Trop. J. Anim. Sci. 1 (2): 177-186 (1999)
ISSN: 1119 - 4308

ECONOMIES OF SIZE IN POULTRY EGG PRODUCTION IN ABEOKUTA, OGUN STATE, NIGERIA

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Target Audience: Policy makers, agricultural extension workers, poultry farmers

ABSTRACT

Small scale commercial egg production has remained a common feature of the livestock industry in South-Western Nigeria since its introduction to the country about 4 decades ago. One of the major problems which have plagued the sector is the high cost of inputs. Based on the theoretical postulate that scale increases can result in unit cost reduction, this study attempts to establish the possibility of improving the profitability of egg production through the agency of increased scale of operation. The study concluded that even though economies of size exist in the egg production industry in the study area, the degree of response of unit cost to enterprise size increase is too small to have any substantial effect on profitability of enterprise. Thus poultry-egg farm sizes will have to be increased far more beyond the current prevalent range of flock-size (200-1800 layers), if the benefits of cost economies are to be substantially reaped by the industry. It is suggested that policy be directed towards encouraging farmers to take egg production as a full-time and permanent occupation rather than as a part-time, tem-porary, and mere income supplementing business which is presently the case. Access to production credit will also need to be eased up.

Key words: Economies of size, Poultry eggs, Production, Nigeria

DESCRIPTION OF PROBLEM

Since its introduction into Nigeria about four decades ago, modern poultry production in Nigeria has passed through many stages of development each with its peculiar problems. Poultry production and marketing system commercialization on a large scale started in the early 1960. Its development was closely guided by the government through the production and supply of day old chicks and feeds at subsidized prices to farmers involved in the farm settlement scheme. Free veterinary, extension and training services were provided for poultry farmers. By 1970, the population of layer hens in Nigeria was estimated to be about 50 million while meat birds were about 224 million, given a total of 275 million birds. By 1981, this figure had dropped to 130 million. From 1982 to 1987, the figure rose steadily to 175 million, from where it took a downward path to 103 million in 1991. (1).

Many researchers (1,2,3,4,5,6) have attributed the downward trend in poultry production in Nigeria to increasing cost of feeds, drugs and other production inputs for example, the price of a 25kg bag of feed rose from an average of ₦27.50 in 1987 to an average of ₦280 in 1994, and ₦560 in 1997. This represents a rise of about 1900% in the 10-year period between 1987 and 1997. In contrast egg prices have not witnessed comparatively dramatic increases. The price of a crate of egg which sold for an average of ₦14 in 1987 cost about ₦150 in 1997 given an increase of about 1000%. It can therefore be said that prices of feeds have grown by an average of 193.6% per annum while that of eggs have grown by 104% per annum in the past 10 years. These discrepancies in the rate of increase in prices of feeds and eggs have resulted in dwindling profits to producers, and have caused many to fold up.

Thus the answer to the declining production of eggs would seem to lie in the ability of the sectoral operators to take full advantage of *economics of size*. That is, industry operators should look for ways of stemming the steady decline in profitability by reducing the average cost of production.

This study is aimed at analysing whether the potentials exist for profitability in poultry egg production business to be improved through the agency of increased scale of operation. Specifically the study aimed:

- To determine the cost structure of egg production enterprises in the study area.
- To compare the efficiency levels of various poultry farm-size groupings in terms of profit per unit.
- To determine whether economics of size exists in the egg production enterprise in the study area.
- To highlight the problems and prospects of egg production in the study area.

MATERIALS AND METHODS

Theoretical Framework of Analysis

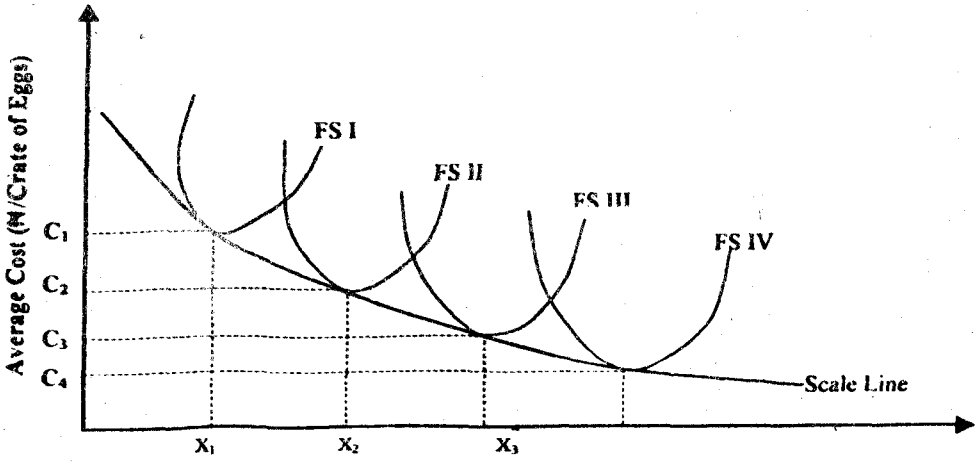
Any increase in the total quantity of resources used can be described as an increase in "farm size" whether or not factor proportions vary. However, increase in scale only refers to a case when increases in total quantity of resources used is done without changing factor proportions. Therefore increase in scale is a special case of increase in farm size. Farm size can be measured as size of land, labour requirements, total quantity or value of output produced, size of fixed assets or total cost of production (7).

The variable of interest in this study is the flock size. It is assumed that flock size can serve as a composite measure of size with the assumption that increase in flock size will necessitate a corresponding increase in all other inputs such as feeds, drugs, cages and to some extent labour hours. However, within limits some inputs such as electricity and housing are expected to remain fixed. Since most of the poultry producers sampled were not big-timers, cost of electricity and housing were not significant components of the cost structure (see Table 2). Thus the stage is theoretically set for an economics of size

analysis. The study also assumes that increase in flock size is usually accompanied by a corresponding increase in the size of other inputs that are of significance in poultry egg production.

Investigations on *economics of size* theoretically can be approached from two perspectives: the cost approach and the profit approach. This study has adopted the cost approach. The cost function is preferred to the profit function for evaluating size economies since the entire range of average cost curve (ACC) is theoretically admissible (8). The profit function approach is only valid where decreasing returns to scale exist. Theoretically, average cost of production is expected to be a decreasing function of farm size.
Thus the average cost function is expected to be as shown in Figure 1.

Fig 1: Theoretical Representation of Scale Line for Egg Production



PS I-IV represent the cost functions for egg production enterprises with flock sizes categories I to IV as defined in Table 1. C1 C2 C3, and C4 represent the minimum average cost of production for each of the 4 flock size. Categories X1, X2, X3, X4 represent the actual flock sizes within each category that will minimize average cost of egg production. Economics of size shown as flock size increases from X1 to X4, are accompanied by average cost decline from C1 to C4. It is necessary to state here that the use of cross-sectional farm-level data as utilized in this study, cannot do much than provide the analyst with some insights into the economies of plant utilization for a given plant. It cannot provide sufficient information needed to determine plant sizes necessary to

attain either minimum average cost or maximum profit (8). The question this paper therefore attempts to answer is whether or not, economics of size exist among poultry farmers in Abeokuta zone of Ogun State. To do this, a "Scale line" as indicated in figure 1 must be estimated. The scale line is an envelope curve for all the short average cost curves labelled FS 1 to FS IV.

Method of Data Collection and Analysis

The study was carried out in Abeokuta township which encompasses 3 adjacent local government areas in Abeokuta zone of Ogun State, Nigeria. They are Abeokuta North, Abeokuta South and Odeda Local Government Areas. These represent the highest egg producing areas in Ogun State. The state occupies an area of 16400 square kilometres of the 93 million sq. km that constitute Nigeria. It is made up of 20 Local government areas. The areas chosen for this study are in the Northern part of the state. Abeokuta town is the capital of Ogun State. The town cuts through the 3 local government areas. A lot of urban dwellers in the state are salaried workers who engage in commercial backyard poultry farming. Data used in the analysis were collected from a random sample of 21 poultry farmers. 60 farmers were originally selected. Poor responses however made the number of questionnaires found suitable for analysis to be reduced to 21. The inferences from the analysis should still be statistically valid despite the sample size limitation. This is based on the fact that when the relative frequency of the target population is normal (which the assumption of this study), the sample mean will have a normal sampling distribution regardless of the sample size (9).

The scope of the study covered commercial egg producers having 200 layers and above who produced eggs for sale during the production period from January 1st 1995 to June 30th, 1996. This was to ensure that we made observations only on established and operating farms over a specific period of time. In addition, only farmers who stocked at point of lay and made use of battery cages were used as observation units. The fixed cost items were valued at their 1996 prices. This valuation approach called "replacement cost approach" was used so as to avoid gross underestimation of costs that may result if historical costs were used. Profitability analysis method was used to determine the relative profitability of the various size categories of egg production enterprises. The formula for the estimation of profit is given.

$$p = TR - TVC - TFC$$

where:

TR = Total revenue per production period (6 months)
TVC = Total variable cost per production in period
TFC = Total fixed cost (depreciated cost for 6 months)
p = Profit per production period (6 months)

The total revenue is defined as the total money value of all eggs produced whether sold, consumed or in stock. Total fixed cost are those costs incurred which do not vary when output changes and therefore have no influence on

production decisions. Total variable cost is the cost of variable inputs as feed, labour, drugs, vaccines used in production. They change directly with the level of production.

The economic efficiency ratio: "Profit per 100 layers" was computed from the estimated profit figures and used to assess the comparative levels of economic efficiency of the different farm-size categories.

Economics of size was specifically investigated on one hand through the estimation of the efficiency ratio: "Cost per 100 layers" for different average farm size categories. The second approach was through the estimation of scale-line or long-run average cost curve for whole range of sampled farmers through the least-square regression estimation procedure. The postulated relationship was

$$C = aX^b \quad (1)$$

$$\text{Or in } C = a + b \ln X \quad (2)$$

Where C is the cost of production/crate of egg.

a = is the intercept

X = is the size of flock (no of layers) and

b = is the estimated elasticity or scale coefficient

The double-log functional form was selected for the analysis because of its ability to show both increasing and diminishing returns to scale as well as the fact that its estimated coefficient tends itself to easy interpretation.

The major disadvantage of the functional form in terms of the analysis in this paper is the fact that is assumes constant scale coefficient over all size categories. However, this deficiency can be accommodated, since the size range covered in the study was not very large (i.e between 200-1800 birds).

RESULTS AND DISCUSSION

About sixty-two percent of the poultry egg farmers sampled entered the business less than 5 years ago (between 1993 and 1995). All the farmers wer e educated with about 61 percent at the level of University graduate and above, while 28.0% were Ordinary National Diploma/National Certificate of Education graduates. About 71.0% of the respondents were civil servants/ professionals who kept poultry as part time business. Only 9.5% of the respondents producers got any form of bank loan to finance their operations. Hired labour was used more commonly relative to family labour. As much as 76.0% used hired labour while only 52.0% used family labour (implying that some used both types of labour). About 38% of the respondents had their flock size been 200 and 600, while 33.3% had 600-1000 birds. 9.5% and 19.1% had flock sizes of between 1000-1400 and between 1400-1800 respectively. The average flock size for all respondents was 829 birds (Table 1).

Table 1: Distribution of Respondents according to Flock Size

Group no	Flock size[1]	Average flock size	Frequency	% Distribution
I	200-600	312.5	8	38.1
II	600-1000	657.1	7	33.3
III	1000-1400	1,205.0	2	9.6
IV	1400-1800	1,625.0	4	20.0
Aggregate	200-1800	829	21	100.00

1. The ranges of flock-size in any class are inclusive of the lower class mark and exclusive of the upper class mark.

Source: Field survey- December 1996.

Investigations showed that there were three major problems facing poultry-egg producers in the study area. While 66.7% of the producers saw high cost of feeds as their most pressing problem, 19.1% said their most pressing problem is high cost of fixed inputs. The remaining 14.3% said mortality/diseases outbreak is their most pressing problem. This result is a clear demonstration of the need for promoting cost efficiency in the poultry industry, since the most pressing problem of 86% of the producers is cost-related.

Analysis of Cost Structure

The cost structure of the various size-categories of egg production enterprises is given in Table 2. The cost structure reveals that feeds cost account for as much as 77.0% of the total cost of production. This finding confirms the findings of previous studies that feed accounts for over 70 percent of the cost of poultry egg production. (10,11,12). Another major feature of the cost structure is the fact that the cost of flock (layers) was about 90% of the total

Table 2 Cost Structure of Egg Production Enterprises

Cost Items	200-600 %	600-1000 %	1000-1400 %	1400-1800 %	Aggegrate (200-1800)
Labour	6.9	2.9	2.3	1.8	4.2
Feeds	73.7	78.7	78.4	79.0	77.0
Drugs and vet. Services	1.6	1.2	1.5	2.3	1.6
Other variables Cost	0.3	0.7	0.9	0.5	0.5
Total variable Cost items	82.4	83.4	83.1	83.7	83.3
Fixed input Building (depr)	0.3	0.2	0.2	0.2	0.3
Cages (depr)	1.2	1.4	1.2	1.3	1.2
Other (depr)	0.2	0.2	0.7	0.3	0.2
Stocks	15.6	14.8	15.4	14.6	15.0
Total cost of fixes items	17.3	16.6	17.0	16.4	16.7
Total	100	100	100	100	100

Source: Field Survey December 1996.

fixed cost. This is in agreement with the findings (12), which showed the cost of matured stock to be 89.78% of total fixed cost. As a result our earlier assumption that the size of flock could serve the purpose of a composite measure of business size is easily established.

Profitability/Efficiency Analysis

Table 3 presents a summary of the profitability analysis carried out. The result shows the total cost incurred, revenue made, and profit accrued per 100 layers in a production period of 6 months for each of the four flock size categories.

From the results presented on Table 3, profit per unit increased with increases in average flock size. The average farm operating in the 200-600 flock size category incurred losses (N9,244.05). The possible reason for this negative profit is because the profit calculation reported in this paper is the "Returns to Management". This implies that all cost including the imputed cost of family labour was deducted from the gross revenue.

Table 3: Profit per 100 Birds per Production Cycle

Stock size	Total cost per 100 birds per cycle (₦)	Revenue per 100 birds per cycle (₦)	Profit per 100 birds per cycle (₦)
200-600	190,816.84	181,572.79	-9,244.05
600-1,000	187,304.91	197,792.91	10,388.00
1,000-1,400	192,737.88	238,380.05	45,642.17
1,400-1,800	192,742.15	258,046.13	65,303.90

Source: Field survey, December 1996

A very interesting point of note from the Table is that the differences in profit/unit associated with the different flock-size groupings is more attri-butable to revenue rather than cost differences. Thus, one can infer that the increased efficiency observed with increasing farm size is not as a result of cost maximization. Rather it as a result of revenue maximization. The major interest of this study however is the economies of size that results from cost efficiency.

Economics of Size Analysis.

It is observed from Table 3 that the difference in unit cost implication of the four farm size categories did not show substantial difference. That is, when efficiency is assessed through the cost approach, the larger sized farms do not seem to be significantly more efficient than the smaller sized farms. This finding may be a subtle confirmation of the statement of Stelanou and Madden (13) that, "studies of economics of size have over the years provided supporting evidences that economic efficiency is not concomitant with a very large size of farm, and that family-size farms are as efficient as larger farms in Canada and U.S.A"

The estimated long-run average cost curve or "Scale-Line" is given as

$$\ln C = \ln 6.151 - 0.410 \ln X \quad \ldots\ldots (3)$$
$$(50.12) \qquad (-9.89)$$

Or

$$C = 6.15X^{-0.14} \quad \ldots\ldots (4)$$

The estimated equation had an R^2 of 0.85 and a t-calculated value of -9.89 which makes the estimated coefficient (b = 0.14) to be judges statistically significant at 1% α-level. The equation is also judged significant as the calculated F-value was 65.36 which is far above the tabulated value at 1% α level. For the double-log function estimated here, the estimated b-coefficient is a direct measure of "scale coefficient". That is the effect of size increases on Unit cost of production. Thus the estimate of -0.14 is the scale coefficient for egg production in the study area.

The interpretations are as follows:

- The negative sign attached to the estimated b coefficient indicates the existence of economies of size within the egg production industry in Abeokuta.
- The significance of the estimated equation through the F - value calculated show that the degree of size economies can be conveniently assumed to be constant over the investigated range of flock size categories.
- The scale coefficient of -0.14 implies that the measure of economies of size advantages in the poultry egg production in the study area is small. That is, for every 100% increase in size of flock, there is only a 14% decrease in unit cost of egg production.

CONCLUSION AND APPLICATIONS

The study concludes as follows:

1. Most poultry-egg farmers in Abeokuta can be regarded as small-scale, part-time producers with average flock-size of less than 1000 birds.
2. Feed costs are clearly the most important component of production cost in poultry-egg farms of all size categories in Abeokuta.
3. High cost of inputs is the most pressing problem of the farmers.
4. Profitability was found to be positively related to average flock size
5. Economies of size (in terms of reduction in unit cost of production associated with flock-size increases) was found to be present but was very small/low.
6. With the present sizes of commercial poultry enterprises in the study area therefore, scale increases within the prevalent size groupings may not bring about a substantial positive effect on profit as a result from cost minimizing effect of scale increases.

7. Even though small scale commercial egg production in the study area has shown prospects of benefiting from economies of size, by increasing their scale of operations, the low scale coefficient could only be an indication that scale increases within the range 200 to 1,800 flock size will not bring about much reduction in unit cost of egg production. A good reason for this is that within the prevalent range of flock size in the area, purchased feed (which is the major production cost item) is not associated with much reduction in unit feed cost. This is because most of the operators are limited in the their resource base and cannot afford to buy and/or prepare their feeds in economic size quantities, that could actually reduce unit cost of purchase or preparation.

8. Poultry farmers in the study area will therefore need to be encouraged to increase their scale of operation far much beyond the current range if the industry is to enjoy the benefits of scale-economies. This can be achieved first, more producers should be encouraged to take the poultry-egg production business as a full-time and permanent occupation. The present situation in which most of the producers see egg production as a mere supplementary income source will impose serious limitations on their motivation to expand. Second, is by increasing the farmers' access to credit so that inputs can be purchased at economic-size quantities.

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