employed, while cost and revenue determination was obtained by the use of cost and revenue analysis through marginal cost and marginal revenue approach. MC = $\delta Tc/\delta q$ and MR = $\Delta tr/\delta q$

Result and Discussion (Objective one)

The analysis was based on physical product analysis of chicken production and labor employed per farm. Other parameters used are Marginal Cost (MC) and Marginal Revenue (MR) analysis

Figure: 1 Optimal Productivity of Labor employed in chicken Production

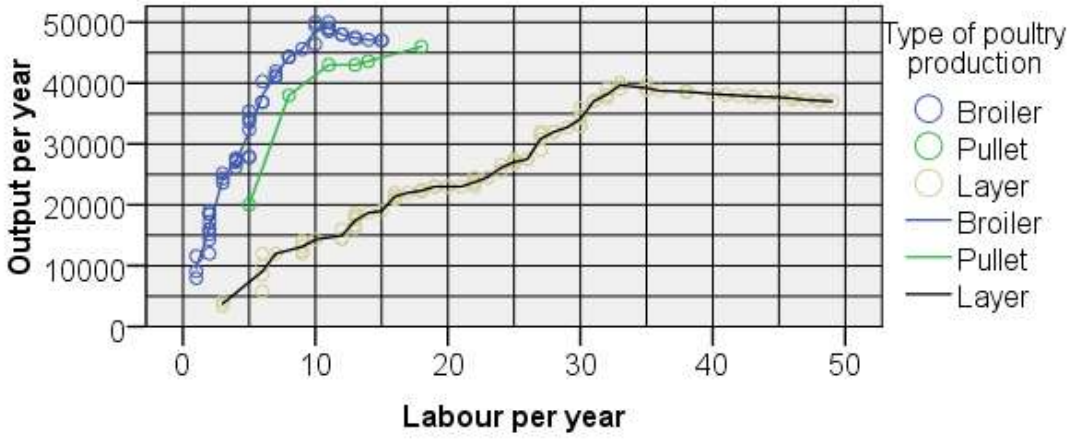


Figure 1 showed the average output and labor employed in each category of chicken production. In layer production, the productivity of 34 labors was 40,000 layer birds per farm. Broiler production of 50,000 was by 10 labors per

farm, the nature of pullet production was almost the same with that of broiler production with less than 15 labor produced 45,000 pullet outputs.

Table 4.1 Output, Costs and Revenue Analysis of Chicken Production

Poultry production	Broiler production	Pullet production	Layer production
Total Physical Product (TPP)	40,056	38,933	39,982
Laboe Employed	7	12	25
Fixed Costs (FC)	191,869.20	681,894.67	107,923.89
Variable Costs (VC)	15,995,548.40	27,464,683.33	53,027,673.81
Total Costs (TC)	16,187,417.60	28,146,578.00	53,135,597.71
Average Fixed Costs (AFC)	4.79	17.51	2.7
Average Variable Costs (AVC)	399.33	705.43	1326.29
Average Total Costs (ATC)	404.12	722.95	1328.99
Marginal Cost (MC)	164.82	6,562.64	273.10
Total Revenue (TR)	31,005,213.7	47,778,167	326,895,551
Average Revenue (AR)	774.02	1227	8176
Marginal Revenue (MR)	929	1647	6825

Sources: Primary Data, 2015

Table 4.1 indicated the physical product analysis of chicken production and optimum productivity of labor employed in each category of chicken production in the study area. Average labor employed per farm in the study area (L), the Total Physical Product (TPP), costs and their averages as well as revenue averages.

Optimum productivity of Labor Employed in Broiler Production

Table 4.2 indicates the Total physical product (TPP), average physical (APP), and marginal Physical product (MPP) of the broiler production with the optimum productivity of labor employed per farm per year.

Table 4.2 TPP, APP and MPP of Broiler Production and Labor Employed

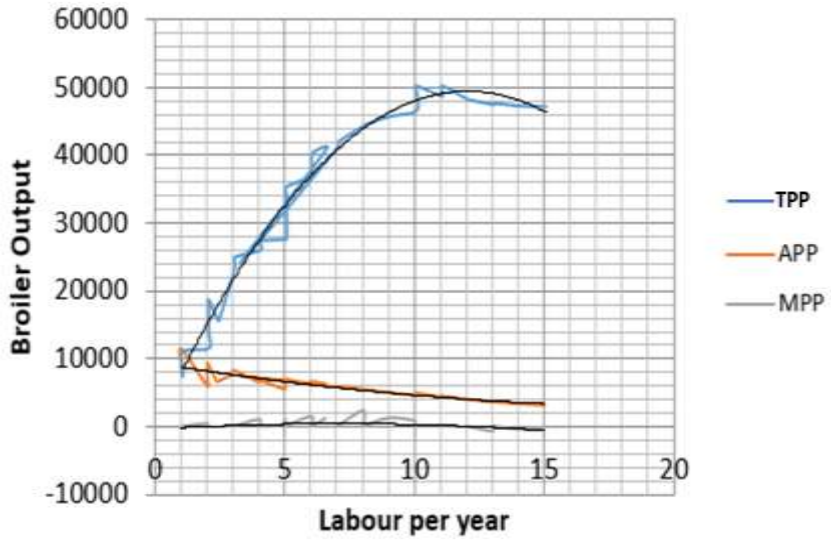
Poultry products	Broiler birds
Total Physical Product (TPP)	40,056
Labor (L)	7

Average Physical Product (APP)	5722
Marginal Physical Product (MPP)	747

Source: Primary Data 2015

Table 4.2 indicates that the TPP of average broiler production was 40,050; the APP of labor was 5722 birds per farm, per year. This corresponds to about 1431 birds per labor per farm, since most of the broiler producers in the study area had 4 batches of broiler production in a year. This finding contradicted Mnimekalai (2010) and TNAU (2009) on optimum productivity of labor to a 1000 chicken birds per labor and contrary to Pawaria and Jheeba (2015) where 3117 birds per worker The MPP is 747 for 1 additional labor. Broiler MPP was lower than the APP and therefore, suggests that the optimum productivity of labor employed in broiler farms was 12 labor in the production of 50,000 broiler output as indicated in figure 2.

Figure. 2: TPP, APP, MPP and labor employed in Broiler production



The APP of labour in broiler production farms began with 1 labour where the APP was at 9000 broiler birds per farm, per year, but when more labours were employed to 15 workers the TPP decline to 46,000 and APP to 3,200 broiler birds per farm. This indicated that the average physical productivity of labour was 200 of broiler birds produced per labor, when APP of broiler production was declinimg the MPP was at zero level (Tabari and Abuga, 2017).

Optimal productivity of Labor Employed in Pullet Production

Table 4.3 indicated the Total physical product (TPP), average physical (APP), and marginal Physical product (MPP) of the pullet production and the labor employed per farm / year.

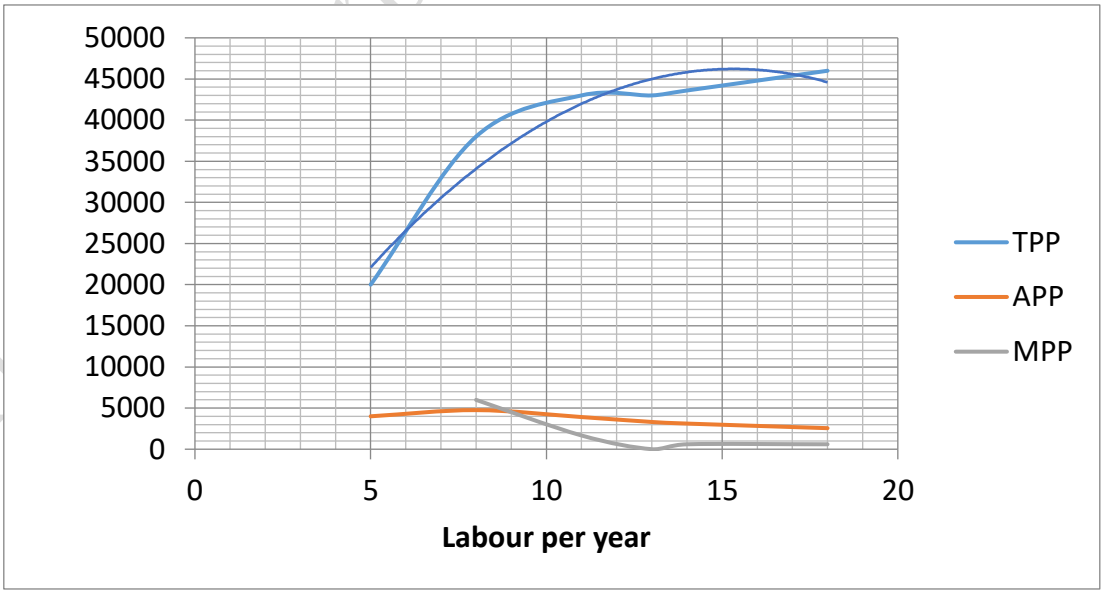
Table 4.3 TPP, APP and MPP of Pullet Production and Labor Employed

Poultry products	Pullet birds
Total Physical Product (TPP)	38,933
Labor (L)	12
Average Physical Product (APP)	3244
Marginal Physical Product (MPP)	1773

Sources: Primary data, 2015

The TPP of labor was 38,933 pullet birds per farm per year, produced by 12 labors or workers. The APP of labor in pullet production per farm was 3,244 in a year, which is 1,081 birds per labor which is in line with Aboki *et al* (2003), since the pullet producers has 3 batches per year in the study area. The MPP of labor on the other hand was 1,773 pullet birds per added labor force as indicated in table 4.3.

Figure 3:TPP, APP, MPP and labor employed in Pullet production



Sources: Primary Data, 2015

Figure 3 indicated the TPP of labor was 45,000 pullet output produced by 15 labors. At 10 workers, 42,000 pullets were produced but when quantity of pullet birds increased to 45,000 the number of workers increases to 15. Optimal level of pullet production was at a point where APP = MPP where 9 workers were employed to produced 5000 pullets and each labour produced 533 pullet birds per farm and the optimum level of labor employed in production of 45,000 pullets was 15 workers, any additional labor beyond that level, the TPP, MPP and the APP curves declined as indicated in Figure 3.

Optimal Productivity of Labor employed in Layer Production

Table 4.4 indicated the (TPP), average physical (APP), and marginal Physical product (MPP) of the layer production and labor employed per farm within a year.

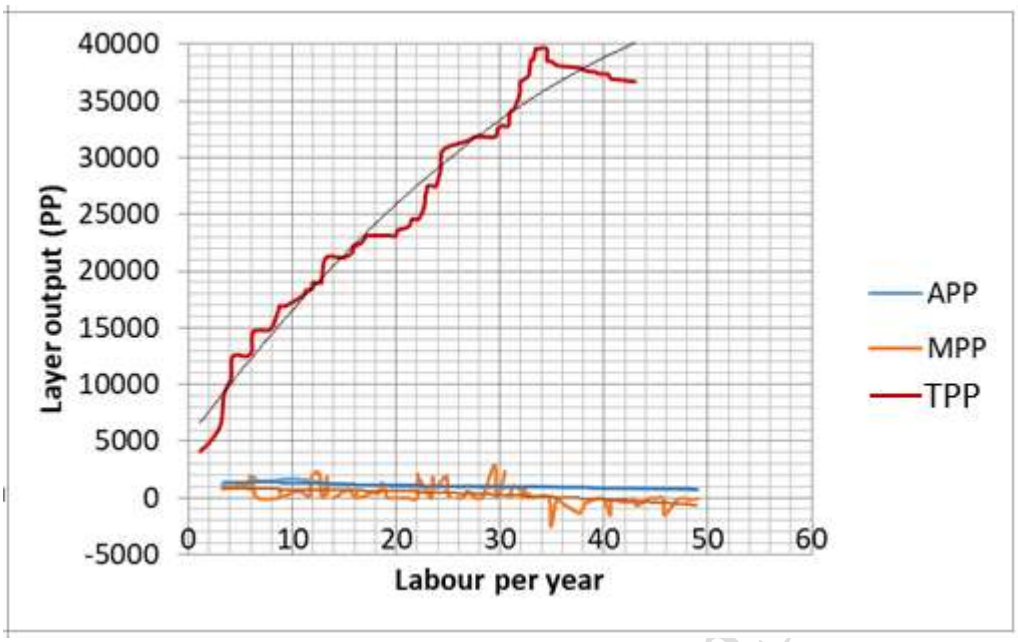
Table 4.4 TPP, APP and MPP of Layer production and labor employed

Poultry products	Layer birds
Total Physical Product (TPP)	39,982
Labor (L)	25
Average Physical Product (APP)	1599
Marginal Physical Product (MPP)	1163

Sources: Primary Data, 2015

The TPP of layer was 39,982 layer birds per farm per year produced by approximately 25 workers. The APP value showed that each worker was able to produced 1,599 layer birds per farm per year and this is above the suggested range of 1000 birds per labor. The additional output for an additional worker MPP was 1163 which is less than the APP, implying that optimal level of production exists (Kakade *et al*, 2011)

Figure 4:TPP, APP, MPP and labor employed in layer production



Sources: Primary data, 2015

Production of layer birds in Figure 4 indicated that the optimal productivity of labor employed in layer production was 34 workers for the production of 40,000 layer birds. The adjusted APP curve does not meet the adjusted MPP and the MPP was below the APP. At 1,400 layer birds 4 labor units were employed, but when 43 labor units were employed the TPP declined to 37,000 layer birds with the APP of 860 layer birds per farm, the MPP at the lowest level of labour on the other hand was 800 layer birds per farm, the MPP was zero when 36 workers were employed, then it started going into negative. Based on the nature of APP and MPP the level of labour employed was at 34 workers, where each labour produced 1170 layer birds per farm per year and any additional labor attracts declined in TPP,APP and zero or even nagetive MPP as indicated in figure 4. This finding was contrary of the suggestion of (Douglas, 2004), (Dolberge, 2005), (TNAU, 2004) and (Prabakaran, 2003) of average productivity of labor is 1000 birds.

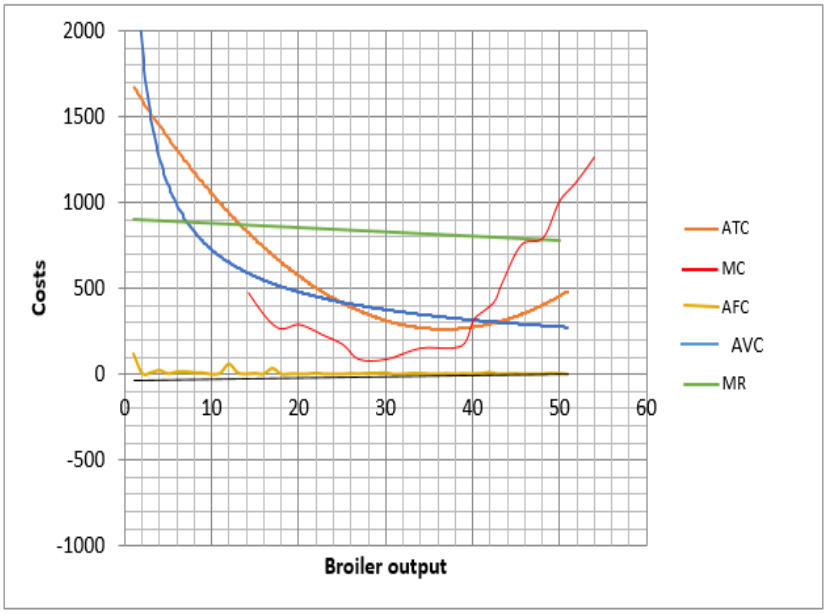
Objective two

Table 5.0 indicated the cost and revenue analysis of chicken production in Kaduna state. The analysis was based on the category of each chicken production and later explained by their respective curves of ATC, MC, AR and MR respectively.

ATC, MC, AR and MR Analysis of Broiler Production

Figure 5 indicated the nature of ATC, AVC, AFC, MC and MR of broiler production in the study area was downward sloping as more broiler birds were produced, which consequently reduces the cost of production. At 8,000 broiler production, the cost of producing one broiler bird was as high as N1700. At 40,000 broiler output the ATC is at its minimum (ATC ≈ MC) and therefore, this is the optimal level of production, where one unit of broiler was produced at lowest MC and additional production attracts zero cost. Beyond this optimal point, production is characterized with increasing MC and increasing ATC. The AVC was also declining as production of broiler output is increasing, while AFC was almost the same throughout the production period. Profit was attained at a point where MR=MC at 49,000 broiler output.

Figure.5: The ATC, AVC, AFC, MC and MR of Broiler Production curve



Sources: Primary Data, 2015

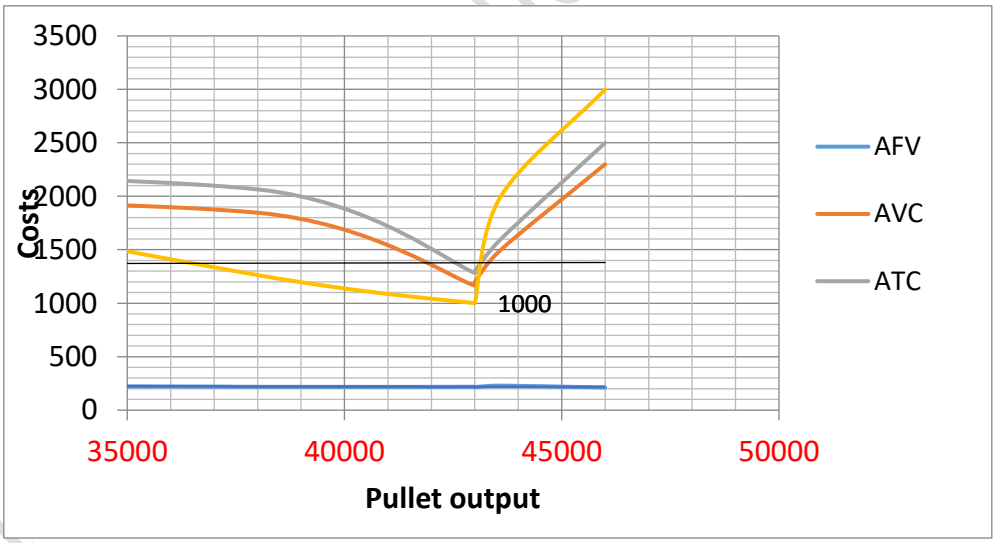
ATC, MC, AR and MR Analysis for Pullet Production

The ATC, AVC curves for pullet production were downward sloping which implies that an increase in the level of pullet bird production leads to decrease in the ATC and AVC, thus a reduction in the cost of production. The MC curve

for pullet production on the other hand rises at first to a maximum level and later falls.

The MC in pullet production was above the MR curve when production was below 36,000 pullet birds, after which, the MC was less than the MR which implies that the pullet farms were able to make profit at production above 36,000 birds. All the cost curves: MC, AVC, ATC fall continuously until production reaches 43,000 birds, beyond which, the cost curves begin to rise. The optimal level where MC = ATC it was also a profit maximizing point MR = MC. At this point, the pullet farms were producing 43,000 birds at an additional cost and at additional revenue. The curve showed that, beyond the profit maximization point, the production costs rise sharply above the revenue curve. This can be as a result of the nature of this type of chicken business. Farms must sell off all the production by the 18th to 20th week to the layer farms. If the available market is unable to absorb the production, the pullet farm will incur extraordinary costs that can greatly affects its profits as indicated in figure 6.

Figure 6: The ATC, AVC, AFC, MC and MR of Pullet Production curve



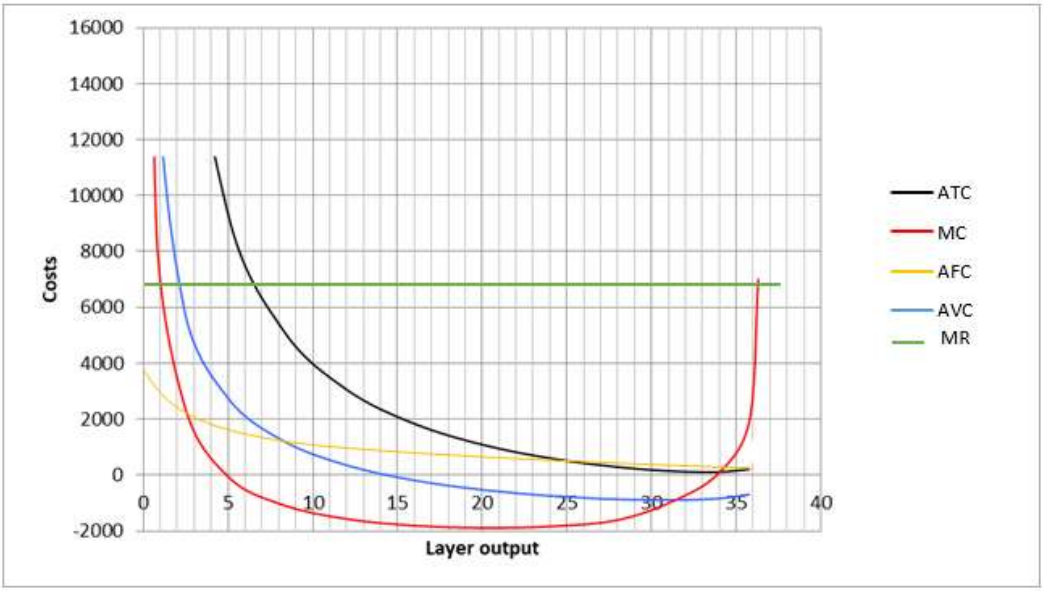
Source: Primary Data 2015

ATC, MC, AR and MR Analysis of Layer Production in Kaduna state

The ATC, AVC and MC in layer production indicated in Figure 7 showed downward sloping, implying that the cost reduces with the growth in layer production up to a point where MC was minimum at 34,000 layer output, at this

point farms can increase output at no extra cost. MR on the hand was 6,800 at 36,300 layer output a point where farms maximize profits, production beyond that point is characterized by profit decline because MC curve is above the MR.

Figure 7: The ATC, AVC, AFC, MC and MR of Layer Production Curve



Sources: Primary data, 2015

Conclusion and Recommendation

The research established that the optimum productivity of labor employed in chicken production differs by the categories of chicken production farms. The productivity of labor employed in pullet farms was 1,080 pullet birds per labor per batch, 1,431 broiler birds per labor in broiler farms per batch and in layer farms were 1599 layer birds per labor per year in the study area. Additional labor employed above those levels leads to diminishing returns and declined in output as well as loss of profitability as indicated by the curve, but at the same time the chicken producers in the study area have exceeded the average number of 1000 birds per labor. The chicken farms in Kaduna state were economic performing farms because they maximize profit at point where MC=MR.

The optimum productivity function of labor in farms should always consider productivity of labor employed, excess labor above the production requirement leads to diminishing returns, increases cost of production and loss in profit. Low labor in a large flock size may lead to neglect of the birds which may serve as a

serious setback in chicken production. The chicken producers should observe the cost and revenue trend with keen interest in order to avoid losses.

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