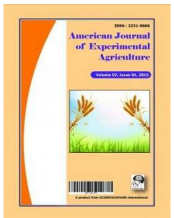

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Efficiency Analysis of Wheat Farmers of District Layyah of Pakistan

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Authors' contributions

This work was carried out in collaboration between all authors. Author WA designed the study, wrote the protocol and wrote the first draft of the manuscript. Authors IJ, MAM, QA and MW did data collection and data entry. Author MU managed the analyses of the study and performed the statistical analysis. All authors read and approved the final manuscript.

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ABSTRACT

Like many other developing countries, Pakistan has lower agricultural productivity. It is due to the reason that the farming community is almost illiterate and, has traditional and conservative farming practices. Adoption and diffusion of new technology at farm level is hindered due to these factors. This study aimed at estimating; technical, allocative and economic efficiency. The determinants of inefficiency for the wheat farms in district Layyah were also quantified. Data of 120 farmers for the crop year 2010-11 were used for the analysis purpose. A non-parametric approach, Data Envelopment Analysis (DEA) was used to find out the efficiency scores. Separate regression was used for these inefficiency scores for socio-economic and farm specific variables by using a Tobit regression model. The results showed that mean technical, allocative and economic efficiency of farms in the sample area was 84, 81 and 68 percent, respectively. Results of Tobit regression models showed that impact of years of schooling, access to credit, number of contacts with extension agents, and distance of farm from main road were negative and significantly affecting technical inefficiency of wheat farms. The farm size variable sign was negative and had significant impact on the allocative inefficiency. The coefficient of access to credit dummy variable was positive

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and had significant impact on allocative inefficiency. The coefficient of distance from main road was negative and significant which implied that as the distance of farm from main road increased the economic inefficiency will decreases. Quantified results urged the need of improvement in the agri-extension services, timely and proper availability of inputs, and establishment of local level markets at lower administrative units (like, town or union council) for the improvement of existing farming system.

Keywords: Wheat; efficiency; data envelopment analysis; Tobit regression; Layyah.

1. INTRODUCTION

Like other developing countries agriculture in Pakistan is a dominant driving force for country's growth. Agriculture contributes about 21 % in the GDP of Pakistan and provides directly/indirectly sustenance to 43.5 percent of county's population residing in the rural areas. The raw material of different industrial sector comes from this sector and it is also market of manufacturing foodstuffs.

Wheat is the leading food grain of Pakistan occupying the largest area under single crop. Wheat contributes 10 percent to the value added in agriculture and 2.1 percent to GDP. Area under wheat has decreased to 9180 thousand hectares in 2014-15 from last year's area of 9199 thousand hectares which shows a decrease of 0.2 percent. The production of wheat stood at 25.478 million tons during 2014-15, showing a decrease of 1.9 percent over the last year's production of 25.979 million tons [1].

Agricultural productivity is low in developing countries like Pakistan. This slow agricultural growth is unable to cope with the fast and persistently increasing population in these countries. The impact of this low growth is result in undernourishment and recurring famines [2]. The ILO [3] study stated that food consumption inequalities had increase overtime in the food deficit countries as well as countries having high agricultural productivity. This result in food insecurity and malnutrition in the countries experiencing slow growth in per capita food production and perverted income distribution [2]. These countries can get rid of from this havoc by enhancing food production and providing better access to food consumption for the poor masses [4].

Despite serious efforts made by the wheat breeders in developing new high yielding varieties during the past three decades, wheat production in Pakistan remained short of demand and thus import has been the only alternative to fill the gap. The present wheat requirement of the country is more than 20 million tons. It has been estimated that by the year 2020 wheat import would rise up to 15 million tons costing 2 billion US dollars [5]. The situation could worsen further if Pakistan fails to achieve a higher level of growth rate in wheat production and sustain it. Under the present wheat production system and productivity scenario the realization of this objective appears to be highly unlikely [6,7].

The findings of the World Food Council indicated that the rate of food utilization is higher than that of it production which result declining availability of food on per capita basis in each year [8]. Pakistan imported food over greater period of its existence to fulfill the minimum food need of the country. At present food deficit is of 10-15 percent of the wheat requirement. In some years wheat import went over two million tons. The wheat production for the year 2022 is projected at 23.71 million tons and wheat requirement at 28.92 million tons, representing a deficit of 5.2 million tons [9]. The ever increasing rate of human population is squeezing availability of land and water on per capita basis. The rapidly deteriorating state of ground water and land quality are also factors of food insecurity. The further expansion of land and water resources are impossible due to significant constraints [10].

Ahmad [11] studied that the declining efficiency in the major cropping zones of cotton, rice and mixed cropping zone (which account about 70 percent of the crop wealth of Pakistan), are happening because of land degradation. the land degradation occur due to nutrient exhaustive cropping patterns, frequently increasing salinity and water logging, the use of salty underground water and insect and diseases. The agronomic, physiological, socio-economic, political instability and poor resource management are also the factors of low yield in Pakistan. Poor management, particularly in term of input use is more conspicuous of all factors. That is why irrigated wheat per hectare varies from 0.5 ton to 5.5 tons, in Pakistan [12].

The above conversation stated that the source of additional wheat can be bring by the way of enhancing the wheat productivity. The planned study was designed to achieve the higher productivity by improving the efficiency of the wheat farmers in the study area. The study estimated the technical, allocative and economic efficiency of the sampled wheat farmers. The impact of socio-economic and farm specific factors affecting inefficiencies were also investigated.

The remainder of the paper is organized as: data collection technique, variables used in the analysis and model employed are discussed in section 2. Results of the study and discussions are presented in part 3, while section 4 show conclusion and policy implications.

2. RESEARCH METHODOLOGY

2.1 Data Collection Procedure

The planned study was conducted in district Layyah of Punjab Pakistan. It is located in the Southern part of the province. Layyah City is the district headquarter of Layyah District. It has hot climate, most of the area is desert. It lies between 30–45 to 31–24 degree north latitudes and 70–44 to 71–50 degree east longitudes. The area consists of a semi-rectangular block of sandy land between the Indus River and the Chenab River in Sindh Sagar Doab. The total area covered by the district is 6,291 km^2 with a width from east to west of 88 km and a length from north to south of 72 km.

One representative Tehsil was selected for study purpose. In order to collect data simple random sampling technique was used. Six villages were taken from the selected Tehsil. All randomly selected villages were situated at different distances and directions from the market. A well designed and pretested questionnaire was drafted to get relevant information regarding various farm specific variables. Twenty five farmers were selected from each village represented by small, medium and large farmers in proportion to their number in the village. A sample of 120 farmers was taken as total. Data was collected for the crop year 2010-11.

2.2 Empirical Models

Efficiency is an important economic concept and is used to measure the economic performance of a production unit. Frontier production function is that it gives the maximum output from a given level of inputs, given the current state of technology in an industry. Farrell [13] referred frontier as the best practice frontier. The best practice frontier is used as a standard against which the efficiency of a firm is measured. The purpose of frontier production function approach is to estimate a frontier rather than an average production function. Since Farrell's original work in 1957, frontier methodology has been extensively used in applied production analysis.

2.2.1 Estimation of technical efficiency

Technical efficiency scores obtained from constant returns to scale DEA model is called total technical efficiency and from variable returns to scale DEA model as pure technical efficiency.

2.2.2 Variable returns to scale DEA model

Coelli, [14] suggests that constant returns to scale DEA model is only appropriated when all firms are operating at optimal scale but it is not possible in agriculture due to many constrains. The use of constant return to scale DEA model when all firms are not operating at optimal scale results in measures of technical efficiencies that are confounded by scale efficiencies. In order to avoid this problem, Bankers, [15] modified constant returns to scale DEA model to variable returns to scale model by adding convexity constraints. The use of variable returns to scale DEA model allows the calculation of technical efficiency free from the effects of scale efficiencies.

The envelopment form of the input-oriented variable returns to scale DEA model is specified as follows:

$$\text{Min}_{\theta,\lambda}\ \theta,$$

subject to

$$-yi + Y\lambda \geq 0$$
$$\theta xi - X\lambda \geq 0$$
$$N1^{/}\lambda = 1$$
$$\lambda \geq 0$$

Where:

- Y represent output matrix for N farms.
- θ represents the total technical efficiency of i^{th} farm.

- λ represents Nx1 constants.
- X represent input matrix for N farms.
- y_i represents the total farm income of the i^{th} farm in Rs.
- x_i represents the input vector of $x_{1i}, x_{2i}, \ldots\ldots x_{7i}$ inputs of i^{th} farm.
- x_{1i} represents the total cropped area in acres on the i^{th} farm.
- x_{2i} represents the total quantity of seed in kg used on the i^{th} farm.
- x_{3i} shows the total number of tractor hours used for all farm operations including ploughing, planking, ridging, hoeing, fertilizing, spraying, land leveling etc. on the i^{th} farm.
- x_{4i} represents NPK nutrients (kg) used on the i^{th} farm. It was observed that few farmers in the sample area also used farmyard manure. It is, therefore, more plausible to determine the quantity of NPK present in farmyard manure. These nutrients were calculated on the basis of chemical composition given by Brady [16].
- X_{5i} indicates the labour input consisting of family and hired labour and was calculated as the total number of man-days required to perform various farming operations on the i^{th} farm.
- X_{6i} represents the active ingredients used on the i^{th} farm.
- X_{7i} represents the irrigation hours for i^{th} farm

2.2.3 Estimation of economic efficiency

Economic efficiency is estimated by dividing minimum cost by observed cost. Cost minimization DEA model is used for the estimation of cost minimizing vector of input quantities.

Cost minimization DEA model is specified as follows:

$$\text{Min}_{\lambda,\, xi^E}\ wi\ xi^E$$

subject to

$$-yi + Y\lambda \geq 0$$
$$xi^E - X\lambda \geq 0$$
$$N1'\lambda = 1$$
$$\lambda \geq 0$$

Where:

- w_i is vector of input price $w_{1i}, w_{2i}, \ldots\ldots\ldots, w_{7i}$ of the i^{th} farm.
- x_i^E is the cost minimizing vector of input quantities for the i^{th} firm.
- N refers to total number of farms in the sample.
- W_{1i} represents land rent of i^{th} farm in Rs.
- W_{2i} represent total cost of seed used on the i^{th} farm in Rs.
- W_{3i} represents total amount paid for the use of plough on the i^{th} farm in Rs.
- W_{4i} represents total cost of NPK used on the i^{th} farm in Rs.
- W_{5i} represents total cost of labour used on the i^{th} farm in Rs.
- W_{6i} represents total cost of pesticides/weedicide used on the i^{th} farm in Rs.
- W_{7i} represents total cost of irrigation water used on the i^{th} farm in Rs.

Economic Efficiency = minimum cost/observed cost

$$EE = wi\ xi^E / wi\ xi$$

2.2.4 Estimation of allocative efficiency

Allocative efficiency is the ratio of economic efficiency to technical efficiency and can be calculated residually as:

Allocative Efficiency = Economic Efficiency / Technical Efficiency

$$AE = EE/ TE$$

Technical, allocative and economic efficiency scores in this study was estimated by using the computer software *DEAP 2.1* as described in Coelli [17].

2.2.5 Tobit regression model

In order to estimate the sources of technical, allocative and economic inefficiency of farms, various socio economic and farm specific variables were regressed on inefficiency estimates of farms using Tobit regression model.

According to Bukhsh [18], a range of factors like distinctiveness of farms, management, physical, institutional and environmental aspects could be the cause of inefficiencies in the production process of the farmers. These factors directly or indirectly affect the quality of management of farm's operators. Bravo-Ureta and Pinheiro [19] indicate that it is not possible to come up with complete list of all the factors affecting the farm specific efficiency but only the most important socio-economic and demographic variables that are expected to affect the farm specific efficiency are considered.

Socio-economic and farm specific variables included in this study were: years of schooling of the household head, age of farm's operator, contact with extension agents, farm to market distance, access to credit and tenancy status of the farm's operator.

In order to examine the impact of relevant socio-economic and farm specific variables on inefficiency estimates Tobit regression model [20] of the following form was estimated:

$$E_i = E^*_i = \beta_0 + \beta_1 Z_{1i} + \beta_2 Z_{2i} + \beta_3 Z_{3i} + \beta_4 Z_{4i} + \beta_5 Z_{5i} + \beta_6 Z_{6i} + \beta_7 Z_{7i} + \beta_8 Z_{8i} + \beta_9 Z_{9i} + \mu \qquad \text{If } E^* > 0$$

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

Where;

- i refers to the i[th] farm in the sample.
- Ei is an inefficiency measure representing technical, allocative and economic inefficiency of the i[th] farm.
- E_i * is the latent variable.
- Z_{1i} represents the farm size of the i[th] farmer in acres.
- Z_{2i} represents the education of the i[th] farm's operator in years.
- Z_{3i} represents the experience of the i[th] farmer in years.
- Z_{4i} represents the extension visits by extension workers at the i[th] farm from main market in kilometers.
- Z_{5i} is a dummy variable having value equal to one if farmer has access to credit otherwise zero.
- Z_{6i} is the house hold size of the i[th] farms
- Z_{7i} is the distance from the main road of the i[th] farms
- Z_{8i} is a dummy variable having value equal to one if renter operator otherwise zero.
- Z_{9i} is a dummy variable having value equal to one if owner cum renter otherwise zero.
- Z_{10i} is a dummy variable having value equal to one if middle reach otherwise zero.
- Z_{11i} is a dummy variable having value equal to one if tail reach otherwise zero.
- ß'[s] are unknown parameters to be estimated.
- μ_i is the error term.

3. RESULTS AND DISCUSSION

3.1 Descriptive Analysis

The results of the findings revealed that small farmers used 51.44 kg seed per acre, while medium farmers used 51.21 kg and large farmers used 52.22 kg seed per acre. The average tractor hours used was 2.67, 2.66 and 2.60 for small, medium and large farmers. The average total NPK use per acre by small, medium and large farmers were found to be 89.92, 91.47 and 94.99 kg, respectively. The average labors per acre by small, medium and large farmers were found to be 16.39, 18.28 and 19.45 days. Average irrigation hours applied per acre by small farmers are found to be 19.55, while for medium and large wheat farmers' average irrigation hours applied are found to be 17.98 and 17.44, respectively.

Seed cost per acre was higher for small farmers which were Rs. 2,626 while for medium and large farmers costs per acre were Rs. 2481 and Rs. 2622, respectively. The average ploughing cost (tractor cost) were found to be 1826, 1917 and 1804 rupees per acre for small, medium and large farmers. The average total fertilizer cost for small, medium and large farmers were found to be Rs. 4376, Rs. 4598 and Rs. 4778y. The average labor cost for small, medium and large farmers were found to be Rs. 2463, Rs. 2688 and Rs. 2877, respectively. Average irrigation cost per acre for small farmers was found to be Rs. 2309 while for medium and large farmers average irrigation cost are found to be Rs. 2640 and Rs. 2356.

3.2 Econometric Analysis

This section presents the discussion on results obtained through DEA and Tobit regression models. The section is divided into three sections. First section exhibits the efficiency estimates of the sample farms. The second section elaborates the relationship between efficiency estimates and farm size. Last section describes the sources of inefficiencies.

3.2.1 Efficiency estimates

The mean technical efficiency of the sampled farms in the study area were 0.85, with a low of 0.38 and a high of 1. The findings of the study indicated that if the farmers under study operate at full efficiency level they could lessen, their input utilization, on an average by 16% and still produce the same level of output. The result of

DEA revealed that the mean allocative efficiency was 0.81 with a highest of 1 and a minimum of 0.05. The joint effect of allocative and technical efficiency indicated that the average economic efficiency was 0.68 and fluctuating from 0.052 to 1. There was occurrence of considerable allocative and economic inefficiency the sample farms for wheat in the study area. The results of the study demonstrated the sample farmers could reduce their production cost by 32% without reducing the level of output and existing technology, if they are operating at full efficiency level.

The technical efficiency of majority of the ample farms lies between 0.71 and 0.80 and between 0.91 and 1.0. Out of 120 sample farms, 40 percent farms have technical efficiency greater than 0.90, 24 percent farms have technical efficiency between 0.71-0.80, 20 percent farms have technical efficiency between 0.81-0.90, 10 percent farms have technical efficiency between 0.61-0.70 and other 3 percent farms have technical efficiency below 0.60 (See Table 1).

Allocative efficiency of the sampled farms was mainly within the range of 0.71 and 1. About 43% farms have allocative efficiency in the range of 0.80-0.90 and 20% farms of 0.71 to 0.80.

Results of the findings revealed that 10.8 percent farms lies in allocative efficiency range 0.61-0.70 and 6.5 percent farms have allocative efficiency below 0.60.

About 8% farms have economic efficiency of 0.90-1.0 and majority of the farms lies within the range of 0.61 to 0.70, 27.5 percent farms have economic efficiency between 0.61-0.70, 22 percent farms have economic efficiency between 0.71-0.80, 16 percent farms have economic efficiency between 0.51-0.60. 15 percent farms have economic efficiency between 0.81-0.90 and 11 percent farms have economic efficiency less than 0.50.

Table 1. Frequency distribution of total technical, allocative and economic efficiency of wheat crop

Frequency ranges	TE		AE		EE	
	Freq.	%	Freq.	%	Freq.	%
0.01-0.10	0	0	1	0.83	1	0.83
0.11-0.20	0	0	0	0	0	0
0.21-0.30	0	0	1	0.83	3	2.5
0.31-0.40	2	1.67	0	0	2	1.67
0.41-0.50	0	0	2	1.67	8	6.67
0.51-0.60	3	2.5	4	3.33	20	16.67
0.61-0.70	12	10	13	10.83	33	27.5
0.71-0.80	29	24.17	24	20	26	21.67
0.81-0.90	25	20.8	51	42.5	18	15
0.91-100	49	40.8	24	20	9	7.5

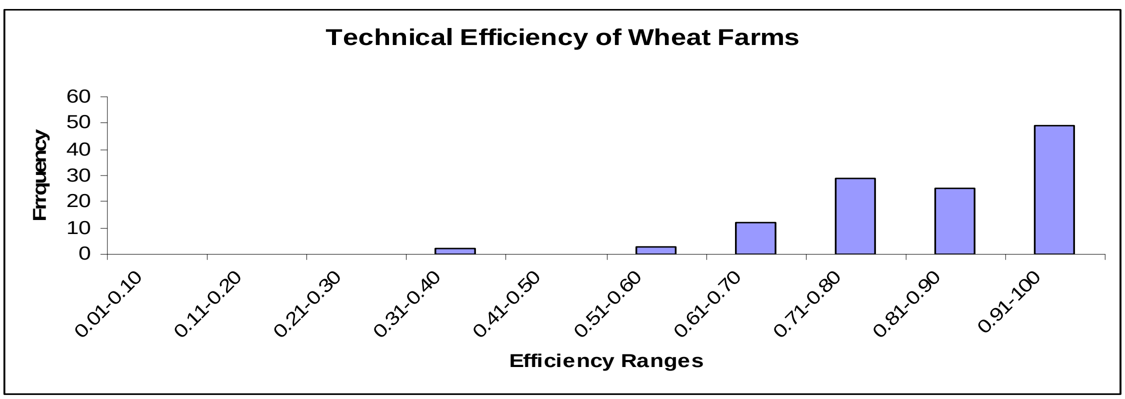

Fig. 1. Frequency distribution of technical efficiency of wheat farms

3.3 Relationship between Efficiency Estimates and Farm Size

To check the correlation between allocative, economics and total efficiency and farm size, these efficiencies were estimated according to farm size. The farmers were categorized as small (less than 12.5 acres), medium (12.5-25 acres) and large farms (more than 12.5 acres) according to the basis of their land holdings. The results of the study revealed that sampled large farmers were efficient technically than their counterpart of small and medium farms. The small farmers were least efficient tehcnically as compares to large and medium farmers. The similar results are reported by [21]. It is indicated from Table 4 that, on average, small farms are the least scale efficient and large farms are the most allocatively and economically efficient (Fig. 4).

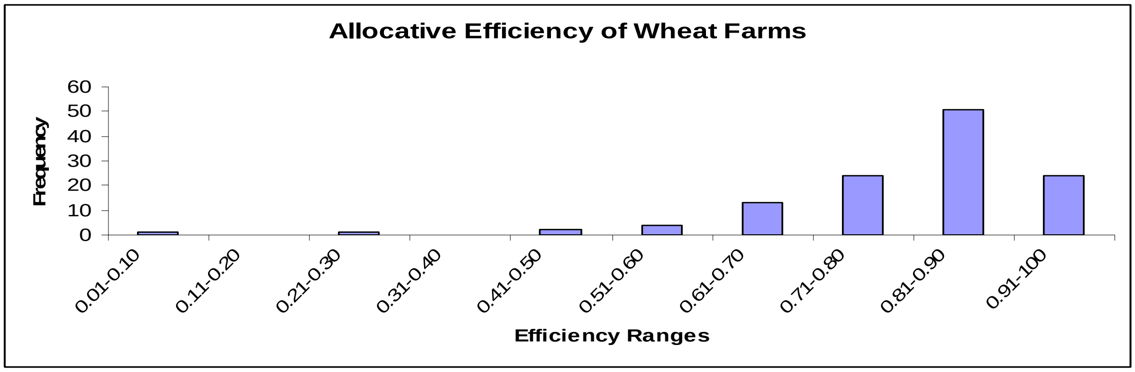

Fig. 2. Frequency distribution of allocative efficiency of wheat farms

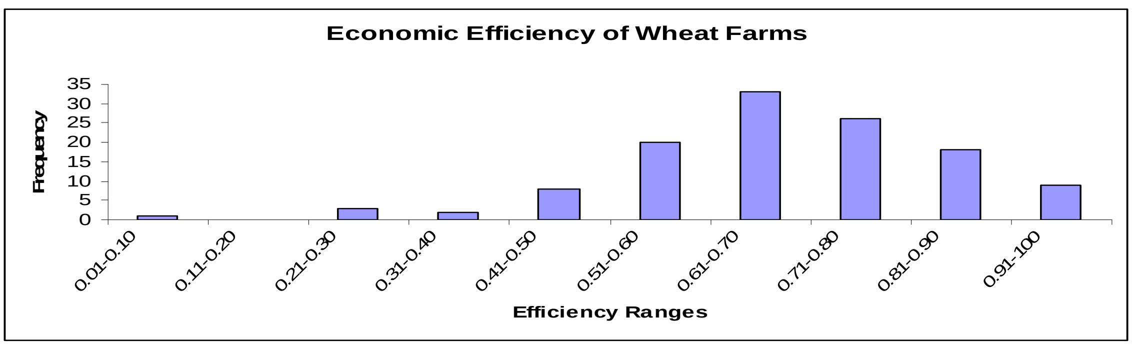

Fig. 3. Frequency distribution of economic efficiency of wheat farms

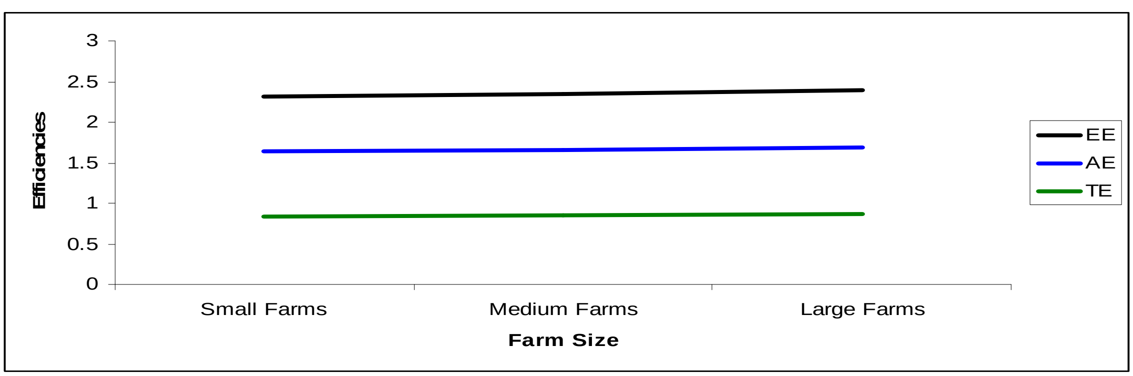

Fig. 4. Total technical, allocative and economic efficiency with respect to farm size

3.4 Sources of Inefficiencies

Socioeconomic and specific farm factors are probable to affect the level of technical, allocative and economic inefficiency of farmers. The present study makes an effort to examine sources of technical, allocative and economic inefficiency of wheat farms of district Layyah. In order to find sources of technical, allocative and economic inefficiency Tobit regression model was used. In Tobit model technical, allocative and economic inefficiency estimates were separately regressed on socio-economic and farm specific variables. The coefficients of explanatory variables in Tobit regression models are of particular interest in terms of understanding the inefficiency differentials among the farmers and for making policy options.

The coefficient of extension visits variable was negative and significant. The farmers having frequent contact with extension department were less inefficient technically than their counterparts who have less or no contact with extension agents. Similar results are reported by Ali [22], Hassan [23] and Yaseen [24]. This may be reason that farmers having availability of extension services whenever is required are able to get information about production technology, seed, cultural practices and approved modern agricultural technology along with its uses.

The farm to main road distance variable was negatively and significantly associated with the technical inefficiency of farms. The farm to road distance variable was used as a proxy for convenience to easy access to transportation. Result of the study suggests that the technical inefficiency of sample farms would significantly decrease with the development of road and market infrastructure. According to FAO [25], the utilization of purchased inputs would have been higher in developing countries if the supply outlets were made available to the farming communities at a walking distance. Ghura and Just [26] argue that only price incentives are not adequate to enhance supplies of agricultural commodities unless these measures are supplemented with continued investment in rural infrastructure (Table 2).

The access to credit dummy variable was introduced to check the impact of availability of credit/loan on technical inefficiency of farmers. The parameter estimate of access to credit dummy variable carries a negative sign. Results of the study imply that farmers having easy availability of credit were less inefficient technically than those farmers who have not this facility. These results are in accordance with the study of Bravo Uretta and Evenson [27], Ali and Flinn [28], Hassan [23], Bozogolo and Ceyahan [29] and Idiong [30]. The obvious reason for this relationship may be that availability of credit enables the farmer to purchase inputs more easily particularly during peak seasons. Ali [22] studied that credit availability motivated the farmers to use high yielding varieties to increase per acre yield.

The coefficient of renter dummy variable was positive and insignificant which implies that there was no significant difference between the technical inefficiency of renters and owner operators. The coefficient of dummy variable owner cum renter was positive and non-significant which implies that there was no significant difference between the technical inefficiency of owner cum renters and owner operators.

Table 2. Sources of technical inefficiency of wheat farmers

Variables	Coefficient	Std. error	Prob.
Constant	0.187	0.072	0.009
Farm size	-0.001	0.002	0.441
Education	-0.004	0.004	0.364
Experience	-0.003	0.002	0.096
Extension visits	-0.011	0.007	0.098
Loan (Dummy)	-0.104	0.049	0.032
House hold size	0.011	0.007	0.097
Distance from main road	-0.003	0.002	0.082
Renter	0.028	0.119	0.815
Owner cum renter	-0.009	0.096	0.923
Middle	0.023	0.037	0.541
Tail	0.110	0.044	0.013

The farm size variable had negative and significant impact on the allocatively inefficiency. This result implies that farmers having large farm size would be less alllocatively inefficient. The coefficient of access to credit dummy variable had a positive and significant impact on allocative inefficiency. The result of the study implies that the farmers having better access to credit were allocatively more inefficient than the farmers having less access to credit. The possible reason for this relationship may be that farmer may not use credit for the agricultural purposes.

The coefficients of renter dummy and owner cum renter dummy variables were negative and insignificant which implies that there was no significant difference between the allocative inefficiency of renters; owner cum renters and owner operators in the study area. The coefficient of dummy for middle and tail farmer was positive and insignificant which implies that there was no impact of location of area on inefficiency of wheat farmers.

The coefficient of the farm size was negative and significantly affecting the economic inefficiency of wheat farmers. As farm size increases, economic inefficiency will decrease. The coefficient of distance from main road was negative and significant which implies that as the distance of farm from main road increases the economic inefficiency will decreases. The coefficient for education and experience were negative but insignificant which implies that education and experience had no impact on economic inefficiency of wheat sampled farms. The dummy for credit access and owner cum renter was negative and non-significant which shows that there was no difference in economic inefficiency due to credit access or ownership. House hold size coefficient was also negative implies that there was no impact of house hold size on the economic inefficiency of wheat farmers (Table 4).

Table 3. Sources of allocative inefficiency of wheat farmers

Variables	Coefficient	Std. error	Prob.
Constant	0.290	0.057	0.000
Farm size	-0.003	0.001	0.052
Education	0.001	0.003	0.832
Experience	0.002	0.001	0.122
Extension visits	-0.002	0.005	0.749
Loan (Dummy)	0.064	0.038	0.093
House hold size	-0.010	0.005	0.066
Distance from main road	-0.003	0.002	0.042
Renter	0.030	0.099	0.761
Owner cum renter	-0.104	0.077	0.175
Middle	0.018	0.030	0.553
Tail	-0.036	0.036	0.313

Table 4. Sources of economic inefficiency of wheat farmers

Variables	Coefficient	Std. error	Prob.
Constant	0.431	0.068	0.000
Farm size	-0.003	0.002	0.037
Education	-0.001	0.004	0.779
Experience	0.000	0.002	0.937
Extension visits	-0.008	0.006	0.223
Loan (Dummy)	-0.014	0.045	0.763
House hold size	-0.001	0.006	0.917
Distance from main road	-0.005	0.002	0.006
Renter	0.042	0.117	0.721
Owner cum renter	-0.083	0.090	0.354
Middle	0.031	0.035	0.386
Tail	0.040	0.043	0.351

4. CONCLUSION AND SUGGESTIONS

The most obvious implication from the findings of the study is that there is a need of sound policies to promote formal education of rural households as a mean of enhancing efficiency over the long period of time. This will enable farmers to make better technical decisions and helps them in allocating the inputs efficiently and effectively. Government should ensure the provision of timely and better extension services. There is a need to strengthen the extension department and allocating more fund to extension services in the remote areas.

Farmers having better access to credit are more efficient than those with poor access to credit. It is therefore recommended that soft loan should be provided to the farmers, which enable them to cope with increasing production cost and efficient use of input resources. The transaction cost of credit should be reduced by the government supported programs, it has positive impact on farm efficiency.

As the farms located closer to the market are technically less inefficient than those located away from the market. So, the development of market and road infrastructure should be focused. Supply outlets should be made closer to the farm gate. Younger farmers are technically less inefficient than the older ones. Policies should be devised to attract and encourage younger people in farming by providing them incentives. This would lead to enhance agricultural productivity and efficiency by the injection of new blood in agriculture. Increasing scale of operation is imperative to improve overall technical efficiency of the farms. So, cooperative and corporate farming appears to be the most feasible options in this regard.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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