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The Economic Evaluation of Efficiency of Pomegranate Growers in Khash City

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Abstract

Pomegranate product in Khash city causes this city enjoys a considerable advantage in terms of the production of this product. In this paper the performance of Khash township pomegranate producers was evaluated with a comprehensive analysis of supercharged performance. In this regard, the relevant information to complete the questionnaire in 2015 pomegranate growers in Khash city, were collected based on a comprehensive analysis method and the desired results were compared with analysis ubiquitous super-efficiency. In general, the results showed that the average level of technical efficiency in the model assuming constant returns to scale (CCR method) 0.46% and the mean level of technical efficiency in the model, the variable returns to scale (BCC method) 0.68%. Also pomegranate orchards under different levels of technical efficiency is evident that the major cause of inefficiency in the management of inputs, It is suggested that, with proper management and allocation of inputs used in the vineyards, pomegranate production efficiency can be increased.

Keywords: Data Envelopment Analysis, Super Efficiency, Pomegranate Growers, Khash.

JEL Classification: Q_{10}, N_5.

1. Introduction

One of the most important issues in the development process of any country, especially in developing countries like Iran is efficient use of production factors in the production process (Je et al., 2018). In fact, all countries seeking to obtain improvements in agriculture, especially in

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cases where longitudinal expansion using more resources are faced with barriers to access, Trying to get the same amount of available resources to increase their productivity (Shahnavazi, 2017). Increase the efficiency of utilization of inputs in the production of the basic principles and key objectives are to raise the efficiency of production (Sardar Shahraki, 2017). One of the most important indicators of performance evaluation using the performance index. Efficiency is a relative concept involves the ratio of inputs to outputs (Shahnavazi, 2017). Their performance is measured by parametric and nonparametric methods. Also, stochastic frontier production function is the most important performance calculation method (Dahmardeh and Sardar Shahraki, 2015). The latter method requires the determination of the shape of the production function in the frontier production function estimation. There are two major methods (linear programming and econometric) during and after introduction of this technique, in science, in recent years, after 34 years of integrity and popularity of these two methods (Sardar Shahraki et al., 2013). The strategy does not seem beneficial in the short term for developing new technologies for natural problems and poor economic conditions of pomegranate growers, however, the current level of technology and resources available have been considered for the possibility of increasing production and income pomegranate growers. Therefore, in this study the possibility of increasing production and their income of pomegranate growers examined and assessed the current situation and issues of importance to the economic performance of these activities. In this context, this paper seeks to answer the following questions:

1. Has the Khash city in pomegranate production efficiency units a garden?
2. Are units in the Khash city for produce pomegranate good measure of performance?
3. Do the inputs which are used in the consumption of pomegranate growers, act reasonably and economically?

2. Literature Review

After the end of World War II, the orientation and the attention of a major study issues related to the efficiency and productivity of the researchers in this direction came in 1957, famous essay was published on the subject of their investigation (Sardar Shahraki et al., 2013). From 1957, the issue of efficiency among economists was seriously discussed the foundation and new ways to study the productivity and efficiency of the micro-level, in practice, the foundation (Dahmardeh and Sardar Shahraki, 2015). Generally, new perspectives on this issue are focused on the following topics:

1. How to define the efficiency and effectiveness;
2. How to calculate and measure the efficiency and effectiveness (Je et al., 2018).

The underlying assumption was that this may be inefficient manufacturing enterprises to operate. It refers to the concept of frontier production function to measure the efficiency (Kumbhakar et al., 1993). In table (1), a summary of the studies related to the present paper is shown.

Table 1: A Summary of the Research Background Related to this Article

Name	Year	Method	Country (Case Study)
Kidane et al.	2013	SFA	Tanzania
Djavan et al.	2017	DEA	South China
Qiang et al.	2017	DEA	Water conservancy investment-Chin
Esfahani et al.	2018	DEA	Iran
Alipoor et al.	2018	DEA	Agricultural Bank Branches in Guilan in Iran
Hosseinzadeh et al.	2018	DEA	peanut production of Iran
Ji et al.	2018	SFA	China’s Agricultural
Bachev	2018	DEA	Bulgarian Agriculture

3. Materials and Methods

DEA method of data input and output of each unit to build a nonparametric production frontier uses in such a case, all units are observed on or below the cover boundary. Thus, the efficiency of each unit is tested the relative performance of all the units in the sample. This standard units with a predetermined level of function cannot be compared, but it is a criterion for evaluating the performance of decision-making units in the same condition, in this method instead of the frontier production function, the performance of firms that have the highest ratio of output to input, are considered as the boundary.

Thus, the relative efficiency of firms surveyed, firms studied in comparison with each other. The advantage of linear programming, no need to specify the form and function; But this method is not considered random impulses and all deviations from the efficient frontier, is considered dysfunctional. DEA models can be product-oriented or input-oriented (Sardar Shahraki et al., 2013).

The product-oriented model aimed at maximizing production is given a certain amount of input, but the input-oriented approach aims to minimize the use of inputs with respect to a given level of product. Data coverage (both product-oriented and input-oriented) can be constant to scale or variable returns to scale (Bjurek et al., 1990).

3.1. Constant Returns to Scale Model (CRS)

This model is an input-oriented model which was proposed by Charnz and colleagues (1978). CRS model can be expressed as follows:

$$\begin{aligned} &MIN_{\theta,\lambda}\ \theta \\ &s.t. \quad -yi + Y\lambda \geq 0 \\ &\qquad\ \ \theta x_i - X\lambda \geq 0 \\ &\qquad\ \ \lambda \geq 0 \end{aligned} \tag{1}$$

where, value of θ in firm level technical efficiency show the rate is less than or equal to one represents the value of a firm's technical efficiency. The above linear programming problem N times is dissolved for each firm in the sample. nonparametric DEA approach may be difficult because of the parallel with the axis of the efficiency frontier, and a firm's performance after correction of the axes are parallel with the efficient frontier, then reduce the possibility of inputs without production loss (if the analysis is oriented input) will exist.

The surplus for firm *i*, taking bets $\theta xi - X\lambda = 0$ is satisfied and the amount of surplus equal to zero, also a shortage of product, taking into account the constraints $Y\lambda - yi = 0$ equal to zero is considered to be the assumptions in equation (1) are provided, and there is no need to modify the model (Coelli et al, 2002; Cooper, et al, 2000).

3.2 Variable Returns to Scale Model (VRS)

The model assumes constant returns to scale is appropriate only when all firms act in optimal scale, but factors such as imperfect competition, limited resources, etc. can cause a firm to operate at an optimal scale. Therefore, to separate the VRS technical efficiency, scale efficiency of the models used to measure pure technical efficiency. VRS model by adding constraints to the CRS model $N\acute{I}\lambda = 1$, variable returns to scale (VRS) developed (Coelli et al., 2002; Cooper et al., 2000):

$$\begin{aligned} & MIN_{\theta,\lambda}\ \theta \\ & s.t. \quad -y_i + Y\lambda \geq 0 \\ & \qquad \theta x_i - X\lambda \geq 0 \\ & \qquad N\acute{I}\lambda \leq 1 \\ & \qquad \lambda \geq 0 \end{aligned} \tag{2}$$

A firm's technical efficiency values between the two methods exist CRS and VRS indicate that there is scale inefficiency and scale inefficiency between the CRS and VRS:

$$\begin{aligned} & MIN_{\theta,\lambda}\ \theta \\ & s.t. \quad -y_i + Y\lambda \geq 0 \\ & \qquad \theta x_i - X\lambda \geq 0 \\ & \qquad N\acute{I}\lambda = 1 \\ & \qquad \lambda \geq 0 \end{aligned} \tag{3}$$

Technical efficiency is two methods (Coelli, 2002; Greene, 1990). This performance measure is calculated by the following equation:

$$SE = \frac{TE_{CRS}}{TR_{VRS}} \tag{4}$$

TE_{CRS}: technical efficiency obtained from constant returns to scale model.

TE_{VRS}: The technical efficiency of variable returns to scale model.

3.3 Non-Increase Model to Scale (NIRS)

These models do not scale efficiency, however, can be realized the firm that has constant returns to scale. This is an increasing problem solving model to scale to be resolved. Determining the relative inefficiency of scale (increase or decrease) for each firm by comparing the values of the two methods, NIRS[1] and VRS technical efficiency occurs. If technical efficiency values obtained from the two models it is equal to the firm increasing returns to scale for supporting ,If technical efficiency values obtained from the two models are not equal, firms are with decreasing returns to scale (Coelli et al, 2002; Cooper, et al, 2000).

3.4 Super-Efficient Method

Method efficiency is also known as linear programming method, first time introduced by dissertations Rhodes in 1978 and in the same year as the introduction of DEA (CCR) led (Charnes et al., 1978). This method is based on the basic definition of efficiency on the maximum ratio of total output to total inputs and limitations are including the performance of any of the units under study which cannot be more than its importing, The method of calculating the efficiency of DEA was first introduced in 1978 by Cooper and colleagues (Charnes et al., 1978), which universalize Farrell's method (Farrel, 1957). The frontier production function approach based on linear programming techniques derived and it is also called the method of linear programming.

This method is not need to specify the form of production function estimates; therefore, less prone to error is modeled explicitly. The efficiency of the method according to the returns can be fixed, variable, increasing and decreasing the scale ratio can be calculated and effectiveness of multi-product mode is also possible. This linear form shows - like to get a piece and convex; for each unit of N and M outputs. Vector ix, iq, respectively input and output for unit i,. $N \times I$ (X) input matrix, and $M \times I$ (Q) output matrix for all units. The ratio of all outputs over all inputs can be measured. This value indicates the level of productivity:

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1. Non-Increase Return to Scale

$$T = Uq_i / Vx_i \tag{5}$$

A decision-making unit (DMU[1]) can maximize the amount of catch-up as a target. So:

$$\begin{aligned} & Max \quad {U'q_i}\big/{V'x_i} \\ & S.t: \quad {U'q_j}\big/{V'x_j} \leq 1 \ ; \quad j = 1, 2, \ldots, I \\ & U, V \geq 0 \end{aligned} \tag{6}$$

But not determine input and output weights. The limitations of the first states to maximize the effectiveness of each firm are equal to the limits indicated or output data rate cannot be negative. In order to weight the data and outputs a variety of ways such as price or experimentally determined in accordance with department policy decision-makers. But for maximum efficiency in terms of the determination of optimal values has many solutions (the same ratio as the optimal values of a positive answer). This model is also nonlinear. To solve these problems, in 1978, a comprehensive analysis was made by normalizing the denominator of the objective function (Banker et al., 1984):

$$\begin{aligned} & Max \quad \mu' q_i \\ & S.t: \quad \upsilon' x_i = 1 \\ & \qquad \mu' q_j - x_j \leq 0 \ ; \ j = 1, 2, \ldots, I \\ & \qquad \mu, \upsilon \geq 0 \end{aligned} \tag{7}$$

The problem is that the dual model under fewer restrictions is used:

$$\begin{aligned} & Min \quad \theta \\ & S.t: \quad -q_j + Q\lambda \geq 0 \\ & \qquad \theta Xi - X\lambda \geq 0 \\ & \qquad \lambda \geq 0 \end{aligned} \tag{8}$$

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1. Decision Making Unit

θ shows the performance of each unit and the other variables are defined as before. The above model can be written as follows:

$$Min\ \acute{\varepsilon} - \theta\left[\Sigma_i{}^m S_i{}^- + \Sigma_r{}^s S_r{}^+\right] = D_{ot}\left(x_{ot}, y_{ot}\right)$$

$$S.t\ :$$

$$\begin{aligned}
&\Sigma_j{}^n \lambda_j y_{rj} - S_r{}^+ = y_{rp} && ;\quad r = 1, \dots, S \\
&\Sigma_j{}^n \lambda_j x_{ij} + S_i{}^- = \theta X_{ip} && ;\quad i = 1, \dots, m \\
&\lambda_j \geq 0 && ;\quad j = 1, \dots, n \\
&S_i{}^-, S_r{}^+ \geq 0 && ;\ r = 1, \dots, s\ ;\ i = 1, \dots, m
\end{aligned} \tag{9}$$

So, function of distance (the distance between the unit and the efficient frontier), S^- variable corresponding to the lack of input and output that corresponds to the lack of S^+ variables to convert inequality constraints were added to the model to draw.

Increasing the ratio of input to output is changed by the same proportion. These conditions mean that each decision-making unit (DMU) can alter the amount of inputs without restrictions. In other words, this model considers units in the long run. Bunker et al (1984) have developed the CCR model (BCC) and by adding the assumption of variable returns to scale assumption $\sum_j^n \lambda_j = 1$ was considered (Charnes et al., 1978). This assumes the simplest case (one input and one output) production function with constant slope from a line out and a convex shape and the piece gives it. Variable set of weights λ is the constant reference numbers indicate. The BCC model name or variable returns to scale (VRS) is a famous prototype (Primal) as follows:

$$Min\ \acute{\varepsilon} - \theta\ \left[\Sigma_i{}^m S_i{}^- + \Sigma_r{}^s S_r{}^+\right]$$

$$S.t$$

$$\begin{aligned}
&\Sigma_j{}^n \lambda_j y_{rj} - S_r{}^+ = y_{rp} && ;\quad r = 1, \dots, S \\
&\Sigma_j{}^n \lambda_j x_{ij} + S_i{}^- = \theta X_{ip} && ;\quad i = 1, \dots, m \\
&\Sigma_j{}^n \lambda_j = 1 && \\
&\lambda_j \geq 0 && ;\quad j = 1, \dots, n \\
&S_i{}^-, S_r{}^+ \geq 0\ ;\ r = 1, \dots, s && ;\ i = 1, \dots, m
\end{aligned} \tag{10}$$

In this model, the objective function for solving the problem of the number of non-zero weights are used based on Archimedes ε. Corresponding lack of inputs and S^+ and S^- variable corresponding to the scarcity of the product. The two models of efficient and inefficient units are divided into groups and are rated-ranking inefficient units do. But all the units on the frontier, corresponding to a performance, and thus it is not possible to distinguish between efficient units. For ranking efficient units classified by Anderson and Peterson (1993) procedure introduced (Andersen and Petersen, 1993). That is able to efficiently determine the best estimate of the how can a functional unit inputs (outputs) to increase (decrease) and still remain effective. This approach is similar to the standard model of comprehensive analysis of the functional units which are excluded from the reference set. This condition allows a single decision maker to be able to go beyond the boundaries of performance. From a mathematical point of view this means that λ_j is zero, so that the basic model of a single efficient value is equal to or greater than one. However, the effectiveness inefficient units is the same as the previous model. Algebraic model is as follows:

$$
\begin{aligned}
& Min\ \ \theta - \varepsilon\left[\Sigma_i{}^m S_i{}^- + \Sigma_r{}^s S_r{}^+\right] \\
& S.t: \\
& \Sigma^n \lambda_j y_{rj} - S_r{}^+ = y_{rp} \quad ; \quad r = 1,\ \dots\ ,S \\
& j = 1,\ \neq p \\
& \Sigma^n \lambda_j x_{ij} + S_i{}^- = \theta X_{ip} \quad ; \quad i = 1,\ \dots\ ,m \\
& j = 1,\ \neq p \\
& \Sigma_j{}^n \lambda_j = 1 \\
& \lambda_j \geq 0 \quad ; \quad j = 1,\dots,\ n \\
& S_i{}^-, S_r{}^+ \geq 0 \quad ; \quad r = 1,\dots,s\ ;\ i = 1,\dots,m
\end{aligned}
\tag{11}
$$

The variable x_{ij} and y_{rj} input and output of the i, r, i and j are the single decision maker S^- variable input variable corresponding shortage and lack of S^+ variable corresponding product.

3.5 Data Collection Method

A two-stage cluster sampling method of the main cluster of villages in Khash city is its sub-clusters and pomegranate growers. 144 samples were selected according to the relationships and formulas city of Khash finally selected through interviews, questionnaires, they were acting.

3.6 Introducing the Variables Used in the Study (A Questionnaire)

According to the statistics of the local and national and international studies of observed data available to researchers, the six factors of production (inputs) stochastic frontier model variables were selected as follows:

X_1: Cultivated area (ha), X_2: Labor force rental (day-people), X_3: Labor force family (days-people), X_4: Irrigation frequency (time), X_5: Animal manure (kg), X_6: Fertilizer (kg).

4. Results and Discussion

The first producers of pomegranate were used and the performance index using data envelopment analysis based models, including models with the assumption of constant returns to scale and variable returns to scale, was estimated then scale efficiency was calculated separately. The super-efficiency DEA technique was used. All these solving approach-models (Input-Oriented) were used which means that the technical efficiency due to the constant taking of pomegranate vines and a relative decline in the level of inputs was used. The results of the DEA method are discussed.

Also, in order to ensure unbiased efficiency scores obtained in this way, the normalization and removal of outlier observations, to calculate efficiency scores was little different between the results and the preliminary results as superior to the results presented it . In table 2 results of DEA model are shown.

Table 2: Summary Results of the Performance of Various Scale Samples in Khash City

	Max	Min	SD	Average
Technical Efficiency With Constant Returns To Scale	1	0.02	0.28	0.46
Technical Efficiency Of Variable Returns To Scale	1	0.16	0.28	0.68
Efficacy Scale	1	0.03	0.28	0.66

Source: Research findings

According to the results in table 2, an example of gardens in the city of Khash in terms of technical proficiency scale has the potential to reduce 54 percent of the value of the inputs. The phrase can be used as inputs in production without reducing greatly reduced. As well as pure technical inefficiency gardens in the city of Khash, 32% and 34% are achieved scale inefficiency. By eliminating inefficiency of scale, technical efficiency in city gardens can increase to 0.46 to 0.68. The results of returns are shown to scale gardens in table 3.

Table 3: Summary of Returns to Scale in the City of Khash Samples

	present	No
Technical Efficiency With Constant Returns To Scale	11.80	17
Technical Efficiency Of variable Returns To Scale	9.02	13
Efficacy Scale	79.16	114

Source: Research findings

According to table 2, which is observed in approximately 79% of Khash city gardens in the ascending scale return to work. Also, about 9% of the returns to scale plantations have been selling. Therefore, gardens in terms of increasing returns to scale (IRS[1]) activities, they must increase their production levels. In other words, the optimal adjustment of all inputs, the average cost per unit of output can be reduced by increasing the size of the firm. The economic rationale for this is that increasing returns to scale, an increasing proportion of the product is greater than the increase in input and assuming constant prices of all factors of production, the average cost curve will move

1. Increasing Returns to Scale

on; therefore, the production cost is increasing and spreading. Thus, decreasing returns to scale in terms of units (DRS[1]) to operate, to improve their status should reduce the activity level. Production and improve the overall efficiency are achieved. Levels of technical efficiency models listed in table 4 are summarized.

Table 4: Calculation of DEA Efficiency Assuming in Khash City

CRS	VRS	Efficiency of Scale	Type
0.35	0.75	0.35	IRS
0.83	0.91	0.8	IRS
0.48	0.89	0.34	IRS
0.76	1	0.67	IRS
0.78	0.85	0.7	IRS
0/78	0/65	0.85	IRS
0.70	1	0.77	IRS
0.57	1	0.57	IRS
1	1	1	-
0.93	1	0.93	IRS
0.62	1	0.62	IRS
1	1	1	-
0.73	0.81	0.9	IRS
0.23	0.67	0.44	IRS
0.95	1	0.96	IRS
1	1	1	-
0.32	0.55	0.68	IRS
1	1	1	-
1	1	1	-
1	1	1	-
1	1	1	-
0.55	0.71	0.65	IRS
0.61	1	0.74	IRS
0.93	0.94	0.87	DRS
0.77	0.84	0.89	IRS
0.26	1	0.89	IRS
0.58	0.84	0.75	IRS
0.482	1	0.58	IRS
0.54	0.72	0.68	IRS
1	1	1	-

Source: Research findings

1. Decreasing Returns to Scale

Table 4 mean levels of technical efficiency pomegranate growers the CRS model results showed that the mean level of technical efficiency in Khash city in the model assuming constant returns to scale (CCR) 0.46% and the mean level of technical efficiency in the model output variable scale (BCC) 0.68% percent IRS and DRS data were evaluated by using two models also are analyzed. The efficiency of using variable-yield model and compared with two recent models of returns to scale can be achieved in any garden; That the value obtained from the model of variable returns to scale performance with the performance obtained from the model were increasing returns to scale, The garden also will be increasing returns to scale, and vice versa. Indeed, increasing returns to scale implies that the increase in area under cultivation and other inputs, producing substantial increases. Therefore, in this region, producers increased use of inputs cans due to constant other conditions have a positive impact on performance.

Table 5: Ranking of Khash City Pomegranate Orchards Using a Super-efficient Approach, Given the Input-oriented

Super Efficiency	Rank	Super Efficiency	Rank
6.86	1	1.65	16
5.79	2	1.33	17
4.88	3	1.32	18
4.77	4	0.87	19
2.82	5	0.82	20
1.98	6	0.81	21
1.97	7	0.8	22
1.96	8	0.79	23
1.96	9	0.78	24
1.93	10	0.65	25
1.93	11	0.35	26
1.84	12	0.32	27
1.82	13	0.15	28
1.8	14	0.10	29
1.78	15	0.08	30

Source: Research findings

As a result, more farmers producing it do not use the inputs and can also increase the amount of its inputs, to increase the production of pomegranates. Table (4) Average current consumption (real consumption) and has been compared to the optimal consumption and inefficiency in the use of inputs is also provided. To calculate the optimal values (mean optimal consumption) in order to achieve the efficiency of the production and utilization of the area, the amount of any excess consumption of inputs, each of them out of actual consumption (the amount spent on inputs) will be low (Necat and Alemdar, 2005). This can be expressed by dividing the amount of the surplus on the actual consumption of inputs; the degree of inefficiency in the use of inputs in the production area is obtained. As a result of this model is similar to the previous model's performance level inefficient gardens and therefore a change in how the ranking inefficient units are found. Performance levels in this model range among 0.08 to 6.68, show the enormous differences between the samples of Pomegranate gardens in the Khash city.

5. Conclusions

This study aims to evaluate the efficiency of Khash city pomegranate growers. In this context, technical efficiency using data envelopment analysis models with the assumption of constant returns to scale (CRS) and variable returns to scale (VRS), respectively. The scale efficiency and returns to scale gardens it was clear.

In addition, the use of DEA model to rank the samples was gardens. Then the pomegranate growers envelopment analysis based method was compared with the results comprehensive analysis. According to the results, the following suggestions are offered:

- According to the results, performance, scale samples, eliminating the inefficiency of scale, this can be noted that the units that have diminishing returns to scale are avoid adding inputs into the production process and production units that are increasing returns to scale, you can add inputs, increase production and improve the way they scale and increase efficiency.
- The average scale efficiency of the gardens and comparison with the level of technical efficiency (net) management, it can be concluded that one of the causes of inefficient management of orchards, vineyards, has taken a different way. In other words, it is suggested; with appropriate management inputs used in the process of pomegranates reduce the amount of inefficiency.

- Creating and strengthening infrastructure facilities required such as roads, transport, social overhead fridge Scheme (SOC) in partnership with the Government and people.
- Evaluation of the efficacy and field studies showed that none of the study, other factors also affects the types of performance unfortunately; the possibility of importing or collecting from the farmers did not get the right answer. These factors include the personal interests of agriculture, the opportunity cost for other tasks or person's access to credit, the correct estimation of the extent of use of certain inputs like water; it is suggested people high degree of efficiency promoter's interviews and positive in their approach to consider.
- New methods and technologies for water supply and farming methods to suit the climatic conditions of the region.

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