Journal of Animal and Veterinary Advances 12 (18): 1473-1477, 2013
ISSN: 1680-5593

Assessing Production Efficiency of Laying Hens Farms in Afyon Province, Turkey

[1]Turan Binici, [2]Vecdi Demircan, [2]Hasan Yilmaz, [2]Mevlut Gul and [2]Tufan Bal
[1]Department of Agricultural Economics, Harran University, Sanliurfa, Turkey
[2]Department of Agricultural Economics, Suleyman Demirel University, Isparta, Turkey

Abstract: This study finds that a sample of 75 laying hens farmers located in Afyon Province, Turkey, exhibit inputs allocation and utilization are not efficient. Efficiency ranges from 45-97% with the average being 94%. The 97% of the variation in egg production among the sampled farmers is due to differences in their production efficiency. The returns to scale of the poultry egg production is found to be positive and more than unity implying that inputs allocation and utilization are not efficient. Three statistically significant factors associated with the variation in production efficiency are identified: feding, drug and veterinary service and electricity inputs.

Key words: Stochastic frontier analysis, production efficiency, laying hens farms, egg, drug

INTRODUCTION

The poultry sector is considered to be the most developed branch of animal production. The level of Turkey in the poultry sector both in terms of egg production and meat production is equal to those of developed countries. In the poultry sector, there are nearly 10000 broiler and 5000 egg production farms. It is estimated that around 2 million people earn their living from the poultry sector (SPO, 2007). Due to the need for animal protein, the possibility of intensification, the contribution of scientific improvements in the field of breeding and feeding, the need for relatively smaller areas when compared to other animal husbandry branches and its contribution to rural development, the poultry sector has an important role in animal production.

In recent years, significant improvements were achieved in the poultry sector in Turkey. This improvement has emerged, especially in the number of hens, production, yield, production technologies and marketing organization. As a result of these improvements, the traditional village poultry activities were replaced by the commercial and industrial poultry farms. In last 10 years, the total egg production in Turkey was doubled. Total eggs production increased from 7.809-15677 million eggs during the years of 2002 and 2012 (Yum-Bir, 2012). Turkey's egg exports also have increased 19 times between 2006-2012, reaching 350,995 million US dollars from 18,928 million US dollars (Yum-Bir, 2012).

Numerous studies have examined laying hens production efficiency in both developed and developing countries. Recent studies include Ike (2011) and Adepoju (2008). However, to the researcher's best knowledge, no study has examined the production efficiency of laying hens farms in Turkey. The objective of this study is to asses production efficiency of laying hens farms and to determine farm specific factors that might be causing efficiency variations among laying hens farmers in Afyon Province, Turkey.

MATERIALS AND METHODS

The data used in this study were collected through personel interviews with laying hens farms in Afyon Province, Turkey during the Spring of 2006. This area was selected because it is known as an center of eggs production. The total number of laying hens in the Afyon Province is 9,142,240 which is contributes 11.6% of total laying hen of Turkey (Yum-Bir, 2012). It also contributes 17.6% of country's eggs export (UFT, 2007). According to these figures, the Afyon Province ranks first in Turkey in the terms of egg production and export. In addition, the Afyon Province has a significant trade potential due to its location at the junction of many highways and its proximity to large consumption centers such as Ankara, Izmir and Antalya. In addition, egg stock exchange has been established in this province. Prices of eggs is determined in the stock market and all eggs producers fallow this price.

Afyon Province city centre, Basmakci, Bolvadin and Suhut counties identified as an study area for survey through communication with the Directory of Agriculture in Afyon Province and Laying Hen Farms Associations (Yum-Bir, 2012). According to the records of Directory of

Corresponding Author: Turan Binici, Department of Agricultural Economics, Harran University, Sanliurfa, Turkey

Agriculture in Afyon Province, there were 126 farms in the area. It was planned to interview all the laying hen farms. However, some of the farms were closed down and some of the producers did not want to give the information, only 75 producers were interviewed.

A wide range of socio-economic and business characteristics were elicited in the interview. They include number of number of stock of bird, number of eggs produced, major production expenses (feed, labor, drug and veterinary service, electricity, marketing, etc.), operator's education, experience and age, farm contact with private consulting firm or cooperative extension service and membership in cooperative.

Farrell (1957) developed the first theoretical treatment of production technical efficiency (hereafter, referred to as production efficiency). The standard methodology for measuring farm level production efficiency is to estimate a production frontier that envelopes all the input/output data available for the analysis. Within this context, technical efficiency of a farm is measured relative to the input/output performance of all other farms in the sample. Farms located on the production frontier are considered efficient. Farms located inside the frontier are considered inefficient because it is generating less output that is feasible given its level of inputs.

Cobb-Douglas production function is used to estimate the Stochastic Production Frontier (SPF) (In preliminary analyses, the Cobb-Douglas Model was found to adequately represent the data, given the specification of the translog stochastic frontier involving the five input variables). This function has been widely used to analyze production efficiency in developing and developed countries (Bravo-Ureta and Rieger, 1991; Sharma *et al*., 1999; Binam *et al*., 2004). Taylor *et al*. (1986) argued that despite its well-known limitations, the Cobb-Douglas function provides an adequate representation of production technology as long as the analysis is interested in the efficiency of production and not the structure of the production technology.

Given the choice of the Cobb-Douglas production function, the data available from the survey and the objective of explaining the variation in output among the sampled laying hens farms, the following SPF Model was estimated (Battese and Coelli, 1995; Rahman, 2003):

$$\ln Y_i = \beta_0 + \sum_{j=1}^{5} \beta_j \ln X_{ji} + v_i - u_i \quad (1)$$

And:

$$u_i = \delta_0 + \sum_{m=1}^{5} \delta_m Z_{mi} \quad (2)$$

Where:

- ln = Natural logrithm
- Y_i = Value of eggs produced per annum by laying hen farm i measured in value (TL)
- X_{1i} = Expenses of annual feed intake in Turkish Lira (TL)
- X_{2i} = Veterinary and pharmaceutical expenses (TL)
- X_{3i} = Human labor expenses (TL)
- X_{4i} = Electricty expenses (TL)
- X_{5i} = Other operating expenses (TL)
- Z_{mi} = Socio-economic charecteristics
- v_i = A symmetric, identically and independently distributed N (0, σ_V^2) error term. It represents random variation in production due to random exogenous factors such as measurement errors, unobserved production inputs and statistical noise
- u_i = A non-negative error term. It reflects technical inefficiency relative to the stochastic frontier

The socio-economic characteristics (Z_{mi}) examined in this study were defined as follows. Z_{1i} is laying hen farmer age, Z_{2i} is laying hen farmer experience, Z_{3i} is a binary variable equal to one if the laying hen farmer had a degree higher than elementary school and to zero otherwise. Z_{4i} is a binary variable equal to one if the laying hen farmer buying chick from cooperative administration and to zero otherwise. Z_{5i} is a binary variable equal to one if laying hen the farmer buying consultancy from private consulted firm and to zero otherwise. Because all the sampled laying hen farmers were members of the egg producers sale cooperatives, this variable have not been included in the regression equation. Following Coelli and Perelman (1996), technical efficiency of farm i equals:

$$EEF_I = E\left[\exp(-u_i)|\varepsilon_i\right] = E\left[\exp\left(-\delta_0 - \sum_{m=1}^{5} \delta_m Z_{mi}\right)|\varepsilon_i\right] \quad (3)$$

where, E is the expectation operator. The technical inefficiency of farm i, i.e., u_i is conditional upon the observed value of ε_i from the estimated Cobb-Douglas stochastic production frontier.

Maximum likelihood is used to estimate simultaneously the unknown parameters of the Cobb-Douglas stochastic frontier (Eq. 3) and the measure of inefficiency (Eq. 3). The likelihood function is expressed in terms of the variance parameters, $\sigma^2 = \sigma_v^2 + \sigma_u^2$ and $\gamma = \sigma_u^2/\sigma^2$ (Battese and Coelli, 1995). γ must lie betveen zero and one with zero indicating that the deviation from production efficiency is due entirely to noise and with one indicating that the deviation is due entirely to the farmer's production inefficiency

(Battese and Coelli, 1995). FRONTIER 4.1 (Coelli, 1996) is used to obtain the Maximum Likelihood Estimates (MLE).

RESULTS AND DISCUSSION

A basic summary of the values of the key variables used in the stochastic frontier production function is presented in Table 1. There is a substantial difference among laying hens farms regarding average size and inputs usage. The maximum likelihood estimates for parameters in Stochastic Frontier Model are presented in Table 2.

The coefficient of explanatory variables of drug and veterinary service and electricity expenses were positive with significant at the 99% level of statistical confidence. Coefficients are less than unity implying that variables are efficiently allocated and utilized. Allocation levels of those factors are in second stage of production surface. The coefficient of feed is negative and significant at the 99% level of statistical confidence, implying that total revenue from egg production decreases with increase in feed cost. This factor allocation is already is stage III of the production surface and to come back to the stage of efficiency the allocation has to be reduced.

The results of explanatory variables are similar to other poultry egg efficiency studies (Ojo, 2003; Adepoju, 2008). The Returns to Scale (RTS) of the poultry egg production is as presented in Table 2. The RTS is 1.0511. It is positive and more than unity indicating that eggs production is in stage III of the production surface. This implies that inputs allocation and utilization are not efficient.

Table 1: Characteristics of laying hens, Afyon Province, Turkey

Input/Output variable	Minimum	Maximum	Mean	SD
Number of hen (hen/farm)	1000	147000	24259	31529
Feed expenses (TL)	6989	2620800	463596	563566
Veterinary-pharmaceutical expenses (TL)	250	17500	2306	3733
Labor expenses (TL)	806	174300	20757	32957
Electricity expenses (TL)	100	240000	6357	27733
Other operating expenses (TL)	1663	177684	32206	47768

Table 2: Maximum likelihood estimates for parameters of the stochastic frontier for laying hens farms, Afyon Province, Turkey

Variables	Coefficient	SE	t-values
Feed expenses (TL)	-0.00010	0.000005	20.56
Veterinary-pharmaceutical expenses (TL)	0.00009	0.000006	15.41
Labor expenses (TL)	0.00815	0.014803	0.55
Electricity expenses (TL)	10.22887	1.866860	54.79
Other operating expenses (TL)	0.00003	0.000050	0.57
Farmer experience	0.06045	0.122310	0.49
Farmer age	-0.00004	0.000050	-0.68
Farmer education	0.60447	0.773670	0.78
Chick obtained from cooperative	0.00023	0.000320	0.72
Obtained consultancy from private company	-0.03852	0.063560	-0.61
$\sigma^2 = \sigma_v^2+\sigma_u^2$	0.27251	0.368026	0.74
$\gamma = \sigma_u^2/\sigma^2$	0.97000	0.036265	26.88

Log likelihood = 50.16; LR statistic = 22.8

This study finds that age is positively related with production efficiency but statistically insignificant at the 10% test level. Finding is in line with a priori indeterminate relationship. The a priori relationship between a farmer's age and technical efficiency is indeterminate. Older farmers have acquired more human capital through their experiences but they also may be less willing to adopt new ideas. Consistent with an indeterminate a priori relationship, findings from empirical earlier studies are mixed. For example, Abdulai and Huffman (1998) find that older rice farmers in Northern Ghana were less efficient than younger farmers while Coelli *et al.* (2002) find that younger rice farmers in Bangladesh were more efficient than older rice farmers. Binici *et al.* (2006) found that age has no statistically significant effect on cotton farms technical efficiency in Turkey.

Education is negatively associated with efficiency but it is statistically insignificant. Similar results were reported for farmers in Bangladesh (Rahman, 2003), Ethiopia (Weier, 1999) and Cameroon (Binam *et al.*, 2004). Conceptually, education improves the skill and entrepreneurial ability of the farmer to organize inputs for maximum efficiency. However, Joshi (2001) argues that the gains from education are higher in modernized agriculture than in traditional agriculture. The findings in this study are consistent with Joshi's argument.

Obtaining consultancy from private consultant firm rather than from cooperative veterinary or an extension officer during the past year was positively related to laying hen farm efficiency but statistically insignificant. Buying chick from cooperative rather than private company was negatively related to laying hen farm efficiency but statistically insignificant.

This study shows that experience is negatively associated with efficiency but it is statistically insignificant. This finding is consistent with the findings of Ojo (2003), Adepoju (2008), Mbaga *et al.* (2003) and Baily *et al.* (1989). To test efficiency, the following base calculations were made: $\sigma^2 = \sigma_v^2+\sigma_u^2 = 0.272$ and $\gamma = \sigma_u^2/\sigma^2 = 0.97$. The null hypothesis that $\gamma = 0$ is rejected at the 99% of statistical confidence (LR test statistics is 22.8), indicating that technical inefficiency effect exists. A γ^* of 0.97 indicates that 97% of the variation in output among the farmer is due to differences in production efficiency (γ does not equal the ratio, variance of ineffeicency to total residual variance because the variance of u_i equals $[\pi\text{-}2/\pi]\sigma^2$ not σ^2. Thus, the relative contribution of inefficiency to total variance γ^* equals $\gamma/[\gamma+(1-\gamma)\pi/(\pi-2)]$ (Rahman, 2003)).

Table 3 presents the distribution of production efficiency scores. About 69% of the 75 sampled laying hen farms had a production efficiency score of 90% or

Table 3: Distribution of farm level measures of technical efficiency for laying hens farms, Afyon Province, Turkey

Decile range of technical efficiency	Number of laying hens farms	Share of total sampled farm (%)
0.40-0.69	1	1.3
0.70-0.79	9	12.0
0.80-0.89	13	17.3
0.90-0.99	52	69.4

more. The highest score was 97%. On the other hand, 13% of the sampled laying hen farmers had efficiency scores of <80%. The lowest score was 45% and the average score was 90%. When taken as a group, these scores suggest soma potential for increasing output and/or reducing inputs by improving production efficiency. For example, if a farmer with average efficiency improved efficiency to that of the most efficient farmer in the sample, then the average laying hen farmer could realize an 7%, i.e., 1-(90/97) cost saving. Average production efficiency was estimated to be 76% for a sample of Nigeria (Osun State) laying hens farms (Ojo, 2003; Adepoju, 2008).

CONCLUSION

Stochastic Production Frontier analysis is used to analyze the production efficiency of a sample of 75 laying hens farmers located in Afyon Province, Turkey. These farms have an average efficiency score of 90% which is higher than the level of efficiency found in other studies of laying hens farms in developing countries. Further, analysis reveals that 97% of the variation in output among the sampled farmers is due to differences in their production efficiency.

The returns to scale of the poultry egg production is found to be positive and more than unity indicating that eggs production is in stage III of the production surface. This implies that inputs allocation and utilization are not efficient. Three statistically significant factors associated with the variation in production efficiency are identified: feeding, drug and veterinary service and electricity expenses. The coefficient of feed is negative, implying that total revenue from egg production decreases with increase in feed cost. This factor allocation is already is stage III of the production surface and to come back to the stage of efficiency the allocation has to be reduced.

REFERENCES

Abdulai, A. and W.E. Huffman, 1998. An examination of profit inefficiency of rice farmers in Northern Ghana. Staff Paper, Swiss Federal Institute of Technology, Department of Agricultural Economics.

Adepoju, A.A., 2008. Technical efficiency of egg production in Osun State. Int. J. Agric. Econ. Rural Dev., 1: 7-14.

Baily, D.V., B. Biswas, S.C. Kumbhakar and B.K. Schulthies, 1989. An analysis of technical, allocative and scale inefficiency: The case of Ecuadorian dairy farms. Western J. Agric. Econ., 14: 30-37.

Battese, G.E. and T.J. Coelli, 1995. A model for technical inefficiency effects in a stochastic frontier production function for panel data. Empirical Econ., 20: 325-332.

Binam, J.N., J. Tonye, N. Wandji, G. Nyambi and M. Akoa, 2004. Factors affecting the technical efficiency among smallholder farmers in the slash and burn agriculture zone of cameroon. Food Policy, 29: 531-545.

Binici, T., C.R. Zulauf, O.O. Kacira and B. Karli, 2006. Assessing the efficiency of cotton production in the Harran plain, Turkey. Outlook Agric., 35: 227-233.

Bravo-Ureta, B.E. and L. Rieger, 1991. Dairy farm efficiency measurement using stochastic frontiers and neoclassical duality. Am. J. Agric. Econ., 73: 421-428.

Coelli, T.J. and S. Perelman, 1996. Efficiency measurement, multi-output technologies and distance functions: With application to European railways. http://orbi.ulg.ac.be/handle/2268/35665.

Coelli, T.J., 1996. A guide to frontier version 4.1: A computer program for stochastic frontier production and cost function estimation. CEPA Working Paper 96/07, Department of Econometrics, University of New England, Armidale, Australia.

Coelli, T.J., S. Rahman and C. Thirtle, 2002. Technical, allocative, cost and scale efficiencies in Bangladesh rice cultivation: A non-parametric approach. J. Agric. Econ., 53: 607-626.

Farrell, M.J., 1957. The measurement of productive efficiency. J. R. Stat. Soc. A, 120: 253-290.

Ike, P.C., 2011. Resource use and technical efficiency of small scale poultry farmers in enugu state, nigeria: A stochastic frontier analysis. Int. J. Poult. Sci., 10: 895-898.

Joshi, P.K., 2001. Education, technology adoption and agricultural productivity. Ind. J. Agric. Econ., 56: 33-37.

Mbaga, M.D., R. Romain, B. Larue and L. Lebel, 2003. Assessing technical efficiency of Quebec dairy farms. Can. J. Agric. Econ., 51: 121-137.

Ojo, S.O., 2003. Productivity and technical efficiency of poultry egg production in Nigeria. Int. J. Poult. Sci., 2: 459-464.

Rahman, S., 2003. Profit efficiency among Bangladeshi rice farmers. Food Policy, 28: 487-503.

SPO, 2007. 7th five year development plan. Commission report of animal Husbandry, Ankara.

Sharma, K.R., P. Leung and H.M. Zaleski, 1999. Technical, allocative and economic efficiencies in swine production in Hawaii: A comparison of paremetric and nonparametric approaches. Agric. Econ., 20: 23-35.

Taylor, T.G., H.V. Durmmmond and A.T. Gomes, 1986. Agricultural credit programs and production efficiency: An analysis of traditional farming in Southeastern Minas Gerais, Brazil. Am. J. Agric. Econ., 68: 110-119.

UFT, 2007. Registrations of under secretariat of foreign trade. Under Secretariat of Foreign Trade, Ankara.

Weier, S., 1999. The Effects of Education on Farmer Productivity in Rural Ethiopia. CSAE, IES, University of Oxford, USA., Pages: 50.

Yum-Bir, 2012. Data of laying hens. Turkish Egg Producers Association. http://www.yum-bir.org/.