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Economic Analysis of Water Demand in Greenhouses of Khash Township

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Abstract

The main goal of this study was to investigate the way of affecting of water in production of cucumber. From aspect of econometrics, mutual relationships of production function and expenses have been analysed in which Translog cost function has been used. This function has been estimated using the conditional input demand functions, the shefard theorem, chemical fertilizer, animal fertilizer, labour force, seed, and pesticide in the framework of a system of equations by taking advantage of the irrelevant regression method. Applied inputs is for 151 cucumber Beneficiaries in Khash in farming year of 2011-12 that insider and crossing tendency of input demand for this product has been investigated through collecting questionnaires and using obtained coefficients. The results show that the translog cost model is a good fit compared to the data of research. According to the reviews, demand for water has a minor Insider-succession tendency more than one which shows possible stretch of demand function rather than the price of the inputs. Hence, appropriate pricing policies can be used to take a positive step in preventing the extreme usage of this input and directing beneficiaries for optimum use of these inputs.

Keywords:
Irrigation water demand, Price elasticity of demand, Succession elasticity of demand, Translog cost function

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INTRODUCTION

Water is the Nowadays water is one of the main scarce input of natural resource and life on Earth. More than 70% of the Earth surface is covered with water (nearly 360 million out of 510 million cube meter). Despite of this enormous volume of water, only 2% of the Earth's water is fresh and drinkable and the remaining in unusable due to a variety of soluble salts, especially uneatable ones. From this two per cent of the fresh water, more than 90 per cent is in the form of frozen in two poles and is located away from the human access (Iran hydrology). Management and optimal decision making about water is one of the most important human concerns today due to increasing population and limited water resources.

Undoubtedly, providing Sufficient and guaranteed irrigation water for plants is the main axis of human challenge because one of the main consumers of world water resources is agricultural sector. (Kouhpayee, 2004). In water management we did not create balance just control, motivate and limit partners at both supply and demand sides. One of the management practices of increasing water efficiency in demand section, that specify the water resource value and has non-organic structures, is establishing actual price of water in both supply and demand sides because determination of actual price of water will considerably help optimal allocation of water among different products and also to logical and proper consumption of water which will finally increase application and efficiency of water. Continuing process of unreal and non-economical determining of price of water will escalate extreme consumption and indiscriminate waste. In other words, determine the actual water price will cause water usage considering allowed capacity from underground and surface water of aquifers and quotas. (Ghaffari Shirvan, 1998). On the other hand Managing water demand involves better and more effective harnessing of water which is possible through legislation of laws, planning rules and regulations, using economic tools, programming and supervising as well as contributing of beneficiaries. So the main objective of water demand management is controlling the amount of demand and efficient application of water meaning development in depth. Considering the limitation of to limitation of water supply in the Iran, it is clearly seen that emphasizing on demand management is a necessary issue to direct water sources to sustainable usage. Creating new perspectives consistent with sustainable development objectives of resources among beneficiaries and controlling the amount of water taken through existing tools can be highlights of water -demand management.

Including national and international studies have been done include:

Torkamani and Kalani (2001) have used multi-product Translog cost function to estimate cost functions and demand of inputs at the same time in agriculture of Fars province. Results show that Translog cost model is a good fit of the investigated data and chemical fertilizer is a complementary for consumed seeds and workforce, machineries, and chemical fertilizer have replacement relationships. Also, all prices stretching of demand for inputs is less than one indicating no stretching of demand for them.

Hajir Keyani and HajiAhmad (2002) have investigated the estimation of demand functions for production inputs and supply of water and dry-farming wheat in Iran agriculture. In this research Translog flexible-profit function as well as profit equations, supply and demand of production inputs using equation system seemingly duplicated unrelatedly were used. And results indicate that all stretching obtained from estimation of coefficients for both water and DEIM wheat have signs corresponding theoretical expectations. And all self-stretching for input demand indicate negative inverse relationship between price and amount of production inputs.

Abedi (2005) used multi-product Translog cost function to estimate cost functions and demand of inputs at the same time in agriculture of Zayande Roud and results show that Translog cost model is a good fit of the investigated data and according to investigations from the pattern, minor self-replacement and crossing stretching is less than one however it was near to one for water. Additionally, self-price and crossing stretching of demand for all inputs is less than one.

Bostani and Mohammadi (2006) investigated productivity and demand function of water in production of sugar cane in Gelid district. Results show that Cobb Douglas production function of consumed water inputs, poison, machineries, planted area and funds have meaningful effects on production in which consumed water and cost of machine operations is positive. Average of positive productivity and final water uses are 0.89 and 0.304, respectively. According to R^2 estimated production function is able to determine 85 per cent of changes in production. Also price stretching of demand is more than one which illustrates stretchable demand function rather than input price.

Shajari *et al.* (2008) investigated management of water demand using policy of water -price determination in Jahrom date farms and case study of Shahani date. Results show that there is a positive and meaningful relationship between number of productive date trees in the garden, number of used workforce and frequency of irrigation and amount of date produced. Final productivity and final production value of water in drip and GHARGHABI irrigation is 0.194 kg and 204.06 kg, respectively and was calculated 67.23 Rials. In final price of water, price stretching for water for drip and water irrigation was obtained -3.035 and -2.093 respectively which shows that demand for water in both methods is stretchable.

Al.Qunaibet and Johnston (1985) estimated demand function of water using time- series data in Kuwait. According to results, price stretching of water comparing to the price was calculated -0.9 .So they mentioned that increasing the price of water can lead reduction of water consumption. Diagnosis coefficient was also more than 80 per cent in this estimation. Glas *et al.* (1989) investigated agricultural structure of Northern Ireland using multi-product Translog cost function. This model contains two product of livestock and its derivations as well as plants and four inputs including fund, workforce, chemical fertilizer and related index of sum of livestock food and imported livestock to the region. They, using the mentioned model, estimated replacement stretching among inputs, self and crossing stretching of demand of inputs, parameters taken from scale and rate of Hiks technology change for each year. In this study, they concluded that agricultural structure of Northern Ireland is not homothetic and inputs of fund is stretchable while workforce is not stretchable and input includes sum of livestock food, seeds and livestock import is also not stretchable .

Ali and Parikh (1992) used estimation of Translog cost function as well as extraction of functions of cost shares using Shephards lemma in order to investigate the relationships among inputs .Equations of cost share along with total cost function were estimated using limitations of symmetry and unity by SUR method and the authenticity of these limitations were investigated by Coefficient of langraz.

Following goals are taken in to consideration:

The main purposes of this research are:

1-Estimating Translog cost function of greenhouse cucumber of Khash

2-Estimation of Cucumber water demand function in greenhouses of Khash

3-Determining insider minor elasticity, Allen crossing and insider price stretching and crossing of demands of water inputs through Translog cost function

MATERIALS AND METHODS

To estimate water – demand function and determine price elasticity of water demand for greenhouse cucumber ,first ,production function of cucumber is estimated like Translog production function.

$$\mathbf{Y} = \boldsymbol{\alpha}_0 \prod_{i=1}^{n} \mathbf{X}_i^{\alpha_i} \mathbf{e}^{\frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{m} \gamma_{ij} \mathrm{Ln}\mathbf{X}_i \mathrm{Ln}\mathbf{X}_j} \qquad (1)$$

Where Y is Output, a_0 is efficiency, X_i and X_j are i, j, a_i and γ_{ij} of unknown parameters. Logarithmic form of this function is as follows.

$$LnY = Ln\alpha_0 + \sum_{i=1}^{n}(\alpha_i Lnx_i) + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n}(b_{ij} Lnx_i Lnx_j) \qquad (2)$$

Each production function has one cost function. So, form of Translog cost function is as follows:

$$\ln c = \ln a_0 + \Sigma a_i \ln p_i + a_Q \ln Q + 1/2 \Sigma\Sigma \gamma_{ij} \ln p_i \ln p_j + \Sigma \gamma_{iQ} \ln Q \ln P_i + 1/2\, \gamma\, (\ln Q)^2 \qquad (3)$$

Where I,j=1,……,N

In which in above equation, Pi and Pj are price of inputs and C is the total cost.

Based on the characteristics of neoclassic pro-

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duction theory which says that cost share is addable, the following limitations are considered for demand function.

a) unity assumption $\Sigma a_i=1, \Sigma\gamma_{iQ}=\Sigma\gamma_{ij}=\Sigma\gamma_{iQ}=0$

b) symmetric assumption $\Sigma\gamma_{ij}= \Sigma\gamma_{ji}$

On the other hand , because the total of cost shares is one ($\Sigma s_i=1$) ,using these conditions on cost function, we need n-1 share and the prices in main function will change in to relative. To avoid becoming zero for koarians Variance matrix, one of equations of cost share is omitted and it is normally omitted in experimental tasks which has the minimum contribution to production costs (Mcgeehan,1993).

To estimate the cost function, ISUR has been applied. The reason to use this technique is existence of unity between impaired sentences in equations of cost share. Since total of cost share is one, if the left side of demand equations are summed ,this sum should be one. Thus, the sum of impaired sentences of equations is zero. On the other hand, independent variables (price of inputs and amount of production) are the same in all demand equations. As a result, all variables which have not been entered will appear in impaired sentences and will unity among impaired sentences. The common way to estimate functions is that one of equations of cost share is taken ways from the simultaneous –function category, and parameters of other functions are estimated and then relevant parameters of taken-away equation are calculated based on other parameters of equations. Since sum of equations of cost share is one, omitting any equation is optional (we deleted poison equation here). Regressions seemingly duplicated unrelatedly tend to maximum method of being true and are independent from omitted equation.

Elasticity of substitution and price elasticity of demand

One common index to measure level of reaction to price changes of production input is Allen AES –Evzaza V_{ij} between to inputs of I and j which are obtained from first and second derivation of cost function to price of I and j inputs.

$V_{ij} = c\ c_{ij} / c_i c_j$

For logarithm cost function, Allen AES can be written as follows:

$V_{ij} = b_i + s^2_i - s_i / s^2_i$

And self-replacement stretching is as follows:

$V_{ij} = b_{ij} + s_i s_j / s_i s_j$

There is a positive replacement between production inputs meaning the replacement of these inputs. While, negative replacement stretching determines that inputs are completing each other. One main gaol of this study is estimating replacement stretching among production factors to investigate the level of replacement of complementary of each pair of production inputs in agricultural sector. Investigation of this issue has interesting applications in policy making in investment.

One factor that can illustrate the technology in one production unit in summary is price stretching of demand for production inputs (Eij) which is defined as follows:

$E_{ij} = \partial \log X_i / \partial \log P_i$

Where production amount (Xi) and the price of all production inputs (Pi) are fixed.

Price self-stretching of demand (Eij) of a production input shows relative changes of input demanded of that input resulting from relative changes of that input. Price crossing stretching of demand (Eij), i ≠j measures relative changes in amount of an I input being demanded because of relative changes of price of j input.

We can show that Allen AES is related with price stretching of demand for production factors. Price crossing stretching of demand for production inputs can be written as follows:

$E_{ij}= S_j\ V_{ij}$

And price self-stretching of demand is written as follows:

$E_{ij}= S_i\ V_{ii}$

Where I, j=L, H, SH, W, S, B (Sherafat,1996)

In this research price of inputs and products is determined according to market price. Share of costs has been calculated through dividing paid costs for that factor to total of varying costs.

RESULTS AND DISCUSSION

Estimation of function of water-input demand for cucumber using Translog cost function Estimation results of Translog cost function coefficient using regression seemingly unrelated are illustrated in table number 1. Poison cost has been omitted in estimation of this model.

Table content illustrates that most coefficient

Table 1: Estimation of total cost of production equation for greenhouse cucumber in Khahsh.

Parameter	Coefficient	t-value	Parameter	Coefficient	t-value
C(1)	101.61	8.13	C(15)	-0.14	-2.22
C(2)	-16.4	-8.04	C(16)	-2.79	-1.72
C(3)	-3.74	-1.72	C(17)	4.51	3.50
C(4)	10.05	2.23	C(18)	-0.81	-3.71
C(5)	17.79	4.55	C(19)	-2.59	-1.78
C(6)	-2.01	-2.32	C(20)	0.42	1.70
C(7)	0.31	1.64	C(21)	0.057	0.56
C(8)	0.25	2.47	C(22)	-1.67	-1.04
C(9)	-1.38	-4.47	C(23)	0.43	6.58
C(10)	-1.87	-6.77	C(24)	0.066	0.49
C(11)	0.14	2.16	C(25)	0.21	0.62
C(12)	0.15	1.08	C(26)	-0.65	-2.25
C(13)	-0.48	-1.61	C(27)	-0.13	-1.54
C(14)	-0.2764	-0.99	C(28)	-0.09	-0.65

R^2=0.82 D.W=2.02

in a=0.05 are meaningful and thus the issue that most equation coefficients are meaningful is a suitable result. According to the fact that determination coefficient is 0.82 per cent and shows a good fit of equation, it means that independent variables have been able to explain the reason of total cost change. And Durbin- Vatson data shows that Autocorrelation phenomenon does not exist. (c(1) Labor, c (3) livestock fertilizer, c (4) water, c (5)seeds, c (6) chemical fertilizer).

Based on research goal, share of water cost which is too similar to demand function has been used as follows in order to analyse more.

$$S_w = 10.05-1.38\log(P_L/P_s) - 0.48\log(P_H/P_S)-2.79\log(P_W/P_S)+4.5\log(P_B/P_S)-0.81\log(P_{SH}/P_S)+0.21\log Q$$

t= (4.4) (0.30) (0.30) (1.62) (1.28) (0.21) (0.34)

As it can be seen, all coefficient of cost-share equation is meaningful based on amount of t. Investigating above coefficients show that cost-share equation of water has a positive relationship with amount of production and price of seeds and negative relationship with price of workforce, livestock fertilizer, water and chemical fertilizer. In other words, increasing the price of seeds as well as increasing production, water cost out of total cost increases and increasing the price of workforce, livestock fertilizer, water, and chemical fertilizer decreases relatively.

Calculating stretching

In this section, minor self and crossing stretching of Allen and self and crossing price stretching of demand using average cost of inputs are being calculated and investigated.

The following results are taken from table 2 and 3:

1- The self-stretching of water has a logical sign(negative) which is compatible with economic theories and show that there is an inverse relationship between prices and amount of inputs and that illustrates the inverse relationship

Table 2: Estimation of replacement stretching of inputs for production of cucumber.

	Labor	Animal manure	water	Seed	Chemical fertilizer
Labor	-0.9	0.3	0.3	0.8	0.2
Animal manure	0.3	-1.6	6.7	19.5	5.4
water	0.3	6.7	-1.6	16.4	4.1
Seed	0.8	19.5	16.4	-3	19.3
Chemical fertilizer	0.2	5.4	4.1	19.3	-0.3

Table 2: Estimation of Demand price stretching of inputs for production of cucumber.

	Labor	Animal manure	water	Seed	Chemical fertilizer
Labor	-0.36	0.12	0.12	0.12	0.03
Animal manure		-0.58	2.27	2.72	0.75
water			-1.69	2.81	0.57
Seed				-2.49	2.69
Chemical fertilizer					0.03

between demand for water and its prices.

2- Absoulute amount of self-stretching for inputs including workforce and chemical fertilizer is less than one which shows none stretching of demand for them. However absoulute amount self-stretching of inputs including water, seeds, livestock fertilizer is more than one which shows stretching of demand inputs.

3- Crossing stretching of demands for water with other inputs shows that it has a replacement stretching in comparison with work force, livestock fertilizer, seeds and chemical fertilizer.

4- Maximum level of replacement of water stretching among inputs is for seeds. In other words, increasing the price of water will increase applying the seeds. And the sensitivity of replacement between these two inputs is less than one and that shows that if the price water goes up , seeds with better quality and modified ones will be used to save water in order to decrease water consumption.

CONCLUSIONS AND RECOMMENDATIONS

1- According to high self-stretching of price , derived demand of water shows that policy in determination of price can be a useful tool to control extreme usage of water in production of green houses.

2- Since amounts of crossing stretching of demand(except work-force input) is more than one, policies to change the price in these inputs will have a considerable effect on planting composition.

3- The amount of self-stretching for water demand is more than one. Thus, changing the price of this input (deep water) may create a pressure on consumption of other kinds of water(surface water).

4- Existence of replacement connection among water, workforce, livestock and chemical fertilizer, and seeds expresses higher usage of these inputs in planting cucumber to save water.

5- Small replacement stretching of workforce in comparison with water lead that relevant policies to factor change affecting in demand of an input not to have considerable effect on composition of other consuming inputs.

As results show demand for water is stretchable. According to being stretchable for water demand, it can be certainly said that price determination of water has an important role in applying this input.

According to obtained results from this study, following solutions are recommended:

1- Possibility to implement the policy of water-price determination with determined water price in this research should be gradually done during the time unless farmers with low efficiency will be omitted.

2- Of course this important issue needs to be taken un consideration that determining water price is not only enough and it is necessary to apply collecting water price and using it in order to improve water resources along with this policy.

3- Creating association to supervise water resources, collecting water cost and expending it to improve the water resources is necessary.

4- Increasing the efficiency of water usage in farms and greenhouses (due to growing up the price of water for irrigation) to farmers and investors is an essential subject.

5- Installing smart counters on agricultural well and controlling the amount of water being taken as well as controlling the irrigation of farms using micro irrigation in greenhouse planting.

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