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DETERMINING TECHNICAL EFFICIENCY WITH RISK FOR GRAPE GARDENS IN SISTAN AREA BY USING STOCHASTIC FRONTIER ANALYSIS

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ABSTRACT: Grape is the most important and economical garden crop in sistan area, that has key role in this area's economic. Therefore, according the all factors the produce it, scrutiny about it's efficiency. Also, because agriculture is risky job and this point is important to analyze farmer's behavior. in this study, efficiency of producing grape with risk has been paid attention. SFA are used to analyze data. In agricultural year of 2009-2010 data gathered by filling questionnaires of 265 farmers in Zabol, Zahak and Hirmand county. The results show the technical efficiency the city of Zabol, Hirmand and Zahak are respectively 83, 77 and 80 percent. Also for the city of Zabol, age, experience, household size, number and size of garden plots for city and for city of Zahak, experience, size of household and garden, for city of Hirmand, experience are significant impact on technical efficiency. On the other hand, results of risk analyzing in technical efficiency of land for Zabol and Zahak county was sequence risk-reducing and risk-increasing, rental worker in Zabol county, risk-increasing and animal fertilizer for Zahak and Hirmand county were risk-reducing. The rate of output to scale in Zabol, zahak and Hirmand County was 1.35, 1.18 and 1.34 and all factors (rental worker that was used more than normal in 3 cities is exception) were used by grape producers logically and economically. At the end, by paying attention to answers of grape producers about their problems and result of this study, some suggestion was offered to improve efficiency.

Key words: Efficiency, Stochastic Frontier Analysis, Production Risk, Grape, Sistan

INTRODUCTION

Understanding the possibilities and constraints of agricultural sector in Iran, can be help to increasing production and revenue with using factors correctly of maximization production with fixed inputs. Farmers are looking to minimize the variance of income and profits. Thus, improving the efficiency and resource allocation is necessary. Applied model in this study is stochastic frontier production and elasticity production inputs. In developing and developed countries, due to resource constraints in food production and food needs of growing human populations, agricultural operators can measure efficiency, the gap between the best producer and other producers in similar Constance technology set. Determining efficiency of farmers can be used in analysis of agricultural policies. Agricultural products and inputs are facing risks. And of risk as an important factor, influencing behavior of continuous imbalance of farmers in traditional agriculture is cited (villiano et al., 2005).

Besides agriculture in these countries, activity is associated with risk and risk to the farmer behavior model analysis, it is very important. Evidence suggests there is a risk or threat to agriculture and various reasons such as lack of agricultural operators to control climatic factors, pests and diseases and the market supply and demand of

EXPERIENCE RESEARCH

Shahraki and colleagues (2012) to evaluate the performance of Sistan grape growers have been using DEA.The results showed that the method DEA, Zahak city with 71% allocated to the most efficient scale.

Karagiannis and Sarris (2004) Lack of technical efficiency and scale tobacco farming using parametric random boundary techniques.

Nicat and Almdera (2005), use technical efficiency of tobacco farms in southeastern Antalya with both a comprehensive data analysis and stochastic frontier analysis.

Mashayekhi and Kshavardy (2005), use technical efficiency of farms in Tehran province with using a random boundary.

Battese and Broca (1996), Wheat farmers in four districts of Pakistan with the technical efficiency analysis of random boundary. Apply studies and observations of the effectiveness of agricultural research. Both methods of analysis of stochastic frontier and data envelopment analysis have been done.

Tozr (2010) efficient farmers in Western Australia use Stochastic Frontier Analysis.

Croppenstedt (2005), wheat farmers in Egypt in technical efficiency using stochastic frontier analysis.

Much of this amount is grown in Sistan. It is the most economical garden product in this region. Therefore, the potential of grape production is important in this region. Existing methods for increasing the production of grapes is not useful, for instance increasing production of basic resources and developing new technologies (shahraki et al,. 2012).

Among the garden products, grapes with 302 thousand hectares are including the 11.8% of horticulture in Iran. Total of no-fertilized and fertilized is 302729 hectares, also water produced of grapes is 1598573 tons and rain fed production of grapes is 140930 tons. Yield of water grape is equal to 7960 kg per hectare and rain fed yield is 1832.2 kg per hectare. Sistan and Baluchistan province with 482.7 hectares irrigated non-fertilized cultivation, 1100 irrigated fertilized cultivation and 9982.7 tons of fertilized cultivation has yield equal to 9075.1 kg per hectare (Statistics a horticultural crops, 2010).

RESEARCH OBJECTIVES

The main objectives of this research are:

1. Determine the technical efficiency of grape gardens in Sistan region.
2. Determining the factors affecting technical efficiency of grape gardens in sistan.
3. Measure the elasticity of production and institutions areas of production inputs to Grapes gardens the Sistan region.
4. Measuring the effect of risk factors on the production and identification of risk factors - increased risk - reducing the gardens the Sistan grapes.

METHODS OF RESEARCH

In this paper, technical efficiency have been studied with (SFA) parametric method to achieve the objectives, the extraction, the difference regression model were estimated. Then stochastic frontier production is estimated. So lack efficiency random is estimated to linear form, that both of these models using maximum likelihood.

Data collection

Questionnaire was used to collect information and needed data to evaluate the efficiency of grape gardens was collected from year statistical community 2009- 2010. To achieve better results, the information was collected in third city (Zabol, Hirmand and Zahak), and then homogenization and the objectives is looking for the area study. A typical method of making the cluster is the one–stage cluster of grape farmers in the city of Zabol, Hirmand and Zahak. To this end, 266 farmers were selected, among it the 144 samples are from the city of Zabol and 80 samples are and 42 samples from Zahak and Hirmand, and through interviews with them the questionnaire was completed.

$$Y_{it} = f (X_{it}, \alpha) \exp (\varepsilon_{\_it}) \qquad (1)$$

α is one vector $(1 \times k)$ of the unknown parameters to be estimated, N number of observations and t is the number of periods. In this model Y_{it} is the garden product i for time t, the vector $(k \times 1)$ of production inputs and other explanatory variables ε_{it} compound sentence of error is defined as follows (Tan et al., 2010; Khan et al., 2010):

$$\varepsilon_i=g (X_i; \beta)V_i-h(X_i;\delta)U_i \qquad (2)$$

$g (X_i; \beta) V_i$ is a function of risk and, $(X_i; \delta) U_i$ is the indicator of inefficiency function.

β and δ are vector parameters. Model when the function $f (X_{it}, \alpha)$ was determined, Ej of the Cobb-Douglas or Translog Transndntal) and, assumptions with regard to the distribution for V_{it} (normal) and U_{it} (usually semi-normal), Can be estimated using maximum likelihood. Finally the technical efficiency is obtained the flowing equation (Aigner et al., 1977).

$$EF_{it} \exp(-U_{it}) \quad (3)$$

And therefore quite useful in terms of technical efficiency is equal to one. Otherwise, number is calculated between 0 and 1. The index of farm production is exactly on the frontier production function. Villano et al (2005) positive or negative effects on the risk of production in accordance with the model's inputs and Pope (1978) are allowed:

$$\varepsilon_i = g(X_i;\ \beta)[V_i - U_i] \quad (4)$$

Assuming the equality g (X_i; β) V_i= h (X_i; δ) U_i can be written as:

$$Yi = f(X_i; \alpha) + g(X_i;\beta)[Vi - U_i] \quad (5)$$

Stochastic frontier production function of Equation 5 criteria consistent with flexible risk properties using (Batties et al., 1997) is.

U_i;β)X_i;α) $_-$ g(X_i) = f(U_i,X_i |Y_i E((6)

Variance risk function is defined according to equation 7:

;β) X_i(g^2) = U_i,X_i|Y_i Var((7)

The final product of my risk taking input j produced by the partial derivative with respect to Xj variance is defined as:

$$\frac{\partial Var(Y_i \mid X_i, U_i)}{\partial X_{ij}} > 0 \ \ or < 0 \quad (8)$$

Accordingly, technical proficiency farmer i am (TE_i) is the ratio of average production for the farmer, i have provided the quantities of inputs (X_i), and the lack of technical proficiency to (U_i), the average production, if any lack of technical proficiency, there is no:

$$TE_i = \frac{E(Y_i \mid X_i, U_i)}{E(Y_i \mid Xi, Ui=0)} = 1 - TI_i \quad (9)$$

TI_i Technical inefficiency and loss of potential output is defined as:

$$TI_i = \frac{U_i \cdot g(X_i, \beta)}{E(Y_i \mid X_i, U_i = 0)} = \frac{U_i \cdot g(X_i, \beta)}{f(X_i ; \alpha)} \quad (1$$

0) If the stochastic frontier production function parameters are known, then the best measure to predict if U_i would hope TE_i that the realized values of the random variable Ei = V_i - U_i is given (Villano et al., 2005; Khan et al., 2010):

RESULTS AND DISCUSSION

In the present study, three types of Cobb Douglas function, Transndntal (transcendent) and Translog (transcendental logarithmic) as well as possess the classical features was estimated by the software Eviews6 Estimated coefficients for these functions is necessary the become a simple linear form can be found with the logarithm of these functions (Debertin, 1376).

THE TEST MODEL ASSUMPTIONS TO ESTIMATE THE TECHNICAL EFFICIENCY

Table (1) shown the test results of the model assumptions and estimates of technical efficiency factors for sistan area.

Table 1. Results of maximum likelihood ratio test functions in Sistan

decision	The critical values	DF	Likelihood ratio (λ)	The null hypothesis
		ZAbol		
Refusal	19/04	11	64/6	$\gamma = \delta_0 = \delta_1 = ... = \delta_9 = 0$
Refusal	5/13	2	63/54	$\gamma = 0$
Refusal	17/67	10	21/08	$_0 = \delta_1 = ... = \delta_9 = 0\delta$
		Zahak		
Refusal	19/04	11	30/98	$\gamma = \delta_0 = \delta_1 = ... = \delta_9 = 0$
Refusal	5/13	2	21/68	$\gamma = 0$
Refusal	17/67	10	32/92	$_0 = \delta_1 = ... = \delta_9 = 0\delta$
		Hirmand		
Refusal	19/04	11	28/66	$\gamma = \delta_0 = \delta_1 = ... = \delta_9 = 0$
Refusal	5/13	2	33/92	$\gamma = 0$
Refusal	17/67	10	28/54	$_0 = \delta_1 = ... = \delta_9 = 0\delta$

The critical values has been extracted from the table of Kadeh and Palm (1986)

The third hypothesis suggests that The inefficiency effects model variables such as farmer's age, education, experience, size of household, Attending promotional activities of grape grown, the gardens, the trees, the number of units in garden plots on technical efficiency levels were not affected in this study. Note that each of these variables was tested separately can impact on the critical values and levels of technical efficiency. The results in Table shown Maximum likelihood estimator of the null hypothesis was rejected in each city and the variables considered on the level of technical efficiency effects are subjects.

Estimation results of the frontier production function and technical inefficiency factors

X_i inputs used in the production of grapes, including land (X_1) per hectare, hire labor (X_2) per day - person, the working family (X_3) per day - person, the frequency of irrigation (X_4), animal manure (X_5) per kg and fertilizer (X_6) per kg part $V_{I.}$

Table 2. Estimate the results of the stochastic frontier model and technical inefficiency grape

	Hirmand			Zahak			Zabol	
Variable	coefficient	t statistic	Variable	coefficient	t statistic	Variable	coefficient	t statistic
C	14.75***	13.24	C	14.34***	9.84	C	54.72***	55.64
Lnx_1	1.66**	2.52	Lnx_1	1.53***	13.5	Lnx_1	9.91***	12.66
Lnx_2	-1.09*	1.91	Lnx_2	-0.54***	-2.69	Lnx_2	0.33	-0.42
Lnx_3	0.11	0.62	Lnx_3	0.09	1.05	Lnx_3	-10.1***	-10.8
Lnx_4	-0.44	-0.56	Lnx_4	-0.4	-1.1	Lnx_4	4.41***	4.99
Lnx_5	-0.34	-1.89	Lnx_5	-0.47***	-2.59	Lnx_5	-6.21***	-9.99
Lnx_6	0.45	1.61	Lnx_6	0.28**	2.41	Lnx_6	27	0.31
X_1	-1.15	-1.6	X_1	-1***	-10.28	$Lnx_1 \times lnx_2$	-0.05	-0.53
X_2	0.008	1.36	X_2	0.007	1.07	$Lnx_1 \times lnx_3$	-1.23***	-5.81
X_3	0.0007	0.37	X_3	0.0006	0.92	$Lnx_1 \times lnx_4$	0.31**	2.13
X_4	0.07	1.19	X_4	.05**	2.33	$Lnx_1 \times lnx_5$	-0.54***	-4.4
X_5	0.00002	1.57	X_5	0.00002***	2.6	$Lnx_1 \times lnx_6$	0.18	1.62
X_6	-0.0005	-0.03	X_6	0.0003	0.35	$Lnx_2 \times lnx_3$	-0.07	-0.98
						$Lnx_2 \times lnx_4$	0.11	1.22
						$Lnx_2 \times lnx_5$	-0.002	-0.04
						$Lnx_2 \times lnx_6$	0.1*	1.79
						$Lnx_3 \times lnx_4$	0.13	0.64
						$Lnx_3 \times lnx_5$	0.81***	8.11
						$Lnx_3 \times lnx_6$	0.18	1.22
						$Lnx_4 \times lnx_5$	-1.25***	-10.6
						$Lnx_4 \times lnx_6$	0.34***	3.37
						$Lnx_5 \times lnx_6$	-0.16**	-2.24

Source: research Findings (* and ** and *** respectively significant at 10, 5 and 1% of showing)

More Table 2-Technical inefficiency effects model

Himand			Zahak			Zabol		
T	Coefficient	Variable	T	Coefficient	Variable	T	Coefficient	Variable
0.80	0.49	C	1.08	0.35	C	-0.29	-0.09	C
-0.55	0.00	Z_1	0.03	0.00	Z_1	3.45	-0.01***	Z_1
-0.91	-0.09	Z_2	-0.64	-0.03	Z_2	0.76	-0.04	Z_2
1.72	-0.004*	Z_3	2.60	-0.001**	Z_3	-2.90	0.001-***	Z_3
-1.31	-0.08	Z_4	-2.67	-0.05***	Z_4	-4.82	-0.6***	Z_4
1.52	0.16	Z_5	1.65	0.1*	Z_5	-0.19	-0.01	Z_5
-0.37	-0.03	Z_6	1.23	0.01	Z_6	-2.74	-0/09***	Z_6
0.84	0.12	Z_7	0.26	0.01	Z_7	0.72	0.03	Z_7
-0.82	-0.23	Z_8	0.37	0.05	Z_8	-0.56	-07/0	Z_8
2.17	0.0002**	Z_9	1.21	0.00	Z_9	3.91	0001/0***	Z_9
4.07	0.03***	σ^2	3.09	0.02***	σ^2	6.64	0/03***	σ^2
101.00	0.99***	γ	590.00	0.99***	γ	395.00	0/99***	γ
	32.74			54.23		122.60		Loglike
	0.88			0.87		0.90		R^2

Source: research Findings (* and ** and *** respectively significant at 10, 5 and 1% of showing)

In the city of Zahak variable coefficients of hire labor and X in the Hirmand task force looking to rent and animal manure have been negative, and have a negative impact on grape production. Thus, by adjusting the amount of inputs, to improve technical efficiency and increased production of grapes, there is no increase in the use of inputs. In general, the coefficients being significant for the city of Zabol, according to the stochastic frontier model, the factors, frequency of irrigation and cultivation in city of Hirmand and Zahak has increased the most effective and positive impact on grape production. Also according to incidental Translog in the city of Zabol and Transndntal in the city of Zahak and Hirmand (models estimate the technical efficiency) effects of variables is visible on technical efficiency of grape grower.

The results indicate that variables of the farmer's age, household size, number and size of garden plots with grape production, have increasing age, experience, and squinty increase the technical efficiency has increased : Table (2) to examine these factors are addressed Farmer age (Z_1): effect coefficient of age is negative and significant on the inefficiency in the city of Zabol, while there is the lack inefficiency of Hirmand and significant relationship with inefficiency in the city of Zabol. While in city of zahak the size of household and non- grape grown Zahak variables and, variable of grape garden is found sized in Hirmand garden significant relationship inefficiency: Table (2) to examine these factors are addressed Farmer age (Z_1): effect coefficient of age is negative and significant on the inefficiency in the city of Zabol. While there is the lack inefficiency of Hirmand and Zahak any significant effect. Therefore, this factor shows that age and Technical inefficiency Grape Growers in city of Zabol have an inverse relationship wit.

In other words, technical efficiency of grape grower has increased when age increase, in city of Zabol. In fact, older farmers may have more experience in producing. Thus they are efficient. Experience (Z_3): The relationship between these factors and inefficiency is significant in each city. The negative coefficient on this Zahak any significant effect. Therefore, this factor shows that age and Technical inefficiency grape growers in city of Zabol have an inverse relationship wit. In other words, technical efficiency of grape growner has increased when age increase, in city of Zabol.

Table 3. Production elasticity estimates results in Sistan

level of technical efficiency (percent)	Hirmand		Zahak		Zabol	
	percent	number	percent	number	percent	number
50-60	4/76	2.00	758/	7.00	2/08	3.00
60-70	21/43	9.00	23/75	19.00	13/88	20.00
70-80	21/43	9.00	27/5	22.00	22/91	33.00
80-90	23/8	10.00	21/25	17.00	15/91	23.00
90-95	7/15	3.00	11/25	9.00	20/16	29.00
Greater than 95	21/43	9.00	7/5	6.00	25	36.00
Average	0/80		0/77		0/83	
Standard deviation	0/14		0/12		0/12	
minimum	0/51		0/53		0/50	
maximum	0/99		0/99		0/99	

Source: research Findings (* and ** and *** respectively significant at 10, 5 and 1% of showing)

City under cultivation inputs, labor family and frequency of irrigation is used to logically in Helmand t statistic is significant inputs of chemical fertilizers and animal, but grape growers in each city of Zabol, Helmand and Zahak, have been production in the workforce looking to rent area. In other words, reducing the inputs, not only will not increase production but also will increase the labor convention to be used for rent, Total elasticity production for each of the functions can be Returns to scale and the flexibility to production. Results indicate that returns to scale in the city of Zabol, Helmand and Zahak is respectively 1/35, 1/18 and 1/34, Thus, if all factors of production can increase 100% rate increases production More than 100, which in this case also confirms the efficiency. Acreage amounts of elasticity production inputs, labor, family, frequent irrigation, animal manure and chemical fertilizers in the city of Zabol is between zero and one, and it shows the consumption of inputs is logically. For the city Zahak, cultivation, family labor, fertilizer and irrigation frequency is significantly and the t statistic of animal manure is not significant in this city.

The results of risk estimate marginal products

To study the effect of inputs on grape production risk, the risk was estimated to produce a linear fashion. Table 4 the results show the estimate risks of production inputs.

Table 4. Results of grape production risk estimate based on the mean values of the inputs

Input	hirmand		zahak		zabol	
	T-statistics	coefficient	T-statistics	coefficient	T-statistics	coefficient
The area under cultivation	-1.15	-1.36	2.25	1.67**	-1.67	-0.92*
Family labor	1.2	0.79	-0.66	-0.38	1.91	0.47*
Irrigation frequency	0.21	0.18	0.1	0.07	-0.89	-0.36
Irrigation frequency	-3.27	-0.97***	2.29	-0.23**	-2.21	-0.09*
Animal fertilizers	-2.51	-1.55**	-2.95	-2.07***	-0.33	-0.11
Chemical fertilizer	0.64	0.52	-1.58	-0.73	1.01	0.44
Coefficient of determination	R^2=0.15		R^2=0.27		R^2=0.12	

Source: research Findings

As seen in the results in Table 4 is the relatively low value of R^2 for each of the three cities, Represents the percentage of low-risk production in cities is related to the manufacturing inputs. The results of this study villano and Fleming (2006), Saha (2001), which determine the risk factor of production in the region was estimated to have a low value confirms. Irrigation frequency on the negative effects of risk factors in each city is producing; In other words, increasing the risk factor of production will decrease. Water is scarce in the study area for a given and Critical water situation in the region has been reported, Therefore, the lack of resources, reduce production risk in the study are.

Table 5. Frequency distribution of grape growers in the various levels of technical efficiency

Input	Hirmand		Zahak		Zabol	
	T-statistics	elasticity	T-statistics	elasticity	T-statistics	elasticity
The area under cultivation	2.9	0. 46***	3.4	0.34***	3	0.24***
labor	-3.2	-0.44***	-3/9	-0/34***	-3.1	-0/1***
Family labor	2.6	0.36**	3.5	0.26***	5.7	0.34***
Irrigation frequency	4.5	0.66***	6.7	0.58***	9.5	0.62***
Animal fertilizers	1.07	0.11	1.13	0.08	2.2	0.12**
Chemical fertilizer	1.61	0.19	3.8	0.26***	2.9	0.13***
Returns to scale	1.34		1.18		1.35	

Source: Research Findings

Table (5) Frequency distribution of grape growers in the various levels of technical efficiency in the region of Sistan Table (5) of the minimum values, maximum and average technical efficiency in the three city study shows Farmers can reduce the difference in efficiency between the efficient

operation and other grape growers in the city's average technical efficiency of Zabol, Helmand and the Zahak respectively 16, 22 and 19 percent improved It can be used without major changes in technology and resources has increased only through farmers' technical efficiency, production a lot.

SUGGESTIONS

Between variables, education and advocacy attending technical and relationship with economic efficiency, there Was no significant, so should be the level of quality and quantity of classroom science to promote agriculture and farmers, adequate and proper supervision.

The results of this study, the following suggestions are offered to improve the efficiency of grape growers.

Results showed that the experienced gardener who has a positive effect on technical efficiency, therefore be trained to transfer their experiences to new farmers through extension classes.

Reviews of the results revealed gardeners are not optimally treated in use of hire labor inputs, so it should conduct extension services to farmers on the efficient use of inputs and employing experienced and trained workforce to increase their production.

Planning and conversion industries related to the excess supply of grapes and creating added value at the time of product purchase creating and strengthening infrastructure facilities required such as roads, transport, storage.

Study Factors affecting efficiency Field studies showed the factors studied except other factors also affect the types of efficiency.

Government support for manufacturers, to monitor prices and banking facilities, providing can be improved market access requirements for production and supply of grapes

The basic strategies for success manufacturers and their revenue and their strategies for success is essential, cooperative Union of grapes in the region to improve the timely supply market, and credit insurance products.

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