AMM -05

Economy of Broiler Production as Influenced by Stocking Density, Protein and Energy Levels, and Season

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Abstract
This study was carried out to assess the effect of stocking density, protein and energy levels,and season on the economy of broiler production. In a 6x3x2 factorial arrangement using completely randomized design, six diets with three metabolisable energy (ME kcal;/kg) and two crude protein(%) levels combination: 3106.00 and 23.00 (control, diet 1); 3112.00 and 21.70 (Diet 2); 2928.00 and 23.40(Diet 3); 2933.00 and 21.90(Diet 4); 3227.00 and 23.10(Diet 5); 3230.00 and 21.80 (Diet 6), were formulated. Three stocking densities (birds per m^2):10,Low SD (LSD); 12,Recommended SD(RSD); and 14, High SD (HSD), were used in Late Wet Season (LWS), August-November) and Late Dry Season(LDS,February-April). In a seven-week feeding trial, 576 one-week old broilers were assigned to the respective diets and stocking densities, at 32 birds per treatment, in each season. Live weight per m^2 (LW/m^2, kg), Feed cost per live weight (FC/LW, kg), Gross margin/m^2 (GM/m^2, ₦), Total Variable Cost/m^2 (TVC/m^2), were assessed. Data were analyzed using descriptive statistics and ANOVA at $_{\alpha 0.05}$.The LW/m^2 was highest ($p>0.05$) for birds on HSD in both seasons. Birds on diet 4 had highest LW/m^2 and lower FC/LW during LWS, while those on diet 1 had highest LW/m^2 and lower FC/W during LDS. Birds raised on HSD had highest LW/m^2 during both seasons, while those raised during LDS had highest Gm/m^2. Late dry season (LDS), RSD&HSD had higher Gm/m^2. Total Variable Cost was highest for LWS at HSD and least for LDS at LSD.Broiler production is more profitable during late dry season at stocking 14 birds/m^2 with diet containing 3106 MEkcal/kg and 23.0% crude protein.

Keywords: Economy, stocking density, protein, energy, season

Introduction
The productive and economic performances of broiler chickens are under the influence of genetic make-up and environmental factors (climate, housingcondition, management and nutrition). The focus on maximizing productivity, production efficiency and profitability led to the development of intensive animal rearing conditions (Verspecht *et al.*, 2011). Under tropical conditions, birds are exposed to marked seasonal changes in the thermal environment. Combination of high ambient temperature and relative humidity causes major environmental distress in poultry, impairing their performance (Ajakaiye *et al.*, 2010).

Broilers exposed to excess heat decrease feed intake to reduce metabolic heat production resulting in slower growth, and reduced muscle yield per unit area. Apart from its effect on the physiological and productive performance of birds, production and yield of the major livestock, feed raw materials are dictated by prevailing climatic elements. Poultry feed prices have been observed to vary with seasons where prices are inversely proportional to national grain production levels (Njoroge *et al.*, 2015). Additionally, cost of other poultry inputs (day old chicks, litter and brooding materials) are also affected by season and festive period. However, prices of poultry products have been static or declining because of the large numbers of producers producing small quantities of outputs, and competition by imported frozen chickens whose prices are sometimes lower than the cost of domestic production (Shittu *et al.*, 2004). Although in higher stocking densities, the productive performance per chicken decreases, but total production of meat per unit floor surfaces increases, which result in higher economic efficiency of broiler production in higher stocking densities (Skrbic *et al.*, 2009).Energy and protein are two main feed constituents that can affect all production parameters and hence economic returns (Kamran*et al.*, 2008). These constituents are the major factors that influence the cost of chicken ration.

This study was therefore carried out to assess the effect of stocking density, protein and energy levels, and season on the economy of broiler production.

Materials and Methods
The experiment was conducted at the poultry unit of the Teaching and Research Farm, University of Ibadan, Nigeria. The periods of the experiment were August to November (Late wet season (LWS) with an average temperature of 25.44^{0}Cand relative humidity of 83.52%, and February to April (Late dry season(LDS) with an average temperature and relative humidity of 27.77^{0}C and 74.34% respectively.

The experimental design was a complete randomized design (CRD) in a 6× 3×2 factorial arrangement.Six diets with three metabolisable energy (ME kcal;/kg) and two crude protein(%) levels combination: 3106.00 and 23.00(control, diet 1); 3112.00 and 21.70(Diet 2); 2928.00 and 23.40(Diet 3); 2933.00 and 21.90(Diet 4); 3227.00 and 23.10(Diet 5); 3230.00 and

21.80 (Diet 6), were formulated.Three stocking densities (birds per m²):10, LowSD (LSD); 12, RecommendedSD (RSD); and 14, HighSD (HSD), were used.

For each season, five hundred and seventy six (576) one- week old Arbor-Acre broilers were assigned to the three stocking densities and six diets interaction at the rate of eight (8) birds per interaction unit with four replicates each. Birds were housed in an open sided house. Thermo hygrometers were placed at strategic points to monitor temperature and relative humidity. Vaccination and medication were administered as recommended by the hatchery operator. Feed and water were provided *ad libitum*. Records of feed intake and birds' weight were taken weekly, while mortality record was taken daily. The cost of the following variable items and operations were kept: Day old chicks, drugs and vaccine, brooding materials, labour, feed, and transportation. These in conjunction with some growth performance parameters were used to determine the economy of feed and space. Gross margin analysis was used to determine profitability as described by Olukosi and Erhabor (1988).

Data generated were subjected to analysis of variance using General Linear Model (GLM) of SAS soft ware 9.2 (SAS 2008). Significantly different means were separated using Duncan Multiple Range (DMR) test, with level of significance set at $p< 0.05$.

Results and Discussion

Table 1 shows the effects of stocking density, protein and energy levels and season on the economy of broiler production. Season and energy and protein levels (diet) had no significant effect on the live weight per meter square (Lw/m²), however birds on HSD had significantly higher (p>0.05) Lw/m²(28.86kg) than LSD (21.68kg) and RSD(25.79kg). Feed cost per live weight (FC/Lw) was lower (p>0.05) during LWS,on diets 3, 4 and 6; LSD and RSD. Late dry season(LDS) RSD,HSD had higher gross margin per meter square(Gm/m²) while there was no significant difference in the Gm/m² among the diets. There were significant interactive effects (p>0.05) of season and stocking density on the space and feed economy with birds raised on HSD having highest LW/m² during both seasons while birds raised during LDS had highest GM/m².There were also significant interactive effects of season and diet on the economy of broiler production. However there were no interactive effects of SDx Diet and Season x SD x diet on the economy of broiler production.

Table 1: Effects of stocking density, protein and energy levels and season on economy of broiler production.

Main effect		LW/M²	FC/LW (₦)	Revenue/m² (₦)	TVC/m² (₦)	GM/m² (₦)
Season	LDS	25.11	217.46^{a}	11551.69	9151.49^{b}	2390.27^{a}
	LWS	25.57	213.66^{b}	11762.84	9971.00^{a}	1791.83^{b}
	SEM	0.34	0.99	157.52	133.69	59.73
Stocking density (bird/m²)						
	10 (LSD)	21.68^{c}	213.67^{b}	9853.84^{c}	7981.69^{c}	1872.18^{b}
	12 (RSD)	25.79^{b}	213.61^{b}	11845.48^{b}	9594.12^{b}	2251.36^{a}
	14 (HSD)	28.86^{a}	219.65^{a}	13272.44^{a}	11107.93^{a}	2144.49^{a}
	SEM	0.34	0.99	157.52	133.69	57.93
Diet	1	25.50	219.80^{a}	11730.58	9737.87	1992.70
	2	25.11	219.76^{a}	11548.49	9642.71	1905.78
	3	25.19	209.52^{b}	11547.98	9441.86	2147.88
	4	25.11	210.29^{b}	11549.45	9337.30	2170.48
	5	25.60	219.11^{a}	11775.43	9631.55	2143.88
	6	25.55	214.88^{ab}	117512.66	9576.18	2175.47
	SEM	0.34	0.99	152.52	133.69	59.73
Interaction						
	Season × SD p-value	0.03	0.026	0.02	0.054	0.04
	Season × Diet p-value	0.0035	0.0038	0.002	0.039	0.0004
	SD × Diet p-value	N/S	N/S	N/S	N/S	N/S
	Season × diet × SD p-value	N/S	N/S	N/S	N/S	N/S

a-c,: Means on the same column with different superscripts are significantly different (p<0.05). LDS: Late Dry Season; LWS: Late Wet Season. SEM: Standard Error of Mean, , D1- Recommended protein & energy; D2- Lower protein & Recommended energy; D3- Recommended protein & lower energy; D4- Lower protein & lower energy; D5- Recommended protein & higher

energy; D6- Lower protein & high energy; TVC: Total Variable Cost. ; LW: Live Weight; GM/m^2- Gross margin per meter square; SD-Stocking Density.

The space economy as indexed by LW/m^2 increased linearly with each increase in stocking density in agreement with the observation of Mitrovic *et al.* (2010). There was an increase of between 1.54 and 2.06kg live weight for each additional bird produced per m^2.Higher Fc/Lw during LDS is a reflection of the high cost of feed ingredients during off-season (Feb-April). Prices of agricultural produce usually fluctuate with season of production with fall in prices during harvesting and price increase within few month of harvest and heightened at the commencement of land preparation and planting (Njoroge *et al.*, 2015). The higher FC/Lw by birds on the recommended and higher energy levels attested to the fact that the cost of broiler diets is influenced greatly by energy sources and levels (Skinner *et al.*, 1992). The higher gross margin(Gm/m^2) during LDS was due to the fact that apart from cost of feed; drug and vaccination other major items of the variable cost(Day-old-chicks, brooding materials and labour) were higher during later wet season(LW) while selling prices were the same for the two seasons and the live weight per meter square (LW/m^2) were not significantly different between the seasons. The higher Gm/m^2 recorded by birds on the RSD and HSD was due in part to the higher final live weight(FLW) by birds on the RSD and LWS.This is in agreement with the observation of Mehmood *et al.*(2014).The higher total production of meat per unit of floor space by birds on HSD, during LDS which was in agreement with the submissions of Skrbic *et al.* (2009) that in higher stocking densities the productive performance per chicken decrease, but total production of meat per unit of floor surface increases,which result in higher economic efficiency of broiler production in higher stocking densities. The higher Gm/m^2 observed for the HSD(14birds/m^2) during LDS over the HSD during LWS must have been due to the higher TVC/m^2 occasioned by the higher cost of day-old chicks, brooding materials and labour during LWS.

Conclusion and Recommendation

Season and stocking density singly and interactively affect profitability of broiler production. Broiler production is more profitable during late dry season at stocking density 14birds/m^2 with diet containing 3106 MEkcal/kg and 23% crude protein.

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