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Evaluation of Agricultural Advisory Services Effects on Sugar Beet in Razavi Khorasan Province

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Abstract: In this study, effects of agricultural advisory services on input and output of sugar beet are examined by means compare and estimating the transcendental engineering production function. The empirical results based on the farm level data from 453 sugar beet producers of the main region of sugar beet production (Razavi Khorasan province) in 2008 suggested that agricultural advisory services has a positive and significant effect on sugar beet yield and negative effect on N, P, K fertilizer and pesticide inputs. Sugar beet output in group with advisory services was 0.0637 higher of alternative group. The results also implied that advisory of agricultural engineering had a positive and significant impact on utilization of herbicide, cultivated area, labour, number of irrigation and agricultural machinery rather than alternative group. These results call for more investment in agricultural advisory services through agricultural engineering in rural area and to organize the agricultural graduate students in this context for accelerating the agricultural growth.

Key words: Transcendental, elasticity, agricultural, engineering advisory

INTRODUCTION

Assisting farmers to become more productive has long been common practice in development assistance, as well as the objective of ministries of agriculture and sub-national governments around the world. Agriculture is still the main economic activity for the majority of the world's population and it is generally correlated with low socioeconomic indicators, such as education, health and poverty (Cerdan-Infantes *et al*., 2008). In fact, as noted the World Development Report (2007), three out of poor people in developing countries live in rural areas and most of them depend on agriculture for their livelihoods. In addition, agricultural products, whether in bulk or processed form, are common exports in developing countries and many people depend on their production as their main economic activity. However, while the objective of improving farmers' productivity and agricultural workers livelihood is common to numerous types of agriculture or rural development programs, the approaches vary significantly by type of program. The most common interventions include infrastructure development, market access, the provision of fertilizer or other inputs, or provision of advisory services to producers, among others (Cerdan-Infantes *et al*., 2008).

In this study, we focus on agricultural advisory services and particularly a program in Iran (Razavi Khorasan province) that provides agricultural advisory services to sugar beet producers through agricultural engineering. Agricultural advisory services generally aim at transferring specific knowledge to producers, such as the transfer of technology, the improvement of management practices or the transfer of knowledge and capacities (Birkhaeuser *et al*., 1991; Evenson, 2001; Owens *et al*., 2001). Duffle and Kremer (2003) showed that farmers did not use the optimal amount of fertilizer due to risk aversion. Godtland *et al*. (2004) estimated the effect of farmer's field school program and a traditional extension program on farmers' knowledge of integrated pest management practices, using both is regression with controls and matching techniques and showed significant positive effect of both programs. With regards to the farmer field school approach, Feder *et al*. (2003) used a modified differences-in-differences model and found no impact on yields or on the reduction of pesticide use for Indonesia. On the other hand, Praneetvatakul and Waibel (2006) claimed that two time-point observations were not enough to estimate the impact of this kind of programs. They used a panel of four years that comprises eight rice-growing seasons in Thailand and found a positive impact on knowledge and pest management practices both on the short and long run. Nevertheless, in a companion study they did not find any impact of the program on rice production yield. Owens *et al*. (2001) and Romani (2003) estimated the impact of traditional extension services using panels of farmers for Zimbabwe and Ivory Coast, respectively. Both studies found a positive impact of extension services on productivity and yields. However, they noted that this impact is neither present for all the years nor for all the crops studied. Purcell and Anderson (1997), including availability of occasional assistance by agricultural specialists when demanded by producers, formal trainings on specific topics for groups of producers, or specialists working directly with farmers.

In summary, the evidence on the impact of extension and advisory services on farmer's productivity and technological adoption is generally positive, though it generally suffers from biases resulting from endogenous placement and omitted variable bias. The results of pseudo-experimental studies highlight the heterogeneity of program impacts based on farmer's characteristics, such as education, experience and wealth. Alston *et al.* (2000) reviewed an important number of evaluations, with the majority dedicated to agricultural research and found a median rate of return of 58%. Evenson (2001) described rates of return between 5 and 50% for developing countries, but also noted that impacts vary widely. These results pointed to the specificity of impacts depending on the specific design of the program, especially as it related to the methodology for selecting beneficiaries.

Razavi Khorasan province is the important region of sugar beet producing that placed in Northeast of Iran. This study focuses on the program of agricultural advisory services that began from 2002 in Iran, which seek to increase the value of agricultural by improving quality and increasing production volumes by advisory services on key topics in sugar beet producing. The services were free, publicly financed and provided by consultants hired by the program. The services were offered to all sugar beet producers, who had the option to receive the services. Since the stated objectives of the study are to improve quality and increase production, we focus our evaluation of its impact on these two outcomes, yield (our measure of productivity) and inputs utilization in sugar beet production (a measure of allocative efficiency).

MATERIALS AND METHODS

Conceptual framework: Agricultural advisory services contribution to agricultural production, input utilization and productivity consists of worker and allocative effects. The literature also identified other benefits of advisory, namely innovative effect, market efficiency and externality effect. The worker effect of advisory refers to the technical efficiency, a more advised farmer's ability to produce more output from a given bundle of inputs. The worker effect arises because advisory may improve the quality of labour component. The allocative effect of advisory refers to allocative efficiency the ability of the advised farmers to obtain, analyse and understand economically useful information about inputs, production and commodity-mix, which enhances their ability to make optimal decisions with regards to input use and production mix.

Under perfect competition, given prices of inputs and outputs and technology (information about the production process), there is no scope for allocative efficiency. However, in a dynamic modernizing agriculture with changing technology, farmers face imperfect information and make allocative errors, in the sense of not being able to equate the marginal value product of inputs to their respective opportunity costs. The presence of disequilibria arising out of such changes in technology may create incentives for farmers to learn and adjust their resources towards attaining an optimum level. The allocative hypothesis proposes that advisory service enhances the productive skills of persons by making them to adjust quickly to disequilibria (Shultz, 1975). It is expected that farmer's education and advisory services enable him to acquire, receive and decode new information, to evaluate benefits of alternative sources of economically useful information and to have earlier access to such information. This kind of increase in information-acquisition is likely to constitute a major source of higher allocative and productive efficiency among more advised farmers. The worker effect can be estimated by estimating an engineering production function for a single commodity with education as on of the inputs. Consider an engineering production function:

$$Y = f(X,E) \quad (1)$$

where, Y is the physical output of a single crop, X is a vector of quantities of variable and fixed inputs and E is a vector of education, extension, agricultural advisory services and other environmental variables.

In this case the marginal product of education or advisory services refers only to the worker effect, the ability to get more (physical output), given the resources at hand.

Empirical specification and estimation: The single crop production function is estimated for sugar beet cultivators using data from all sample farm households. There are two major approaches used in estimating and testing the worker effects of agricultural advisory services of agricultural engineering), namely, the production function and profit function methods. Although, the profit function method offers several advantages over the production function method in testing the hypothesis related to various economic efficiency. It is more appropriate to use production function to measure the economic returns to agricultural advisory services on output not on profit. Although, it is possible to derive the production elasticities from the parameter estimates of profit function, the standard errors cannot be computed and hence the tests of hypothesis on production elasticities and advisory coefficient cannot be performed. Hence, we prefer to use the production function method rather than other methods such as frontier production function, profit function and linear programming in this study.

The choice of functional form for the engineering production function (1) is a matter of empirical question. The choice depends on flexibility, computational ease, relevance for the study and comparability with previous studies. In this paper we experimented with two functional forms- Cobb-Douglas and Transcendental. However, after estimation of two model and use of restricted F-test (F = 13.92 significant in 1% level), we select transcendental production function for evaluating the agricultural advisory services on sugar beet in Razavi Khorasan province. The transcendental engineering production (hence yield) function of sugar beet can be written as:

$$LnY_i = a + \sum_{i=1}^{10} \alpha_i LnX_i + \sum_{i=1}^{10} \beta_i X_i + \gamma D + u_i \qquad (2)$$

where, Y is the quantity of sugar beet output (t ha^{-1}), X_i(i = 1, 2, 3,..., 10) is the variable inputs such as seed (kg ha^{-1}), labour (man-day ha^{-1}), number of irrigation (time), fungicide, herbicide, pesticide (L ha^{-1}), machinery (h ha^{-1}), N, P and K fertilizer (kg ha^{-1}), D is a dummy variable for agricultural advisory services (dummy takes the value of one if the farmer use the advisory services and zero otherwise), u is random error term. Ln is logarithm, α, α_i, β_i and γ are parameters of the production function to be estimated.

For computation of inputs elasticity of transcendental model, we used following equation:

$$E_{x_i} = \alpha_i + \beta_i X_i \qquad (3)$$

where, E_{xi} is the elasticity of ith inputs of sugar beet.

In this study for comparing mean of the inputs and output in two groups (with and without agricultural advisory services), we used t-test. The production function (3) is estimated by Ordinary Least Square (OLS) method.

Data: The data used in this study come from a primary survey conducted by authors in 2008 in Razavi Khorasan province of Iran. Farmers of this province are classified into two groups based on using of agricultural advisory services (agricultural engineering advisory). By using simple random method seven cities and 5 villages from each city were selected. From the selected villages a list of farm households (sugar beet producers) was prepared and 10% of these households were selected at random. The survey thus covered 453 sugar beet producers from 35 villages in two groups. Detailed information pertaining to inputs, output and prices sugar beet in 2008 and other environmental data such as socio-economic and advisory services of the farmers were collected.

RESULTS AND DISCUSSION

Compare mean: Table 1 show that environmental variable such as age, education of farmers, family size and number piece of land in group with agricultural advisory services are higher than the alternative group. But only difference mean for family size and number piece of land between two groups are statistically significant a 1% level. Also, sugar beet price and yield predication in group with advisory are 520 rial kg^{-1} and 60.72 t ha^{-1}, respectively. These predictions are statistically significant at 1% level and higher if the farmer has advisory services for guidance.

Compare the mean of inputs and output of sugar beet in two groups show that area, herbicide, labour, number of irrigation and farm machinery in group with agricultural engineering advisory are higher than of without advisory services. Also, group without advisory services has more N, P K and pesticide rather than alternative group. These differences between two groups are significant at 1% level and show that agricultural advisory services by agricultural engineering cannot positive effect on sustainable agriculture and move to organic sugar beet because advisory services for sugar beet don't conclude safety and sustainable principles training. Also, Table 2

Table 1: Comparison of environmental variable in two groups

	Group		
Variables	With advisory	Without advisory	t-statistic
Age (year)	55.02	54.43	0.51ns
Education (class)	2.30	2.06	1.46ns
Family size (person)	8.26	7.76	2.35*
Farmer experience (year)	30.19	31.34	-0.89ns
No. piece of land	1.69	1.31	3.72*
Sugar beet yield prediction (t ha^{-1})	60.72	57.85	2.65*
Sugar beet price prediction (rial kg^{-1})	520.90	502.50	2.62*
Distance to factory (km)	28.45	90.20	-20.61*

*: Significant at 1% level and ns: Non significant

Table 2: Comparison the effects of agricultural advisory services on inputs and output of sugar beet in Razavi Khorasan province

Variables	Group: With advisory	Without advisory	t-statistic
Cultivated area (ha)	29.28	4.27	6.08*
Seed (kg ha^{-1})	20.04	21.84	-1.42ns
N (kg ha^{-1})	425.00	604.61	-4.26*
P (kg ha^{-1})	277.00	511.00	-13.52*
K (kg ha^{-1})	87.14	79.16	1.99*
Pesticide (L ha^{-1})	0.79	1.71	-6.23*
Herbicide (L ha^{-1})	2.60	1.40	5.82*
Fungicide (L ha^{-1})	2.87	3.33	1.25ns
Labour (man day ha^{-1})	136.66	86.33	11.81*
No. of irrigation (time)	15.47	11.44	5.84*
Machinery (h ha^{-1})	11.95	10.06	4.33*
Output (t ha^{-1})	55.59	48.75	6.29*

*: Significant at 1% level and ns: Non significant

Table 3: Regression estimates of engineering production function (transcendental model) for sugar beet in Razavi Khorasan province

Independent variable	Parameter	t-statistic
Seed	0.02093	6.005*
Labour	0.001491	1.156ns
No. of irrigation	-0.0307	-2.337*
Fungicide	0.0008605	0.010ns
Herbicide	0.0333	2.172*
Pesticide	-0.212	-6.017*
Machinery	0.01736	1.192ns
N	-0.000492	-7.277*
P	-0.00113	-4.752*
K	0.0013	3.109*
Advisory services	0.0673	1.995**
Ln (Seed)	-0.108	-2.179*
Ln (Labour)	-0.115	-0.982ns
Ln (No. of irrigation)	0.827	4.261*
Ln (Fungicide)	-0.0230	-0.452ns
Ln (Herbicide)	-0.00654	-0.725ns
Ln (Pesticide)	0.04213	3.543*
Ln (Machinery)	-0.136	-1.053ns
Ln (N)	0.519	8.639*
Ln (P)	0.515	4.403*
Ln (K)	-0.00872	-1.353ns
Constant	-2.876	-3.568*
R^2	0.67	
F-value	41.67*	

*: Significant at 1% level, **: Significant at 5% level and ns: Non significant

shows that yield of sugar beet in group with and without advisory services are 55.59 and 48.75 t ha^{-1}, respectively. These figures indicate that agricultural engineering by introducing technical advisory services related to cultivation and conservation of soil and product has positive effect on yield of sugar beet.

Engineering production function: The OLS parameter estimates of transcendental engineering production (yield) function for sugar beet is reported in Table 3. Based on the estimation, coefficient of seed, number of irrigation, herbicide, pesticide, N, P and K are significant at 1 and 5% levels. The parameter estimate of the agricultural advisory services (dummy variable) is positive

Table 4: Sugar beet inputs elasticity

Variable (inputs)	Inputs elasticity
Seed	-0.0637
No. of irrigation	0.4301
Herbicide	0.0004
Pesticide	-0.0275
N	0.2540
P	0.0343
K	0.0015

and statistically significant at 5% level. In other words, advisory services have a positive effect on sugar beet yield. The advised producers get 0.0637 higher sugar beet output than the alternative group (unadvised farmers). This confirms the fact that agricultural advisory services for sugar beet in Iran (Razavi Khorasan province) have not high productivity on yield of sugar beet. So, agricultural ministry must improve mission of agricultural advisory services. Previous studies found this result but the extension and advisory effect was higher of this study (Birkhaeuser *et al*., 1991; Evenson, 2001; Owens *et al*., 2001; Duflo and Kremer, 2003; Godtland *et al*., 2004; Feder *et al*., 2003; Praneetvatakul and Waibel, 2006; Owens *et al*., 2001; Purcell and Anderson, 1997; Alston *et al*., 2000). In this study, assumption on the neutrality effect of advisory services is tested using t-test. t-statistic is 1.995 which is statistically significant at 5% level. So, the null hypothesis that advisory services have a neutral effect is not accepted.

The explanatory power of the model (R^2) is high i.e., 67% of sugar beet yield in Razavi Khorasan province explained by 7 variable inputs such as seed, number irrigation, pesticide, herbicide, N, P and K. In transcendental model, we can not use directly coefficient of inputs for interpretation except dummy variable of agricultural advisory services because there are linear and logarithmic form of variable. So, we need to compute elasticity of inputs by using Eq. 3. Results of this computation (the significant inputs elasticity) reported in Table 4. The production elasticity of number of irrigation, herbicide, N, P and K are positive and statistically significant at 1% level. This elasticities indicating that these inputs are crucial to production of sugar beet. The estimated effects on yield of sugar beet are 0.4301, 0.0004, 0.254, 0.0343 and 0.0015% for number of irrigation, herbicide, N, P and K, respectively. This suggests that the farmers having higher level of these inputs, has higher yield in sugar beet production. On the other words, on percent increase in these inputs increases the sugar beet yield by 0.4301, 0.0004, 0.254, 0.0343 and 0.0015%, respectively. With regards to this elasticity, irrigation and N are the important positive inputs that affect sugar beet yield. Also, the production elasticity of seed and pesticide are negative and significant at 1% level. One percent increase in seed and pesticide decreases sugar beet yield by 0.0637 and 0.027%, respectively.

CONCLUSION

In this study effects of agricultural advisory services on input and output of sugar beet are examined by means compare and estimating the transcendental engineering production function. The empirical results based suggested that agricultural advisory services has a positive and significant effect on sugar beet yield and negative effect on N, P, K fertilizer and pesticide inputs. Sugar beet output in group with advisory services was 0.0637 higher of alternative group. The results also, implied that advisory of agricultural engineering had a positive and significant impact on utilization of herbicide, cultivated area, labour, number of irrigation and agricultural machinery rather than alternative group. These results call for more investment in agricultural advisory services through agricultural engineering in rural area and to organize the agricultural graduate students in this context for accelerating the agricultural growth.

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