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Empirical Analysis of Broiler Production Function in Calabar, Cross River State Nigeria

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Abstract: The study was carried out to of determine the extent to which total weigh of broiler birds is explained by feed intake, mortality rate and floor space during the first four weeks, second four weeks and the eight weeks of rearing. Twenty-nine farms were purposively selected for the study. Relevant information in feed intake, feed price, mortality rate, floor space and price of live broiler were obtained. Data were collected from market surveys, farm records and direct measurements of weight and floor space using weighing balance and measuring tapes. Data analysis involved the use if descriptive statistics and ordinary least squares method. The linear models provided the lead equations for the first four and second four weeks of rearing while the double-log model provided the lead equation for the entire eight weeks of rearing. The variation explained 97, 92 and 98% of total variation in broiler weight gain during the first and second weeks and eight weeks of rearing respectively. Findings show that feed intake and floor space affected weight gain positively while mortality rate affected it negatively. The results further showed that the farms were not efficient in their production with regards to the amount of feed given to the broilers. The study recommends that, farms should increase the amount of feed given to broiler to maximize weight gain.

Key words: Broiler, production function, marginal value product (MVP), feed intake weight gain, mortality rate

INTRODUCTION

Feed is by far the largest item in the cost of broiler production usually representing between 60 and 70% of the total production cost. This is followed by chick cost, which ranges between 12.3 and 16.10%. Efficiency of feed utilization by broiler has been increasing steadily for a number of years partly because of the selection and breeding of chicken capable of rapid growth and partly due to better management and improved housing which have resulted in lower mortality rate[1-3]. Since feed contributes the largest cost in broiler production, the rate of feed conversion into poultry meat is very important[4-7]. Idiong [7] noted that the weight gain tended to be lower when birds are on restricted feeding implying that growth is directly governed by amount of feed consumed. Breed, temperature, management, crowding and energy level of feed however usually affect growth[8-11]. Gain in weight increase from day old until reaching a maximum at about the 8th week. Broiler birds make economic gains within ten weeks. Management must provide a good programme of disease prevention if successful broiler production is to occur [12,13]. This is due to the fact that broiler has a short growing period-too short for the birds to recover from disease outbreak prior to marketing time. North [11], had stated that healthy birds consume more feed and have better feed conversion than sick birds. Oluyemi and Roberts[14] reported that dead birds in proportion to their percentage of the total flock has a negative effect on total weight of broiler as it reduces it. Growth and feed conversion are inversely related to floor space per bird. Overcrowding broilers reduces weight. As floor per bird reduces, the weight of broiler produced tends to increase and this will increase up to a certain point where there will be increase returns on investment. A mature bird of weight 2.3 kg requires 0.09 $m^2$of floor space. Overcrowding should always be avoided as it breeds vice habits such as cannibalism, pecking and rapid spread of disease. Cannibalism induces nervousness thereby lowering feed consumption, feed conversion and consequently growth. On the other hand, over spacing leads to a lot of exercise which tends to reduce feed conversion since much of the energy will be used in moving about form place to place [14]. Thus, the objective

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of the study is to determine the extent to which total weight gain of broiler birds is explained by feed intake, mortality rate and floor space during the first 4 weeks; second 4 weeks and the 8 weeks of rearing and to determine if farmers were rational in their use of feed resource.

MATERIALS AND METHOD

Study area: The study was undertaken in Calabar, Cross River State. A total of twenty-nine (29) Commercial Poultry farms were involved in the study. The four commercial broiler breeds commonly kept in the farms were Anak, lohmann, Topbreed and S and D breeds.

Sampling procedure: Purposive sampling was undertaken to select the 29 farms for the study. The purposive selection was informed by the number of farmers that gave supports for the study. The farms were ready to stock at the time of the study and willing to make their records available.

Data collection: Data were collected daily for the 8 weeks period. The data collected include the stock number, price of day old chicks, price of feeds, cost of medication, feed intake and mortality rate. The weights of chicks were taken using a weighing balance and the floor spaces measured using measuring tape.

Data analysis: Data were analyzed using descriptive statistics such as means and percentages. Stepwise regression analysis was used to estimate parameters and the model is stated below:

$Y = F(x_1, x_2, x_3/ x_4, ---, xn)$ (1)

Where Y = Total weight gain in kilogrammes
X_1 = Total feed intake in kilogrammes
X_2 = Mortality rate
X_3 = Floor space in meters
X_4, ---, Xn = Fixed inputs.

Economic theory does not however specify the exact mathematical form. The estimation was based on suggested by[15]. The linear, log-linear, semi-log and exponential models were estimated.

Rationality model with respect to feed

$MPPx_1 = \Delta y/\Delta x$.....(2)

$$EP = \frac{\Delta y}{\Delta x_1}.\frac{x_1}{y}$$.....(3)

$MVP = MPP_{x1}.Py$.....(4)

Where:
Ep = Elasticity of production
MPP_{x1} = Marginal physicals product with respect to feed.
Py = Price of product
However, rationality in resource use occurs in stage II of the production frontier. At this point, $MVP = P_{x1}$;
Where P_{x1}= Price of the input

RESULTS

First four weeks of rearing: Table 1 summarize the stepwise regression results for the first four weeks of rearing. Step three of the linear function provided the lead equation in view of having highest R^2 and the parameter b_1, b_2 and b_3 being statistically significant.

Step 3 of the linear equation shown in Table 1 is the lead equation given the fact that the three parameter of interest bear the expected signs and are statistically different from zero. The estimated value of b_1 marginal product of feed is 0.316 during the first four weeks of rearing. The calculated t-statistic for b_1 3.352. This shows that feed intake was highly significant at 0.01 level. The elasticity of production was 0.401. The value of the parameters for mortality rate (b_2) is-3.536 and floor space (b_3) is 0.934. The parameters were mortality rate were statistically significant at 5 and 1% levels respectively.

Second four weeks of rearing: The result of the stepwise regression of the second four weeks of rearing shows that step 3 of the linear equation provided the best fit. The parameter of feed intake and mortality rate were statically significant. The results are shown in Table 2.

The marginal value product (b_1) for feed intake is 0.027 (t-statistic 7.901) during the second four weeks of rearing is statistically significant at 1%. The effect of feed intake on weight gain was positive; the sign conforms to *a-apriori* expectation. The elasticity of production is 0.332. The parameter for mortality rate (b_2) is -30.363 (t-statistic-2.383) and significant at 5%. The parameter for floor space b_3 in the lead equation is not significant.

The entire eight weeks of rearing: Analysis of the entire weeks of rearing shows that the step 3 of the double-log function is the lead equation. The equation had the highest R^2 values as well as the three variables significant. The R^2 value shows that 98.4% of the variability in the weight gain of broilers were explained by feed intake, mortality rate and floor space. The coefficient for feed intake (b_1) is 0.758 (t- Statistic. 8.412) during the entire 8 weeks of rearing. Since the coefficients are direct elasticity of production, the implication is that a 10% increase in feed intake increase total weight gain by 7.58%. The effect of feed intake on weight gain was positive and significant at 1%.

The parameter for mortality rate (b_2) had an elasticity of production-0.08 (t statistic 2.820) and significant at 5%. The parameter for floor space (b_3) is positive (0.281) and statistically significant at 5%.

Rationality in broiler production with respect to feed intake: The elasticity of production and the marginal physical with respect to feed intake for the first four weeks, second four weeks and the entire eight weeks were 0.401, 0.332 and 0.758 and 0.316, 0.270 and 0.268 respectively (Table3). The marginal value product for the entire eight weeks was 55.37.

DISCUSSION

Feed intake: The parameter estimates for feed intake for the study periods the first four weeks, second four weeks and the entire 8 weeks of rearing were 0.316, 0.270 and 0.268 respectively (Table 1-4). The parameter estimates were statistically significant at the 0.01 level. The elasticity of production (Table 4) shows that feed intake was inelastic during the periods (0.401, 0.332 and 0.758). The implication is a 10% increase in feed intake by broilers birds will result in a less proportionate increase in weight gain by 4.01, 3.32 and 7.58% during the study 1st 4 weeks, 2nd weeks and entire 8 weeks of rearing.

Mortality rate: Mortality rates (b_2) were -3.536, -30.363 and - 0.08 for the first four weeks, second four weeks and the entire eight weeks of rearing. Mortality rate was significant at the 5% level during the first four weeks and second four weeks but significant at the 1% level during entire eight weeks of rearing. The signs of the parameters were also negative. During the entire weeks of rearing, the elasticity of production was-0.08 implying that a 10% increase in mortality rate will reduce total weight by 0.8%. The above findings are in conformity with those of[16], which showed that mortality rate had a negative effect on weight gain.

Floor space: The parameter estimates for floor space (b_3) during the three periods were 0.934, 1.28 and 0.213 respectively. Although the parameter appeared in the lead equation for the second four weeks, it was not significant. It was significant at the 1% level during the first four weeks and at the 5% level during the entire eight weeks of rearing. The parameter estimate for the floor space for the entire eight weeks shows that the effect of floor space is inelastic (Table 3). This confirms a-priori expectation that successive increase in floor space will result in less proportionate weight gain.

Table 1: Stepwise regression result of the first four weeks (Linear function)

Stapes	Constant	X_1	X_2	X_3	R^2	Adj.R^2	Fvalue
1	9.358	0.380**			0.958	0.957	621.28**
	(8.355)	(0.015)					
2	16.332	0.387**	-1.857		0.960	0.957	315.91**
	(0.387)	(0.016)	(1.567)				
3+	21.408	0.316**	-3.536*	0.934**	0.974	0.971	313.19**
	(8.522)	(0.624)	(1.375)	(0.258)			

Sources: Result from study data.note:+lead equation. Significant at 1% ( ) = standard errors of estimates in parentheses

Table 2: Stepwise regression results of the second four weeks (Linear Function)

Steps	Constant	X_1	X_2	X_3	R^2	Adj.R^2	Fvalue
1	32.89	0.296**			0.906	0.902	101.461**
	(19.97)	(0.18)					
2	2861	0.296**	19.69		0.915	0.909	140.499**
	(19.45)	(0.021)	(11.49)				
3+	29.39	0.270**	-30.36*	1.28	0.924	0.915	259.420**
	(18.79)	(0.034)	(12.74)	(0.75)			

Source: Result from study data, note:+ lead equation* significant at 5% **Significant at 1%. ( ) = standard errors of estimates in parentheses

Table 3: Estimated Ep, MMP and MVP with respect to feed intake for the three study periods

Periods of Production			Ep	MPP	MVP
First	4	Weeks	0.401	0.316	
Second	4	Weeks	0.332	0.270	
Entire	8	Weeks	0.758	0.268	55.37

Source, computed from Tables 1-3

Table 4: Stepwise regression result of the entire 8 eight weeks of rearing (Double- log)

Steps	Constant	LnX_1	LnX_2	LnX_3	R^2	Adj.R^2	Fvalue
1	-0.763	0.963**			0.976	0.975	1093.70**
	(0.205)	(0.029)					
2	-0769	0.986**	-0.070		0.980	0.978	631.26**
	(1.910)	(0.028)	(0.031)				
3+	0.067	0.758**	-0.080**	0.218*	0.984	0.082	513.59**
	(0.369)	(0.090)	(0.028)	(0.083)			

Source: Result from field data.note: + Lead equation. *Significant at 5% ** Significant at 1%. ( ). Standard- error of estimates in parentheses

Rationality in broiler production: Table 4 had shown that the E_P with respect to feed for the study periods were 0.401, 0.332 and 0.758 with MPP of 0.316, 0.270 and 0.268 respectively. It also shows that the marginal value product per kg of broiler with respect to feed intake was N55.37 for the entire eight weeks of rearing. The value is however lower that the value of MVP of N137.752 gotten by[16]. The MVP was calculated based on the price of live broiler, which was N400.00 (given that average live broiler weight 1936 gm, therefore 1 kg will sell at N206.6). Furthermore, given that the price of live broiler finisher during the study period was N730.00 per 25 kg, therefore 1 kg of feed was sold for N29.2. From the above, it shows that the marginal value product of the entire eight weeks of rearing exceeded the cost of feed, therefore the farms were not rational in use of feed. More feed should have been given to the broilers.

CONCLUSION

The production function estimates of the relationship between weight gain in broilers and feed intake, mortality rate and floor space shows that the linear model provided the lead equation for the first and second four weeks of rearing. The double-log model provided the lead equation for the entire eight weeks of rearing. The estimated production functions showed that 97, 92, 98% of total variations in weight gain during the three study periods were explained by the three explanatory variables (feed intake, mortality rate and floor space) in each case. Feed intake had a positive effect on weight gain in broiler production. The effect of floor space on weight was positive and significant in the first 4 weeks and the entire eight weeks of rearing. The incremental effect was less proportional as the coefficient was inelastic. The marginal product of feed was greater than the cost of feed, the implication for the farms is that they were not efficient in the use of feed. The study recommended that to attain maximum weight gain more feed should be given during the entire eight weeks of rearing.

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