Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.6, No.12 2016

Effect of Different Crop Management System on Technical Efficiency in Sugarcane Production in Faisalabad, Punjab Region of Pakistan

Shamsheer ul Haq* Vedat CEYHAN Ismet BOZ Pomi Shahbaz

Department of Agricultural Economics, Ondokuz Mayıs University, 55139, Samsun,Turkey

Abstract

Sugarcane plays an important role in the economic sustainability of the sugarcane growers. The high return of it attracts the farm scale to devote a part of land to sugarcane relatively to their land holdings and economic returns differs associated with crop management type such as ratoon, fresh and mixed. Therefore, the study examined the technical efficiency level of small, medium and large farmers under different crop management system as fresh, ratoon and mixed crop system. The bulk of the data were collected from randomly selected 100 sugarcane growers by using face to face interview. Cluster analysis was performed to select similar growers in terms of manager's profile, profitability and land ownership for small, medium and large farmers. Data envelopment analysis (DEA) was used to calculate the efficiency scores such as technical efficiency, allocative efficiency and economic efficiency. Research results showed that the education level of the large farmers was satisfactory level comparing to others. Most small farmers were illiterate. The difference among the farm size in terms of the variables of age of respondents, sugarcane experience and family members were statistically significant at the 5% probability level. The high acreages of land holdings enabled the farmers to devote the huge area to sugarcane crops. The acreages at large farms were significantly high and also keep their more acres of land under sugarcane crop by 6.49 acres out of 13.66 acres. Based on the results of efficiency analysis, the main sources of economic inefficiency was allocative efficiency in the research area, indicating that monitoring input prices in market was critical for the sample farmers. Comparative analysis showed that mixed cropping system was the worst management system in terms of efficiency scores. Farmers would increase their economic efficiency if they improved their skills through participating the extension and training programs and by monitoring the input market conditions when allocated their factors harmonious with factor prices.

Keywords: Efficiency scores, Sugarcane, Farm scale, Faisalabad, Management system

1. Introduction

Agriculture is a one of the most significant sectors of Pakistan, which contributes 19.8 percent in gross domestic product of country. Agriculture sector creates a huge platform for the peoples to work and to earn money to meet their needs. According to (GOP, 2016), the 42.3 percent of total rural population is highly contingent on agriculture for their livelihood. One of the most important cash crops cultivating in the Pakistan is sugarcane. Sugarcane is growing in many countries of the world. Brazil is the first largest sugarcane producing country with 728.13 tonnes followed by India (349.56 tonnes), China (123.46 tonnes) and Thailand (96.50 tonnes). Pakistan has fifth order among the sugarcane producing countries (Bashir *et al*. 2012; Nisha, 2015).

Sugarcane is ranked at third among the thirteen crops being cultivated in Pakistan. Sugarcane contributes 3.1 percent in agriculture value adding and 0.6 percent in gross domestic product. This crop requires almost 10 months to harvest. The total sugarcane cultivated area in the previous year is 2.82 million acres while the production of sugarcane stood at 62.7 million tons (GOP, 2016).

Sugarcane cultivation is a powerful tool in uplifting the social and economic condition of the Pakistani farmers. Beside of that, 99 percent of the country's sugar is being extracted from the sugarcane and remaining is obtained from sugar beet (Azam & Khan, 2010) (Batool *et al*. 2015). Likewise, in every province of country this crop is being grown but the Punjab and Sindh are founded as main producers of the sugarcane. Both provinces have 90 percent share in the total production of the sugarcane (Munir *et al*. 2015). It is grown for the sugar and the other raw products like molasses. As contributing in the development of the economy of country, the sugar industry has secured a second position after textile industry. Nowadays number of working sugar mills in Pakistan is 86 having capacity of producing 7.0 million tons sugar annually. Government is earning revenue of 22.0 billion rupees whereas farmers are enjoying Rs. 110-135 billion. Rupees 20.0 billion is being earned by the vendors transporters, contractors and suppliers. About 1.20 million people are employed directly and indirectly by this industry (PSMA, 2015).

Where the sugarcane plays a vital role both in socioeconomic condition of farmers and sugar industry at the

same time importance of the management practices and efficient use of the inputs has become a radial part of improvement of farmer's condition and development of sugar industry. In sugarcane production, usually two cropping system are being experienced one is fresh crop and second is ratoon crop. In fresh crop system, farmers are practicing every stage from land preparation to harvesting. Farmers prepare the land and sow the seed in furrows. After sowing the seed, the seed is covered by the soil. While in the ratoon crop system seed is not required and land preparation is not practiced. In this system the roots and lower parts of the crops are remained uncut which gives the ratoon crop. Ratoon crops decreases the cost of seed and land preparation. Which reflects the ratoon cost is lower than fresh crop (Dawn, 2008). The fresh crop is able to give high production with low vulnerability of pest and disease attacks as compare to ratoon crop (Roka *et al.* 2009). Every year farmers face with decision conflict among the fresh crop and ratoon crop or both.

Sugarcane production is not only a complex process but also depends on the efficient use and combination of different inputs such as land, capital, management practice or system and many other inputs. This use of the various input's combinations to produce the crop is known as technology. The experience of the farmers in yield difference is the result of the usage of various combinations of inputs. Land preparation, seed, fertilizer, irrigation, capital and chemicals are the inputs that a farmer uses in cultivating the sugarcane. Quantity of the inputs and labor requirement for the fresh and ratoon crop is different. This difference between fresh and ratoon crop also differs the grower's efficiency.

Up to now, there have been some studies focused on the resource's use efficiency of sugarcane growers (Fernandez & Nuthall, 2009) and (Omotesho *et al*. 2013*)*. However, there have been less comparative studies related to efficiency measures under different management system such as fresh crop system and ratoon crop system. Therefore the study examined the technical, allocative and economic efficiencies of the sugarcane producers under different management systems. The results of this study will help us in understanding the farmer's efficiency in fresh, ratoon and overall sugarcane crop separately. This will help the farmers in taking into account fresh and ratoon crop separately to increase the yield of both crops with efficient usage of inputs.

2. METHODOLOGY

2.1 Study Area

The study area is located in the rolling flat plains of northeast Punjab between longitude 73°74 East, latitude 30°31.5 North. Faisalabad comprises approximately 1,230 km2 while the district encompasses more than 16,000 km2. Faisalabad is one of the agrarian part of Punjab province. District of Faisalabad has five tehsils. Tehsil Samundri and Jaranwala was selected as a research area due to their contribution to sugarcane production. Faisalabad farmers in the research area allocated the 93.89 thousand hectares of land to sugarcane and produced 5065.69 thousand tonnes of sugar every year (DOA, 2015).

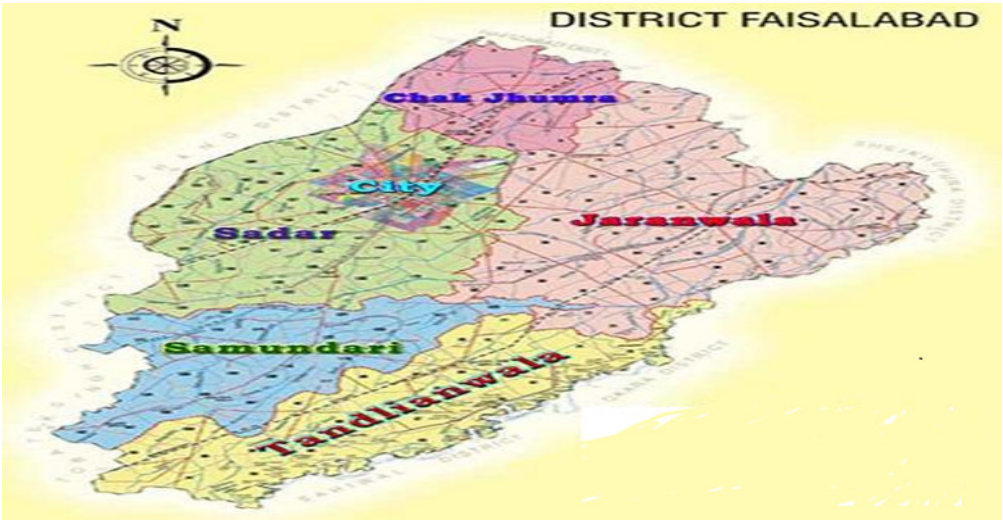

Figure 1. Map of Study Area

2.2 Research Data

The research data were collected from randomly selected 100 sugarcane growers by using the questionnaire administered in July and August 2015. The variables measured the study was summarized 3 main groups such as

socio-economic characteristics of sample farmers, production characteristics and market characteristics. The variables of age, education levels, experience, and family size, cooperative membership, labor and farmland were included into the socio-economic characteristics. In production characteristics group, the variables of quantity of input such as labor, capital, irrigation water, chemicals, fertilizer etc. and output by management type, yield as a productivity measures were measured. The research was also used the variables related to market such as inputs and sugarcane prices.

The average prices used for the inputs like DAP, urea and farm yard manure was 73.45, 35.22 and 0.32 Rupees per Kg of the inputs. The interest rate used for the working capital was 6.2 percent. The average price prevailed on the mill's gate was about 170.45 Rupees per month. The wage per hour for the labor in the area was observed about 24 Rupees.

2.3 Grouping the Sugarcane Farmers

Cluster analysis was performed to form homogenous group of sample farmers. Cluster analysis gathers the individuals into the cluster and the objects in the same cluster are more alike to each other against the other cluster (Hair *et al*. 2009). Cluster analysis included the variables of manager's profile, profitability and land ownership. Education was considered as an important manager's profile because due to the education, farmers can easily take into account the prevailed situation in the market. It also enables the person to upgrade himself with the updated technology. The share of land devoted to the sugarcane by the farmers got our attention to include this variable as second variable of cluster analysis. The third variable was return to working capital.

Based on the results of the cluster analysis, sample farmers were grouped as a small scale farmers, medium farmers and large farmers. The results of cluster analysis showed that the 25 farmers included in small groups, while the number of assigned farmers in to the medium and large ones were 47 and 28, respectively. The level of the education of the respondents shows significantly different between the groups of farmers ($p < 0.01$). The land share of sugarcane at different farm was not significantly different but the average land share of sugarcane was high at large farms following by medium and small farms. The return to working capital was significant among the farm groups ($p < 0.10$).

Table 1. Farmers Classification Based on Cluster Analysis

Farmers	Education	Land share of Sugarcane	Return to Working Capital**
Small farmers	0.00±0.00 a	0.43±0.042 a	3.25±0.19 a
Medium Farmers	9.30±0.018 b	0.51±0.029 a	3.37±0.14 b
Large Farmers	12.57±0.20 c	0.52±0.033 a	3.89±0.22 c

**Different letters referred that the size groups were statistically different in terms of selected variables at the 5% probability level.*

2.4 Efficiency Model for Sugarcane Farmers

The study was based on the efficiency concept suggested by Farrell (1957), which is the distance between observed input–output combinations and the best-practice frontier. Farrell (1957) suggested that maximum output attainable from each input level was assumed as the best-practice frontier. Since the sugarcane farmers have the more control power over their inputs comparing to their outputs, the input-orientated efficiency model was constructed to estimate the efficiency scores. The economic efficiency of sugarcane farmers was decomposed to the technical efficiency (TE) and allocative efficiency (AE). It is recognized from the Farrell (1957) that TE reflects the ability of sugarcane growers to use minimal input to reach given level of output, while AE reflects the ability of sugarcane growers to use the inputs in optimal proportions, given their respective prices and the production technology. Then both TE and AE constitute the measure of economic efficiency (EE). TE was decomposed into pure technical efficiency (PTE) and scale efficiency (SE). Pure technical efficiency reflects the ability of the producer to produce the maximum output at an optimal scale. While the scale efficiency refers the ability of producer to choose the optimal inputs level that will give the expected production level (Kumar & Gulati, 2008). The Farrell efficiency measures equal 1 for efficient farmers, and then decreases with inefficiency (Coelli *et al.* 2005).

Two-stage approach was followed when estimating the efficiency measures of sample farmers. In first stage, efficiency measures such as technical efficiency, allocative efficiency and economic efficiency were estimated.

Following, inefficiency determinants were explored in second stage. Data envelopment analysis (DEA) was used to measure the efficiency scores of sugarcane farmers (small, medium and large) under different crop management system.

In fist stage, we followed the suggestion of Charnes *et al.* (1978) and Banker *et al.* (1984) when constructing the DEA model for sugarcane farmers. In farm level DEA model, we assumed that the sugarcane yield (kg/ha) ($^{y}_{i}$) was outputs, while DAP (kg), urea (kg), farm yard manure (kg), Labor (hours), capital (Rs.) were the inputs ($^{x}_{i}$). In DEA model, each sugarcane farmer (i) was allowed to set its own set of weights for both inputs and output. The data for all farmers were represented by the K×N input matrix (X) and M x N output matrix (Y). TE was calculated for the i-the sugarcane farmer via linear programming (LP):

Minimize $_{\theta,\lambda}$ θ

Subject to $-y_{i} + Y\boldsymbol{\lambda} \geq 0$

$$\theta x_i - X\lambda \geq 0$$

$$\lambda \geq 0$$

Where θ was the TE score and the vector $\boldsymbol{\lambda}$ is an N×1 vector of weights which defined the linear combination of the peers of the i-th sugarcane farmer. The economic efficiency for the i-th sugarcane farmer can be generated by solving the following LP problem:

$$Minimize_{\lambda,xi^*} \; w_i^T x_i^*$$

Subject to $-y_i + Y\lambda \geq 0$

$$x_i^* - X\lambda \geq 0$$

$$\lambda \geq 0,$$

Where w_i is a vector of input prices for the i-th sugarcane farmer; superscript T is the transpose function; x^*_i is the cost-minimizing vector of input quantities for the i-th sugarcane farmer calculated by the LP, given the input prices w_i and output level $^{y}_{i}$ and $\boldsymbol{\lambda}$ is a Nx1 vector of constant. Equation 1 and 2 represents the cost minimization under constant returns-to-scale (CRS) technology. CRS means that output increases in proportion to changes in all inputs. The economic efficiency ($EE_{i,CRS}$) of the i-th sugarcane farmer was calculated as:

$$EE_{i,CRS} = w_i^T x_i^* / w_i^T x_i$$

That is, $EE_{i,CRS}$ is the ratio of the minimum cost to the observed cost, given input prices and CRS technology (Coelli *et al.* 2005).

Since sugarcane farmer in the research area were conducted their activities under imperfect competition due to imperfect information about market such as input and output prices, and because the size of many sugarcane farmer made them ineligible for institutional loans, we transformed equation (1) to the variable returns-to-scale (VRS) technology model by adding the convexity constraint: $N1\boldsymbol{\lambda} = 1$, where N1 is an N×1 vector of ones and $\boldsymbol{\lambda}$ is an Nx1 vector of constant to the equation (1). In this scenario, the efficiency score is calculated by using equation (1) under convexity constraint added to decompose the technical efficiency score into two component, PTE and SE. SE was estimated by using the ratio of TE score of sugarcane farmers under CRS to the TE score of the farmers under VRS. When SE =1 or $TE_{CRS} = TE_{VRS}$ then sugarcane growers are assumed at an efficient scale. The scale inefficiency of the sample farmres was determined by comparing the efficiency score under non increasing return to scale (NIRS) with technical efficiency score under CRS. The farmers were assumed scale inefficient under increasing return to scale when SE < 1 and $TE_{NIRS} = TE_{CRS}$. The farmers were classified scale inefficient due to decreasing return to scale if SE < 1 and $TE_{NIRS} > TE_{CRS}$. The AE was calculated residually by

$$AE_i = EE_{i,VRS} / TE_i$$

2.5 Statistical Analysis

In the study, farm size groups were compared in terms of measured variables. Before farm size groups were compared by using variance analysis, continuous variables had been tested whether they distributed normally, or not by using Kolmogorov Smirnov test. If the continuous variables were not normally distributed, we performed logarithmic transformation to normalize them. The tests of Mann-Whitney U, Kruskal Wallis and Chi-square were performed to test the differentiation among groups for the discrete variables.

3. Results and Discussion

3.1 Socio-Economic Characteristics of Sample Sugarcane Farmers

The socio-economic characteristics of sample sugarcane growers presented in Table 2. There were statistically significant differences among the small, medium and large growers in term of ages, education, sugarcane experience and family members ($p<0.01$). The large farmers were younger comparing to the rest. The mean age of small farmers was about 46 years, which was higher than other groups ($p<0.05$). The medium and large farmers' education level were comparatively better than that of small ones, with 9 and 13 years of schooling education, respectively. The small farmers had been cultivating the sugarcane since 25 years, representing that small farmers were more experienced comparing to others in sugarcane production. The sugarcane cultivation experience of medium and large farmers were about 19 and 12 years, respectively. The size of small farm's family, with 8 persons, was higher than that of medium farms, 7 persons, and large farms, 6 persons.

Table-2; Socio-Economic Characteristics of the Sample Sugarcane Farmers

Characteristics	Small Farmers	Medium Farmers	Large Farmers
Age of farmers (year)***	46±2.36	44±1.73	37±1.98
Schooling (year)***	0±0.00	9±0.19	13±0.20
Experience of sugarcane production (year)***	25±2.21	19±1.53	12±1.61
Family size (person)***	8±0.74	7±0.35	6±0.33
Farmland (Acre)			
Owned land***	5.22±0.87	7.06±0.82	11.84±1.33
Rented land	2.32±0.85	3.19±0.87	1.75±0.65
Rented out land	0±0.00	0.28±0.19	0±0.00
Sharecropping land	0.44±0.27	0.27±0.17	0.14±0.14
Shared out land	0±0.00	0±0.00	0±0.00
Operational land***	7.9±0.90	10.24±1.08	13.66±1.32
Land allocated to sugarcane **	3.04±0.37	5.55±0.90	6.49±0.53
Revenue and cost (Rs. per acre)			
Revenue**	93985.93±7280.85	115182.93±5556.64	129265.27±7274.40
Variable cost	31452.23±2888.25	37405.85±2213.66	36772.48±2402.50
Gross margin***	62533.71±5327.04	77777.08±4500.77	92492.80±5533.54
Net return including land rent***	30864.63±5234.44	45738.88±4463.31	60493.86±5442.22
Net return without land rent***	60483.67±5234.44	75357.92±4463.31	90112.90±5442.22
Family Labor Cost	16061.37±2955.93	12175.65±1737.44	7011.21±488.81
Return to management with land rent***	14803.25±7049.16	33563.22±5065.39	53482.65±5415.48
Return to management without land rent***	44422.29±7049.16	63182.26±5065.39	83101.69±5415.48

** and *** referred that there were statistically significant difference among the mean values of farm size group in terms of related variable at the probability level of 0.05 and 0.10, respectively.

Based on the results of the comparative analysis, the owned farmland differed associated with farm size ($p<0.05$). The farmland increased by farm size and farmland of small, medium and large farms were 5.22, 7.06 and 11.84 acres, respectively. However, the reverse was the case for rented in area. The small farmers rented much area than others. The mean sharecropping area of small, medium and large farmers were 0.44, 0.27 and 0.14 acres, respectively. The amount of farmland that rented and shared out were not common practicing in the research area.

The shared in area was just average 0.28 acre only on medium farms. The high operational land holding enabled the growers to devote the high area to the sugarcane crop.

Having large farmland made farmers allocate much more land to sugarcane. Land allocated to sugarcane production differed associated with farm size ($p<0.05$). Sugarcane land at the large farms was larger than that of medium and small farms. The revenue of sugarcane production was satisfactory level in the research area. The revenue, gross margin, and net return increased associated with farm size ($p<0.05$). The mean gross margin of small, medium and large farm were 62533.71, 77777.08 and 92492.80 rupees per acre, respectively. The calculated return to management figures showed that it exceed the all farm cost together with family labor compensation and opportunity cost of own capital, promoting the farmers to continue sugarcane production. Sample farmers tended to conduct their activities using own capital rather than credit use.

3.2 Management Type and Farm Size Relation

Table-3 represented the number of farmers by management type. Research results showed that 53% of the sample farmers preferred the mixed production system, while the share of fresh and ratoon ones was 25% and 22%, respectively. Management type preference varied associated with farm size. Mixed production was common in small, medium and large size farms, while ratoon production was wide in medium size farms. Ratoon management was not experienced by the large farms

Table-3' Farms According to the Management System

Management type	Small Farmers	Medium Farmers	Large Farmers
Fresh Crop	8.00	12.00	5.00
Ratoon crop	8.00	14.00	----------
Mixed crop	9.00	21.00	23.00

When considering the share of land allocated to different management type, it was clear that share of mixed one in land was greater than other management system. Each farm category preferred to keep their land under the mixed crop. In farm comparison the small farm's share of their land devoted to fresh and ratoon crop system was high than medium and large farms. Their share to mixed one was less than 50 percent. The large farms preferred to grow mixed crop.

Table-4; Yield of and land allocated to sugarcane to by farm size

Management type	Small Farmers	Medium Farmers	Large Farmers
Land (Acre)			
Fresh Crop*	1.04 (34.21%)	0.57 (10.25%)	0.54 (8.39%)
Ratoon Crop**	0.60 (19.74%)	0.83 (14.95%)	0.00
Mixed Crop**	1.40 (46.05%)	4.15 (74.84%)	5.95 (91.62%)
Yield (Monds)			
Fresh Crop*	618.75±58.20	715.41±45.17	755.00±122.57
Ratoon Crop**	346.87±30.04	491.07±43.19	--
Mixed Crop*	743.05±38.70	754.16±39.28	758.25±19.98

(*) and (**) that there were statistically significant difference among the mean values of farm size group in terms of related variable at the probability level of 0.10 and 0.01 respectively.

The land allocated to ratoon crop was larger than that of fresh crop in sample farms. The area under fresh and ratoon crop at large farms was higher than others ($p<0.05$). The mean farmland allocated to sugarcane production was 5.19 acres, which covered the 48.84% of total farmland. The yield of the ratoon crop was smaller than that of the fresh and mixed crop. In all farm size groups, yield of sugarcane in mixed cropping system was higher comparing to the ratoon and fresh crop. The yield of ratoon crop at medium farms was 491.07 monds per acre,

on average, which was statistically larger than that of small farms. The fresh crop yield was high than ratoon at each farm category

3.3 Efficiency Measures of Examined Sugarcane Growers

Based on the results of efficiency analysis, the small and large farms were technically efficient in fresh management system, indicating that large and small farmer's had ability to use the minimal inputs to produce given level of output. The EE and AE scores of large farmers were higher comparing other farm size groups. Large farmers were more economically efficient in fresh cropping system than others. The medium farmer' economic efficiency level was the smallest in fresh management type (Table 5).

Table-5; Efficiency Scores of Sample Farms by size and different cropping system

	Small Farmers	Medium Farmers	Large Farmers
	Fresh Crop	Fresh Crop	Fresh Crop
EE	0.86±0.05	0.75±0.05	0.94±0.02
AE	0.86±0.05	0.79±0.04	0.94±0.02
TE	1.00±0.00	0.94±0.03	1.00±0.00
PTE	0.97±0.02	0.92±0.04	0.91±0.08
SE	0.97±0.02	0.97±0.01	0.91±0.08
	Mixed Crop	Mixed Crop	Mixed Crop
EE	0.79±0.05	0.83±0.02	0.70±0.03
AE	0.79±0.05	0.88±0.02	0.71±0.03
TE	1.00±0.00	0.95±0.02	0.98±0.01
PTE	0.97±0.02	0.90±0.02	0.86±0.03
SE	0.97±0.02	0.95±0.02	0.88±0.03
	Ratoon Crop	Ratoon Crop	Ratoon Crop
EE	0.89±0.04	0.76±0.06	--
AE	0.89±0.04	0.84±0.04	--
TE	1.00±0.00	0.90±0.04	--
PTE	0.90±0.04	0.84±0.05	--
SE	0.90±0.04	0.92±0.03	--

In mixed cropping system, the all small farmers were fully technical efficient. The large farmer's technical efficiency level was also better than medium farmers. The large farmers used more inputs by 30% comparing to fully technical efficient farms. However the medium farmer's technical efficiency level was lower, their economic and allocative efficiencies were better than that of small and large farmers (Table 5).

All small farmers were fully technically efficient under ratoon crop management system. Their ability of using inputs to get optimal level of output and at optimal input scale were better than that of medium farmers in ratoon crop. The AE and EE scores of the small farmers were larger than that of medium farmers, indicating that medium farmers would reduce their cost by 24%. These result revealed that small farmers were more efficient than medium farmers (Table 5).

The large farmers were better in fresh crop. The medium farmers had the better position in mixed type cropping system while small farmers were better in ratoon based on the technical, allocative and economic efficiency scores.

3.4 Farmer's Distribution associated with Economic efficiency scores by Crop Management systems

The high level of technical efficiency and relatively smaller allocative efficiency level indicated the need to get market orient information. It was clear from the figures in Table 6 that the most number of inefficient farms observed in mixed cropping system. While the percentages of economically efficient farms were larger in other management systems ($p<0.05$).

Table-6; Distribution of the farmers by crop Management and Efficiency level

	Economically inefficient Farmers		Economically Efficient Farmers	
Crops Types	Percentage	Frequency	Percentage	Frequency
Fresh Crop	21.00	15	34.00	10
Mixed Crop	61.00	43	34.00	10
Ratoon Crop	18.00	13	32.00	9

Chi-Square Value = 5.627

Research results also showed that economically efficient farmers had better figures comparing inefficient ones in terms of the variables of age, family members, and area under sugarcane, working capital and labor. However the case was the reverse education level (Table 7).

Table-7 Some Socio-Economic Characteristics of Economically Efficient and Inefficient Farmers

Variables	Economically inefficient Farmers	Economically efficient Farmers
Age	42.96±1.34	41.38±2.56
Education	8.46±0.56	6.48±0.95
Sugarcane experience	18.63±1.29	18.66±2.24
Family Members	6.35±0.31	6.90±0.58
Area under sugarcane	4.79±0.48	6.16±1.13
Working Capital	28318.10±1637.57	28369.31±1665.67
labor hours	284.45±8.60	295.72±11.39

4. Conclusion and Recommendations

The study examined the efficiency of farmers under different crop system of sugarcane. The calculated efficiency scores revealed that the small farmers was more technical efficient in all cropping system comparing to the other farm size. In fresh and mixed crop system, the medium and large farmers were not at the optimal level in technical efficiency, but their ability on input allocation by price was satisfactory level. The cost in fresh and mixed cropping system were lower than small farmers. In the research area, the large scale farms was the best in fresh cropping system, while medium farmers was the best in mixed one. Small farmers were good at in ratoon cropping system. Sample farmers were at the satisfactory level in resource allocation, but they had problems of higher production cost due to having low level of allocative and economic efficiencies

In conclusion, all farm size groups were experienced high production cost in all management type. Farmers should be pay attention to the monitoring the input markets. The severe investment is needed to increase education level for small farmers to judge the market price situation to reduce their expenditures. If farmers manage their ratoon crop by taking into account the price level and allocation of resources then they can increase their yield and reduce their expenses. Mills development activities and effective extension services may enhance the growers knowledgeable in managing their crop systems.

References

Azam, M. & Khan, M. (2010), "Significance of the Sugarcane Crops with Special Reference to NWFP", Sarhad J. Agric., 26(2), 289-295.

Banker, R. D., Charnes, A. & Cooper, W. E. (1984), "Models for Estimation of Technical and Scale Inefficiencies in Data Envelopment Analysis", Management Science. 30:1078-1092.DOI: 0025-1909/84/3009/1078501.25.

Bashir, A., Haq, S. U., Azhar, M., Munir, M. A. & Afzal, A. (2012, "Impact of sugarcane Mills Development Activities on Cane Production in Punjab", Pakistan J. Agric. Res., 25(1), 21-27.

Batool, S., Habib, N., Nazir, M., Saddique, S., & Ikram.S. (2015), "Trend Analysis of Sugarcane Area and Yield in Pakistan. Science", Technology and Development, 34(1), 46-48.

Charnes, A., Cooper, W. W. & Rhodes, E., (1978), "Measuring the efficiency of decision making units", European Journal of Operational research, 2:429-444. DOI: 10.1016/0377-2217 (78)90138-8.

Coelli, T. J. Rao, D. S. P., O. Donnel, C. J. & Battese, G. E.,(2005), "An Introduction to Efficiency and Productivity Analysis", 2nd Edition, Springer, New York, 350 pp.

Dawn, (2008), "Sugarcane: Yield and Profitability" Downloaded at 16-03-2016 from http://www.dawn.com/news/839132/sugarcane-yield-and-profitability

D.O.A., (2015). Directorate of Agriculture. "Crop reporting service" Government of Punjab, Pakistan.

Farrell, M. j., (1957), "The Measurement of Productive Efficiency", Journal of Royal Statistical Society, 20 (A) 253-290. DOI: 10.2307/2343100.

Fernandez, A.D.P. & Nuthall, P. L. (2009), "Technical Efficiency in the production of Sugarcane in Central Negros Area, Philippines: An Application of Data Envelopment Analysis", J. ISSAAS, 15(1), 77-90.

Government of Pakistan, (2016), "Economic survey of Pakistan 2015-2016", Government of Pakistan. Finance Division Economic Advisor's wing, Islamabad.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E., (2009), "Multivariate Data Analysis" 7th Edition, Prentice hall, Upper Saddle River.

Kumar, S. and Gulati, R., (2008), "An Examination of Technical, Pure Technical, and Scale efficiency in Indian Public Sector Banks using Data Envelopment Analysis", Eurasian Journal of Business and Economics, 1(2), 33-69.

Munir, M. A., Hussain, M., Imran, M. A., Zia, S., Anwar, H., Ayub, M., Rashid, M., Jamil, I., & Ghaffar, I. (2015), "Analysis of profit Efficiency in Sugarcane Production in District Sargodha, Punjab, Paksitan", International J. of Eco. Commerce and management, 3(9), 649-658.

Nisha, (2015), "Top 10 Sugarcane Producing Countries", published at www.perfectinsider.com. Dated 16-03-2016, On http://www.perfectinsider.com/top-10-largest-sugarcane-producing-countries/

Omotesho, O. A.,. Lawal, A. M., Olatinwo, K. B., Adenuga, A.H. & Bello, A. J. (2013), "Technical Efficiency of Sugar Cane (Saccharum officinarum) Production in Niger State, Nigeria", J. of Agriculture, Forestry and Social sciences, 11(1), 2013.

PSMA. (2015), "Pakistan Sugar Mills Association. Sugar industry, History". Downloaded at 16-03-2016. From http://www.psmacentre.com/sgindustry.php?sgid=1&type=history&status=1

Roka, F. M., Baucum, L. E. & Alvarez, J. J. (2009), "Costs and return for sugarcane production on Muck Soilsin Southern Florida 2008-2009". EDIS paper SC088.