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Total and Input Factor Productivity Analysis of Poultry Production in Khorasan Province, Iran

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Abstract: Poultry production is one of the most important agricultural economic activities in Iran. According to the latest information in Iran, there were about 15383 poultry farms producing about 799,367 tones of meat in 2002. 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. Transcendental and Cobb-Douglass production functions were estimated using cross-sectional data collected from 150 farmers in the Khorasan 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 0.93. 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 0.4, 0.09, 572 Rials, 0.38 and 31% respectively. The findings for similar measures above for pullet input were 1.8, 1.2, 7095 Rials, 4.16 and 1.5, respectively. Results showed, the average productivity of the poultry farm was 1.07. 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 word: Productivity analysis · Production function · Transcendental · Khorasan province · Iran

INTRODUCTION

The purpose of this paper is to determine the productivity level of the poultry industry in order to develop a more sustainable and high productivity production system can be developed. The province of Khorasan 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 3200m elevation in the Binalood mountain range and lowest part of 275m in Sarakhs township [1].

Table 1 details the number and capacities of chicken farms in the province in 2002, while Table 2 shows the quantity and value of production. There were 1544 poultry farms with 1139 still in operation while 405 had ceased to operate. Overall, in 2002, the farm produced 86580-tons of chicken meat.

Theoretical Framework: A production function expresses the relationship between an organization's

Table 1: Quantity and Capacity of Broiler Chicken Farms

	Total		In operation		Out of operation	
Description	No.	Capacity (1000 fowls)	No.	Capacity (1000 fowls)	No.	Capacity (1000fowls)
Khorasan	1544	17945	1139	13591	405	4354
Iran	15383	184786	11279	144946	4104	39839

Source: Statistical Center of Iran [2].

Table 2: Quantity and Value of Broiler Chicken Farms Production

	Full-grown		Cull*		Manure	
Description	Quantity (Tons)	Value (mil.Rials)	Quantity (Tons)	Value (mil.Rials)	Quantity (Tons)	Value (mil.Rials)
Khorasan	80988	489735	1511	5423	98590	9606
Iran	799367	5082299	11283	43584	747091	65032

*Chicken culled for various reasons or delivered to slaughterhouses at the end of raising period can be used as meat. Source: Statistical Center of Iran[2].

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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 particula,r 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 [3]

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 [3].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, labour, raw materials, land, technology, or management)

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

$$Q= aX1b\ X2c \quad (2)$$

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

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

$$Q= aX1b\ X2c\ edx1+fx2 \quad (3)$$

Where, e is the nutural logarithmic base, b and c are partial cofficents of X1 and X2,respectively, d and f are trans-paramters measuring the variabiity of b and c in response to changes in production scale and input substitution (complementrity). if d and f are ziro equation (3) becomes Cobb-Doglas production function.For nonzero trans-paramter the Cobb-Duglas special case is rejected becase in this case,equation (3) is nonliner and characterised by variable marginal products, short-run input elasticities and marginal rate of technical substitution [4]. Even so, equation (3) can still be estimated by conventional regression methods becuase its natural logarithmic version is linear in the parameters.

$$LnQ=ln\ a+ blnX1+clnX2+dX1+fX2 \quad (4)$$

The most diffence transcendental production function from Cobb-Doglas is Transcendental can shows up three stage of production.

Marginal product (MP) and Production Elasticity equations are persented as follow:

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

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

Types and Sources of Data: Both primary and secondary data were used for this study. Primary data was collected from 150 poultry farms in Khorasan 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

RESULTS

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:

$$Q=-6.94+0.55lnFED+0.43lnCHICKEN-1.43\text{-}6FED+7.05\text{-}6ln\ CHICKEN \quad (7)$$
$$(0.31)\ (0.096)\ (0.105)\quad (4.8)\text{-}7\quad (2.4)\text{-}6$$

R2=0.978 R2=0.978
DW=1.59 F=1325

Where,
Fed is amount used fed in units farm
CHICKEN is amount chicken in units farm
(Figures in parenthesis are standard errors)

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

Farm size	Sample size	AP	MP	MRP (Rials)	MRP/Px	EP
X<5000	17	0.44 (034)	0.17 (0.066)	1030 (42)	0.67 (0.28)	0.39 (0.09)
5000<X<10000	38	0.41 (.43)	0.179 (0.058)	1097 (39)	0.69 (0.24)	0.44 (0.08)
10000<X<20000	32	0.40 (0.41)	0.104 (0.07)	621 (40)	0.44 (0.38)	0.26 (0.01)
20000<X<30000	22	0.39 (0.51)	0.02 (0.10)	124 (60)	0.08 0.03	0.05 (0.21)
X>30000	13	0.38 (0.33)	-015 (0.128)	-922 (84)	-0.58 (0.53)	-0.39 (0.31)
Mean		0.40 (0.29)	0.09 (0.127)	572 (79)	0.38 (0.53)	0.31 (0.127)

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

Farm size	Sample size	AP	MP	MRP (Rials)	MRP/Px	EP
X<5000	17	1.8 (0.17)	0.93 (0.19)	5677 (1327)	3.13 (0.88)	1.5 (0.09)
5000<X<10000	38	1.7 (0.09)	0.95 (0.16)	5864 (1219)	3.29 (0.87)	1.6 (0.10)
10000<X<20000	32	1.8 (0.09)	1.1 (0.21)	6821 (1522)	4.088 (1.47)	1.5 (0.16)
20000<X<30000	22	1.8 (0.067)	1.3 (0.28)	8318 (2104)	5.018 (1.28)	1.3 (0.19)
X>30000	13	1.8 (0.405)	1.8 (0.46)	11154 (3536)	6.78 (2.09)	1.3 (0.32)
Mean		1.8 (0.101)	1.2 (0.36)	7095 (790)	4.16 (1.7)	1.5 (0.29)

R2 of 0.98 means that 98 percent of the variation in equation 4 was explained by two inputs variable (Fed and Chicken)

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

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

The overall mean of Average Product of FED was 0.40. This shows that every one Kilogram of feed used can produced 400Gramme of Chicken meat. Minimum and maximum AP FED was 0.28 and 0.87, respectively. Table 3 presents AP of Fed for difference size of farms. It can be concluded that AP of fed received as the size farms increased that indicted however with increasing size, AP fed reduces.

Data in Table 4 show that the average product of CHICKEN was 1.8. This implicates, each chicken produced an average 1.8 Kg of meat chicken (live).

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.0.09. This meaning that every one kilogram fed used increased output by 0.09 Kg. The Minimum and maximum MP for fed were -0.32 and 0.37, respectively. Table 3 also shows that in some of farms MP had a negative value. A negative MP means that the chicken farms were operating in stage 3 of production.

From table 3, the overall mean for the MP of CHICKEN was 1.2. This indicates every one additional chicken increased production by 1.2 kilogram. Table 4 also shows that as the number of chicken rise the marginal products also increased.

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

$$MRPx= MPx* MRQ \quad (9)$$

If the farmer can sell all of production at a price, then we consider MRQ equal to the price of output.

Average MRP of FED estimated 572 Rilas. This means that an additional unit of FED input increases revenue by 572Rilas. At that year (2001) price of one unit fed was 1579Rilas therefore use more FED input was not economically.In other words use more FED input reason diminished profit.

The overall mean for MRP of CHICKEN calculated 7095 Rilas. This illustrates that an additional unit of CHICKEN input increases revenues by 7095 Rilis. Taking into consideration price of one chicken of 1781 Rilas the use of additional chicken would be profitable.

Table 4 reveals that larger farms had bigger MRP of CHICKEN. This implies that the lager-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 of the variable input use in production process. The follow ratio determinate this optimization

$$MRPx/Px \quad (10)$$

Where, Px 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.

Data in Table 3, indicated that the ratio of marginal revenue of product to it price was 0.38. This reveals that farmers were using more than optimal level of inputs. Table 3 also reveals that smaller farms were using inputs more effectively than the larger-sized farms.

The optimal input ratio for chicken was 4.16 (Table 4), which shows that farmers were not optimally using their inputs.

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.031(31 percent), which means that a one percent increase in Fed input, increased output by 31 percent.the overall average of EP of CHICKEN calculated 1.5, which indicates that a one percent increases in use of chicken, increased production by 150 percent..

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 1.07. This mean that framer of poultry in province of Khorasan had low productivity level.

CONCLUSION

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

- Total productivity was low and farmer could provide for their costs of production;
- The productivity of fed input was also low 0.40;
- The productivity of CHICKEN input considerably good (1.8), but can be further improved;
- The MP, MRP and optimal input level of fed showed that farmers were using more than optimal level. Farmers should use lesser fed higher quality fed (Better quality and better formulae);
- The MP, MRP and optimal input level ratio for chicken revealed that farmers
- Were not optimally using their chicken inputs and had excessive capacity. In their farms. Farmers should increase the quantity of chickens to effectively use their empty capacity. Therefore farmer can increases productivity with using a fed (and also chicken) with better quality and use more chicken in units

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