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AN EFFICIENCY ANALYSIS OF TUBEROSE CUT-FLOWER: A CASE STUDY

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ABSTRACT

Cut-flowers and potted plants have an almost 80 percent share of the world trade among ornamental plants. In Pakistan, about six percent of arable land is under horticultural crops, out of which only 0.5 percent is under floriculture. Total local production of cut-flowers is estimated to be 10,000-12,000 tons per annum. The present study examined the technical, allocative and economic efficiency of tuberose cut flower in district Kasur Pakistan, using non-parametric Data Envelopment Analysis (DEA) technique. The study also investigated the impact of socioeconomic and farm specific factors on these inefficiencies by employing Tobit regression model. The mean technical, allocative and economic efficiency of the sampled farms were calculated as 0.72, 0.59 and 0.42 percent, respectively. The results of the analysis indicated that the number of family farm worker and purchased seed has negative impact on technical, allocative and economic inefficiency of the sampled farmers. It was also found that age and education also significantly and negatively affected the technical inefficiency of the tuberose farmers. The study also highlighted the contribution of timely availability of good quality seed from the market. The government should encourage the younger and educated farmers in this venture and also take certain measures for the development of proper flower seed markets.

Key word: Tuberose, Cut-Flower, Efficiency, DEA, Tobit Regression, Kasur, Pakistan.

INTRODUCTION

Flowers are inseparable from the social fabric of human life. Flowers being an adorable creation of God, befits all occasions as at birth, marriage and death. In the past, flowers were not of much economic importance. One would grow flowers to fulfill his or her aesthetic desire. With the passage of time drastic changes brought about in the life style of people leading to commercialized cultivation of flowers. Today, flower plants are no longer meant for only window garden but play an important role in the decoration of the living houses and office establishments.

About 305,105 hectare was under flower cultivation in different countries of the world, of which the total area in Europe was 44,444 ha, North America 22,388 ha, Asia and Pacific 215,386 ha, the Middle East and Africa 2,282 ha and central and South Africa 17,605 ha. Flowers have been grown in 46,008 ha under protected greenhouses in different countries around the world. India has the maximum area under ornamental crops (88,600 ha) followed by China (59,527 ha), Indonesia (34,000 ha), Japan (21,218 ha), USA (16400 ha), Brazil (10285 ha), Taiwan (9.661 ha), the Netherlands (8,017 ha), Italy (7.654 ha), the United Kingdom (6,804 ha), Germany (6,621 ha) and Colombia (4,757 ha) (Sudhagar, 2013).

Globally more than 145 countries are involved in the cultivation of ornamental crops and the area under these crops is increasing steadily. The production of flower crops has increased significantly and there is a huge demand for floricultural products in the world, resulting in growing international flower trade. The world consumption of cut-flowers and potted plants is increasing at 10 to 15 percent annually due to globalization and its effect on income. In case of developed countries, the consumption of flowers is closely linked with GNP per capita income and urban population (Sudhagar, 2013). Its importance among the commercially grown flowers is due to its potential for cut flower trade, long vase life and essential oil industry (Singh, 1995). Cut-flowers and potted plants have an almost 80 percent share of the world trade among ornamental plants (Usman, 2013).

Usman and Ashfaq (2013) studied that growing of tuberose is profitable business as returns are double than cost. There are some problems and constraints faced by the tuberose grower like; high fertilization cost, shortage of water, fluctuation in daily prices, no proper flower markets and no training institute. Haque *et al.*, (2012) reported that tuberose cultivation is highly profitable at farm level in Bangladesh, compared to its competitive crops like banana and papaya.

In Pakistan, about six percent of arable land is under horticultural crops, out of which only 0.5 percent is under floriculture. Total local production of cut-flowers is estimated to be 10,000-12,000 tons per annum (Usman, 2013). Pakistan is a country of small farming households, where, floriculture is the best option of enhancing the income of the under privileged. The diverse agro-climatic conditions in Pakistan suit all kinds of floriculture crops, including cut flowers, and potted plants throughout the seasons (Usman *et al*., 2013). Pattoki and Chunian are emerging as a leading and pioneering home for cut-flowers in Pakistan (Usman and Ashfaq, 2013). Introduction to the floriculture crops could be an important intervention in this regard, where the farmers can earn much more by exploiting available natural resources more efficiently. Pakistan has favorable climate and cheap labor for growing these crops whereas they need less land and water for production. These crops also give the premium prices almost round the year and there is no need to wait for a long time as in the case of other traditional crops. Net profit is much higher for these crops compared with other conventional crops. These products are in high demand all over the world.

In Pakistan, floriculture is in its embryonic stage. There are constraints in the development of floriculture industry due to substandard quality of planting material, inadequate and low financial investments by private sector, insufficient incentives and support from the government, poor marketing, absence of standardization of packing and post-harvest technology, lack of availability of good quality elite plants material and infrastructural facilities for scientific handling, transportation and marketing. There are lack of resources and skilled persons to develop the floriculture industry up to the international standards. It is need of the time to produce skilled personals and explore new means to ensure survival of our farmers and explore appropriate marketing strategies to protect the farmers (Usman, 2013).

Aman and Haji (2011) estimated estimate technical, allocative and economic efficiency of rose cut-flower industries in Ethiopia using a Non-Parametric DEA model. The factors affecting these inefficiencies were determined by Tobit regression model. The overall mean technical; scale and overall technical efficiency of the sampled industries were 92 percent, 61 percent and 58 percent, respectively. The major source of technical inefficiencies was scale of operation rather than pure technical inefficiency. The farming experience, years of schooling and age of the farmer were negatively related with inefficiencies.

Need of Study/Objectives: During data collection it was observed that there is a significant difference in the yield of tuberose cut flower among the sampled farmers. Previously no study was conducted to estimate efficiency of tuberose cut-flowers in Pakistan. As this study is the pioneer in the field of Tuberose cut flower in district Kasur, so it will achieve the goal of higher productivity by improving efficiencies of tuberose cut-flower farmers.

The study focused to estimate technical, allocative and economic efficiency of tuberose cut-flower farmers in district Kasur. The study also investigated the impact of socio-economic and farm specific factors responsible for efficiencies differentials among the sampled farms. The study at hand will definitely help to bridge the productivity gap by improving the technical, allocative and economic efficiencies of Tuberose growers. It also presented some policy recommendations to improve these efficiencies.

The remainder of the paper has been organized as: Section 2 discussed the sampling procedure and methodology. Results and discussions are presented in part 3 and the last section explained summary, conclusion and policy recommendations.

Sampling Procedure and Data: District Kasur is the main tuberose cut-flowers growing area in Punjab, Pakistan. Primary data were collected from tehsils Pattoki and Chunian of district Kasur during 2011. Purposive random sampling technique was used in the process of data collection. A well designed and pretested questionnaire was drafted to get relevant information regarding various farm specific variables. Eight villages were selected from each tehsil and five farmers were interviewed from each village. Thus the total data set of eighty farmers was used in the analysis.

MATERIALS AND METHODS

Production Efficiency Estimate: Non-parametric approach i.e. Data Envelopment Analysis (DEA) was employed to estimate technical, allocative and economic efficiencies of tuberose cut flower farmers of district Kasur. That approach is based on mathematical programming techniques. Specifically, a linear programming technique that uses data on inputs and outputs is used to construct a best practice production frontier over the data points. The efficiency of each farm is measured by the distance between the observed data points and the frontier. Farms lying on the frontier are the most efficient within the sample while the remaining farms lying below the frontier are inefficient (Coelli *et al.*, 1998). Their inefficiency increases with the increase in distance from the production frontier.

Estimation of Technical Efficiency: Technical efficiency scores were obtained by running DEA model with the variable return to scale as modified by (Bankers *et al.,* 1984).

Assuming there is data on K inputs and M outputs of N farms, x_i is an input vector for the i^{th} farm and y_i is an output vector for the i^{th} farm. The K x N input matrix, X, and M x N output matrix, Y, represent the data of all for N farms. For each farm, to obtain a measure of the ratio of all outputs over all inputs, such as $u/y_i/v/x_i$, where u is an M x 1 vector of output weights and v is K x 1 vector of input weights.

To select optimal weights the study solved the mathematical programming problem as specified by Coelli *et al*., (1998).

$$\mathrm{Max}_{u,v}\ (u'y_i\ /\ \mathbf{v}'x_i)$$

Subject to $u'y_j / v'x_j \leq 1$, j= 1, 2 …N,
$u, v \geq 0$

This problem involves finding the value of u and v, such that the efficiency measure of the i[th] farm ($u'y_i / v'x_i$) is maximized, subject to the constraints that all efficiency measures must be less than or equal to 1.

One problem with this particular ratio formation is that it has an infinite number of solutions. To overcome this problem, the study impose the constraints $v'xi = 1$ to the above problem.

$max_{u,v} (u'y_i / v'x_i)$
subject to $v'x_i = 1$
$u'y_j / v'x_j \leq 1$, j= 1,2,……N,
$u, v \geq 0$

Using the duality problem in linear programming, the study can derive an equivalent form of this problem:

min θ, λ θ,

$$\text{subject to } -y_i + Y\lambda \geq 0$$
$$\theta x_i - X\lambda \geq 0$$
$$\lambda \geq 0$$

Where θ is a scalar and represents the technical efficiency score of the i[th] farm. The value of θ must satisfy the restriction: $\theta \leq 1$. If θ is equal to 1, it indicates that the farm is on the production frontier and is a fully technically efficient farm. λ is a N x 1 vector of constants. The linear programming problem must be solved N times, once for each farm in the sample. A value of θ is then obtained for each farm.

The linear problem for the i[th] firm under the assumption of a variable returns to scale DEA model is given as:

$\min_{\theta, \lambda} \theta$

$$\text{subject to } -y_i + Y\lambda \geq 0$$

$x_i - X\lambda \geq 0$
$N1' \lambda = 1$
$\lambda \geq 0$

Where N1 is an N x 1 vector of ones and $N_1' \lambda = 1$ is a convexity constraint that ensures that an inefficient farm is only benchmarked against farms of a similar size.

Estimation of Economic Efficiency: Economic efficiency is the ratio of the minimum cost to the observed cost. Following Coelli *et al.*, (1998) a cost minimization DEA model was used to estimate the minimum cost as follows:

$$\min_{\lambda, x_i^E} X_i^E w_i$$
$$\text{subject to } -y_i + Y\lambda \geq 0$$
$$X_i^E - X\lambda \geq 0$$
$$N1'\lambda = 1$$
$$\lambda \geq 0$$

Minimizing vector of input quantities for the i[th] farm, given the input prices w_i and output level y_i.

Economic efficiency = minimum cost/observed cost, thus

$$EE = w_i x_i^E / w_i x_i$$

Estimation of Allocative Efficiency: Allocative efficiency was estimated by dividing economic efficiency by technical efficiency:

Allocative efficiency = Economic efficiency/technical efficiency

Empirical Models: The output variable used to estimate technical efficiency was total farm revenue (Y). The total revenue from tuberose cut-flower was estimated by multiplying the output by the price received by the farmer. The inputs used in this study included plowing (X_1), planking (X_2), rotavator (X_3), ridges (X_4), labor (X_5), seed (X_6), FYM (X_7), urea (X_8), DAP (X_9), SSP (X_{10}), irrigation (X_{11}) and pickings (X_{12}).

Following Coelli *et al.*, (1998) an input-oriented variable returns to scale DEA model was used to estimate technical efficiency as follows:

$$\min_{\theta,\lambda} \theta,$$
$$\text{subject to } -y_i + Y\lambda \geq 0$$
$$\theta xi - X\lambda \geq 0$$
$$N1' \lambda = 1$$
$$\lambda \geq 0$$

θ represents the total technical efficiency of the i[th] farm.
λ represents N x 1 constants.
$N1' \lambda = 1$ represents a convexity constraint which ensures that an inefficient farm is only benchmarked against firms of a similar size.
Y represents the output matrix for N farms.
X represents the input matrix for N farms.
y_i represents the total revenue of the i[th] farm in rupees.
x_i represents the input vector of $x_{1i}, x_{2i}, \ldots\ldots x_{12i}$ inputs of the i[th] farm.
x_{1i} shows the total number of plowing used on the i[th] farm.
x_{2i} represents the total number of planking used on the i[th] farm.
x_{3i} represents the total number of times rotavator used on the i[th] farm.
x_{4i} represents the total number of ridges on the i[th] farm.
x_{5i} represents the total number of labor man-days used on the i[th] farm.
x_6i represents the total seed quantity (Mounds) used on the i[th] farm.
x_{7i} represents the total FYM trolleys used on the i[th] farm.
x_{8i} represents the total number of urea bags used on the i[th] farm.
x_{9i} represents the total number of DAP bags used on the i[th] farm.
x_{10i} represents the total number of SSP bags used on the i[th] farm.
x_{11i} represents the total number of irrigation used on the i[th] farm.
x_{12i} represents the total number of pickings on the i[th] farm.

Following Coelli *et al.*, (1998), a cost minimization DEA model was used to estimate the minimum cost:

$$\min_{\lambda,\, X_i^E} X_i^E w_i$$
$$\text{subject to } -y_i+Y\lambda \geq 0$$
$$X_i^E - X\lambda \geq 0$$
$$N1' \lambda = 1$$
$$\lambda \geq 0$$

Where

w_i is the vector of input price $w_{1i}, w_{2i}, \ldots\ldots\ldots, w_{12i}$ of the i[th] farm.3

X_i^E is the cost minimizing vector of input quantities for the i[th] farm.

N refers to the total number of farms in the sample.

w_{1i} shows the total cost of plowing used on the i[th] farm in rupees.

w_{2i} represents the total cost of planking used on the i[th] farm in rupees.

w_{3i} represents the total cost of rotavator used on the i[th] farm in rupees.

w_{4i} represents the total cost of ridges used on the i[th] farm in rupees.

w_{5i} represents the total cost of labor man-days used on the i[th] farm in rupees.

w_{6i} represents the total cost of seed used on the i[th] farm in rupees.

w_{7i} represents the total cost of FYM trolleys used on the i[th] farm in rupees.

w_{8i} represents the total cost of urea bags used on the i[th] farm in rupees.

w_{9i} represents the total cost of DAP bags used on the i[th] farm in rupees.

w_{10i} represents the total cost of SSP bags used on the i[th] farm in rupees.

w_{11i} represents the total cost of irrigation used on the i[th] farm in rupees.

w_{12i} represents the total cost of pickings used on the i[th] farm in rupees.

Economic efficiency is the ratio between minimum cost and observed cost and was estimated using the following formula.

$$EE = w_i x_i^E / w_i x_i$$

Allocative efficiency was obtained by dividing economic efficiency by technical efficiency.

Empirical Model of Tobit Regression: A question of great interest to policymakers is why efficiency differentials occur across farmers from the same farming system. These could be a reflection of the managerial ability and skill of a farm's operator and the interaction of various socioeconomic factors. The present study made an attempt to investigate the impact of various socioeconomic and farm-specific factors on the technical, allocative, and economic inefficiency of the tuberose cut-flower in district Kasur. In order to estimate the sources of technical, allocative, and economic inefficiency of farms, various socioeconomic and farm-specific variables were regressed on the inefficiency estimates of farms using a Tobit regression model as mentioned in Tobit (1958). This takes the form:

$$E_i^* = Z_i\beta + \mu_i$$
$$E_i^* = 0 \quad \text{if } E_i^* \leq 0$$
$$E_i = E_i^* \quad \text{if } E_i^* > 0$$

Where E_i is an inefficiency score, *ß* is a vector of unknown parameters and Z_i is a vector of socioeconomic and farm-specific variables. E_i^* is an index variable (sometimes called the latent variable) with $E = [E_i^* \mid Z_i]$ equals $Z_i\beta$, and is the error term with a normal distribution $\mu \sim N(0, \delta 2)$.

The socioeconomic and farm-specific variables included in this study were: years of schooling of the selected farms, age of the farm operator, family worker number, and flower growing experience years, tenancy status, irrigation source, seed source and tuberose acreage of the selected farms.

In order to examine the impact of these socioeconomic and farm-specific variables on inefficiency estimates, the following Tobit regression model was used:

$$E_i = E_i^* = \beta 0 + \beta_1 Z_{1i} + \beta_2 Z_{2i} + \beta_3 Z_{3i} + \beta_4 Z_{4i} + \beta_5 Z_{5i} + \beta_6 Z_{6i} + \beta_7 Z_{7i} + \beta_8 Z_{8i} + \beta_9 Z_{9i}$$

$$\text{If } E_i^* > 0$$
$$E = 0 \qquad \text{if} \qquad E_i^* \leq 0$$

Where;

i refers to the i[th] farm in the sample.

E_i is an inefficiency measure representing the technical, allocative, and economic inefficiency of the i[th] farm.

E_i^* is the latent variable.

Z_{1i} represents the age of the i[th] farm's operator in terms of number of years.

Z_{2i} represents the education of the i[th] farmer in terms of years of schooling.

Z_{3i} represents the family workers number working on the i[th] farm.

Z_{4i} represents the total operational land holding (acres) of the i[th] farm.

Z_{5i} represents the flower growing experience in years of the i[th] farm.

Z_{6i} is a dummy variable with a value equal to 1 if the farmer is owner of the land. Otherwise it is 0.

Z_{7i} is a dummy variable with a value equal to 1 if it is canal water. Otherwise it is 0.

Z_{8i} is a dummy variable with a value equal to 1 if the farm used purchased seed. Otherwise it is 0.

Z_{9i} represents the area under tuberose cut-flower of the i[th] farmer in acres.

ß's are unknown parameters to be estimated.

μ_i is the error term.

RESULTS AND DISCUSSION

Efficiency Estimation: The empirical results obtained from DEA models are presented in Table 1. The results of the study showed that the mean technical efficiency of sample farms was 0.72, with a minimum of 0.30. The results of the study explain that the same level of output can be produced by reducing input cost by 28 percent. The results of the study also indicate that the majority of the sampled farmers were fairly technically efficient in utilizing their scare resources. The majority of the sampled farms fall within a range of technical efficiency between 0.21 and 0.80. The 10 percent sampled farms operate at level of technical efficiency between 0.81 and 0.90 and 25 percent sample farms operate at level of technical efficiency between 0.91 and 1.

The mean allocative efficiency level of the sampled farm was 0.59 with a low of 0.26. Table 2 shows that allocative efficiency of the majority of sampled farms fall within a range of 0.21 and 0.76. It was found that 8.8 percent sampled farms operate at level of allocative efficiency between 0.71 and 0.80 and 12.5 at level of allocative efficiency between 0.81 and 0.90. These results indicate that allocative efficiencies are dominated by inefficient farms. No sampled farms operate at level of allocative efficiency less than 0.21and only 1.3 percent (1 out of 80) farms were allocatively efficient.

Table 1. Technical, Allocative and Economic Efficiency of Tuberose Cut Flower Farmer

Particular	Technical Efficiency	Allocative Efficiency	Economic Efficiency
Mean	0.716	0.591	0.416
Minimum	0.301	0.264	0.200
Maximum	1	1	1

Source: Author's Own Calculations

The mean economic efficiency of the sample farm was 0.42, with a minimum of 0.20. The findings indicate that, if sample farms operated at full efficiency, 58 percent cost of production can be reduced maintaining the same level of output at the existing technology. The results of the study also reveal that the economic efficiency of the majority of sampled farms falls within the range of 0.21 and 0.60. Only 1.3 percent (1 out of 80) sampled farms were economically inefficient and operate at level of economic efficiency of 0.20. Out of 80 sample farms only 1.3 percent farms operate at level of economic efficiency greater than 0.90. The 5 percent farms operate at level of economic efficiency between 0.61 and 0.70, 9.5 percent at level of economic efficiency between 0.71 and 0.80 and 5 percent at level of economic efficiency between 0.80 and 0.90.

Table 2. Frequency Distribution of Technical, Allocative and Economic Efficiency of Tuberose Farms.

Efficiency Range	Technical Efficiency		Allocative Efficiency		Economic Efficiency	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
0.01-0.10	---	---	---	---	---	---
0.11-0.20	---	---	---	---	1	1.3
0.21-0.30	1	1.3	1	1.3	18	22.5
0.31-0.40	7	8.8	4	5	30	37.5
0.41-0.50	7	8.8	24	30	16	20
0.51-0.60	14	17.5	19	23.8	4	5
0.61-0.70	5	6.3	14	17.5	4	5
0.71-0.80	18	22.5	7	8.8	2	2.5
0.81-0.90	8	10	10	12.5	4	5
0.91-1.0	20	25	1	1.3	1	1.3
Total	80	100	80	100	80	100

Source: Author's Own Calculations

Determinants of Inefficiencies among Sample Farmers: Socioeconomic and farm specific factors are likely to effect the level of technical, allocative and economic inefficiency of the farmers. The present study investigated the sources of inefficiency of the tuberose cut flowers farms in Punjab. Tobit regression model was employed in order to determine sources of said inefficiencies

Sources of technical inefficiency are presented in Table 3. The results of the study revealed that age has negative impact on the technical inefficiency of the sampled farms. Younger farmers were more efficient than their older counterparts in tuberose production. This result is consistent with previous studies (Coelli and Battese, 1996; Abdulai and Eberlin, 2001; Bozoglu and Ceyhan, 2007; Dolisca and Jolly, 2008; Islam *et al.*, 2012). Older farmers are less receptive in using modern inputs, have less extension contacts and hesitate to adopt new practices (Hussain, 1989).

The variable of years of schooling has negative impact on the technical inefficiency of the sampled farms. This result is in accordance with the study of (Dhungana *et al*., 2000; Balcombe *et al*., 2008; Khan *et al*., 2010; Nargis and Lee, 2013). Government and non-government organizations should give attention to educate the inefficient farmers, using the best practices of their efficient counterparts. In this context, the inefficient farmers can be educated by using extension tools such as field-level schooling or night school. The variable of family worker number has negative impact on the technical inefficiency of the sampled farms. Larger families with more agricultural workers may facilitate the timely availability of labor and gain knowledge of the technical know-how required for tuberose flower production. Previous studies (Hollaway *et al.*, 2002; Islam *et al.*, 2012) also reported similar results indicating that higher subsistence pressure can lead to increasing the adoption of new agricultural technologies that ensure continuous food access for these households.

The variable of total land holding has negative impact on the technical inefficiency of the sampled farms. The result is in line with the previous studies (Allauddin and Tisdell, 1988); Hollaway *et al.*, 2002; Islam *et al.*, 2012). Large farmers were more efficient than small farmers. The results of the study revealed that the dummy variable of canal water use has negative impact on the technical inefficiency of the sampled farms. The results explained that farmers applying canal water to Tuberose are likely to be more technically efficient compared to those farmers not applying the canal irrigation. Khai and Yabe (2011) reported that farmers with canal irrigation produce more efficiently than those without canal irrigation.

The purchased seed has negative and significant impact on technical inefficiency. This emphasized to ensure the availability of high quality tuberose seed at reasonable prices to farmers in cut flower markets. The variables of flower growing experience, tenancy status and tuberose acreage in the study area of the sampled farms has negative and insignificant impact on the technical inefficiency. The results of the study revealed that tenant farmers are more efficient in using scare resources effectively and efficiently than the owner. The result is in accordance with the study of Nargis and Lee (2013).

Table 4 illustrated the sources of allocative inefficiency differentials among the sample farmers. The results of the study shows that the variable, family farm worker number, total land holding, tenancy status, irrigation source and seed purchase has negative relation with the allocative inefficiency. The increasing trend in these variables reduces the allocative inefficiency.

Table 3. Sources of Technical Inefficiency of Tuberose.

Variable	Coefficient	Standard Error	Z-Statistic	Prob.
Constant	0.996	0.117	8.537	0.000
Age	-0.004	0.002	-2.111	0.035
Education	-0.008	0.005	-1.657	0.098
Family Worker No.	-0.091	0.020	-4.547	0.000
Total Land	-0.008	0.003	-2.252	0.024
Flower Growing Experience	0.001	0.003	0.289	0.773
Dummy for Tenancy	-0.066	0.042	-1.564	0.118
Dummy for Irrigation source	-0.079	0.039	-2.036	0.042
Dummy for Seed source	-0.182	0.048	-3.800	0.000
Tuberose Area	-0.024	0.027	-0.904	0.366

Source: Author's Own Calculations

Table 4. Sources of Allocative Inefficiency of Tuberose.

Variable	Coefficient	Standard Error	Z-Statistic	Prob.
Constant	0.823	0.064	12.798	0.000
Age	-0.002	0.001	-1.614	0.107
Education	-0.005	0.003	-1.516	0.130
Family Worker No.	-0.052	0.012	-4.487	0.000
Total Land	-0.004	0.002	-1.866	0.062
Flower Growing Experience	0.000	0.002	-0.124	0.902
Dummy for Tenancy	-0.046	0.027	-1.717	0.086
Dummy for Irrigation source	-0.043	0.024	-1.807	0.071
Dummy for Seed source	-0.119	0.030	-3.952	0.000
Tuberose Area	-0.007	0.016	-0.436	0.663

Source: Author's Own Calculations

The results of economic inefficiency analysis are presented in Table 5. The findings revealed that years of schooling, family farm worker number, tenancy status and seed purchased has negative and significant relation with the economic inefficiency, indicating that with the improvement in these variables economic inefficiency decreased. The variable of age, total land holding, flower growing experience, canal water use and tuberose area has negative but non-significant relation with the economic inefficiency.

Table 5. Sources of Economic Inefficiency of Tuberose.

Variable	Coefficient	Standard Error	Z-Statistic	Prob.
Constant	1.032	0.073	14.047	0.000
Age	-0.001	0.001	-0.872	0.383
Education	-0.008	0.003	-2.304	0.021
Family Worker No.	-0.065	0.013	-4.889	0.000
Total Land	-0.004	0.002	-1.525	0.127
Flower Growing Experience	-0.001	0.002	-0.383	0.702
Dummy for Tenancy	-0.058	0.031	-1.912	0.056
Dummy for Irrigation source	-0.043	0.027	-1.556	0.120
Dummy for Seed source	-0.102	0.034	-2.951	0.003
Tuberose Area	-0.009	0.018	-0.497	0.619

Source: Author's Own Calculations

Conclusions and Policy Recommendations: The average technical, allocative and economic efficiency of tuberose sampled farms were found 0.72, 0.59 and 0.42, respectively. The results of the study showed that family worker number and seed source (purchased seed) have negative impact on technical, alloative and economic inefficiency of the sampled farms. There is a need to increase the family farm worker by giving them incentives. Government should ensure the availability of high quality seed at reasonable prices. Similarly the results also revealed that younger farmers were more efficient than their older counterparts in tuberose production. This emphasizes that younger farmers should be targeted by the public and private institutions to create awareness among them to produce tuberose production. The government should encourage the younger farmers in this venture and also take certain measures for the development of proper flower seed markets.

Education of the farmers emerged as a major determinant contributing towards decline in inefficiencies of tuberose production. Thus it is also highly recommended that government and non-government organizations should give attention to educate the inefficient farmers, using the best practices of their efficient counterparts. In this context, the inefficient farmers can be educated by using extension tools such as field-level schooling etc. The study suggested that policy makers should also focus on the development of markets, road infrastructure and supply outlets should be established closer to the farm gate. In this context, special awareness campaigns should be launched in the study area.

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