# Analysis of the production structure and economic efficiency of wheat in Shahin Dezh District

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**Abstract:** Based on the importance of wheat production in the country, the main objective of this paper is to analyze the relationships between inputs and economic efficiency in the production of wheat using cost dual approach. So, after estimating the cost of flexible functions, translog cost function was used to estimate function coefficients, returns to scale and elasticity of substitution. This function was estimated along with the seemingly unrelated regression equations share of the cost to duplicate, in the crop year 2013-2014. Allen partial cross elasticity for each pair of inputs showed that inputs of fertilizer is replaced by machines and labors and seed has complementary relationship with labor, fertilizer and machinery. The results indicated that there is relationship between replacement of machinery and labor. Calculation the price elasticity of demand indicates that seed has more elasticity and fertilizer is without elasticity in wheat production process. Besides, these results suggest that economies efficiency derived from scale is less than 1. In other words, the production of wheat in Shahin Dezh District has decreasing returns relative to the scale.

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**Key words**: cost function, elasticity of substitution, returns to scale, seemingly unrelated regression, wheat

## Introduction:

Agricultural development is precondition and essential need of economic development of country. For agricultural development goals such as increasing agricultural production, self-sufficiency in strategic crops and raise farmers' incomes followed. Despite high agricultural potential of the country, performance and productivity of agricultural production is lower than international standards. So identify the relations of production and the factors affecting the level of production as well as the composition and the relationships between them in the analysis of economies of scale would be an effective step to increase efficiency and enhance the productivity of factors of production in agriculture products [1].

Changes in the relative prices of factors of production are typically due to the use of production inputs and substitute for each other. Aware of the possibility of substitution between inputs is possible to identify the structure of production technology. In this study, we tried the wheat crop production technology as one of the basic strategic products. Because the pricing policy of agricultural inputs, lack of attention to the relationship between the substitute and complementary production inputs may reduce the level of production and refuse government to pursuit the goals of the production of valuable product. To identify the technological structure of production, due to the advantages of the cost of the production function, the estimated cost of the various inputs and cost share equations was used [2].

## Literature review:

Amjadi et al. (2007) have studied the structure of wheat production technology using panel data to identify the structure of production and the relationship between various inputs in the production of wheat. For this purpose a dual approach was used to estimate the cost of inputs. The results show that wheat production function is non-hypotonic and needs machine and labor. However, due to lack of agricultural machinery in the country, to encourage increased production of machinery and equipment required to provide special attention is needed [2].

Mohammadi (2012) in study of application of data envelopment analysis to evaluate the efficiency of the production of greenhouse cucumber in Fars Province to determine the share of production inputs, translog production function was used. Results showed that despite the constant returns to scale, technical efficiency in the range of 35-100% of the units are located, which shows a wide range of performance [3].

Hosseini et al (2012) in the analysis of the structure of production and economic efficiency in the production of sugar beet to estimate coefficients of the translog cost function, returns to scale and elasticity of substitution is used. Allen partial cross-elasticity results showed that for each pair of inputs fertilizer inputs substitute for labor and land based machines but complementary. The results indicated that there is relationship between land and labor and calculate the

price elasticity of labor demand showed that the factor with the most elastic elasticity of land has been in the sugar beet production process [4].

Due to the importance of studies have been done in relation to the size of the economy which each of them has a different method to determine the optimal size of production units, the relationship between size and cost of production factors and the factors affecting the size of production units in different industrial and agricultural activities which are as follows:

Rasmussen (2000) technological changes and economies of scale in agriculture Denmark translog cost function to determine the optimum size of production units, agricultural, dairy and pigs used for breeding. The results showed increasing returns to scale, crop and dairy farms and pig farms were drawing [5].

Songqing et al (2006) using a cost function secondarily generalized scale and economic efficiency of China's agricultural research fields studied. The results indicate the existence of economies of size in the fields of new corn and wheat [6].

Boussemart et al (2006) study as economies of scale and optimize the size of the farm in the Estonian dairy industry to four of the studied dairy operations. The four methods are: Cobb-Douglas production functions with constant returns to scale, respectively. Investigation revealed that the cost of milk production at low cost units with production capacity of 200 thousand and 300 thousand kg of milk is done. The optimal size of the square in the cost of production was 700 thousand kg mil and the results using data envelopment analysis showed that the optimal size is between 200 thousand and 300 thousand kg [7].

Gervais et al (2006) studied the economies of scale in the food industry in Canada. Using translog cost function returns to scale for the production of meat, bread and milk obtained. There are increasing returns to scale results in the production of bread, meat and milk [8].

Sharzehei et al. (2002) and the cost of rice production in the province as using a translog cost function was investigated. In this cross-sectional study of data from 1997 was used to pull funding for rice farmers in about 0.897, indicating increasing returns to scale in production of rice in the Gilan province [9].

According to studies carried out in order to provide a more economical agricultural production as well as the need to enable the agricultural sector to meet domestic needs, identifying technical and economic aspects of wheat production has become a necessity. In this context and to the importance of wheat and the problems of production and processing of this product is one of the strategic products; this study sought to identify the relations of production and economic cost analysis in order to enhance the ability of the wheat production in Shahin Dezhd district.

**Material and Methods:**

Information and data needed was obtained by support of agricultural research and through interviews and questionnaires Shahin Dezh city by 103 farmers in the crop year 2013-2014. For statistical analysis Excel and Eviews 8 software was used.

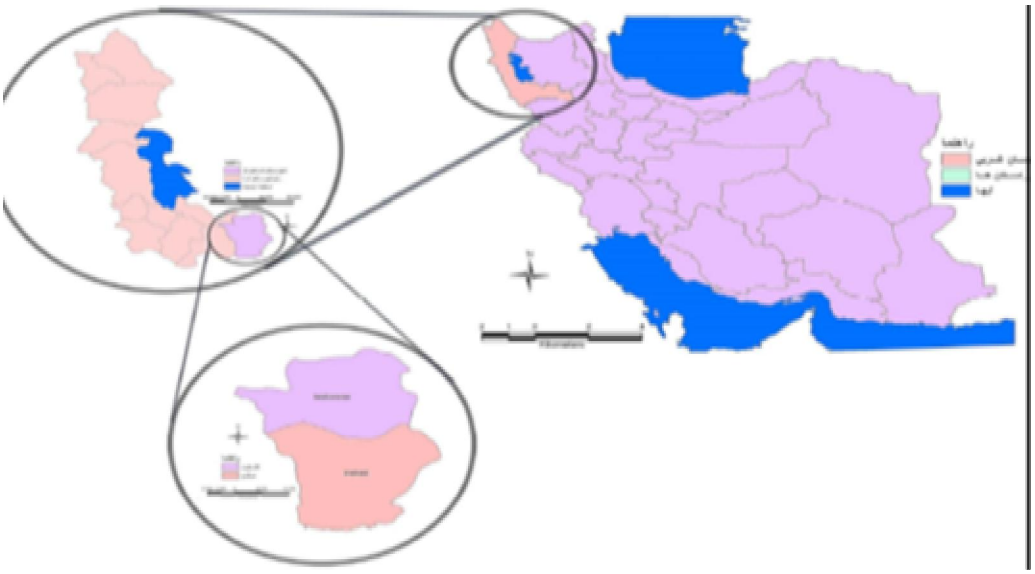

Figure 1- Study area, Shahin Dezh district

To identify the structure of production as well as this study dual theory can be used. Dual theory suggests that the structure can be manufactured using a production function and the cost function to be studied. However Stier (1985) states that the cost function has several advantages, including the overall cost functions are more flexible form, Thus it can be said without placing restrictions on production technology parameters, the parameters estimated using a cost function is easier because the costs are not a function of the price of production factors and their values are more likely to industry input prices are exogenous. In addition, the possibility of a line between the inputs prices less than their values seem more appropriate production technology is the cost function analysis [10].

Economic and how the money can be generated by an industry production function or cost function and studied. But according to binswanger (1974) using the function rather than the production cost due to the use of input prices rather than physical quantities of production factors as independent variables and low risk of it in input prices and demand functions enabling the extraction and production of an advantage. Thus, in this study to determine the relationship between the factors of wheat production and economies of scale, the cost function is used. View the cost function is:

(1) $C = c(P1, P2, ..., PN, Q)$

In the above equation, C is total cost; Pi is the price of i-th inputs, Q is value of the product [11]. The input cost share equations derivative of the cost function with respect to prices of Shephard Lemma is obtained by equation 2:

(2)

$$S_i = \frac{\partial LnC}{\partial LnP_i} = \frac{\partial C}{\partial P_i} \cdot \frac{P_i}{C} = \frac{P_i X_i}{C}$$

Si is i-th share of the costs of inputs. The estimated cost to the cost of all share positive and their sum is equal to a [12]. To analyze the relationship between the inputs and the price elasticity of substitution of factors are used. Elasticity of substitution of the sensitivity of one variable to another variable changes show. Elasticity of substitution that allows it to combine the inputs used in the manufacture of a product at the time of the change in the ratio of input prices and technology changes and replacement cost inputs instead of expensive inputs becomes possible [13].

Elasticity's considered by the study are:

1. Conditional cross price elasticity of production factors

Direct Price Elasticity of Demand for production factors shows the percentage change in quantity demanded adopted the (at any time) per one percent change in the price of production factors; On the other hand, price elasticity of demand for the relative sensitivity of quantity demanded to changes in price is defined. Cross Price Elasticity of Demand is the percentage change in the value of a one percent change in the price of production factors for the production with the assumption of stable prices of other factors of production. This tension is a measure to describe the relationship between alternative and complementary factors of production. If the tension is greater than zero, it means that the increase in the price of production factors, increase the demand for other production factors, so the relationship between the two factors of production the type of relationship replacement. If the cross-price elasticity be less than zero, indicating the existence of a complementary relationship between the two factors of production. Because of increase in prices, the demand for other factors is low.

Cross-price elasticity's of own production factors, are as follows:

(3)

$$\eta_{ii} = \frac{\partial LnX_i}{\partial LnP_i} \Rightarrow \eta_{ii} = \frac{\alpha_{ii} + S_i^2 - S_i}{S_i} \quad for: i = j$$

$$\eta_{ij} = \frac{\partial LnX_i}{\partial LnP_j} \Rightarrow \eta_{ij} = \frac{\alpha_{ij} + S_i S_j}{S_i}$$

$for: i \neq j$

Allen Elasticity of Substitution (*AES*): This type of stretching the elasticity of substitution was named as Alan-Ozawa, for each pair of input groups are used to supplement and substitute. Allen Elasticity of Substitution, the degree of substitution between two inputs shows, the tension in the relationship 4 is defined as:

(4)

$$AES_{ij} = \frac{C(Q,P).C_{ij}(Q,P)}{C_i(Q,P).C_j(Q,P)}$$

$C(Q,P)$ is total cost, $C_{ij}(Q,P)$, $C_i(Q,P)$ and $C_j(Q,P)$ are respectively second and first order derivative of the cost function is compared to the prices of production factors.

Allen Elasticity of Substitution based on Translog cost function is expressed as follows:

(5) $for: i = j$ $\sigma_{ii} = \frac{1}{S_i^2}(\alpha_{ii} + S_i^2 - S_i)$

$for: i \neq j$ $\sigma_{ij} = \frac{\alpha_{ij}}{S_i S_j} + 1$

Which $S_j, S_i$ are functions of $j, i$ and $\alpha_{ij}$ is Cross multiplication factor parameter log prices i-th in logarithm of the price factor j-th in Translog cost function. If $AES_{ij}$ be greater than zero, the concept of substitution relationship between production inputs and if be less than zero, indicating a complementary relationship between two production inputs. Relationship between Allen partial elasticity of demand and the relationship between price elasticity's are as follows:

(6)

$$\eta_{ij} = \sigma_{ij} S_j$$

According to the above equations, the values of minor pull Allen over time in terms of the cost of production factors and product technology trends to use a special inputs, it has actually increased the level of tension. In addition, the price elasticity of demand factors (levels of consumer demand for the relative volatility of production factors) elasticity against minor changes (changes in the cost of production factors for each of the changes in their relative prices) will change. In other words, changes in the cost of production factors directly partial substitution elasticity's and price elasticity's of demand levels are affecting production factors. To assess the presence or absence of an increase in the size of the economy, it is possible to measure the elasticity of production costs in general, in relation to the cost function used from equation 7 [14].

(7)

$$\varepsilon_c = \frac{\delta \ln c}{\delta \ln Q} = \frac{\frac{\delta c}{c}}{\frac{\delta Q}{Q}} = \frac{MC}{AC}$$

For example, the above equation for the translog cost function is derived as follows:

(8) $\varepsilon_c = \alpha_Q + \gamma_{QQ} LnQ + \gamma_{Qi} Lnp_i$

According to the results obtained in practice to draw the costs, with regard to the presence or absence of economical production units deduced:

State $\varepsilon_c < 1$ That is money that is indicative of a much larger plants is more economically effective.

State $\varepsilon_c > 1$ Indicating the size and the lack of money $\varepsilon_c = 1$ shows that the difference between small and large units relative to each other in terms of their cost effectiveness [15].

In order to achieve the purpose of the survey, flexible translog functions, quadratic extended and generalized Leontief, Finally, the study also translog cost function based on widely used in national and international studies, as well as with regard to the selection criteria [16], mathematical relationship for the first time was introduced by Christensen, Jorgsnun and Lao [17].

For a well-behaved production function, it's necessary that function of the degree of homogeneity in the level of fixed production costs. In this case, a proportionate increase in the price of all inputs increase in spending is appropriate. The translog cost function there must be limitations-of the following:

(9)

$$\text{LnC} = \alpha_0 + \sum_{i=1}^{N} \alpha_i \, \text{Lnp}_i + \frac{1}{2} \sum_{i=1}^{N} \sum_{j=1}^{N} \gamma_{ij} \, \text{Lnp}_i \cdot \text{p}_j + \alpha_Q \text{LnQ} + \frac{1}{2} \gamma_{QQ} (\text{LnQ})^2 + \sum_{i=1}^{N} \gamma_{Qi} \, \text{LnQ} \cdot \text{Lnp}_i$$

$$\sum_{i=1}^{N} \sigma_{iq} = 0 \quad , \quad \text{for all j} \qquad \sum_{j=1}^{N} \gamma_{ij} = 0 \qquad \sum_{i=1}^{N} \alpha_i = 1$$

As well as to provide a concave condition of translog cost function, to the matrix of second derivatives of the cost function with respect to input prices ( $\frac{\partial^2 C}{\partial P_i \partial P_j}$ )be a negative semi-definite matrix. This requirement if the price elasticity of their demand for all observations with negative values is provided. In order to meet the condition of being monotonic cost function in input prices is necessary to share the cost of the inputs of the production cost per sample is positive [18].

Experimental model to study the relationship according to the translog cost function 10 provides:

(10) $\ln(tc/pt)=b_0+b_Q\ln(Q)+b_s\ln(P_s/pt)+b_F\ln(P_F/pt)+b_M\ln(P_M/pt)+b_L\ln(P_L/pt)+½b_{ss}\ln(P_s/pt)^2 + ½ b_{FF}\ln(P_F/pt)^2 +½b_{MM}\ln(P_M/pt)^2+ ½ b_{LL}\ln(P_L/pt)^2 + b_{sF}\ln(P_s/pt)\ln(P_F/pt) + b_{sM}\ln(P_s/pt)\ln(P_M/pt) + b_{sL}\ln(P_s/pt)\ln(P_L/pt) +b_{FM}\ln(P_F/pt)\ln(P_M/pt) + b_{FL}\ln(P_F/pt)\ln(P_L/pt) + b_{ML}\ln(P_M/pt)\ln(P_L/pt)+ ½ b_{QQ}\ln(Q)^2+ b_{Qs}\ln(Q)\ln(P_s/pt) + b_{QF}\ln(Q)\ln(P_F/pt)+ b_{QM}\ln(Q)\ln(P_M/pt)+ b_{QL}\ln(Q)\ln(P_L/pt)$

(11) $Ss= bs+ bss\ln(Ps/pt)+ bsf\ln(PF/pt)+ bsM\ln(PM/pt)+ bsL\ln(PL/pt)+ b_{QT}\ln(Q)$
$SF= bF+ bFT\ln(PT/pt)+ bFF\ln(PF/pt) +bFM\ln(PM/pt)+ bFL\ln(PL/pt) + b_{Qf}\ln(Q)$
$SM = bM + bMT\ln(PT/pt)+ bMF\ln(PF/pt) + bMM\ln(PM/pt) + bML\ln(PL/pt) +b_{Qm}\ln(Q)$
$SL = bL + bLT\ln(PT/pt) + bLF\ln(PF/pt) + bLM\ln(PM/pt) + bLL\ln(PL/pt) +b_{Ql}\ln(Q)$

In the above model, TC is total cost of production (IRR), Pf is price of fertilizer, PT is toxins prices, PM is price of machinery, PL is price of labor, ps is seed pric and Q is seed crop (wheat).

All prices are based on the price of 10 toxic inputs (Pt) is divided and so prices relative to the prices of all inputs have normal poison. About 11, si share of the cost of each component is input through Shephard Lemma is obtained. The product consists of 4 main input variable seed, fertilizer, machinery, and labor is, therefore, a translog cost function and 4 cost share function will remain. With required data can be compared to the cost of the necessary system functions. Although the cost function parameters can be estimated with OLS, the equation does not include the share of the cost factors. In such a case, to estimate the cost function parameters, if any, correlation between the sentences at the same time was disturbing the equation of costs and to enhance efficiency parameters, the estimated system of equations using an iterative seemingly unrelated regression method Allen Elasticity of Substitution used. Considering that the number (N-1) share of the cost equation of linear independence, for each observation, the sum of the equation is zero disruption clauses, the covariance matrix of the variance-components are disturbing individual and non-diagonal and the reverse is inevitable. Variance matrix to prevent singularity of disturbing statements, one of the share equations cost of the system was removed. Since the cost of the total system costs of one is the, equation coefficients can be removed from the rest of the equation coefficients obtained.

**Result and discussion;**

In view of the experimental model for the study of the function and the estimation of parameters was attempted. As a result of the translog cost function estimates for wheat production is reported in Table 1.

To estimate cross elasticities to measure the relationship between the 4 Allen is applied. Bssed on the cost of inputs and coefficients derived from translog cost function, the results of measuring the elasticity of the (AES) is presented in Table 2.

As Table 2 shows, the entire elasticity of partial self Allen, expected signs are negative, but the results are positive traction for seed set and seed is very poor given that the share of input costs. On the other hand, seed demand due to small price changes can be considered Giffen good and therefore does not cause prejudice to the applicable law of demand.

Table 1. The estimated coefficients dependent on translog cost of wheat

| Parameter | coefficient | statistics t | Parameter | coefficient | statistics t |
|---|---|---|---|---|---|
| $b_0$ | 20.79 | 0.61 | $b_{sM}$ | -4.25 | **-2.315** |
| $b_Q$ | 3.78 | 0.89 | $b_{sL}$ | -1.5 | **-1.54** |
| $b_s$ | 32.27 | 2.29 | $b_{FM}$ | 1.21 | **1.34** |
| $b_F$ | -10.45 | -1.64 | $b_{FL}$ | 0.08 | **-0.231** |
| $b_M$ | -2.54 | -0.37 | $b_{ML}$ | -0.0006 | **-0.0010** |
| $b_L$ | -8.37 | -2.094 | $b_{QQ}$ | -0.521 | **-1.28** |
| $b_{ss}$ | 10.81 | 2.64 | $b_{Qs}$ | -0.616 | **-0.873** |
| $b_{FF}$ | -0.071 | -0.105 | $b_{QF}$ | 0.336 | **1.059** |
| $b_{MM}$ | 2.415 | 1.76 | $b_{QM}$ | -0.722 | **-1.409** |
| $b_{LL}$ | 0.49 | 0.74 | $b_{QL}$ | 0.415 | **1.620** |
| $b_{sF}$ | -2.3 | -1.59 | | | |
| | | | | | |

Reference: research findings

Table 2. Allen's self and cross elasticity's translog cost function

| Input | Seed | Fertilizer | Machinery | Labor |
|---|---|---|---|---|
| Seed | 16.2 | -30.81 | -70.7 | **-38.8** |
| Fertilizer | | -57.8 | 0.78 | **1.01** |
| Machinery | | | -1.98 | **2.34** |
| Labor | | | | **3.02** |

Reference: research findings

Table 3. Self and cross price elasticity of demand

| Input | Seed | Fertilizer | Machinery | Labor |
|---|---|---|---|---|
| Seed | 41.1 | -0.43 | -31.14 | **-14.4** |
| Fertilizer | | -0.81 | 0.43 | **0.37** |
| Machinery | | | -0.87 | **0.87** |
| Labor | | | | **-1.12** |

Reference: research findings

Inputs of fertilizer and labor are replaced by machines and complementary relationship with labor, seed, fertilizer and machinery. The results indicated that replacement of machinery and labor relations.

The relationship between fertilizer and labor succession suggests that the rising cost of labor in the process of applying fertilizer to increase the production of wheat. In other words, in the absence of access and use less fertilizer, need more care is the product of human resources and labor to spend more time with agricultural operations done properly and therefore adverse effects of using less fertilizer is lost.

Successor relationship between labor and machinery suggests that because of the high cost of labor, equipment and machinery manufacturers using various efficiency and productivity increase, which leads to a reduction in costs.

Because a strong substitution between labor and machinery arises, the cost of the wheat plant is the largest cost items, the farmers are still not one hundred percent dependent on the use of machinery, and the smallest increase in prices of machinery in order to reduce costs and increase profits, reduce the use of machinery and labor are replaced.

Positive tension that suggests a cross between a fertilizer and machinery operations, preparation, planting and found it can be done in a timely manner due to the use of agricultural machinery. Thus, even if the reduction of fertilizer use, the wheat crop is not affected. This is especially important in the development of sustainable agriculture for optimal use too much fertilizer the bad consequences of such pollution will follow.

To measure the elasticity of demand is a factor of about 4. The results of measuring the elasticity of demand are presented in Table 3. It's obvious that stretching their price, except for seed inputs, all inputs have been negative. The price elasticity of their production factors Table 3, the amount of tension placed seed is larger than 1. If only one percent of the price of seed fall, consumption increased more than one percent. It is the seed of elasticity. In the meantime, its lowest price elasticity of demand is live animal manure. The tension was inevitable because of the importance of these inputs in the production process, so that the increase in fertilizer prices, the demand for it does not decrease and only add to the cost of production. Elasticity of machine is smaller than 1 and cost factor and highlights the inevitable tension of the inputs in the production process.

Cross elasticity of demand factors indicate a change in the quantity demanded of a live animal prices of other input, it can be used with the type of relationship between complementary and substitute inputs are realized.

According to numbers obtained in Table 3, the chemical fertilizer inputs of land, labor, land and labor are complementary relationship Machines and the relationship between other inputs replacement relationship that these results are due to the elasticity of substitution is technically Allen is reported in Table 3. Traction measure the percentage change compared to the percent change in total product inputs shows. In this study, traction cost is calculated as follows:

$$\varepsilon = (\varepsilon\, C\,)^{-1} = \left(\alpha_Q + \gamma_{QQ}\, LnQ + \gamma_{Qi} Lnp_i\right)^{-1}$$

Cost elasticity is 8.6, indicates that production efficiency is decreased to scale (scale stretching to elasticity the image which cost is -0.11). The results show that with the increase in production costs increase.

**Conclusion and suggestion:**

This study analyzes the cost structure of wheat in Shahin Dezh District. The results calculated for each pair of input pull in partial cross Allen indicated that fertilizer inputs and labor is considered a successor to machines and complementary relationship with labor, seed, fertilizer and machinery. The results indicated

that replacement of machinery and labor relations. Estimation the price elasticity of demand indicates that seed and fertilizer inputs are inputs in the production process, wheat is the most elastic. In addition, these results suggest that economies of scale derived from less than 1. In other words, the production of wheat in Shahin Dezh District with decreasing returns to scale.

Due to the above, the use of extension services to increase efficiency in using inputs, reducing production costs and curb the supply of inputs to farmers leading to efficient use of factors of production, is advantageous.

Based on these two inputs fertilizer and labor are substitutes for each other, reducing the price of fertilizer, on the other hand to reduce the use of human resources employment and on the other hand, increasing the consumption of these inputs and contamination of soil, water and general environment will bring. In line with the objectives of sustainable development and environmental protection, to determine the optimal price for the fertilizer to take advantage of this factor of production helps the economy.

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