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Potato Production Efficiency: Evidence from Firoozkuh, Iran

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Abstract: The aim of this paper is to determine the technical, allocative and economic efficiency of potato farmers in Firoozkuh a city located in the Province of Tehran during 2011 farming year. To do so, first, technical efficiency has been estimated using Stochastic Frontier Analysis (SFA) method. The result of the technical efficiency analysis indicates some farmers are operating at a lower than optimal scale of operation. This finding is also the case regarding both, allocative as well as economic efficiency. In other words, the estimated results indicate that the overall technical, allocative and economic efficiency for the whole sample are 93, 51 and 47 percent respectively. Therefore, the farmers activities are not justified from efficiency point of view -especially economic and allocative ones.

Key words: Technical Efficiency % Allocative efficiency % Economic Efficiency % Potato % Firoozkuh

INTRODUCTION

The crop that is studied in the present research is potato and reason is that potato plays an important role in the self-sufficiency of Iran's economy. This crop is one of the important staple foods for a large part of people. Therefore, it has a vital and key role in food security of the Iranian households' consumer basket. Recently, increasing agricultural products have been much attention in the governmental economic policies [1].

Generally, Efficiency in production is a way to ensure that products of firms are produced in the best and most profitable way. Therefore, from the output perspective, technical efficiency measures the potential increase in output, keeping the inputs constant. But it from the input perspective measures the ability of the firms to produce a given output using the smallest set of inputs [2].

Usually, for the estimation of technical efficiency, several methods are used. Such as, OLS method that stands for Ordinary Least Squares in the form of regression, SFA method that stands for Stochastic Frontier Analysis and TEF method that it is the beginning of total factor productivity. The considerable point is that the OLS method requires the specification of a functional form for the production technology and provides information about the average performance rather than frontier performance. The SFA method is an econometric technique that requires a functional form to be specified, by specifying a composed error-term, with one part capturing data noise and the other, inefficiency [3].

In order to achieve the aim of this paper, stochastic Frontier Analysis (SFA) method will be used.

In the next section we briefly consider the methodological framework consistent of area of study and analytical techniques. Section 2 contains description of the data and section 3 describes the empirical results. At last, section 4 concludes.

Methodology and Model: This study was carried out in the Firoozkuh region of Tehran state in Iran. The region situated in the easternmost corner of Tehran that lies between longitudes 52°46´E and latitudes 35°45´N. The annual rainfall across the region is about 364 mm. Minimum average temperature, usually, in Firoozkuh ranges from 2°C to 3°C while maximum average temperature varies from 17°C to 18°C [4]. The main agricultural products grown are potato, wheat, pomegranate, cherry, apple and walnut. This region was chosen for this research because agriculture plays a key role in its local economy.

A two-stage random sampling technique was used to select the respondents for this research. 20 villages from

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70 villages were purposely selected at first stage. In the second stages, 150 potato farming households were selected randomly from these 20 villages for interview. Therefore, we have a sample with size of 150 respondents for this study and all of them were however found useful for research.

Simple descriptive statistics were utilized to describe the socio-economic characteristics of the potato farmers. A stochastic production frontier model was used to measure technical efficiency and inefficiency of inputs. The approach specifies the relationship between output and input quantities using two error terms. One is the traditional normal error term with a mean zero and constant variance and the other is shows the technical inefficiency which is estimated by Maximum Likelihood Estimation method [5].

Now, we consider a form of Cobb-Douglas production function as the best production function as follows:

$$Y_i = A\prod_{j=1}^{k} X_{ij}^{b_j} e^{si}$$

In which, A, Y_i and X_{ij} are technological coefficient, yield product by the ith farmer on a hectare and the jth used input by the ith farmer respectively. Also, $\$_j$, e and γ_i are the jth product elasticity, Nipper number and compound error term in regression respectively. So we write the error term as:

$$e_i = u_i - v_i$$

In which, u-$N(0, \sigma_u^2)$ and v-$N(0, \sigma_v^2)$. u_i is random error due to mis-specification of the model and variation in output due to exogenous factors outside the producer's control. And also, v_i is inefficiency component of the error term. So the inefficiency model can be showed as following:

$$v_i = B + \sum_{i}^{n} b_i z_i$$

Where B is intercept, bi is coefficient to be estimate and Z_i is cocio-economic such as years of experience of the potato farmers, access to bank credit, level of education, land ownership, extension visits and etc.

Then, in order to compute allocative and economic efficiency, we can obtain the frontier cost function as follows:

$$C_i = \left(\frac{Y_i}{A}\right)^{\frac{1}{j}} j \coprod_{j=1}^{k} \left(\frac{b_j}{w_j}\right)^{\frac{b_j}{j}}$$

Table 1: Variable Definitions

X_1	:	Land measured in squares meter of cultivated areas
X_2	:	Seed used measured in kilogram
X_3	:	Fertilizer used measured in kilogram
X_4	:	Labor in the form of man-days
X_5	:	Water (in the form of number of irrigation)
X_6	:	Machinery (in hour)
X_7	:	Pesticides in the form of kilogram

Table 2: Obtained results from estimate by OLS and MLE method

Variable	Coefficient (OLS-estimates)	Coefficient (MLE-estimates)
Intercept	0.43(0.9)	0.99(2.3)
X_1	0.24(3.6)	0.24(4.6)
X_2	0.76(9.2)	0.73(10.2)
X_3	0.1(2)	0.1(2))
X_4	0.02(0.4)	0.1(1.6)
X_5	0.04(0.8)	0.04(1.1)
X_6	-0.07(-2.3)	-0.09(-3.5)
X_7	0.006(3.5)	-0.003(-0.2)

In this function, γ considered as $\sum_{i=1}^{k} b_i$. According to the Shepard's Lemma, by derivation of the frontier cost function respect to ith input, one can obtain the level of this input that has economic efficiency.

In this section at first the considered variables is introduced in Table 1 and then some issues associated with the data will be explained. The used data in this paper were obtained from 150 households in 20 villages in the frame of interview for farming year 2011.

Finding: Maximum Likelihood estimates of parameters of production function were obtained by software FRONTIER 4.1. The obtained results, together with the Ordinary Least Square estimates are presented in Table 2. The figures in parenthesis are the standard deviation of mean. The important point is that the OLS method yields estimates of the average production function, while the ML method provides estimates of the stochastic production frontier.

As Table 3 shows, the 45.4 percent of potato farmers have technical efficiency more than 95 percent. Maximum and minimum technical efficiency for potato farmers are 98 and 70 percent. Also, its mean is 93 percent. Thus, although there is possibility for improvement in direction of increasing efficiency, economically, technical efficiency of potato producers in the Firoozkuh region is relatively satisfactory.

Table 4 indicates only the 16 percent of potato farmers have allocative efficiency more than 95 percent. Maximum and mean allocative efficiency are 99 and 51 percent. The 58 percent of potato farmers have allocative efficiency less than 50 percent. Therefore there is a considerable gap in allocative efficiency to fill.

Table 3: Obtained results about technical efficiency of potato farmers

Range of technical efficiency	Frequency	Percentage
70<TE<80	4	2.6
80<TE<88	9	6
88<TE<90	6	4
90<TE<92	14	9.3
92<TE<95	49	32.7
95<TE	68	45.4
Maximum	0.98	
Minimum	0.70	
Mean	0.93	

Table 4: Allocative efficiency of potato farmers in Firoozkuh

Range of Economic Efficiency	Frequency	Percent
AE<50	87	58
50<AE<65	17	11.3
65<AE<75	11	7.3
75<AE<85	7	4.6
85<AE<95	4	2.6
95<AE	24	16
Maximum	0.99	
Mean	0.51	

Table 5: Economic efficiency of potato farmers in Firoozkuh

Range of Economic Efficiency	Frequency	Percent
EE<50	92	61.3
50<EE<65	16	12
65<EE<75	5	3.4
75<EE<85	9	6
85<EE<95	8	5.3
95<EE	18	12
Maximum	0.99	
Mean	0.47	

As in Table 5 is considered, economic efficiency of potato producers in the Firoozkuh region is not relatively satisfactory. Although, 12 percent of farmers have economic efficiency over 95 percent, but 61.3 percent of them have economic efficiency less than 50 percent. Broadly speaking, with notice to the result of this study, a mean economic efficiency 47 percent, cannot be satisfied the potato farmers.

As Table 3 to 5 show the estimated results represent that overall technical efficiency, allocative efficiency and economic efficiency for the whole sample in the study period on average are 93, 51 and 47 percent respectively.

As mentioned before, this study has been done for the Firoozkuh region in Iran. Thus, a total sample of 150 potato producers was used for the analysis. By using Maximum Likelihood method, estimates of parameters of production function were obtained by software **Frontier 4.1:** The some important findings are classified as follows:

- Mean technical efficiency of potato farmers is 93 percent. Thus, their performance is relatively satisfactory. But technical efficiency analysis shows that some potato producers are operating with less than optimal scale of operation.
- Only the 16 percent of potato farmers have allocative efficiency more than 95 percent. Maximum and mean allocative efficiency are 99 and 51 percent. The 58 percent of potato farmers have allocative efficiency less than 50 percent.
- As in the result section mentioned, economic efficiency of potato producers in the Firoozkuh region is not relatively satisfactory. Although, 12 percent of farmers have economic efficiency over 95 percent, but 61.3 percent of them have economic efficiency less than 50 percent. Broadly speaking, with notice to the result of this study, a mean economic efficiency 47 percent, cannot be satisfied the potato farmers. Thus, Substantial economic inefficiency is observed for potato producers during the period under study.

The attitude of technical, allocative and economic efficiency across potato farmers provides useful information for policy makers in raising efficiency for each of them. Thus for policy purposes, it is useful to identify the causes of the inefficiencies, which can be done by investigating the relationship between farmer characteristics and the computed technical, allocative and economic efficiency. Hence, the research presents some important suggestions as

Follows:

- It is suggested that more land be put into potato cultivation to improve the efficiency at which farmers operate.
- Number of land plots is relatively high and this mater can creates inefficiency in producing potato. But there is suggested that some plots be emerged.
- Some industries such as flour mills and bakeries could be enlightened and encouraged to exploit the potentials of potato.
- Potato farmers should be encouraged to obtaining loan from banks.

This research, although accomplished in the Firoozkuh region, may have implications for other regions.

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