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The paper does not meet the standards of "Agricultural Sciences".

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An Efficiency Analysis of Gladiolus Cut-Flower in Punjab, Pakistan

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Abstract

The present paper examined the technical, allocative and economic efficiency of gladiolus cut-flower farms in Punjab, Pakistan. Analysis was carried out by Data Envelopment Analysis (DEA) by using DEAP and by using a sample of 100 farmers. Determinants of inefficiencies were also quantified by employing Tobit regression model. Mean technical, allocative and economic efficiencies were quantified as 0.72, 0.89 and 0.63, respectively. Hence, in order to increase gladiolus productivity production function, new production tools should be employed. The results explained that age, family labor, tenant farmers and seed source had negative and significant influences on the inefficiencies of gladiolus farms. Further, the results emphasized the motivation of younger farmers in cultivation of flowers, availability of good quality seed at reasonable prices and better infrastructure increase the efficiencies of flowers farms.

Keywords

Cut-Flower, DEA, Efficiency, Gladiolus, Tobit Regression

1. Introduction

Although cut-flower cultivation in Pakistan is comparatively a new venture, but it has been considered as a token of love and beauty from ancient time. It has now become an inseparable part of our culture. People usually use flowers in all their ceremonies like wedding, birthday and marriage day greetings, and religious offerings

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and sometimes in social, political and historical occasions. The universal usage has created a real trend of producing flowers on a commercial basis to meet its increasing demand in the market. The floriculture is a profitable enterprise in the agriculture sector of Pakistan. The area under floriculture is increasing day by day, particularly adjacent to big cities. Flower farming is labor intensive as compared to other horticultural crops and it requires the skilled labor force and modern techniques. The number of nurseries, flower markets and flower auction centers has increased in the last few years and the production of flowers is turning from 10,000 to 12,000 tons per annum. Investment in this sector is yielding high returns to the farmers [1].

Pakistan exported flowers in 2007 of worth US$ 191 thousand, 2008 (US$ 681 thousand), 2009 (US$ 225 thousand), 2010 (US$ 518 thousand) and 2011 (US$ 761 thousand). The commercial cultivation of gladiolus is limited by rare production of corms and cormels (small corms that grow at the side of a mature corm) and thereby does not fulfill local demand. Flower can become Pakistan's second largest export sector after textile if government of Pakistan encourages the growers by facilitating them to provide better technology in production, refrigerated transportation, easy loan, extension services and exploring more foreign markets [2].

Pattoki and Chunnian regions of district Kasur serve as the center for floriculture activities in Pakistan. Flower market at Pattoki is emerging as a prominent and pioneering home for flower business and it is main market for flowers in Pakistan. It is estimated that up to one million bits of flowers are transported daily from Pattoki to different market in Pakistan, especially to Karachi, Peshawar, Lahore and Islamabad [3]. Cultivation of flowers return 3 to 5 times and 1.5 to 2 times more returns than obtained from rice and vegetables, respectively. Because flowers are fragile items, there are several problems in production, marketing and transportation of flowers' cultivation [4].

Although there is a great potential for export of flowers, Pakistan is still far behind in competition at international level with regard to quality and other international standards. The research and development in floriculture sector are also very little and the data on production, marketing and other aspects of floriculture are very scanty. Previously no study was conducted to estimate efficiency of gladiolus in Pakistan. In this study, ways of higher productivity by improving economic efficiency of gladiolus farmers were found. Further, technical, allocative and economic efficiency of farmers was estimated. Impacts of socio-economic and other farm specific factors on technical, allocative and economic inefficiency of farms were investigated.

2. Material and Methods

2.1. Sampling Procedure and Data

Primary data were collected from district Kasur in 2011. Simple random sampling technique was used to collect data. District Kasur is the main flowers growing areas in Punjab. A well-considered and already tested questionnaire was drafted to get relevant data regarding various specific variables at farm. Fifty respondents were interviewed from each region *i.e.* Pattoki and Chunian of selected district. In this way a total sample of 100 farmers were taken. Information of one respondent was omitted due to abnormal figures and was acting as outlier. Remaining 99 farmers' data were used for analysis purpose. Analysis was carried out by Data Envelopment Analysis (DEA) by using Data Envelopment Analysis Program (DEAP) [5].

2.2. Efficiency Estimates

The concept of efficiency was first given by Farrell [6], efficiency was defined as the real productivity of a firm with respect to its optimal productivity or the production frontier [7]. Oftenly two approaches are used to estimate the efficiency; first is the parametric approach by using Stochastic Frontier Analysis (SFA) and second is the non-parametric approach by using Data Envelopment Analysis (DEA). These both techniques quantify the best practice frontier and calculate the efficiency of a firm relative to that frontier [8]. While the non-parametric models are mathematical programming based. A linear programming technique which uses data on inputs and productions is used to build a best practice production frontier.

2.2.1. Technical Efficiency

Scores for technical efficiency could be gained by applying a constant return to scale non-parametric model. This was first developed by [9] under the assumption of constant returns to scale. This model is only appropriate when all firms are operating at an optimal scale; this is not possible in agriculture due to many constraints [5].

An input-oriented model under the postulation of variable returns to scale was used to assessment of technical efficiency in the study.

The output for the estimation of technical efficiency was farm revenue (Y). The total revenue from gladiolus flower was valued by multiplying output with price received by the respondents. The inputs variables considered in the analysis were tractors (X_1), ridges (X_2), labor (X_3), seed (X_4), FYM (X_5), NPK (X_6), irrigation (X_7), and pickings (X_8) respectively in the model. Further, w_{1i} represents the total cost of tractor, w_{2i} represents the total cost of ridges, w_{3i} represents the total cost of labor, w_{4i} represents the total cost of seed, w_{5i} represents the total cost of FYM, w_{6i} is the total cost of NPK, w_{7i} is total cost of irrigation water and w_{8i} is the total amount paid for pickings purpose in rupees for ith farm.

2.2.2. Economic Efficiency

This is the ratio between the minimum and observed costs and cost minimization model was used for minimum cost assessment [5]. It could be written as (Equation (1)),

$$\text{Economic efficiency} = \text{Minimum Cost}\ (\text{MC})/\text{Observed Cost}\ (\text{OC}) \tag{1}$$

2.2.3. Allocative Efficiency

It was valued by taking the ration between economic and technical efficiencies it could be written as (Equation (2))

$$\text{Allocative efficiency} = \text{Economic Efficiency}\,(\text{EE})/\text{Technical Efficiency}\ (\text{TE}) \tag{2}$$

2.3. Determinants of Production Inefficiency

Oftenly two approaches are used to investigate association in farm inefficiency and various socioeconomic variables. The first method is simple non-parametric analysis while on other hand regression model is used. The second method is two-step procedure, it is commonly used in the studies and same was used in the study to date [10]. The method adopted by Ogunyinka and Ajibefun [11] was used to analyze inefficiency. The technical, allocative and economic inefficiency scores were separately regressed on various socioeconomic and farm explicit factors for finding the sources of efficiencies. Sometimes Ordinary Least Square (OLS) regression becomes inappropriate because it lead to biased parameters values [12] for this reason Tobit regression model, as mentioned in Long [13] was used. Generalized form of model could be written as (Equations (3) to (5)),

$$E_i^* = Z_i \beta + \mu_i \tag{3}$$

$$E_i^* = 0 \ \text{ if } E_i^* \le 0 \tag{4}$$

$$E_i = E_i^* \ \text{ if } E_i^* > 0 \tag{5}$$

Here E_i shows the inefficiency score, β is for unknown factors and Z_i is for socioeconomic as well as farm-specific variables. E_i^* is index or latent variable.

2.3.1. Tobit Regression

In order to find the rational for the efficiency disparities across the farms of study area Tobit model was used. Factors involved in the analysis were, education (year), respondent age (year), number of family workers, experience, tenancy status, irrigation source, seed source, total operational land holding and rose flower acreage of the selected farms. Model used can be written as (Equation (6)),

$$E_i = \beta_0 + \beta_1 Z_{1i} + \beta_2 Z_{2i} + \beta_3 Z_{3i} + \beta_4 Z_{4i} + \beta_5 Z_{5i} + \beta_6 Z_{6i} + \beta_7 Z_{7i} + \beta_8 Z_{8i} + \beta_9 Z_{9i}$$

if

$$E_i^* > 0 \tag{6}$$

where, Z_i represents the age (year), Z_{2i} represents the education (year), Z_{3i} represents family labor (No.), Z_{4i} represents the total farm size (acres), Z_{5i} represents the experience (year), Z_{6i} is a dummy variable for land ownership (with 1 if yes otherwise 0). Z_{7i} is a dummy variable for canal water, Z_{8i} is a dummy variable for purchased seed and Z_{9i} represents the area under rose flower of the i^{th} farmers in acres. β's represent the slops and μ_i shows the noise term.

3. Results

3.1. Summary Statics

Average revenue of gladiolus farm was Rs. 1,012,339 with standard deviation of 255,368, indicating that there was high variability in the gladiolus farm's revenue from the production of gladiolus. The average tractor hours used by farms were 3.72. The average number of ridges per acre was 69.15. The average seed quantity used by the sample farm of gladiolus was 74,520 bulbs per acre with high standard deviation of 7167. FYM trolleys and NPK (Kg) applied per acre were 1.14 trolleys and 198 kg on average, respectively. The number of labor (man days) and number of irrigation applied were 63.92 and 11.55, respectively. The average number of picking in the study area was 24.4 per season. Average costs of tractor hours and ridges were Rs. 4192 and Rs. 652. The average seed cost was Rs. 317,237 with high standard deviation value showing the high variability for that variable. The average FYM and NPK costs were Rs. 2221 and Rs. 14,516, respectively. Labor cost was Rs. 19,176 for the farm on average. The irrigation and picking costs were Rs. 892 and Rs. 11,700.

The results of the findings revealed that the average age of the farmers were 39 years and schooling years of 9. The average family members involved in gladiolus cultivation were of 2 and average land holding of the sampled farmers were of 12 acres. The average flowers growing experience of the farmers were of 112 years with a maximum of 25 years and minimum of 1 year (**Table 1**).

3.2. Efficiency Estimation

The efficiencies of farms were assessed by using non-parametric approach. Results showed that if the each farmer was 28 percent technically inefficient and could get the same production by using less input (**Table 2**). It was also found that only 22 percent farms operate at a level of technical efficiency less than 60 percent. The highest number of farm (27.3%) operates between 60 to 70 percent. The 20 and 17 percent farms fall between the technical efficiency ranges of 0.71 to 0.8 and 0.81 to 0.9, respectively. Only 13 percent from total number of farms were at the higher level of technical efficiency *i.e.* 0.91 and 1.

While for the case of mean economic efficiency it was 0.63 with least value of 0.35. The findings revealed that if farmers enhance their efficiencies they could reduce their farm variable production cost upto 37. In case of allocative efficiency it was 0.89 on average. Most of the farms were falling (49.5%) in 0.9 and 1 range. This showed that about 50 percent farms are allocatively efficient. The 1 percent farms between 0.51 to 0.6, 3 percent falling in the range of 0.61 to 0.7, 17.2 percent in 0.71 to 0.89 and 29.3 percent were in the range of 0.81 and 0.9 for allocative efficiency. According to the results most of the farms in the study are allocatively inefficient.

3.3. Determinants of Inefficiency among Sample Farms

The sources of inefficiencies for all three cases are given in **Table 3**. The results of study revealed that age has

Table 1. Summary statistics of the tobit regression model variables.

Variable/Unit	Mean	Standard Deviation	Minimum	Maximum
Age (Year)	38.8	13.0	21	70
Education (Year)	9.0	3.8	0	14
Family Worker (No.)	2.2	0.9	1	4
Total Land (Acre)	12.3	16.1	2	130
Flower Growing Experience (Year)	12.0	6.2	1	25
Dummy for Tenancy (1 = Owner, 0 = Otherwise	0.5	0.5	0	1
Dummy Irrigation Source (1 = Canal ,0 = Otherwise	0.5	0.5	0	1
Dummy Seed (1 = Purchase, 0 = Own)	0.7	0.4	0	1
Gladiolus Area (Acre)	3.0	9.9	1	100

Table 2. Frequency distribution of technical, allocative and economic efficiency of Gladiolus.

Efficiency Range	Technical Efficiency		Allocative Efficiency		Economic Efficiency	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
0.31 - 0.40	4	4	---	---	9	9.1
0.41 - 0.50	6	6.1	---	---	10	10.1
0.51 - 0.60	12	12.1	1	1	22	22.2
0.61 - 0.70	27	27.3	3	3	33	33.3
0.71 - 0.80	20	20.2	17	17.2	13	13.1
0.81 - 0.90	17	17.2	29	29.3	10	10.1
0.91 - 1.0	13	13.1	49	49.5	2	2
Total	99	100	99	100	99	100

Table 3. Sources of inefficiencies of gladiolus farms.

Variables	Technical Inefficiency		Allocative Inefficiency		Economic Inefficiency	
	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
Constant	0.572	0.047	0.572	0.047	0.667	0.048
Age	−0.003	0.001	−0.003	0.001	−0.003	0.001
Education	0.004	0.003	0.004	0.003	0.001	0.003
Family Labor	−0.030	0.012	−0.030	0.012	−0.023	0.012
Total Farm Size	0.000	0.001	0.000	0.001	0.001	0.001
Flower Growing Experience	−0.002	0.002	−0.002	0.002	−0.004	0.002
Dummy for Tenancy	−0.064	0.020	−0.064	0.020	−0.043	0.022
Dummy for Irrigation Source	0.040	0.020	0.040	0.020	0.025	0.019
Dummy for Seed	−0.077	0.020	−0.077	0.020	−0.104	0.023
Gladiolus Area	−0.001	0.001	−0.001	0.001	−0.001	0.002

negative relation with the technical inefficiency. The variable of education was positive and insignificant. Family farm labor worker have highly significant impact on the technical inefficiency. Flower growing experience variable was negative and had significant impact on the technical efficiency. Coefficient of tenancy status was negative and significantly related with technical inefficiency. The coefficient of seed was significant with the negative sign. The coefficient of variable of gladiolus area has negative relation with technical inefficiency. The variable of total farm size was positive and insignificant. The dummy variable of irrigation was positive and significant. Table 3 also reveals the sources of allocative inefficiency of the sample gladiolus farms. The results of the study indicated that age, family labor worker on the farm, dummy for tenancy status, dummy for irrigation source and dummy for seed sources had negative impact on allocative inefficiency.

The results indicated that with the increase of gladiolus acreage of the sample farms and experience of the farmers, allocative inefficiency decreased but not significantly. The findings of the study revealed that, variable of age; family farm worker, flower growing experience, tenancy, seed source and area could positive impact on the economic efficiencies of study area farms. Increase in the said variables, reduced the economic inefficiency of the sample farms. The variables of gladiolus acreage in the study area have negative impact on economic inefficiency but it was insignificant.

4. Discussion

Younger farmers were more efficient than their older counterparts in producing gladiolus flower. This finding was in line with previous studies [14]-[16]. The variable of education was positive and insignificant. Particularly this may be due the reason that the educated owner farmers did not involve in gladiolus growing but did all the practices from the permanent and hired labor. Larger families with more agricultural workers may facilitate the timely availability of labor and gain knowledge of the technical know-how required for flower production. Islam [16] also described 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. Flower growing experience variable was negative significant and Huffman [17] and Islam [16] also assessed that experience could increase the technical efficiency. Banik [18] reported that tenant farmers are technically efficient than their counter part who are owner farmers.

Farmers that purchased seed of good quality are less technically inefficient than their counterpart that used own seed. The results of the study revealed that with the increase in the gladiolus area of the sampled farms, their technical efficiency increases. Large farmers face management problems than the small farmers due to shortage of technical labor during peak season of the gladiolus cultivation. Islam [16] and Hollaway [19] reported that small farmers quickly adopt new innovations at a faster rate. Abedullah [20] reported that with the more use of canal water the sampled farmers become more technically efficient. The findings indicated that with increase of age, family farm worker number, purchase of good quality seed and the use of canal water reduced the allocative inefficiency of the sampled farms.

5. Conclusion

The results of the study implied that if farms worked at optimal efficiency level they could reduce their farm variable production cost up to 37. Tobit regression model findings showed that age, education, flower growing experience and seed source (purchased seed) had negative impacts on the inefficiencies of farms. Young farmer were found to be technically, allocatively and economically less inefficient, the farmer having more gladiolus growing experience and family worker employed in the production of gladiolus were less inefficient than the others. On average, farms are 72 percent technically efficient, 89 percent allocatively efficient and 63 percent economically efficient, suggesting that there is significant potential for improvement of efficiencies in gladiolus farms. Therefore, in order to improve productivity of gladiolus farms, new technologies should be adopted to operate at optimal production level. For this purpose, research organizations should focus on the introduction of high genetic potential verities and like.

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