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Investigating the Factors Affecting Sugar Beet Production - A Case study: Miandoab County

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Abstract

Introduction: Given the importance of the sugar beet production in the household consumption basket, self-sufficiency in producing this productis one of the most important objectives of the government. Modifying the production system and utilization of inputs can help us to achieve this goal.

Purpose: The purpose of this study is investigating factors affecting sugar beet production in Miandoab County. In order to achieve the above objective; required data have been collected during the years 1991-2011 and the transcendental production function is utilized to estimate the production yield and acreage function.

Results: The results of the production function showed that seed, mechanization and rainfall inputs are effective for sugar beet production, but these inputs level of usage is not in optimum levels. Explanatory variables could explain 93 percent of dependent variable changes. The total elasticity of affecting inputs on the yield function shows decreasing returns to scale.

Conclusion: Results obtained for sugar beet acreage shows that the labor cost and sugar beet price are as inputs affecting the production of sugar beet butusing these inputs is not at effective optimum level and explanatory variables explain about 87 percent of changes in dependent variable. The total elasticity of factors affecting the acreage, shows decreasing returns to scale.

Keywords: Production function, Sugar beet, Miandoab, Elasticity

INTRODUCTION

Sugar beet is one of the strategic products for its variety food usage. This product provides part of people's needsdirectly through the production of sugar and indirectly through livestock feeding. In addition, beet molasses, which is considered as thesugar beet byproduct, used toproduce alcohol in industry; this productis also used in Pharmacy (Hosseini and Poor Ebrahim, 2006). In 2010, the production rate of beet sugar and sugar cane factories were 49 and 50 percent, respectively.[1-6]

However, due to increasing demand and insufficient domestic production of sugar in country, every year a lot of sugar has been imported from abroad. This shows the importance of planning and paying more attention to increase production of sugar beet. West Azarbaijan province due to the special climatic conditions is very convenient for cultivation of this product. The province has achieved the first rank among the provinces of the country in terms of acreage and sugar beet production in year 2010-2011. In the meantime, the Miandoab County has the first rank in province in terms of sugar beet acreage. Therefore, this place can be promoted by proper plans for optimal use of production inputs and lowering production costs, in order to optimize production activities. Among the great ideals of any society is the optimal use of its natural and human resources. Growth and development in agricultural sector requires fundamental and comprehensive changes in existing agricultural structure, massive participation of forces and optimal management of factors. In addition to the above items, the factors such lack of proper planning in agriculture, inefficient management and lack of utilization of limited resources in various economic activities in the agricultural sector can be mentioned. Various restrictions on yield and crop production are

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effective in this regardwhich can be divided into two parts. In order to achieve self-sufficiency in sugar production in the country, plans are developed in this regard and is tried to bring down the costs of production per area unit and yield per hectare; in order to continue reducing costs and increase the efficiency of crop production per hectare,the extensive research should also be done on the marginal productivity of production inputs and consumption level and calculating production elasticity so thatpartialelasticity caused by the production function analysis and enables us to apply the research finding in promoting sugar beet product with higher level of sugar in Miandoab county and use the water and soil resources optimally.[7-10]

The aim of this study is to evaluate the present situation and determine a reasonable level of consumption of production inputs and determine the farmers' weaknessesin terms of production factors and the relative importance of each factor in increasing production. Hence, relying on scientific research, we can expect an improvement in the productivity and performance of the agricultural units. The overall goal of the study is to estimate the sugar beet production yield, determining the elasticity of production, and measuring the effect of production factorsin producing sugar beet product. In this study, transcendental production function has been used to evaluate the factors affecting the production of sugar beet (case study: Miandoab county). Also in this study, by calculating t-statistic, each of the variables and their significance at 5% level and also F-statistic which indicated total significance for the regression and Durbin-Watson statistic which solve auto correlation problem, have been utilized.; finally, by calculating the variables affecting both function,the relative return to scaleand triple production regions can be obtained.[11-15]

Literature Review

Studies have shown that each of the studies conducted about reviewing the factors affecting the production have considered certain aspects. (Safavi and Tour,2005) have used quadratic functions in the estimation of Kiwi production function in Mazandaran province. Their obtained results show that the usage rate of production factors, fertilizer, labor and area under cultivation, is less than optimal; that should be optimized by the necessary measures in the coming years. In another study (Mohammadi et al., 2005), in examining productivity in sugar beet farms of Eghlid county, the Cobb-Douglas and transcendental functions have been used and the results of this study suggest thatthe labor, machinery and seed inputs are used more than their optimal levels and the input such as chemical fertilizer are used less than optimal level.(Arsalanbod,2005) used the Frontier stochastic parametric approach for studying the effectiveness of beet producers in West Azerbaijan province. The results of this study showed that the average efficiency of sugar beet producers in sampleis 69.5 percent which is variable from 15.9 to 100 percent. The results show that with available facilities and technologies it is possible to increase sugar beet production in producing sugar beet. (Rezaei,2006) has used transcendental production functionin examining the productivity of cultivated potato production in Damavandcity. The results of this study demonstrate that the region's farmers used irrigation frequency and seeding level less than optimal and instead, they have used the inputs of manure and chemical and frequency of plowing and spraying more than the optimal level. The overall result of the study shows the farmers in the region act uneconomically in using production factors (Mousavi et al., 2008). In examining the factors affecting the supply of sugar beet in Fars province, the data related to 1990-2004 and Nerlove partial adjustment method have been used. The results of this study indicate that all variables are statistically significant except of sugar beet supply in a year ago. The explanatory variables explainthat 71 percent of dependent variableand the function elasticity showed that the area under cultivation with 94 percent of elasticity is more sensitive.(Yazdani and Rahimi,2012) assessed the efficiency of sugar beet producers in Qazvin fields.In this study, the DEA method is used. The results showed that the average technical and managerial efficiency and sugar beet producers scale in the region, are respectively, 89.6, 70.5 and 79 percent. The fertilizer, labor and seed inputs are also used more the optimal value, and pesticide and water inputs are less than optimal amount. (Riazi et al, 2014) estimated the long-grain rice production in the northern countriesand obtaining an appropriate production function, estimated the effect of each input on production and used the data needed to assess the proper function during the years 2000-2011. The results of this study show that the translog production function is selected as the most appropriate function for long-grain rice (Mirotchi and Taylor, 1993). In this study, Cereals production is analyzed using the Translog production function in Ethiopia farms, and found that farms acts with constant returns to scale and less labor is usedwhile machinery and other modern inputs are too much used. The elasticity of substitution between labor and highly consumed inputs is low. (Dawson and Lingard,1989)utilized estimation method of Stochastic frontier production function in form of the Cobb-Douglas functionin order to estimate the efficiency of Philippine rice farmers between 1970 and 1982. The results of this study show that the average yield during the period under studyhas increased with fluctuations and its reason refers to return to farmers training and promotional services. (Jain and Kumar,1992) conducted a study to determine the productivity of the production factors in Punjab agriculture for wheat product and using the Cobb-Douglas function found that in each period, it is possible to raise agricultural productivity by increasing the area under cultivation and development of education in rural areas. (Goni and baba,2007) conducted a study entitled "Assessment of Agricultural Resources in rice production in Nigeria". They used inputs Cobb-Douglas function for wheat product and found that all inputs except labor have been less than optimal level.

Summarizing and reviewing literature also shows that to investigate how to allocate inputs, a variety of rigid and flexible functional forms have been used.The results show that farmers have mainly used inputs in non-economic form.In the region under study namely Miandoab County, the large quantities of inputs is used yearly in the sugar beet production process as well. However, the type of relationships of inputs with sugar beet product as well as how to allocate these factors in production process in different farmsis not very logical and clear.

MATERIALS & METHODS

Research Method

The study is an applied research in term of thepurpose and descriptive-analytical methods is applied used for conducting it. In this study, in order to estimate and evaluate the impact of each factor on production yieldfunction and the area under cultivation, time series from 1991 to 2011 has been used. The study population is consisted of all sugar beet farmers of Miandoab city; the study's data have been gathered from the agriculture organization of West Azarbaijan province and Miandoab city; data collection has been performed by library method and Eviews Software was used to analyze the data. Estimating function has been performed using the method of least squares (OLS). In order to achieve the objectives of the research, the transcendental production function, that is one of the common methods to estimate agricultural production and the best known and simplest production functions, has been used.

Interpreting The Parameters of Factors Affect the Sugar Beet Production

producing sugar beet is affected by many factors.Generally, the product volumeis obtained by multiplying the yield by the area under cultivation. Any changes in yield and the are aunder cultivation affect production.Therefore, in analyzing the factors affecting yield and acreage, the production changes can be justified. In this study, at first, the factors influencing crop yield and acreage have been investigated and eventually, the general model of production function (Transcendental production function) has been obtained. Splitting production variables into two models ofyield and area under cultivated function, enables us to investigate more variables affecting production witha limited number of available observations. This method is important in econometric results.

Factors affecting sugar beet production function: According to the above function, the yield has been shown as follows.

$$Y_t = F\,(K_t, Bz_t, Mec_t, Wat_t, Tox_t, Tem_t) \quad (1)$$

Where, (Y_t) represents product (Ton), (K_t) for fertilizers, (Mec_t) for mechanization, (Bz_t) for Seeds, (Wat_t) for water (rainfall), (Tox_t) for toxin, and (Tem_t) is the average maximum temperature.

Factors Affecting Cultivated Area

Sugar-beet cultivated area is dependent on various economic and social factors. These factors are very wide so thatincluding all in themin onefunction in order to estimate the cultivated area is difficult. In the present study, economic factors such as the price of sugar, the price of competing products by one period delay (onion), sugar beet yield over a year ago, the production cost of sugar beet per hectare are used. According to what is mentioned,cultivated area function is defined as follows.

$$S = F(P_b, P_c, Y_n, Cost_t) \quad (2)$$

Where, (S) is sugar beet cultivated area, (P_b) sugar beet purchase price, (P_c) the price of competing products (onions) with one period delay, (Y_n) is sugar beet last year yield, ($Cost_t$) cost of labor employed forproducingone unit of sugar beet.

Factors Affecting the Production

Obviously, in addition to the above variables, many other factors such as geographical factors, namely topography, weather factors, differences in temperature (night and day), as well as technical factors, such as how and when fertilizer should be used, as well as how and the time and duration of watering or weeding, impact the crop production. But, their impact on production function is not considered because the lack of availability to required data or lack of possibility to convert them to the appropriate quantities. In other words, it is assumed that the effect of such factors on crop production is the same for all farmers. The general form of the sugar beet production is therefore presented as follows:

$$Q_b = F\,(K_t, Bz_t, Mec_t, Wat_t, Tox_t, Tem_t, P_b, P_c, Y_n, Cost_t) \quad (3)$$

Model introduction: in the mid-1950s, economists are well aware of the limitations of Cobb-Douglas function.They recognized that this function cannot well express the three neoclassical production areas. The main problem was the constant elasticity of production that requires a constant ratio of AP and MP, relative to each other. According to a study done on selecting model and the results of the comparison of Cobb-Douglas and transcendental functions, it can be concluded that it is among the limitations of Cobb-Douglas production function that the Production elasticity is always constant; and it is not able to indicate the estimated model parameters in all three production regions simultaneously. But there is a more perfect production function called transcendental function, in which the production elasticity depends on the level of usingthe same input; Cobb-Douglas production function is considered a special mode of transcendental function; transcendental function well indicates three neoclassical production stepsand elasticity of substitution is variable in which. Among its other desirable featuresis that, returns to scale is not constant in it but depends on the quantity of inputs (Rezaei, 2006). Generally, the production function should have theoretical justification and it is not true to select any type of function as the production function without considering the production conditions.In other words, there must be congruence between the production conditions and characteristics of the production function. For example, it is misleading to select linear production function for the product that its production is faced with decreasing return to scale. The type of production function should also be justifiable statistically and econometrically which is performed after estimation of function; Production function and the variables included in it should be in the form that through which we can explain the nature and purpose of the study.Transcendental production function which is one of the generalized production functions of Cobb-Douglas production functions, for some reason, is in good condition in agricultural studies compared with Cobb-Douglas function. In describing the model, because the partial elasticity is assumed variable, makes it possible to change the elasticity of production substitution by the production factors ratios. Given these features, transcendental function can be considered as an appropriate form to express the production relationships and its general form is as follows:

$$Y = A\Pi X_i^{\alpha_i} e^{\Pi\beta_i x_i},\quad Y = AX_2^{\alpha_2} e^{\beta_2 X_2 + \beta_2 X_2} \tag{4}$$

That is simultaneously expressible through such function; therefore, has a good position in agricultural studies. Its general form is as follows:

$$Y = A\ \Pi\ X_i^{ai} e^{b_i x_i} \quad i = 1, 2, \ldots, n \tag{5}$$

And it is required to convert it to the linear and simple form to estimate the function coefficients.

$$\log y = \log\ \alpha_0 + \sum_{i=1}^{n} \alpha_i \log\ x_i + \sum_{i=1}^{n} b_i x_i \tag{6}$$

If (b_i) is equal to zero, then Cobb-Douglas function will be obtained. Average production and marginal production is as follows:

$$AP_i = \frac{Y}{X_i} \tag{7}$$

If we calculate the derivative for its variables namely inputs,the marginal production will be obtained:

$$MP_1 = \frac{dy}{dx},\ MP_{x_1} = Y\left(\frac{\alpha_1}{X_1} + \beta_1\right),\ MP_{x_2} = Y\left(\frac{\alpha_2}{X_2} + \beta_2\right) \tag{8}$$

Partial sensitivity factor or partial elasticity of inputs is as follows:

$$E_1 = \frac{MP_1}{AP_1} \tag{9}$$

This factor depends on the input amount and linear function is obtained from its various levels.(X_i) is the quantity of inputs and (Y_i) is the amount of production. This function can be turned in Log-linear relationship which can be estimated as regression (Mosanejhad, 1993).

(A) Production yield function variables per hectare is as follows based on the above equation:

$$\begin{aligned} &\text{In } Y = A + \alpha_1 \text{ In } X_1 + \ldots + \alpha_n \\ &\text{In } X_n + \beta_1 X_1 + \ldots + \beta_2\ X_2 + \ldots + \beta n\ X_n \end{aligned} \tag{10}$$

(A) Intercept, (X_1) the amount of consumable fertilizer, (X_2) the amount of consumable seed, (X_3) the amount of consumable pesticide, (X_4) mechanization index (number of machines), (X_5) the amount of rainfall (mm), (X_6) the average temperature,

(B) The cultivation area function variables:

(X_1) price of sugar beet, (X_2) competing product price of sugar beet with a year's delay, (X_3) sugar beet yield over a year ago, (X_4) labor cost for the employed work force in producing sugar beet.

To calculate the production elasticity as well as for simplicity, the single-input Transcendental is usedand the answer can be generalized for(n) inputs.

$$Y = Ax^{\alpha} e^{\beta_x} \tag{11}$$

The general formula for the elasticity is as follows:

$$E_x = \frac{dy}{dx}, \frac{x}{y} \rightarrow \alpha A X^{\alpha-1} e^{\beta_x} + \beta A X^{\alpha} e^{\beta_x} \frac{\alpha A X^{\alpha} e^{\beta_x}}{X}$$

$$+\beta_y = \alpha \frac{y}{x} + \beta_y \rightarrow E_x = (\alpha \frac{y}{x} + \beta_y) = \alpha + \beta_x \quad (12)$$

As can be seen from above formula, by changing the value of X, the amount of production elasticity (E_x) will also change. The above formula can be used for the production elasticity of each input (Mosanejhad, 1993). In the same way, the production elasticity of inputs X_1 and X_2 can be obtained that the final result is as follows:

$$E_{x_1} = \alpha_1 + \beta_1 x_1, \quad E_{x_2} = \alpha_2 + \beta_2 x_2 \quad (13)$$

In this type of functions, as can be seen in the above equations, production elasticity of each input is a function of the value of that input. For example, if the value of inputs X_1 changes one unit, the partial elasticity of this input changesby the amount of β_1. So, the rate of change of any input can be obtained from the following equation.

$$\beta = \frac{\alpha E_x}{\alpha_x} \quad (14)$$

Elasticity relationship in the transcendental production function for two inputs of X_1 and X_2 are as follows:

$$E = \frac{(\beta_1 + \alpha_1 x_1)(\beta_2 + \alpha_2 x_2)}{\beta_1 \beta_2 - \alpha_1 \alpha_2 x_1 x_2} \quad (15)$$

Given that the elasticity of substitution is not constant in these function sunlike production functions (CES1), so, these group of functions are calledas production functions with variable elasticity of substitution (VES2).

RESULTS

Estimation Results for Production Yield Function

generalized Dicky-Fuller unit root test for the variables of the production yield function is conducted and its results are shown in Table(1).

According to Table(1), the absolute value of the calculated statistic for all variables of the yield function is smaller than the critical value. So, generalized Dickey–Fuller test are conducted for the first difference of the model variables which results are shown in Table(2).

1 Constant elasticity of substitution

2 Variable elasticity of substitution

Table 1: The generalized Dicky-Fuller unit root test results for production yield function

Variable	Unit	The calculated statistics	Critical values 1%	5%	10%
Sugar beet yield	T/h	–1.42	–3.85	–3.04	–2.66
Fertilizer	Kg/h	–1.33	–3.57	–3.69	–3.26
Seed	Units/h	–1.48	–3.8	–3.02	–2.65
Mechanization	Number/h	–1.1	–3.85	–3.04	–2.66
The amount of rainfall	Mm/h	–2.61	–4.49	–3.65	–3.26
Pesticides	L/h	–1.34	–3.85	–3.04	–2.66
Temperature	Centigrade	-0.28	–2.69	–1.96	–1.6

Source: Research findings

Table 2: Generalized Dickey-Fuller unit root test results of first difference

Variable	Unit	The calculated statistics	Critical values 1%	5%	10%	Degree
Sugar beet yield	T/h	–5.62	–3.85	–3.04	–2.66	1
Fertilizer	Kg/h	–6.75	–3.57	–3.69	–3.26	1
Seed	Units/h	–4.79	–3.8	–3.02	–2.65	1
Mechanization	Number/h	–5.8	–3.85	–3.04	–2.66	1
The amount of rainfall	Mm/h	–6.29	–4.49	–3.65	–3.26	1
Pesticides	L/h	–3.45	–3.85	–3.04	–2.66	1
Temperature	Centigrade	–3.33	–2.69	–1.96	–1.6	1

Source: Research findings

According to the table (2), all variables are static in first rank differences.

The results of the estimation yield function in the production of beet sugar with regard to the transcendental production function is provided in table (3).

$$LnY_t = A + a_1K_t + a_2Bz_t + a_3Mec_t + a_4Wat_t + a_5Tox_t + a_6Tem_t + a_7LnK_t + a_8LnBz_t + a_9LnMec_t + a_{10}LnWat_t + a_{11}LnTox_t + a_{12}LnTem_t \quad (16)$$

According to Table(3), only three variables of seeds, mechanization, and rainfall among(Water) the 6 assumed variable was effective in the results of estimating the production function. Because the absolute value of these 3 variables t-statistic is higher and their significance level is less than 5 percent,so the null hypothesis is rejected and the estimated coefficients will be significant. Three other variables of fertilizer, temperature and pesticides are not influential in sugar beet Product yield because their calculated statistic is lower and their significance level is greater than 5% and the null hypothesis will not be rejected for these variables;the estimated coefficient is not also significant and it is equal to zero. According to Table(3), F-statistic represents the total significanceof the regression. Also, in the estimated model of R^2, exploratory variables

Table 3: The estimation results of the production yield function

Variable name	The first model-dependent variable LnY t		
	coefficient	t-statistics	Likelihood level
K_t	−0.000138	−1.217	0.2598
Bz_t	0.00433	5.5727	0.0005*
Mec_t	0.00567	2.8152	0.0227*
Wat_t	−0.00497	−2.7602	0.0247*
Tox_t	0.00667	0.938	0.3757
Tem_t	0.09017	0.0803	0.938
LnK_t	3.5955	1.4394	0.188
$LnBz_t$	−1.231	−5.2454	0.0008*
$LnMec_t$	−3.095	−3.7009	0.0151*
$LnWat_t$	0.8234	3.7009	0.006*
$LnTox_t$	−2.9652	-0.8222	0.4348
$LnTem_t$	0.2604	0.012	0.9907
Intercept	26.67	0.59	0.5715
R^2	0.9727	R^2	0.9317
F statistic	23.7547	Prob	0.00
DW-statistic	2.2697	-	-

Source: Research findings (*significant at the 5% level)

revealed about 93 percent of the variability in dependent variable. Durbin-Watson statistic is also estimated as 2.26 and because this statistic is between 1.5 and 2.5 then we can say that the estimated model has not the problem of serial autocorrelation of disturbance terms. The final result of estimating the production yield function is as follows and t-statistic is represented in parentheses below each variable.

$$LnY_t = 26.67 + 0.00433BZ_t + 0.0056Mec_t - 0.00497Wat_t - 1.23LnBZ_t - 3.095LnMec_t + 0.8234LnWat_t$$

$(t_{BZ}=5.57)$, $(t_{Mec}=2.81)$, $(t_{Wat}=-2.76)$, $(t_{LnBZt}=-5.24)$, $(t_{LnMect}=-3.07)$, $(t_{LnWatt}=3.7)$

$(F=23.75,\ R^2=0.93,\ DW=2.26)$

Productivity and Production Elasticity of Production Agents

according to the prior estimated function, productivity of significant variables in the production function is obtained by derivating the production function to the given input which is as follows:

Marginal productivity of seed variable:

$$MP_{BZ} = (-1/231 + 0/00433BZ)Y$$

Marginal productivity of mechanization variable:

$$MP_{Mec} = (0/00567 - 3/095Mec)Y$$

Marginal productivity of rainfall variable:

$$MP_{Wat} = (0/00497 + 0/8234Wat)Y$$

Given the above relationships, the marginal productivity and its average for seeds, mechanization and rainfall variables are -691496, -2742532 and -605077.6, respectively. The average productionis also the average yields produced by each inputwhich is equal to 5.031, 3.189 and 0.00145 for seed, mechanization and rainfall inputs, respectively. Production elasticity of each input which isthe percentage change in production per each percent change in inputsis equal to -133743, -859866 and -4185.14 for seeds, mechanization and water respectively. The total input elasticity is negative which indicates that the return to scale is descending. About the production area, it can be said that sugar beet farmers are in the third stage for seed, mechanization and rainfall inputs which implies that the marginal productivity of this input is negative and more than the optimal level.

The estimation results of the cultivated area: the generalized Dickey-Fuller unit root test results for the variables of cultivated area function are shown in the table (4).

According to the table (4), the absolute value of the calculated statistics for all variables of cultivated area function is smaller than the critical values. So the generalized Dickey-Fuller unit root test for the first difference of the model variablesare conducted; the results are shown in Table (5).

According to the table (5), all variables are static in first-order differences.

The estimation results of the area under sugar beet cultivation are providedin the table (6) according to the transcendental function:

$$LnS_t = A + a_1Pb_t + a_2Pc_t + a_3LnYn_t + a_4Cost_t + a_5LnPb_t + a_6LnPc_t + a_7LnYn_t + a_8LnCost_t \quad (17)$$

According to the table (6), in the results obtained from estimating the cultivated area function, only two variables of sugar beet priceand the cost of labor were effective. According to statistics calculated for the variables of cultivated area function,only sugar beet price and labor cost were significant at 5% level. So, the null hypothesis for these two variables will be rejected and the estimated coefficients will be significant. But about the competent products price variable namely onion and sugar beet yield in the past year, the null hypothesis was not rejected for these two variables and the estimated coefficients for these two variables are not meaningful and equal to zero. According to Table (6), F statistics represents the total significance of the regression. Also, inthe estimated model of R^2, the explanatory variables explain about 87 percent of the changes in dependent variable. The Durbin-

Table 4: The generalized Dickey-Fuller unit root test results for the cultivated area function

Variable	Unit	Calculated statistics	Critical values		
			1%	5%	10%
Sugar beet acreage	h	–1.39	–4.57	–3.69	–3.28
The price of sugar beet	rials/ton	0.15	–4.66	–3.73	–3.31
Price of competing product	rials/ton	1.72	–4.66	–3.73	–3.31
sugar beet yield years ago	Tons	0.52	–4.53	–3.67	–3.27
Labor costs	person/day	–0.25	–4.61	–3.71	–3.29

Source: research findings

Table 5: The generalized Dickey-Fuller unit root test results for the first difference of the model variables

Variable	Unit	The calculated statistics	Critical values			Degree
			1%	5%	10%	
Sugar beet acreage	hectare	–6.75	–4.57	–3.69	–3.28	1
The price of sugar beet	rials/ton	–4.02	–4.66	–3.73	–3.31	1
Price of competing product	rials/ton	–6.3	–4.66	–3.73	–3.31	1
Sugar beet yield years ago	Tons	–6.1	–4.53	–3.67	–3.27	1
Labor costs	person/day	–7.96	–4.61	–3.71	–3.29	1

Source: Research findings

Table 6: The estimation results of the cultivated area function

Variable name	LnSt: the first model-independent		
	Coefficient	t- statistics	Likelihood level
Pb_t	–0.00168	–3.2717	0.0074*
Pc_t	–0.00187	0.9809	0.3477
Yn_t	–0.0363	–1.1216	0.2859
$Cost_t$	3.86	0.9835	0.3465
$LnPb_t$	–0.6188	–3.338	0.0066*
$LnPc_t$	0.2476	0.9269	0.3738
$LnYn_t$	1.1998	1.0825	0.3022
$LnCost_t$	0.824	4.1964	0.0015*
(A) Intercept	–10.1387	–2.5725	0.0259
R^2	0.92	R^2	0.8775
F- statistics	18.0184	Prob	0.00
DW- statistics	2.0762	-	-

Source: Research findings (* significant at the 5% level)

Watson value is also estimated 2.07; because this statistic is between 1.5 and 2.5, it can be said that the problem of serial correlation in disturbance terms has not been observed in the estimation model. The final result of the estimation of the area under cultivation function is as follows: and the calculated t-statistic of variables has been also mentionedin brackets.

$$LnS_t = 10.13 - 0.000168Pb_t - 0.6188LnPb_t + 0.824LnCost_t$$

$$(t_{Pbt} = -3.27),\ (t_{LnPbt} = -3.33),\ (t_{LnCostt} = 4.19)$$

$$(F=18.01,\ R^2=0.87,\ D.W=2.07)$$

Productivity and Elasticity of Factors Affecting Cultivation

Based on the prior estimated function, productivity of significant variables in the production function is obtainedthrough derivatetheproduction function than the intended input as follows:

Marginal productivity for sugar beetprice variable:

$$MP_{pb} = (-0/00168 + 0/6188Pb)Y$$

Marginal productivity of labor costs variable:

$$MP_{Cost} = (3/86 + 0/8240Cost)Y$$

Given the above relationships, marginal productivity and its mean forsugar beet and total labor cost variables are respectively -9547.42 and -8085130.5 respectively. Also, the average productionis the average of product producedby each input that is equal to 1.64 and 0.00019 for sugar beet price and cost of labor inputs, respectively. The elasticity of the area under cultivation for each factor, which is the change percentage in cultivated area per one percent change in each of the factors, is equal -58086.05 and -4.166 for Sugar beet price and cost of labor variables respectively. Total inputs elasticity is negative, indicating that the return to scale is descending. About the production partof cultivated area, it can be said that the landsunder cultivation of sugar beet product is in the third stage forsugar beet price and cost of labor inputs which implies that the marginal productivity of this factor is negative and the area dedicated to cultivation of sugar beet is higher than optimal level.

CONCLUSIONS AND RECOMMENDATIONS

According to production function, except seed, mechanization (tractors) and the rainfall rate coefficients, the rest of the coefficients are zero; the zero value for pesticide, fertilizer and temperature coefficients leads to conflict with the theory. In addition to what is obtained from the results of study, negative marginal production of three significant variables in production function for the entire farm indicates that local sugar beet farmers uneconomically use inputs.Seed, mechanization and rainfall production negative elasticity, indicates the more than optimal usage of these inputs, which puts the production function at the third stage and negative value of input elasticity indicates that return to scale is decreasing. On the other hand, the cultivated area and inputs only have a significant relationship with sugar beet price and labor costs. These factors also have negative elasticity with cultivated area which leads to decreasing returns to scale and puts production in the third stage. Negative marginal production of three significant variables incultivated area function for the entire farm suggests that local Sugar beet farmers act uneconomically in using the mentioned inputs. According to the results, we can conclude that because of low land area, lack of integrity and the land non-geometric form, technological problems and lack of agricultural machinery, old machinery and low productivity of small farm machinery lead to lack of efficient use of mechanization. Small size of landsmakes mechanized planting difficult; traditional cultivation causes using seeds more than optimal level; increased seed consumption causes reducing production and in addition direct and negative impact on optimal production, imposes remarkable costs to the affiliated organizations and farmers. On the other hand, the positive impact of labor costs on cultivated area and negative value of its marginal production in area under cultivation can also be influenced by the family work by farmers. Due to the lack of significant, prior period sugar beet product yield does not have a positive impact on the area under cultivation.Because there is no significant relationship between the onion and sugar beet cultivation area as the competing products,farmers do not have any sensitivity to increase or decrease the price of competing products or increasing or decreasing the area under cultivation for any product.Reformingthe pricing system, because of the mismatch between the sale price and the real cost of sugar beet production has caused that farmers areless benefited from government support policies. The increased guarantee rate from the government, in addition to cover the real costs causes creating incentives for the farmers to increase the area under cultivation and production. Among the training, promotional and research programs, the excessive use of production inputs andlack of local farmers' technical information can be mentioned; it is proposed that by conducting the training courses, the production productivity can be enhanced with the minimum cost. The reason for excessive use of machinery is the small size and lack of integration of theregion lands. It is proposed that affiliated organization andofficials proceed toinvest in order to integrate the lands according to the last research achievements to optimally use the machineries. Timely and appropriate procurement and distribution ofseeds, fertilizers, pesticides, machinery etc. and justifying farmers in order to optimal use of these inputs and reform credit system.

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