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Productivity Analysis of Eggs Production in Khorasan Razavi Province, Iran

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Abstract: Egg production is one of the most important agricultural economic activities in Iran. According to the latest information in Iran, there were about 1432 poultry eggs farms producing about 576478 tons of edible eggs in 2005. The poultry farmers, however, complained that the cost of production was very high and that failed to gain considerable profit from their farming operations. The consumers, on the other hand, protested that the poultry price was very high. The purpose of this study is to determine the productivity level of the industry so that a more sustainable and high productivity production system can be developed. Production function was used to measure productivity. A transcendental production function was estimated using cross-sectional data collected from 47 farmers in the Khorasan Razavi province. Secondary data from the Iranian Statistical Year Book (published by the Statistical Center of Iran) were also used. The results of the study found that the cost-benefit ratio was 0.96. The Average Product (AP), Marginal Product (MP), Value Marginal Product (VMP), Optimal Allocation Ratio and the Elasticity of Production (EP) of the feed input were 0.41, 0.16, 577 Rials, 0.48 and 41% respectively. The findings for similar measures above for pullet input were 18.38, 4.24, 14826 Rials, 1.23 and 0.23 respectively. From the study, the average productivity of the poultry farm was 1.04. This shows that the income approximately equals the variable cost. When the fixed costs were taken into consideration, the profit of the average farm was negative. The results indicated that farmers were using feed more than "the optimal level" and that they were using pullet less than "the optimal level." Therefore, to improve profitability, they should use less feed and keep more pullets. In this manner, the cost of production can be reduced.

Key words: Productivity analysis, production function, transcendental, Khorasan province, Iran

INTRODUCTION

Food security is an important issue in the world. We should consider quality and quantity of food for this issue. Egg is one of the best foods in this term, because:

- Poultry birds are good converters of feed into useable protein in meat and eggs.
- The production cost per unit is low relative to other types of livestock and the return to investment is high, thus farmers need just a small amount of capital to start a poultry farm.
- Poultry meat is very tender. So its palatability and acceptability to consumers are very high.
- It has a short production cycle (pay back period) through which capital is not tied down over a long period (Ojo, 2003).

Also Egg is one of the most nutritious and complete foods known to man. Chicken egg protein has biological value of 1.0 and so shares with human protein the distinction of being a perfect protein (Orji *et al*., 1981). Egg is cheaper than other sources of animal protein. An average an egg costs about 1000 Rials. (O.10 US dollars) in 2009 in Iran, hence it can buy by poor people. The main key of economic growth is as a result of an increase in productivity in every industry because improvement in productivity is related to increased profitability, lower costs and sustainable competitiveness. Poverty, unemployment may be resulting low productivity level and this case it can only be broken by increasing productivity.

The purpose of this paper is to analysis productivity of Eggs Production industry in order to develop a more sustainable and high productivity production system can be developed. The province of Khorasan Razavi in Iran was chosen to achieve this purpose. The province is located between 30°-21′ and 38°-17′ and 55°-28′ till 61°-20′ latitude. The average altitude at the province is 1000 m with the highest summit of 3200 m elevation in the Binalood mountain range and lowest part of 275 m in Sarakhs township.

Table 1 details the number and capacities of chicken farms in the province in 2005, while Table 2 shows the quantity and value of production in Iran and Khorasan Razavi province. There were 1432 farms with 5096 halls and 76 million capacity. Those numbers were 249, 638 and 9167 million in Khorasan Razavi respectively.

Overall, in 2005, the farms produced 576478 tons of edible eggs, 10712 tons broken and shell-less egg, 7476526 flows sold pullets, 23301 tons cull and 4983212 tons manure. Therefore total value their production were 3313075 million Rilas.

Table 1: Number and capacity [1] of layer chicken and pullet farms

Year and province	Number of farms	Number of poultry halls	Capacity (1000 fowls)
1385	1432	5096	76046
Khorasan Razavi	249	638	9167936

1. Capacity refers to the number of chickens-hen or cock- that can be reared with regard to installations and equipment available on the farm.
2. Excluding farms raising pullets. Source: Statistical Centre of Iran

Table 2: Quantity and value of production at of layer chicken and pullet farms (ton; mln rials)

	Edible eggs		Broken and shell-less eggs		Sold pullets (fowl)	
Year and province	Quantity	Value	Quantity	Value	Quantity	Value
Iran	576478	3021222	10712	27670	7476525	127098
Khorasan Razavi	57232	304048	557	1412	725531	13523

	Cull (1)		Manure	
Year and province	Quantity	Value	Quantity	Value
Iran	23301	91212	498321	45873
Khorasan Razavi	2373	11337	52783	5795

Chicken culled for various reasons or delivered to slaughterhouses at the end of raising period can be used as meat.
Source: Statistical Centre of Iran

MATERIALS AND METHODS

Theoretical framework: The literature on productivity and efficiency measurement has grown dramatically since the publication of seminal papers by Solow (1956), Aigner and Chu (1968). Increasingly sophisticated methodologies have been developed to tackle noisy data; reduce the restrictions imposed by functional forms and behavioural assumptions; identify the components and determinants of productivity growth; and address many other theoretical and econometric issues. The techniques have been applied to a large variety of contexts and sectors, in particular agriculture, where hundreds of published papers on productivity and efficiency analysis exist (Irz and David Hadley, 2005).

A production function expresses the relationship between an organization's inputs and its outputs. It indicates, in either mathematical or graphical form, what outputs can be obtained from various amounts and combinations of factor inputs. In particular it shows the maximum possible amount of output that can be produced per unit of time with all combinations of factor inputs, given the current factor endowments and the state of available technology. Unique production functions can be constructed for every production technology (James *et al*., 2002).

Alternatively, a production function can be defined as the specification of the minimum input requirements needed to produce designated quantities of output, given available technology. This is just a reformulation of the definition above (James *et al*., 2002).

The relationship is non-monetary, that is, a production function relates physical inputs to physical outputs. Prices and costs are not considered.

The production function as an equation in its most general mathematical form, a production function is expressed as:

$$Q = f(X1, X2, X3...) \quad (1)$$

Where:

Q = Quantity of output

X s = Factor inputs (such as capital, labor, raw materials, land, technology, or management).

There are several ways of specifying this function. One is as Cobb-Douglas production function (multiplicative)

$$Q = aX1^{b} X2^{c} \quad (2)$$

Where a, b and c are parameters that are determined empirically.

Another is as a Transcendental production function (Halter *et al*., 1957):

$$Q = aX1^{b} X2^{c} e^{dx1+fx2} \quad (3)$$

Where e is the natural logarithmic base, b and c are partial coefficients of X1 and X2 respectively , d and f are trans-parameters measuring the variability of b and c in response to changes in production scale and input substitution (complementarily). if d and f are zero equation (3) becomes Cobb-Doglas production function. For nonzero trans-parameter the Cobb-Duglas special case is rejected because in this case, equation (3) is nonlinear and characterized by variable marginal products , short-run input elasticity's and marginal rate of technical substitution (Halter *et al*., 1957). Even so, equation (3) can still be estimated by conventional regression methods because its natural logarithmic version is linear in the parameters.

$$LnQ = \ln a + b\ln X1 + c\ln X2 + dX1 + fX2 \quad (4)$$

The most difference Transcendental production function from Cobb-Doglas is Transcendental can shows up three stage of production.
Marginal Product (MP) and Production Elasticity equations are presented as follow:

$$Mp = [b/X1+d]\ Qi \quad (5)$$

$$EP = b+dX1 \quad (6)$$

Types and sources of data: Both primary data and secondary data were used for this study. Primary data collected from 47 poultry farms in Khorasan Razavi province. The Category and Circle systematic sampling method used were utilized. The first according to size the frames had been category and then chose some farms by Circle systematic method. Data from poultry farmers were gathered by the means of a structured questionnaire. Questions with regard to output, input, price of output and input and some major social-economic characteristics of the farmers were included in the questionnaire. Secondary data for this study were mostly gathered from the Iranian Statistical Year Book published by the Statistical Center of Iran (Mohaddes *et al*., 2002).

RESULTS AND DISCUSSION

In this study Transcendental and Cobb-Douglass production function were estimated using cross-sectional however, the transcendental function proved to be better than the Cobb-Douglass function.

The transcendental function is estimated as:

$$\underset{(1.56)}{Q=-7.1}+\underset{(0.21)}{0.38\ln Pol}+\underset{(0.14)}{0.39\ln FED}+\underset{(0.17)}{0.40OTH}-\underset{(1.3^{-6})}{7.5^{-6}POL}+\underset{(0.0001)}{1.25^{-6}FED}-\underset{(9.7^{-9})}{4.8^{-9}OTH} \quad (7)$$

R^2 = 0.98
R^2 = 0.98
DW = 1.95
F = 354
Where
Q is amount out put in unit's farm
Fed is amount used fed in unit's farm
POL is amount chicken in unit's farm
OTH is amount other cost unit's farm
(Figures in parenthesis are standard errors)
R^2 of 0.98 is means that 98% of the variation in equation 4 was explained by three inputs variable.

Productivity of inputs

Average Product (AP): The Average product is defined as the ratio of total output to the amount of the variable input used in producing the output. For the variables that have been defined, the average product is equal to:

$$Ap_x = Q/X \quad (8)$$

The overall mean of Average Product of FED was 0.42. This shows that every one Kilogram of feed used can produced 420 Gram of eggs Chicken. Minimum and maximum AP FED were 0.38 and 0.87 receptivity. Table 3 presents AP of Fed for difference size of farms. From this table, it can be concluded that AP of Fed were approximately the same in all size farms.
From Table 4 the mean of the average product of POL was 18.38. This implicates, each chicken produced an average 18.38 Kg of eggs in year.

Marginal Product (MP): The Marginal Product (MP) is defined as the incremental change in total output that can be produced by the use of one more unit of the variable input in the production process. From Table 3, the overall mean for the MP of Fed measured 0.165. This meaning that every one kilogram Fed used increased output by 0.165 Kg. The Minimum and maximum MP for Fed were 0.12 and 0.20 receptivity but this index is same in all sizes. From Table 3, the overall mean for the MP of POL was 4.24. This indicates every one additional chicken increased production by 4.24 kilogram. Table 4 also shows the marginal products of POL decreased by size.

Marginal revenue product: Marginal Revenue Product (MRP_x) is defined as the amount that an additional unit of the variable input adds to total revenue (James *et al*., 2002). MRP_x is equal to the marginal product of X (MP_x) times the marginal revenue (MR_Q) resulting from the increase in output obtained:

$$MRP_x = MP_x * MR_Q \quad (9)$$

If the farmer can sell all of production at a price, then we consider MR_Q equal to the price of output.
Average MRP of FED estimated 577 Rilas. This means that an additional unit of FED input increases revenue by 577 Rilas. At that year (2001) price of one unit fed was 1200 Rilas therefore use more FED input was not economically. In other words use 1 kg more FED input reason diminished 623 Rilas profit.
The overall mean for MRP of POL calculated 14826 Rilas. This illustrates that an additional unit of POL input increases revenues by 14826 Rilis. Taking into consideration price of one POL of 12000 Rilas the use of additional chicken would be profitable.
Table 4 reveals that small farms had bigger MRP of POL than large farm. This implies that the small-sized farms had excessive unused capacity and that should increase the quantity of chicken to gain greater revenues.

Optimal input level: Given the marginal revenue product and price of input, we can compute the optimal amount

Table 3: AP, MP, MRP, EP and optimal level for FED input

Farm size	Sample size	AP	MP	MRP (Rials)	MRP/P_x	EP
X<10000	7	0.42 (0.07)	0.17 (0.03)	590 (90)	0.49 (0.07)	0.40 (0.01)
10000<X<20000	12	0.42 (0.04)	0.18 (0.02)	594 (62)	0.5 (0.05)	0.41 (0.01)
20000<X<30000	17	0.41 (0.34)	0.16 (0.01)	457 (49)	0.48 (0.04)	0.41 (0.01)
X>30000	11	0.38 (0.06)	0.16 (0.03)	522 (87)	0.46 (0.07)	0.41 (0.01)
Mean	47	0.41 (0.05)	0.16 (0.02)	577 (69)	0.48 (0.05)	0.41 (0.01)

Table 4: AP, MP, MRP, EP and optimal level for POL input

Farm size	Sample size	AP	MP	MRP (Rials)	MRP/P_x	EP
X<10000	7	19.96 (4.53)	5.44 (2.03)	19050 (7101)	1.59 (0.59)	0.27 (0.06)
10000<X<20000	12	18.02 (1.52)	4.25 (1.53)	14874 (5384)	1.23 (0.44)	0.23 (0.08)
20000<X<30000	17	18.2 (2.9)	4.42 (1.22)	15464 (4273)	1.28 (0.36)	0.24 (0.05)
X>30000	11	18.01 (3.5)	3.21 (2.27)	11251 (7581)	0.93 (0.63)	1.7 (0.01)
Mean	47	18.38 (3.05)	4.24 (1.76)	14826 (6186)	1.23 (0.52)	0.23 (0.08)

of the variable input use in production process. The follow ratio determinate this optimization:

$$MRP_X/P_X \quad (10)$$

Where P_x is price of input.

The use of input is said to be optimal when this ratio equal 1. If this ratio shows value less than 1, farmer are using more than the optimal level of input. However if this ratio exceeds one the framers are using less than optimal level of input.

From Table 3, this study found that ratio of marginal revenue of product for fed input to it price was 0.48. This reveals that farmers were using more than optimal level of fed inputs. Table 3 also reveals this index is the same in different farm sizes.

The optimal input ratio for POL was 1.23 (Table 4), which shows that farmers were not optimally using their inputs. Table 4 also reveals that large farms were using inputs more effectively than the small-sized farms.

Production Elasticity (EP): The Elasticity of production is defined as the percentage change in output Q resulting from a given percentage change in the amount of the variable input X employed in the production process, with Y remaining constant. The production elasticity indicates the responsiveness of output to change in the given input.

The overall mean for the production elasticity of Fed was 0.41 (41%), which means that a one percent increase in Fed input, increased output by 41%. The overall average of EP of POL calculated 0.23, which indicates that a one percent increases in use of chicken, increased egg production by 23%.

Cost-benefit: Cost-benefit ratio shows how much cost involved to generate a unit of income. The ratio for this study was 0.93, which means that each Rial of income had a cost of 0.93. This implies that farmers did not earn a high enough profit.

Total productivity: Total productivity is calculated by the ratio of output to input. Total productivity for this study computed 1.04. This mean that framer of poultry in province of Khorasan Razavi had low productivity level.

Conclusion: This project focused on the Productivity analysis of Poultry production in the Khorasan Razavi province, Iran. The results show that:

1) Total productivity was low and farmer could provide for their costs of production.
2) The productivity of fed input was also low very 0.41.
3) The productivity of POL input considerably good (18.38), but can be further improved.
4) The MP, MRP and optimal input level of fed indicated that farmers were using more than optimal level. Farmers should use lesser fed higher quality fed (Better quality and better formulae).
5) The MP, MRP and optimal input level ratio for POL revealed that farmers were not optimally using their POL inputs and had excessive capacity. In their farms. Farmers should increase the quantity of POL to effectively use their empty capacity.

There for farmer can increases productivity with using a fed (and also chicken) with better quality and use more chicken in units.

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