TECHNICAL EFFICIENCY OF COTTON FARMS AND ITS DETERMINANTS.

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ABSTRACT: *Cotton is one of the major crops in Pakistan and it has leading role in export products. For bumper crop production it is important to utilize the resources in a best way. Technical Efficiency (TE) is one of the most important indicators to judge the best use of resources and it can also show the influences of varying range of the endowment and socio-economic factors. In addition to technological development, socio-economic factors of the farmers play important role in the agriculotural production. Hence, in this piece of work TE has been estimated using Data Envelopment Analysis (DEA), the most preffered method used in the literature. In addition to this Kruskal Wallis & Bonferroni comparison test have been used as post estimation tests to see the effects of socio-economic factors on TE of cotton farms. In total seven socio-economic factors; agriculture farm type, farm machinary, farm size, farmers' age, qualification, experience, and their working style have been considered. The results show that farm size and farmers' working style have, statistically, very significant influence on TE of cotton farms; large cotton farms and farmers working as part time are the most efficient. Moreover, renters farm type and farmers having personal tractors are more efficient as compared to owners and farmers without tractors, respectively. Young farmers are more efficient than the old ones and farmers having qualification of matriculation or intermediate are more efficient than the other levels of qualification. Moreover, farmers having experience of 6 to 20 years are technically more efficient than the others.*

Key words: Agricultural Production, Data Envelopment Analysis, Cotton Farms, Socio-Economic Factors, Kruskal Wallis test, Bonferroni Comparison test.

INTRODUCTION

In context of Pakistan, cotton at large, contributes directly or indirectly in exports and ultimately it contributes a lot in earning foreign exchange. In Pakistan, about 2806 thousands hectares of land is cultivated with the cotton crop and it produces about 12769 thousand of bales of 375 pounds each [1]. Beside this, cotton farming provides the farmers with an opportunity for family employment as well as for the other laborors in the area. Hence, it take parts in the livlihood of the farmers. In agricultural business, it is much important that natural as well other resources should be used efficiently which will enhance the livelihood of the agricultural farmers as well as it will also contribute in the national earnings. Considering the bestowed and human managed resources, socio-economic factors play important role in the agricultural production and Technical Efficiency (TE) measure is one of the most important indicators which can show the influences of varying range of the endowment and socio-economic factors.

Agricultural farming is a complex process. For efficient production, a number of factors are needed to be considered. Economic factors; farm type (tenure or ownership), farm size, farm machinery and social factors; farmers' age, education, experience & other human skills, and environmental factors such as, soil, crops cultivated, infrastructure, markets, government policies, and international trade contribute directly or indirectly in the production process of agriculture farming [2]. Moreover, a number of activities such as selection of seed, varieties, fertilizers, pesticides/weedicides, seed bed preparation, use of water, and selection of market to sell the products influence the farms' efficiency. In this regard, best use of resources and best selection of the technological options may enhance the crop production efficiently. The most efficient farmer would be that who chooses the input bundle which contributes to a maximum feasible bundle of output(s) or inversely chooses a smallest possible input bundle that can produce a given level of output or some combination of the two. It is very important to identify the bundles of inputs which improve the efficiency of crop production. For example, water use efficiency under intelligent irrigation system is higher than that of irrigation control system [3]. In the literature, one can find a number of definitions of efficiency and it can be described in different terms. The concept of TE can be explained as: a comparison between observed and optimal values of output and inputs of a production unit [4]. Therefore, this comparison takes the form of the ratio of observed to maximum potential output attainable from the given inputs, or the ratio of the minimum potential to observed input required to produce the given output(s), or some combination of the two. This gives rise to the concept of TE. A productive entity is technically inefficient when (given its use of inputs) it is not producing the maximum possible output or given its output, it is using more inputs as compared to required ones [4].

In this realm, this paper contributes in cotton farm management by estimating the cotton farm's TE and by estimating the influencing economic factors; farm type, farm size, and farm machinery and social factors; farmers' age, qualification, experience, and working style in the study area.

STUDIES ON AGRICULTURE PRODUCTIVITY AND EFFICIENCIES

In literature, a number of studies concerning the calculation of efficiencies and models which can be considered to estimate TE, could be found. Most of the researchers have focussed to measure the sustainability of any entity by estimating different types of efficiencies because and efficient production can enusre the sustainability. For example, [5] compared the Scale Efficiency (SE) scores of conventional and sustainable farms. The analysis included DEA CCR (Charnes Cooper Rhodes) and BCC (Banker Charnes Cooper) models efficiency calculations. The author found that sustainable farms had more profitable input/output relationship than conventional farms. Similarly, [6] measured sustainability based on socio-economic and bio-ecological attributes. The authors have used DEA models to measure the sustainability of a group of Dutch sugar beet growers over four consecutive periods of time. [7] assumed sustainability as being a mix of environmental efficiency plus economic performance. In his words "if farmers improve the TE of their use of polluting inputs, they simultaneously achieve economic and environmental objectives". It means that improvements of TE may support sustainability. In another work, [8] analyzed DEA-CCR efficiency measurements of input used in tobacco production in Turkey with respect to sustainability. The results showed a positive relationship between the efficiency of inputs used and sustainability of agriculture. [9] used DEA-BCC models to evaluate the most efficient irrigation districts in Andalusia (Spain) relative to water use. The authors believed that the study of efficiency allows them to assess when the use of water leads to greater profitability. Hence, the results may help to improve water management. [10] studied tobacco production in Tanzania. The authors were looking for the existence of empirical relations among production efficiency, biodiversity, and resources use. The results suggested that an increase in tobacco production efficiency is conducive to environmental sustainability in Tanzania. [11] used DEA models to evaluate sustainability in agriculture. Several variables were taken into account and the resulting efficiency was measured by comparison.

Sustainable and efficient farming systems has been historically dependent on constant productivity for long periods of time. During the last decades, sustainability has become a variable that needs to be analyzed and measured [12]. In agriculture, sustainability involves physical, biotic, economic feasibility, and socio-cultural factors. We can mention, for instance, [13] work on the sustainable agriculture theme. There are several approaches in the literature to evaluate agricultural efficiency and sustainability. In this concern, the related works by [14 - 23] are wrothy to be mentioned. In addition to DEA models, some of the researchers also have used the Stochastic Frontier Analysis (SFA) models to estimate the TE. However, most of the authors have proposed the use of DEA models to measure agriculture sustainability. For detail please consult the studies by [24,10].

[2] studied the factors of farm performance through an empirical analysis of structural and managerial characteristics. The authors classified the explanatory variables that influence the farm efficiency into two groups: first, agent factors comprising of age, education, and experience of the farmer or farm manager; and secondly, the structural factors which include on-farm and off-farm factors. On-farm factors could be location of farm, farm type, and size of farm while off-farm could be up-downstream relations, policy etc. The authors found that many managerial and structural characteristics are linked to farm performance. They concluded that the farm size, farm accounting and having a high share of own land have a positive effect on efficiency. On the other hand farm solvency, farmer's age and farmers' dependency on support payments are negatively related to farm efficiency.

MATERIAL AND METHODS

Primary data on agricultural practices at farm level was collected with the help of a well structured questionnaire in 2012. Data was collected for cotton output and 3 input variables including; land, fertilizers, and pesticide chemicals from 142 farmers in two districts (Dera Ghazi Khan and Rahim Yar Khan). Half of the samples were collected from each of the two districts randomly throughout the agricultural area. It should be noted that all of the variables were measured in absolute values and in international standard units. Output was recorded in kilograms while the input variables: land was recorded in acres; fertilizers were recorded in kilograms; pesticides chemicals were recorded as total number of acres sprayed. In addition to these input and output variables which have been discussed above, socio-economic data of the farms and farmers such as total number of acres at farm, number of acres cultivated with cotton crop, ownership of land, farm machinery/tractors, farmers' age, qualification, experience, and working style (full time or part time) was also collected. The socio-economic data have been used to make inferences about cotton crop accordingly. For estimation of TE, input oriented and variable return to scale, DEA models (given below) were used through software, DEA-Max. The TE scores (which can be from 0 to 1, if measured through DEA) were used then for post estimation tests i.e. in Kruskal Wallis and Bonferroni comparison tests. In post estimation tests, comparison based on socio-economic factors was taken where socio-economic factors were considered as ranking variable whereas TE scores were considered as outcome variable.

Model 1: Estimation of TE

Let us consider:

$x^j = (x^j_1, x^j_2, x^j_3, ... x^j_n)$ be the bundle of n inputs used and $y^j = (y^j_1, y^j_2, y^j_3, ...,y^j_m)$ be the bundle of m outputs, produced by an agricultural farm j (j = 1, 2, 3,......, N). Suppose that k is the observed agricultural farm and we want to measure the TE of farm 'k'. The observed input-output bundle of farm 'k' is (x^k, y^k). Then the correspondent mathematical (algebraic) formula for TE will be:

$$\max \varphi \text{ s.t.}$$

$$\sum_{J=1}^{N} \lambda_j x_{ij} \leq x_{ik} \qquad (i = 1, 2, ... ,n);$$

$$\sum_{J=1}^{N} \lambda_j y_{rj} \geq \varphi y_{rk} \qquad (r = 1, 2, ..., m);$$

$$\sum_{J=1}^{N} \lambda_j = 1; \lambda_j \geq 0 \qquad (j = 1, 2, ..., N); \varphi \text{ unrestricted}$$

Hence TE of farm k would be measured by

$$\tau_k = 1/\varphi^*$$

here φ^* is the optimum solution of the DEA linear programming problem given above.

Model 2: Estimation of output and input oriented TE

It would be better to define the production possibility set constructed from the sample data set $D = \{(x^j,y^j) ; j= 1, 2, ,3 ....,N\}$. the sample estimate of the underlying production possibility set 'S' is:

$S = \{(x,y) : x \geq \Sigma^N_{j=1}\lambda_j x^j ; y \leq \Sigma^N_{j=1} \lambda_j y^j ; \Sigma^N_{j=1} \lambda_j = 1; \lambda_j \geq 0 \ (j= 1, 2, ,3 ....,N)\}$

After estimation of the TE of a farm, a measure of output oriented TE (TE^o) of a farm with observed input and output bundle (x^k, y^k) is

$\tau^y_k = 1/ \varphi^*$ where $\varphi^* = \max \varphi : (x^k , \varphi y^k) \in S$

The above model gives the TE^o in the output oriented context.

When the input conservation is regarded as more important than expanding the outputs, the appropriate measure of performance of farm 'k' would be its input oriented TE (TE^i).

$\tau^x_k = \theta^* = \min \theta : (\theta x^k , y^k) \in S$

TE^i can be then presented through the mathematical (algebraic) as:

$\min \theta$

s.t.

$$\sum_{J=1}^{N} \lambda_j x_{ij} \leq \theta x_{ik} \quad (i = 1, 2, ... ,n);$$

$$\sum_{J=1}^{N} \lambda_j y_{rj} \geq y_{rk} \quad (r = 1, 2, ..., m);$$

$$\sum_{J=1}^{N} \lambda_j = 1; \lambda_j \geq 0 \quad (j = 1, 2, ..., N); \theta \text{ unrestricted}$$

RESULTS

After TE calculation it was found that the cotton farms have mean TE score as 0.631 with maximum as 1 and minimum as 0.262. Only 15 out of 142 farms achieved the TE score more than 90%. The figure-1 describes the frequency distribution of the TE of the cotton farm. TE of cotton farm is widely distributed over a range of 0.262 to 1. None of the groups got maximum extreme number of cotton farms, indicating that the most of the farms are technically inefficient and there is wide range of farms that can be considered in different dimension to reach up to the maximum achievable TE.

In the following, the results regarding the effects of socio-economic factors on TE of cotton farm have been described in detail. In order to see the effects of socio-economic factors of the farms, Kruskal Wallis and Bonferroni comparison test were conducted and the results are shown in the table-1.

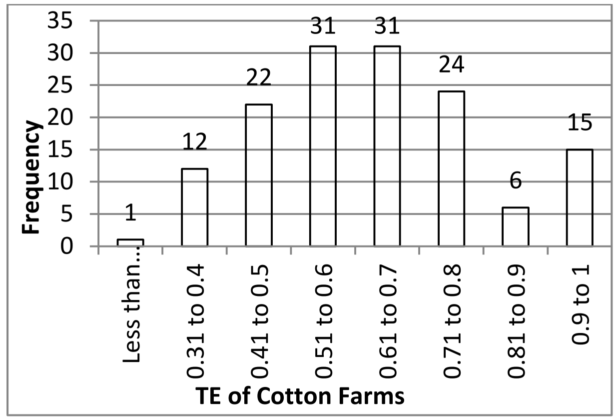

Figure-1: Frequency distribution of TE of Cotton Farms

Effects of agriculture farm type (AFT) on TE of cotton farms

The results showing effects of AFT on TE of cotton farm indicate that maximum mean TE score was achieved by renters as 0.715 and minimum mean TE score was achieved by owners as 0.620, while owner-renters achieved mean TE score as 0.628. The χ^2 value was calculated as 4.147 with prob. > χ^2 as 0.126 i.e. the difference among the groups is statistically not much significant. According to Bonferroni test results maximum difference was found between the mean of owners & renters as 0.095 with p value as 0.198 i.e. the difference between two is large but statistically insignificant. Minimum difference was found between owners & owner-renters as 0.007 with p value as 1.000 while difference between owner-renters & renters was found as 0.088 with p value as 0.450 i.e. the differences are too small to be statistically significant. These resutls are given in the table-1.

Effects of agricultural farm machinery (AFM) on TE of cotton farms

The results show that cotton farms without AFM got the mean TE score as 0.616 while the cotton farms having AFM got the mean TE score as 0.671, indicating that the cotton farms with tractors have better TE than the farmers without personal tractors. According to Kruskal Wallis test results, the value of χ^2 was found as 1.823 with prob. > χ^2 as 0.177 i.e. the difference between the two groups is too small to be statistically significant. The difference between mean of two groups was found as 0.055.

Effects of agricultural farm size (AFS) on TE of cotton farms

After analysis it was found that the medium cotton farms (89 in total) got minimum mean TE score as 0.572, while the large cotton farms (10 in total) got the maximum mean TE score as 0.749 and the small cotton farms (43 in total) got mean TE score as 0.725. The χ^2 value was found as 23.733 with prob. > χ^2 as 0.000, i.e. differences between the mean of groups are, statistically, significant. According to the Bonferroni comparison test, the most bigger difference was found between medium and large cotton farms (i.e. 0.176) with prob. as 0.005 indicating that this difference is statistically very significant whereas the difference between small and large cotton farm is smaller (i.e. 0.024) and,

Table-1: TE of cotton farm and socio-economic factors

Factors	Type/Levels	Kruskal Wallis Test				Bonferroni Comparison test	
		Farms	Mean TE	χ^2	Prob. > χ2	Differences	Prob.
Farm type	Owner Farms	104	0.620	4.147	0.126	0.007 (1,2)	1.000
	Owner-Renter Farms	24	0.628			0.095 (1,3)	0.198
	Renter Farms	14	0.715			0.088 (2,3)	0.450
Farm machinery	Farms without Tractors	104	0.616	1.823	0.177	0.055 (0,1)	0.107
	Farms with Tractors	38	0.671				
Farm size	Small Farms	43	0.725	23.733	0.000	- 0.152 (1,2)	0.000
	Medium Farms	89	0.572			0.024 (1,3)	1.000
	Large Farms	10	0.749			0.176 (2,3)	0.005
Farmers' age	18 to 30 Years	34	0.651	0.942	0.625	-0.035 (1,2)	1.000
	31 to 45 Years	80	0.616			-0.002 (1,3)	1.000
	46 to 65 Years	28	0.649			0.033 (2,3)	1.000
Farmers' qualification	Uneducated	22	0.608	2.722	0.437	0.028 (1,2)	1.000
	Basic Level Education	67	0.636			0.040 (1,3)	1.000
	High School or Colledge Level Education	43	0.648			-0.036 (1,4)	1.000
	University Education	10	0.572			0.011 (2,3)	1.000
	-	-	-			-0.064 (2,4)	1.000
	-	-	-			-0.076 (3,4)	1.000
Farmers' experience	0 to 5 years	8	0.550	2.051	0.359	0.090 (1,2)	0.550
	6 to 20 years	82	0.640			0.080 (1,3)	0.749
	More than 20 years	52	0.630			-0.010 (2,3)	1.000
Working Style	Full Time	134	0.621	6.561	0.010	0.171 (1,2)	0.009
	Part Time	8	0.792				

statistically, insignificant as p value was found as 1.000 while the difference between the small and medium cotton farms was found as -0.152 with prob. as 0.000 i.e. the difference is large enough to be, statistically, very significant.

Effects of farmers' age on TE of cotton farms

According to the results (shown in table-1), farmers' age has negative influence on TE of cotton farm as the mean TE scores of middle age and old age farmers are lesser than the young cotton farmers and difference is very small. Moreover, χ^2 value was found as 0.942 with prob. > χ^2 as 0.625. The mean TE scores achieved by the young, middle age, and old age farmers were calculated as 0.651, 0.616, & 0.649 respectively. Bonferroni test shows that maximum difference was found between young and middle age farmers as -0.035 and minimum difference was found between young and old age farmers as -0.002 while the difference between the middle and old age farmers was calculated as 0.033 but in all of the three cases the difference is insignificant as prob. > χ^2 was found as 1 in each case.

Effects of farmers' qualification on TE of cotton farms

After analysis, it was found that qualification has positive influence on the TE of cotton farm as the mean TE score (0.636) of farmers with basic education and farmers with high school or college level education (0.648) is greater than that of uneducated farmers (0.608), but the mean TE score of farmers with university education (0.572) is even lesser than uneducated farmers and minimum among all of the groups. The χ^2 value was found as 2.722 with prob. > χ^2 as 0.437, indicating that differences among groups of cotton farmers on the basis of their qualification are, statistically, insignificant. The minimum difference between the mean TE scores was found between the farmers with basic level education and high school or college level education as 0.011 and maximum difference was found between the farmers with high school or college level education and farmers with university education as -0.076. According to Bonferroni test results, no significant difference between any of the six pairs of groups was found as the prob. > χ^2 in each case was found as 1.

Effects of farmers' experience on TE of cotton farms

The farmers' experience has positive effect on the TE of the cotton farm. According to analysis, middle level experienced group of farmers got maximum mean TE score as 0.640 while low level experienced group of farmers got minimum mean TE score as 0.550 and the farmers having maximum experience got the mean TE score as 0.630. The χ^2 value was found as 2.051 with prob. > χ^2 as 0.359 which indicates that differences among farmers' groups based on experience are statistically insignificant. On the other hand, according to Bonferroni test results, maximum difference was found between low and middle experienced farmers as 0.090 but it is statistically not significant as the prob. > χ^2 was calculated as 0.550. Minimum difference was found between the middle and highly experienced farmers as 0.010 with prob. > χ^2 as 1 while the difference between the low and highly experienced farmers was found as 0.080 with prob. > χ^2 as 0.749, hence, statistically insignificant.

Effects of farmers' working style on TE of cotton farms

The working behavior of farmers i.e. full time or part time, has significant influence on TE of cotton farm. The results as shown in table-1, indicate that maximum mean TE score was achieved by the farmers working as part time as 0.792, while mean TE score achieved by farmers working as full time was calculated as 0.621. According to Bonferroni test results, a difference of 0.171 with prob. > χ^2 was found as 0.009. While according to Kruskal Wallis test, χ^2 value was calculated as 6.561 with prob. > χ^2 as 0.010, indicating that difference is much larger and it is statistically very significant too.

DISCUSSION ON THE RESULTS

The TE of cotton farm show different responses to different socio-economic factors. Statistically significant relation exists between TE of cotton farm and AFS, and farmers' working style only while all the other socio-economic factors have insignificant influence on TE of the cotton farm. AFT has a negative effect on the TE of cotton farm i.e. the renters are technically more efficient than the owners. The logic behind such results is that, in the study area, the renters are mostly those farmers which like agriculture farming and their liking is derived from their personal and family labor. Therefore, in order to get their family and them selves employed, farmers having no or few acres of land get more land from the land lords, on rent. Such farmers are very enthusiastic for agriculture farming and they work very hard, hence, get more production constituting higher TE. These results are very similar to the results concluded by [25] and the study by [26] also support such results. Similarly, AFS has significant but non linear relationship with the TE of cotton farm i.e. medium farms are technically less efficient as compared to the small and large cotton farms. However, the large cotton farms are the best of the three. The results of this part of study are some how similar to the results as discussed by [27]. Logically, small farmers are more efficient due to a number of reasons. First, almost all of the small farms are self operated farms and the farmers work at farm their selves with the family members. Secondly, as the total fertilizers and chemicals used at small farms are lesser (in amount) than the large farms, so, small farmers are able to buy these inputs according to the requirement well in time i.e. less financial constraint. On other hand, large cotton farms are more efficient as compared to medium farms and small farms too, because of scale of economy and due to maximum investment on fixed assets and AFM. According to the data collected, almost all of the large farmers have personal AFM. These results also match with the results as discussed by [25] and [28] for the agriculture farms in Brazil; in Philippine [29]; in the UK [30]; in the Greek agriculture [31]. Besides this, large wheat farms in eastern England [32] and large dairy farms in Portugal [33] are more efficient than the smaller farms.

The AFM, in this study, showed a positive but insignificant relationship with the TE of cotton farm i.e. the farmers which are using AFM on rent and they do not have personal tractors at farm are technically less efficient as compared to the farmers who have personal tractors. Results achieved from this part of study are very similar to the findings by [34] in Zimbabwe who studied the effects of AFM on the farm production. According to their analysis, AFM has some positive relation with efficiency. Therefore, cotton farms having personal AFM are more efficient than the cotton farmers using AFM on rent. The time factor is very important in agriculture farming. The farmers which have their personal farm machinery are capable to do farm operations well in time as they have farm machinery at their door step while the farmers without personal farm machinery may have to wait for the same.

Farmers' age, in this study, show a non linear and statistically insignificant relationship with cotton farms' TE. The young farmers are more efficient as compared to the middle aged farmers and also that the old age farmers are more efficient than the middle aged farmers. However, the old farmers got the maximum efficiency. Similarly, experience of cotton farmers has insignificant effect and non linear influence on TE of cotton farm i.e. the farmers having experience less than five years have lesser TE as compared to the farmers having experience of more than five and less than twenty years. Although, farmers having experience more than 20 years are less efficient than the farmers having experience of more than five and less than twenty years but the difference is very small. These results are different from the results discussed by [30], [35] and [36]. Deliberately, it can be stated that the age has negative and experience has positive effect on the efficiency of the cotton farms. Logically, and practically too, the age and experience go side by side. Farming in Pakistan is mostly labor based, hence, the young farmers due to their muscular power have the edge to do hard agricultural work and the old aged farmers get the benefit of experience. For detail, the study by [37 in UK is very helpful. According to the author, agricultural farmers are more efficient up to the age of 49 years while according to [38] farmer's efficiency inclines up to age of 40 years and later declines.

Farmers' qualification show an insignificant and non linear relationship with TE of cotton farm i.e. first increasing and then declining for the most highly qualified farmers. Conceptually, highly educated farmers do not work themselves while the uneducated or less educated farmers work their selves, hence, get the benefit of self labor and are more efficient. In the literature, a number of studies can be found showing a positive relation of education with the farm efficiency such as studies by [36, 39, 38, 40, 41, 26, 38, 28]. As pointed out by [42], the effects of education are much more likely to be positive in modern agriculture environments than in traditional ones. Hence, so far, in this study the agriculture farming is not modernized and education does not show the similar results as explained by the researchers in the literature. Therefore, it can be stated that the education is not playing its role in the cotton farming in the study area.

On the other hand, the TE of cotton farm has significant influences from the working style of the cotton farmers. In the literature it is difficult to find some results about the effects of full or part time working in agriculture farming. However, our results show that the farmers working as part time are more efficient than the farmers working as full time at their farms. Conceptually, it is opposite such that the full time working farmers may give more attention towards their corps but in the study area, the farmers face a lot of problems with reference to cash or money. The farmers, who work solely on their farms as full time job, get the revenue or cash at the end of season or at the time of crop harvesting, so they are mostly deficient with the credit to buy inputs well in time. On other hand, the farmers working as part time on their farms mostly do some other works to earn money on monthly or weekly basis, which can be spend for buying the inputs for agriculture farming. It should be noticed that the farmers working as part time, mostly have their family labor at their back that can work and take care about the crops. Therefore, financial problem are faced by the farmers who are working solely on the farms and they are less efficient as compared to the farmers who work as part time. Hence so far, it can be stated that the working style play important role for managing the credit to invest in the agriculture which causes better crop production and leads to better efficiency of the cotton farms in the study area.

CONCLUSION

It is concluded that the socio-economic factors factors play mcuh important role in the business of agriculture. Most of the factors have significant influences on the technical efficiency of the cotton farms. Based on the analysis, it is concluded that the economic factor; farm size of the cotton farms have very significant effects on the technical efficiency of the cotton farms in such a way that larger cotton farms having land more than 25 acres, are the most efficient whereas the medium cotton farms having land 5 to 25 acres, are the least efficient. Similarly, the cotton farmers who work part time are more efficient as compared to the farmers working as full time at thier cotton farms. On the other hand, economic factors; farm type and farm machinery effect the cotton farms' technical efficiency, statistically, insignificantly. However, renters' farms are more efficient than owners' farms. Similarly, the farmers having thier personal tractors and farm machinery are more efficient than the farmers which do not have their personal farm machinery. Likewise, the social factors; farmers' age, qualification and experience effect the cotton farms' technical efficiency insignificantly. However, the young farmers are more efficient than others. The farmers having qualification of secondary or higher secondary school education are the most efficient and the farmers having university education are the least efficient. Similarly, farmers having experinece of 6 to 20 years are the most efficient and young farmers are the least efficienct.

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