Optimum poultry enterprise combinations among small holder farmers in Osun State, Nigeria

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Abstract

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Poultry farmers are confronted with choice for efficient allocation of farm resources between the different enterprises so as to optimize production objectives. The study therefore, was focused on optimum poultry enterprise combinations among small holder farmers in Osun State, Nigeria. Primary data were collected using questionnaires and were analyzed using descriptive statistics, budgetary technique and linear programming model. Of the seven poultry enterprises identified, the most profitable enterprise combination was that of layers/broilers with a benefit cost ratio of 1.92 while the enterprise that yielded the least net farm income was the sole cockerel which had a benefit cost ratio of 1.57. The profitability of sole and combined poultry enterprises was limited by high cost of production in which the feed cost constitutes more than three-quarter of the total cost. Although, the optimal poultry enterprise combination was layers/broilers, the farmers in the study area attested to the fact that poultry business was still highly profitable. It is therefore recommended that both farmers and government must partner to find a means of reducing feed cost by financing poultry research. Also, poultry farmers should concentrate and intensify their poultry combination practices especially that of layers/broilers, which may be the appropriate optimal combination enterprise.

Keywords: Poultry enterprise, small holder farmers

Introduction

Livestock sector plays a crucial role in rural economy and livelihood. This is one sector where the poor contributes to the growth directly instead of getting benefit from growth generated elsewhere. In Nigeria, the livestock sector forms an important livelihood activity for most of the farmers, supporting agriculture in the form of critical inputs, contributing to the health and nutrition of the household, supplementing incomes, offering employment opportunities, and serving as a store of wealth in times of need. It acts as a supplementary and complementary enterprise. It is also an important part of agriculture diversification and income enhancement as it plays a vital role in the overall economic development of the farm households and nation as a whole. The prolificacy of livestock which include;

cattle, sheep, goat, pig and poultry are the influencing factors for rearing them. The returns are quick; losses, if any, are recovered soon and the poor can afford them. The multiple species-animal husbandry system is also environmental friendly. Income from livestock production contributes a significant percentage of the total income of rural farm households engaged in agricultural production. In Nigeria, livestock resources consists of about 14,000,000 cattle; 34,500,000 goats; 22,000,000 sheep, 3,500,000 pigs; 100,000,000 poultry (Amos, 2006). However, It was discovered that the number as increased to approximately 160 million birds, which produced 650, 000 metric tonnes of eggs and 290,000 metric tonnes of poultry meat in 2013 (Sahel, 2015). From this figure, poultry accounted for 58.2 percent of the total livestock production.

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This indicates the important place of poultry sub-sector in the livestock sector. Ezeibe (2010) reported that poultry production is a very important arm of the livestock sector as poultry has high feed conversion rate, high fecundity and contributes high to economic gains of the operators in Nigeria. He stressed further that poultry production enjoys high interest among livestock production and the meat has high demand in Nigerian markets because of its nutritional facility. In Nigeria, poultry contributes about 15 percent of the total annual protein intake with approximately 1.3kg of poultry products consumed per head per annum. The poultry industry has assumed greater importance in improving employment opportunities and annual food production in Nigeria (Ologbon *et al.* 2012). An earlier report by Mbanasor (2002) showed that about 10 percent of the Nigerian population is engaged in poultry production, mostly subsistence and small or medium sized farms. It is observed that apart from the provision of direct employment and livelihood to thousands of people, the laying birds industry provide remarkably high quality nutritious food especially animal protein in discrete convenient and hand packets known as eggs. Meat and egg production has evolved as one of the most efficient industries producing food. World chicken production was put at 8 billion per year and records further showed that each person in USA consumes about 15kg of chicken meat and over 300 eggs per year (Ajibefun and Daramola, 2000).

Small holder farms are known for low level of operations, illiteracy of operators and labor intensive production (Olatomide, 2010). Experience has shown that small farms out-yield large farms on calorie output per hectare and are therefore more efficient (Olatomide, 2010). Even though

smallholder farmers' access to agricultural innovations is often limited by unfavorable economic, socio-cultural and institutional conditions, they have achieved some level of efficiency through deployment of their indigenous knowledge (Afolabi *et al.*, 2013). If provided the right inputs, feasible technology and relevant information, they are capable of transforming traditional agriculture. Chukwuji (2008) shows that small-holder farmers combine two or more enterprises because they are more profitable than sole enterprises. Enterprise combination has been broadly defined by Agboola (2004) as encompassing the arrangements of crops, or the distribution of plants and animals in time and space as dictated by some factors like ecological situation, market forces, culture etc. However sustainable enterprise combination is the freedom to access and combine on farm production factors and practices that are compliant with natural laws that lead to increased production of crop and livestock products sufficient for local and export markets. A sustainable enterprise combination must ensure increased food production, productivity and income, while simultaneously protecting the environment (Agboola, 2004). Creating and increasing diversity plays a key role in promoting resilience against unfavorable and uncertain ecological and/or economic conditions. Therefore, greater emphasis upon efficient utilization of the existing resources and combination of enterprises in an optimal manner in the Agricultural sector is paramount (Gunther *et al.*, 2001). Many of the farm enterprises are associated with low incomes due to price fluctuations, poor utilization of scarce production resources and increasing land sub-division. To improve the low farm incomes, farmers have gradually diversified their farming activities by adopting other enterprises

perceive to be high yielding with high market value. Farm diversification at optimal level therefore remains one of the best alternative strategies to alleviate poverty through increase and stable farm income under conditions of resource constraints and price instability. Poultry farming in Nigeria is characterized by mixed poultry farming. Several farmers diversify with the aim of reducing risk and increasing profitability. The principles of enterprise combination in farm management is often confronted with the problem of what enterprise should take up, how far should we go in combining the enterprise with another or replacing an enterprise, depend partly on the interrelationship between different enterprises and the price of products and inputs (Adejobi and Kormawa, 2003). It is a known fact that a typical farmer anywhere in the world has limited level of resources. He is faced with the problem of myriads of choices for allocating farm resources between the different enterprises so as to optimize production objectives by making efficient utilization of the available resources and combining the enterprises in an optimal manner. Identifying the best farm plan is a difficult task for small scale farmers with low level of literacy (Ohajianya and Oguoma, 2009). In a regional/ inter-regional frame work, linear programming approach has been used for studies in optimum resource allocation and resource requirement in many countries (Onyenweaku, 1980; Alam, 1994; Alam *et al.*, 1995; Schipper *et al.*, 1995 and Sama, 1997). Within Nigeria, application of linear programming models to farm enterprises in various states has also been reported (Osuji, 1978; Tanko, 2004; Igwe *et al.*, 2013). However, the livestock component particularly animals whose production cycles last within a year are yet to be fully

targeted such as poultry. The objective of the study was to investigate the optimum poultry enterprise combination among small holder farmers in Osun State, Nigeria

Research methodology

Study area

Osun-State is situated in the south western part of Nigeria. The major sub- ethnic groups in Osun-State are Ife, Ijesha, Oyo, Ibolo and Igbomina of the Yoruba tribe. The state comprises three agro-ecological zones rain forest (Ife-Ijesha), derived savannah (Oshogbo) and guinea savannah (Iwo) zones. Economically, the state is predominantly rural and agrarian in outlook with larger percentage of its people being farmers. The main hub of poultry production in the country is located within the southwestern states of the country (Oyo, Osun, Ogun and Lagos). Osun State was chosen for the study because of the special interest of the state Government as at the time this study was conceived in poultry and its products in her O'meal project which increased the demand for poultry and its products in the state.

Data Collection and Sampling Technique

The data for the study were primary data collected from one hundred and seventy nine (179) poultry farmers from five Local Government Areas (Osogbo, Ede north, Ife central, Ifelodun and Atakumosa west). A two-stage sampling technique was used to collect data. The first stage involved a selection of five local government areas based on the population of poultry farmers, size and availability of market for the poultry products. Osogbo, Atakumosa west, and Ife central are more densely populated than Ede-north and Ifelodun local government Areas. The second stage was the random selection of thirty six (36) poultry farmers from each local Government who are engaged in broilers,

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layers or cockerel or a combination of two or three of the enterprises (i.e, broiler-layers, broiler-cockerel or broiler-cockerel and layers). These poultry enterprises were the major poultry enterprise from each local government area.

Method of data analysis

Descriptive statistics was used to describe the socio-economic characteristics of the respondents in the study area. These characteristics include farming experience, age, level of education, marital status, household size and motive for farming. Budgetary analyses was employed to determine cost and returns to the combination categories on the farm using gross margin analysis and net farm income analysis

Gross margin analysis

$$GM = TR - TVC \quad (i)$$

Where,

GM = Gross margin (N); TR = Total Revenue (N); TVC = Total variable cost (N)

Net farm income analysis

$$NFI = TR - TC \quad (ii)$$

Where,

NFI = Net Income (N); TC = Total cost (N)

Linear programming technique was employed to determine the optimum enterprise combinations among the poultry farmers in the study area. The model was used to obtain combination of enterprises that maximizes total gross margin (farm income) of an average poultry farmer in the study area subject to resource constraints. Linear programming tools find easy application in optimization problem, where the aim is to maximize or minimize a linear objective function subject to a set of linear constraints. For optimal poultry combination problem, the linear programming is considered appropriate because the farmer is interested in a poultry enterprise combination that maximizes his or her gross margin. Thus, the solution of

the linear program matrix represents the profit maximizing poultry combination and this solution can be tested for changes in resource availability under alternative livestock combination. This same technique was utilized by Adesiyani *et al.* (2004) and Bamiro *et al.* (2012)

$$\text{Max } Z = \sum P_j X_j = P_1 X_1 + P_2 X_2 + \dots + P_N X_N \\ J=1 \text{ } j=1$$

Where

Z = The objective function (gross margin)

P_j = price/unit of activity (contribution of Z for each unit of activity j for j = 1, 2, ..., n)

X_j = level at which activity is to be produced/number of units of activity j, for j = 1, 2, ..., n

Subject to;

$$A_{11} X_1 + A_{12} X_2 + \dots + A_{1N} X_N \leq B_1$$

$$A_{21} X_1 + A_{22} X_2 + \dots + A_{2N} X_N \leq B_2$$

$$A_{31} X_1 + A_{32} X_2 + \dots + A_{3N} X_N \leq B_3$$

$$A_{M1} X_1 + A_{M2} X_2 + \dots + A_{MN} X_N \leq B_N$$

X₁, X₂, ..., X_N > 0 that is Non-negativity restrictions

Where; Z = The objective function (gross margin)

m = Number of resources

n = Number of activities

C_j = Net price/unit of activity (contribution of Z for each unit of activity j for j = 1, 2, ..., n)

X_j = level at which activity is to be produced/number of units of activity j, for j = 1, 2, ..., n

B_i = Amount or resources available for i = 1, 2, ..., m

A_{ij} = Amount of i_{th} resource consumed by each unit of activity j.

Subject to m constraints which can be express as follows:

Activities in the model: the poultry enterprise combinations are:

X₁ = sole layers

X₂ = sole broilers

X₃ = sole cockerel,

X_4 = layers/broilers

X_5 = layers/cockerel

X_6 = broilers/cockerel

X_7 = layers/broilers/cockerel

The constraints were labour, capital and feed.

Price coefficient “ P_j ”

The price coefficient “ P_j ” of a production activity in the model was the gross margin per production cycle of the j_{th} activity.

Input coefficients

The input coefficients were the requirements of a poultry activity in respect of the inputs of the different resources required per production cycle. The inputs coefficients for all poultry activities were calculated on the basis of the actual quantities of different resources that were used for those poultry activities.

Capital

Capital for the purpose of this study was considered to be working capital required to meet the day to day production expense. These consist of veterinary services, transportation, and cost of stock e.t.c. These were taken as a separate resource.

Feed

This was a constraint introduced into the model, this refers to the quantity of feed consumed by each poultry enterprise combination in a production cycle and it was calculated in kilogram.

Labor

Value of labor was gotten in naira per man-day. That is, the amount paid for labor per day and the actual amount incurred on labor was then gotten by multiplying the amount paid per man-day by the number of days of production.

Activities in the model

The poultry activities were seven poultry enterprise combinations. 38.5% Broiler only, 13.4% layers only, 4.5% cockerel only, 25.7% broilers /layers only, 2.8%

broiler/cockerel only, 3.4% layers/cockerel only and 11.7% broiler/layers/cockerel.

Resource constraint to the model

Three set of constraints / restriction were incorporated in the model. These are: Feed, labour and capital constraints.

Linear programming model

$$\text{Maximize } Z = 515938.17X_1 + 142550.58X_2 + 27492.500X_3 + 611577.385X_4 + 283489.667X_5 + 39420X_6 + 308447.1445X_7$$

Subject to

$$6134.61X_1 + 2106.26X_2 + 228.50X_3 + 4428.07X_4 + 3397.0X_5 + 414.40X_6 + 6046.67X_7 \leq \text{KG (feed)}$$

$$1.478X_1 + 1.25X_2 + 1X_3 + 1.67X_4 + 1X_5 + 1X_6 + 2.11X_7 \leq \text{Man-days (labour)}$$

$$682910.70X_1 + 176134.2X_2 + 34695X_3 + 616785.3X_4 + 354660X_5 + 1162.20X_6 + 397151.2X_7 \leq \text{N(capital)}$$

Results and discussion

The results of descriptive analysis showed that age influenced the capability to cope with changes in farm operation, among others. Data revealed in Table 1 showed that 71.6 percent of the respondents were below the ages 50 years while 18.4 percent of the respondents were above 50 years. This agrees with the findings of Bamiro *et al.* (2013) that most poultry farmers are in their productive years. The result also showed that poultry subsector was male dominated (70.4 percent) while 29.6 percent of the respondents were female. This agrees with the findings of Ologbon *et al.* (2012) that majority of the poultry farmers are male. This could be because females are more involved in off farm activities such as buying, selling and processing of farm products, while their male counterpart are more involved in crop and livestock production. Mean household size was approximately 5 and almost 42 percent had

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a household size of less than 5, 54.7 percent had household between 5 and 7 while about 3.4 percent had household size above 7. The result also showed that 62 percent of the respondents had higher education; 20.6 percent had secondary school education, while only 3.9 percent had primary school education. This is in consonance with the findings of Ologbon *et al.* (2012), Bamiro *et al.* (2013) that majority of poultry farmers have higher education. Almost about 46.4 percent of the respondents were farmers, 19.0 percent were artisan, 17.9 percent were traders, while 15.6 percent of the respondents were civil servant/ paid worker. Furthermore, about 20.1 percent of the respondents acquired their poultry farm through inheritance, 35.2 percent obtained theirs through lease/rent while 44.7 percent purchased their poultry farm. The table also indicated that majority (38.5 percentage) of the respondents were involved in the production of sole broilers, 25.7 percent were involved in the production of layers/broilers, 13.4 percent were involved in the production of sole layers, 11.7 percent were involved in the production of layers/Cockerel/broilers, 4.5 percent were involved in the production of sole cockerel, 3.4 percent of the respondents were involved in the production of layers/cockerel while 2.8 percent of the respondent were involved in the production of broilers/cockerel.

Budgetary Analysis

Costs and returns structure for each poultry enterprise

The cost-return structure of the poultry firms in the study area was further examined to ascertain the most profitable enterprise and the results are presented in Table 2. The result indicated that farmers involved in sole layers production are likely to encounter problems in terms of the ease of conversion into other combinations

since they had very high percentage of fixed cost. The most flexible is broiler/cockerel production enterprise with the least percentage of fixed cost. The result further showed that cost of feed takes the lion share in all combinations. The result further revealed that the gross margin per production cycle for sole layers, sole broilers, and sole cockerel were ₦ 516,000, ₦ 142,551, and ₦ 27,500, respectively. While the gross margin for layers/broilers, layers/cockerel, broiler/cockerel, and layers/broiler/cockerel were ₦ 611,600, ₦ 638,150, ₦ 39,420 and ₦ 308,450, respectively. The benefit cost ratio showed for every ₦ 1 invested, ₦ 1.79 was realized on sole layers, ₦ 1.67 on sole broilers, ₦ 1.57 on sole cockerel, ₦ 1.92 on layers/broilers, ₦ 1.71 on layers/cockerel ₦ 1.66 on broiler/cockerel and ₦ 1.64 on layers/broilers/cockerel. Furthermore, the Gross Ratio (GR) is expected to be less than one as any value greater than one means a loss. Gross ratio for each of the enterprises were 0.56 for sole layer, 0.60 for sole broiler, 0.62 for sole cockerel, 0.52 for layers/broilers, 0.58 for layers/cockerel, 0.60 for broiler/cockerel and layers/broilers/cockerel. This implies that enterprise 4 is the most profitable while enterprise 3 is the least profitable. The Operating Expense Ratio (OER) for each enterprise shows that 54 percent of gross revenue was used for operating expense by enterprise 1; 55 percent was used by enterprise 2; 56 percent was used by enterprise 3; 50% was used by enterprise 4; 55% was used by enterprise 5; 58 % was used by enterprise 6; and 57% was used by enterprise 7. The Net Income Ratio (NIR) obtained indicates that 44 % of gross revenue went into the equity of enterprise 1; about 40% went into enterprise 2; 36% went into enterprise 3; 48% went into enterprise 4; 41% went into enterprise 5; about

40% went into enterprise 6; and 39% went into enterprise 7. These showed that

enterprise 4 is the most profitable while enterprise 3 is the least.

Table 1: Distribution according to Socio-Economic characteristics of respondents

Variables	Frequency	Percentage
AGE		
Below 30	46	25.7
31-40	65	36.3
41-50	35	19.6
51 and above	33	18.4
SEX		
Male	126	70.4
Female	53	29.6
RELIGION		
Christianity	59	33
Islam	117	65.4
Traditional	3	1.7
MARITAL STATUS		
Single	25	14.0
Married	139	77.1
Divorce	9	5.02
Separated	7	3.91
HOUSEHOLD SIZE		
Below 5	75	41.9
5-7	98	54.7
8-10	3	1.7
Above 10	3	1.7
EDUCATION		
No formal	18	10.1
Adult literacy	6	3.4
Primary	7	3.9
Secondary	37	20.6
Tertiary	111	62
MEANS OF FARM ACQUISITION		
Purchase	36	20.1
Lease/rent	63	35.2
Inherited	80	44.7
PRIMARY OCCUPATION		
Farming	28	46.4
Trading	32	17.9
Civil servant	83	15.6
Artisan	34	19.0
Others	2	1.1
POULTRY ENTERPRISES		
Sole layers	24	
Sole broiler	69	
Sole Cockerel	8	
Layers/Broilers	46	
Layers/Cockerel	6	
Broiler/Cockerel	5	
Layers/ Cockerel/Broiler	21	

Source field survey 2015

The cost-return structure results presented in Table 2 confirmed the findings of Bamiro *et al.* (2013) on livestock

production wherein they concluded that feed cost is the major important single cost item associated with poultry

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production. However, all the indicators employed in cost and return analysis show

that poultry enterprise is still profitable in the study area.

Table 2: Return structure and profitability ratios of enterprise combinations in poultry among Small-holder farmers in Osun State

Variables	Sole broilers	Sole cockerel	Layers/broiler	Layers/cockerel	Broiler/cockerel	layers/broilers/cockerel
Cost of feed	101,754.5	24,325	332,285	281,960	35,840	288,017.9
Total fixed cost	14647.34	4975	19,777.81	19,320.83	3,880.02	32,248.41
Total variable cost	176,134.2	34,695	616,785.3	354,660	116,220	397,151.2
Total cost	190,781.53	396,70.00	636,563.09	373,980.83	433,899.60	429,399.6
Revenue from sales of broiler	318,684.78		450,975.61		146,000	100,000
Revenue from sales of cockerel		62,187.50		47,916.67	53,800	
Revenue from sales of spent hen			187,434.15	114,000		119111.11
Revenue from sales of eggs			589,952.91	476,233		478,592.779
Total Revenue	318,684.78	62,187.5	1,228,362.67	638,149.67	199,800	710,098.34
Gross margin (TR-TVC)	142,550.584	27,492.500	611,577.39	283,489.67	39,420	308,447.15
Profit	127,903.24	22,517.50	591,799.58	264,168.84	79,699.99	276,198.74
Benefit cost Ratio	1.67	1.57	1.93	1.71	1.66	1.64
Operating expense ratio	0.55	0.55	0.50		0.58	0.57
Net income ratio	0.40	0.36	0.48	0.56	0.41	0.39
Gross ratio	0.60	0.63	0.51	0.57	0.60	0.60

Source: field survey, 2015

Linear programming analysis of the enterprise combinations

Table 3 presents the optimum farm plan for the seven identified enterprises used by sampled farmers in the study area. Enterprises X_1 , X_2 , X_3 , X_5 and X_6 did not enter the final plan, since they have non-zero opportunity cost indicating that these enterprises were not in the best competitive positions as compared to enterprise X_4 . This result further corroborates the result of the gross margin analysis conducted for each enterprise and shows that the best/optimal enterprise combination which is capable of maximizing net farm income in poultry enterprise in the study area is layers/broiler enterprise. The optimal solution occurs with most of the resources not fully utilized

as indicated by less than or equal sign ($\leq$). The gross margin realized for the optimal farm plan was ₦ 1,381,140 (programme value). However, if each of programs X_1 , X_2 , X_3 , X_5 , X_6 and X_7 were separately forced into the optimum plan, the gross margin of the optimum plan would be reduced by ₦ 331,336, ₦ 148,353, ₦ 4066.49, ₦ 185683, ₦ 17814.3 and ₦ 526589, respectively. The opportunity cost of resources used in poultry production in the area indicates that feed is the only limiting resource unlike labor and capital which are non-limiting. The shadow price of feed is ₦ 137.89 indicating that by increasing the quantity of feed available by 1 kg, the gross margin would increase by ₦ 137.89.

Table 3: Sensitivity Analysis for linear programming analysis

Variable	Current COST	Min COST	Max COST	Reduced Cost
X ₁	515938	-infinity	847274	331336
X ₂	142551	-infinity	290903	148353
X ₃	27492.5	-infinity	31559.0	4066.49
X ₄	611577	532773	+infinity	0
X ₅	638149.67	-infinity	469172	185683
X ₆	39420	-infinity	57234.3	17814.3
X ₇	308447	-infinity	835036	526589
Constraint	Current RHS	Min RHS	Max RHS	Dual Price
Feed	10000	0	15177.5	137.888
Labor	13	3.77139	+infinity	0
Capital	2117500	1395160	+infinity	0

Source: Field survey 2015

Conclusion

The study has shown that all the seven identified poultry enterprise combination; sole layers, sole broilers, sole cockerel, layers/ broiler, layers/ cockerel, broiler/ cockerel, layer/broiler/cockerel in the study area were profitable, but farm income can be maximized if the farmer concentrated on one of the enterprise layers/ broiler. However the profitability of poultry enterprises is limited by high cost of production in which the feed cost constitutes the lion's share. The study further revealed that farmers in the study area were not operating at optimal level based on the available resources. These resources were not efficiently allocated in terms of inputs as seen in the optimal plan. Further, the resource use allocation in the study depicted that since the poultry farmers held some resources in excess, it is an indication of inefficiency in actual resource use by them in their poultry enterprise.

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